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POISONOUS PLANTS AND THEIR USES IN CAJAMARCA, PERU

by

OLGA OROZCO

A dissertation submitted to the Graduate Faculty in Biology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York

2003

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This manuscript has been read and accepted for the Graduate Faculty in Biology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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Abstract**POISONOUS PLANTS AND THEIR USES IN CAJAMARCA, PERU**

by

OLGA OROZCO

Advisor: Dr. David Lentz

This research highlights the role of poisonous plants in nature and their importance for humans in indigenous cultures. The study includes information and references about history, geography and ethnography from the Department of Cajamarca, Peru, with emphasis on the past and present state of agriculture, and a literature review on reported species used as medicinals, but particularly about plants reported as pesticides, repellents or crop protectants. The fieldwork was conducted in four municipalities, all located in different ecological zones. The interviews and collection of specimens yielded 42 poisonous species and 22 species that are considered useful because of their toxic properties. The yellow fever mosquito (YFM) bioassay was applied to methanolic extracts of the latter 22 species to determine their toxicity to *Aedes aegypti* L. larvae and provide preliminary information about pesticidal activities in such botanical extracts. Most extracts showed weak to moderated activity except three that were found to have strong pesticidal activity.

The main purposes for this research are to document traditional uses of the flora in the region, and to explore the possibility of encouraging traditional technologies that are well adapted to the Andean environment and low impact, as well as inexpensive alternatives for local agriculture. By doing so, I hope we will be advocating preservation of the precious biodiversity of the Andes and the valuable ancient knowledge of the local communities.

Dedication

To the thin air of the Jalca, the Apus along the Andes and the dress code of the Cajamarquinas, who ignore the existence of pastel colors.

To the children of Cajamarca, who reminded me so many times that the future is here. For a while now.

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CHAPTER 1. INTRODUCTION AND LITERATURE REVIEW

Everything is a poison, nothing is a poison. Dosage alone determines poisoning.

-Paracelsus-

The occurrence of toxins as secondary metabolites in plants arises from a widespread and significant phenomenon known as coevolution: changes that occur in two or more populations as a consequence of the reciprocal selective action of the populations on one another (Janzen 1980). The result of this interaction between plants and herbivores is an intricate relationship whereby plants, the source of food to animals, have evolved chemical armor to avoid being overeaten. Effective reduction of animal feeding is accomplished by reducing the edibility or nutritive status of leaves or fruits, or introducing a toxin, an unpleasant taste or an offensive odor into tissues (Harborne 1993:104). In response, animals have evolved in this dynamic interaction by overcoming the plant's defenses with a variety of reactions such as detoxification mechanisms and even sequestration of plant toxins that are later used as defense against their own enemies. Since ancient times, humans have also been aware of the presence of poisonous plants in their surroundings. Native people pondered their physiological effects and learned to identify, avoid, and in some cases, to take advantage of these plants. Recognizing potentially harmful plants and telling them apart from edible ones, is a survival mechanism transmitted from parents to

children in every culture. Empirical knowledge, through time, teaches observers that some toxins can be washed away or degraded by denaturing the molecules by means of high temperatures (cooking); others can be used as medicines, psychoactive substances or recreational drugs. Finally, toxic plants have been used particularly by indigenous peoples as bioactive compounds against crop pests, for fishing, hunting, and to keep homes, domestic animals and humans, free of insects.

Most of this valuable indigenous knowledge is rapidly disappearing. Our urban society does not need to rely on wild plants for food, and synthetic chemicals solve the problems of infestations. At the same time, many useful plants are becoming extinct due to environmental changes, pollution and deforestation. Very soon, we may be deprived of the possibilities of exploring the traditional knowledge of botanical pesticides, insect repellents, natural vermifuges and fish and animal poisons. Every one of these plants uses could help provide chemists with innovative models of molecules with novel and useful effects.

GEOGRAPHY OF THE STUDY AREA

The present project took place in Cajamarca, Peru (Figure 1.1). The study area, crossed by the Andes, is located in a transitional zone, between the northern tropical Andes of

Colombia and Ecuador, and the Andes of southern Peru [Figure 1.2 from Troll (1986)].

Cajamarca lies within the *jalca* ecosystem (discussed below), with its own

Figure 1.1: Location of Cajamarca, the study area

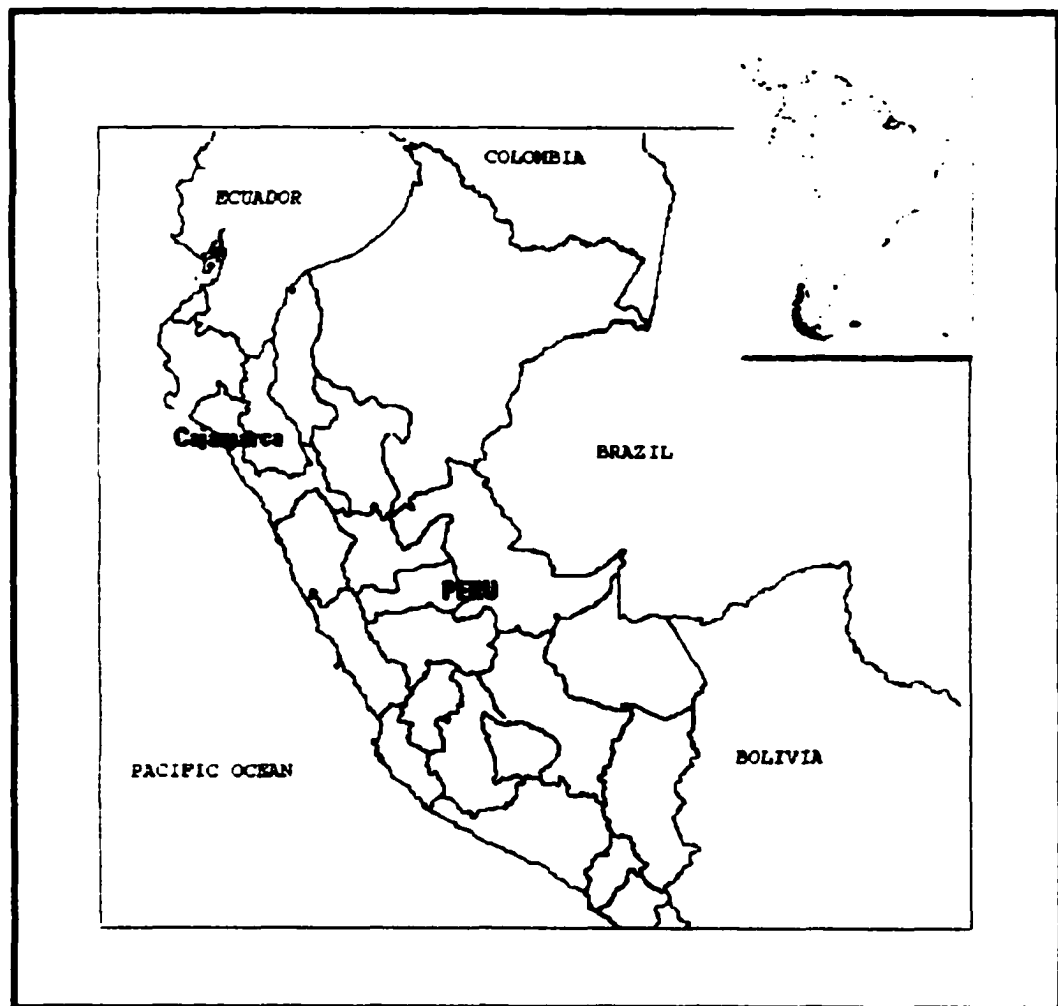
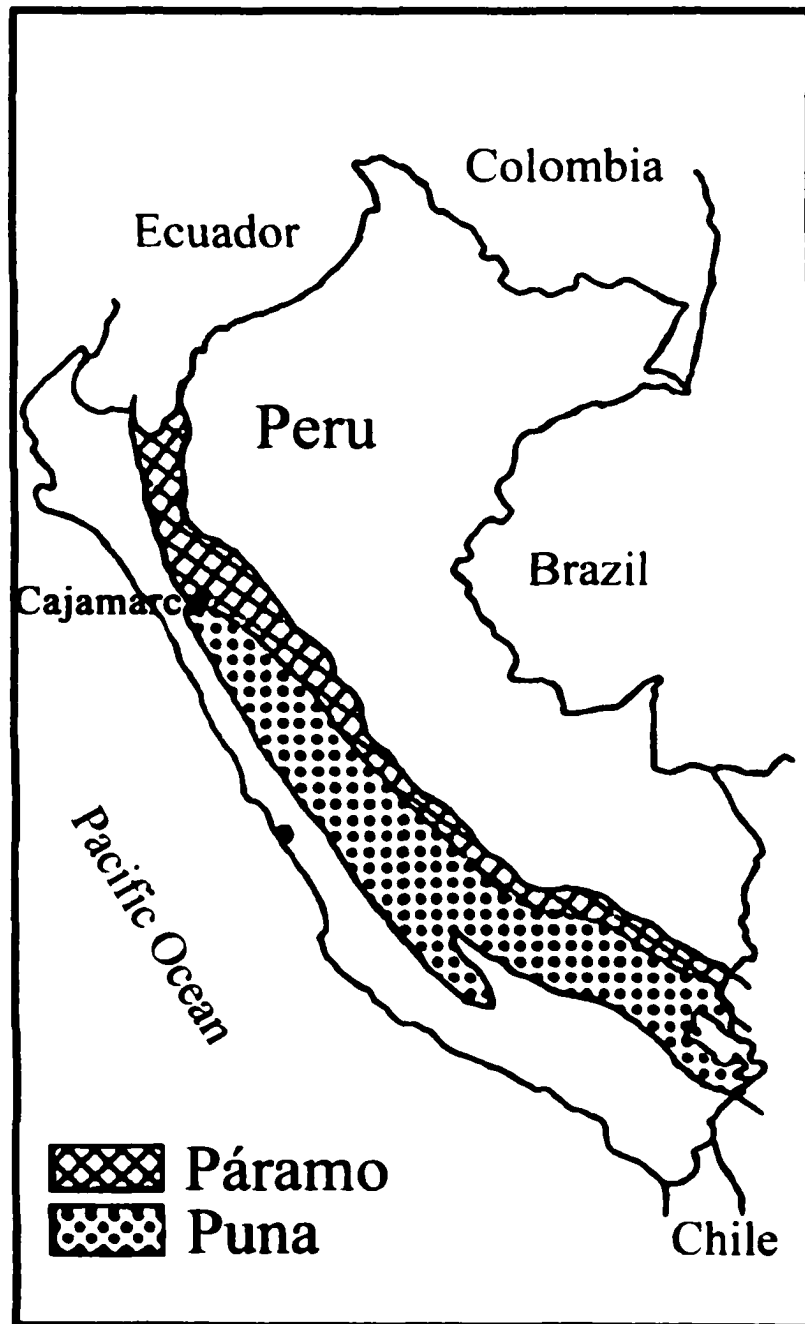


Figure 1.2 Location of *páramos* and *punas* in the Peruvian Andes



characteristic flora (Becker, B. 1988). In addition, Cajamarca comprises ecological regions between 400 and 4000 meters above sea level. This altitudinal diversity contributes to the area's special biodiversity (Dillon 1994; Sagástegui 1994; Sánchez-Vega 1994; Troll 1986). The endemism of Angiosperm in Cajamarca has been calculated as 318 taxa, not including orchids which is the largest Peruvian Angiosperm family (Hensold 1999)

The most dominant plant families in the Cajamarca area are Poaceae, Asteraceae, Scrophulariaceae, Fabaceae, Solanaceae and Lamiaceae (Sagástegui, et al 1999). A detailed list of species reported from Cajamarca, with their local names and distribution within the different ecological zones, was compiled by Montoya and Figueroa (1990). The area was first described in the legendary works of Ruiz and Pavón (1794) and Weberbauer (1945), but more recently in local floras by Sagástegui (1995) and Sánchez-Vega (1993; 1997)

In 1981, Javier Pulgar-Vidal, based upon the traditional knowledge of pre-Columbian inhabitants, established a classification of natural regions in Peru, defining eight different zones according to geography, altitude, climate and vegetation (see Figure 1.3). His system has been widely adopted by scientists working in the country, especially in the archeological literature. According to Pulgar-Vidal, the study area includes four natural regions:

Figure 1.3. The eight natural zones of Peru.



CHALA

The *chala* formation, altitude ranges between 0 and 900 m, is located on the lower part of the Andean valleys, western slopes, and is characterized by a warm, semi-dry climate and a topography surrounded by rocky, steep hills. The precipitation is 250 to 500 mm annually, most of which falls during the three months of the rainy season, between January and March. In the area of Cajamarca, the predominant vegetation corresponds to tropical premontane thorn woodland (Tosi 1960:26). A number of plants in the Cactaceae and Bromeliaceae are found forming homogeneous, densely populated communities that grow

on rocks and steep slopes. Among the trees and shrubs commonly found are the genera *Ephedra* (Ephedraceae), *Cassia* and *Caesalpinia* (Fabaceae), *Schinus* (Anacardiaceae), *Cordia* (Boraginaceae), *Baccharis*, *Mutisia*, and *Helianthus*, (Asteraceae), and *Jatropha* (Euphorbiaceae). Poaceae are also abundant, especially the genera *Stipa*, *Melica*, *Andropogon*, *Eragrostis* and *Pennisetum*. Given the low precipitation and the absence of irrigation systems, the agricultural potential is very limited. Land use is restricted to breeding goats and to the exploitation of the forest for firewood or charcoal. These activities have been taking place for centuries without control or rationalization and the results are exposure of the soil leading to advanced erosion and the threat of extinction for some species due to overexploitation. The indiscriminate use of the tree *Loxopterygium huasango* Spruce (Anacardiaceae) for wood-floors is a conspicuous example (Tosi 1960:30).

YUNGA

Altitude in the *yunga* formation ranges between 900 and 2300 m, with a topography dominated by steep slopes and narrow valleys. The landscape varies from desert-like conditions in the lower areas to limited green areas in the upper region where availability of water allows for agricultural activities. The precipitation fluctuates between 500 and 1000 mm annually and the temperatures vary from warm to temperate (14-22 °C), with increasing rainy periods and lower temperatures as the altitude increases. Due to the mild

weather and dry conditions throughout the Andes of Peru, the *yunga* supports the highest human population density in the Peruvian *sierra* (Andean highlands). The natural vegetation prior to settlers, mainly composed of deciduous forest, has been largely altered by hundreds of years of human disturbance. According to Tosi's ecological map, the vegetation of this area in Cajamarca is defined as a tropical premontane dry forest, mostly composed of Poaceae, dispersed bushes and trees. Among the most common trees and shrubs found in this secondary forest are species of *Cassia*, *Dalea*, *Acacia*, and *Mimosa* (Fabaceae), *Barnadesia* (Asteraceae), and *Clusia* (Clusiaceae). Along roads and trails, *Agave americana* L. (Amaryllidaceae) and *Spartium junceum* L. (Fabaceae) grow abundantly. *Opuntia ficus-indica* (L.) Mill. (Cactaceae) grows in pastures, in many cases as an invasive weed filling up poor overexploited soils (Montoya and Figueroa 1990:33).

KECHWA

Altitudes in the *kechwa* formation range between 2300 and 3000 m. In this area, the topography is less variable with rounded hills that are less steep than the *yunga*. The climate varies from temperate to cool with lots of bright sunshine most of the year. During the summer months, from December to April, there is frequent rain and hailstorms and overnight freezing temperatures that contrast with daytime temperatures, which can reach 26°C. The vegetation type corresponds to a tropical premontane moist forest. Forests prior to settlers were composed of species of Lauraceae, Myrtaceae and

genera like *Oreopanax* (Araliaceae), *Brunellia* (Brunelliaceae), *Vallea* (Elaeocarpaceae), *Clusia* (Clusiaceae), *Bejaria* (Ericaceae) and *Cedrela* (Meliaceae). At the lower altitudes, *Chusquea* (Poaceae), *Carludovica* (Cyclanthaceae), *Anthurium* (Araceae) and *Peperomia* (Piperaceae) are abundant in humid spots (Tosi 1960:166). Because of the suitable weather for human populations and agricultural activities, pastures and *chacras* (cultivated fields) dominate the landscape. In some sectors, extensive farms are dedicated to dairy production on pastures of *Pennisetum clandestinum* Hochst. ex Chiov. and other grasses. Cornfields are predominant in the lower limits and wheat, barley and potatoes in the upper limits.

JALCA

Areas from 3000 up to 4000 m are considered *jalcas*, which is the local name for *paramos* in northern Peru. Actually, *jalcas* are the southernmost *paramos* since they are a transition zone between the latter vegetation type and *punas*. *Paramos* can receive from 800 to 2000 mm of rain annually and have a high relative humidity while *punas* are typically xeric and more seasonal, with a shorter wet season and six months or more of almost no rain. *Punas* are characteristic of the central and southern Andean highlands of Peru, Bolivia and Chile, while *paramos* are found from the northern tip of Colombia and Venezuela to the southern part of Ecuador and northern Peru. In the southern part of their range, páramo becomes drier because of the influence of two air masses: one from

the Amazon basin, which has already released its moisture on the eastern slope, and another dry cold air mass from the west under the influence of the Humboldt Current. *Jalcas*, as well as *páramos*, have a generally cold and humid climate with sudden changes in weather and a diurnal fluctuation in temperature from below freezing to as much as 30 C°, which often result in a daily freeze-and-thaw cycle (Luteyn 1999:29; Monasterio 1980). Because of the characteristic vegetation, *jalcas* are defined as seasonally humid grasslands (Becker, B. 1988). Species present in *jalcas* may include short-grass communities dominated by bunchgrasses (*pajonales*) with both herbaceous and woody vegetation. Pastures frequently include *Calamagrostis*, *Agrostis*, *Festuca* and *Paspalum*. Small herbs like *Puya* (Bromeliaceae), *Perezia* (Asteraceae), *Phyllactis* (Valerianaceae) and small shrubs like *Lupinus* (Fabaceae) and *Cynoxys* (Asteraceae) (Sánchez-Vega 1997) are common. *Jalcas* have been used since pre-Hispanic times, typically for herding Andean camelids and later for sheep and bovines. In the last 30 years, the pressure for productive land is forcing a change, increasing the agricultural activity in the area. New frost resistant varieties of potatoes and wheat are fostering the change that is resulting in the reduction of natural vegetation cover and threatening the original composition of the *jalca* vegetation.

In the Cajamarca area, *jalcas* and *kechwas* still show stone terraces and evidence of human activity, suggesting the land has been cultivated for millennia (Brush 1976). Today, this zone is mainly used for production of potato [*Solanum tuberosum* L. (Solanaceae)], corn [*Zea mays*

L. (Poaceae)], oca [*Oxalis tuberosa* Molina (Oxalidaceae)], ullucu [*Ullucus tuberosus* Caldas (Basellaceae)] and natural pastures [*Calamagrostis*, *Stipa*, *Paspalum*, *Festuca* (Poaceae)] (Schjellerup 1989:37). The lower lands are used for more technically advanced crops with irrigation systems and for the production of fruits (Montoya and Figueroa 1990:49)

HISTORY OF THE STUDY AREA

Before the Spanish conquest in 1522, there existed in Cajamarca an agrarian system, where autonomous peasant communities paid taxes to the *curacuzgos*, the ruler society of Cuismango. Eighty years before the arrival of the Spaniards, the Inca Túpac Yupanqui, took over the region, keeping the peasant community systems and only replacing Cuismango's aristocracy, with the Inca nobles from Cuzco. In 1532, the Spanish conqueror Francisco Pizarro arrived and won the war against the Incan ruler, Atahualpa. He was made prisoner by Pizarro in Cajamarca, who in a legendary act of treachery, took Athualpa's life even though the ransom was paid. In 1535, what was the *wamani* (kingdom) of Cuismango was re-constituted as the Province of Caxamarca [sic] and given to the *encomendado* Melchor Verdugo, sadly remembered as the initiator of the violence against indigenous people. There was savage expropriation of the communities lands and possessions (Seifert 1990:27). After

that, the institution of the *haciendas* (big farms) assigned to Spanish nobles and to influential *criollos* (Spanish borne in America) was just the beginning of a long history of poverty and abuse against the native Quechuas and their descendants.

By the 19th century, the widespread introduction of European cultivated plants, working methods and domestic animals have produced a huge impact on the ecosystem. The steep slopes saw accelerated erosion because the sharp-hoofed sheep, goats and cattle replaced llamas and alpacas, characterized by broad and soft feet. Through the selective grazing of all these animals, thorny, poisonous and otherwise less-palatable plants (such as many Lamiaceae, Asteraceae, Euphorbiaceae and Solanaceae) were able to spread and dominate the landscape (Ellenberg 1979). The forest and original vegetation of the area is by now nearly lost in vast zones due to the high timber demand imposed since the time of the Spanish conquerors, and later by intensive agriculture demanding more fields and the use of forest products as fuel for cooking. This human disturbance over hundreds of years has resulted in degradation of the vegetation cover and loss of organic matter in sheet erosion, being in some areas so severe that the parent rock is exposed (Becker, B. 1988).

THE PRESENT AND FUTURE OF CAJAMARCA

The majority of the inhabitants of Cajamarca are Quechua people and probably many of them, Incan descendants. At the time of the arrival of the Spaniards, a large part of the population dwelling in Cajamarca city and Baños, the nearest town, belonged to the Incas, the elite of the society. Athualpa, his family, his court and individuals of high military rank were living there and probably many never left after Atahualpa was strangled by Pizarro and all became prisoners or slaves for the new ruling lords (De la Vega 1609). Today, the people of Cajamarca still keep many of the traditions and customs of their ancestors. In part because of poverty and in part because of a strong sense of their own culture, the simple way of living of these peasant communities is remarkable. Although 98% of the people of Cajamarca speak Spanish, their lifestyle is very similar to the indigenous population that speaks Quechua (Hudson, R. A. 1993). They are extremely conservative and retain many indigenous customs and attitudes, but it would be erroneous to designate their material and non-material culture as “native,” for the colonial Spanish element in their way of life is remarkably strong, as a result of 500 years of contact with outsiders. A vast majority of the population can be described as a transformed Indian class referred to as *cholo*, consisting of people who stand culturally, although not necessarily racially, between Indians and *mestizos*. *Cholos*, as referred by Gade (1975:29), may be identified by their mostly factory-made clothing, the white derby hats and colorful skirts worn by the women, and the preference for *wayno* music. A second class of citizens is comprised of *mestizos*, who manifest many of the values of Western civilization. However, *mestizos* do not have

a purely Hispanic culture any more than the *cholos* have a pure Quechua culture. They are landowners or merchants and mostly literate. This may give a clue about the distribution of the population, as Cajamarca has an illiteracy rate that greatly surpasses the national average. In Peru, the illiteracy rate is 12.8% and in Cajamarca 27.2% (INEI 1997). This figure includes the population of Cajamarca city, which allows us to estimate the real number of illiterate people in the rural area alone to be closer to 50% (Specific data for the rural area was not found. This figure has been estimated from data collected through the interview process).

According to the Peruvian Institute of Statistics and Informatics (INEI 1997), the main economic activity in the region of Cajamarca is agriculture, but the participation of this area in the state's Gross Domestic Product (GDP) is only 32%. The second main activity is the extraction of gold from the nearby gold mine of Yanacocha and others. This activity is growing and represents more than 20% of the economic movement in the state. However, the mining businesses customarily employ and benefit mostly outsiders. The highly industrial methods typically used will require technical training and skills not common among the locals. It is evident that increasing tourism around the region and the gold boom created by the exploitation of the Yanacocha mine are progressively modifying the landscape (Morrow 1997). Because of the mining methods used by the company, large sections of the mountains have completely disappeared in the last five years.

According to Sánchez-Vega (pers. comm.), entire areas that were unique *jalca* microenvironments have been bulldozed and little more than the pictures and vouchers he collected during his expeditions in the region remain. The mining company Yanacocha demonstrates interest in the topic and has studies and projects focusing on soil and vegetation recovery of the area, but the results from these efforts appear inconclusive to most people.

The influence of the mining companies on the culture of the Cajamarquinos is not widespread, but it is tangible. Peasants, especially youngsters, living in the surrounding areas, compare their income and life styles to the miners, who earn their salaries in cash paid weekly, ride fast 4x4 vehicles and wear fancy safety attire. The constant stream of newcomers also has steadily transformed the city's streets. Abundant restaurants and newly opened brothels seem to respond to the demand created by men with no family in the area.

Another aspect of the traditional way of life that is quickly disappearing is the herding activity. Children attending schools are no longer free to spend their days roaming the hillsides in slow pursuit of sheep. In addition, homemade woven garments are being replaced by confections of industrial clothes, announcing the eventual end of pastoral life. Taking care of animals in the fields has an interesting implication on the people's

knowledge of plants. Children that accompany animals to the fallow zones have a lot of time in close contact with nature. They learn the names of the plants, play with them and often do not hesitate to take a bite of nearly anything in their environment. As Franquemont reports for the children of Chinchero (southern Peru), the motivation for these activities are mostly recreational, not hunger, but they serve a higher purpose in their knowledge of the Quechua life. It is probable that these wild plants will end their social existence as children grow up without learning about them (Franquemont 1988)

Although Cajamarca and its 13 provinces have the highest percentage of rural population in Peru, as mentioned above, the participation of agriculture in the active economy is low. This is the result of a subsistence economy, in which the main concern is focused on self-sufficiency with no regular planned surplus for sale. Extensive subdivision of the agricultural units has led to overexploitation of the land. According to INEI (1997), 46% of the land useful for agriculture is considered *minifundios* (units of three hectares or less) or small farms (between three and ten hectares). With time, these percentages are likely to get higher, because the mechanics of land inheritance tend to produce further division of already small units. Such undersized productive areas have as visible results, besides the evident poverty, advanced erosion and removal of organic matter from the soil.

Moreover, Cajamarca is one of the states with higher poverty levels, and at the same time, one of the most densely inhabited, surpassed only by Lima and Piura (Indacochea, et al. 2001:65). This is susceptible to change in the future, since Cajamarca has a very low population growth, due to migration toward the lowlands. Poor conditions for agriculture and cattle raising are forcing migration to places with active industry and more technological agriculture. Towns like Trujillo, Chiclayo and the capital city, Lima, meet these requirements and absorb a good part of the migration, hiring the Cajamarquinos as cheap labor (Seifert 1990:72).

The future of Cajamarca probably includes a boom in the tourism business, which will incorporate valuable archeological sites and the abundant bucolic landscape of the Cajamarca valley into the regular tours visiting Cuzco and Nasca. This possibility has been widely discussed and encouraged by the Peruvian government and repeatedly analyzed in books like *Cajamarca Competitiva* by (Indacochea, et al. 2001:68). All these transformations underscore the importance of collecting and studying the ethnobotanical knowledge of these indigenous communities, which is being lost not only because of the oral nature of communication, but also because of current social and economic changes.

EXPECTATIONS AND BACKGROUND ON THE USE OF BOTANICAL PESTICIDES IN THE STUDY AREA

As stated in the first line of this chapter, the notion of toxicity is a very subjective one. Almost anything in nature could be a poison, depending on the dose and the organism in question. For this particular project, a toxic plant is defined as one that people in the Cajamarca region recognize as being harmful in any way to humans or to their domestic animals (intoxicating effects, dermatotoxic, deadly if ingested, etc). Besides this category, other plants were collected based on the informant's description of plants that have compounds used for different purposes that imply toxicity or repellency for insects, fungi or bacteria. Notwithstanding these are not restricted to insects, they are collectively referred to as botanical pesticides throughout this document.

Because of the wide range of altitudes that comprise the region, there is an also wide variety of species and plant families in each ecological zone. Some of these species will have similar uses in different communities, while in other cases, people living at a different altitude or ecological condition will use the same plant in a different context; situation reflected in the case that the same species receives different names in neighbor communities.

The toxicity of plants can be altered by altitude or ecological condition, and that influences or determines the use that the communities give to a specific plant. I hypothesize that the same species of plants residing in different ecological zones will be used the same way by local

inhabitants in all different zones. If not, changes in chemical composition, concentration as a result from environmental differences should be explored as an explanation.

It is also expected that people living in different ecological zones will seek alternative bioactive plants for the same problem when useful plants are not common to all zones. They may also try to move plants from one zone to another where it does not normally grow.

Finally, I theorize that plants with strong consensus in the use will be empirically more effective than plants with low consensus among the communities. The YFM bioassay and the scientific literature reports will be used as measure of empirical value to be compared with the claims of the informants in order to determine efficacy.

An extensive literature review preceded fieldwork in Cajamarca. In this process, some references were found regarding the use of botanical pesticides in the area. Most of them refer vaguely to a plant and the mode of use, but no further research is mentioned. This information is presented in Table 1.1 along with references to the scientific literature that back up the claims of bioactivity for these plants, if any has been reported.

Table 1.1: Botanicals used as pesticides in the Cajamarca area according to literature review.

Species (Family)	Part of plant used	Use	Known biochemistry
<i>Annona cherimola</i> Miller (Annonaceae)	Seeds	To kill lice in cattle (PRATEC 1989)	Acetogenins (Bories, 1991)
<i>Avena</i> sp. (Poaceae)	no information	To protect stored corn from insects (Vizconde, 1990)	no information
<i>Capsicum pubescence</i> Ruiz & Pav. (Solanaceae)	Fruit	As insecticide for potato plants (Vizconde, 1990)	Capsisin and other irritant phenolic compounds (Michael, 1985)
<i>Datura arborea</i> L. (Solanaceae)	no information	As insecticide for potato plants (Vizconde, 1990)	Tropane-alkaloids (Papadoyannis, 1994)
<i>Lupinus mutabilis</i> Lindl. (Fabaceae)	Seeds	To kill lice in domestic animals or as insecticide (Ferreira, 1986; Mateo, 1987; PRATEC, 1989; Towle, 1961)	Lupinine and lupanine (alkaloids) (Pothier, 1998; Vega, 1996)
<i>Mimhostachys glabrescens</i> Epl. (Lamiaceae)	Foliage	To protect potato seed from insects (Becker, 1988; Montoya, 1990; Alkire, 1994; La Torre, 1998)	Monoterpenes: thymol, carvacrol, pulegone, menthone (Alkire, 1994; Muñoz-Collazos, 1993; Zygadlo, 1996)
<i>Nerium oleander</i> L. (Apocynaceae)	Foliage	As insecticide for stored corn (Castillo, 1995)	Cardiac glycosides (Consoli, 1988)
<i>Nicotiana tabacum</i> L. (Solanaceae)	Foliage	As insecticide for potato and other plants (PRATEC, 1989)	Anabasine, nicotine (El-Gayar, 1975)
<i>Psoralea glandulosa</i> L. (Fabaceae)	no information	As vermifuges (PRATEC, 1989)	Bakuchiol (Erazo, 1997)
<i>Schinus molle</i> L. (Anacardiaceae)	Foliage	As insect repellent (Mantilla, 1994)	Essential oils: thymol, citronellyl (Steinbauer, 1995)
<i>Siparuna muricata</i> (Ruiz & Pav) A. DC. (Monimiaceae)	Flowers	To kill lice (La Torre, 1998)	no information

CHAPTER 2. METHODOLOGY

Following Alexiades' (1996:55-68) and Martin's (1995:96-116) guidelines for ethnobotanical fieldwork, the data collected in this project was gathered mainly during semi-structured interviews, conducted during two periods of five months each, both in the year 2000

TECHNIQUES OF INQUIRY

The techniques of inquiry combined two or more of the following approaches

- A. Direct participation and observation, particularly for agricultural procedures, animal care and housekeeping.
- B. Field interviews or informal "walking in the field" conversations
- C. Structured interview, although the informants never filled out the questionnaire themselves. This technique was never used on first or single visits given a natural reluctance of the people to see their thoughts put into writing. Special circumstances (discussed later) surrounded the time of the study, creating a need for extra time in establishing rapport.

D. Probing was used to confirm reliability on a particular subject, within subjects.

Plants or references mentioned in the past by one informant will be mentioned again during second or third visits, to confirm the accuracy of the information

E. Cross-examination was employed to confirm information. This technique was practiced in the advanced stages of study, with live material when available, or with pressed material that was shown to the informants. The voucher specimen or live material was accompanied by an interview about the specific plant in question. Although I conducted interviews using dried specimens, people sometimes felt less comfortable identifying dried plants. Quechua people can identify a growing plant more readily than a dried specimen, which may have lost important clues of smell, color or form, even though people are used to seeing dried plants that have been bought or collected and are kept for use as medicines.

SUBJECTS OF STUDY

The subjects of the study were chosen using a variety of parameters. In each locality, established specialists were sought: healers, midwives, elder members of the community or any person known and respected because of their knowledge about plants and agricultural practices.

Once the specialists were identified and interviewed, average men and women, e.g., middle age peasants with a wide variety of characteristics took part in the study. In spite of my intention to collect a sample not biased by gender, I ended up with a higher number of interviews with women than with men. The explanation comes from the fact that it was always easier for me as a woman, to establish contact and long-term relationships with women. This could be seen as a disadvantage in terms of the information collected related to agricultural and veterinary practices. As per my own experience, I could say that women have a good level of knowledge in these two fields and additional knowledge in an area that usually men have no interest, which is household pests. Overall, the resulting sample is representative and large enough to be of value for the observations of toxic plant uses.

Economic and social background was also a parameter in choosing subjects. For obvious reasons, families with above average income will be more likely to have access to and probably prefer commercial chemicals to solve infestation problems. In the same way as non-peasant families that dedicate most of their time to activities not related to agriculture or herding were considered less likely to have extensive ethnobotanical knowledge. City dwellers were not used as subjects in this study, with the exception of herb merchants, who sell their goods in the town's market places, and healers or midwives, who do not practice agriculture as their main activity.

An additional bias was incorporated in the sample, since only informants older than 12 years of age were interviewed. In the peasant communities of the Cajamarca area, a child 13 years and older is considered fully able to participate in the economic activities of the household. Actually, it is common to see three or four year olds helping with basic tasks, such as the collection of potato crops. Only children that live close to a school, and whose parents encourage them to devote their time to education, will attend classes more or less regularly. Their presence at school will frequently be interrupted because of special circumstances that may arise at home. Teachers of schools in the countryside know that attendance will be low during times when increased labor for agricultural practices is required. Despite the large involvement of children 12 or younger in agriculture and work in general, it was decided not to include their knowledge which is sometimes remarkable. The reason also has a cultural background. In this society it is not frequent that an adult will devote time to listen to children. These kids found the interview to be a new and exciting experience and I realized that they tended to say more than they really knew, just because of the delight of being heard.

Before interviewing adolescents, the youngster first needed to show an open interest in the topic and eagerness to participate. Then, their parents or tutors were asked for permission.

Another factor taken into account when choosing subjects was ethnic background. As mentioned before, Cajamarquinos are basically comprised of two groups: *cholos* and *mestizos*, both with strong influences from the Quechua and Spanish culture. After personally visiting all the study sites, I reached the conclusion that in terms of race it is very difficult to determine differences between one town or province and the next one. In terms of culture, it was evident to me that in this area there was a relationship between geographical altitude and the conservation of traditional culture. The higher the area, the better the traditions and ethnic factors seemed to be preserved. My observations were based on the number of people able to speak Quechua and the proportion of women wearing traditional costume (very rarely will men use them in any area). This applies even to areas close to large cities. In fact, one of the best-preserved areas for Quechua language and culture is found less than 15 miles from Cajamarca city, at 2650 m. It was evident that in areas below 1000 m, the presence of traditional attire and other signs of strong cultural preservation are difficult, if not impossible to find. Taking into account this factor, I interviewed a similar number of informants in each area and ecological region to be able to compare the level of knowledge in the different ecological areas.

VALIDITY OF INFORMATION

A degree of validity (1-3) was given to each interview (Elliot n.d.). Only values 2 and 3 were incorporated into the data. The scale of validity includes the following parameters

Directly used by the informant in the past or present (highest validity = 3)

Reported to have been seen used in the past by the informant (validity = 2)

Reported to have been used or named by a third person, not interviewed (lowest validity = 1, not included herein because of dubious reliability).

COLLECTION OF VOUCHER SPECIMENS

Four plant vouchers were collected to document each report and they have been deposited at The New York Botanical Garden herbarium (NY) and at the Herbarium of Universidad Nacional de Cajamarca (CPUN). The voucher labels contain all basic information, including coordinates derived from a Global Position System device (GPS). Although some of the plants were collected because of claims of activity against particular insects (agricultural or household pests), no formal collection of insects was made since the permits obtained from the Peruvian government did not include animals in the protocols.

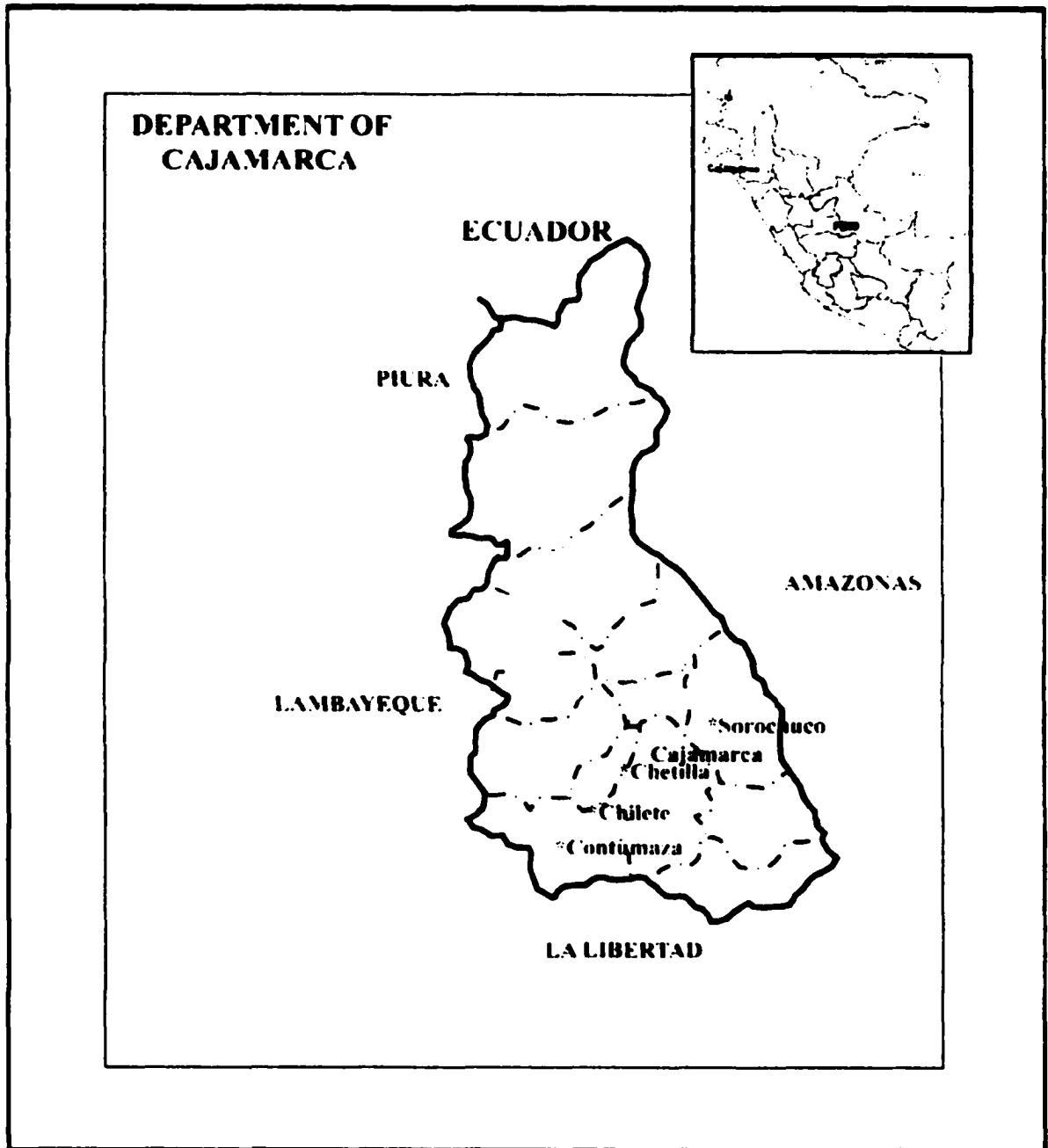
In those cases, a minimal sample of a couple of individuals was taken for identification at the Universidad Nacional de Cajamarca and discarded later.

STUDY SITES

The study sites were chosen to cover a range of altitudes and natural biodiversities. After accomplishing this, the goal was to get reports for different plants that could be used for similar applications. In addition, the differences in climate and geographical regions provided me with a range of living conditions for people with diverse agricultural practices.

According to these parameters, four municipalities were chosen as study sites (see Figure 2.1).

Figure 2. 1 Location of study sites



A. CONTUMAZA, Province of Contumazá

Contumazá is a district of 334 km² that is characterized by steep slopes and mild weather. Most of the area is located in the *kechwa* zone between 2300 and 2800 m. The agricultural products are very diverse, but confined to a subsistence economy. The majority of the productive fields are dedicated to corn (*Zea mays*) and wheat (*Triticum aestivum* L.), but manioc (*Manihot esculenta* Crantz), oranges (*Citrus sinensis* Osbeck), cherimoyas (*Annona cherimola* Miller), plantains (*Musa paradisiaca* L.), avocados (*Persea americana* Mill.) and a variety of other fruits are commonly grown. The population of Contumazá has suffered economic depression due to low productivity and a high emigration rate to the coastal lowlands. There, irrigation systems and better roads make agriculture more stable and productive (Montoya and Figueroa 1990:243). Quechua speakers are rare in this district.

B. CHETILLA, Province of Cajamarca

Chetilla is a small district (73 km²) that includes some *yunga* but mostly *jalca* areas (between 2800 to 4000 m). The main agricultural products are wheat, barley and potatoes. Chetilla was the only area of study where Quechua speakers were regularly found, although all of the people interviewed were bilingual. In fact,

bilingual teaching has been imposed on the local schools for the last 20 years (Bazán and López 1991:148).

C. SOROCHUCO, Province of Celendin

The capital of the District of Sorochuco is located at 2540 m with most of the territory occupying *jalca* zones. The main economic activity is the exploitation of natural pastures with cattle, sheep and goats (Montoya and Figueroa 1990:272).

Quechua is still the language for community activities, but for everyday life,

Spanish is the language of choice. Traditional costumes and manners are well preserved by the locals in this district.

D. CHILETE, Province of Contumaza

Yungas dominate the landscape of this district (133 km²), although most of the populated centers are located between 500 and 700 m, where the characteristics of the geography and vegetation can be defined as a *chala* environment. The Chilete area relies on some irrigation systems and uses a fairly good paved road, towards Cajamarca and towards the coast, to commercialize their main products (rice, fruits and corn) (Montoya and Figueroa 1990:237). No Quechua speakers were found in this area.

FIELD RESEARCH

The initial schedule for field interviews proposed one visit per month to each of the four sites. Each visit lasted about one week and was repeated at least five times. The preliminary work was on track in February 2000 and the actual visits and interviews started in March. For two months, the visits were restricted to Chilete and Contumazá since frequent landslides on the roads that go to Chetilla and Sorochuco impeded access to those areas. With the improvement of the weather conditions around the month of April, visits to all four zones were regular and systematic.

This first period of study, from March through June, corresponded to the period of flower formation in herbs and the time for agricultural activities like weeding, treatment for pests, and finally collection of crops (Sánchez-Vega and Tapia-Núñez 1992:20). The months of July and August were used to organize the material collected, make taxonomic determinations and produce preliminary reports from the literature on the information gathered so far. A second trip took place from September to December 2000. During this time, more visits and interviews took place, but a lot of the effort was allocated to the collection of plant extracts for the laboratory tests. This period corresponds to the spring,

when the planting of crops, flowering of trees and shrubs and re-growth of annual herbs were taking place (Sánchez-Vega and Tapia-Núñez 1992:20).

ETHICS

All required permits from the regulatory organ in Lima (INRENA) were granted (see Appendix 1 for copies). Special authorizations from the heads of the communities (e.g., mayors of the towns) where the project took place were also obtained. This study was reviewed and accepted by the Institutional Review Board for the Protection of Human Subjects at CUNY (copy also included)

As mentioned before, special circumstances surrounded the period of time of the study. The year 2000 in Peru was marked by two presidential elections that turned out to be historically unique. The elected president for three terms at that point, Alberto Fujimori, was shortly after the election suspected of being involved in unethical political maneuvers and received criminal accusations that are still unresolved. The government then called for second elections that year, and a *cholo* (person identified as belonging to the Indian class) was elected for the first time as president. His name is Alejandro Toledo. All this political

turmoil had an effect on my fieldwork since people were particularly cautious about anyone asking questions. Because of the political practices in the country, rural inhabitants are used to seeing governmental employees or campaign runners frequently roaming their towns, but only shortly before an election. They will ask a few questions and commit the peoples vote, in exchange for a few pounds of rice or a bag of cement. Most people do not seem to be troubled by this practice, but the political climate of this particular year made it all much more complicated. Fujimori had, and still has, very candid and fervent followers, especially among the poorest classes. He is seen by a large percentage of the population, as the exterminator of the Shining Path guerrilla movement, which terrorized the country for more than 10 bloody years. During any conversation, Fujimori was always discussed. How he won his elections, who he really was (Peruvian or Japanese?), and the conditions of his successor were unavoidable topics. I had to be extremely cautious about voicing my opinions to avoid any kind of confrontation

An important and troublesome part of the ethics of ethnobotanical work involves the means to compensate the informants for their time and information. Paying cash and by the hour has a downside. The prospect of being an informant as a job that could be extended for many hours or days opened the possibility to members of the community to make some "easy money." I realized that people would try to come up with information to keep the clock

ticking. After a few attempts to pay the informants in this manner, a different approach was determined to be more promising. Working with people under the premise that there will be no compensation for their time and that they will participate only because of their willingness to share their experiences with me provided me with fully cooperative and honest informants. After a couple of visits to the communities, families received “presents” (household items or food that they do not grow, like sugar or oil; pencils and notebooks; footballs, etc. and sometimes money) just as a token of my appreciation for their friendship. Small items like pictures and newspapers were always welcome. Because of this unique relationship, the informants frequently felt the need to be reciprocal with the presents. I always accepted to share their food, but rarely took something home. Knowing the special economical conditions of most households, it was very difficult to neither accept nor reject the offers. With a couple of exceptions, I succeeded in expressing my appreciation for the offer while politely refusing it. When I failed to properly do so, I ended up carrying a 5 kg pumpkin all the way home, about 5 km up the hill.

LABORATORY PROCEDURES

McLaughlin and Rogers (1998), have been advocating the use of general bioassays in the testing for bioactive compounds. Their experience of almost 20 years concludes that

bioassays can detect responses in the chemical complexities found in crude botanical extracts, which cannot be identified with physical analytical methods such as chromatography. Desired biological responses are frequently due to synergistic effects among two or more compounds. Although the proportion of those components will vary from batch to batch, the bioactivity will usually remain within tolerable limits. Consequently, McLaughlin has adopted and developed a set of “bench top” bioassays used for specific screening of botanicals, which includes a specific assay that determines the pesticidal activities of botanical extracts, fractions and isolated compounds. This assay is known as the yellow fever mosquito (YFM) larvae microliter plate assay. The YFM test has become very popular among scientists screening for pesticidal activities (Geerts, Blerk and Triest 1994, Ioset, et al. 2000, Redwane, et al. 2002, Sathiyamoorthy, et al. 1997), because it is inexpensive, fast, technologically simple, uses little material and produces consistent results.

Even though the samples of plant extracts collected during this project were an eclectic array of repellents and pesticides used for agricultural, household and veterinary purposes, only the YFM assay was chosen to confirm their activity in the laboratory. The application of a single extraction procedure employing a polar solvent (methanol), and the use of the YFM as bioassay, is a standard and general approach to the problem of testing pesticidal bioactivity. It is implicit that for more accurate and meticulous results, the

extraction procedure should match the physical characteristics of the substance in question as well as the ethnobotanically defined uses. In this project, the actual active components of many of the plants collected were unknown, making it impossible to determine beforehand the physical details such as their polarity and therefore, a general approach was considered appropriate. Methanol is one of the most common solvents used, because of its ability to extract a wide spectrum of compounds such as polar alkaloids, tannins, terpenoids (Taylor, R., et al. 1996), anthocyanins, saponins (Murphy 1999), lactones (Rao, et al. 1993), flavones (Sato, et al. 1996) and polyphenols (Vijaya, Ananthan and Nalini 1995), among others. The extraction method was chosen as a common general-purpose technique recommended by Kennelly (pers. comm.) and others (Escoubas, Lajide and Mizutani 1994:11, Morgan and Wilson 1985:10)

1) Extraction procedure

This procedure was applied only to plants that had reports of use as repellents, pesticides, vermifuges or related purposes. In total, 23 extracts were prepared including one of the positive control substances, pyrethrin (discussed below).

- a) Plant material was collected including a voucher sample. The extracts were prepared using only the organ or organs of the plant reported to be used by the

informant (ethnobotanically defined parts). Fruits, stems and any thick or fleshy sections were cut in small pieces before drying.

- b) The plants were dried in a 40° C electric oven for four to seven days depending on the consistency of the tissues used.
- c) Once dry, 200 g samples of the material were ground into a powder.
- d) The material was immersed in methanol (95%) and soaked for 24 hours.
- e) The mixture was passed through filter paper and the residues discarded.
- f) The methanol was evaporated under a hood and the extract was set aside in a labeled and tightly closed plastic container. The bottles were stored in a freezer at -2° C.

2) Procedures for the Yellow Fever Mosquito test (YFM)

The YFM test (WHO 1970) was applied following McLaughlin and Roger's (1998) guidelines although a few variations were introduced regarding the number of larvae used per well and the type of well plates used. The frequency and final number of observations throughout the assay was also increased. The design of the experiment consisted of five doses per treatment plus a negative control. Each dose had eight replicas and three larvae per replica (24 individuals per dose). The assay was executed four times and the calculations are based on the accumulation of the results for all the replicates. This was done under the premise that the results derived from each repeat will present a variation

no greater than 10%. When a replica produced results with a greater variation, the data was discarded and a fifth repeat was performed. The readings were done every 24 hours for four days. The full protocol for the assay is included in Appendix 2

3) Positive controls

Two substances were chosen as positive controls to be used in the YFM bioassay, pyrethrins and rotenone. These two botanical pesticides have been known for many decades and because of their effectiveness, they make good subjects to compare the plant extracts collected in the field. For pyrethrins, a commercial botanical pesticide from Ecozone derived from *Chrysanthemum* sp. flowers was used to prepare an extract. The technique applied for the extraction was the same technique described for the plant material collected in the field. Pyrethrins are natural insecticides produced by *C. cinerarifolium* Vis. and *C. roseum* Adam. (Asteraceae). The flowers are harvested shortly after blooming and dried and powdered, or the oils within the flowers are extracted with solvents. The solvents of choice for this procedure are light petroleum and aqueous methanol (Morgan and Wilson 1985:10). The resulting powder and extracts usually have about 30% of the active ingredient content. These active insecticidal components are collectively known as pyrethrins. The most prominent pyrethrins are pyrethrin I and II, but there are four other different active ingredients known as cinerin I and II, and jasmolin

I and II. Pyrethrin compounds have been used primarily to control human lice, mosquitoes, cockroaches, beetles and flies (Sugavanam and Tianjian 1999).

The second positive control used is the one suggested by McLaughlin and Rogers (1998) in the protocol for the YFM bioassay. In this case, the substance did not require extraction, because the material used was pure rotenone 95-98% from Sigma. Rotenone is also a typical example of a pesticide of botanic origin that has been used commercially. The use of rotenone in the pure form gave the opportunity to test the collected extracts against a pure proven powerful insecticide and fish control agent. Rotenone is a biologically active isoflavonoid, obtained from species such as *Derris* spp., *Lonchocarpus* spp. and *Tephrosia* spp. in the Fabaceae family (Matsumura 1985). Rotenone-containing extracts are obtained mainly from the roots but also from seeds and leaves of these species and are normally extracted with water or an organic solvent such as dichloromethane (Morgan and Wilson 1985:11).

STATISTICAL PROCEDURES

The data collected from the YFM assay was analyzed using two different formulas -- mortality calculations corrected with Abbott's formula (Abbott 1925) and probit analysis according to Finney's formulas (Finney 1952)

Abbott mortality calculation

For each pesticide concentration, a percentage of mortality is calculated. The mortality calculation needs a correction for the number of insects that die due to conditions unrelated to the pesticide, like handling, starvation and natural death.

$$\text{Percent mortality} = \frac{[X - Y] \times 100\%}{X}$$

X = percent survivors of control treatment

Y = percent survivors of toxicant treatment

The results of Abbott mortality calculations will be presented as charts that show the percentage of mortality in the course of time for each dose.

Probit analysis

Probit is a unit of measurement of statistical probability based on deviations from the mean of a normal distribution. The probit method is a technique commonly used to analyze response variables. To produce the probit analysis, software created by the Ecological Monitoring Research Division of the U.S. Environmental Protection Agency (EPA) was used. The program transforms the raw data into mortality rates using the Abbott formula

(Abbott 1925) to obtain percentages that are adjusted to the reality of natural mortality among the individuals in the absolute control. These mortalities are used to produce a response curve that is further modified to produce a logarithmic response

In probit analysis (Finney 1952), probit of dead individuals is plotted on the y -axis and the log concentration is plotted in the x -axis, producing a probit regression line with an equation, which slope (b), is calculated as:

$$b = \frac{Y_1 - Y_2}{X_1 - X_2}$$

This line has a zero intercept equivalent to

$$a' = Y_1 - bX_1$$

as described by Rachlin (1967)

In terms of the graphic representation, the program plots an adjusted probit and a predicted regression line, which turns S-shaped curves that one will get if plotting number of insects that are dead versus the log of the concentration of pesticide, into straight lines that are easier to read. The original curve is S-shaped because the number of insects that die due to pesticide exposure will increase exponentially with increasing pesticide concentration at first. At about the point where half of the insects are dead, however, it will take ever-increasing amounts of pesticide to kill off the last few tough individuals, so

the curve levels off. This S-shaped curve is related to the familiar normal distribution, and is in fact the cumulative distribution for the normal curve (Singer 2000).

To measure the amount of variation between the expected response and the empirical data, a goodness of fit and confidence limit are set. The goodness of fit, chi-square (X^2) is a statistical measure for heterogeneity of variance and is tested against the tabular (critical) value as one indicator of how well the data fit the probit model. The smaller the value, the better the fit. The values can be plotted from standard tables, which are used with degrees of freedom. The number of degrees of freedom equals $N-2$, where N is the total number of doses used. If the X^2 value calculated from the test line is greater than the value in the standard table (7.815), the data does not fit the predicted line, meaning that the empirical results are not according to what is expected.

The final product of the probit analysis is the Lethal Concentration for 50% of the population (LC_{50}) and associated 95% confidence limits. To calculate the LC_{50} , the formulas are applied:

$$\log LC_{50} = \frac{5 - a'}{b}$$

The approximated standard error is calculated as:

$$s \log LC_{50} = \frac{1}{b (N/2)^{1/2}}$$

where N is the number of individual used to determine the probit points. The antilogarithm of $\log LC_{50} = LC_{50}$.

The standard error of LC_{50} (S.E.) is calculated from

$$S.E. = LC_{50} \times 2.303 \times s \log LC_{50}$$

Therefore, LC_{50} is expressed as $LC_{50} \pm S.E.$ (Finney 1952; Rachlin 1967)

The program estimates the normal population parameters, μ (μ) or mean of the standard population equivalent to the log of LC_{50} , and σ (σ) or standard deviation for this parameter.

The probit analysis was applied to the data produced for the last reading of each experiment, four days after the application of the treatment. This can be regarded as a final mortality point because if the organism is not dead after 96 hours the substance is not considered efficient in terms of a pesticide.

Because of the principles and the dependence of probit analysis on homogeneity of the population, it is accepted that only pest insects bred in the laboratory for at least one generation can be relied on to produce dependable data (field populations of pest insects are seldom homogeneous). The present project fits into the description because the *A.*

aegypti individuals used came from long time established breeding lines. Probit analyses give fundamentally sound toxicity measurements if using standard techniques and become the best-known statistical way of presenting the data (Lever 1990: 5)

LITERATURE REVIEW

Using a final list of collected plants, each species was submitted to multiple databases in search of information related to the bioactivity, phytochemistry and ethnobotanical reports. The databases that provided the most references were NAPRALERT (Natural Products Alert, from the University of Illinois), STN International Chemical Abstracts Service and ScienceDirect (Elsevier Science Journals). The information included in this study is composed mainly of reports that tend to corroborate the activity reported in the field by the informants. In absence of these kinds of reports, any known bioactivity or chemical characteristics were included. In many cases, there were no reports regarding any of these topics for a species and reports from other species in the same genus or at a higher taxonomic level were used as a suggestion of possible bioactivity or phytochemistry.

CHAPTER 3. RESULTS

"The physical world is approached from opposite ends in the two cases (traditional knowledge vs. western science): one is supremely concrete, the other supremely abstract" - C. Levi-Strauss-

PARAMETERS OF NATIVE CLASSIFICATION OF PLANTS

There are two basic forms of classification for the native flora in the area of Cajamarca (Bazán and López 1991) according to size and shape and according to utility. According to size and shape, they recognize three groups -- *quewua* (herbs), *sacha* (bushes), and *kero* (trees). According to utility, two categories are recognized -- peasants state that plants, as the universe, are in the midst of a struggle between God (*el Amito* – the Master) representing good, and the Devil (*Shapi* or *del diablo*), representing evil. Plants associated with *Amito* are useful to humankind, do not present danger in any way or are consumed by domestic animals. On the other hand, *Shapi* plants will have stinging hairs, thorns, spines or toxic properties. Also belonging to this category are plants used in shamanism and black magic practices or consumed as hallucinogens. A special category of *Shapi* plants is defined by the Quechua word *khisa*. These are plants with urticant

(dermatotoxic) hairs, related to *khisqa*, which refers to plants having sharp spines. *Khisa* includes members of both the European genus *Urtica*, (stinging nettles or *ortiga* in Spanish) and the native plant family Loasaceae. Injection into the skin of the poisonous histamine and acetylcholine contained in hair cells, are the source of pain and discomfort that characterize these plants (Franquemont 1988).

Only when I reached a full understanding of these classifications, especially the later, was I able to truly capture the meaning of the task that I had ahead. I intended to ask about the presence of *Shapi* among the Quechua and their relationship to this evil entity. I recognized the sensitive nature of the information and understood the reluctance of some people to discuss the subject. This cultural phenomenon was the reason for the collection of medicinal plants, which were not really an intended part of the project. People were eager to discuss the good (*Amito*) plants they had on their properties, rather than the *Shapi* plants around them. Being that the information collected is considered valuable, all the plants reported are included here, even if they are strictly medicinals.

Although the Peruvian peasant communities of northern Peru recognize the empirical etiology of disease, the ultimate cause of illness is often related to the weather or to a supernatural source. Empirical cures are valued, but are supplementary to supplication and praying. Two major etiological categories of illness are *mal aire* (bad air), and *susto*

(fright). *Mal aire* encompasses disease-producing vapors or airs believed to emanate from tombs, sacred places or simply from “ill intentioned weather conditions.” Currents of air in the late afternoon and going from a warm place into a cold environment are conditions believed to be particularly bad. Pains in various parts of the body, paralysis of extremities, pneumonia and gastro-intestinal disturbances are often attributed to *mal aires* (Dobkin 1968). This study did not include references to plants used to treat *mal aire*, the determination of effectiveness and relation to phytochemistry could not be determined.

Susto is another common illness, mainly affecting children. The symptoms range from difficulty falling asleep to uncontrollable crying caused by colic. It can also include fever and gastric problems. Plants ethnobotanically defined to treat *susto* were included in this project. The correlation with the scientific literature review was focused on determining any relation to nervous disorders, sedative effects or effectiveness in treating gastric problems.

Regarding the information on scientific literature included here, in many cases database searches for the phytochemistry of the plant or the activity in question did not yield results. Mention of papers or research found on plants in the same genus is included, as a suggestion of possible relation to the plant collected. Nevertheless, the uncertainty of chemotaxonomy as a completely reliable way of predicting the presence of the same

chemicals, in species of related genera or families has been taken into account. Likewise, although the scientific reports do not always address the actual use as reported by the informant, the references included could still be interpreted as a sign of interest of the scientific community for the phytochemistry or the ethnobotany of the plant.

Although toxicity and/or uses described for a given plant may differ among the informants, all reports are included in the account, as well as all reported local names. Quechua names for the plants collected were included if reported by the informants. Many of these Quechua words have been incorporated into Spanish for so long that they are written with regular Spanish orthography. Some other names, less commonly used by Spanish speakers were recorded in a tape as pronounced by the informant and a bilingual person wrote down the names using a phonetic system. Regarding this issue, it should be said that the orthography of Quechua has been characterized by some degree of anarchy.

Quechua was not a written language until the late sixteenth century and because every writer had his/her own idea of how to transcribe the phonetics, no uniform orthography was established until 1954. However, these rules have not been universally accepted as subsequent writings show and orthographical anarchy continues (Gade 1975:29). As of today, a bitter discussion about the use of three or five vowels in written Quechua seems to be an ongoing debate among linguists (Heggarty 1999). This study will follow the

newly official three-vowel orthography, accepted in Peru, Ecuador and Bolivia. As mentioned before, there will be some exceptions with names and other terms, which are so standardized (and commonly used in Spanish), that to devise new spellings would be improper. Some words taken from other authors, whose original work used five-vowel spellings (Bazán and López 1991) were also transcribed as the original author intended. In numerous cases, the spelling of Quechua words was confirmed by scientific publications, during the literature research. The similarity with name usage and spelling on works from the Quechua of Ecuador (known there as Quichua) was particularly consistent.

Below is an alphabetical account (by family) of the plants collected through 276 interviews, their uses, preparation, and means of administration as reported by the informants. Additionally, scientific literature related to the phytochemical, medicinal and toxicological information. Plants reported by the informants, as toxic, are identified by an asterisk next to the scientific name. Table 3.1 is a summary of the botanical families most frequently found to be reported as toxic, throughout the region.

Table 3.1: Collected plants and their uses.

Family	Scientific name	Voucher*	Spanish	Quechua	T-H	D-T	T-A	U-P	U-R	U-V	M	B
Adiantaceae	<i>Adiantum subvolubile</i> Mett. ex Kuhn	167	culantrillo								✓	
Amaranthaceae	<i>Alternanthera elongata</i> (Willd) Schinz.	147	tabardillo								✓	
	<i>Iresine diffusa</i> Humb. & Bonpl. ex Willd. var <i>spiculigera</i> (Seub.) Eliasson	135	lancetilla								✓	
Anacardiaceae	<i>Schinus molle</i> L.	117	molle					✓	✓		✓	✓
	<i>Loxopterygium huasango</i> Spruce ex. Eng.	153	hualtaco			✓						
	<i>Mauria heterophylla</i> H.B.K.	223	tres hojas			✓						
Apiaceae	<i>Apium graveolens</i> L.	165	apio								✓	
	<i>Cyclospermum laciniatum</i> (DC.) Constance	142	culantrillo				✓				✓	
	<i>Contum maculatum</i> L.	114	visnaga				✓					
	<i>Daucus montanus</i> Humb. & Bonp. ex Spreng	193	culantrillo	suk'a perejil			✓					
	<i>Foeniculum vulgare</i> Mill.	138	hinojo							✓	✓	✓
	<i>Sanicula liberia</i> Cham. & Schlect	110	culantrillo				✓					
Apocynaceae	<i>Nerium oleander</i> L.	116	laurel de campo		✓		✓	✓			✓	✓

Family	Scientific name	Voucher*	Spanish	Quechua	T-H	D-T	T-A	U-P	U-R	U-V	M	B
Apocynaceae	<i>Vallesia glabra</i> (Cav.) Link	159	perlillo								✓	
Araliaceae	<i>Oreopanax eriocephalus</i> Harms	145		maqui-maqui							✓	
Asteraceae	<i>Ageratina sternbergiana</i> (DC.) R. M. King & H. Rob.	169	mangapaque	ch'ilka							✓	
	<i>Ambrosia arborescens</i> Mill.	126	marco	markhu			✓	✓	✓	✓		✓
	<i>Perreyranthus verbascifolius</i> (H. B. K.) Robinson and Brettel	171	coca antepasados								✓	
Asteraceae	<i>Hieracium peruanum</i> Fries.	230	balsamo del campo								✓	
	<i>Philoglossa peruviana</i> D.C.	161	botoncillo				✓					
	<i>Schkuhria pinnata</i> (Lam.) Cabrera	182	escoba suave	kanchalawa					✓		✓	✓
	<i>Sonchus oleraceus</i> L.	139	serraja	upa khisa							✓	
	<i>Tagetes elliptica</i> Smith	125	honrada								✓	
Bixaceae	<i>Bixa orellana</i> L.	156	achiote	manduru							✓	
Brassicaceae	<i>Brassica campestris</i> L.	175	mostaza	llullu			✓					
Capparaceae	<i>Cleome longifolia</i> Presl.	192	yuquilla								✓	
Caryophyllaceae	<i>Stellaria chilensis</i> Pedersen	166	hierba de tabardillo								✓	
	<i>Stellaria media</i> (L.) Mill.	200	guañuna				✓					
Convolvulaceae	<i>Ipomea carnea</i> Jacq.	187	hoja ancha				✓					
Cucurbitaceae	<i>Cucumis dipsaceus</i> Ehrenberg. ex Spach	184	jaboncillo					✓				✓

Family	Scientific name	Voucher*	Spanish	Quechua	T-H	D-T	T-A	U-P	U-R	U-V	M	B
Cucurbitaceae	<i>Sicyos montanus</i> Poepp. & Endl.	172	pachalanga	putaqlanku					✓			✓
Equisetaceae	<i>Equisetum giganteum</i> L.	118	cola de caballo					✓			✓	✓
Euphorbiaceae	<i>Asclepias curassavica</i> L.	155	lechosa			✓	✓					
	<i>Dalechampia weberbaueri</i> Pax & Hoffm.	214	raspa			✓						
	<i>Euphorbia huanchahana</i> Boiss	228	michoacán	wachanka	✓					✓		✓
	<i>Euphorbia urucalli</i> L.	186	lechero			✓						
	<i>Jatropha curcas</i> L.	158	piñón		✓							
	<i>Pedilanthus tithymaloides</i> (L.) Poit.	185	diablo			✓					✓	
	<i>Ricinus communis</i> L.	119	higuerilla		✓		✓				✓	
Fabaceae	<i>Apurimacia boliviana</i> (Britton) Lavin	203	barbasco					✓		✓		✓
	<i>Astragalus garbancillo</i> Cavend.	208	garbancillo	huska/quira			✓				✓	
	<i>Caesalpinia spinosa</i> (Molina) Kuntze	113	taya/tara/taro								✓	
	<i>Desmodium molliculum</i> (Kunth) DC. B103	129	pie de perro								✓	
	<i>Leucaena trichodes</i> (Jacquin) Benth.	178	peladera	motuy			✓					
	<i>Lupinus arvensis</i> Benth.	189	chocho	tarwi				✓				

Family	Scientific name	Voucher*	Spanish	Quechua	T-H	D-T	T-A	U-P	U-R	U-V	M	B
Fabaceae	<i>Lupinus mutabilis</i> Lindl.	225	chocho	tarwi				✓				✓
	<i>Medicago polymorpha</i> L.	174	trebol				✓					
	<i>Otholobium glandulosum</i> Grimes	163	culén	wallwa						✓	✓	✓
	<i>Otholobium munyense</i> (Macbr.) Grimes	206	culén	wallwa							✓	
	<i>Spartium junceum</i> L.	149	retama						✓		✓	✓
	<i>Phacelia pinnatifida</i> Griseb. ex Wedd.	210		khisa		✓						
Lamiaceae	<i>Minthostachys mollis</i> Griseb	226	chamcua	muña					✓	✓		✓
	<i>Minthostachys tomentosa</i> (Benth.) Epling	196	chamcua	muña					✓	✓		
	<i>Stachys arvensis</i> L.	146	rasmio	supiquewa							✓	
	<i>Stachys</i> sp.	179		arañaquewa			✓					
Loasaceae	<i>Catophora contorta</i> (Desr.) C. Presl.	212		khisa/ishguin		✓						
	<i>Catophora septaria</i> (Ruiz & Pav. ex G. Don) J. F. Macbr.	195	ortiga de zorro	khisa		✓						
	<i>Nasa macrantha</i> (Urb. & Gilg.) Weigend	229	ortiga de león	khisa		✓						
	<i>Nasa macrothyrsa</i> (Urb. & Gilg.) Weigend	205		ishguin		✓						
	<i>Nasa picta</i> (Hooker) Weigend	204		ishguin		✓						

Family	Scientific name	Voucher*	Spanish	Quechua	T-H	D-T	T-A	U-P	U-R	U-V	M	B
Loasaceae	<i>Nasa ranunculifolia</i> (Kunth) Weigend	211	ortiga	orko khisa		✓					✓	
Loranthaceae	<i>Ligaria cuneifolia</i> (Ruiz & Pav.) Tiegh.	111	popa	carawanuche							✓	
Malvaceae	<i>Fuertesimalva limensis</i> (L.) Fryxell	176	malva/botoncillo				✓					
Malvaceae	<i>Malva parviflora</i> L.	137	malva								✓	
Myrtaceae	<i>Eucalyptus globulus</i> Labill.	132	eucalipto					✓			✓	✓
Oxalidaceae	<i>Oxalis dombeyi</i> A. St. Hil.	168		chulco							✓	
	<i>Xanthoxalis corniculata</i> (L.) Small	136		chulco							✓	
Piperaceae	<i>Peperomia hutchisonii</i> Yunker	173	conguna silvestre	yuthu-panga							✓	
	<i>Piper aduncum</i> L.	143	matico								✓	
Plantaginaceae	<i>Plantago major</i> L.	130	llantén								✓	
Poaceae	<i>Cynodon dactylon</i> (L.) Pers.	151	grama dulce								✓	
Polygonaceae	<i>Muehlenbeckia tamnifolia</i> (Kunth) Meisn.	191	chacapetaca	mullaka							✓	
Portulacaceae	<i>Calandrinia ciliata</i> (Ruiz & Pav.) DC.	199	guañuna				✓					
Primulaceae	<i>Anagallis arvensis</i> L.	198	guañuna				✓					
Proteaceae	<i>Oreocallis grandiflora</i> (Lam.) R. Br.	144	cucharilla								✓	
Rosaceae	<i>Rosa indica</i> L.	124	rosa de castilla								✓	

Family	Scientific name	Voucher*	Spanish	Quechua	T-H	D-T	T-A	U-P	U-R	U-V	M	B
Rosaceae	<i>Sanguisorba officinalis</i> L.	133	pimpinela								✓	
Rubiaceae	<i>Borreria laevis</i> (Lam.) Griseb	181	araña				✓					
Rutaceae	<i>Citrus aurantium</i> L.	183	naranja agria					✓	✓			✓
Salicaceae	<i>Salix chilensis</i> Molina	127	sauce						✓		✓	✓
Santalaceae	<i>Quinchamalium chilense</i> Molina	170		chinchimal							✓	
Solanaceae	<i>Capsicum pubescens</i> Ruiz & Pav.	122	rocoto					✓			✓	
	<i>Cestrum peruvianum</i> Roem. & Schult.	218	hierba santa	sauco pishij						✓	✓	✓
	<i>Cestrum tomentosum</i> L.	162	hierba santa lanuda				✓					
	<i>Cestrum weberbaueri</i> Francey	123	hierba santa	sauco pishij						✓		
	<i>Datura arborea</i> (L.) Laberheim	112	floripondio	guantu/war-war	✓		✓				✓	
	<i>Datura stramonium</i> L.	180	chamico		✓		✓					
	<i>Nicotiana rustica</i> L.	201	tabaco	tahuaco	✓		✓	✓			✓	
	<i>Nicotiana tabacum</i> L.	115	tabaco	tahuaco	✓		✓	✓			✓	✓
	<i>Solanum luteoalbum</i> Pers.	160	guañuna				✓					
Urticaceae	<i>Pilea microphylla</i> (L.) Liebm.	148	contra-yerba								✓	
	<i>Urtica magellanica</i> Juss. ex Poir	194	ortiga	chini/ishguin		✓					✓	
	<i>Urtica urens</i> L.	197	ortiga negra	chini/ishguin		✓					✓	

Family	Scientific name	Voucher*	Spanish	Quechua	T-H	D-T	T-A	U-P	U-R	U-V	M	B
Valerianaceae	<i>Phyllacns rigida</i> (Ruiz & Pav.) Pers.	232	valeriana					✓	✓			✓
Verbenaceae	<i>Verbena litoralis</i> Kunth	131	verbena						✓		✓	✓

T-H = toxic to humans

D-T = dermatotoxic

T-A = toxic to animals

U-P = used as pesticide

U-R = used as repellent

U-V = used as vermifuge

M = medicinal

B = YMF bioassay

*All numbers are O. Orozco collections

Table 3.2: Most frequent toxic families.

Family	Genera	Species
Fabaceae	7	9
Euphorbiaceae	6	7
Solanaceae	5	9
Apiaceae	5	5
Anacardiaceae	3	3
Asteraceae	3	3
Loasaceae	2	6
Lamiaceae	2	3
Cucurbitaceae	2	2
Urticaceae	1	2
Apocynaceae	1	1
Brassicaceae	1	1
Caryophyllaceae	1	1
Convolvulaceae	1	1
Equisetaceae	1	1
Hydrophyllaceae	1	1
Malvaceae	1	1
Myrtaceae	1	1
Portulacaceae	1	1
Primulaceae	1	1
Rubiaceae	1	1
Rutaceae	1	1
Salicaceae	1	1
Valerianaceae	1	1
Verbenaceae	1	1

PLANTS COLLECTED AND ETHNOBOTANICAL INFORMATION

Angiosperms

Amaranthaceae

Alternanthera elongata (Willd. ex Roem. & Schult.) Schinz

Collection voucher: *Orozco 147*

Common name: Tabardillo (Spanish)

Description: Plant sold at Cajamarca's herb market. Plant usually found in *kechuwa* areas.

Use 1: To wash women's genital areas

Preparation: Prepare decoction by boiling the leaves in water.

Administration: Use decoction to wash genitalia once a day for a week

Use 2: To treat swollen kidneys

Preparation: Prepare decoction by boiling the leaves in water

Administration: Drink the hot decoction, three cups a day.

Scientific literature review: The pharmacological activity has been studied for a related species, *A. philoxeroides* (Mart.) Griseb. The antiviral effect of extracts was studied in lethal epidemic hemorrhagic fever virus (EHFV) infection model of suckling mice. The plant extract administration could interrupt viremia and eliminated the infectious virus in the tissues. It mitigated pathological lesions and virus antigens in tissues as compared

with the control group (Peng, et al. 1997). Specific reports on *A. elongata* were not found.

***Iresine diffusa* Humb. & Bonpl. ex Willd. var. *spiculigera* (Seub.) Eliasson**

Collection voucher: *Orozco 135*

Common name: Lancetilla (Spanish)

Description: Scandent herb; cultivated as an ornamental. Collected in *kechwa* area

Use 1: To treat kidney problems.

Use 2: To treat irregularities in menstrual cycles and as an emmenagogue (probably abortifacient).

Preparation: Prepare decoction from the leaves

Administration: Drink one cup of the decoction once a day.

Scientific literature review: *Iresine diffusa* is known to have alkaloids that could account for the activity described by the informants (Blunden, et al. 1999); but no bioactivity assay can confirm the case. For other members of the genera, as *I. celosioides* L., assays looking for anti-inflammatory activity had negative results (Bork, et al. 1996). Also negatives are the results on assays testing toxicity in mouse (Mokkhasmit, Swatdimongkol and Satrawaha 1971).

Anacardiaceae***Schinus molle* L.***

Collection voucher: *Orozco 117*

Common name: Molle (Spanish)

Description: Tree 3-5 m tall, with a weedy tendency. *Molles* grow normally along watercourses and elsewhere only in the higher regions. Its vertical distribution is from sea level, although it avoids the immediate coast, to 2300 m in northern Peru (actual collections and reports from informants include specimens from *yunga*, *kechwa* and *jalca*)

Toxicity: Besides claims of medicinal properties (see below), the leaves are believed to have toxic and repellent properties against insects

Use 1: To treat rheumatoid pains.

Preparation: Leaves and fruits are macerated in alcohol for at least two weeks.

Administration: The alcohol is rubbed on the affected areas.

Use 2: When the bark is cut, a milky sap flows easily. This sap is applied externally, to treat pains and swelling of the legs as a remedy for swelling and sores. Taken internally the sap is a purgative and a diuretic

* toxic plant

Use 3: As a repellent, the leaves will be hung by the door or placed in flasks on tables. to avoid the presence of flies (*Musca domestica* L.).

Use 4: As insecticide to control *Brevicoryne brassicae* L. (Homoptera) in lettuce and cauliflowers and *Myzus persicae* Sulzer and *Macrosiphum euphorbiae* Thomas

(Homoptera) in potato, tomato, chili pepper, quinoa, pumpkin, tobacco, beans and lettuce

Scientific literature review: The essential oils of *S. molle* have been well-studied (Jennings and Bernhard 1975; Lawrence 1997), as well as their pharmacological activities (Bello, et al. 1998; Zaidi, Hanan and Babar 1970). Also the information on insecticidal activity against pests like moths (Noctuidae) (Gebre-Amlak and Azerefegne 1993), *Drosophila melanogaster* Meigen (Diptera) and *Tribolium confusum* Duv. (Coleoptera) (Steinbauer 1995) is abundant. Results of this research vary depending on the species and the type of extract used. Very high mortality was found in fruit fly *Drosophila melanogaster*, when using the essential oil extracted from seeds. Sixty to ninety percent mortality of larvae in species like *Scirpophaga incertulas* Walker and *Pyrilla perpusilla* Walker (Lepidoptera) when using leaf extracts (Anwar, et al. 1992). The repellent activity has been scientifically tested against *Blattella germanica* L. (Blattodea) using steam distillation of the leaves. Among the most active essential oil compounds that have been identified in *Schinus* spp. are thymol, which yielded a repellency index of 95%, citronellyl acetate (86%) and beta-caryophyllene (85%) (Guardiola, Miguel and Primo 1990). In bioassays involving *Musca domestica*, the volatile extracts of the leaves were shown to have

repellent and feeding-deterrent activity attributed to menthol and piperitol (Wimalaratne, et al. 1996). Additionally, activity of *S. molle* extracts have also been studied as fungitoxicants (Dikshit, Naqvi and Husain 1986).

Schinus molle has been and still is an important tree to the Peruvians. In Inca times, it apparently was a cultivated species along roads and near palaces. The Incas also value the tree's resin for embalming material and the whole plant for the medicinal properties that are still attributed today. After the Conquest, great numbers of large *molle* trees were cut down to make charcoal (De la Vega 1609:274). Later, lye was made from *molle* ashes to promote the transformation of molasses to granulated sugar (Pérez Vidal 1954). The fruits, which contain the alkaloid piperine, are soaked in warm water. Then, the bitter seeds are squeezed out and removed and the water, which has dissolved the sweet flesh of the fruit, is strained and left standing for some days. This produces a pleasant and healthy wine-like drink, which subsequently may be cooked into syrup or fermented into vinegar. The tree also contains tannin and the leaves give a yellow dye, but there is no reference of use in Peru for these two properties (Kramer 1957).

***Loxopterygium huasango* Spruce ex Engl. ***

Collection voucher: *Orozco 153*

Common names: Gualtaco or hualtaco (Spanish)

Description: Tree 3 m tall; abundant on the sides of the trails, it is a common species in tropical desert scrubland. Actual collections and reports were gathered in *chala*, *yunga* and *kechwa* areas

Toxicity: Dermotoxic to humans. Contact with the leaves or the sap produces swelling and/or blisters (depending on the particular sensitivity of the individual)

Treatment: Dancing around the tree is believed to help heal the rash. In addition, applying to the affected area leaves of *Bixa orellana* that have been burned for a short while on top of logs

Scientific literature review: No research is available on the dermatitis-producing compounds of this species. A related plant, *L. lorentzii* Griseb has yielded the alkaloid loxopterygine (Willaman and Schubert 1961). Any relation of this compound with the effect described by the informants has not been determined. It is more likely that oleoresins, frequently found in the Anacardiaceae family (Mitchell 1990), cause contact dermatitis like that described for *Loxopterygium*.

One of the very few activities that areas with no access to irrigation can support is the husbandry of goats. The animals graze on the leaves and new twigs of *L. huasango*, killing the young trees or leaving them as small shrubs with no value for wood. Shepherds cut mature trees for their valuable hard wood, appreciated for fancy floor tiles. In the areas surrounding the Pan-American Highway, the irrational exploitation of this species is

leading to their extinction. Tosi described a similar situation in 1960 and is certainly not getting any better in the last 40 years.

Mauria heterophylla* H.B.K.

Collection voucher: *Orozco 223*

Common name: Tres hojas (Spanish) = three leaves

Description: Small tree, 3 m tall, purplish-green fruits; growing on secondary forest

Collected in *kechwa* zone.

Toxicity: The latex from the stems and leaves produces a rash.

Scientific literature review: Like many other Anacardiaceae, the dermatotoxicity of this plant is well known, but the scientific literature has not addressed the topic for the genus *Mauria*. For the family in general, it is accepted that the cell-mediated contact dermatitis is produced by the presence of oleoresins (phenolic compounds) (Mitchell 1990).

Apiaceae

***Apium graveolens* L.**

Collection voucher: *Orozco 165*

Common name: Apio (Spanish)

Description: Perennial herb; occasionally grown in backyards and gardens, cultivated for its seeds and leaves rather than for its edible stalk in *kechwa* and *yunga* areas.

Use: To treat stomachache

Preparation: The seeds are ground and prepared in a decoction (boiling out).

Administration: Drink the decoction every two hours as needed.

Scientific literature review: Extracts of *A. graveolens* were tested for their hepatoprotective activity against induced hepatotoxicity in rats. The methanolic extracts showed the most significant hepatoprotective activity, comparable with standard drugs (Ahmed, B., et al. 2002). *Apium* extracts are also known to have some degree of anti-inflammatory activity (Al-Hindawi, et al. 1989). It is known that the seeds contain numerous coumarins, furanocoumarins (Garg 1979; Innocenti, Dall'Acqua and Caporale 1976) and phenolic compounds (Garg 1979). This composition could well explain reports of bioactivity against fungi (Kher and Chaurasia 1977). Finally, some research has been done on the repellent activity of the essential oil against *Acanthoscelides obtectus* Say (Coleoptera), without noteworthy results (Papachristos and Stamopoulos 2002).

***Cyclospermum laciniatum* (DC.) Constance ***

Collection voucher: *Orozco 142*

Common name: Culantrillo (Spanish)

Description: Annual herb up to 20 cm tall; found as a weed in pastures in *kechwa*.

Toxicity: Toxic to guinea pigs, if ingested. Actual intoxication will seldom happen since guinea pigs do not graze but are fed in their pens or inside the house (more exactly, under the stoves) where they are kept. Frequently, kids are assigned to the task of cutting grass and herbs to feed the guinea pigs. They learn from early age, which plants have toxic properties that will affect them. This statement applies to all plants reported as toxic to guinea pigs.

Use: To treat “*susto*” in kids.

Preparation: Mix with *Eucalyptus globulus* leaves and boil in water

Administration: Bath the child with the decoction.

Scientific literature review: No research was found for *C. laciniatum* or for any other species in the genus. It is possible that the notion of toxicity comes from similarities of the plant with species in other genera in this family, like *Conium*, which are well known to be rich in toxic alkaloids (Mitich 1998). Other prospects will be the presence of coumarins, furanocoumarins and/or phenolic compounds known to be abundant in genera like *Apium* (Garg 1979; Innocenti, Dall'Acqua and Caporale 1976).

***Conium maculatum* L. ***

Collection voucher: *Orozco 114*

Common name: Visnaga (Spanish)

Description: Annual herb 0.3 m tall with white flowers. Very common as a weed in pastures (*yunga* and *kechwa*).

Toxicity: To cattle and guinea pigs by ingestion

Scientific literature review: Although poison hemlock is native to Europe, it is now widely distributed across the United States, Central and South America. Besides coniine, the main alkaloid on *C. maculatum* (Mitich 1998), the plant contains a variety of piperidinic alkaloids, flavonoids, coumarins and polyacetylenes that are biologically active (Zdanevich and Belodubrovskaya 1997). The toxic properties of the plant have been known for centuries, being used in ancient Greece in executions. The most famous example was the philosopher Socrates, who drank a cup of hemlock tea after being condemned for “corrupting the youth of Athens.” More recently, teratogenic effects have been included in the warnings regarding this plant (Keeler, et al. 1980, Panter, Bunch and Keeler 1988). The toxicity has been compared for various species, including chickens, quails and turkeys (Frank and Reed 1990), sheep (Panter, Bunch and Keeler 1988), cows, ewes, mares (Keeler, et al. 1980) and man (Smith, et al. 1982). The scientific literature mentions the fact that *C. maculatum* is attacked by few insects (Goeden and Ricker 1982). Additional research has been done on control of slug damage using *C. maculatum* (Dodds 1996), but no mention was encountered during the fieldwork on use of this plant as insecticide or any other

Daucus montanus* Humb. & Bonp. ex Spreng .

Collection voucher: *Orozco 193*

Common names: Culantrillo (Spanish) = small cilantro, suk'a perejil (Quechua-Spanish) = malevolent spirit parsley.

Description: Annual herb 0.3 m tall, found as a weed in *kechwa* and *jalca* pastures.

Toxicity: Toxic to guinea pigs when ingested.

Scientific literature review: There is no research for this species in particular, but the genus *Daucus*, is known to be by far the richest taxon in essential oils among the Apiaceae. It is distinguished by the presence of the sesquiterpenes carotol and geranyl acetate (Williams and Harborne 1972). At least one species in this genus has been extensively studied -- *D. carota* L. (carrot). Few reports include the bioactivity of the aerial part producing dermatitis (Munoz, et al. 1989), acting as antitumoral extracts (Maeda, et al. 1992) and as antibacterial (Ross, et al. 1980). No further information was found that could be linked to the reported bioactivity of *D. montanus*.

***Foeniculum vulgare* Mill. ***

Collection voucher: *Orozco 138*

Common name: Hinojo (Spanish)

Description: Old World perennial growing up to 1 m high and found in all parts of the Cajamarca valley except the *jalca* area; regularly cultivated as medicinal in backyards or found volunteering on trash heaps

Toxicity: Toxic to intestinal parasites (*Taenia saginata*).

Use 1: The flowers and fresh leaves are used in decoction to cure kidney inflammations, cramps, bronchial cough and nervous disorder.

Administration: Drink a cup of tea before breakfast for a week.

Use 2: Decoctions of the leaves and stems used as remedy for non-specific ailments like *mal aire*.

Preparation: Boil leaves to prepare decoction.

Administration: The preparation can be taken as needed.

Use 3: The fruits and leaves are used as an antihelmintic.

Administration: Fresh seeds chewed and eaten or decoctions of the leaves taken a tea.

Scientific literature review: The ethnobotanical claims for this species are very well documented in the scientific literature, although no medical trial or pharmacological report was found. Larvicidal activity of aqueous extract of *F. vulgare* has been tested against *A. aegypti* with moderate results (Sathiyamoorthy, et al. 1997). Methanol extracts and essential oils have been tested for their insecticidal activities against adults of *Sitophilus oryzae* L. (Curculionidae) and *Callosobruchus chinensis* L. (Bruchidae), using direct contact application and fumigation methods. Over 90% mortality at three or four days

after treatment was achieved using extracts of *F. vulgare* fruit. At 0.7 mg/cm² (direct contact method), extracts from *F. vulgare* were highly effective against both species. In the fumigation test with *S. oryzae* adults, the oils described were much more effective in closed containers than in open ones, indicating that the insecticidal activity was attributable to fumigant action (Kim and Young 2001). Antimicrobial and antioxidant tests for the essential oils were also assayed against 25 genera of bacteria, including animal and plant pathogens, food poisoning and spoilage bacteria. *Foeniculum vulgare* shows activity against a broad variety of these organisms (Ruberto, et al. 2000). Trans-anethole was found to be the main constituent of the essential oil (Bilia, et al. 2000).

***S. libertia* Cham. & Schlect. ***

Collection voucher: *Orozco 110*

Common name: Culantrillo (Spanish)

Description: Annual herbaceous, 0.3 m tall; growing as a weed on pea field (*kechwa* zone).

Toxicity: Poison to guinea pigs.

Scientific literature review: No reports on phytochemistry of this specific plant, although two papers state bioactivity on a member of the same genera (*S. europea* L.) against the influenza virus (Turan, Nagata and Kuru 1996; 1999). Another report describes

moderated biological activity of *S. graveolens* Poepp. ex DC. as beta-glucuronidase inhibitor (Schemeda-Hirschmann, et al. 1999).

Apocynaceae

Nerium oleander L.*

Collection voucher: *Orozco 116*

Common name: Laurel de campo (Spanish)

Description: Tree up to 5 m tall. Bright pink or white flowers. Very common in *chala*, *yunga* and *kechwa*, as an ornamental

Toxicity: All parts of the plant are recognized as very poisonous. Domestic animals will not ingest it under normal circumstances, but some informants believe that just burning the wood will be enough to produce toxic fumes that can kill small animals like guinea pigs.

Use 1: To treat foot dermatitis produced by fungi (probably *Dermatophytes* or *Candida*).

Preparation: Boil leaves and flowers and bath the affected area for 15 minutes, twice a day.

Use 2: To treat corn seed before planting as protection against *Feltia experta* Walker.

Agrotis ipsilon Hufnagel and *Spodoptera frugiperda* Smith (Lepidoptera). Also to treat grain before storage, to protect against *Acanthoscelides obtectus* Say (Coleoptera).

Preparation: Flowers and leaves should be ground and mixed with water. The seed should be soaked in the water for 12 hours before planting.

Scientific literature review: The toxic principles are present all over the plant even conserving the toxicity when the plant is dry. Cardiac glycosides with a similar action to digitoxin (from *Digitalis* sp.), neriine, oleandrin, cornivin and neriantin are abundant (Abe and Yamauchi 1979; Knight, A. P. 1988; Sener and Ozata 1982). After few hours of ingestion, the symptoms will start with nausea, vomiting, cramps, acute gastroenteritis and bloody diarrhea. Later, reactions include weak pulse, irregular cardiac rhythm, convulsions and finally paralysis and death. Oxalate crystals have been found in the stems and leaves of the plant, but, apparently, there is no relationship between the distribution of calcium oxalate crystals and the toxicity of organs in the plant (Doaigey 1991).

Regarding the insecticidal properties, research has been done on a few species: in *Aedes fluviatilis* Lutz (Diptera) larvae, *Nerium* extracts enhanced larval mortality at 100 ppm (Consoli, et al. 1988). Different instars of *Culex quinquefasciatus* Say (Diptera) and *Anopheles stephensi* Liston (Diptera) have also been tested for susceptibility to *N. oleander* extracts. The results show considerable larval mortality and interference with pupal-adult metamorphosis. At very low concentration, the active fractions of the plant

extract extended the duration of the various larval instars and of pupation. In general, I and II instar larvae were more susceptible to the active fraction (Pushpalatha and Muthukrishnan 1995). The insecticidal effect of ethanolic extract from leaves of this plant was tested against instar II larvae of *Muscina stabulans* Fallén (Diptera). The LC_{50} of the extract was 113 ppm. This dose delayed larval and pupal duration, suppressed oviposition and decreased adult longevity of the survivors. Morphogenic abnormalities were recorded in larval, pupal and adult stages, which were produced from treating instar II larvae with different concentrations of the extract (El-Shazly, Nassar and El-Sherief 1996).

***Vallesia glabra* (Cav.) Link.**

Collection voucher: *Orozco 159*

Common name: Perlillo (Spanish) = small pearls (resemblance of the small white fruits)

Description: Shrub up to 2 m tall; small white flower and green fruits turning white; often growing as part of a fence in *yunga* areas.

Use 1: To treat skin infections

Preparation: Crush the fresh fruits and apply to the affected area as a poultice.

Use 2: To treat viral infection of undetermined origin in chickens.

Preparation: Crush the fruits and let them sit on water for one day. The water should be filtered and then drops of the water, put in the animal's eyes

Scientific literature review: The plant is known to have at least 11 indole alkaloids.

Vallesine, aspidospermine, 11-methoxydichotine, apparicine, tubotaiwine, vincadifformine, condylocarpine, (minus)-rhazinilam (a cytotoxic compound), aspidospermatine, haplocidine and 18-oxohaplocidine have been isolated from leaves and stems (Zeches, et al. 1995). No further works have been found on bioactivity of the compounds or on the composition of the fruits.

Araliaceae

***Oreopanax eriocephalus* Harms**

Collector voucher: *Orozco 145*

Common name: Maqui-maqui (Quechua) = hand-hand (resemblance with the shape of the leaves).

Description: Tree; palmately veined leaves. This is an endemic species found in the *kechwa* and low *jalca* areas.

Use: To reduce swelling.

Preparation: Boil leaves two or three leaves in two liters of water.

Administration: Drink a cup of the decoction twice a day

Scientific literature review: No reference was found for this particular species. Some work has been done on *O. guatemalensis* Decne. & Planch. ex Hemsl., which has been screened for molluscicidal activity with a 100% mortality result (Shoeb, et al. 1994). The phytochemistry of the latest species has also been studied, finding it to contain abundant triterpenoid saponins (Melek, et al. 2002).

Asteraceae

***Ageratina sternbergiana* (DC.) R. M. King & H. Rob.**

Collection voucher: *Orozco 169*

Common names: Mangapaque (Spanish); ch'ilka (Quechua).

Description: Herb 0.2 m; small yellow flowers; growing on a very disturbed area among potato plants in *kechwa* and *jalcas*.

Use 1: To increase menstruation.

Preparation: Boil five leaves in two liters of water.

Administration: Drink one cup of the decoction a day.

Use 2: To treat fractures and bumps.

Administration: Rub the plant on the affected area.

Scientific literature review: Research on other members of the genus has yielded information on the presence of abundant sesquiterpenes. Specifically cadenine sesquiterpenes isolated from *A. adenophora* Spreng., were found to produce hepatotoxicity in mice (Oelrichs, et al. 1995). No further information found.

Ambrosia arborescens* Mill.

Collection voucher: *Orozco 120*

Common names: Marco (Spanish), markhu (Quechua)

Description: Shrub up to 3 m tall. Frequently grows as a weed in pastures, on slopes and humid patches of secondary forest (*yunga* and *kechwa*)

Toxicity: Toxic to animals (although they will usually avoid it)

Use 1: To treat intestinal worms.

Preparation: Boil 5 g of fresh leaves in 500 cc of water.

Application: Drink one cup of the water before breakfast for a week

Use 2: As a repellent against lice (*Pediculus humanus* var. *capitis* L. Phthiraptera) and fleas (*Ctenocephalides felis* or *C. canis*).

Preparation: Place abundant fresh foliage under bedding and areas susceptible to infestation (cats or dogs bedding). In addition, sweep the floors with a broom made with the branches

Use 3: As insecticide for aphids in corn (*Rhopalosiphum maidis* Fitch, *R. padi* L., Homoptera) and aphids in potato, tomato, chili peppers, quinoa, pumpkin, tobacco, beans, lettuce (*Myzus persicae*, *Macrosiphum euphorbiae*)

Preparation: Soak one kg of fresh leaves in 10 liter of water. The next day, boil the water and the leaves for half hour. When cool, spray on the affected plants

Scientific literature review: Regarding particularly *A. arborescens*, no research on bioactivity was found. In the other hand, extensive research has been done on the related species, *A. maritima* L., because of toxicity, mutagenicity and molluscicidal effects (Alard, et al. 1991). When evaluated on toxicity against *Anopheles stephensi* Liston (Culicidae) and *Aedes aegypti*, the plant was found to have little or no effect on these larvae (Geerts, Blerk and Triest 1994). The acute and subchronic toxicity has also been tested on rats, with no toxic signs detected (Alard et al. 1991). Despite these results, the presence of sesquiterpene lactones with cytotoxic activity has also been evident on scientific research (Abdallah, Ali and Itokowa 1991). Research on the antibiotic principle of *Ambrosia trifida* L. and the synthesis of the source of the bioactivity, thiarubrine B have been published by Block, Guo and Thiruvazhi (1994). The attributes mentioned in this paper, as an herbal medicine to be used as antiseptic and to treat intestinal worms and fever, are partially matched with reports collected during this research in Cajamarca, where *Ambrosia arborescens* is used to treat intestinal worms. Research specifically directed to *Ambrosia arborescens* was found only to mention antiviral activity against herpes simplex

type I (HSV-1), at concentrations from 150 to 500 µg/ml without cytotoxic effects (Abad, M., et al. 1998). According to usage of the plant on Bolivian folk medicine, *Ambrosia arborescens* has a cytoprotective activity on the gastric mucosa (protection against gastric ulcer processes). The claims were validated by Gonzales et al. (1999), who state that the aqueous extract of *Franseria artemisioides* Willd. (syn : *A. arborescens*) has a 90% cytoprotective activity on rats. No further research on vermifugal activity was found.

***Ferreyranthus verbascifolius* (H.B.K.) H. Rob. & Brettel**

Collection voucher: Orozco 171

Common name: Coca de los antepasados (Spanish) = coke of the elders.

Description: Perennial herb growing erect up to 1.5 m tall, growing in patches on rocky *kechwa* areas.

Use: To keep teeth in good condition.

Administration: Chew on the leaves.

Scientific literature review: The bitterness of the leaves is notorious and possibly attributable to sesquiterpene lactones, commonly found on related species like *F. fruticosus* (Muschl.) H. Rob. (Jakupovic, et al. 1988). Specific information on *F. verbascifolius* was not found.

***Hieracium peruanum* Fries**

Collection voucher: *Orozco 230*

Common name: Balsamo del campo (Spanish) = rustic balsam.

Description: Small herb, flowers yellow; growing among *Stipa* and other Poaceae in *jalca* zone

Use: As a disinfectant for wounds.

Preparation: Boil the entire plant in water

Administration: Wash the affected area with the water extract at least twice a day.

Scientific literature review: Other species of *Hieracium* are used in folk medicine for similar purposes (e.g. in former Yugoslavia as a healing preparation). Some information was found describing the presence of triterpenoids on *H. plumulosum* Kerner (Petrovic, et al. 1996). There is also evidence of the consistent presence of phenolic acids and flavonoids in few species of *Hieracium*, like *H. naegelianum* Pancic and *H. rotundatum* Kit. ex Shult. (Petrovic, et al. 1999). Although not discussed in these papers, it is possible the presence of similar compounds in *H. peruanum*.

Philoglossa peruviana* DC.

Collection voucher: *Orozco 161*

Common name: Botoncillo (Spanish).

Description: Annual herb, erect, 0.2 m tall; frequent weed in *kechwa* pastures.

Toxicity: Described as toxic to guinea pigs. Cut grass intended as fodder may contain leaves and flowers of *P. peruviana* and, if ingested, animals will suffer colic and in some cases, death.

Scientific literature review: There is no particular information on the ethnobotany or chemistry of this plant, and very limited information for the genus. The presence of thiophenes has been determined for *P. mimuloides* (Hieron.) H. Rob. & Cuatrec. (Bohlmann, Grenz and Zdero 1977). This compound is known to be phototoxic, and to have antiviral (Hudson, J. B., et al. 1993) and pesticide activity (Arnason, et al. 1995). No further information was found

Schkuhria pinnata* var. *pinnata* (Lam.) Cabrera

Collection voucher: *Orozco 182*

Common names: Escoba suave (Spanish) = smooth broom; kanchalawa (Quechua) = corn crumbles.

Description: Annual herb, erect 0.4 m tall; frequently growing in *chala*, as weed on cornfields.

Toxicity: Toxic to insects.

Use 1: To ward off fleas (probably *Ctenocephalides felis* or *C. canis*).

Preparation: Boil the plant in abundant water and sprinkle the decoction on the floors and near bedding

Use 2: To treat skin infections (fungi, probably *Dermatophytes* or *Candida* and others).

Preparation: Prepare a decoction with the plant and wash the affected area twice a day

Use 3: To treat excessive sleepiness

Preparation: To make a tea, plant is boiled in the evening, and then given to children in the morning. Because the tea is very bitter, parents must add lots of sugar to get the children to drink it.

Scientific literature review: *Schkuhria pinnata* is known to produce abundant and unusual sesquiterpene lactones (Ganzer and Jakupovic 1990), particularly heliangolides (Del-V-Pacciaroni, et al. 1995). These compounds have shown antimicrobial and cytotoxic properties in laboratory experiments (Delgado, et al. 1998). The repellent activity has also been tested. Novo, Viglianco and Nassatta (1997) found that chloroform extracts of *S. pinnata* were active as repellent against *Tribolium castaneum* Hbst. (Coleoptera)

***Sonchus oleraceus* L.**

Collection voucher: *Orozco 139*

Common names: Serraja (Spanish); upa khisa (Quechua)

Description: Annual herb, 20 cm tall; a major herbaceous weed in *kechwa* grain fields, native to the Old World, it may have been introduced in the sixteenth century along with wheat or barley.

Use: To treat colds.

Preparation: Boil leaves and flowers

Administration: Drink three cups a day as needed

Scientific literature review: Aqueous extracts of *S. oleraceus* have been tested against some pathogenic fungi. The extract showed effect against the potato black scurf, caused by *Rhizoctonia solani* (Qasem and Abu-Blan 1996). *S. oleraceus* is recognized as an invasive weed and as such the physiology of the plant and some pathological problems have been addressed. No report on pharmacological use or other ethnobotanical information.

***Tagetes elliptica* Smith**

Collection voucher: *Orozco 125*

Common name: Honrada (Spanish)

Description: Annual herb, 0.3 m tall, terminal inflorescence with orange flowers, growing as a weed in cornfield in *kechwa* areas.

Use: To treat colds.

Preparation: Prepare a tea from the flowers.

Administration: Take a cup of tea twice a day.

Scientific literature review: No reference was found regarding this particular species, but some studies have been directed to the identify antiviral effects of *T. pusilla* Kunth, where

the aqueous extracts inhibited the replication of vesicular stomatitis virus (VSV) (Abad, M. et al. 1999).

Several species of marigolds have records of their cultivation and extensive use in Mexico and South America that extends back before the time of the Conquistadores. The pre-Columbian Indians believed that many of the more aromatic marigolds had lifesaving and magical properties. Just as offensive odors become associated with poisonous qualities, plants with aromatic properties often became identified as medicinals. It follows then that the species of *Tagetes* with their various pungent odors would be likely candidates for use by the herbalist (Trostle-Neher 1968). In fact, these plants had a variety of uses in Peru. Good luck in business is one of the most popular uses, practiced not only in the remote areas of Cajamarca, but also in every street in the capital city, Lima.

Bixaceae

***Bixa orellana* L.**

Collection voucher: *Orozco 156*

Common names: Achiote (Spanish); manduru (Quechua).

Description: Small tree native to tropical South America. Inside spiny brown pods, tiny red seeds are found. Common in *chala* and *yunga*

Use: To promote urination and to treat prostate problems

Preparation: Decoction of the leaves.

Administration: Drink two cups a day.

Use 2: The seeds are used as folk dye all over tropical America, to give color to chocolate and stews. The use of this plant as a coloring agent is very deeply rooted, and possibly in Inca times this red dye was a blood symbol that had religious significance (Gade 1975:189)

Scientific literature review: *Bixa orellana* has been positively tested as antimycotic on selected plant pathogens (Mohamed, et al. 1996) and on other fungal pathogens (Freixa, et al. 1998). The bark was found to be active inhibiting strains of *Neisseria gonorrhoeae* (Cáceres, et al. 1995)

Brassicaceae

Brassica campestris* L.

Collector voucher: *Orozco 175*

Common names: Mostaza (Spanish); llullu (Quechua) = tender.

Description: Annual herb, erect up to 1 m tall; weed on wheat and barley fields (*kechwa*).

Toxicity: Described as toxic to cattle and guinea pigs

Scientific literature review: *Brassica* species contain isothiocyanates, which are irritant to mucous membranes and if consumed in sufficient quantities can be toxic. Isothiocyanates can also have powerful effect interfering with the synthesis of thyroid hormones (Brown 2001)

Capparidaceae

***Cleome longifolia* Presl**

Collection voucher: *Orozco 192*

Common name: Yuquilla (Spanish) = small cassava

Description: Perennial herb up to 2 m tall; cultivated in *kechwa* backyards as an ornamental.

Use: To treat rheumatism.

Preparation: The leaves are to be macerated in alcohol for at least a week.

Administration: The macerated leaves are applied as plasters on the affected area and tied with cloth to keep them in close contact for few hours a day.

Scientific literature review: No scientific report on *C. longifolia*'s bioactivity or chemical composition, but there are numerous scientific papers on other species in the genus. *C. aculeata* L. has strong activity as cytotoxic (Nascimento, Chiappeta and Lima 1990) and *C. arabica* L. tested positive for anti-inflammatory activity (Harraz, Ayad and Zagazig 1994). Abundant information regarding other species in the genus support the idea of the presence of a variety of triterpenes (Ahmad and Alvi 1987), sesquiterpenes (Mekkawi, et al. 1985) and flavols (Sharaf, El-Ansari and Saleh 1997) in the phytochemical composition of this plants.

Caryophyllaceae

***Stellaria chilensis* Pedersen**

Collection voucher: *Orozco 166*

Common name: Hierba del tabardillo (Spanish).

Description: Annual ascending herb; weed on pastures (*kechwa* and *jalca*).

Use: Antipyretic.

Preparation: Boil the plant minus the roots in water

Administration: Drink the decoction.

Scientific literature review: The scientific information includes tests on *S. holostea* L. for activity against bacteria (Kumarasamy, et al. 2002), and on *S. media* for antioxidant activity (Pieroni, et al. 2002). No information was found regarding *S. chilensis*

Stellaria media* (L.) Mill.

Collection voucher: *Orozco 200*

Common names: Guañuna (Spanish)

Description: Very small herb with tiny, terminal white flowers, growing as a weed on *Lupinus* field (*kechwa* and *jalca*).

Toxicity: Toxic to guinea pigs.

Scientific literature review: *Stellaria media* is considered a wild, edible green, popular for human consumption in Europe and particularly in southeast Spain. Nutritional components like ascorbic acid, dehydroascorbic acid and carotenes were determined to be high (content of carotene ranged from 4.2 mg/100 g) in *S. media* (Guil, Rodriguez-Garcia and Torija 1997). Also beneficial antioxidant activity is attributed to the species (Pieroni, et al. 2002). Phytochemical studies on the lipid components of the plant show the presence of triacontanol. This compound was tested for bioactivity and showed

significant inhibition of feeding activity against the insects *Spilosoma obliqua* Walker (Lepidoptera) and *Spodoptera litura* Fabricius (Lepidoptera) (Pande, Shukla and Tripathi 1995). Notwithstanding the nutritional aspects of the plant, an adverse effect on guinea pigs, as suggested by the informant, should not be completely ruled out given the information on antifeedant capacity of the species.

Convolvulaceae

***Ipomoea carnea* Jacq. ***

Collection voucher: *Orozco 187*

Common name: Hoja ancha (Spanish) = wide leaf

Description: Small shrub; grows in patches in humid areas of *chala* zone

Toxicity: Produces nervous disorders in goats. The effects of the plant are described as erratic movements of the head and ataxia that progress and can result in death of the animal.

Scientific literature review: Moussatché and Daló (1973) have scientifically documented the toxicity of *I. carnea* in sheep and goats. They experimentally fed a group of animals on the plant leaves (which is well liked by the subjects), and determined that after 100

days the symptoms of nervous disorders start to manifest and that death will ensue anytime between 150 and 220 days after. Similar results have been reported in other scientific papers (Misra and Misra 1965). Regarding the phytochemistry of the plant, it is known that the seed of *I. carnea* have compounds derived from lysergic acid and ergot alkaloids. The leaves have non-alkaloidal and non-saponifiable fractions that act as depressants of the central nervous system in experiments with rats and mice (Ehattacharya and Dasgupta 1975).

Cucurbitaceae

Cucumis dipsaceus* Ehrenberg. ex Spach.

Collection voucher: *Orozco 184*

Common names: Jaboncillo (Spanish) = little soap.

Description: Prostrate annual herb, scandent; growing as an invasive weed in highly disturbed areas in *chula* environment.

Toxicity: Toxic to insects.

Use: To wash lice infested animals or human heads.

Preparation: Open the fruits and use the seeds and pulp as soap.

Scientific literature review: Oxygenated, tetracyclic triterpenes and their glycosides, or cucurbitacins, as they are commonly known, are found abundantly in the fruits and roots of wild *Cucumis* species. They are amongst the bitterest substances known to man and because of that, rarely anyone will consume enough to be poisoned by them (Fenny, Hunter and Chambliss 2002). Although there is no report on phytochemistry or bioactivity of *C. dipsacens*, it is plausible the possibility of founding cucurbitacins in the fruit, that could be repellent or even toxic to insects

***Sicyos montanus* Poepp. & Endl. ***

Collection voucher: *Orozco 172*

Common names: Pachalanga (Spanish); putaqlanku (Quechua) = agua sucia

Description: Scandent herb that can reach several meters; grows as an invasive weed on pastures or highly disturbed areas (e.g., backyards or abandoned fields in *kechwa* zone)

Toxicity: Toxic to insects.

Use: As repellent for fleas (*Ctenocephalides felis* or *C. canis*), put leaves and stems underneath bedding.

Scientific literature review: Oxygenated, tetracyclic triterpenes and their glycosides, or cucurbitacins, as they are commonly known, are abundantly found in the fruits and roots of wild *Cucumis* species. They are among the most bitter substances known and because of that, rarely anyone will consume enough to be poisoned by them (Fenny, Hunter and

Chambliss 2002). Presumably, these are the principles at play in this case, but no reference was found citing characteristics of *S. montanus*.

Euphorbiaceae

Asclepias curassavica L. *

Collection voucher: *Orozco 155*

Common names: Lechosa, lechera (Spanish)

Description. Sufrutice, erect, 0.5-1.5 m tall. Common weed in pastures below 1500 m (*yunga* and *chala*)

Toxicity: Latex is dermatotoxic for humans and consumption of the plant is toxic to cattle.

Scientific literature review: The chemistry of milkweeds has been well studied, since the poisoning of cattle with the leaves is a frequent problem in various areas of the world (Tokarnia, Dobereiner and Canella 1972). The toxicity is attributed to the presence of immunoreactive cardiac glycosides (Radford, et al. 1986). Concerning the bioactivity of the compounds, the latex has been tested for antibacterial activity against *Candida albicans*. The effect was positive, and it can be attributed to activity of the bioactive compounds on the cell wall -- the substances presumed to be responsible for these effects

are terpenes and cardenolids but also enzymes, in particular glucanases (Moulin-Traffort, Giordani and Régli 1990). Regarding dermatotoxicity in humans, the plant is known to induce corneal edema (Chakraborty, Siegenthaler and Buchi 1995).

***Dalechampia weberbaueri* Pax & Hoffm. ***

Collection voucher: *Orozco 188*

Common name: Raspa (Spanish) = that scratches

Description: Scandent herb, growing around cultivated fields in *chala* and *yunga* zones.

Toxicity: Dermotoxic. Produces temporal rash and discomfort

Scientific literature review: No reference was found regarding phytochemistry or bioactivity of *D. weberbaueri*. The only species in the genus that has been tested for biological activities is *D. scandens* L., which was found to be cytotoxic (Ayoub and Babikera 1984) but the particular compounds producing the effect are not reported.

***Euphorbia huanchahua* Boiss. ***

Collector voucher: *Orozco 228*

Common names: Michoacán (Spanish), wachanka (Quechua), ñuñupunqa (Quechua) = related to breast-milk and nursing, probably referring to the milky sap.

Description: Perennial herb, no more than 0.1 m tall. The root can reach 0.2 m long and 2 to 3 cm in diameter and produces a white-yellowish sap. The plant can be found growing on a typical *jalca* environment, among rocks.

Toxicity: Produces strong diarrhea and vomiting in humans.

Use: The plant is a strong purgative and vermifuge, especially the root. One taste is enough to make people vomit and have diarrhea. It is administered to cure *cólico* (intestinal blockage).

Preparation: The tuberous roots contain the purgative property, which was well known in Inca times (De la Vega 1609). The root can be boiled in water. Only about 40 cc of the aqueous extract should be administered. The latex also can be expressed from the root. A patient should swallow about four drops of the latex.

Scientific literature review: Additional information on the use of this plant as abortifacient (Hoet 1980) was found, but no information on the phytochemistry or possible compounds responsible for the bioactivity. It is possible to presume that the variety of toxic diterpene esters and triterpenes known for other members of the genus *Euphorbia* (Baslas and Gupta 1982; Halaweish, et al. 2001) could account for the activity in *E. huanchahana*.

***Euphorbia tirucalli* L. ***

Collection voucher: *Orozco 186*

Common name: Lechero (Spanish) = milky tree.

Description: Tree up to 4 m tall; cultivated as ornamental in *chala* households.

Toxicity: Dermotoxic properties are contained in the caustic milky sap. Severe burning and inflammation result after the skin is exposed to the latex. Ingestion causes burning and irritation of the mouth and stomach, accompanied by pain and diarrhea.

Scientific literature review: The latex contains a number of tetracyclic triterpenes (e.g., euphol, euphorbol, and cycloartenol) and probably others with physiological actions not yet studied (Baslas and Gupta 1982). Many of these compounds have irritant properties (Kinghorn 1979) and are used in traditional medicine to treat cancer, rheumatism and gastric disorders (Cataluna and Rates 1997). *Euphorbia tirucalli* has been tested as antimycotic on plant pathogens with positive results (Suhaila, et al. 1996) and as insecticide against *Dacus dorsalis* Hendel (Diptera) (Areekul, Sinchaisri and TigvatanAnon 1987). The toxicity in cattle (Tokarnia, et al. 1996) has also been studied, as well as the fish stupefying effect (Kulkarni, Kumbhojkar and Nipunage 1990) that is used in Africa for fishing purposes. The informants in Cajamarca reported none of the potential uses for the plant

***Jatropha curcas* L. ***

Collection voucher: *Orozco 158*

Common name: Piñón (Spanish)

Description: Small tree 3 m tall; it grows abundantly on disturbed sites in the *chala* valleys, on the sides of trails or as part of fences.

Toxicity: Produces strong purgative effect

Use: As laxative and vermifuge (in humans: *Taenia saginata*). It is commonly used as “practical joke”, by giving it to people without their knowledge

Preparation: Swallow the seeds.

Administration: Usually three seeds will be used since there is an esoteric context to the number of seeds used. Odd numbers are said to be effective, while even numbers are supposed to be even deadly.

Antidote: not known. To lessen the effects, drink abundant black tea with salt or eat seeds of *Bixa orellana* (achiote)

Scientific literature review: The toxic principle in the seed is a lectin named curcin. No analytical procedures have been described yet for the toxicology in humans (Gaillard and Pepin 1999), but the symptoms are similar to the ones produced by ingestion of *Ricinus communis* seeds. In *J. curcas*, the albumin is concentrated also in the seeds, but it can be rendered inactive by toasting them, becoming edible. The ingestion of the latex present in stems and leaves produces intense irritation of the throat, abdominal pains, diarrhea, vomit, and severe gastroenteritis (Aguilar and Zolla 1982: 124). The properties of the plant as a disinfectant and antiparasitic have been scientifically tested in abundant assays. The sap shows germicidal actions against *Staphylococcus*, *Bacillus* and *Micrococcus*

(Fagbenro-Beyioku, Oyibo and Anuforom 1998). In the same study, the sap also exhibited a strong inhibitory effect on mosquito larval growth. The sap was highly toxic to mice when given orally or intraperitoneally. Other studies backup the later claim, concluding that *J. curcas* seeds have an antifertility effect on guinea pigs (Makonnen, et al. 1997). The extract has also been found to cause anemia in rats (Oluwole and Bolarinwa 1997). On additional bioassays directed to test the effectiveness of the species as anti-viral, the water extract of the branches strongly inhibited the HIV-induced cytopathic effects with low cytotoxicity (Matsuse, et al. 1999). Methanol extracts of the leaves afforded moderate protection of cultured human lymphoblastoid CEM-SS cells against the cytopathic effects of human immunodeficiency virus (Muanza, et al. 1995). Regarding pesticidal activity, which was not reported on this study, *J. curcas* has been tested against *Culex quinquefasciatus* (Karmegan, et al. 1997), and *Manduca sexta* L. (Lepidoptera) showing acute toxicity (Sauerwein, Sporer and Wink 1993). Sauerwein attributes the insect-toxicity to phorbol esters abundantly found on the seeds' oil.

***Pedilanthus tithymaloides* (L.) Poit. ***

Collection voucher: *Orozco 185*

Common name: Diablo (Spanish) = devil.

Description: Perennial herb, cultivated in *chala* as ornamental.

Toxicity: The latex can produce skin reactions similar to burns.

Scientific literature review: The exact composition of the latex could not be found, but the bioactivity has been tested against bacteria with positive results (Sidhu and Behl 1988). The latex is caustic and venomous, especially for cattle and horses that may ingest it in mixture with pastures. The most evident symptoms are colic, diarrhea, and vomiting. The toxicity has also been tested against 2-day-old adults of *Dacus dorsalis*, resulting in moderated to high toxicity (up to 85% mortality in 24 hours) (Areekul, Sinchaisri and Tigvatananon 1987). The latex is reported to be used as medicinal to fight warts and some sexually transmitted diseases in external applications (Aguilar and Zolla 1982:166). Informants in Cajamarca did not report any use for this plant.

***Ricinus communis* L. ***

Collection voucher: *Orozco 119*

Common name: Higuerilla (Spanish).

Description: Small tree, 3 m tall, growing as part of fences and around pastures in *kechwa* areas.

Toxicity: The seeds are recognized as poison to humans and cattle. They produce strong diarrhea in humans.

Use: As laxative.

Scientific literature review: Abundant information is available about the toxic properties of ricin, the highly potent toxalbumin on *R. communis* seeds (Balint 1974). Also present

toxic lectins (Lin, et al. 1976; Wei and Koh 1978), and a mildly toxic alkaloid named ricinine. Ricin is released only if the seed husks are disrupted. Since ricin is not soluble in lipids, the medicinal castor oil contains no ricin (Gaillard and Pepin 1999). In bioassays, high mortality and severe changes occurred in chicks on *Ricinus* diet indicating that caution should be observed in tropical countries, where people are accustomed to chewing castor beans when in need of a laxative (Badwi, Adam and Hapke 1995). Oxalate crystals have been found in the stems and leaves of the plant, but apparently there is no relationship between the distribution of calcium oxalate crystals and the toxicity of other organs in the plant (Doaigey 1991).

Fabaceae

***Apurimacia boliviana* (Britton) Lavin ***

Collection voucher: *Orozco 203*

Common name: Barbasco (Spanish).

Description: Shrub 2-3 m tall, grows as part of scrub vegetation in *kechwa*, among cacti and Bromeliaceae.

Toxicity: Toxic to insects

Use 1: As insecticide to control external parasites like *Dermatobia hominis* L. (Diptera), in cattle and sheep.

Preparation: The root should be ground and pressed in a cloth to obtain an extract

Administration: The extract should be applied to the affected area (where the presence of the parasite is evident).

Use 2: To treat *aliciya*, which is a common illness of cattle and sheep scientifically known as hepatic distomatosis. The problem is caused by the obstruction of the common bile duct by the parasite *Fasciola hepatica* (sheep liver fluke)

Preparation: Grind the root to obtain an extract that is later dissolved in water (the proportion should be approximately 5 cc of the extract in 200 cc of water)

Administration: The infected animal drinks the preparation three days in a row

Apurimacia boliviana is known to have a stupefying effect on fish (Zegarra 1969), but this characteristic was not mentioned by any of the informants in this study

Scientific literature review: No reference was found on phytochemical composition or bioactivity for this plant or for the genus *Apurimacia*. Nevertheless, the abundance of toxic compounds and the variety of such structures in the Fabaceae family makes it easy to identify few suspects, but difficult to reach a sensible approximation to the real source of toxicity in this particular plant. For example, pyrrolizidine alkaloids are feeding deterrents and insecticidal for many species of insects and are found in few genera of the Fabaceae like *Adenocarpus* (Greinwald, et al. 1992) and *Crotalaria* (Gerhard and Wyk 1991).

These two species share with *Apurimacia*, the same tribe in the Fabaceae family -- Papilionoideae. Other notorious genera in the Papilionoideae known to have toxic properties are *Abrus* (Humphreys 1969), *Astragalus*, *Lupinus* (see below for comments on this two species), and *Canavalia* (Carlini and Guimaraes 1991). Very significant is the presence of the genera *Derris* and *Lonchocarpus* in the tribe. These are two of the better known rotenone producing genera and extracts from the roots of these species have been used as commercial pesticides since 1911 (Morgan and Wilson 1985:7).

***Astragalus garbancillo* Cav. ***

Collection voucher: *Orozco 208*

Common names: Garbancillo; hierba loca (Spanish) = crazy herb; huska; q'ira (Quechua).

Description: Shrub, 0.4 m tall; growing as a weed in *jalca* pastures.

Toxicity: Deadly poisonous to cattle and sheep that eat it. The effect is accumulative. The first signs of intoxication include disorientation, erratic behavior and stiff muscles.

Use: To treat contusions.

Preparation: Macerate the leaves in alcohol.

Administration: Apply the macerated leaves as a poultice or the alcohol extract as a rub to the affected area.

Scientific literature review: Locoweed poisoning in livestock has been very well studied.

Consumption of the plant causes severe neurological dysfunction and adverse effects on

reproduction, including disruptions on mating behavior, abortion and behavioral retardation of offspring (Panter, et al. 1999). Animals feeding on locoweed acquire a preference for feeding on the plant, which makes it even a more difficult problem to control (Ralphs, Panter and James 1990). The neurological pathology is manifested by depression, lack of coordination, and unpredictable behavior especially when the animal is stressed or excited. The toxic principle is the indolizidine alkaloid swainsonine, which is present in all parts of the plant and persists in the dried plant. Swainsonine interferes with the metabolism of complex sugars. As a result, these sugars accumulate in the brain cells and other organs, thus interfering with their normal function (Knight, T. 2002)

***Caesalpinia spinosa* (Molina) Kuntze**

Collection voucher: *Orozco 113*

Common names: Taya, tayo, or tara (Spanish)

Description: Tree 2.5 to 5 m tall; yellow flowers, reddish fruits. Growing on cultivated areas, or as secondary *kechwa* forest

Use: To cure throat infections. The seeds have commercial value since their abundant tannins are used to treat leather.

Application: Boil the seeds in half a liter of water and gargle three times a day.

Scientific literature review: Analytical studies on the tannins present in the plant (Galvez, Riedl and Conner 1997) do not include specific information about their bioactivity.

although it is known from other studies, that the main biological and pharmacological effects of tannins include antibacterial and antiviral activities, enzyme inhibition, anti-oxidative effects, antimutagenic and antitumoral properties (De Bruyne, et al. 1999) Other studies suggest antibacterial and antiinflammatory effects (Agrawal and Kapadia 1982; Vijayasaraty, Sharma and Prakash 1981)

***Desmodium molliculum* (Kunth) DC.**

Collection voucher: *Orozco 129*

Common name: Pie de perro (Spanish) = dog's paw (resemblance to the shape of the leaf).

Description: Prostrate herb; lavender flowers. Found in *kechwa* areas.

Use: To treat kidney problems

Preparation: Boil leaves and flowers to obtain decoction

Administration: Drink a cup of this tea twice a day for a week

Scientific literature review: Particularly for *D. molliculum*, no medical or phytochemical reference was found. Other species in the genera have been studied in pharmacological trials for the presence of free-radical scavenging antioxidants (Gyamfi, Yonamine and Aniya 1999). The research for *D. adscendens* (Sw.) DC., demonstrated effects on the nervous system of rats, acting as an analgesic (N'gouemo, Baldy-Moulinier and Nguemby-Bina 1996). The treatment of kidney diseases with antioxidants has been studied for

extracts of *D. canadensis* DS. The results show effect on rats, by improving conditions leading to renal insufficiency and inhibiting hemolysis (Shantanova 1998).

***Leucaena trichodes* (Jacquin) Benth. ***

Collection voucher: *Orozco 178*

Common names: Peladera, guayo (Spanish), mutuy (Quechua)

Description: Small deciduous tree 3 m tall, growing on rocky slopes by the roads (*chala* and *yunga*).

Toxicity: Produces shedding of the coat on the animal (e.g., goats, sheep, and donkey) that ingests the leaves. On occasions, it is given to pigs before slaughter, so the skin is free of hairs.

Scientific literature review: Ingestion of the plant is known to produce alopecia in some animals, particularly horses and pigs. Other mammals seem to be unaffected. The toxic principle is a non-protein aminoacid named mimosine (Crounse, Maxwell and Blank 1962)

***Lupinus arvensis* Benth. ***

Collection voucher: *Orozco 189*

Common names: Chocho (Spanish); tarwi (Quechua).

Description: Small shrub; cultivated for the seeds in *kechwas* and *jalcas*

Toxicity: Toxic to insects.

Use: Besides using the seed for human consumption, a by-product of the preparation process is used as pesticide

Preparation: *Lupinus* seeds are boiled for one hour in abundant water. The water left in the pot contains powerful alkaloids that are recognized by the local people as a potent pesticide. This is used mainly to treat tick and lice infestation on cattle, sheep and dogs.

Administration: The animals should be sprinkled abundantly with the water and left to dry in the sun.

Scientific literature review: Quinolizidin alkaloids are abundantly found in the genus *Lupinus*, and they are a clear example of the defense strategy in plants against herbivores (Bermúdez, et al. 1998). The biological activity of these alkaloids has been the subject of numerous tests. The bactericide-like effect against *Pseudomonas* and *Erwinia* strains (common pathogens in tomato) was found to be high (Vega, et al. 1996). The herbicidal effect has also been explored (Muzquiz, et al. 1994), testing the germination of seeds in peas, tomatoes and wheat among others. The results show high antigermination effect in most species and effects on postgermination stages. Regarding the effects in mammals, studies of the toxicity of sparteine, lupanine and lupin extract on the central nervous system of the mouse (Pothier, et al. 1998) determined that the highest toxicity is given by sparteine. Some sedative effect was also found on all three compounds. The exact mode of action for the quinolizidin alkaloids has also been determined by numerous studies on

the binding of the alkaloids on acetylcholine receptors (Schmeller, et al. 1994). Insecticide activity with acetone extracts was found positive for *Drosophila melanogaster* (Barakat, et al. 1985)

***Lupinus mutabilis* Lindl. ***

Collection voucher: *Orozco 225*

Common names: Chocho (Spanish); tarwi (Quechua)

Description: Erect herbaceous annual with blue flowers born on a raceme, cultivated in *kechwas* and *jalcas*

Toxicity: Toxic to insects.

Uses: Use. Besides using the seed for human consumption, a by-product of the preparation process is used as pesticide.

Preparation: *Lupinus* seeds are boiled for one hour in abundant water. The water left in the pot contains powerful alkaloids that are recognized by the local people as a potent pesticide. This is used mainly to treat tick and lice infestation on cattle, sheep and dogs.

Administration: The animals should be sprinkled abundantly with the water and left to dry in the sun.

Scientific literature review: *Lupinus mutabilis* is a native domesticate grown for its edible seeds. *Tarwi* very probably was domesticated in Peru, if only because several of the wild species that resemble tarwi are found in this part of the Central Andes. The time of

domestication is not yet known, for no archeological evidence has been found. In pre-Conquest times, *tarwi* was a major source of vegetable protein. The first historical reference to the plant was in 1539 when Valverde (Herrera 1941) in a letter to the king, suggested a tax on this crop to create revenues. The Spaniards first called it *altramuz* after *L. albus* L. which was cultivated in Spain at that time, also for their edible seeds, but later called them *chochos* (Gade 1975:168). The great amount of work involved in processing *tarwi* for consumption may partly explain its decline and its replacement by broad beans, which resist equally well low temperatures but do not require such complicated processing. *Lupinus* seeds must be boiled and then soaked in running water for 3–4 days to rid them of the alkaloids. They are usually served in a fresh salad with *Capsicum* peppers, onions and herbs or eaten as a confection. Dried *tarwi* is for sale as one of the lowest-priced foods. Some farmers grow *tarwi* not as food but as a cover crop because of its nitrogen-fixing properties. Regarding the toxic properties, it is known that quinolizidin alkaloids are abundantly found in the genus *Lupinus* (Bermúdez, et al. 1998). The biological activity has been repeatedly proven. The bactericide-like effect against *Pseudomonas* and *Erwinia* strains (common pathogens in tomato) was found to be high (Vega, et al. 1996). The herbicidal effect has also been explored (Muzquiz, et al. 1994), testing the germination of seeds in peas, tomatoes and wheat among others. The results show high antigermination effect in most species and effects on postgermination stages. Regarding the effects in mammals, studies of the toxicity of sparteine, lupanine and lupin

extract on the central nervous system of the mouse (Pothier, et al. 1998) determined that the highest toxicity is given by sparteine. Some sedative effect was also found on all three compounds. The exact mode of action for the quinolizidin alkaloids has also been determined by numerous studies on the binding of the alkaloids on acetylcholine receptors (Schmeller, et al. 1994)

***Medicago polymorpha* L. ***

Collection voucher: *Orozco 174*

Common names: Trébol (Spanish)

Description: Annual herb; growing on *kechwa* pastures.

Toxicity: Described producing gastric problems on cattle.

Scientific literature review: Research on the phytochemistry of the plant revealed the presence of triterpenoid glycosides (Kinjo, et al. 1994), which have been reported in instances to have cytotoxic effects (Bader, et al. 1998, Ye, et al. 1996).

***Otholobium glandulosum* Grimes ***

Collection voucher: *Orozco 163*

Common name: Culén (Spanish); wallwa (Quechua).

Description: Shrub up to 2 m tall; frequently found in backyards and near streams in *kechwa* area.

Toxicity: Toxic to worms.

Use 1: Used as a vermifuge, to treat intestinal parasite problems, and various stomach ailments

Preparation: Place leaves in hot water to prepare infusion (steeping without boiling).

Administration: Drink a cup of the infusion with milk of magnesia (laxative)

Use 2: As an antipyretic.

Preparation: Place the leaves in hot water to prepare an infusion.

Administration: Drink a cup of the infusion every 6 hours.

Scientific literature review: Antimicrobial properties of leaf extracts of *Psoralea glandulosa* L. (syn.: *O. glandulosum*) has been determined by Erazo et al (1997) against Gram positive bacteria like *Staphylococcus aureus*, *S. epidermidis*, *Micrococcus flavus* and *Bacillus pumilus*. The assays showed that bakuchiol, a phenolic monoterpene, was the compound responsible for the activity. Bakuchiol was also tested in this assay for activity on *Artemia salina*, where even low concentrations affected the motility of the shrimp, but the effect was not lethal. Besides, bakuchiol from the leaves of *O. glandulosum* exhibit activity on *Spodoptera littoralis* Boisduval (Lepidoptera) larvae, acting as feeding inhibitors (Labbe, et al. 1996). Regarding the medicinal properties, *O. glandulosum* exhibited antipyretic properties in rabbits with *Escherichia coli*-induced pyrexia and anti-inflammatory properties on edema test in guinea pigs (Backhouse, et al. 1996). Insecticide activity of cyclohexane extracts show positive results for *Drosophila*

melanogaster (400 μ /ml) (Chesney and Adams 1985). It is also noteworthy the high content of furocoumarins in most species of *Otholobium*, which induce skin photosensitization, followed by skin hyperpigmentation and photolesions (Innocenti, Cappelletti and Caporale 1991). The informants did not describe this characteristic, although the abundant psoralen on leaves and twigs of *O. glandulosum* could produce photosensitivity to any human or animal consuming the plant or infusion of the leaves.

***Otholobium munyense* (Macbr.) Grimes**

Collection voucher: *Orozco 206*

Common names: Culén (Spanish); wallwa (Quechua).

Description: Shrub or small tree; growing as part of a fence, in *jalca* pastures and wet areas by the road.

Use: As carminative and antidiarrheal

Preparation: Prepare infusion in hot water with the leaves.

Administration: Drink a cup of the tea three times a day

Scientific literature review: Despite the big amount of chemical and biological information on the genus *Otholobium*, there are not available references for this particular species.

See *O. glandulosum* for congeneric comparison.

***Spartium junceum* L. ***

Collection voucher: *Orozco 233*

Common name: Retama (Spanish)

Description: Broom-like shrub with nearly leafless branches and papilionaceous, yellow flowers that bloom throughout the year. This plant has a very weedy nature and occupies several habitats. Areas of former landslide, roadside and trailside and fringes of *Eucalyptus* groves are all favorable habitats, as well as sandbars and riverbanks, essentially disturbed areas.

Toxicity: Toxic to insects and internal parasites.

Use 1: For treating kidney stones

Preparation. Infusion prepared with the leaves.

Use 2: Liver ailments

Use 3: As purgative.

Preparation: Flowers and seeds are boiled.

Administration: Drink the infusion daily for a week.

Use 3: At a lower altitude, the foliage is used in the storage of maize to repel insects (*Acanthoscelides obtectus* Say, Coleoptera).

Scientific literature review: Numerous studies confirm the link between *S. junceum* and a toxicity factor produced by quinolizidine alkaloids (Lurz, et al 1990), especially in young plants and reproductive organs (Barboni, et al. 1994). These facts are interpreted as a

defensive strategy against predators. The main active substances in the plant are sparteine, lupanine, scoparoside, isolupanine, anagyrine and cystisine (Gaillard and Pepin 1999). Regarding the medicinal claims, scientific literature reports screening of *S. junceum* for antiulcerogenic activity (Yesilada, et al. 1993). An oleanene-type saponin (spartitrioside) with potent anti-ulcerogenic activity in a rat model has been isolated from the flowers (Yesilada and Takaishi 1999). The relation of these studies with the actual claim of the informants is not clear, but the interpretation of liver problems, for instance, could be a manifestation of gastrointestinal problems that could be positively influenced by treatment with *S. junceum*.

Spartium junceum was brought to Arequipa (southern Peru) from Spain in 1650, thus, this plant has been in the country for at least 300 years. The plant has become an important thatch and is considered more water-resistant than grass thatch. Maize ears are dried in a bed of *retama* branches, which protects the maize from ground moisture. Homemade brooms are also made of the branches and sheep and goats will browse on the plant. It is also added to *chicha* to make it more intoxicating.

Hydrophyllaceae

***Phacelia pinnatifida* Griseb. ex Wedd. ***

Collection voucher: *Orozco 210*

Common names: Khisa (Quechua) = with spines; *ashñaq khisa* (Quechua) = smelly stinging plant.

Description: Small shrub 1.5 m tall, abundant brown pubescence covering stems and leaves; growing on rocky slopes in a *jalca* environment

Toxicity: After a day's delay, this plant causes a very painful skin reaction lasting more than a week.

Scientific literature review: Geranyl(hydro)quinone and related phenolic substances, including geranylhydroquinone and geranylgeroniol have been determined to be the source for the allergic reaction that produce in some individuals, species from the genus *Phacelia*. The compounds are present in the glandular trichomes of the plant and are potent allergens comparable to poison ivy (Ippen 1990; Reynolds and Rodriguez 1986)

Lamiaceae

***Mintostachys mollis* Griseb. ***

Collection voucher: *Orozco 226*

Common names: Chamcua (Spanish); muña (Quechua).

Description: Erect, perennial herb growing as small shrub, abundantly growing on the sides of trails. Common in *kechwa* and lower *jalca* areas

Toxicity: Irritant to insects and toxic to internal parasites

Uses and phytochemistry: See *M. tomentosa*.

***Minthostachys tomentosa* (Benth.) Epling ***

Collection voucher: *Orozco 196*

Common names: Chamcua (Spanish); muña (Quechua).

Description: Erect perennial herb growing as small shrub, growing abundantly on the sides of trails. Common in *kechwa* and lower *jalca* areas.

Toxicity: Irritant to insects and toxic to internal parasites.

Use 1: Potatoes are stored packed in *ichu* (*Stipa* sp.) grasses with liberal quantities of *M. tomentosa* or *M. mollis*, to repel insects that attack stored potatoes (*Premnotrypes solani* Pierce, *P. vorax* Hustache, and *P. latithorax* Pierce, Coleoptera).

Use 2: Anthelmintic used in cases of intestinal tapeworms (*Taenia saginata*).

Preparation: It can be used by preparing a decoction and drinking it before breakfast everyday. More commonly, *Minthostachys* is added in liberal quantities to “*caldo verde*”

(green soup) that is typically served for breakfast and consists of white cheese, eggs and milk.

Scientific literature review: *Minthostachys* has been repeatedly reported as a plant used to repel insects in stored crops throughout the Andes. The essential oils and their components have been isolated and successfully tested as insecticides on various pests including the Chagas disease vectors. It is known now that pulegone, menthone and isomenthone are commonly found in the volatile essential oils (Fournet, et al. 1996). In *M. tomentosa*, the compound responsible for the insecticidal effect has been identified as 1,2-epoxymenthyl acetate (Cantin, et al. 2001). Dichloromethane extracts of *M. setosa* have been tested for larvicidal activity against *Aedes aegypti* larvae. The results are labeled as to be useful in the search for new larvicidal natural compounds ($LC_{50}=9.2 \mu\text{g/ml}$) (Ciccia, Coussio and Mongelli 2000). No references were found for *M. mollis*, but it is likely that the information for *M. tomentosa* is relevant to *M. mollis* too. It is important to add that there is research indicating that the volatile constituents of *M. verticillata* (Griseb.) Epling leaves are highly variable. Plants from various phytogeographic areas of Argentina were steam distilled and analyzed by GC and GC/MS, finding that the composition of the oil changed dramatically from one population to another, leading to the conclusion that there are several chemotypes in these species (Zygadlo, et al. 1996). Although no research on this aspect was found for *M. mollis* or *M. tomentosa*, the possibility of chemotypes and/or variations in essential oil content

depending on vegetative stage and conditions of collection, should be taken into account (Muñoz-Collazos, et al. 1993).

***Stachys* sp. *** (Note: one sample, sterile)

Collection voucher: *Orozco 179*

Common names: Arañaquewa (Spanish - Quechua) = spider-herb

Description: Prostrate annual herb; growing on the shed of *Persea* trees on an orchard.

Collected on *kechwa* zone

Toxicity: Described as toxic to guinea pigs

Scientific literature review: Since the species was not identified, it is not possible to even speculate about the nature of the toxicity described. For information on this genus, see below, *S. arvensis*

***Stachys arvensis* L.**

Collection voucher: *Orozco 146*

Common name: Rasmio (Spanish); raime (Spanish); Supiquewa (Quechua) supi = flatulence, quewa = herb (the Quechua name actually could be interpreted as a reference to the use as an antidiarrheal).

Description: Annual herb 0.3 m tall; lavender flowers, growing as a weed on disturbed *yungas* and *kechwas*

Use 1: To cure headaches.

Use 2: Antidiarrheal.

Preparation: Tea.

Administration: Drink tea.

Scientific literature review: Reports related to ethnobotanical uses related by informants were not found. Furthermore, the plant is known to produce the clinical signs and pathology of a neurological locomotor disorder in sheep (Bourke 1995; Philbey, Hawker and Evers 2001).

Loasaceae

***Caiophora contorta* (Desr.) C. Presl ***

Collection voucher: *Orozco 212*

Common names: Ishguin (Quechua); khisa (Quechua) = stinging plant.

Description: Scandent herb with yellow flowers and abundant stinging hairs. Collected in *jalca*.

Toxicity: Dermotoxic

Scientific literature review: The phytochemistry in the Loasaceae in general has been poorly studied. According to Weigend (pers. comm.), no information is found on the genus *Caiophora* or in general in the irritant substances in the Loasaceae family. The only phytochemical reference for the genus is related to the presence of iridoid monoterpenes and iridoid glucosides that are used as chemotaxonomic markers in the Loasoideae (Muller, et al. 1999).

***Caiophora sepiaria* (Ruiz & Pav. ex G. Don) J. F. Macbr. ***

Collection voucher: *Orozco 195*

Common names: Ortiga de zorro (Spanish); khisa (Quechua) = stinging plant.

Description: Annual herb, abundant urticant hairs, orange flowers; growing on moist banks in partially disturbed areas of *kechwas* and *jalcas*, surrounded by Asteraceae and Solanaceae

Toxicity: Dermotoxic.

Scientific literature review: The phytochemistry in the Loasaceae in general has been poorly studied. According to Weigend (pers. comm.), no information is found on the genus *Caiophora* or in general in the irritant substances in the Loasaceae family. The only phytochemical reference for the genus is related to the presence of iridoid monoterpenes and iridoid glucosides that are used as chemotaxonomic markers in the Loasoideae (Muller, et al. 1999).

***Nasa macrantha* (Urb. & Gilg.) Weigend ***

Collection voucher: *Orozco 229*

Common names: Ortiga de león (Spanish); khisa (Quechua) = stinging.

Description: Perennial herb, stems and branches densely setoses, orange flowers, growing by water source on shady place (*jalca*).

Toxicity: Dermotoxic. Produces long lasting rash (up to three days)

Scientific literature review: The phytochemistry in the Loasaceae in general has been poorly studied. According to Weigend (pers. comm.), no information is found on the genus *Nasa* or in general in the irritant substances in the Loasaceae family. The only phytochemical reference for the genus is related to the presence of iridoid monoterpenes and that are used as chemotaxonomic markers in the Loasoideae (Muller, et al. 1999). On the ethnobotanical information, there are reports on the use of *Loasa speciosa* Donn. Sm. [syn.: *N. speciosa* (Donn. Sm.) Weigend] and *L. triphylla* Juss. [syn.: *N. triphylla* (Juss.) Weigend], for anti-inflammatory purposes. The bioactivity has been confirmed in laboratory tests (Badilla, Mora and Poveda 1999). This report is coincident with the use of another genus that has similar dermatotoxic characteristics -- *Urtica* (Urticaceae). The mechanisms of activity after contact with *Urtica* has been connected with the presence of high levels of LTB₄ and LTC₄ (leukotrienes) as well as histamines. Leaf extracts of stinging nettle *U. urens* and *U. dioica* have been found to block the cytokines that

stimulate inflammatory joint diseases. The responsible compound in these species has been identified as Hox alpha and is listed as a very promising remedy for therapy of inflammatory joint diseases (Kavalali and Tuncel 1997, McCaleb 1998, Schulze-Tanzil, et al. 2002). As mentioned before, the dermatotoxic mechanisms in the Loasaceae family has not been studied, but the comparison with the mechanisms in the genus *Urtica* may perhaps be valid.

***Nasa macrothyrsa* (Urb. & Gilg.) Weigend**

Collection voucher: *Orozco 205*

Common names: Ishguin (Quechua).

Description: Shrub 2 m tall with yellow-greenish flowers, growing on *jalca*, secondary forest.

Toxicity: Dermotoxic. Abundant urticant hairs present along leaves and stems

Scientific literature review: The phytochemistry in the Loasaceae in general has been poorly studied. According to Weigend (pers. comm.), no information is found on the genus *Nasa* or in general in the irritant substances in the Loasaceae family. The only phytochemical reference for the genus is related to the presence of iridoid monoterpenes and that are used as chemotaxonomic markers in the Loasoideae (Muller, et al 1999). On the ethnobotanical information, there are reports on the use of *Loasa speciosa* Donn. Sm. [syn.: *N. speciosa* (Donn. Sm.) Weigend] and *L. triphylla* Juss. [syn.: *N. triphylla* (Juss.)

Weigend], for anti-inflammatory purposes. The bioactivity has been confirmed in laboratory tests (Badilla, Mora and Poveda 1999). This report is concurrent with the use of another genus that has similar dermatotoxic characteristics -- *Urtica* (Urticaceae). The mechanisms of activity after contact with *Urtica* have been connected to the presence of high levels of LTB₄ and LTC₄ (leukotrienes) as well as histamines. Leaf extracts of stinging nettle *U. urens* and *U. dioica* have been found to block the cytokines that stimulate inflammatory joint diseases. The responsible compound in these species has been identified as Hox alpha and is listed as a very promising remedy for therapy of inflammatory joint diseases (Kavalali and Tuncel 1997; McCaleb 1998; Schulze-Tanzil, et al. 2002). As mentioned before, the dermatotoxic mechanisms in the Loasaceae family has not been studied, but the comparison with the mechanisms in the genus *Urtica* may perhaps be valid.

***Nasa picta* (Hook.) Weigend ***

Collection voucher: *Orozco 204*

Common name: Ishguin (Quechua).

Description: Annual herb 0.3 m tall with bright yellow, white and red flowers, growing on jalca pastures and along roads.

Toxicity: Dermatotoxic. Produces rashes and blisters where the hairs get in touch with the skin.

Scientific literature review: The phytochemistry in the Loasaceae in general has been poorly studied. According to Weigend (pers. comm.), no information is found on the genus *Nasa* or in general in the irritant substances in the Loasaceae family. The only phytochemical reference for the genus is related to the presence of iridoid monoterpenes and that are used as chemotaxonomic markers in the Loasoideae (Muller, et al. 1999). On the ethnobotanical information, there are reports on the use of *Loasa speciosa* Donn. Sm. [syn.: *N. speciosa* (Donn. Sm.) Weigend] and *L. triphylla* Juss. [syn.: *N. triphylla* (Juss.) Weigend], for anti-inflammatory purposes. The bioactivity has been confirmed in laboratory tests (Badilla, Mora and Poveda 1999). This report is coincident with the use of another genus that has similar dermatotoxic characteristics: *Urtica* (Urticaceae). The mechanisms of activity after contact with *Urtica* have been connected with the presence of high levels of LTB₄ and LTC₄ (leukotrienes) as well as histamines. Leaf extracts of stinging nettle *U. urens* and *U. dioica* have been found to block the cytokines that stimulate inflammatory joint diseases. The responsible compound in these species has been identified as Hox alpha and is listed as a very promising remedy for therapy of inflammatory joint diseases (Kavalali and Tuncel 1997, McCaleb 1998, Schulze-Tanzil, et al. 2002). As mentioned before, the dermatotoxic mechanisms in the Loasaceae family has not been studied, but the comparison with the mechanisms in the genus *Urtica* may perhaps be valid.

***Nasa ranunculifolia* (Kunth) Weigend ***

Collection voucher: *Orozco 211*

Common names: Ortiga (Spanish); orko khisa (Quechua) = male stinging plant.

Description: Annual herb, yellow flowers with orange center; growing on a rocky slope in a *julca* zone.

Toxicity: Dermotoxic

Use: Used externally to treat sharp pains. Fresh leaves applied externally to treat wounds, bruises and sprains, or to alleviate nerve-caused pain, are made into poultices

Scientific literature review: The phytochemistry in the Loasaceae in general has been very poorly studied. According to Weigend (pers. comm.), no information is found on the genus *Nasa* or in general in the irritant substances in the Loasaceae family. The only phytochemical reference for the genus is related to the presence of iridoid monoterpenes and that are used as chemotaxonomic markers in the Loasoideae (Muller, et al. 1999). On the ethnobotanical information, there are reports on the use of *Loasa speciosa* Donn. Sm. [syn: *N. speciosa* (Donn. Sm.) Weigend] and *L. triphylla* Juss. [syn.: *N. triphylla* (Juss.) Weigend], for anti-inflammatory purposes. The bioactivity has been confirmed in laboratory tests (Badilla, Mora and Poveda 1999). This report is coincident with the use of another genus that has similar dermatotoxic characteristics: *Urtica* (Urticaceae). The mechanisms of activity after contact with *Urtica* have been connected with the presence of high levels of LTB₄ and LTC₄ (leukotrienes) as well as histamines. Leaf extracts of

stinging nettle *U. urens* and *U. dioica* have been found to block the cytokines that stimulate inflammatory joint diseases. The responsible compound in these species has been identified as Hox alpha and is listed as a very promising remedy for therapy of inflammatory joint diseases (Kavalali and Tuncel 1997; McCaleb 1998; Schulze-Tanzil, et al. 2002). As mentioned before, the dermatotoxic mechanisms in the Loasaceae family has not been studied, but the comparison with the mechanisms in the genus *Urtica* may perhaps be valid

Loranthaceae

***Ligaria cuneifolia* (Ruiz & Pav.) Tiegh.**

Collection voucher: *Orozco III*

Common names: Popa (Spanish); carawanuche (Quechua) = herb-killer.

Description: Sample collected from a household, who got it from an uncertain locality, probably, by the coast (bought by a relative on a trip to Trujillo). The plant is usually found in *yungas* and *kechwas*.

Use: To stop bleeding after childbirth.

Preparation: Boil about 50 g of the flowers in one liter of water and sift the remaining material.

Application: Use the cool water to wash the genitals of the woman two times a day.

Scientific literature review: This plant is used in Argentine folk medicine for decreasing high blood pressure. Based on this claims, Fernández , et al (1998) researched the flavonoid composition and protein constituents of *L. cuneifolia*, with results suggesting that the extracts exert an “immunomodulatory effect” on the mouse immune system.

Malvaceae

***Fuertesimalva limensis* (L.) Fryxell ***

Collection voucher: *Orozco 176*

Common name: Malva, botoncillo (Spanish).

Description: Perennial herb, erect up to 0.5 m tall; abundantly growing in *kechwa* by trails and roads.

Toxicity: Toxic to cattle when ingested.

Scientific literature review: No information on phytochemistry or toxicity of this species.

Regarding other species, low amounts of thiamine has been detected in *M. parviflora*.

(Meyer 1989), a related genus. The plant is also associated with limb paresis syndromes in sheep (Bourke 1995).

***Malva parviflora* L.**

Collection voucher: *Orozco13*

Common name: Malva (Spanish).

Description: Old World suffrutescent herb, white flowers; cultivated in garden of private residence (*kechwa*).

Use 1: To treat yellow fever.

Preparation: A rag is soaked in *malvas* extract and tied around the stomach.

Use 2: To treat stomach and liver problems. To “refresh” the liver

Preparation: Boil the leaves in 0.5 l of water.

Administration: Drink the decoction cool, three times a day.

Scientific literature review: The plant is listed as an edible weed in Morocco (Tanji and Nassif 1995) and as a medicinal plant for various cultures in Latin America (Giron, et al. 1991) and South Africa (Grierson and Afolayan 1999). No report directly supports the claims of the informants for this study, but antibacterial activity has been detected for methanolic extracts of *M. parviflora* (Grierson and Afolayan 1999). If the claims can be correlated to mild forms of food poisoning or to intestinal parasites problems, the bioactivity of the plant could explain the ethnobotanical information.

Myrtaceae

***Eucalyptus globulus* Labill. ***

Collection voucher: *Orozco 132*

Common name: Eucalipto (Spanish).

Description: Tree. Although this is an introduced species, it is extremely common since it has been largely used for reforestation purposes in the area. It is also grown in *kechwa* pastures for shade and lumber.

Toxicity: Repellent and toxic to household insects

Use 1: Fresh plants applied externally to treat wounds, bruises and sprains, or to alleviate nerve pain

Preparation: Macerate leaves in alcohol for at least a week and apply as a poultice

Use 2: To treat colds, coughs, chest congestion and other respiratory ailments.

Preparation: Drink tea of fresh leaves with honey twice a day, especially before going to bed.

Use 3: As a repellent for housefly (*Musca domestica* L., Diptera) and mosquitoes (*Culex* sp., Diptera)

Preparation. Fresh leaves and twigs are commonly hanged by the door. Burning dry leaves and stems and letting the smoke profusely fill the rooms of the house is believed to not only keep away insects, but also to prevent diseases like the flu. It is also believed that

filling the house with *Eucalyptus* smoke is a ritual that should be performed at least once a year. This will prevent disease and it will maintain evil spirits at bay. This custom has more practitioners among city dwellers than among the people of the rural communities. Being this a foreign species, it is likely that the tradition was never really part of quechua culture.

Scientific literature review: The medicinal properties attributed to *Eucalyptus* have been recognized for a long time. The activity on respiratory ailments however, has been clarified only recently. Alcoholic and hexane extracts of the leaves were determined to inhibit IgE-dependent histamine release from RBL-2H3 cells. The inhibitory effects were found to be more than 80% for extract concentrations of 0.5 mg/ml. The results indicate that the extracts contain active compounds that inhibit mast-cell degranulation, and according to the authors (Ikawati, Wahyuono and Maeyama 2001), provide insight into the development of new drugs for treating asthma and/or allergic disease. *Eucalyptus* oils have also been tested positive for antibacterial activities (Aswal, et al. 1984; Srinivasan, et al. 2001).

Activity of the essential oils of *E. globulus* as repellents and as toxic compounds have been tested against *Acanthoscelides obtectus* with positive results. Toxicity has been proven to be higher for younger stages of the larvae and depends greatly on temperature (Papachristos and Stamopoulos 2001, 2002). Among the constituents of the essential oils

responsible for these effects, 1,8-cineole, alpha and beta-pinene, p-cymene, myrcene, gamma-terpinene, alpha-terpineol and limonene are the most common. Antibacterial effects are also known from the same compounds (Cimanga, et al. 2002).

Oxalidaceae

***Oxalis dombeyi* A. St. Hil.**

Collection voucher: *Orozco 168*

Common name: Chulco (Quechua) = herb that grows by the water.

Description: Annual erect plant 0.5 m tall, very succulent, growing in disturbed areas or as a weed in potato or wheat fields in *kechwa* areas.

Use: To treat stomachache.

Preparation: Boil leaves and stems.

Administration: Drink the decoction as needed.

Scientific literature review: Test on *O. barrelieri* L. (syn.: *O. dombeyi*) result negative for antifungal activity (Cavin, Dyatmyko and Hostettmann 1999). No other reference on biological activity for this particular genus was found. Although the genus *Oxalis* is repeatedly listed as used ethnobotanically for stomach ailments (Bhattaral 1992; Gurib-

Fakima, et al. 1996; Ishkuran 1982), no conclusive biological activity has been determined. Antibacterial activity of the genus has been tested against a variety of organisms with negative results, except for *O. corniculata* L. extracts, which was found active against *Staphylococcus aureus* (Ali, et al. 2001)

***Xanthoxalis corniculata* (L.) Small**

Collection voucher: *Orozco 136*

Common name: Chulco (Quechua?).

Description: Prostrate annual herb, yellow flowers. Common in *kechwa* areas

Use: To treat stomach ailments.

Preparation: Boil the leaves and flowers.

Administration: Drink three cups of the decoction per day.

Scientific literature review: *Oxalis corniculata* is listed in ethnobotanical information from Nepal, as a treatment for gastric conditions (Manandhar 1995), and it has been found to have some antibacterial activity against *Staphylococcus aureus* (Ali, et al. 2001). If the gastric ailments to be treated with this plant have bacterial origin, it could be possible to correlate the claims of the informants with the reports of the literature.

Piperaceae

***Peperomia hutchisonii* Yunker**

Collection voucher: *Orozco 173*

Common names: Conguna silvestre (Spanish); Yuthu-panga (Quechua) = partridge's leaf.

Description: Succulent herb growing erect 0.4 m tall; abundant on rocky outcrops in *kechwa* areas.

Use: To treat *susto*.

Preparation: Boil the leaves in water.

Administration: Bath the child on the decoction.

Scientific literature review: No information was found on *P. hutchisonii*, but another two species of *Peperomia* have ethnobotanical reports of uses related to "nervous disorders". *Peperomia galioides* Kunth is used to treat hysteria in the Peruvian Amazon (Duke and Vasquez 1994), and *P. maequalifolia* Ruiz & Pav. is used as sedative also in Peru (Ramirez, et al. 1988). The species mentioned have not been screened for alkaloids or other substances with obvious sedative effect, and to the present, no other species in the genus report the presence of alkaloids.

***Piper aduncum* L.**

Collection voucher: *Orozco 143*

Common name: Matico (Spanish).

Description: Plant sold at the market in Cajamarca. Usually found in *yungas* and *kechwas*.

Use 1: To treat colds.

Preparation: Boil the leaves in milk.

Administration: Drink a cup of the milk decoction twice a day.

Use 2: Fresh plants applied externally to treat wounds, bruises and sprains, or to alleviate nerve-caused pain.

Preparation: Leaves are made into poultices and applied to the affected area.

Scientific literature review: Plants popularly used in Guatemala for the treatment of gonorrhea were tested for *in vitro* activity against *Neisseria gonorrhoeae* using strains isolated from symptomatic patients and confirmed by standard bacteriological procedures. Among the most active plants was *P. aduncum* (Cáceres, et al. 1995). The plant has also been tested for antiviral activity (HSV-1 and Poliovirus) for which it was found to be active too (Dévéhat, et al. 2002). In antimicrobial screens *P. aduncum* showed signs of *in vitro* activity against bacterial cultures of *Mycobacterium intracellulare*, *Bacillus subtilis* and *Pseudomonas aeruginosa*, (Lentz, et al. 1998). The compounds responsible for the bioactivity in this species have been defined as numerous polyphenols and alkaloids (Parmar, et al. 1998).

Plantaginaceae

***Plantago major* L.**

Collection voucher: *Orozco 130*

Common name: Llantén (Spanish)

Description: Old World plant introduced some time during the colonial period; perennial herb growing in rosettes, 30 cm tall; a common weed in pastures (*yunga* and *kechwa* areas).

Use 1: To treat open skin injuries

Preparation: Boil abundant leaves and stems.

Administration: Apply the leaves as a poultice or plaster and (optional) drink the water from the decoction. Plastering should be done once a day (keep it covered with bandages all day, and remove them at night). Drink one cup of the tea once a day.

Use 2: Diuretic.

Administration: Drink a tea infusion made from the leaves

Scientific literature review: Abundant research on *P. major* corroborates the claims on the ethnobotanical information. Antibacterial activity it is known from a caffeic acid sugar ester found in the plant: pantamajoside (Ravn and Brimer 1988). Analgesic, healing and

anti-inflammatory activities on aqueous extracts have also been studied (Guillen, et al. 1997; Nikol'skaya 1954).

Poaceae

***Cynodon dactylon* (L.) Pers.**

Collection voucher: *Orozco 151*

Common name: Grama dulce (Spanish)

Description: Invasive grass, growing as a weed in a backyard in *yunga* area.

Use: To treat kidney problems.

Preparation: Boil leaves.

Administration: Drink the decoction.

Scientific literature review: Reported in the literature to be used for urinary tract infections (Perez, C. and Anesini 1994), diuretic (Darias, et al. 1986), and to treat urinary inflammation (Defeo, et al. 1992). The essential oils are mostly inactive against various species of *Staphylococcus* and *Candida* (Artizzu, et al. 1996), but extracts from the fresh leaves had better activity as antibacterial and fungicide (Ahmed, S. M , et al. 1994). None of these results is conclusive though, about the claims of the informants

Polygonaceae

***Muehlenbeckia tamnifolia* (Kunth) Meisn.**

Collection voucher: *Orozco 191*

Common names: Chacapetaca (Spanish); mullaka (Quechua)

Description: Perennial herb; growing on *kechwa* pastures.

Use 1: To treat contusions and bruises

Preparation: Prepare a tea with leaves and fruits.

Administration: Drink the tea three times a day

Use 2: As wash to cure white sores on a nursing baby's mouth, a condition caused by heat (*calor*) from the breast milk due to the mother's intoxication on having spent too much time in the sun.

Use 3: The root is made into tea for the kidneys and liver

Scientific literature review: The ethnobotanically defined wound-healing activity of *M. tamnifolia* was evaluated by Villegas et al (1997) in an experiment that did not report any positive results for this species.

Portulacaceae

***Calandrinia ciliata* (Ruiz & Pav.) DC. ***

Collection voucher: *Orozco 199*

Common names: Guañuna (Spanish).

Description: Small herb with succulent stems, growing as weed in *Lupinus* field (*jalca*).

Toxicity: Toxic to guinea pigs

Scientific literature review: Although *C. ciliata* is only reported as used for food (Bocek 1984), the presence of alkaloids reported by (Smolenski, Silinis and Farnsworth 1975) could account for the bioactivity reported in Cajamarca.

Primulaceae

***Anagallis arvensis* L. ***

Collection voucher: *Orozco 198*

Common names: Guañuna (Spanish).

Description: Semierect annual herb, 0.2 m tall; growing as weed in *Lupinus* field (*jalca*).

Toxicity: Toxic to guinea pigs and sheep

Scientific literature review: Bitter principles of the species have been identified as arvenin I and II, which are cucurbitacin glucosides (Yamada, Hagiwara and Iguchi 1977).

Anagallis arvensis has also been detected to have fungitoxic (Thapliyal and Nene 1970), (Qasem and Abu-Blan 1996), and antiviral properties (Amoros, Fauconnier and Girre 1979). The antiviral compounds have been identified as triterpenes saponins (Amoros and Girre 1987). The presence of saponins confers to the plant their molluscicidal properties (El-Sayed, El-Nahas and Refahy 1990). The toxic properties of this plant have been related to sheep poisoning cases in Australia (Rothwell and Marshall 1986). The toxicity in cattle and buffaloes have been deeply studied -- it is known that after feeding on *A. arvensis*, dullness, anorexia, suspended rumination, constipation and edematous swelling will be observed. Death of approximately 65% of a population is to be expected (Sadekar, et al. 1995). Although *A. arvensis* is used as medicine in other cultures (Mukhopadhyay and Duary 1995), no reports about use of this plant were gathered among the people of Cajamarca.

Proteaceae

***Oreocallis grandiflora* (Lam.) R. Br.**

Collection voucher: *Orozco 144*

Common name: Cucharilla (Spanish).

Description: Shrub or small tree; leaves collected at the herb market in Cajamarca city.

Usually found in *yungas* and *kechwas*

Use: To treat kidney problems

Preparation: Boil one of the leaves in 0.5 l of water

Administration: Drink a cup of the decoction twice a day.

Scientific literature review: The scientific literature reports the use of this plant in northern Peru to treat uterine infections and ulcers (Ramirez, et al. 1988), but no other reference was found for the entire genus nor for the family

Rosaceae

***Rosa indica* L.**

Collection voucher: *Orozco 124*

Common name: Rosa de castilla (Spanish).

Description: Thorny shrub with abundant pink flowers 3 cm in diameter; cultivated as an ornamental and medicinal plant in *yunga* and *kechwa* areas

Use 1: To cure earaches.

Preparations: Boil 100 g of fresh flowers into 0.5 l water and let cool overnight

Administration: Put three to four drops of the decoction in the infected ear twice a day

Use 2: To cure eye infections (pink eye).

Preparation: Boil fresh flowers in water and allow cooling overnight.

Administration: Wash the affected eye three times a day with the water, using the flowers as a compress.

Scientific literature review: At least one scientific report validates the claims of informants, since it has been shown that *Rosa* species, particularly *R. canina*, have inhibitory effect on inflammatory cytokines (Yesilada, et al. 1997).

***Sanguisorba officinalis* L.**

Collection voucher: Orozco 133

Common name: Pimpinela (Spanish).

Description: Herb 40 cm tall, grown in a garden as a medicinal plant in *yunga* areas.

Use: To treat stomachache and kidney problems.

Preparation: Decoction of leaves and flowers.

Administration: Drink a cup of the decoction once a day.

Scientific literature review: Abundant research has been completed for this herb, which is widely recognized as a medicinal plant. It is used as hemostatic (Kosuge, et al. 1984) and as antiviral agent in Chinese medicine (Chung, et al. 1997). In scientific trials, it has shown inhibitory effects against soil-borne plant diseases (Ushiki, Hayakawa and Tadano 1996); activity as an antitumoral agent (Goun, et al. 2002; Kashiwada, et al. 1992), and antimicrobial action (Kokoska, et al. 2002). Moreover, *S. officinalis* has been found to have beneficial effects in the regulation of immediate-type allergic reaction (Shin, Lee and Kim 2002). The phytochemistry of the plant also has been studied. Among the tannins and related compounds, six methyl glucoside gallates and gallic acid glucosides have been characterized (Tanaka, Nonaka and Nishioka 1984). Several triterpenoids, including triterpenoid glycosides also are abundant in the species (Reher and Budesinsky 1992). However, none of these papers addresses the claim of effectiveness as an analgesic or in the treatment of kidney problems.

Rubiaceae

***Borreria laevis* (Lam.) Griseb. ***

Collection voucher: *Orozco 181*

Common names: *Araña* (Spanish).

Description: Prostrate annual herb, commonly found growing as a weed in cornfields (*chala*).

Toxicity: Described as toxic to guinea pigs if ingested

Scientific literature review: No particular reference to this species was found, although it is known that other members of the genus [*B. capitata* (Ruiz & Pav.) DC.] carry indole alkaloids like dehydroborrecapine (I) and borrecoxine (II). The astringent properties of the indol alkaloids in *Borreria* have been used as emetic and expectorants (Jossang, et al. 1981)

Rutaceae

Citrus aurantium L. *

Collection voucher: *Orozco 183*

Common name: *Naranja agria* (Spanish)

Description: 5 m tall tree, cultivated in *chala* and *yunga* for the bitter fruit

Toxicity: Repellent and toxic effect on insects.

Use 1: As repellent for ants (*Atta cephalotes* L. and other species of Hymenoptera)

Preparation: Cut slices of the fruit and spread them around newly planted fields, to ward off ants

Use 2: To treat head lice (*Pediculus humanus*) infestations.

Preparation: Wash the affected area with the juice of the fruit

Bitter orange may have been brought to Peru in the sixteenth century by Jesuits who used it as the grafting stock for the sweet orange. The astringent fruit, not edible when fresh, may have been used as it was in Spain, in preserves and as feed for pigs (Gade 1975:180). Today the bitter orange grows from sea level to an elevation of 2200 m, but is not highly valued and is seldom observed.

Scientific literature review: Abundant essential oils and bitter compounds present in the fruits and leaves (He, et al 1997) are responsible for the bioactivity reported by informants. The leaves contain essential oils d-limonene, l-linalol, linalyl acetate, geraniol, geranyl acetate and one alkaloid: l-estaquidrina. The insecticidal and repellent activities have been extensively tested in a variety of pests e.g., pulse beetles (*Callosobruchus phaseoli* Gyll. (Taylor, W. E. and Vickery 1974), red flour beetles *Sitophilus orizae* L. and *Tribolium castaneum* (Prakash and Rao 1997:134) among others. Volatile oils from the peels have been found to inhibit the oviposition of the cotton leafhopper *Amrasca devastans* Distant (Saxena and Basit 1982). The most common essential oils found in the fruit, limonin, nomilin, citronellol and obacumone are

all known to have antifeedant properties and insecticidal activity (Prakash and Rao 1997: 134).

Salicaceae

***Salix chilensis* Molina ***

Collection voucher: *Orozco 127*

Common name: Sauce (Spanish), wayaco (Quechua)

Description: Tree 4 m tall, grown for shade in pastures, very common in river shores in *kechwa* areas

Toxicity: Because of its bitter principles, it is toxic to insects and considered as a repellent.

Use1: To treat liver problems

Preparation: Decoction of the leaves.

Administration: Drink a cup of the tea before breakfast

Use 2: To keep away fleas (*Ctenocephalides felis* or *C. canis*) and to treat head lice (*Pediculus humanus*) infestation.

Preparation: Decoction of the leaves.

Application: Wash the floors of house with the decoction; for head lice, wash the head with abundant soap and rinse with the decoction.

Scientific literature review: The chemical composition of the genus *Salix* has been relatively well studied, especially the phenolic constituents (Julkunen-Tiitto 1989).

Phenolic glycosides and condensed tannins are known in *S. sericea* Marshall, *S. eriocephala* Michx., but no particular information for *S. chilensis* was found. Assays on insecticidal activity on *Musca domestica* L. and *Tribolium castaneum* (Atal, et al. 1978) did not yield positive results.

Santalaceae

***Quinchamalium chilense* Molina**

Collection voucher: *Orozco 170*

Common names: Chinchimal (Quechua) = related to magic; piki piki qhura (Quechua)

Description: Perennial herb, erect 0.3 m tall; frequently growing among rocks in dry slopes of *kechwas* and *jalcas*.

Use: Cold medicine

Preparation: Boil twigs with leaves and flowers on milk

Administration: Drink a cup of the milk decoction three times a day.

Scientific literature review: *Quinchamalium chilense* has not been tested as antiviral, but it is known to have weak antibacterial activity against *Escherichia coli* and *Sacina lutea* (Bhakuni, et al. 1974). The phytochemistry of the genus has not been studied

Solanaceae

***Capsicum pubescens* Ruiz & Pav. ***

Collection voucher: *Orozco/22*

Common name: Rocoto (Spanish).

Description: Herb 50 cm tall, cultivated in *chala*, *yunga* and *kechwa*.

Toxicity: Irritant and/or toxic effect on insects.

Use: As pesticide to treat aphids (*Myzus persicae*, *Macrosiphum euphorbiae*) in potato, tomato, chili peppers, quinoa, pumpkin, tobacco, beans, lettuce. Also, to control trips (*Frankliniella nuberosi* Moulton, Thysanoptera) in potato and quinoa fields.

Preparation: 30 g of the fruits should be ground and mixed with two liters of water

Leave the mixture sitting for a day before applying (spraying)

Scientific literature review: The antimicrobial properties of *Capsicum* species have been tested by Cichewicz and Thorpe (1996), with results that show varying degrees of inhibition against *Bacillus*, *Clostridium* and *Streptococcus* species. Two of the pungent compounds commonly found in *Capsicum* species, capsaicin and dihydrocapsaicin, were found to be active against these organisms. Rivas (1986: 55) tested extracts of *C. pubescens* for toxicity on *Epitrix* sp. and *Diabrotica decolor* Zeller (Coleoptera) finding no positive results compared with the control. The irritating properties of the essential oils mentioned before seem to better explain the activity of *C. pubescens* in insects, probably acting as repellents rather than as insecticide, at least for Coleoptera species

***Cestrum peruvianum* Roem. & Schult. ***

Collection voucher: Orozco 218

Common names: Hierba santa (Spanish); chirac (Quechua?), sauco pishij (Quechua)

Description: Perennial shrub growing on secondary forest or pastures in humid spots (*kechwa*).

Toxicity: Toxic to internal parasites in humans. The fruits are reported to be toxic to cattle

Use I: Antipyretic.

Preparation: Prepare an infusion of the leaves and drink a cup once a day.

Use 2: As a vermifuge to treat infestation of *Taenia saginata* and as pesticide for control in the field of *Epitrix subcrinita* LeConte, *E. ubaquiensis* Harold, *E. yanazara* Beck (Coleoptera) in potato, maize, bean and cauliflower. Also for *Diabrotica decipunctata* Latreille, *D. speciosa* Germar (Coleoptera) in corn, beans, peas, lima beans, wheat, quinoa, lettuce and cauliflower.

Preparation: A strong decoction of the leaves and fruits will be used to spray the affected foliage

Scientific literature review: The toxicity symptoms in cattle have been described by (van der Lugt, Nel and Kitching 1991). The animals that received 5 to 10 g/kg/day showed nervous signs including ataxia, muscle tremors, hypersensitivity and intermittent chewing. High doses induced moderate to severe hepatosis characterized by centrilobular to midzonal coagulative necrosis, hemorrhage and congestion. Other references verify the effect of *C'estrum* species as toxicants to cattle -- *C. diurnum* L. (Durand, Figueredo and Mandoza 1999); *C'estrum intermedium* Sendtn. (Gava, et al. 1996); *C. parqui* L'Hér (Riet-Correa and Mendez 1992). The effects are due to alkaloids, flavonoid glycosides and steroidal saponins. *C. parqui* L'Hér has been used in assessment of molluscicidal properties because of the abundant steroidal saponins (El-Emam, El-Amin and Ahmed 1990).

***Cestrum tomentosum* L. ***

Collection voucher: *Orozco 162*

Common name: Hierba santa lanuda (Spanish) “wooly holy herb.”

Description: Shrub 1.5 m tall, commonly found growing near water streams in *kechwa* areas.

Toxicity: Poisonous to cattle if ingested.

Scientific literature review: Reports on the presence of N-trans-feruloyltyramine, a glycoalkaloid (a well known toxic substance) detected on extracts of the aerial parts of *C. lanatum* M. Martens & Galeotti (syn.: *C. tomentosum* L.) (Turnock, et al. 2001), confirm the claim of the informants.

***Cestrum weberbaueri* Francey ***

Collection voucher: *Orozco 123*

Common name: Hierba santa (Spanish); sauco pishij (Quechua).

Description: Perennial shrub growing in secondary forest or pastures in humid spots (*yunga* and *kechwa*).

Toxicity: Toxic to internal parasites.

Use 1: As vermifuge for intestinal tapeworms (*Taenia saginata*).

Use 2: Used as an antipyretic.

Use 3: Used to stop vomiting.

Preparation: Water infusion of the leaves

Administration: Drink one cup of the infusion every four hours.

Scientific literature review: No information was found on phytochemistry or bioactivity of this plant. Probably some of the phytochemical information found for other species of *Cestrum* (Turnock, et al. 2001) applies to *C. weberbaueri*, and the presence of glycoalkaloids account at least for the vermifuge activity.

Datura arborea* L.

Collection voucher: *Orozco 112*

Common name: Floripondio; flor de campanilla (Spanish), guantu (Quechua), wuar-wuar (Quechua)

Description: Small tree, 2.5 m tall with large flowers. Frequently used in *chala*, *yunga* and *kechwa* as an ornamental plant in household gardens.

Toxicity: The flowers and leaves are recognized as toxic to animals and humans alike if ingested. Even the close proximity to the tree for an extended period is said to have consequences. Parents will warn the youngsters about sleeping under this tree, because they will have vivid and unusual dreams (probably nightmares) and will wake up disoriented. Prolonged proximity of the tree was also reported to produce headaches and even dementia.

Uses 1: Flowers will be placed under the pillow to soothe colicky or irritable babies.

Use 2: Small pieces of the flowers will be mixed with meat, and used as a bait to get rid of unwanted dogs or cats. It can also be prepared by boiling the seeds and adding this water to milk.

Scientific literature review: *Datura* species contain a variety of alkaloids, scopolamine being the most abundant (up to 0.6% dry weight) (Jacinto, Lapa and Caden 1988). When ingested, the plant (particularly the seeds) produces almost immediate effects. The victim suffers amnesia, intoxication without a “high” and s/he is unaware of the condition. This makes *Datura* rape (known in South America as *burundanga*) so well liked by criminals intending to rob people without using any weapons because they can hide this tasteless substance in candy, chewing gum or a drink. Intoxication can also happen accidentally. These plants can grow very large and often need pruning. This is typically how the eye is contaminated by parts of the plants, which can cause dilatation of the pupil, which mimics a neuro-ophthalmological disorder (Wilhelm, Wilhelm and Schiefer 1991). Intoxication from the plant can also happen just from contact of plant parts with the skin (Vieira 1976).

***Datura stramonium* L. ***

Collection voucher: *Orozco 180*

Common names: Chamico (Spanish).

Description: Erect herb covered with spines, up to 1.2 m tall; abundant on highly disturbed sites such as abandoned backyards and sides of the roads in *chala* and *yunga* areas.

Toxicity: Recognized as highly toxic, particularly the seeds.

Use: The seeds are used to poison rats.

Preparation: Prepare bait by combining the seeds with cheese or meat

Scientific literature review: Jimsonweed produces tropane alkaloids, esters of the troponic acid, tropanol or scopolan. Hyoscyamine is mainly present in the fresh plant and atropine in the dried plant together with scopolamine (Aguilar and Zolla 1982:83). The toxicity of *Datura* has been known for a long time. It is said that in the ancient Ottoman Empire, women of the harem would use it to escape the monitoring of the Sultan's eunuchs for a few hours. In the Middle Ages in Europe, it was used (as it is today in South America), as incapacitating agent for rapes and robberies. Due to its easy availability, teens are using it as a drug that produces visual hallucinations similar to those reported by LSD users (Gaillard and Pepin 1999). Originally, *Daturas* in South America were sacred plants used in divination and religious rituals. These practices have greatly disappeared and the plant is better known today as a tool in black magic, to incapacitate or diminish the will of the enemy (Grinspoon and Bakalar 1997:44).

***Nicotiana rustica* L. ***

Collection voucher: *Orozco 201*

Common name: Tabaco (Spanish); tahuaco (Quechua)

Description: Herb 0.6 m tall; growing in secondary forest among rocky outcrops in *kechwa*.

Toxicity: Known to be toxic to a variety of organisms, from insects to humans.

Use 1: Use frequently as a rub for rheumatic affections.

Preparation: Macerate leaves in alcohol and soak for at least a week.

Administration: Rub the affected part with the alcohol.

Use 2. Broad-spectrum insecticide. It is used to control insects (*Epitrix subcrinita* LeConte, *E. ubaquiensis* Haarold, *E. yanazara* Beck, Coleoptera, *Myzus persicae*, *Macrosiphum euphorbiae*, *Rhopalosiphum maidis*, *R. padi*) and *Frankliniella tuberosa* Moulton (Thysanoptera) attacking the foliage of potato and maize. It is also used to control armyworms (*Spodoptera frugiperda* Smith) and other Lepidoptera such as *Feltia experta* Walker, *Agrotis ipsilon* Hufnagel, and *Copitarsia turbata* Herrich-Schaeffer.

Preparation. Grind leaves and mix with water.

Application. Spray mixture on affected plants.

Scientific literature review: The accidental ingestion (in animals) or deliberated use (humans) of *N. tabacum* and *N. rustica* has proven serious health consequences (Benedict, et al. 1975; Mellick, et al. 1999) and others). The bioactive substances are alkaloids: narcotine, narceine, solanina, piperina, delfinina, colchicina, ampomorfina, lobelina, gelsemina, nicotina and anabasine. Anabasine is found in largest proportion (0.62%) and is thought to be the main cause for toxicity (El-Gayar, et al. 1975). The most

characteristic symptoms of anabasine ingestion are: convulsions, congestion in the kidneys and stomach tissues and even death. In cattle, the symptoms start with tremors, muscular rigidity (especially in the limbs), sweating, anxiety, and depression. The symptoms start about two hours after the ingestion and death can occur in three to four hours if the amount is significant (Aguilar and Zolla 1982:158). *Nicotiana* has been commercially used as a pesticide and because of this information on the bioactivity is abundant. Regarding the plant extracts, there are also numerous studies on the growth inhibition and larvicidal activity (Areekul, Sinchaisri and TigvatanAnon 1987; De Moraes, et al. 2001; Sathiyamoorthy, et al. 1997). For example, *N. rustica* extracts are known to produce 70% larval mortality in *Tribolium castaneum* and to produce contact toxicity by topical application (3 µg/insect) (Villalobos 1998)

***Nicotiana tabacum* L. ***

Collection voucher: *Orozco 115*

Common name: Tabaco (Spanish); tahuaco (Quechua)

Description: Herb 2 m tall, cultivated. Collected in kechwa area.

Toxicity and uses: See *N. rustica*.

Scientific literature review: Abundant information on the toxicity but mostly related to smoking. For other types of toxicity, refer to *N. rustica*

***Solanum luteoalbum* Pers. ***

Collection voucher: *Orozco 160*

Common name: Guañuna (Quechua?).

Description: Erect shrub 0.5 m tall; uncommon, growing in disturbed areas along road bank in *chala* and *yunga*.

Toxicity: The fruits reported to be toxic to animals

Use: To poison unwanted dogs and cats.

Administration: Mix the fruit with chunks of meat and distribute as poisoned bait.

Scientific literature review: Specific information on phytochemistry or related research on this species was not found. Nevertheless, it is easy to foresee the presence of toxic glycoalkaloids, abundant in other members of the genus like *S. abutiloides* (Griseb.) Bitter & Lillo (Yoshimitsu, et al. 2002), *S. mammosum* L. (Van Thanh and Thien 2001) and *S. demissum* Lindl. (Sarquis, et al. 2000).

Urticaceae***Pilea microphylla* (L.) Liebm.**

Collection voucher: *Orozco 148*

Common name: Contra-yerba (Spanish).

Description: Small herb with succulent leaves, sold in herb markets. Usually found in *yunga* areas.

Use: To treat kidney problems

Preparation: Boil the leaves in water for five minutes.

Administration: Drink the decoction while still hot.

Scientific literature review: No information found on *P. microphylla*. For other members of the genus, a report on cytotoxic constituents of *P. mongolica* Wedd. reveals cytotoxic triterpenoids that were found active when tested against cultured human tumor cells lines (Kwon, Lee and Zee 1997). Phytochemical screening in the genus has also detected the presence of alkaloids in *P. hamaon* Makino (Chi and Lee 1981). *Pilea pumila* (L.) A. Gray was tested for anti-inflammatory activity in male rats, with negative results (Benoit, et al. 1976).

***Urtica magellanica* Juss. ex Poir. ***

Collector voucher: *Orozco 194*

Common names: Ortiga (Spanish); chini (Quechua); ishguin (Quechua)

Description: Perennial herb, erect up to 0.4 m tall, growing on disturbed areas as well as secondary forest (*kechwa*).

Toxicity: Dermotoxic on contact. Produces a burning sensation that begins as an itch and ends with small blisters. The effect can last up to days, depending on the sensibility of the person

Treatment: To relieve the discomfort, put warm human urine on the affected area

Use: To treat rheumatisms and arthritic pain.

Scientific literature review: Although no specific study was found for the phytochemistry of *U. magellanica*, presumably the same principles at play on *U. urens* could apply. The mechanisms of activity after contact with *U. urens*, has been traced back to leukotrienes and histamine. Nettle hairs therefore were found to resemble insect venoms and cutaneous mast cells with regard to their spectrum of mediators (Czernetzki, Thiele and Rosenbach 1990). Following the same principle applied to the treatment of arthritic diseases with bee venom, leaf extracts of stinging nettle *U. urens* and *U. dioica* have been found to block the cytokines that stimulate inflammatory joint diseases. The responsible compound in these species has been identified as Hox alpha and is listed as a very promising remedy for therapy of inflammatory joint diseases (Kavalali and Tuncel 1997; McCaleb 1998; Schulze-Tanzil, et al. 2002).

***Urtica urens* L. (Urticaceae) ***

Collection voucher: *Orozco 197*

Common name: Ortiga negra (Spanish); ishguin (Quechua); chini (Quechua).

Description: Erect, perennial herb, up to 40 cm tall; found in pastures and humid spots in *kechwa* areas.

Toxicity: Severe dermatitis reaction on contact with leaves or stems

Use 1: To treat bruises and arthritis.

Preparation: Grind leaves to form a paste.

Administration: Apply a poultice on the affected area.

Use 2: Leaves of the plant are rubbed on the head for headaches. People suffering from headache (usually a hangover) plaster the leaves of *Urtica* species on their foreheads and wrap them around with cloth, relieving the pain inside their heads with external agony.

The function is extended to the prevention of hangover as well. By squeezing *Urtica* juice into *trago* (shots) before it is drunk, it is expected that future pain will not ensue.

Use 3: Tea made from the flowers is used as a medicine against measles.

Use 4: Also used to treat allergies by rubbing the fresh plant on the body.

Scientific literature review: The mechanisms of activity after contact with *U. urens*, nettle hair and whole-plant extracts have been examined for the presence of leukotrienes (a mediator of immediate hypersensitivity. Leukotrienes are derived from the action of enzyme 5-lipoxygenase on arachidonic acid and are chemicals, which cause asthma symptoms). Both hair and plant extracts contained high levels of LTB₄ and LTC₄ (leukotrienes) as well as histamine. Nettle hairs therefore were found to resemble insect venoms and cutaneous mast cells with regard to their spectrum of mediators (Czernetzki,

Thiele and Rosenbach 1990). Following the same principle applied to the treatment of arthritic diseases with bee venom, leaf extracts of stinging nettle *U. urens* and *U. dioica* have been found to block the cytokines that stimulate inflammatory joint diseases. The responsible compound in these species has been identified as Hox alpha and is listed as a very promising remedy for therapy of inflammatory joint diseases (Kavalali and Tuncel 1997; McCaleb 1998; Schulze-Tanzil, et al. 2002). *Urtica urens* is also known to be toxic to nematodes (Mohammad, Husain and Al-Zarari 1981) and to possess flavonoids that confer antibacterial and antifungal properties (Saeed, El-Eraqy and Ahmed 1995)

Valerianaceae

***Phyllactis rigida* (Ruiz & Pav.) Pers. ***

Collection voucher: *Orozco 232*

Common name: Valeriana (Spanish)

Description: A rare perennial herb that grows in rosettes in *jalca* grasslands.

Toxicity: Toxic to insects.

Use: As pesticide to protect potato crops from *Premnotypes* spp.

Preparation: The information about the use of the plant is not clear since it fell out of use a long time ago, probably because the plant is now rare and because the *Premnotypes* problem (Andean potato weevil) is so important and complex that farmers mostly rely on commercial chemicals to solve the problem. According to the only informant that reported the use of this plant, grinding the leaves and roots of the plant and mixing with cool water was the most common preparation method. As per the application, it is unclear if the mixture was applied to the potato entire plant or to the potatoes after harvesting.

Scientific literature review: According to one of the authorities on this genus, Dr Bente Eriksen, University of Göteborg, Sweden (pers. comm.), besides the sedative effect of the genus *Phyllactis*, very little is known about the bioactivity. The chemical constituents of *P. rigida* have not been described yet either, but we know of the presence of iridoid monoterpenes in *P. pulvinata* Rauh & Willer (Becker, H , et al. 1986). Monoterpenes are known to have repellency effects on insects (Tripathi, et al. 2000) and if the presence of these compounds is common in the genus, they could account for the reported activity.

Verbenaceae

***Verbena littoralis* Kunth ***

Collection voucher: *Orozco131*

Common names: Verbena (Spanish)

Description: Perennial herb; small lavender flowers; growing as a weed in *kechwa* pastures.

Toxicity: Repellent effect to insects

Use 1: To treat stomachaches and liver problems.

Preparation: Boiling the leaves to prepare a decoction.

Administration: Drink a cup of the tea before breakfast.

Use 2: To keep away fleas (*Ctenocephalides felis* or *C. canis*).

Preparation: Brooms made of the stems are used to sweep homes and are said to be effective in keeping away fleas. In addition, boiling the leaves and stems and washing the floors with the decoction is said to repel insects because of the sour nature of the preparation.

Scientific literature review: *Verbena littoralis* is widely used in Costa Rica to treat diarrhea and other disorders. Verbascoside and two iridoid glycosides, identified as verbenalin and brasosides were isolated from the ethanolic extract of the aerial parts (Umana and Castro 1990). No information was found on clinical trials or bioassays evaluating the medicinal properties reported by the informants. Nevertheless, research in a related species, *V. officinalis* L., shows that extracts exhibit anti-inflammatory activity (Deepak and Handa 2000). No reference was found on insecticidal or repellent activity

for *V. littoralis*, but species like *V. hastata* L. have been confirmed to have insecticide activity against *Culex quinquefasciatus* (Hartzell and Wilcoxon 1941). The phytochemical origin of the activity can be traced to the presence of iridoid monoterpenes (Damtonft, Jensen and Nielsen 1979).

Pteridophytes

Equisetaceae

***Equisetum giganteum* L.**

Collection voucher: *Orozco 118*

Common name: Cola de caballo (Spanish) = Horsetail.

Description: Herbaceous perennial that grows frequently on road banks and humid patches. The fresh plant is sold in the market.

Toxicity: Toxic to insects

Use 1: Diuretic.

Use 2: The entire plant is made into a tea for ache in the waist-area (probably kidney problems).

Preparation: Boil 20 g in 1 l of water

Application: Drink one cup, twice a day

Use3: Insecticide for red mites attacking potato plants (*Polyphagotarsonemus latus* Banks, Acarina)

Preparation: Boil 200 g of dry or fresh plants in 10 l of water, for one hour. Let the decoction rest for one day and add 90 l of water

Application: Apply to the foliage for three days in a row.

Scientific literature review: Regarding the pharmacological claims, the diuretic activity has been confirmed (Caceres, Giron and Martinez 1987; Perez, R., Yescas and Walkowskia 1985; Pérez, Laguna and Walkowski 1985). Their work in mice showed that chloroform extracts produced an effect similar to that of hydrochlorothiazide in relation to the excretion of sodium, potassium and chloride. Toxicity screenings with *Artemia salina* (brine shrimp toxicity test) revealed that *E. giganteum* has a strong concentration-related toxic activity (Gonzalez, et al. 1993), very likely related to the presence of alkaloids in the plant (Davyt, et al. 1991), but no other bioassays were found regarding pesticidal activity.

Pteridaceae

***Adiantum subvolubile* Mett. ex Kuhn**

Collection voucher: *Orozco 167*

Common name: Culantrillo (Spanish).

Description: Small fern growing on humid road banks

Use: To increase menstruation (emmenagogue, probably abortifacient)

Preparation: Boil the leaves

Administration: Drink a cup of the decoction plus a spoonful of honey, twice a day

Scientific literature review: The scientific literature reports the abundant presence of triterpenoids in various species of *Adiantum* (not particularly for *A. subvolubile*)

(Brahmachari and Chatterjee 2002; Tsuzuki, et al. 2001). Although triterpenoids are recognized as bioactive compounds that can exert cytotoxic and antibacterial activity, a direct correlation with the informant's claims could not be established

RESULTS OF BIOACTIVITY ASSAYS

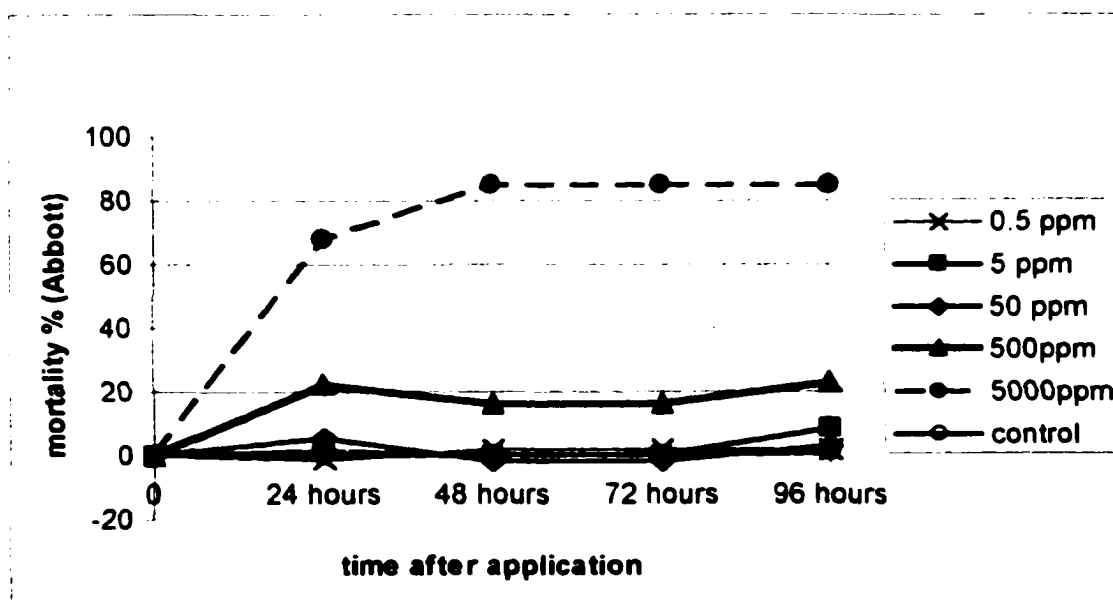
According to the methodology described in Chapter 2, plant extracts were collected for all the species with ethnobotanical information related to pesticidal (insecticide or vermifuge) activity. In total, 22 extracts were collected and tested with the YFM bioassay, to measure their level of bioactivity as insecticides. The results are organized in alphabetical order by species, including mortality rates (Abbott formula) and probit analysis.

***Ambrosia arborescens* (Asteraceae)**

Collection voucher: *Orozco 220*

The leaves of this plant are used to treat intestinal worms and as a repellent against lice (*Pediculus humanus* var. *capitis*) and fleas (*Ctenocephalides felis* or *C. canis*).

Figure 3 1. *Ambrosia arborescens* mortality chart.



Probit analysis

χ^2 for Heterogeneity (calculated) = 1.001

χ^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = 3.401526$

$\sigma = 4.01485$

$LC_{50} = 2520.731$ ppm

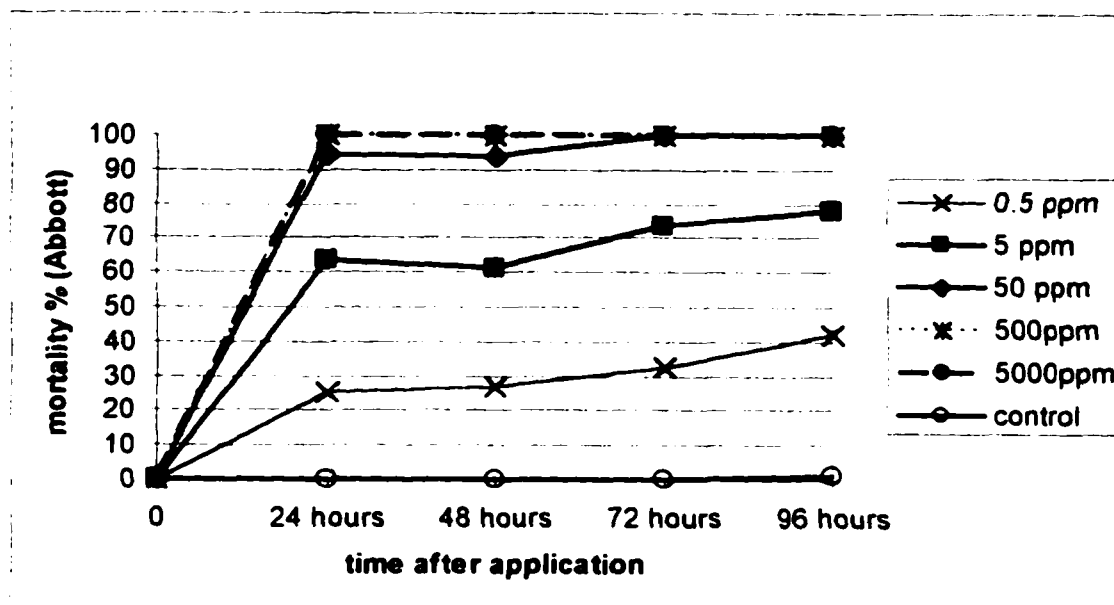
S.E. = ± 350.80

The results show activity that is high only at a 5000 ppm dose. Below 500 ppm, the results are very limited. The probit results state that the curve generated by the actual data fits well the probit model, and the relation between doses and mortality follow the expected, but the LC_{50} of 2520 ± 350 ppm is too high to consider this a species to be effectively used as pesticide. These results agree with reports of scientific literature for species in this genus, where the effect on *A. aegypti* larvae was very weak (Geerts, Blerk and Triest 1994).

***Apurimacia boliviana* (Euphorbiaceae)**

Collection voucher: *Orozco 216*

The root of this plant is used as insecticide to control external parasites like *Dermatobia hominis*, in cattle and sheep. The pure extract is applied to the affected area (where the presence of the parasite is evident), or is given to cattle to treat hepatic distomatosis caused by *Fasciola hepatica* (sheep liver fluke).

Figure 3.2: *Apurimacia holiviana* mortality chart

Probit analysis

X^2 for Heterogeneity (calculated) = 2.157

X^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = -0.072413$

$\sigma = 6.575790$

$LC_{50} = 0.846$ ppm

S.E. = ± 0.1456

Extracts from *A. holiviana* roots showed excellent results. The bioactivity is evident from the first 24 hours after the application and the mortality is 100% for all doses, except at 5

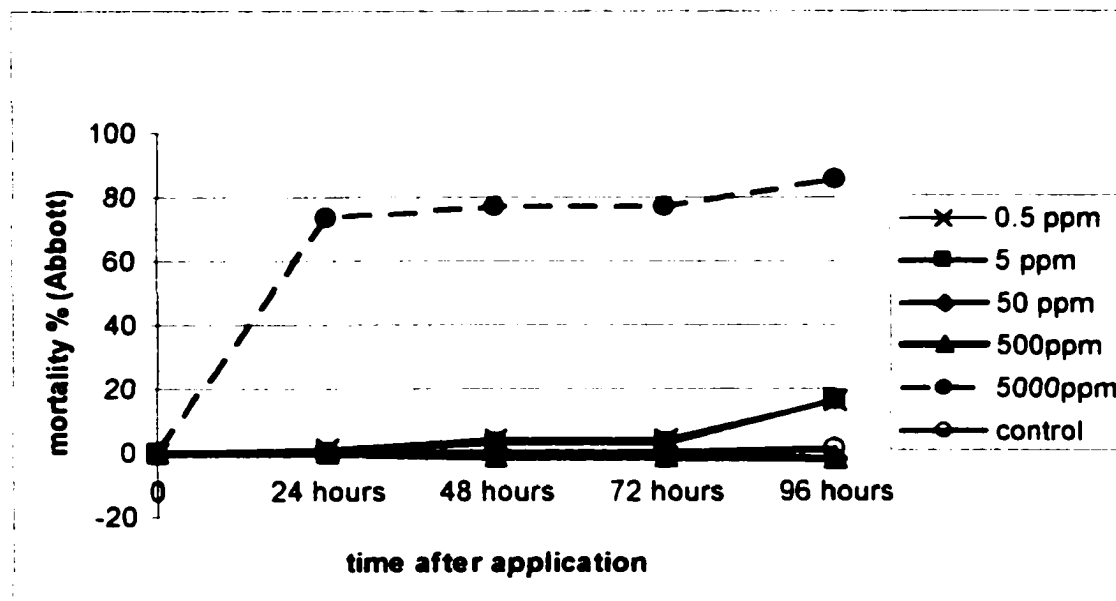
and 0.5 ppm. The calculated LC_{50} of 0.8 ± 0.1 ppm is close to what is consider a useful level of potency (McLaughlin and Rogers 1998) and the adjustment of the empirical data to the expected line is high too, according to the X^2 analysis. The consistency and effectiveness of the extracts emulate results from a commercial pesticide. Because of the interesting results and the lack of knowledge about this plant, it will be important to do further analysis not only on the insecticidal effects, but also on the phytochemistry of the plant.

***Capsicum pubescens* (Solanaceae)**

Collection voucher: *Orozco 122*

The fruits are used as pesticide to treat aphids (*Myzus persicae*, *Macrosiphum euphorbiae*) in potato, tomato, chili peppers, quinoa, pumpkin, tobacco, beans, and lettuce. Also, to control trips (*Frankliniella tuberosi* Moulton, Thysanoptera) in potato and quinoa fields.

Figure 3 3: *Capsicum pubescens* mortality chart.



Probit analysis

X^2 for Heterogeneity (calculated) = 54.164

X^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$LC_{50} = 4111.229$ ppm

S.E. = ± 352.89

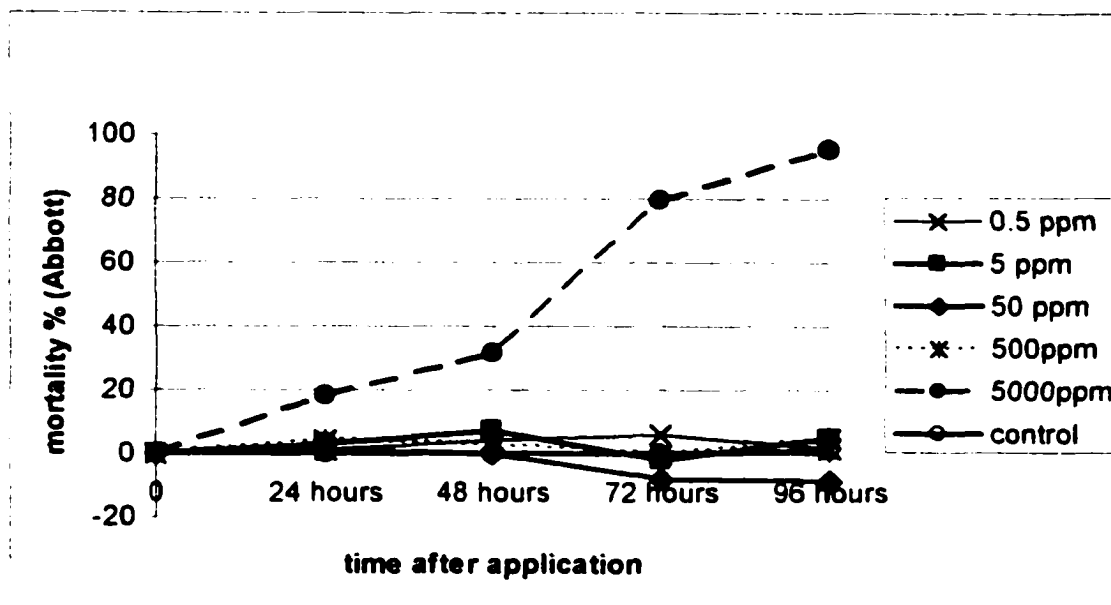
The Abbott chart evidence that the only dose to produce a significant level of mortality was 5000 ppm. The tabular X^2 value exceeds the calculated X^2 value for heterogeneity, which means the line generated by the data, differs greatly from the expected and that the

doses elicited erratic responses on the organisms used for the test. Finally, LC_{50} more than 4111 ± 352 ppm, cannot be considered practical. Insecticidal activity tested by other authors did not yield conclusive results in the past (Rivas 1986:55). It is very likely that the nature of the essential oils in *Capsicum* fruits will produce responses more as a repellent, than as an insecticide.

***Cestrum peruvianum* (Solanaceae)**

Collection voucher: Orozco 218

The leaves are used as a vermifuge to treat infestation of *Taenia saginata* and as pesticide for control in the field of *Epitrix subcrinita* LeConte, *E. ubaquiensis* Harold, *E. yamazara* Beck (Coleoptera) in potato, maize, bean and cauliflower. Also for *Diabrotica decipunctata* Latreille, *D. speciosa* Germar (Coleoptera) in corn, beans, peas, lima beans, wheat, quinoa, lettuce and cauliflower.

Figure 3.4: *Cestrum peruvianum* mortality chart

Probit analysis

X^2 for Heterogeneity (calculated) = 3.374

X^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = 3.183501$

$\sigma = 2.052886$

$LC_{50} = 1525.810$ ppm

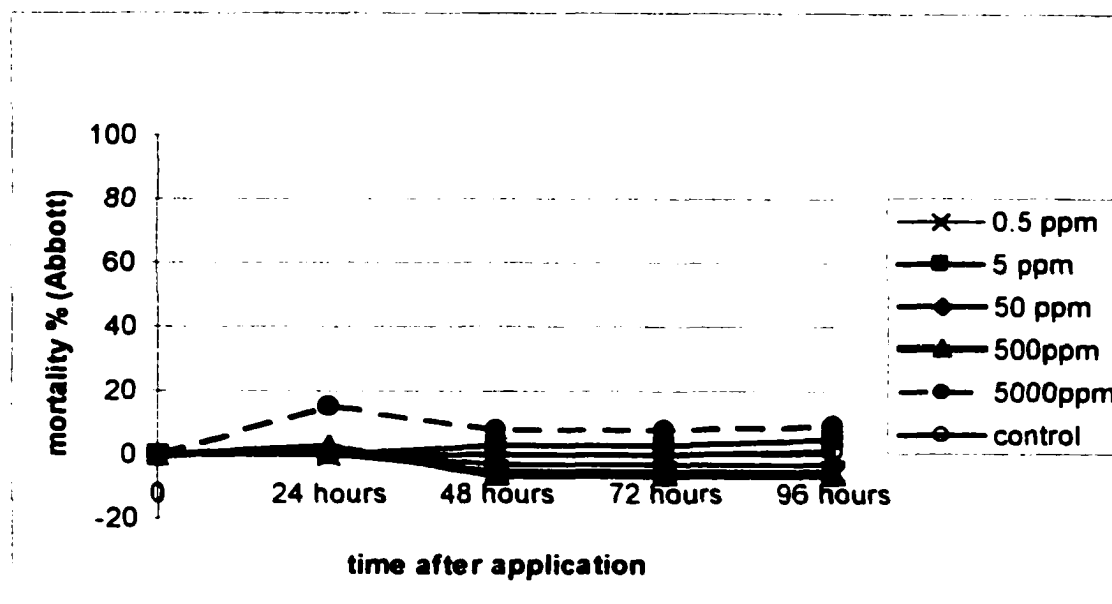
S.E. = ± 1027.12

Cestrum peruvianum did not produce a notorious mortality with doses below 5000 ppm. Even at that high dose, it took more than 48 hours for the mortality to pick up and four days to reach the 100% level. Despite that, the empirical data fits the expected probit (X^2 calculated $< X^2$ tabular value) and a LC_{50} of 1525 ± 1027 ppm was established, although because of high variance, the dose is not reliable. The presence of glycoalkaloids in the genus is likely the cause of mortality, but there are no other references in the literature to compare these results.

***Citrus aurantium* (Rutaceae)**

Collection voucher: *Orozco 183*

The juice and peel of the fruit are used as repellent, particularly for ants (*Atta cephalotes* and other species of Hymenoptera) or to treat head lice (*Pediculus humanus*) infestations.

Figure 3.5: *Citrus aurantium* mortality chart

Probit analysis

$$X^2 \text{ for Heterogeneity (calculated)} = 0.820$$

$$X^2 \text{ for Heterogeneity (tabular value at 0.05 level)} = 7.815$$

$$\mu = 5.21284$$

$$\sigma = 1.43156$$

The Abbott chart makes evident that none of the doses produced a significant level of mortality. The line derived from the empirical data has no significant slope, therefore, a LC_{50} of more than 10,000 ppm was calculated. It is certain the presence of essential oils with antifeedant properties and insecticidal activity in *Citrus* species fruit (Prakash and

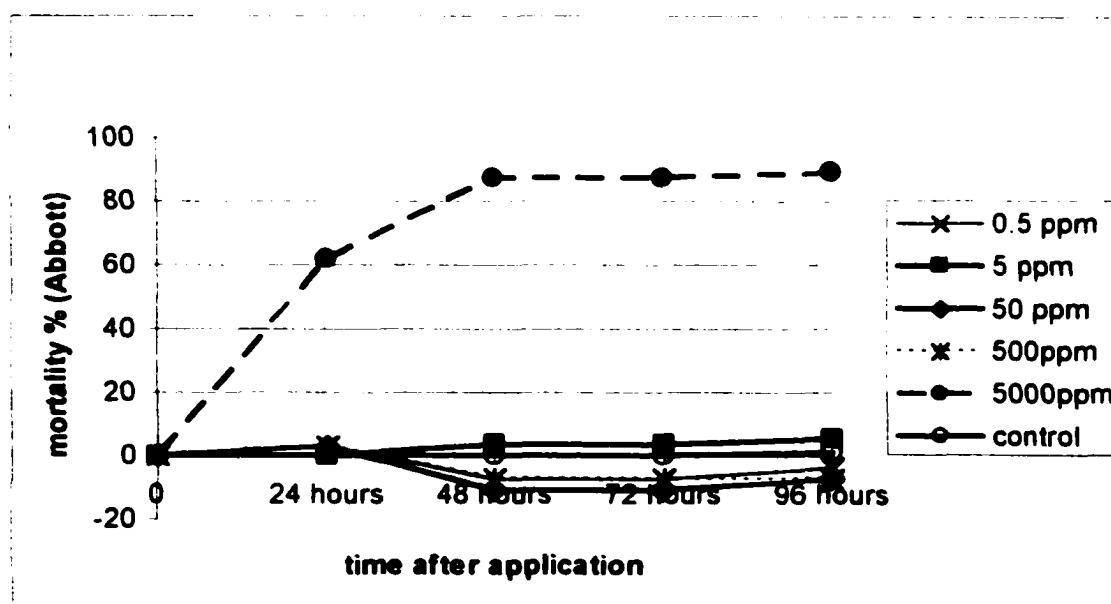
Rao 1997:134), but the volatility of the compounds makes the particular method of extraction used here, inadequate. Even though methanol extracts terpenoids, they are probably lost during the evaporation of the methanol to get the final extract.

Cucumis dipsaceus (Cucurbitaceae)

Collection voucher: Orozco 184

The fruits of this plant are used to wash lice infested animals or human heads.

Figure 3.6 *Cucumis dipsaceus* mortality chart



Probit analysis

$$X^2 \text{ for Heterogeneity (calculated)} = 0.645$$

$$X^2 \text{ for Heterogeneity (tabular value at 0.05 level)} = 7.815$$

$$\mu = 3.583184$$

$$\sigma = 0.407156$$

$$LC_{50} = 3829.87 \text{ ppm}$$

$$S.E. = \pm 327.88 \text{ ppm}$$

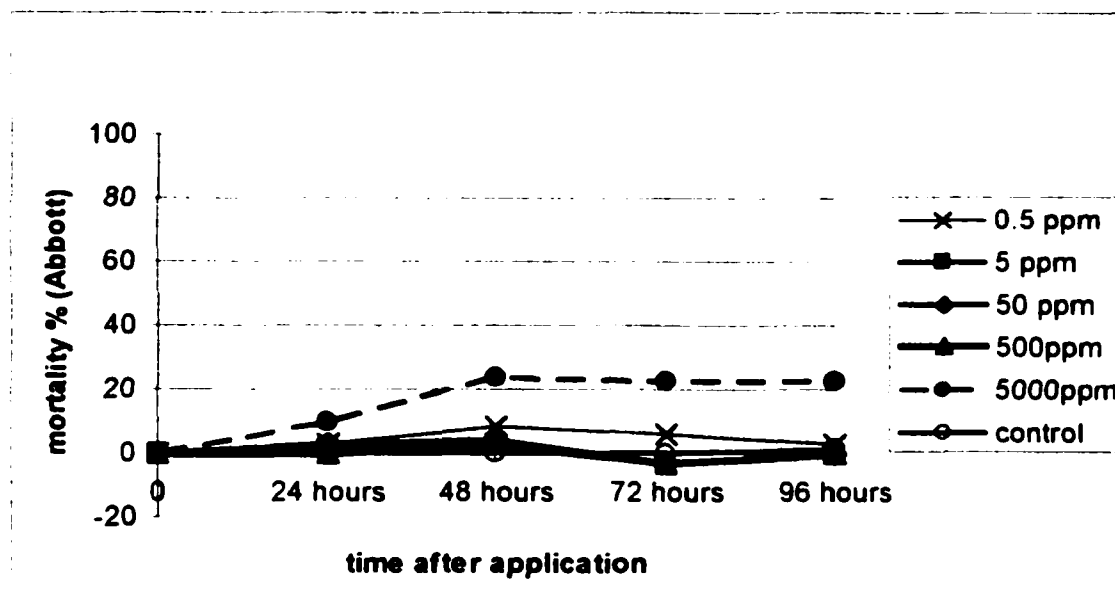
The Abbott chart shows that to obtain a significant level of mortality, the concentration of extract has to be around 5000 ppm. None of the other doses produced a significant effect.

Although the line derived from the empirical data did match the expected regression line, a LC_{50} of 3829 ± 327 ppm is too high to be considered efficient. Tetracyclic triterpenes and their glycosides could account for the toxicity reached with the highest doses in this experiment. It is likely that in the field, the compounds work more like repellents than as pesticides, because of their bitterness.

***Equisetum giganteum* (Equisetaceae)**

Collection voucher: *Orozco 184*

The plant (except the roots) is used as insecticide for red mites attacking potato plants (*Polyphagotarsonemus latus*).

Figure 3.7. *Equisetum giganteum* mortality chart.

Probit analysis

$$X^2 \text{ for Heterogeneity (calculated)} = 10.341$$

$$X^2 \text{ for Heterogeneity (tabular value at 0.05 level)} = 7.815$$

The *E. giganteum* extract produced a 20% rate of mortality only when used at 5000 ppm, while all other doses were ineffective. The line produced by the empirical values and the expected regression line have a difference that is significant. This is evidence that the probit model is not applicable to the results. The slope of the resulting line is not

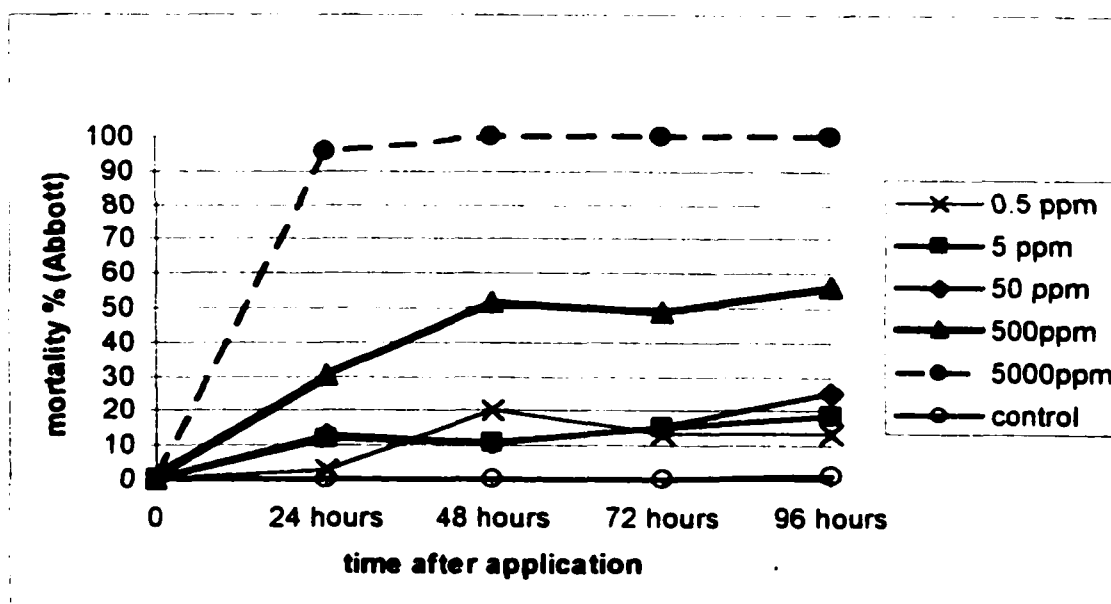
significantly different from zero and a LC_{50} cannot be calculated. The results probably show the activity of some alkaloids present in the plant (Davyt, et al 1991)

***Eucalyptus globulus* (Myrtaceae)**

Collection voucher *Orozco 132*

The leaves of this tree are used as a repellent for housefly (*Musca domestica* L., Diptera) and mosquitoes (*Culex* sp., Diptera)

Figure 3 8: *Eucalyptus globulus* mortality chart.



Probit analysis

X^2 for Heterogeneity (calculated) = 5.209

χ^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = 2.979184$

$\sigma = 0.432356$

$LC_{50} = 953.749 \text{ ppm}$

S.E. = $\pm 86.85 \text{ ppm}$

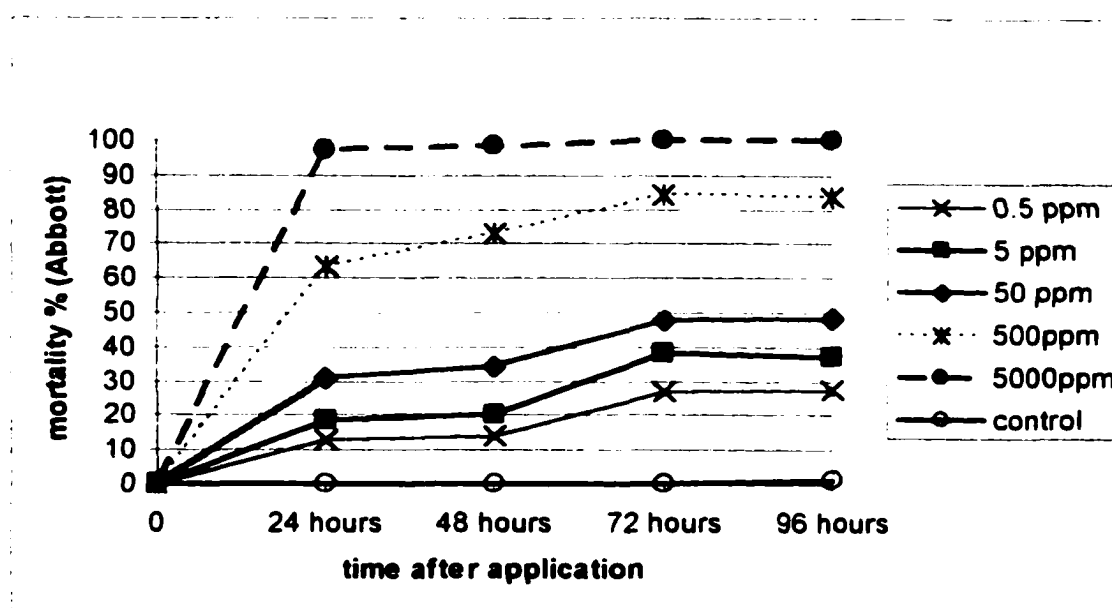
High levels of mortality were reached at 5000 and 500 ppm doses in this treatment. The line fits the expected and a $LC_{50} = 953 \pm 86 \text{ ppm}$ was calculated. While the original reports from the informants indicate the use of this plant as repellent, there is substantial mortality, at least with the highest doses. Previous reports on larvicidal effect of *Eucalyptus* show the activity of the essential oils of *E. globulus* as repellents and toxic, and mention the fact that toxicity greatly depends on temperature (Papachristos and Stamopoulos 2001; 2002). The reason is very likely the volatility of the active compounds. In this particular assay, the compounds are in disadvantage because, although methanol can extract essential oils, the process of evaporation of the methanol to obtain the final crude extract is likely to vanish a good part of the substance of interest. It is also likely that part of the toxicity reported here comes from the presence of toxic tannins.

***Euphorbia huanchahana* (Euphorbiaceae)**

Collection voucher: *Orozco 228*

Aqueous extracts from the roots of this plant are used as vermifuge and to induce diarrhea

Figure 3.9: *Euphorbia huanchahana* mortality chart.



Probit analysis

X^2 for Heterogeneity (calculated) = 0.695

X^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = 1.481906$

$\sigma = 8.384168$

$LC_{50} = 30.332 \text{ ppm}$

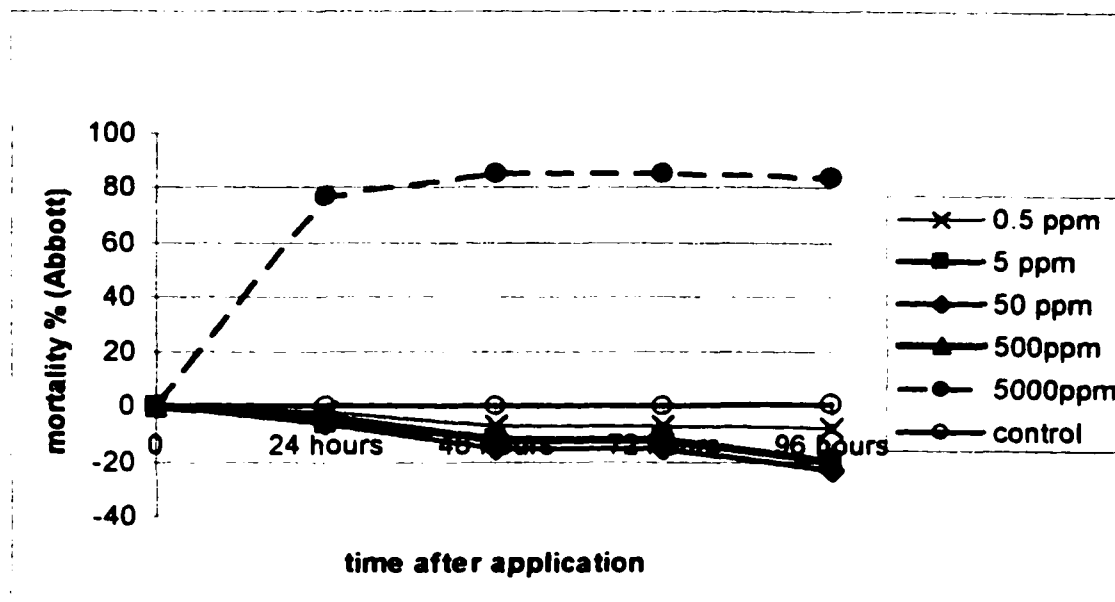
$S.E. = \pm 5.89 \text{ ppm}$

Extracts from *E. huanchahana* roots showed bioactivity that is evident from the first 24 hours after the application and the mortality reaches 100% for the higher dose, and at least 30% for the lowest. The χ^2 for heterogeneity confirms that the line produced by the empirical data closely fits the expected. The calculated LC_{50} of $30 \pm 5 \text{ ppm}$ is low enough to make this an appealing compound. Because of the interesting results and the lack of knowledge about this plant, it will be important to do further analysis not only on the insecticidal effects, but also on the phytochemistry of the plant

***Foeniculum vulgare* (Lamiaceae)**

Collection voucher: *Orozco 138*

Aqueous extracts from the leaves or the seeds are used as vermifuge.

Figure 3.10 *Foeniculum vulgare* mortality chart.

Probit analysis

X^2 for Heterogeneity (calculated) = 2.712

X^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = 3.456906$

$\sigma = 0.322168$

$LC_{50} = 2862.332$ ppm

S.E. = ± 194.83 ppm

Although there is considerable mortality rate for the 5000 ppm dose of *F. vulgare* leaves extract, the other doses did not produce appreciable results. The mortality produced by these doses produce a LC_{50} of 2862 ± 194 ppm, which is too high to be considered practical for application. *Foeniculum vulgare* has been successfully tested in the past against a broad variety of this organisms (Ruberto, et al. 2000). The source of insecticidal power was identified as trans anetol, present in the essential oils (Bilia, et al. 2000). In the present assay, the lost of part of this main component during the evaporation process, could account for the results.

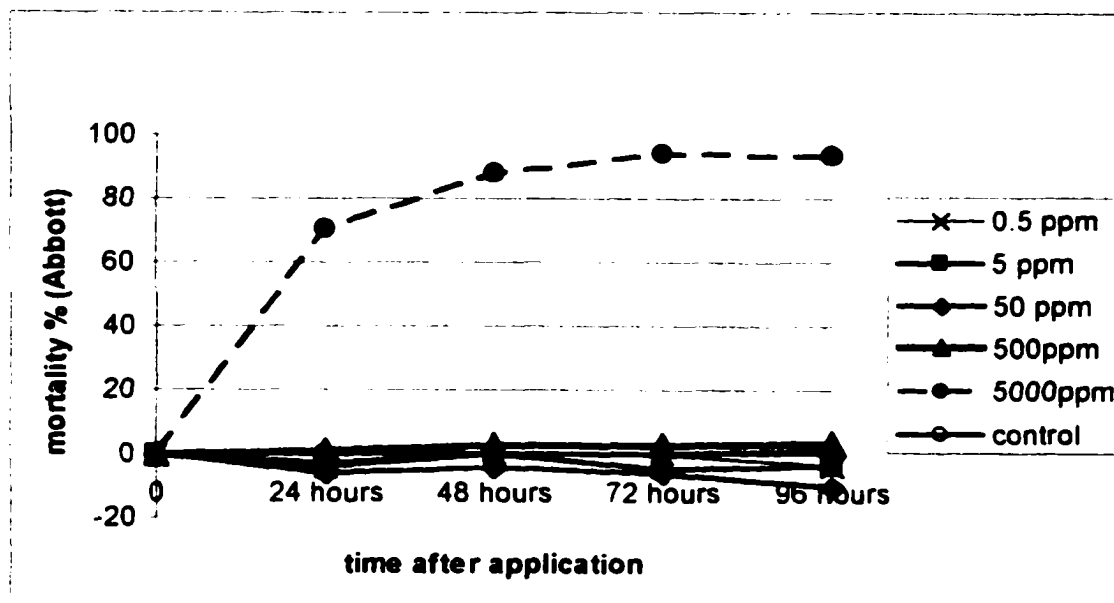
***Schinus molle* (Anacardiaceae)**

Collection voucher: *Orozco 117*

As a repellent, the leaves will be used to avoid the presence of flies (*Musca domestica* L.).

As insecticide, the leaves are used to control Homoptera insects that attack potato.

tomato, chili pepper, quinoa, pumpkin, tobacco, beans and lettuce.

Figure 3.11: *Schinus molle* mortality chart

Probit analysis

X^2 for Heterogeneity (calculated) = 0.533

X^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = 3.196906$

$\sigma = 0.322168$

$LC_{50} = 1556.412$ ppm

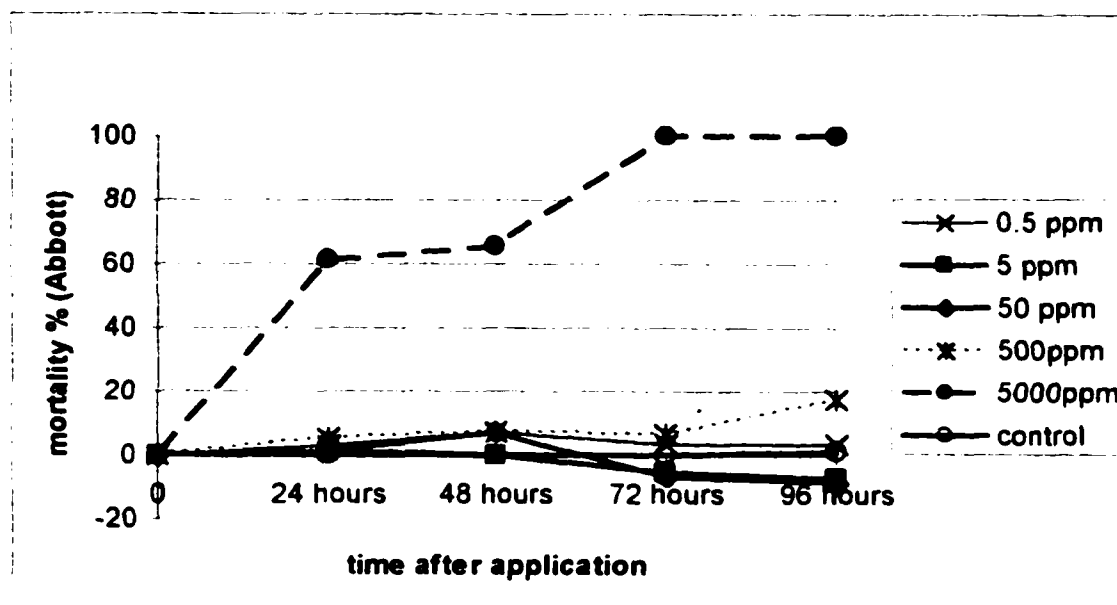
S.E. = ± 107.70 ppm

There is considerable mortality rate for the 5000 ppm dose with *S. molle*, and the observed line fits the expected. The mortality produced a LC_{50} of 1556 ± 107 ppm, which is high to be considered for practical applications. In the past, other authors have achieved high mortality and repellent activity using steam distillation of the leaves. Among the most active essential oils compounds that have been identified in *Schinus* spp. are thymol, citronellyl acetate and beta-caryophyllene (Guardiola, Miguel and Primo 1990). Good parts of these components are likely to be lost during the process of evaporation of the methanol, in this particular assay. This could be the reason for the poor performance of the extract.

***Lupinus mutabilis* (Fabaceae)**

Collection voucher: *Orozco 225*

The seed are boiled in abundant water, and that water is used later to treat tick and lice infestation on cattle, sheep and dogs.

Figure 3.12: *Lupinus mutabilis* mortality chart

Probit analysis

X^2 for Heterogeneity (calculated) = 4.011

X^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = 3.378872$

$\sigma = 5.404978$

$LC_{50} = 2392.609 \text{ ppm}$

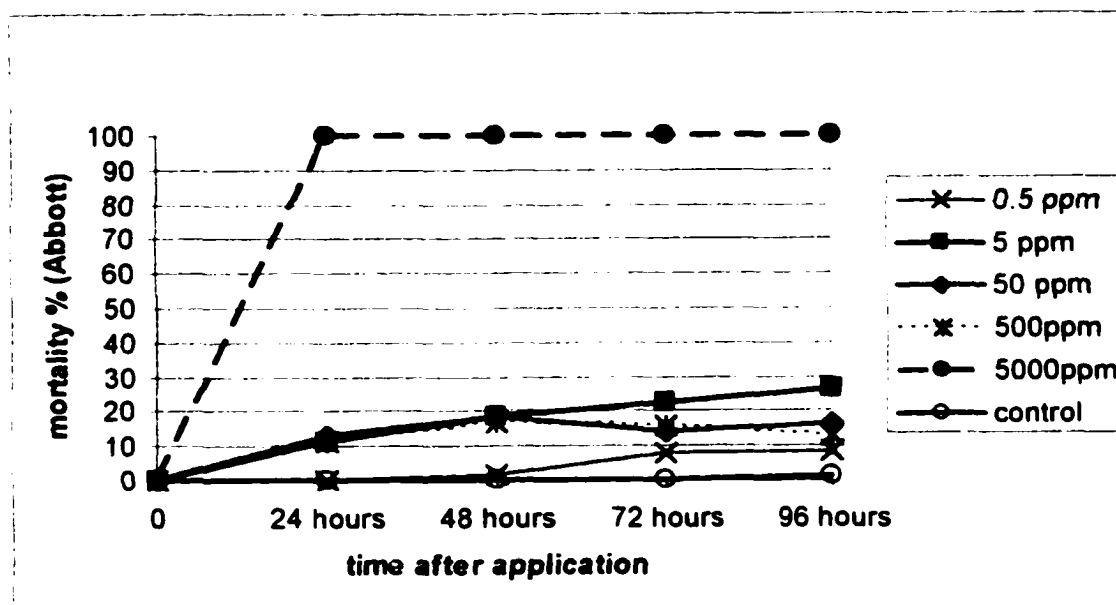
S.E. = $\pm 368.97 \text{ ppm}$

Seed extracts from *L. mutabilis* did not produce a notorious mortality with doses below 5000 ppm. Even at that high dose, it took 72 hours for the mortality to reach the 100% level. Despite that, the empirical data fits the expected probit (X^2 calculated < X^2 tabular value) and a LC_{50} of 2392 ± 368 ppm was established, although because of high variance, the dose is not reliable. There is abundance of information on the presence and nature of the quinolizidin alkaloids in *Lupinus*, but the activity of the compounds as insecticides have not been extensively tested

***Minthostachys mollis* (Lamiaceae)**

Collection voucher: *Orozco 226*

The irritant properties found in the essential oils of the leaves are used as repellent and to treat internal parasites in humans. The plant is particularly popular to protect potatoes during storage. The tubers are packed in *ichu* (*Stipa* sp.) grasses with liberal quantities of *M. tomentosa* or *M. mollis*, to repel insects that attack stored potatoes (*Premnotrypes solani*, *P. vorax*, and *P. latithorax*).

Figure 3.13: *Minthostachys mollis* mortality chart.

Probit analysis:

X^2 for Heterogeneity (calculated) = 29.037

X^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = 2.64628$

$\sigma = 1.902615$

$LC_{50} = 442.879$ ppm

S.E. = ± 177.37 ppm

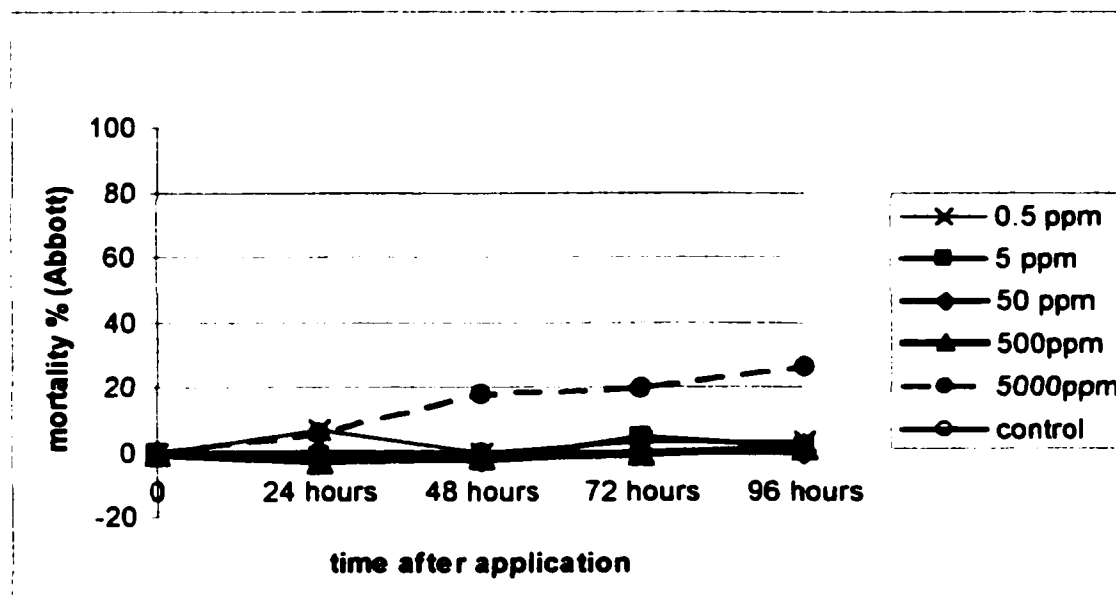
The analysis of the results for extracts from *M. mollis* leaves shows that tabular X^2 value exceeds the calculated X^2 value for heterogeneity. This is evidence that the probit model

may not be appropriate for these data. Although the 5000 ppm dose reached a mortality of 100% in the first 24 hours, all other doses produced inconsistent results. LC_{50} was calculated to be 442 ± 177 ppm, which is unreliable since the standard error surpasses 10%. In the past, other species of *Minthostachys* have been tested for larvicidal activity against *A. aegypti* larvae, using dichloromethane extracts. The results are labeled as useful in the search for new larvicidal natural compounds (Ciccia, Coussio and Mongelli 2000). It is known that components of the essential oils, (pulegone, menthone and isomenthone) are the source of the activity in the genus (Fournet, et al. 1996). Nevertheless, information regarding chemotypes and/or high variations in essential oil content depending on vegetative stage and conditions of collection, (Muñoz-Collazos, et al 1993) should be taken into account when for the analysis of the low performance in this particular assay. There is also the possibility of components being lost during the process of evaporation of the methanol.

***Nerium oleander* (Apocynaceae)**

Collection voucher: *Orozco 116*

Flowers and leaves from this tree are used to treat corn seed before planting as protection against insects like armyworms (Lepidoptera). Also to treat grain before storage, to protect against *Acanthoscelides obtectus*.

Figure 3.14: *Nerium oleander* mortality chart.

Probit analysis

X^2 for Heterogeneity (calculated) = 12.147

X^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = 4.44628$

$\sigma = 2.052615$

The results of the analysis for the application of extracts from *N. oleander* leaves and flowers show a tabular X^2 value that exceeds the calculated X^2 value for heterogeneity.

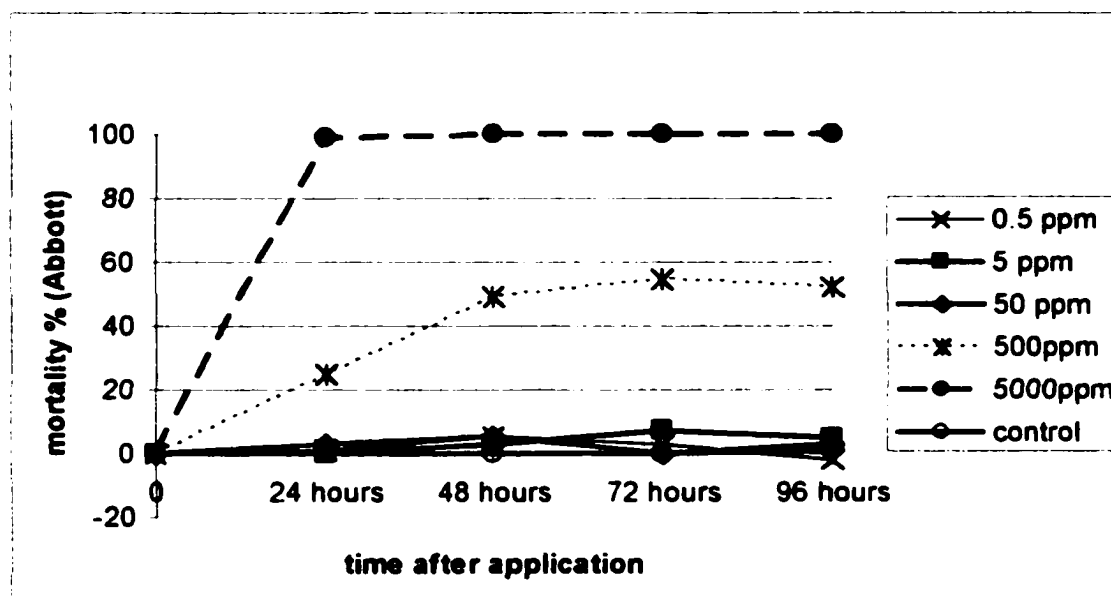
This is evidence that these data do not fit the probit model. All doses produced poor and

inconsistent results that represent a line with a slope not significantly different from zero; therefore, LC_{50} was calculated to surpass 10,000 ppm. In the past, *Anopheles stephensi* has also been tested for susceptibility to *N. oleander* extracts. The results show considerable larval mortality and interference with pupal-adult metamorphosis. At very low concentration, the active fractions of the plant extract extended the duration of the various larval instars and of pupation, suppressed oviposition and decreased adult longevity of the survivors. Morphogenic abnormalities were recorded in larval, pupal and adult stages, which were produced from treating instar II larvae with different concentrations of the extract (El-Shazly, Nassar and El-Sherief 1996). Because of the design of the present experiment, no information was gathered in terms of activity of the compounds, other than lethality. It is likely that in the field, the extract works by disturbing molting cycles, reducing oviposition and/or limiting the longevity of the adults.

***Nicotiana rustica* (Solanaceae)**

Collection voucher: *Orozco 201*

Leaves of *Nicotiana* are used as broad-spectrum insecticide, to control pest in foliage of potato and maize. It is also used to control armyworms (*Spodoptera frugiperda* Smith) and other Lepidoptera.

Figure 3.15: *Nicotiana rustica* mortality chart

Probit analysis

X^2 for Heterogeneity (calculated) = 0.796

X^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = 2.053945$

$\sigma = 5.83337$

$LC_{50} = 113.226 \text{ ppm}$

S.E. = $\pm 45.82 \text{ ppm}$

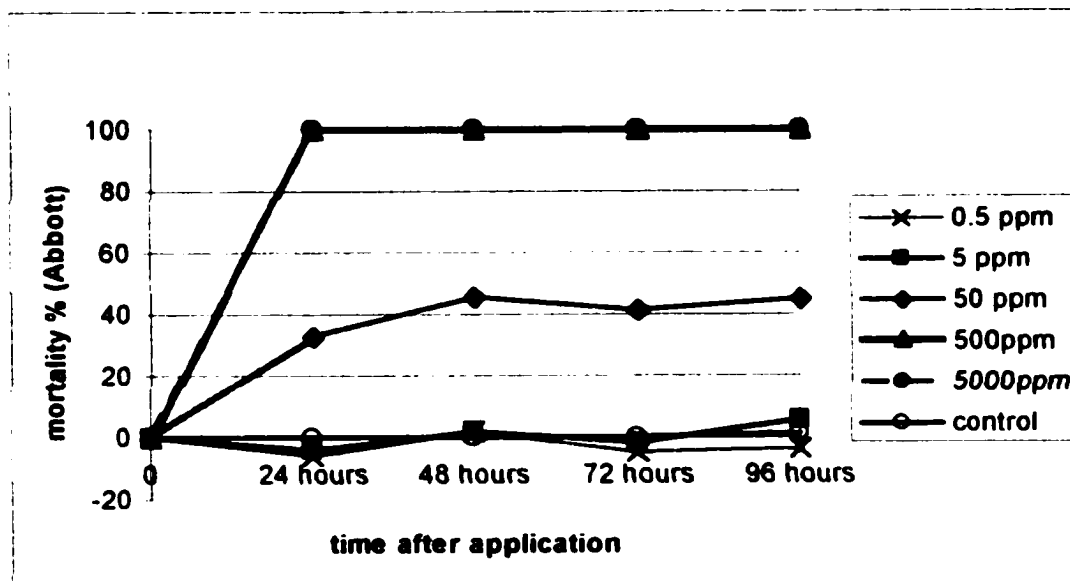
Extracts from *N. rustica* leaves showed bioactivity that is evident from the first 24 hours after the application when the mortality reaches 100% for the 5000 ppm dose. After that,

although the results are not so conspicuous for the other treatments, the line produced by the empirical data closely fits the expected, according to the calculated X^2 . The calculated LC_{50} is 113 ± 45 ppm, which is not too high, but the variance makes the dose not very reliable. In the past, experiments with extracts from *N. glauca* have show moderated results too for *A. aegypti* (Sathiyamoorthy, et al. 1997). This could be a sign that this particular organism is just not too sensitive to the alkaloids derived from *Nicotiana*.

***Otholobium glandulosum* (Fabaceae)**

Collection voucher: *Orozco 163*

The leaves of this shrub are used as a vermifuge, to treat intestinal parasite problems in humans.

Figure 3.16: *Otholobium glandulosum* mortality chart

Probit analysis

X^2 for Heterogeneity (calculated) = 0.801

X^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = 1.508331$

$\sigma = 3.30763$

$LC_{50} = 32.235$ ppm

S.E. = ± 10.05 ppm

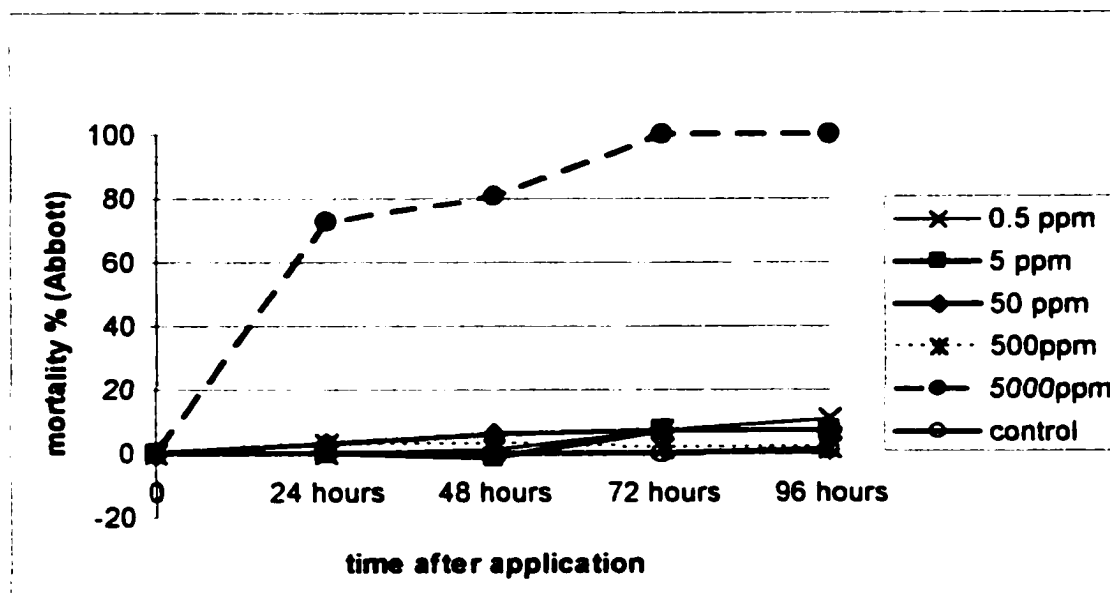
Extracts from *O. glandulosum* leaves showed bioactivity that is evident from the first 24 hours after the application when the mortality reaches 100% for the higher dose. After that, although the results are not conspicuous for the other treatments, the line produced

by the empirical data closely fits the expected, according to the calculated X^2 . The calculated LC_{50} is 32 ± 10 ppm, low enough to make this an interesting extract, although the variance is high, making the dose not very reliable. The results from this assay are better in terms of insecticidal power than those related by (Chesney and Adams 1985) with cyclohexane extracts. The low LC_{50} makes the species a candidate for more detailed studies.

***Phyllactis rigida* (Valerianaceae)**

Collection voucher: *Orozco 232*

Leaves and particularly roots of this plant are used to prepare a pesticide to protect potato crops from *Premnotrypes* spp. (Coleoptera).

Figure 3.17: *Phyllactis rigida* mortality chart.

Probit analysis

X^2 for Heterogeneity (calculated) = 2.794

X^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = 3.414590$

$\sigma = 2.135359$

$LC_{50} = 2597.707$ ppm

S.E. = ± 7974.52 ppm

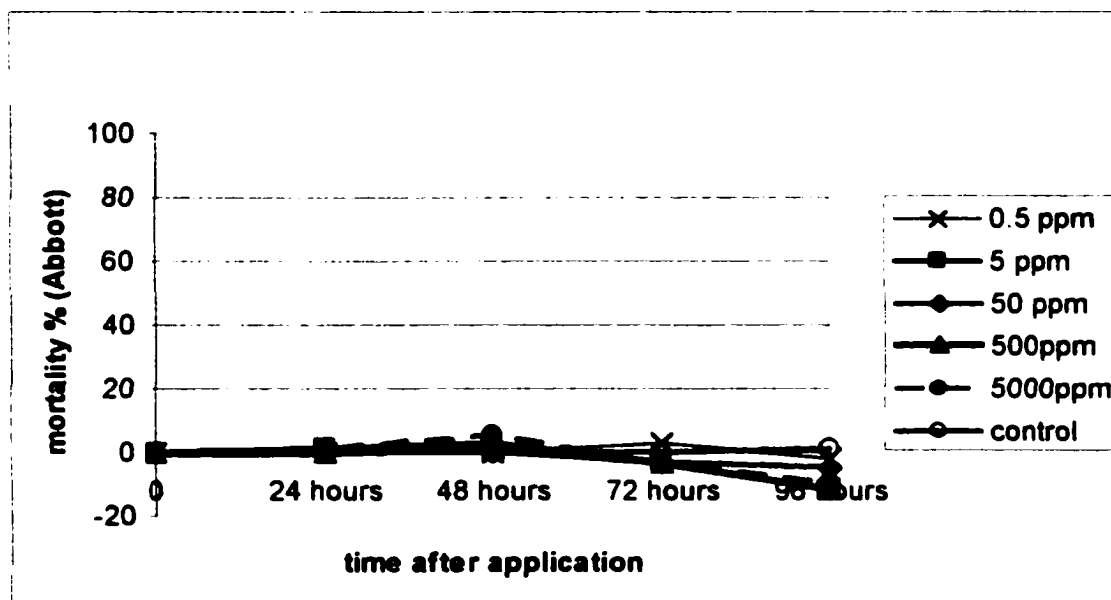
Root extracts from *P. rigida* did not produce a notorious mortality with doses below 5000 ppm. Even at that high dose, it took 72 hours for the mortality to reach the 100% level.

Despite that, the empirical data fits the expected probit (X^2 calculated < X^2 tabular value) and a LC_{50} of 2597 ± 7974 ppm was established, although because of high variance, the dose is not reliable. As of today, we do not have previous insecticidal assays to compare these results. The activity observed is likely due to the presence of iridoid monoterpenes that could be more prone to act as repellents rather than as insecticides. Some insects actually produce this kind of compound to be used as repulsive substance against their enemies (Veith, et al. 1994).

***Salix chilensis* (Salicaceae)**

Collection voucher: *Orozco 127*

A decoction of the leaves from this tree is used to keep away fleas (*Ctenocephalides* or *C. canis*) and to treat head lice (*Pediculus humanus*) infestation.

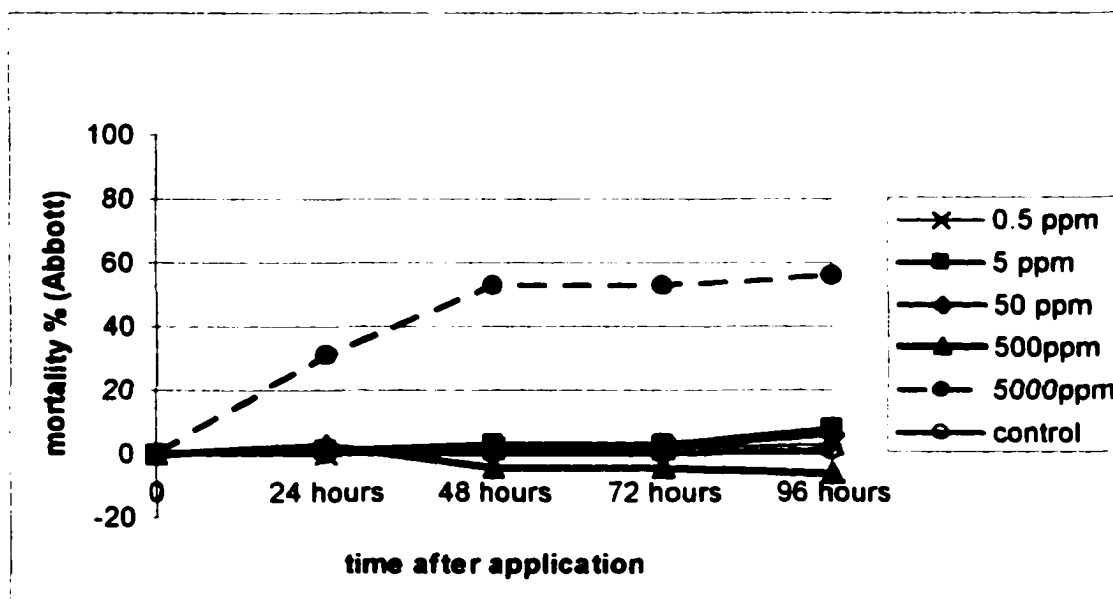
Figure 3.18: *Salix chilensis* mortality chart

Leaf extracts from *S. chilensis* showed no appreciable activity on this bioassay at any dose. The slope of the line produced by the data is not different from zero, and no LD_{50} was calculated. The results confirm the findings of previous authors where extracts of *Salix* had no positive results as insecticide (Atal, et al. 1978).

***Schkuhria pinnata* var. *pinnata* (Asteraceae)**

Collection voucher: *Orozco 182*

The plant (except the root) is boiled in abundant water and the decoction is used to sprinkle floors to ward off fleas (probably *Ctenocephalides felis* or *C. canis*).

Figure 3.19: *Schkuhria pinnata* var. *pinnata* mortality chart.

Probit analysis

X^2 for Heterogeneity (calculated) = 1.563

X^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = 4.04950$

$\sigma = 0.73133$

$LC_{50} = 5197.84$ ppm

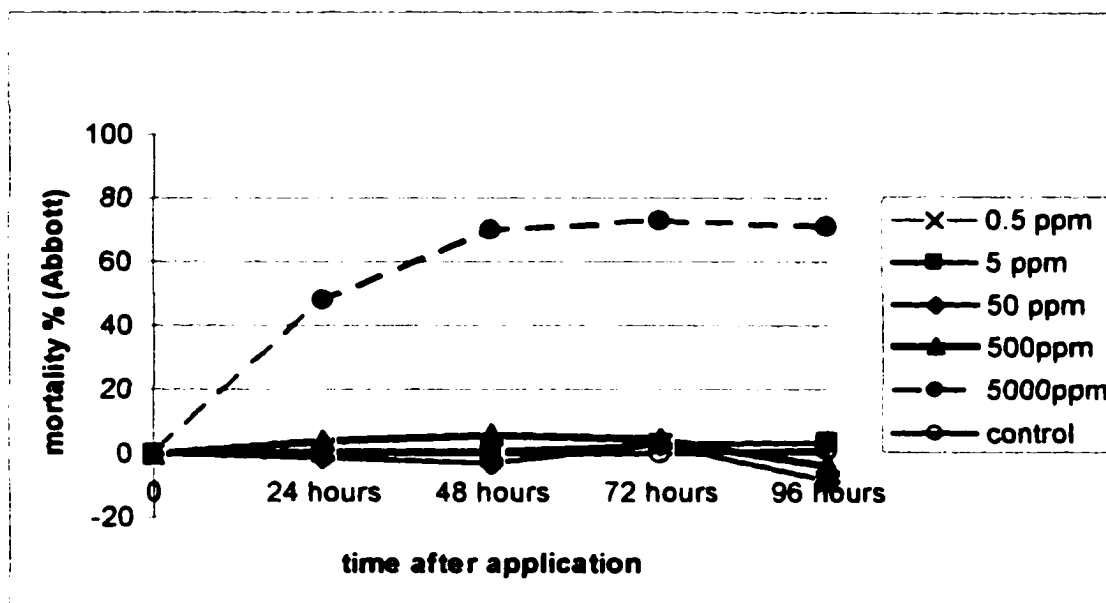
S.E. = ± 789.82 ppm

Leaf extracts of *S. pinnata* var. *pinnata* show activity that is appreciable only at the 5000 ppm dose. Below 5000 ppm, the activity resembles the absolute control, although the expected line fits the probit model. The activity observed should be attributed to the presence of sesquiterpene lactones. According to the literature, the effect of such compounds could be more as repellent than as insecticide (Novo, Viglianco and Nassetta 1997).

***Sicyos montanus* (Cucurbitaceae)**

Collection voucher: *Orozco 172*

The fresh leaves and stems of *S. montanus* are kept underneath bedding, as repellent for fleas (*Ctenocephalides felis* or *C. canis*).

Figure 3.20: *Sicyos montanus* mortality chart

Probit analysis

 X^2 for Heterogeneity (calculated) = 3.097

 X^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

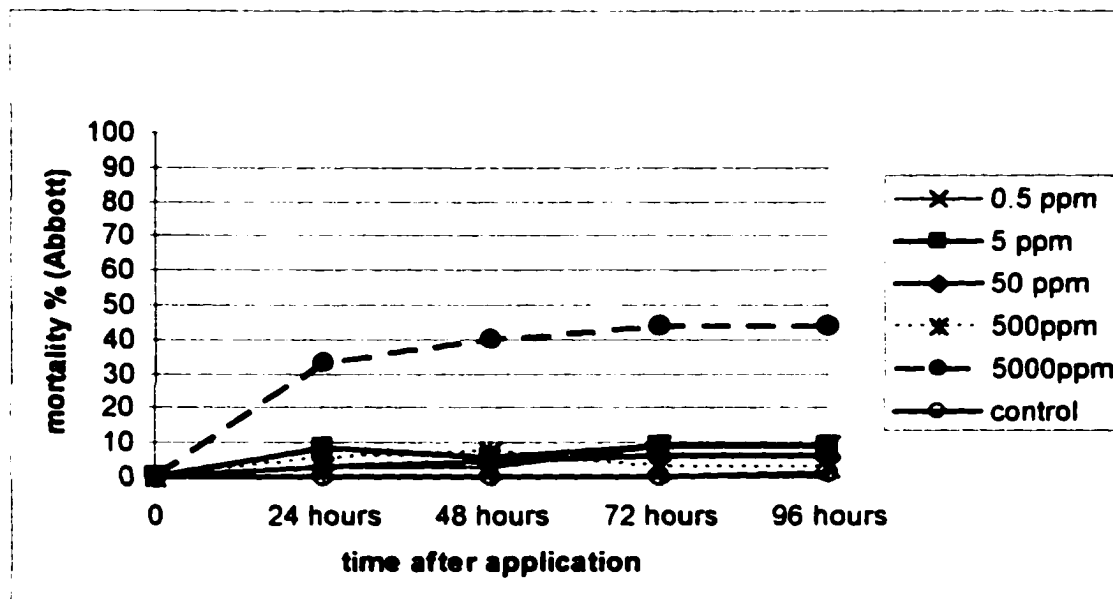
 $\mu = 3.42901$
 $\sigma = 0.348175$
 $LC_{50} = 2587.64 \text{ ppm}$
 $S.E. = \pm 189.62 \text{ ppm}$

Leaf extracts from *S. montanus* showed results when applied at 5000 ppm. The lower doses do not show appreciable results on the Abbott mortality chart. The line produced by the data fits the expected according to X^2 analysis but LD_{50} of 2587 ± 189 ppm is too high to be considered practical for application. The abundant presence of tetracyclic triterpenes and their glycosides (cucurbitacins) could account for the mortality in the high dose and for the actual reported activity in the field, as repellent. No insecticidal experiments are reported in the literature for this genus.

***Spartium junceum* (Fabaceae)**

Collection voucher: *Orozco 233*

The foliage is used in the storage of maize to repel insects, particularly, *Acanthoscelides obtectus*.

Figure 3.21: *Spartium junceum* mortality chart

Probit analysis

X^2 for Heterogeneity (calculated) = 0.821

X^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = 3.913849$

$\sigma = 0.703212$

$LC_{50} = 8200.66 \text{ ppm}$

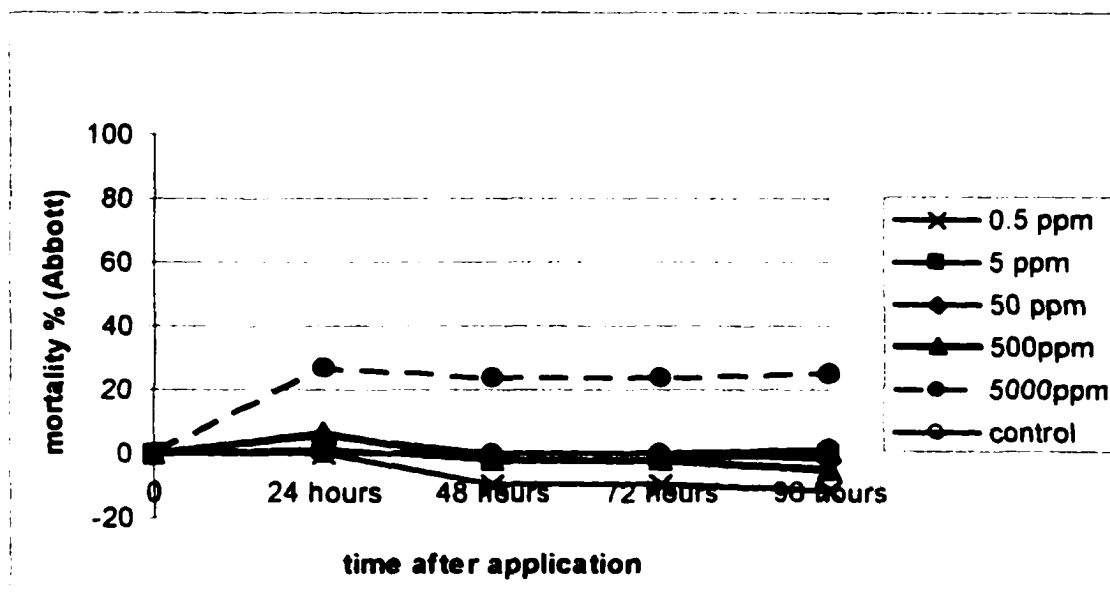
S.E. = $\pm 1212.88 \text{ ppm}$

Extracts from the aerial part of *S. junceum* showed results when applied at 5000 ppm, reaching over 40% of mortality. The lower doses do not show appreciable results on the Abbott mortality chart. Although the line produced by the data resembles the expected, the LD₅₀ calculated even exceeds 8000 ppm making it not practical for application. The pesticidal activity of the plant has not been tested in the past

***Verbena littoralis* (Verbenaceae)**

Collection voucher: *Orozco 131*

The stems and leaves of the plant are used to keep away fleas (*Ctenocephalides felis* or *C. canis*). This can be done by sweeping the floors with brooms made of the stems or by boiling the leaves and stems and washing the floors with the decoction.

Figure 3.22: *Verbena littoralis* mortality chart.

Probit analysis

X^2 for Heterogeneity (calculated) = 3.722

X^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = 5.289361$

$\sigma = 1.776914$

$LC_{50} = 7134.87$ ppm

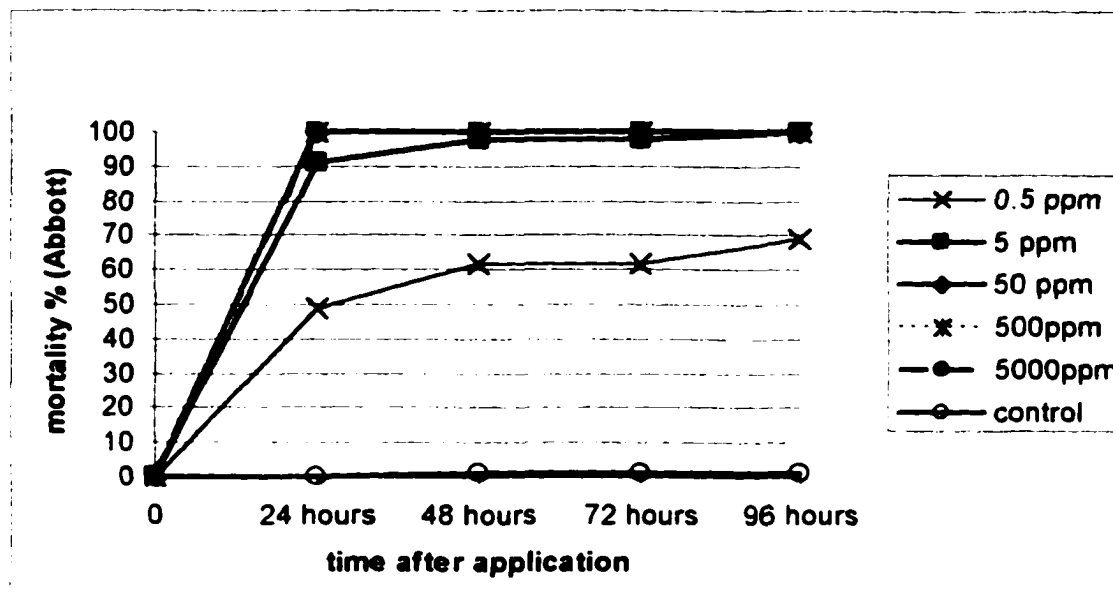
S.E. = ± 2617.80 ppm

Extracts from the aerial part of *V. littoralis* showed results when applied at 5000 ppm, reaching over 20% of mortality. The lower doses do not show appreciable results on the Abbott mortality chart. Although the line produced by the data resembles the expected, the LD₅₀ is too high to be considered applicable (>7000 ppm). Although *V. littoralis* has not been the object of this kind of trial before, results in a related species, *V. hastata* L., resulted positive for insecticidal activity against *Culex quinquefasciatus* (Hartzell and Wilcoxon 1941). The phytochemical origin of the activity can be traced to the presence of iridoid monoterpenes (Damtonft, Jensen and Nielsen 1979) that are probably not benefited with the specific conditions of the extraction in this assay.

Positive control Pyrethrins (*Chrysanthemum* sp. Asteraceae)

This extract was obtained from a commercial botanical consisting of dried *Chrysanthemum* sp. flowers. Pyrethrin compounds have been used primarily to control human lice, mosquitoes, cockroaches, beetles and flies (Sugavanam and Tianjian 1999)

Figure 3.23. Pyrethrins mortality chart.



Probit analysis.

X^2 for Heterogeneity (calculated) = 0.000

X^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = -0.148191$

$\sigma = 2.47993$

$LC_{50} = 0.711 \text{ ppm}$

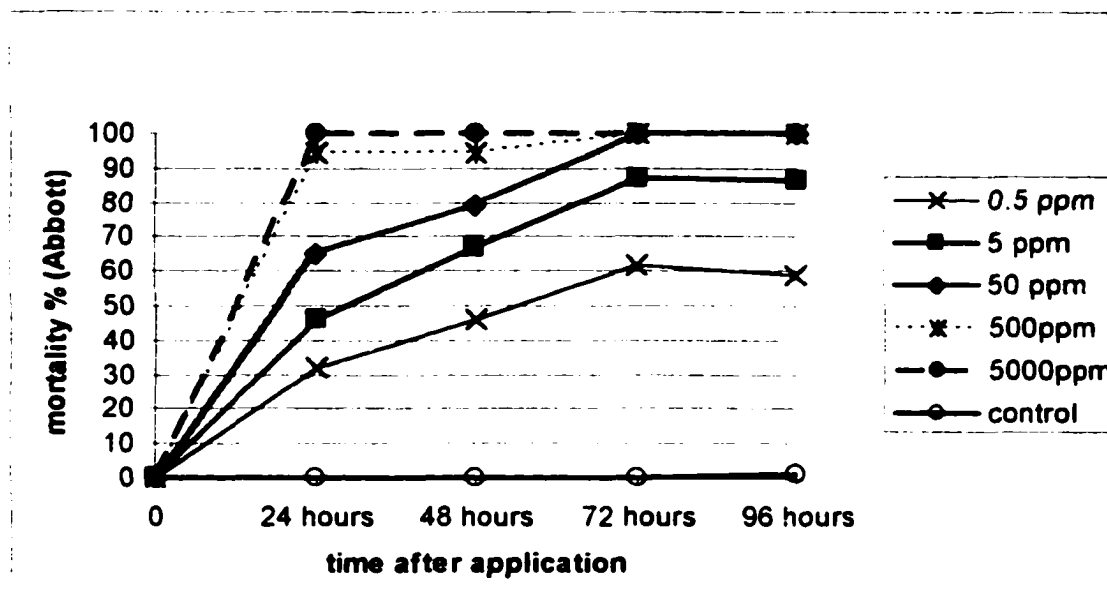
S.E. = $\pm 0.059 \text{ ppm}$

Extracts from *Chrysanthemum* flowers, sold commercially as pesticides, showed excellent results. The bioactivity is evident from the first 24 hours after the application and the mortality is 100% for all doses, except at 0.5 ppm. The calculated LC_{50} of 0.7 ± 0.05 ppm resembles what is estimated for a commercial pesticide (McLaughlin and Rogers 1998) and the adjustment of the empirical data to the expected line is perfect, according to the χ^2 analysis. One of the important messages of these results is the fact that a well adjusted curve and a highly dependable dose were achieved, confirming the reliability of the testing methods: the extraction as well as the YFM bioassay. Besides, this gives opportunity to observe similarities in the tendency of response with the treatments that had good results.

Positive control Rotenone

As suggested by McLaughlin and Rogers (1998) in the protocol for the YFM bioassay, rotenone was used as a positive control. The substance did not required of extraction, since the material used was pure rotenone 95-98% from Sigma. Rotenone is a non-specific botanical insecticide with some acaricidal properties. Rotenone-containing products are typically used in home gardens for insect control, for lice and tick control on pets and for fish eradications as part of water body management.

Figure 3.24: Rotenone mortality chart.



Probit analysis

χ^2 for Heterogeneity (calculated) = 0.496

χ^2 for Heterogeneity (tabular value at 0.05 level) = 7.815

$\mu = -0.516733$

$\sigma = 0.951732$

$LC_{50} = 0.304 \text{ ppm}$

S.E. = $\pm 0.067 \text{ ppm}$

Pure rotenone dissolved in methanol produced a mortality of 100% for all doses above 50 ppm. The calculated LC_{50} of $0.3 \pm 0.06 \text{ ppm}$ confirms the toxicity of the material. The

adjustment of the empirical data to the expected line is high too, according to the X^2 analysis. The value of these results is the fact that a well adjusted curve and a highly reliable dose were achieved, confirming the consistency of the YFM bioassay. Besides, this gives opportunity to observe similarities in the tendency of response with the treatments that had good results

Table 3.3: Summary of YFM bioassay results.**

Family	Scientific name	Voucher*	LC ₅₀ ppm	Bioactivity YFM
Fabaceae	<i>Apurimacia boliviana</i> (Britton) Lavin	203	0.84±0.14	active
Euphorbiaceae	<i>Euphorbia huanchahana</i> Boiss	228	30±5	active
Fabaceae	<i>Otholobium glandulosum</i> (L.) Grimes	163	32±10	active
Solanaceae	<i>Nicotiana rustica</i> L.	115	113±45	moderate
Lamiaceae	<i>Minthostachys mollis</i> Griseb.	226	442±177	moderate
Myrtaceae	<i>Eucalyptus globulus</i> Labill.	132	953±86	moderate
Solanaceae	<i>Cestrum peruvianum</i> Roem. & Schult.	218	1525±1027	weak
Anacardiaceae	<i>Schinus molle</i> L.	117	1556±107	weak
Fabaceae	<i>Lupinus mutabilis</i> Lindl.	225	2392±368	weak
Asteraceae	<i>Ambrosia arborescens</i> Mill	126	2520±350	weak
Cucurbitaceae	<i>Sicyos montanus</i> Poepp. & Endl.	172	2587±189	weak
Valerianaceae	<i>Phyllactis rigida</i> (Ruiz & Pav.) Pers.	232	2597±7974	weak
Apiaceae	<i>Foeniculum vulgare</i> Mill.	138	2862±194	weak
Cucurbitaceae	<i>Cucumis dipsacens</i> Ehrenb. ex Spach	184	3829±327	weak
Solanaceae	<i>Capsicum pubescens</i> Ruiz & Pav.	122	4111±352	weak

*All numbers are O. Orozco collections

** Ordered by lowest LD₅₀ to highest

Family	Scientific name	Voucher*	LC₅₀ ppm	Bioactivity YFM
Asteraceae	<i>Schkuhria pinnata</i> (Lam.) Cabrera	182	5197±1789	weak
Verbenaceae	<i>Verbena litoralis</i> H.B.K	131	7134±2617	weak
Fabaceae	<i>Spartium juncetum</i> L.	149	8200±1212	weak
Rutaceae	<i>Citrus aurantium</i> L.	183	>10,000	inactive
Equisetaceae	<i>Equisetum giganteum</i> L.	118	>10,000	inactive
Apocynaceae	<i>Nerium oleander</i> L.	116	>10,000	inactive
Salicaceae	<i>Salix chilensis</i> Molina	127	>10,000	inactive

CHAPTER 4. DISCUSSION

COMPARISON AMONG LOCALITIES

As stated in the introductory chapter, it was evident from field notes that there was a relationship between altitude and the conservation of traditional culture in the Cajamarca area. According to observations regarding the use of traditional costumes and the use of the Quechua language, the higher the area, the better traditions seemed to be preserved. To clarify this condition in terms of the number of species reported in each area, Figure 4.1 shows a comparison of plants reported as toxic to humans, plants reported as toxic to animals, and botanical pesticides, based on reports by informants. Figure 4.2 shows the number of medicinal plants reported in each area. Concerning the knowledge of plants in each community, there is an increasing number of medicinal and toxic species reported in the *kechwa* and *jalca* areas. In fact, the number of reports is twice that collected from the *chala* and *yunga* areas.

Figure 4.24: Toxic plants and botanical pesticides collected by ecological zone.

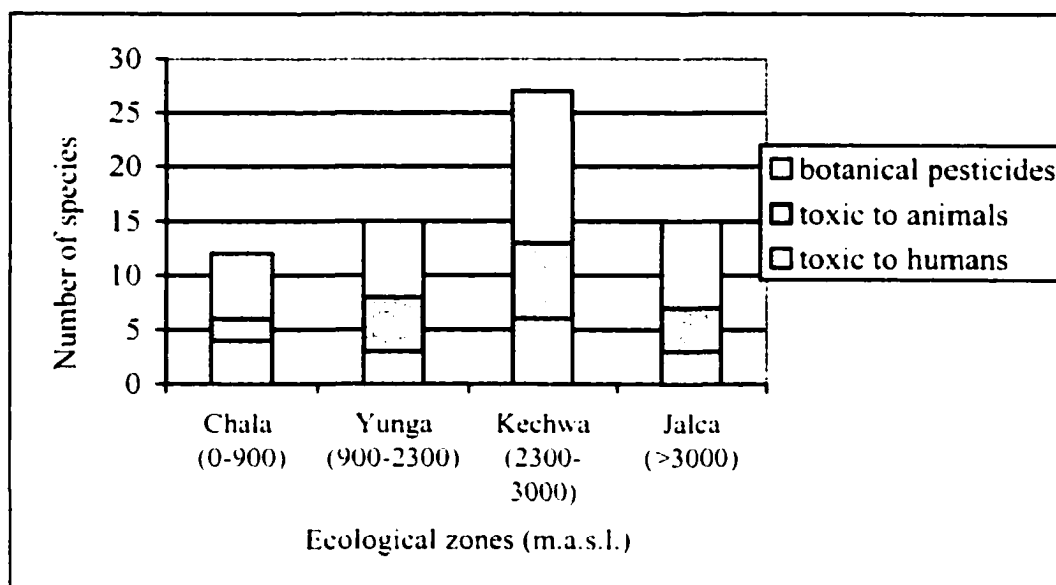
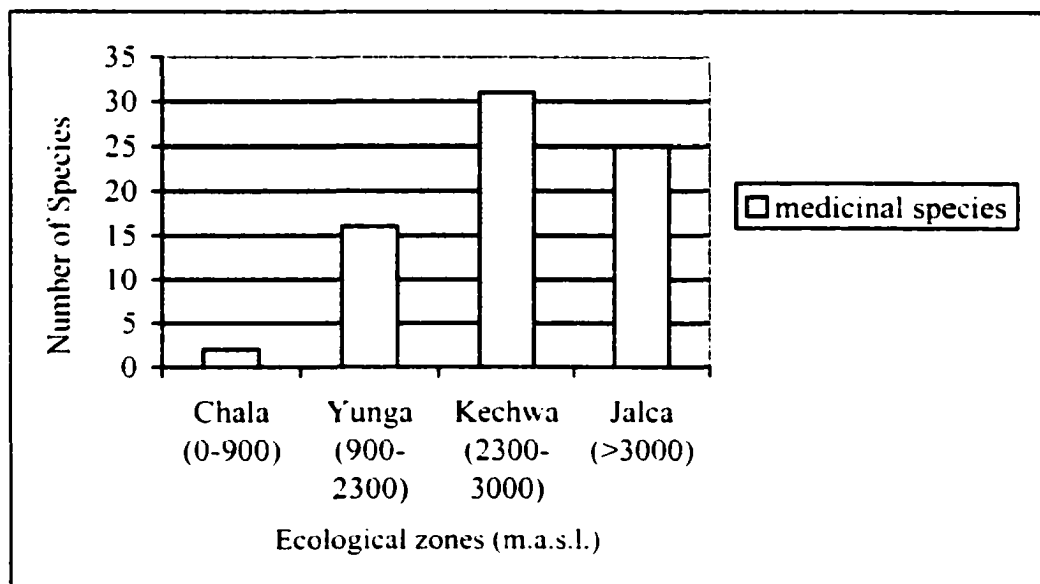


Figure 4.25: Medicinal plants collected by ecological zone.



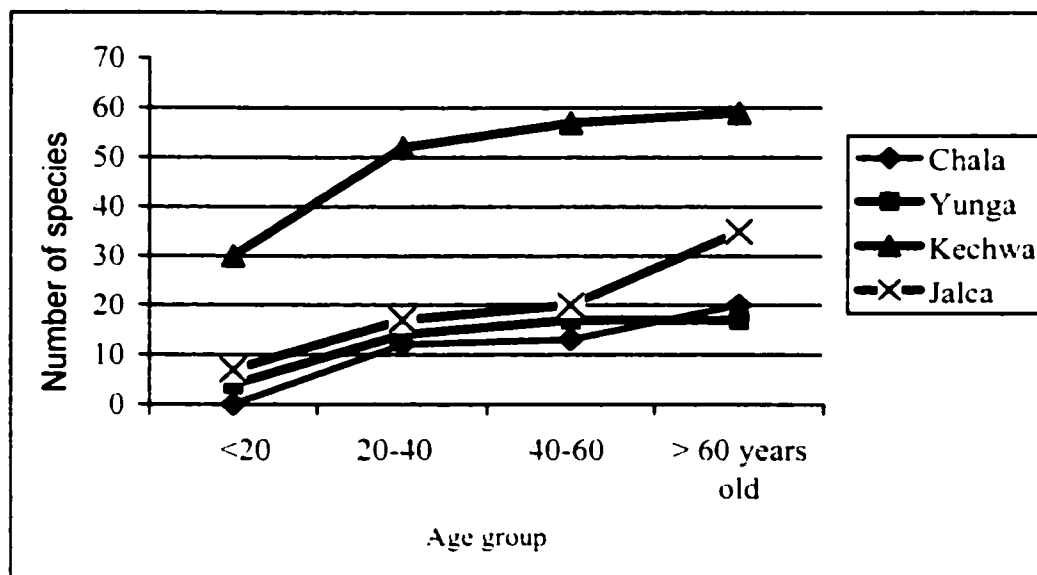
To observe a possible relationship between altitude and the knowledge that people have about plants, a multiplicity of factors playing a role in this process must be considered. To start, the overall diversity of the floras in the different ecological regions sets different preliminary conditions for each community. A full checklist of the flora of each area is not available, but an approximation is possible by extrapolating data from the most recent available catalogue of flora in the adjacent area, which is the Catalogue of the vascular plants of Ecuador by Jorgensen and León-Yáñez (1999). Although similar work exists for Peru (the Catalogue of the Flowering Plants and Gymnosperms of Peru by Brako and Zarucchi (1993), in terms of ecology and biodiversity, Cajamarca has a greater resemblance with the neighboring country of Ecuador than with Peru as a whole. Moreover, the Ecuadorian catalogue is more recent, including data from the last 10 years, which have been very active in terms of collecting the area. Using Jorgensen and León-Yáñez's records (1999: 71), the amount of species that is possible to expect in each area was established. This theoretical figure was calculated by adding the expected numbers of species to be found in 1000 km^2 for each transect of 500 m in altitude. Given that the most marked difference in the amount of plants reported during interviews occurred when comparing the area above and below 2000 m, a comparison with the expected number of species for these two areas was considered. In the area below 2000 m, the expected number of species to be found per 1000 km^2 is 705, versus the amount to be expected above 2000 m, which is 699. Although this is a very speculative approach, these figures

suggest that differences in the amount of plants used by informants in the different areas, might not be related to the flora size.

Furthermore, ecological conditions also determine the kind and amount of agricultural activity and therefore, the size of the population living in each ecological region. In Figures 4.1 and 4.2 the bar decreases for the *jalca* because above 3000 m the population declines. There, the possibilities for agriculture are reduced due to climatic conditions, therefore, fewer people were interviewed and less information was gathered than in more populated areas in the *kechwa* and *yunga*.

Another factor in this analysis is the age of informants. Figure 4.3 shows the relationship between age of informants and number of plants reported. As could be expected, people over the age of 60 reported more species than other age groups. Average age of informants in *chala* was 38 ($\sigma = 14$), in *yunga* 45 ($\sigma = 14$), in *kechwa* 39 ($\sigma = 21$) and in *jalca* 41 ($\sigma = 15$). A T-test comparing the average age in the different areas revealed no significant difference for any of the zones (all significance values above 0.05). Figure 4.3 shows that there is no noteworthy difference between the knowledge of individuals in their 30's and 40's in each of the ecological areas studied in Cajamarca. All these elements lead to the conclusion that age of the informants in the different areas did not play a role in the different numbers of reports received.

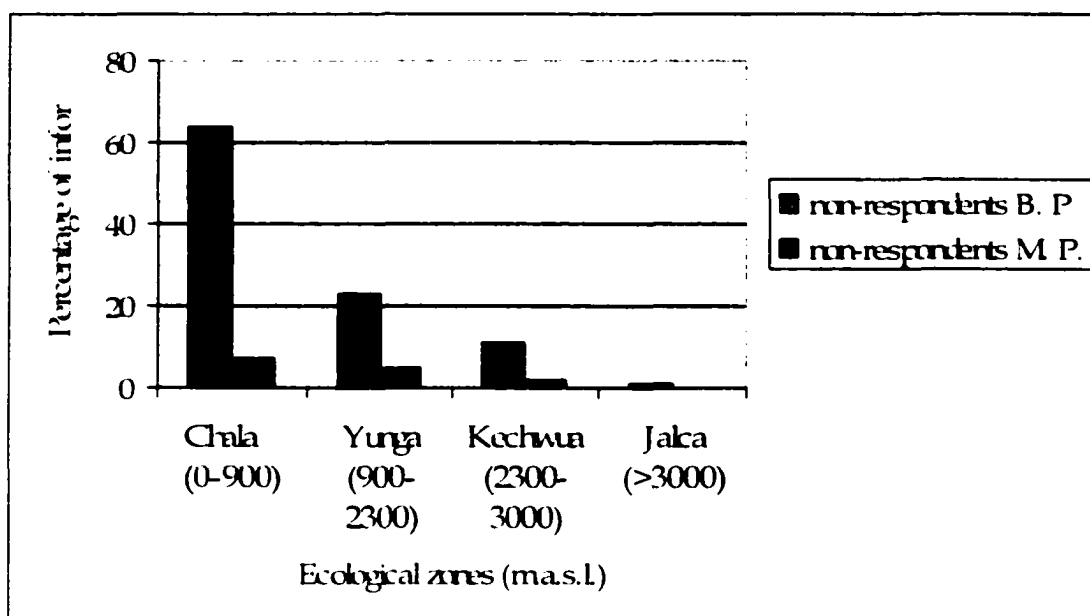
Figure 4.26: Age of informants vs. number of species of plants reported.



The key for explaining the differences between the number of collections in each ecological zone, without falling into discrepancies with flora size or demographic elements, could be found in Fig. 4.4. This chart illustrates the percentage of interviewees who claimed not to have any answers regarding toxic or medicinal plants. They were classified as non-respondents (this category does not include people who refused to be interviewed --about 5% of people approached). The analysis suggests that people living in lower slopes of the Cajamarca Andes have a more pronounced degree of cultural erosion regarding ethnobotanical knowledge than people inhabiting the highlands do, given the fact that 64% of the people interviewed there, claimed not to have any knowledge on the topic of toxic plants. The percentage of people stating not to have answers for questions

regarding botanical pesticides, starts progressively diminishing, being just 1% in the *jalca* area. In the lowlands, people live in closer contact with the industrialized sector of the economy, have better access to transportation and depend less on agriculture for economic survival. All these could be listed as possible reasons to explain the condition found in this study. The analysis of Fig. 4.4 suggests not only that the lowlands have suffered a more pronounced loss of knowledge than the highlands but also that the lost of knowledge has been more pronounced for botanical pesticides than for medicinal plants. The percentage of people classified as non-respondents in reference to medicinal plants is small even in the lower areas (in *chala* area is only 7%) and this group shrinks to be non-existent in the *jalca* area.

Figure 4.27: Percentage of non-respondents by ecological zone, regarding botanical pesticides (B.P.) and medicinal plants (M.P.).



Medicinal plants seem to have a better status in the collective knowledge of the communities of Cajamarca. Another confirmation of this condition comes from observations in herb markets, which were part of the strategy for identifying useful plants.

For four months, visits to the herb markets in Cajamarca city, Jesús, Sorochuco, San Pablo and Chilete provide information on the plants commercialized by 18 different merchants. All reports collected from them were related to medicinal plants. Although some of the merchants knew about plants used as pesticides, these were not part of their merchandise. It is expected that if a plant is recognized as effective in treating a particular

condition, the species will be commercialized and/or “exported” to other geographic areas. This was not the case for botanical pesticides. Plants like *Equisetum giganteum* were sold because of medicinal properties (to treat kidney problems), not because of the acaricidal effect. *Capsicum pubescens* and *Minthostachys* spp. were ubiquitous in markets as food items, not as repellents or pesticides.

The lack of commercial value for plants with toxic properties can be interpreted as an indicator of the significance people assign to a given problem. Medical conditions are important enough to deserve a trip to the market and to pay cash for the goods.

Problems regarding infestations in crops or households seem to have less urgency than medical or even emotional problems. Another factor is consensus among the users. As it will be discussed later in this chapter, agreement about plants used as medicinals is more common among the communities than knowledge about plants used as pesticides.

Certainty about some medicinals results in people adopting and importing these non-local plants to treat specific illnesses. Plants used for toxic properties can also have widespread use among two or three communities or areas, but no cases were found where people imported plants from far away areas in order to treat problems of infestations.

Regarding the presence of the same species in different ecological areas, it is possible to say that toxic plants that were frequently reported were found also to have wide distribution among

the different communities (see Table 4.1.) These plants were collected from two or more contiguous ecological regions. In that sense, the plant that enjoys the highest grade of recognition as a botanical pesticide and repellent in the Cajamarca area is *Capsicum pubescens*, which was reported in all of the four areas of study. Even in zones where the cultivation of the plant would be restricted by ecological conditions, people knew about the pesticidal properties of this species. It is interesting though, that in areas where the fruits of this plant cannot be produced, the informants reported buying the peppers but never with the intention of using them as pesticides, only as an indispensable food item.

Regarding the uses given to a particular plant in different ecological areas, data from Table 4.1 suggest that even when plants have wide distributions, their uses are similar in the different areas with very few exceptions. The most notorious is the use of *Nerium oleander* as a pesticide in the higher elevations and as a treatment for foot dermatitis produced by fungi in the lower areas. Very likely the explanation is that foot dermatitis is a condition associated with high levels of humidity and high temperatures. These conditions will not be easily found at high altitudes. Therefore, *Nerium* is used as fungistatic by people living in the *chala* and *yunga*, but this characteristic is not reported by people living in the *kechwa* zone

Table 4.1. Presence and use of botanical pesticides in different ecological areas. **

Family	Scientific name	Voucher*	Use	Chala	Yunga	Kechwa	Jalca
Solanaceae	<i>Capsicum pubescens</i> Ruiz & Pav.	122	pesticide	X	X	X	X
Solanaceae	<i>Capsicum pubescens</i> Ruiz & Pav.	122	repellent	X	X	X	X
Solanaceae	<i>Nicotiana tabacum</i> L.	115	pesticide	X	X	X	
Solanaceae	<i>Nicotiana rustica</i> L.	115	pesticide	X	X	X	
Apocynaceae	<i>Nerium oleander</i> L.	116	pesticide	X	X	X	
Myrtaceae	<i>Eucalyptus globulus</i> Labill.	132	repellent		X	X	X
Anacardiaceae	<i>Schinus molle</i> L.	117	repellent		X	X	X
Apocynaceae	<i>Nerium oleander</i> L.	116	fungicide	X	X		
Anacardiaceae	<i>Schinus molle</i> L.	117	pesticide		X	X	
Asteraceae	<i>Ambrosia arborescens</i> Mill.	126	pesticide		X	X	
Asteraceae	<i>Ambrosia arborescens</i> Mill.	126	repellent		X	X	
Asteraceae	<i>Ambrosia arborescens</i> Mill.	126	vermifuge		X	X	
Equisetaceae	<i>Equisetum giganteum</i> L.	118	pesticide		X	X	
Fabaceae	<i>Lupinus mutabilis</i> Lindl.	225	pesticide			X	X
Lamiaceae	<i>Minthostachys mollis</i> Griseb	226	vermifuge			X	X
Rutaceae	<i>Citrus aurantium</i> L.	183	pesticide	X			
Rutaceae	<i>Citrus aurantium</i> L.	183	repellent	X			

Family	Scientific name	Voucher*	Use	Chala	Yunga	Kechwa	Jalca
Asteraceae	<i>Schkuhria pinnata</i> (Lam.) Cabrera	182	repellent	X			
Cucurbitaceae	<i>Cucumis dipsaceus</i> Ehrenb. Ex Spach	184	pesticide		X		
Solanaceae	<i>Cestrum peruvianum</i> Roem. & Schult.	218	vermifuge			X	
Cucurbitaceae	<i>Sicyos montanus</i> Poepp. & Endl.	172	repellent			X	
Verbenaceae	<i>Verbena litoralis</i> H.B.K	131	repellent			X	
Fabaceae	<i>Otholobium glandulosum</i> (L.) Grimes	163	vermifuge			X	
Fabaceae	<i>Spartium junceum</i> L.	149	repellent			X	
Fabaceae	<i>Apurimacia boliviana</i> (Britton) Lavin	203	pesticide			X	
Fabaceae	<i>Apurimacia boliviana</i> (Britton) Lavin	203	vermifuge			X	
Lamiaceae	<i>Foeniculum vulgare</i> Mill.	138	vermifuge			X	
Salicaceae	<i>Salix chilensis</i> Molina	127	repellent			X	
Fabaceae	<i>Lupinus arvensis</i> Benth.	189	pesticide				X
Euphorbiaceae	<i>Euphorbia huanchahana</i> Boiss	228	vermifuge				X
Valerianaceae	<i>Phyllactis rigida</i> (Ruiz & Pav.) Pers	232	pesticide				X
Valerianaceae	<i>Phyllactis rigida</i> (Ruiz & Pav.) Pers.	232	repellent				X

*All numbers are O. Orozco collections

** ordered according to presence in four, three, two or one region.

ACTUAL USE OF BOTANICAL PESTICIDES IN THE CAJAMARCA AREA

As mentioned in the methodology, the research includes data only from reports on plant applications directly used or witnessed by an informant in the past. This method resulted in an increased range of detail in the information given by informants and reduced the number of uncertain reports, providing more reliable results at field level. It also allowed determining the proportion of informants actually using the species reported and the proportion that just mentioned the plant because it was used in the past by themselves or by members of their family circle. According to this information, all plants reported as medicinal have current application. For every plant collected, the informants reported to have used it in the recent past or to be eager to use it in the future if they need it. A very different situation was found with the plants reported as botanical pesticides or repellents. In this case only 25% of the reports corresponded to plants currently used by the informants. All others were practices used or witnessed in the past (most cases more than 10 years), but now fallen out of use. This data is a new confirmation of the fact that the knowledge about botanical pesticides in the Cajamarca area has been disappearing and that traditional medicine has a better chance of survival in the collective memory of the community.

EMPIRICAL VALUE OF INFORMATION: CONSENSUS VS. EFFECTIVENESS

Once the data was collected, additional parameters were included in order to determine validity of information. Consensus or the agreement among the informants on the use of a plant was taken into account by analyzing the number of coincident reports for each plant. Furthermore, an exhaustive literature review on phytochemistry and bioactivity reported for medicinal and toxic plants was also included. The last step on the verification of the species' effectiveness was the test of the methanolic extracts with the yellow fever mosquito bioassay.

It is expected that the knowledge of the community is based on empirical results, and consequently, the scientific literature should corroborate the activity for those plants studied. Table 4.2 compares the uses of medicinal plants the community recognizes, with the number of field reports gathered in this project for each particular plant use. This information is complemented with the scientific literature available concerning phytochemistry or bioactivity specific to the reports. Table 4.3 gathers the information pertinent to agreement among members of the community on the recognition of toxic plants and literature review, and Table 4.4 provides information about consensus on plants used as pesticides and availability of scientific literature that corroborates the claims of the informants. It should come as no surprise that a large percentage of the species are not

mentioned in the formal literature regarding chemical composition or bioactivity. In general, only 60% of the plants reported have been formally tested with clinical trials, bioassays, or their chemical composition analyzed (see Table 3.1, which includes mention of the plants in the literature, although not necessarily related or confirming the use or activity proposed by the informants of this study). For toxic plants, 55% of the reports have scientific literature directly related to the bioactivity described by the informants. For medicinals, only 32% have a report directly related to the claimed activity. For plants used as pesticides and/or repellents in Cajamarca, 70% are known by scientific trials. Although the number of botanical pesticides or repellents reported in scientific literature seems to be high, the two species with the highest bioactivity levels recorded in the laboratory as a part of this study with the yellow fever mosquito bioassay have not been scientifically tested regarding their bioactivity or chemical composition. For the specific literature and field reports of each plant, see the results section in Chapter 3.

Table 4.2: Comparison of agreement on use of medicinal plants in the community and corroboration of activity in scientific literature. **

Family	Scientific name	Voucher*	Activity / used to treat	# Field Reports	Scientific Literature
Malvaceae	<i>Malva parviflora</i> L.	137	stomach and liver problems	12	Grierson and Afolayan 1999
Myrtaceae	<i>Eucalyptus globulus</i> Labill.	132	wounds, bruises and sprains	12	Aswal, et al. 1984; Srinivasan, et al. 2001
Myrtaceae	<i>Eucalyptus globulus</i> Labill.	132	colds, cough and chest congestion	12	Ikawati, Wahyuono and Maeyama 2001; Aswal, et al. 1984; Srinivasan, et al. 2001
Plantaginaceae	<i>Plantago major</i> L.	130	wounds	11	Guillen, et al. 1997; Nikol'skaya 1954; Ravn and Brimer 1988
Solanaceae	<i>Nicotiana tabacum</i> L.	115	rheumatism	10	N/A
Urticaceae	<i>Urtica urens</i> L.	197	rheumatism and arthritic pain	10	Czernetzki, Thiele and Rosenbach 1990; Kavalali and Tuncel 1997; McCaleb 1998; Schulze-Tanzil, et al. 2002
Urticaceae	<i>Urtica urens</i> L.	197	bruises and sprains	10	Czernetzki, Thiele and Rosenbach 1990; Kavalali and Tuncel 1997; McCaleb 1998; Schulze-Tanzil, et al. 2002
Equisetaceae	<i>Equisetum giganteum</i> L.	118	diuretic	8	Caceres, et al 1987; Pérez, et al. 1985

** ordered by highest to lowest number of field reports

Family	Scientific name	Voucher*	Activity / used to treat	# Field Reports	Scientific Literature
Piperaceae	<i>Piper aduncum</i> L.	143	cold and flu	8	Cáceres, et al. 1995; Lentz, et al. 1998; Parmar, et al. 1998
Solanaceae	<i>Nicotiana rustica</i> L.	201	rheumatism	8	N/A
Anacardiaceae	<i>Schinus molle</i> L.	117	rheumatism	7	Jennings and Bernhard 1975; Hanna and Babar 1970; Lawrence 1997
Anacardiaceae	<i>Schinus molle</i> L.	117	swollen legs and sores	7	Jennings and Bernhard 1975; Hanna and Babar 1970; Lawrence 1997
Apiaceae	<i>Apium graveolens</i> L.	165	indigestion and stomachache	7	Ahmed, B., et al. 2002; Al-Hindawi, et al 1989; Garg, et al. 1979
Apiaceae	<i>Foeniculum vulgare</i> Mill.	138	indigestion and stomachache	7	Ruberto, et al. 2000
Lamiaceae	<i>Stachys arvensis</i> L.	146	antidiarrheic	6	N/A
Asteraceae	<i>Sonchus oleraceus</i> L.	139	colds and flu	5	N/A
Fabaceae	<i>Caesalpinia spinosa</i> (Molina) Kuntze	113	throat infections	5	Agrawal and Kapadia 1982; De Bruyne, et al. 1999; Vijayasathy, Sharma and Prakash 1981
Rosaceae	<i>Rosa indica</i> L.	124	earaches	5	Yesilada, et al. 1997

Family	Scientific name	Voucher*	Activity / used to treat	# Field Reports	Scientific Literature
Euphorbiaceae	<i>Ricinus communis</i> L.	119	laxative	4	Badwi, Adam and Hapke 1995; Gaillard and Pepin 1999; Lin, et al. 1976
Fabaceae	<i>Desmodium molliculum</i> DC.	129	kidney problems	4	N/A
Solanaceae	<i>Cestrum weberbaueri</i> Francey	123	antipyretic	4	N/A
Verbenaceae	<i>Verbena litoralis</i> H.B.K.	131	stomachache	4	N/A
Verbenaceae	<i>Verbena litoralis</i> H.B.K.	131	liver ailments	4	N/A
Adiantaceae	<i>Adiantum subvolubile</i> Kuhn	167	emmenagogue	3	N/A
Adiantaceae	<i>Adiantum subvolubile</i> Kuhn	167	abortifacient	3	N/A
Asteraceae	<i>Ageratina sternbergiana</i> (DC.) R. M. King & H. Rob.	169	emmenagogue	3	N/A
Caryophyllac	<i>Stellaria chilensis</i> Pedersen	200	antipyretic	3	N/A

Family	Scientific name	Voucher*	Activity / used to treat	# Field Reports	Scientific Literature
Fabaceae	<i>Otholobium glandulosum</i> (L.) Grimes	163	antipyretic	3	Backhouse, et al. 1996; Erazo, et al. 1997
Oxalidaceae	<i>Oxalis dombeyi</i> A. St. Hil.	168	stomachache	3	N/A
Plantaginaceae	<i>Plantago major</i> L.	130	diuretic	3	N/A
Poaceae	<i>Cynodon dactylon</i> (L.) Pers.	151	kidney problems	3	N/A
Solanaceae	<i>Cestrum peruvianum</i> Roem. & Schult.	218	antipyretic	3	N/A
Asteraceae	<i>Schkuhria pinnata</i> (Lam.) Cabrera	182	skin infections (fungi)	2	Delgado, et al. 1998
Bixaceae	<i>Bixa orellana</i> L.	156	diuretic	2	N/A
Bixaceae	<i>Bixa orellana</i> L.	156	prostate problems	2	N/A
Fabaceae	<i>Spartium junceum</i> L.	149	kidney stones	2	N/A
Fabaceae	<i>Spartium junceum</i> L.	149	liver ailments	2	Yesilada, et al. 1997
Fabaceae	<i>Spartium junceum</i> L.	149	purgative	2	Lurz, et al. 1990
Malvaceae	<i>Malva parviflora</i> L.	137	yellow fever	2	N/A
Lamiaceae	<i>Stachys arvensis</i> L.	146	headaches	2	N/A

Family	Scientific name	Voucher*	Activity / used to treat	# Field Reports	Scientific Literature
Rosaceae	<i>Sanguisorba officinalis</i> L.	133	stomachache	2	Kokoska, et al. 2002
Amaranthaceae	<i>Althernanthera elongata</i> (Willd.) Schinz	147	to wash women's intimate parts	1	N/A
Amaranthaceae	<i>Althernanthera elongata</i> (Willd.) Schinz	147	swollen kidneys	1	N/A
Amaranthaceae	<i>Iresine diffusa</i> Willd.	135	swollen kidneys	1	N/A
Amaranthaceae	<i>Iresine diffusa</i> Willd.	135	emmenagogue	1	N/A
Amaranthaceae	<i>Iresine diffusa</i> Willd.	135	abortifacient	1	N/A
Apiaceae	<i>Cyclospermum laciniatum</i> (DC.) Constance	142	colicky baby	1	N/A
Apocynaceae	<i>Vallesia glabra</i> (Cav.) Link	159	skin infections	1	N/A
Apocynaceae	<i>Vallesia glabra</i> (Cav.) Link	159	viral infections	1	N/A
Araliaceae	<i>Oreopanax eriocephalus</i> Harms	145	ant inflammatory	1	N/A

Family	Scientific name	Voucher*	Activity / used to treat	# Field Reports	Scientific Literature
Asteraceae	<i>Ageratina sternbergiana</i> (DC) King & Rob.	169	fractures and bumps	1	N/A
Asteraceae	<i>Ferreyranthus verbascifolius</i> Rob & Brett.	171	to clean teeth	1	N/A
Asteraceae	<i>Hieracium peruvianum</i> Fries.	230	disinfectant for wounds	1	N/A
Asteraceae	<i>Schkuhria pinnata</i> (Lam.) Cabrera	182	to treat excessive sleepiness	1	N/A
Asteraceae	<i>Tagetes elliptica</i> Smith	125	colds and flu	1	N/A
Capparaceae	<i>Cleome longifolia</i> Presl	192	rheumatism	1	N/A
Fabaceae	<i>Astragalus garbancillo</i> Cav.	208	fractures and bumps	1	N/A
Fabaceae	<i>Otholobium munyense</i> (Macbr.) Grimes	206	carminative and antidiarrheic	1	N/A
Oxalidaceae	<i>Xanthoxalis corniculata</i> L.	136	stomach problems	1	Ali, et al. 2001
Piperaceae	<i>Peperomia hutchisonii</i> Yunck.	173	colicky baby	1	N/A

Family	Scientific name	Voucher*	Activity / used to treat	# Field Reports	Scientific Literature
Loasaceae	<i>Nasa ramunculifolia</i> (Kunth) Weigend	211	bruises and sprains	1	N/A
Piperaceae	<i>Piper aduncum</i> L.	143	wounds, bruises and sprains	1	Cáceres, et al. 1995; Lentz, et al. 1998
Polygonaceae	<i>Muehlenbeckia tamnifolia</i> (H.B.K.) Meisn.	191	wounds, bruises and sprains	1	N/A
Polygonaceae	<i>Muehlenbeckia tamnifolia</i> (H.B.K.) Meisn.	191	mouth sores	1	N/A
Polygonaceae	<i>Muehlenbeckia tamnifolia</i> (H.B.K.) Meisn.	191	kidney problems	1	N/A
Polygonaceae	<i>Muehlenbeckia tamnifolia</i> (H.B.K.) Meisn.	191	liver ailments	1	N/A
Proteaceae	<i>Oreocallis grandiflora</i> (Lam.) R. Br.	144	kidney problems	1	N/A
Salicaceae	<i>Salix chilensis</i> Molina	127	liver ailments	1	N/A
Santalaceae	<i>Quinchamalium chilense</i> Molina	170	cold and flu	1	Bhakuni, et al. 1974

Family	Scientific name	Voucher*	Activity / used to treat	# Field Reports	Scientific Literature
Solanaceae	<i>Cestrum weberbaueri</i> Francey	123	to treat vomit	1	N/A
Solanaceae	<i>Datura arborea</i> L.	112	colicky baby	1	Jacinto, et al. 1988
Loranthaceae	<i>Ligaria cuneifolia</i> (Ruiz & Pav.) Tiegh.	111	antihemorrhagic (childbirth)	1	N/A
Urticaceae	<i>Pilea microphylla</i> (L.) Liebm.	148	kidney problems	1	N/A
Urticaceae	<i>Urtica magellanica</i> A. Jussieu ex Poiret	194	rheumatism and arthritic pain	1	N/A

* All numbers are O. Orozco collections

Table 4.3: Comparison of agreement on plants recognized as toxic in the community and corroboration of activity in scientific literature. **

Family	Scientific name	Voucher*	# Field Reports	Toxicity	Literature
Malvaceae	<i>Fuertesimalva limensis</i> (L.) Fryxell	176	17	toxic to animals	Bourke 1995
Apocynaceae	<i>Nerium oleander</i> L.	116	12	toxic to humans	Abe and Yamauchi 1979; Kight 1988; Sener and Ozata 1982
Urticaceae	<i>Urtica urens</i> L.	197	12	dermatotoxic	Czernetzki, Thiele and Rosenbach 1990; Kavalali and Tuncel 1997; McCaleb 1998; Schulze-Tanzil, et al. 2002
Apiaceae	<i>Conium maculatum</i> L.	114	10	toxic to animals	Frank and Reed 1990; Keeler, et al. 1980; Panter, Bunch and Keeler 1988
Anacardiaceae	<i>Schinus molle</i> L.	117	10	toxic to animals	Jennings and Bernhard 1975; Lawrence 1997
Anacardiaceae	<i>Loxopterygium huasango</i> Spruce ex Engl.	153	10	dermatotoxic	Mitchell 1990
Fabaceae	<i>Medicago polymorpha</i> L.	174	10	toxic to animals	Kinjo, et al. 1994
Solanaceae	<i>Nicotiana tabacum</i> L.	115	10	toxic to animals	Aguilar and Zolla 1982:158; El-Gayar, et al. 1975; Villalobos 1998
Solanaceae	<i>Nicotiana tabacum</i> L.	115	10	toxic to humans	Benedict et al; 1975; El-Gayar, et al. 1975; Mellick et al 1999

** ordered by highest to lowest number of field reports

Family	Scientific name	Voucher*	# Field Reports	Toxicity	Literature
Solanaceae	<i>Datura arborea</i> L.	112	9	toxic to humans	Jacinto, Laca and Caden 1988; Vieira 1976; Wilhelm and Schiefer 1991
Asteraceae	<i>Philoglossa peruviana</i> DC.	161	7	toxic to animals	N/A
Solanaceae	<i>Datura arborea</i> L.	112	5	toxic to animals	Jacinto, Laca and Caden 1988; Vieira 1976
Solanaceae	<i>Datura stramonium</i> L.	180	5	toxic to humans	Aguilar and Zolla 1982-83; Gaillard and Pepin 1999; Grinspoon and Bakalar 1997:44
Apiaceae	<i>Daucus montanus</i> Humb. & Bonpl. ex Spreng	193	5	toxic to animals	N/A
Fabaceae	<i>Leucaena trichodes</i> (Jacquin) Benth.	178	4	toxic to animals	Crounse, Maxwell and Blank 1962
Euphorbiaceae	<i>Ricinus communis</i> L.	119	4	toxic to humans	Badwi, Adam and Hapke 1995; Balint 1974; Lin, et al. 1976; Wei and Koh 1978
Solanaceae	<i>Cestrum tomentosum</i> L.	162	3	toxic to animals	van der Lugt, Nel and Kitching 1991
Solanaceae	<i>Datura stramonium</i> L.	180	3	toxic to animals	Aguilar and Zolla 1982-83; Gaillard and Pepin 1999; Grinspoon and Bakalar 1997:44
Euphorbiaceae	<i>Jatropha curcas</i> L.	158	3	toxic to humans	Aguilar and Zolla 1982-124

Family	Scientific name	Voucher*	# Field Reports	Toxicity	Literature
Euphorbiaceae	<i>Ricinus communis</i> L.	119	3	toxic to animals	Balint 1974; Lin, et al. 1976; Wei and Koh 1978
Solanaceae	<i>Solanum luteoalbum</i> Pers.	160	3	toxic to animals	N/A
Primulaceae	<i>Anagallis arvensis</i> L.	198	2	toxic to animals	Yamada, Hagiwara and Iguchi 1977; Rothwell and Marshall 1986
Rubiaceae	<i>Borreria laevis</i> (Lam.) Griseb.	181	2	toxic to animals	N/A
Loasaceae	<i>Caiphora sepiaria</i> (Ruiz & Pav. ex Don) J.F. Macbr.	195	2	dermatotoxic	N/A
Euphorbiaceae	<i>Euphorbia tirucalli</i> L.	186	2	dermatotoxic	Baslas and Gupta 1982, Cataluna and Rates 1997; Tokarnia, et al. 1996
Convolvulaceae	<i>Ipomoea carnea</i> Jacq.	187	2	toxic to animals	Ehattacharya and Dasgupta 1975; Misra and Misra 1965; Moussatché and Daló 1973
Loasaceae	<i>Nasa ramunculifolia</i> (Kunth) Weigend	211	2	dermatotoxic	N/A
Euphorbiaceae	<i>Pedilanthus tithymaloides</i> (L.) Poit	185	2	dermatotoxic	Areekul, Sinchaisri and TigvatanAnon 1987
Euphorbiaceae	<i>Asclepias curassavica</i> L.	155	1	dermatotoxic	Chakraborty, Siegenthaler and Buchi 1995

Family	Scientific name	Voucher*	# Field Reports	Toxicity	Literature
Euphorbiaceae	<i>Asclepias curassavica</i> L.	155	1	toxic to animals	Radford, et al. 1986; Tokarnia, Dobereiner and Canella 1972
Fabaceae	<i>Astragalus garbancillo</i> Cav.	208	1	toxic to animals	Knight 2002; Panter, et al. 1999; Ralphs, Panter and James 1990
Brassicaceae	<i>Brassica campestris</i> L.	175	1	toxic to animals	Brown 2001
Loasaceae	<i>Calophora contorta</i> (Desr.) C. Presl	212	1	dermatotoxic	N/A
Portulacaceae	<i>Calandrinia ciliata</i> (Ruiz & Pav.) DC.	199	1	toxic to animals	Smolenski, Silinis and Farnsworth 1975
Apiaceae	<i>Cyclospermum laciniatum</i> (DC.) Constance	142	1	toxic to animals	N/A
Euphorbiaceae	<i>Euphorbia huanchahana</i> Boiss	228	1	toxic to humans	N/A
Anacardiaceae	<i>Mauria heterophylla</i> H.B.K.	223	1	dermatotoxic	Mitchell 1990
Loasaceae	<i>Nasa macrantha</i> (Urb. & Gilg.) Weigend	229	1	dermatotoxic	N/A
Loasaceae	<i>Nasa macrothyrsa</i> Urb. & Gilg.	205	1	dermatotoxic	N/A
Loasaceae	<i>Nasa picta</i> (Hook.) Weigend	204	1	dermatotoxic	N/A

Family	Scientific name	Voucher*	# Field Reports	Toxicity	Literature
Hydrophyllaceae	<i>Phacelia pinnatifida</i> Griseb. ex Wedd.	210	1	dermatotoxic	Ippen 1990; Reynolds and Rodriguez 1986
Apiaceae	<i>Sanicula libertia</i> Cham. & Schltdl.	110	1	toxic to animals	N/A
Lamiaceae	<i>Stachys</i> sp.	179	1	toxic to animals	N/A
Caryophyllaceae	<i>Stellaria media</i> (L.) Vill.	200	1	toxic to animals	Pande, Shukla and Tripathi 1995
Urticaceae	<i>Urtica magellanica</i> A. Jussieu ex Poiret	194	1	dermatotoxic	N/A

*All numbers are O. Orozco collections

Table 4.4: Comparison of agreement on use of botanical pesticides in the community and corroboration of activity in scientific literature

Family	Scientific name	Voucher*	# Field Reports	Use	Bioactivity YFM	Literature
Apocynaceae	<i>Nerium oleander</i> L.	116	12	pesticide	inactive	ACTIVE. Consoli, et al. 1988; Pushpalatha and Muthukrishnan 1995; El-Shazly, Nassar and El-Sherief 1996
Apocynaceae	<i>Nerium oleander</i> L.	116	12	fungicide	not tested	INACTIVE. Ross, et al. 1980
Fabaceae	<i>Lupinus mutabilis</i> Lindl.	225	12	pesticide	weak	N/A
Anacardiaceae	<i>Schinus molle</i> L.	117	10	pesticide	weak	ACTIVE. Gebre-Amlak and Azerefegne 1993; Anwar, et al. 1992
Anacardiaceae	<i>Schinus molle</i> L.	117	10	repellent	not tested	ACTIVE. Guardiola, Miguel and Primo 1990
Solanaceae	<i>Nicotiana tabacum</i> L.	115	10	pesticide	moderate	ACTIVE. Areekul, Sinchaisri and TigvatanAnon 1987; De Moraes, et al. 2001; Sathiyamoorthy, et al. 1997
Solanaceae	<i>Nicotiana rustica</i> L.	115	10	pesticide	not tested	N/A
Myrtaceae	<i>Eucalyptus globulus</i> Labill.	132	9	repellent	not tested	ACTIVE. Papachristos and Stamopoulos 2001; 2002
Asteraceae	<i>Ambrosia arborescens</i> Mill.	126	8	pesticide	weak	N/A

** ordered by highest to lowest number of field reports

Family	Scientific name	Voucher*	# Field Reports	Use	Bioactivity YFM	Literature
Asteraceae	<i>Ambrosia arborescens</i> Mill.	126	8	repellent	not tested	N/A
Asteraceae	<i>Ambrosia arborescens</i> Mill.	126	8	vermifuge	weak	N/A
Cucurbitaceae	<i>Sicyos montanus</i> Poepp. & Endl.	172	6	repellent	not tested	N/A
Fabaceae	<i>Lupinus arvensis</i> Benth.	189	6	pesticide	not tested	ACTIVE. Barakat, et al. 1985
Solanaceae	<i>Capsicum pubescens</i> Ruiz & Pav.	122	6	pesticide	weak	INACTIVE. Rivas 1986
Solanaceae	<i>Capsicum pubescens</i> Ruiz & Pav.	122	6	repellent	not tested	N/A
Solanaceae	<i>Cestrum peruvianum</i> Roem. & Schult.	218	6	vermifuge	weak	N/A
Lamiaceae	<i>Minthostachys mollis</i> Griseb.	226	5	repellent	not tested	N/A
Lamiaceae	<i>Minthostachys mollis</i> Griseb.	226	5	vermifuge	moderate	N/A
Equisetaceae	<i>Equisetum giganteum</i> L.	118	3	pesticide	inactive	N/A
Fabaceae	<i>Otholobium glandulosum</i> (L.) Grimes	163	3	vermifuge	active	ACTIVE. Chesney and Adams 1985; Labbe, et al. 1996

Family	Scientific name	Voucher*	# Field Reports	Use	Bioactivity YFM	Literature
Asteraceae	<i>Schkuhria pinnata</i> (Lam.) Cabrera	182	2	repellent	not tested	ACTIVE. Novo, Viglianco and Nassetta 1997
Cucurbitaceae	<i>Cucumis dipsaceus</i> Ehrenb. ex Spach	184	2	pesticide	weak	N/A
Fabaceae	<i>Spartium junceum</i> L.	149	2	repellent	not tested	N/A
Fabaceae	<i>Spartium junceum</i> L.	149	2	repellent	weak	N/A
Verbenaceae	<i>Verbena litoralis</i> H.B.K.	131	2	pesticide	weak	N/A
Apiaceae	<i>Foeniculum vulgare</i> Mill.	138	1	vermifuge	weak	ACTIVE. Kim and Young 2001
Euphorbiaceae	<i>Euphorbia huanchahana</i> Boiss	228	1	vermifuge	active	N/A
Rutaceae	<i>Citrus aurantium</i> L.	183	1	pesticide	inactive	ACTIVE. Taylor and Vickery 1974, Prakash and Rao 1997:134
Rutaceae	<i>Citrus aurantium</i> L.	183	1	repellent	not tested	ACTIVE. Saxena and Basit 1982
Salicaceae	<i>Salix chilensis</i> Molina	127	1	repellent	inactive	INACTIVE. Atal, et al. 1978
Valerianaceae	<i>Phyllactis rigida</i> (Ruiz & Pav.) Pers.	232	1	pesticide	weak	N/A
Valerianaceae	<i>Phyllactis rigida</i> (Ruiz & Pav.) Pers.	232	1	repellent	not tested	N/A
Fabaceae	<i>Apurimacia boliviana</i> (Britton) Lavin	203	1	pesticide	active	N/A

Family	Scientific name	Voucher*	# Field Reports	Use	Bioactivity YFM	Literature
Fabaceae	<i>Apurimacia boliviana</i> (Britton) Lavin	203	1	vermifuge	active	N/A

*All numbers are O. Orozco collections

Although table 4.2 shows a tendency for plants with a higher number of field reports on medicinal plants to have more scientific literature that confirms the activity, this correlation could not be established statistically. After applying Pearson's X^2 test, the variables appear as independent. The same holds true for the comparison of number of reports on toxic plants with scientific literature (Tables 4.3 and 4.4). It is likely that because of the diversity of ecological regions and sociological conditions of the informants, the pool of data is not significant to provide statistically sound correlations. There is also the possibility that information on phytochemistry or bioactivity of these plants has been disregarded by the scientific community and more research is necessary. As mentioned before, 40% of the total number of species reported in this project have not been analyzed in these aspects; therefore, the scientific reports are not properly corroborating the empirical values reported by the informants.

Besides comparing the agreement of the informants with the availability of scientific reports, the number of reports agreeing in a particular use for a plant was also analyzed. Some authors only include in their final analysis, treatments or uses confirmed by at least three different informants (Johns, Kokwaro and Kimanani 1990; 1994). They accept formulas to determine consensus as an effective measure of cognitive salience and cultural significance, the working premise being that the two parameters are directly related (Friedman, et al. 1986; Moerman 1978; Trotter and Logan 1986). One of the ethno-

scientific stances based on this hypothesis is the Informant Agreement Index (IAR), devised by Trotter and Logan (1986).

$$\text{IAR} = \frac{(\text{total cases of ailment in sample}) - (\text{number of separate remedies for ailment})}{(\text{total cases for ailment}) - 1}$$

One of the conditions for the IAR to work is that the database be sufficiently large and homogeneous. Although the pool of data generated by this project is significant, the particular circumstances of heterogeneity of the ecological and sociological conditions does not permit lumping all the data together. If the IAR is applied to each individual ecological area, the result is a large number of different species used for the same condition; therefore, many species produce negative IAR values. After analyzing the Cajamarca data and applying the available tools (IAR), I decided to include reports of all plants used by informants or seen used by informants in the past, even if reported only once. As stated by Alexiades (1999:302), even if some individuals report “errors”, those wrong species are still valid in that they represent a response to a culturally valid activity context. Besides, in this particular case, we can use the yellow fever mosquito bioassay and the literature review as pragmatic tools to corroborate (to a certain extent) the veracity of the claims. It will be clear later in this chapter, that discarding plants that were reported only once could have lead to neglect the most conspicuous bioactivities observed during the laboratory test.

It is well known by ethnobotanists and increasingly recognized by natural products chemists, that the modes of preparation and administration of botanical extracts are crucial variables in determining pharmacological efficacy. In a currently funded International Cooperative Biodiversity Group (ICBG) project, an herb that was proven to have therapeutic benefit in a local setting did not exhibit effectiveness in the laboratory until the researchers incorporated local healers' methods of preparation and administration into their testing procedures (Berlin, et al. 1999; Levine 1981). Plant use in folk medicine and bioassay results were not clearly related in a study testing the biological activity of Uruguayan medicinal plants using the brine shrimp toxicity test (Gonzalez, et al. 1993). Many other examples are available to illustrate this point. The importance of following particular protocols described by the informant when testing effectiveness of a preparation is crucial. It is also clear, when dealing with numerous plants, that it is difficult to design methods and protocols to reproduce in a laboratory each preparation and administration form described to the ethnobiologist in the field. In this study, one bioassay was chosen to test all 22 extracts. As stated before, this gives a limited but still valid assessment of the bioactivity of the extract as a pesticide (Escoubas, Lajide and Mizutani 1994:162; Sathiyamoorthy, et al. 1997; Slimestad, et al. 1995).

Recognizing the limitations of using the assay for comparison, nevertheless a general idea of bioactivity can be obtained using the results from the bioassay. The results were classified into four groups: 1) Extracts with no activity even at high doses were labeled as inactive (> 10,000 ppm). 2) Extracts that showed activity only at the higher doses (1000 ppm and up) were labeled as weak. 3) Extracts with LC_{50} below 1000 ppm were labeled moderate and, 4) below 30 ppm, active. This information is presented in Table 4.4. When the data of effectiveness observed in the yellow fever mosquito bioassay is compared with the number of reports collected from the informants and analyzed using Pearson's X^2 , the variables are determined to be independent. This comes as no surprise as some of the most striking results are found with plants reported only once. Take as an example the case of *Apurimacia boliviana*, where only one informant reported the plant, but in the laboratory, it had effectiveness comparable to a commercial pesticide. Moreover, no reports were found in the scientific literature that could be used to determine the phytochemical characteristics responsible for the activity. It is likely that rotenone or related chemicals are present in the roots, as *Apurimacia* is a genus closely related to *Lephosta* (both in the Papilionaceae, Galegea tribe) well known for abundant insecticidal properties due to isoflavones (Prakash and Rao 1997). The test performed for *Euphorbia huanchahana* had the same conditions. The plant was reported only once in the field, but in the laboratory the extract had powerful larvicidal effect. The scientific literature has no mention of the phytochemistry of this plant. Although these could be isolated incidents, I

interpret this as a gap in knowledge of the scientific community about the bioactivity potential of these plants. In contrast, I would like to discuss the case of *Nerium oleander*. This plant was repeatedly reported by informants as a pesticide, but in the laboratory it did not show any effectiveness. It is known though, that *N. oleander* extracts produce interference with pupal-adult metamorphosis and morphogenic abnormalities (El-Shazly, Nassar and El-Sherief 1996). Because of the design used in this research, the type of results described by El-Shazly, et al., were not observable in this particular experiment. Some other examples may fit into this category, where despite the abundant research available and the certainty of the presence of toxic compounds, the results of the laboratory test were not significant. As mentioned before, the possibility of the solvents, method of extraction of compounds, the insect used for the assay, and the particular mode of action of the substance affecting the outcome of the bioassay should also be taken into account when observing these data.

Another possible factor to explain the low numbers of reports for plants that were found active in the laboratory test (like *Euphorbia huanchahana*, for example), had to do with ecology and changes in the local flora. If a plant becomes uncommon in a particular area because of erosion or deforestation, the people in the community will easily forget the use of the plant. To effectively measure if a species is disappearing, we should have reports on the presence of the plants in the past and in present time, so they can be compared.

Based on herbarium observations, we can say that *Euphorbia huanchahana*, is more common in southern Peru than in the northern *sierra*. On the other hand, *Nerium* is an extremely common ornamental tree. It is possible that just because of wide availability and a valid knowledge about the toxic properties of the plant, it is assumed that it will be effective as a pesticide on a variety of organisms. This idea is concordant with the basic principle stated by Berlin (1999) that for a plant to have a major importance in the ethnopharmacopeia of a group, it has to be widely distributed in a particular region. These species, in turn will be expected to show high levels of bioactivity because they are the result of fine-tuning of the information process. It is possible that the widely distributed species reported by the community will turn out to be effective, if we could design an experiment where each extract is used exactly under the circumstances and for the organisms that are claimed in the original reports of the informants. Unfortunately, this approach is not realistic if more than a few plants are to be tested.

The idea of consensus and availability as measurements of effectiveness in ethnobotanical information (in absence of clinical or bioactivity approaches) are quite valid if the main goal of the project is to determine and compile the ethnobotany of a very coherent group with common denominators (culture, language, flora, etc.) and actively living their culture.

The characteristics of this specific project do not allow the use of such indices, given the cultural and geographical diversity included in the survey and the high level of

acculturation observed in the region. In addition, as mentioned before, we do have scientific tests to validate the reported uses although limited, they do provide a hint of bioactivity as pesticides that are valid and useful. Nevertheless, the fact that a few species with single reports showed conspicuous effects on the organism tested in the yellow fever mosquito assay could be a sign of erosion in the ethnobotanical information regarding botanical pesticides. If the average number of medicinal plants recognized by any of the informants is compared with the average number of botanical pesticides, the ratio is 2:1. In communities where people survive on agricultural activities, there should be no reason for them to recognize more plants to be used for medicinal treatments than plants to be used in veterinary applications or as pesticides. Traditional ecological knowledge used in the management of their land, which was commonplace in the past is not now being valued nor effectively transmitted to new generations. Practices falling out of use and new expectations created by acknowledgment of the efficacy of commercial chemical products have created adverse circumstances for the preservation of ethnobotanical knowledge in regards to the use of natural pesticides and other bioactive resources.

CHAPTER 5. CONCLUSIONS

PAST AND PRESENT USE OF TOXIC PLANTS IN CAJAMARCA

The focus of this study has been the use of native plants by the people of Cajamarca for the purpose of controlling and eliminating pests. Ethnobotanical usage information was collected for 112 plants found in the region today. Of these, 22 plants were reported to be used as pesticides and anti-feedants. These plants were tested using the yellow fever mosquito bioassay. Eighteen of the 22 plants tested showed signs of bioactivity. Six of the extracts showed strong activity and three (*Apurimacia boliviana*, *Euphorbia huanchahana* and *Otholobium glandulosum*) showed signs of bioactivity comparable to commercial pesticides. Moreover, the bioactivity of these three plants has not been cited previously in the scientific literature as having pesticide activity. Thus, they represent promising sources of plant-derived pesticides for indigenous farmers and, if further developed, commercial purposes.

When comparing the uses of plant as pesticides in different communities or ecological zones, it was found that the applications for a given plant are the same in 96% of the cases. This confirms great coherence in the collective knowledge of the communities

probably based on the empirical nature of the information and the closely related ancestors for the people of all the areas.

It was also determined that there is no active trade of botanical pesticides in any of the areas of study. In contrast, it was established that there is a large market for medicinal plants. This finding reinforced the idea that botanical pesticides are part of traditional knowledge that is rapidly losing importance in these communities and that it seems to be less valued as practical application than the use of medicinal plants. Furthermore, the remaining knowledge of the community regarding the use of toxic plants is in peril of disappearing in the near future given the fact that only 25% of the reported uses are presently listed as practical applications. All other reports are listed as applications used or witnessed in the past, but fallen out of use in the present time.

When the reports from the informants are evaluated against the effectiveness of the bioassay (yellow fever mosquito), the comparison does not provide evidence of correlation. All extracts found to be active in the laboratory were reported three or less times in the field. Plants with high consensus in this study had moderate to weak results in the laboratory. This phenomenon can be attributed to the specificity of the bioassay employed and the specificity of the bioactivity from the plants themselves. To be able to correlate consensus and bioactivity in the laboratory, the claims of the informants should

be tested following protocols that reproduce exactly the practices and conditions described by the informants in the field. Although this is not a realistic approach, it should be expected that under those circumstances, at least 70% of the claims of the informants would turn out to be confirmed (according to scientific literature presently available). Another consideration in this area is the fact that acute toxicity is rarely the *modus operandi* in the real world of plant defensive chemistry. More commonly, plant compounds exert deterrence in phytophagous insects, or act as growth regulators or as behavior-modifying substances (affecting oviposition or mating activities). According to Isman (1999: 140) this is one of the reasons why only few botanical insecticides have been commercially developed. Plant extracts are being compared in the lab and in the agricultural market, to chemicals whose main activity is lethal toxicity, while the actual effect of the chemical armory of the plants is more dynamic and less conspicuous. For the future, evaluation of this kind of activity rather than acute toxicity will probably provide not only interesting information, but also results that are more in accord with the data provided by the informants in the field.

Information collected during this project regarding the use of botanical pesticides in the Cajamarca area suggests that there is erosion of indigenous knowledge on botanical pesticides. This process is probably accelerated by the close contact of the communities with urban influences and the evolution of markets that highly value machine-made

products coming from outside the region. The phenomenon seems more evident for botanical pesticides than for medicinal plants, because even while being asked about toxic plants, the average informant named at least twice as many medicinal plants as botanical pesticides. Erosion of traditional knowledge on botanical pesticides was found to be more evident in the *chala* and *yunga* areas than at higher altitudes. This was determined by comparing the number of non-respondents (informants that stated not to be able to remember any plants with particular applications) in each area. In the *chala* area, 62% of the interviewees fit into this category and in the *yunga*, 22%. The figures decrease to be almost none existent for the *jalca* area (1% of informants classified as non-respondents). In addition, the number of species collected in each zone provides a sense of the knowledge people have of their surroundings. Plants collected in the *kechwa* and *jalca* area account for 70% of the total collections. These figures do not seem to be related to the size of the flora, or to demographic factors like age, gender or socioeconomic status of the informants.

In this study, the collective knowledge of the communities was correlated with the presence of literature reports validating the claims of the informants. It was found that 32% of the claims regarding medicinal plants were confirmed by scientific literature reports. In this area, although there is an observable tendency for correlation between the number of reports and the presence of scientific information about a plant and the activity

claimed, statistical analysis determined the correlation to be non-existent. When observing the results concerning collective knowledge about toxic plants, the level of validation by scientific literature rises to 55% of the plants examined in the study. For botanical pesticides, 70% of the claims are confirmed by scientific reports. This percentage of empirical corroboration on the claims of the informants confirms the value of the traditional ecological knowledge as valid and important.

In general, what ethnobotanical knowledge is left in Cajamarca is quite useful and ought to be rescued, as confirmed by the results achieved in the laboratory with of the extracts analyzed. *Euphorbia huanchahana*, *Apurimacia boliviana* and *Otholobium glandulosum* provided mortalities on *Aedes aegypti*, comparable to a commercial pesticide. Although other extracts did not performed with such potency, all other plants reported by the informants should be highly valued as tools for the agricultural life of the community. When applied under the particular field conditions that are described by the informants, even a moderate control of pests achieved with the application of a botanical pesticide is definitely more affordable than an industrial chemical option and the response is more ecologically sound. Of special interest for future research will be to corroborate the efficacy of the plants claimed to act as repellents. The use of repellents for crops or in households is a practice particularly benevolent not only to the environment but to the

final consumers of the goods (if used in agriculture) or to the people inhabiting the place that is being protected.

THOUGHTS FOR THE FUTURE

In August 2002, the U.S. government approved a series of measures that affect trade with some Latin American countries, including Peru. The U.S. Congress conferred powers to the President to negotiate with countries not yet included in the Free Trade Area of the Americas (FTAA) that will start in 2005, and decided to extend and broaden the Andean Trade Preferences Act (ATPA) to include Peru for the area of textiles and others. This program of duty-free treatment to nearly all products imported from the beneficiary countries was established 10 years ago by U.S.A. President George H. W. Bush and includes 6000 products from Colombia, Ecuador, Bolivia and Peru. The new regulations offer special opportunities to Peru, making it easy to export garments and agricultural products, tax free, to the U.S.A. (OAS 2002). Although the impact of these laws will have a primary effect on the textile industry, there is also benefit for agricultural products. While asparagus, artichokes and mangoes are already coming into the U.S. duty free, there is still room for growth with other products that could enjoy the benefits of these agreements.

Some of these treaties, especially the FTAA, have been facing resistance from social movements in the Americas. Indigenous groups, *campesinos*, labor, women's groups, environmental, and youth organizations have vowed to shut the summits down. They link the process of globalization to the hand over of power and control of areas of their daily lives to the consolidation of the hegemony of the U S. and multinational companies, via political, economic, and military domination (Stopftaa.org 2002). Despite these fears and regardless of their veracity, the process of globalization and a future common economic market for the world is a very likely possibility for which every country should be prepared

Unfortunately, the agricultural infrastructure in Peru needs significant investment and added innovations to be able to compete in such a market, as stated by S. Gleiser, President of the Peruvian National Chamber of Commerce (Alpiste, 2002). However, there is a special niche market where competence can be created, by entering into a field like organic agricultural products, an expensive market where the absence of chemical pesticides and fertilizers confer to the product a special value. These are relatively new global initiatives, and a country like Peru will have numerous advantages -- inexpensive labor and abundant local varieties of a number of species (potatoes, chili peppers, Andean cereals, and fruits), which are well known for being hardy and resistant to pests. The

knowledge of pre-Hispanic cultures about botanical pesticides and rational use of land that is not exactly ideal for industrialized agriculture given the inclination of Andean slopes, are factors that must be considered when entry into global markets is contemplated.

A second opportunity for development could be the area of novelty crop markets. There is much interest in developing new crop plants from the flora of tropical forest habitats (Evans and Sengdala 2002). Some are species that have a history of cultivation by marginal ethnic groups, others have always been wild harvested, but many are considered to have potential for wider adoption. Authors like Plotkin (1988) and Popenoe, et al (1989) among others, have highlighted many species with potential, including several common to the Cajamarca area. Some examples are *arracacha* (*Arracacia xanthorrhiza* Bancr.), *yancón* [*Smallanthus sonchilolius* (Poepp. & Endl.) H. Robinson], and *berenjena* or *tomate de árbol* [*Cyphomandra betaceae* (Cav.) Sendtn]. Actually, Cajamarca is a center of diversity for the genus *Arracacia* and the Universidad Nacional de Cajamarca, in conjunction with the International Potato Center (CIP), have a live gene bank program for this genus on the University campus. There is also an increased demand around the globe for novelty products like medicinal herbs for tea or beauty products, protein rich cereals and grains like quinoa (*Chenopodium quinoa* Willd.) and *Lupinus* spp., and energetic foods (with claims of aphrodisiac powers) like *maca* (*Lepidium peruvianum* Ch. and

Lepidium meyenii Walp.) (CIP 2002). Some of these products are also part of the CIP efforts in conservation and diffusion of Andean crops (Hermann and Heller 1997). The species mentioned above represent potential opportunities of new markets and investment in the Peruvian *sierra* that could combine a badly needed development in the region with the conservation of precious biodiversity, knowledge, and customs of the people

Another valuable resource that is worth developing is the organization of the communities. The traditional practices of *faenas comunales* or *minka* (communal labor) or the *ayni* (working for a different household for goods or for reciprocal work), which were the norm during the Inca times, are almost non-existent today. The agreement of the communities on the use of land and the cooperative system that is part of the cultural traditions of the Cajamarca area could be part of the answer to the problems of marketing and pricing of agricultural products. The merchant will always take advantage of the lack of information regarding supply and demand, and of the competition that prevails among the *campesinos* for selling the small quantity of products that they have to offer. The use of local institutions to provide leaders, stewards, and rules for social regulation is indispensable, because ecological knowledge does not function in isolation. If the community creates a cooperative front and faces the wholesaler with an agreed price and policy, they will be more competitive and have a better chance to benefit from their products. This structure could also provide an organized system where individuals in the

community could become specialists in particular aspects of their traditional ecological knowledge and traditional resource management. All this reinforcement of traditional practices could also facilitate the preservation of anthropological items as rituals, ceremonies, and other traditions. These are social mechanisms for cultural internalization that help people remember the rules and appropriately interpret signals from ecosystem change (Chapin 1991).

Traditional ecological knowledge is an attribute of societies with historical continuity in resource use practice (Dei 1993). Although not necessarily strictly indigenous or tribal, the peasant culture of Cajamarca is purely traditional, but incorporates both Western science and local practice because of its long history of contact with Europeans. The importance of incorporating traditional ecological knowledge and traditional resource management into resource management plans is increasingly recognized (Ticktin and Johns 2002). The rediscovery of many practices is creating a growing emphasis on agroecology, integrated farming, and polyculture. Water management for irrigation systems, the use of terraces for exploitation of steep agricultural land, traditional cultivation cycles according to weather and moon cycles, botanical pesticides, and production of their own fertilizers are only a few examples of traditional ecological knowledge and traditional resource management skills that could be promoted in these societies. As a community the information should be shared, used, and handed down from

generation to generation, avoiding the fate that we are witnessing today of the loss of traditional knowledge.

All this is achievable as has been demonstrated by the case of the Mopán area in Guatemala. As reported by Steinberg (2002) in Mopán, local farmers became “organic farmers” out of necessity. The Mayan people of Mopán, when asked if they will use chemicals if they were affordable and if the product would increase productivity, all stated “yes”. Despite this and their complaints about minor pests and diseases, their profits derived from exported cacao beans are now tied to the absence of chemical pesticides in their practices. Their industry has been labeled “organic” and now chemical inputs are eschewed. The use of local and wild *Theobroma* varieties is part of the strategy, and the locals are willing to sacrifice the yield of improved varieties for the resistant qualities of the traditional cacao cultivars.

Prior to the start of this project, one of the questions I had about the use of chemical pesticides in Cajamarca was why their use was so restricted. I was aware that at least among the small farmers (1-5 ha) the consumption of chemicals in agriculture was very low. My initial hopes were that the use of chemicals would be so evidently low because of a widespread knowledge and use of botanicals and other natural products. Unfortunately, these expectations were soon extinguished. One of the first details that I learned when

asking questions about the use of chemicals in agriculture was a sense of denial among the *campesinos*. Many will firmly state that they did not apply any chemicals, because they did not need them. They had no pests in their field, so they said, although I will personally (and quietly) confirm the abundant presence of insects and other sanitary problems. I learned later with more visits to the same households that informants with whom I established a strong rapport would end up recognizing that they do have a phytosanitary problem that they cannot afford to control due to the prohibitive prices of chemical pesticides. There is a second factor, not necessarily a determinant in this process, but one that can have a very important impact on the ecology of the region and the health of the *campesinos*. One should have a basic literate level to read the labels on chemical pesticides and have an understanding of basic mathematical processes (percentages) to be able to use them effectively. As mentioned in the introductory chapter, Cajamarca has a high percentage of illiteracy that surpasses by far the national average (27% according to INEI, 1997). This figure includes the population of Cajamarca city, with relatively high literacy rates, so the real number of illiteracy in the rural area alone is probably much higher. According to the interviews generated by this project, only 30% of the informants were able to read and follow the instructions from a handout or the labels on a product. To worsen the prospect of chemical pesticides use in the area, the agrochemical companies do not offer any kind of support or on-site information about their products. The market is so reduced that it is not profitable for them to allocate personnel to offer

informal chats or demonstrations. This came as a surprise to me given my experience working in the rural areas in Colombia, where, if you work or walk in the field, you find chemical companies representatives as commonplace as the *campesinos* themselves. In ten months of fieldwork in Cajamarca, I never crossed paths with a technician or any other professional that could offer advice on the use of agrochemicals. The results of this absence are very serious for the very few peasants who can afford to buy the products. Their handling of the chemicals is frequently inappropriate because of misinformation or misunderstanding of the instructions. There is a risk of ecological damage and health problems not only for the farmer but also for the final consumer of the products (frequently, themselves, their immediate family and local markets)

Given all these circumstances, it is clear that the use of the communities' traditional ecological knowledge of botanical pesticides, and traditional resource management for exploitation of native species and uses of the land could be a major asset for the area. The labeling of their goods as "organic" and their incorporation into a formal economy should not be regarded as a loss of identity, but rather as a way for them to profit from their environment, native knowledge, and improve their individual health. This specific area is not truly geographically or culturally isolated. They have had close contact with Western civilization for the last 500 years, they see cars once a week at least in the most remote

areas, and they acknowledge basic needs that can only be fulfilled with money. However, a circle of poverty has engulfed them during this same 500 years.

Even if the knowledge generated by this kind of project is not intended to be applied as a practical resource in the agricultural practices of the community, additional reasons could be listed to justify the collection of information. One of those reasons was stated on the Convention on Biological Diversity in Rio de Janeiro, Brazil (1992). The convention urged local legislations, to make an effort to *"maintain and preserve knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices"* (Article 8j). This important task should start with the documentation of that knowledge, which will be the first step on the records relevant to intellectual property rights issues. It is my intention to offer this document to the Peruvian government, as a starting point for such formal documentation of traditional knowledge for the Cajamarca area. I hope the information will have a dual purpose and it will be used in the future, not only to protect the rights of the communities, but also to reeducate people on the traditional practices used by their ancestors for thousands of years, protecting the knowledge from becoming extinct.

The use of toxic plants in the area of Cajamarca is in danger of vanishing, because of deep changes in the management of resources for agricultural practices. Some species are even at risk of disappearing from the collective knowledge of the communities, as their uses and names are forgotten by new generations. This is particularly true for areas on the lower slopes of the Cajamarca Andes, where the proximity to industrialized agriculture and close contact with non-agricultural societies is eroding the ethnobotanical knowledge at a faster pace. However, the information collected on the uses of plants has still a lot of potential to be useful and a huge value as expression of folklore and heritage of the people of Cajamarca

This information should be part of a change in the economic perspective of agriculture in the peasant communities of Cajamarca, and other areas with similar conditions.

Ethnobiology should not be exclusively about documenting the knowledge of the communities, but also, about helping the indigenous groups maintain their cultural heritage. Furthermore, this should be a starting point to offer some direction on how to benefit from their resources and knowledge. The protection of the knowledge of the communities should not be part of the economic hardship they suffer, but part of the solution. Providing ideas for the people to make a decent living from their *chacras* is a sure way to prevent them from migrating into the cities and enlarging the list of lost

peasants that live in misery in Lima or other large urban areas. Reminding the young about the value of their ancestors' knowledge stimulates a sense of pride, vital to the cultural survival of their traditions. For the ethnobiologist to be able to help local communities fulfill their economic needs, while protecting their traditions and the environment, seems to me the perfect idea of ethics, respect, and appreciation for a native indigenous culture.

Appendix 1: Permits from Peruvian government



Autorización N° 01-2000-INRENA-DGANPFS-DCFS

Vista la solicitud, presentada por la Srta. Olga Lucía Orozco Angel, con pasaporte N° AE985471, estudiante de doctorado de la City University of New York, U.S.A., para la colecta de especies no vedadas de flora y siendo sus fines exclusivamente científicos, se le autoriza la colecta de no más de cuatro (04) muestras por especie de flora no vedada de las especies *Annona cherimolia*, *Avena sp.*, *Capsicum pubescens*, *Datura arborea*, *Lobelia decurrens*, *Lupinus mutabilis*, *Psoralea glandulosa*, *Minthostachys glabrescens* y otros géneros de la familia Lamiaceae, en el departamento de Cajamarca, provincias de Contumazá, Cajamarca y Celendin, para realizar el estudio "Revisión de las especies tóxicas en Cajamarca y sus usos", por el periodo del 1° de marzo al 31 de julio y del 1° de setiembre al 31 de diciembre del 2000.

Los investigadores se comprometen a:

- a) No coleccionar ejemplares de flora y fauna silvestres no autorizados.
- b) Remitir al INRENA un documento haciendo constar el consentimiento de las comunidades de la zona a participar en el mencionado proyecto. Además deberá reconocerse en los informes y publicaciones, el apoyo dado por ellas para el avance de la investigación.
- c) No utilizar ni ceder a terceros los especímenes o parte de éstos (tejido, cromosomas u otros) para investigaciones relacionadas con acceso a recursos genéticos.
- d) Si por razones científicas acotadas, se requiere enviar al extranjero parte del material colectado, los interesados deberán gestionar el correspondiente Permiso de Exportación CITES ante el INRENA y pasar el control respectivo.
- e) Entregar el 30% del material colectado a una entidad científica nacional, incluyendo holotipos y paratipos, así como ejemplares únicos de los grupos taxonómicos colectados.
- f) Entregar a la Dirección General de Áreas Naturales Protegidas y Fauna Silvestre del INRENA, seis (06) copias del informe de campo final, seis (06) copias de las publicaciones que hicieran con motivo de la presente investigación, así como copias del material fotográfico y/o slides que puedan ser utilizadas para difusión.

Se expide la presente, de conformidad con el Texto Único de Procedimientos Administrativos (TUPA) del Instituto Nacional de Recursos Naturales - INRENA aprobado mediante D.S. N° 020-98-PCM y modificado por R.M. N° 0623-98-AG, el Reglamento de Conservación de Flora y Fauna Silvestres aprobado por D.S. N° 158-77-AG, la Ley Forestal y de Fauna Silvestre aprobado por D.L. N° 21147, la Ley Orgánica del Ministerio de Agricultura aprobado por D.L. N° 25902, que crea el Instituto Nacional de Recursos Naturales (INRENA).

El INRENA no se responsabiliza por accidentes o daños sufridos por los solicitantes de esta autorización, durante la ejecución del proyecto.

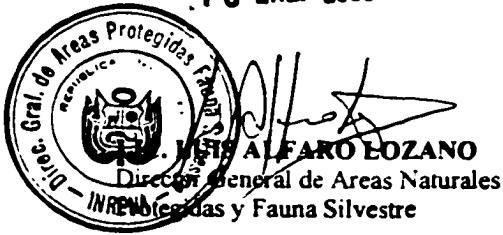
El INRENA a través de la Dirección General de Áreas Naturales Protegidas y Fauna Silvestre, se reserva el derecho de demandar del proyecto de investigación los cambios a que hubiese lugar en los casos y se dicten nuevas disposiciones legales o se formulen ajustes sobre la presente

autorización.

El incumplimiento de los compromisos adquiridos será causal para denegar futuras autorizaciones a nivel institucional.

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Lima, 13 ENE. 2000





Addenda a la Autorización N° 01-2000-INRENA-DGANPFS

Vista la solicitud presentada por la Srta. Olga Lucía Orozco Angel, con pasaporte N° AE985471, estudiante del doctorado de la University of New York, USA., para la ampliación de la autorización N° 01-2000-INRENA-DGANPFS de colecta de especies no vedadas de flora y con fines exclusivamente científicos.

Se resuelve:

Aprobar mediante la presente, la colecta de no más de cuatro (04) muestras por especie de flora no vedada de las siguientes especies:

Nº	Familia	Especies
1	Adiantaceae	<i>Adiantum subvulubile</i>
2	Amaranthaceae	<i>Alternanthera elongata</i>
3	Anacardiaceae	<i>Loxopterygium huasango</i>
4	Anacardiaceae	<i>Mauria heterophylla</i>
5	Anacardiaceae	<i>Schinus molle</i>
6	Apiaceae	<i>Apium graveolens</i>
7	Apiaceae	<i>Conium maculatum</i>
8	Apiaceae	<i>Daucus montanus</i>
9	Apiaceae	<i>Foeniculum vulgare</i>
10	Apocynaceae	<i>Nerium oleander</i>
11	Apocynaceae	<i>Vallesia glabra</i>
12	Araliaceae	<i>Oreopanax eniocephalus</i>
13	Bixaceae	<i>Bixa orellana</i>
14	Capparaceae	<i>Cleome longifolia</i>
15	Caryophyllaceae	<i>Stellaria sp.</i>
16	Asteraceae	<i>Ageratina sp.</i>
17	Asteraceae	<i>Ambrosia sp.</i>
18	Asteraceae	<i>Ferreyranthus verbascifolius</i>
19	Asteraceae	<i>Philogglossa peruviana</i>
20	Asteraceae	<i>Schkuhria pinnata</i>
21	Asteraceae	<i>Sonchus oleraceus</i>
22	Asteraceae	<i>Tagetes elliptica</i>
23	Convolvulaceae	<i>Ipomea carnea</i>
24	Cucurbitaceae	<i>Cucumis dipsaceus</i>
25	Cucurbitaceae	<i>Echinopepon racemosus</i>
26	Equisetaceae	<i>Equisetum giganteum</i>
27	Asclepiadaceae	<i>Asclepias curassavica</i>
28	Euphorbiaceae	<i>Dalechampia weberbaueri</i>
29	Euphorbiaceae	<i>Euphorbia huanchahana</i>
30	Euphorbiaceae	<i>Euphorbia tirucalli</i>
31	Euphorbiaceae	<i>Jatropha curcas</i>
32	Euphorbiaceae	<i>Pedilanthus tithymaloides</i>
33	Euphorbiaceae	<i>Ricinus communis</i>
34	Fabaceae	<i>Apurimacia boliviana</i>
35	Fabaceae	<i>Astragalus garbancillo</i>
36	Fabaceae	<i>Caesalpinia spinosa</i>
37	Fabaceae	<i>Desmodium molliculum</i>
38	Fabaceae	<i>Leucaena trichodes</i>
39	Fabaceae	<i>Lupinus sp.</i>
40	Fabaceae	<i>Medicago polymorpha</i>
41	Fabaceae	<i>Otholobium sp.</i>
42	Fabaceae	<i>Spartum junceum</i>

Calle Diecisiete N° 355
Urb. El Palomar, San Isidro, Lima-27
Apartado Postal 4452

Teléfono (51 1) 224-3298
Facsimile (51 1) 224-3218
LIMA - PERU

43	Lamiaceae	<i>Minthostachys</i> sp.
44	Lamiaceae	<i>Stachys</i> sp.
45	Loasaceae	<i>Caiphora</i> sp.
46	Loasaceae	<i>Loasa</i> sp.
47	Loranthaceae	<i>Psittacanthus</i> sp.
48	Malvaceae	<i>Fuertesimilva limense</i>
49	Malvaceae	<i>Malva parviflora</i>
50	Monimiaceae	<i>Siparuna muricata</i>
51	Myrtaceae	<i>Eucalyptus globulus</i>
52	Oxalidaceae	<i>Oxalis corniculata</i>
53	Oxalidaceae	<i>Oxalis dombeii</i>
54	Piperaceae	<i>Peperomia</i> sp.
55	Piperaceae	<i>Piper</i> sp.
56	Plantaginaceae	<i>Plantago major</i>
57	Poaceae	<i>Cynodon dactylon</i>
58	Polygonaceae	<i>Muehlenbeckia tamnifolia</i>
59	Polygonaceae	<i>Rumex peruvianus</i>
60	Portulacaceae	<i>Calandrinia ciliata</i>
61	Primulaceae	<i>Anagallis arvensis</i>
62	Proteaceae	<i>Oreocallis grandiflora</i>
63	Rosaceae	<i>Rosa indica</i>
64	Rosaceae	<i>Prunus</i> sp.
65	Rosaceae	<i>Sanguisorba officinalis</i>
66	Rubiaceae	<i>Borreria capitata</i>
67	Rutaceae	<i>Citrus aurantium</i>
68	Rutaceae	<i>Ruta graveolens</i>
69	Salicaceae	<i>Salix chilensis</i>
70	Santalaceae	<i>Quinchamalium procumbens</i>
71	Solanaceae	<i>Brugmansia arborea</i>
72	Solanaceae	<i>Capsicum pubescens</i>
73	Solanaceae	<i>Cestrum</i> sp.
74	Solanaceae	<i>Datura stramonium</i>
75	Solanaceae	<i>Nicotiana</i> sp.
76	Solanaceae	<i>Solanum</i> sp.
77	Urticaceae	<i>Pilea</i> sp.
78	Urticaceae	<i>Uruba</i> sp.
79	Verbenaceae	<i>Verbena littoralis</i>



LIC. LUIS ALFARO LOZANO

 Director General de Areas Naturales

 Protegidas y Fauna Silvestre

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MINISTERIO DE AGRICULTURA
INSTITUTO NACIONAL DE RECURSOS NATURALES
INRENA

000067 -AG-INRENA

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PERMISO PARA FAUNA Y FLORA SILVESTRE



EXPORTACION



IMPORTACION



RE-EXPORTACION
Nº Factura

Valido por 60 días calendarios

Nombre : OLGA LUCIA OROZCO ANGEL
Domicilio : 25-40 Shore Blvd. Ap 19 J. Astoria N. Y.
Documento de Identidad : RUC:

Producto (s) :

- SCHIMMUS MOLLE ADIANTUM SUBVOLUBILE. ALTERNANTHERA ELEGATA. LOXOPTERYGIUM HUASANGO
MAURIA HETEROPHYLLA. APIUM GRAVEOLENS. CONIUM MACULATUM. DAUCUS MONTANUS. FOENICULUM
VULGARE. NERIUM OLEANDER. VALLESIA GLABRA. OREOPANAX ERIOCEPHALUS. Bixa ORELLANA
CLEOME LONGIFOLIA. STELLARIA SP. AGERATINA SP. AMBROSIA SP. FERREYRANTHUS VERBASCOFOLIUS
PHILOGLOSSA PERUVIANA. SCHKUHRIA PINNATA. SONCHUS OLERACEUS. TAGETES ELLIPTICA. IPOMEA
CARNEA. CUCUMIS DIPSACEUS. ECHINOPEPON RACEMOSUS. EQUISETUM GIGANTEUM. ASCLEPIAS CURASSAVICA
DALECHAMPA WEBERBAUERI. EUPHORBIA HUANCHAHANA. EUPHORBIA TIRUCALLI. JATROPHA CURCAS
PEDILANTHUS TITHYMALOIDES. RICINUS COMMUNIS. APURIMACIA BOLIVIANA. ASTAGALUS GARBANCILLO
CAESALPINIA SPINOSA. DESMODIUM MOLLE. LAUCAENA TRICHODES. LUPINUS SP. 2 unidades por especie.
con fines científicos *****

Lugar de Procedencia :
Destinatario : OLGA LUCIA OROZCO ANGEL
Dirección : Jardín Botánico de New York
ESTADOS UNIDOS DE AMERICA

Lima, 30 de 10 del 2000



Sello y firma del Control - INRENA

El titular del presente permiso conoce las disposiciones legales vigentes en la materia y es responsable de su cumplimiento y sujeto a las sanciones correspondientes en caso del incumplimiento total o parcial.

Copia



Memorandum

Date: February 10, 2000
To: Olga Orozco
CC: John McDonald, Chair
From: Nicole Banks, Assistant Director
RE: Institutional Review Board Review of Research Protocol
Protocol No: 00-22
Title: Survey of Poisonous Plants in Cayamarca (Peru)
Dates: February 2000 to January 2001
Funding Source: AAUW (PENDING)

The Lehman College Institutional Review Board for the Protection of Human Subjects has reviewed and approved the above referenced project on the condition that you meet with Professor Jose Renique (x. 4998) to discuss doing research in Peru. The Board also waived written informed consent for this project.

This approval is effective for one year. Federal regulations require continuing review of research involving human subjects, and your protocol should be submitted for review before January 2001. It is the responsibility of the principal investigator to advise the IRB of any changes in procedures and the termination of the study.

Please call the Office of Grants and Contracts if you require further assistance.

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Appendix 2: YFM bioassay protocol

Materials used in the experiment:

- a) *Aedes aegypti* eggs 0.5 ml (approximately 25,000 eggs with viability 80-90%) obtained from the New Orleans Mosquito Board Control (New Orleans, LA 70126)
- b) Zinc sulfate solution 0.3 N from Sigma.
- c) MES (2-[N-morpholino] ethanesulfonic acid) sodium salt from Sigma
- d) Bovine liver powder from ICNB Biomedicals, Inc.
- e) Rotenone 95-98% from Sigma
- f) Pyrethrum insect powder (dry *Chrysanthemum* flowers) from Ecozone.
- g) 48-Well plate, flat bottom, with low evaporation lid from Falcon (3078), one for each testing material tested. These plates allow five treatments plus an absolute control; and provide eight repeats per treatment.
- h) Pipettes 5, 100 and 1000 μ l Eppendorf.
- i) 4-ml glass vials with rubber septa from Wheaton. Five for each sample tested

Procedures

- a) *A. aegypti* eggs were maintained at room temperature in a sealed container (1000-ml beaker covered with three layers of parafilm). Inside the container, a 50-ml beaker with saturated zinc sulfate solution maintains a relative humidity 80 to 90%.

- b) To hatch the eggs, the desired amount is put into a small vial. lukewarm water added, covered, and shaken vigorously for 10-15 seconds. The eggs stay in the hatching vial for 30 minutes
- c) The newly hatched larvae and remaining eggs are transferred to a Petri dish (rearing pan) containing 4 mg/ml of bovine liver powder solution. In an incubator, the larvae develop in the dark at 26°C for four days.
- d) After four days, most larvae will develop to a II instar state, which is recommended for bioassay (McLaughlin and Rogers 1998). Second instar *A. aegypti* were determined following Darsie's Key for identification of adult females and fourth stages larvae (Diptera: Culicidae) (Darsie 1985). The larvae are harvested with a plastic dropper and transferred to a 50-ml beaker that contains MES solution (5 mM, pH 6.5).
- e) Fill 48-well with 240 µl MES solution per well.
- f) Testing solutions were prepared in five different concentrations:
 - Solution A: Testing material prepared at a concentration of 5000 ppm. The original plant extract is weighed and dissolved in methanol in a sealed vial, to reach the stated concentration
 - Solution B: Testing material prepared at a concentration of 500 ppm. Solution A is diluted with methanol to reach desired concentration. The procedure is repeated for each solution.

- Solution C: Testing material prepared at a concentration of 50 ppm
- Solution D: Testing material prepared at a concentration of 5 ppm
- Solution E: Testing material prepared at a concentration of 0.5 ppm

Dilutions procedure was repeated for each of the 22 testing materials, and for two positive control materials: pure Rotenone and *Chrysanthemum* flowers extract

- g) Add three larvae per well.
- h) Inject five μ l of each solution into eight wells on the plate (equals 24 individuals/treatment).
- i) A negative control is included in each plate, consisting of injection of five μ l of pure methanol to each well.
- j) Cover the plate and incubate in the dark at 26°C for four days. Keep the environment humid to avoid drying the plate.
- k) Score dead larvae every 24 hours for four days. This is done by tapping on the plate and observing movement of the individuals.

The test was replicated four times. The test was done at about the same time each day, taking into account the concept of circadian rhythm of toxicity (Lever 1990:2), which states that toxicity of an insecticide to any given insect changes during the day and night

Similarly, the cycles of experiments were performed consistently seven days per week, to avoid any subtle differences between batches of larvae.

References

- Abad, M., P. Bermejo, E. Gonzales, I. Iglesias, A. Irurzun and L. Carrasco. 1998. Antiviral activity of Bolivian plant extracts. *General Pharmacology* 32(4): 499-503.
- Abad, M., P. Bermejo, S. Sanchez-Palomino, X. Chiriboga and L. Carrasco. 1999. Antiviral activity of some South American medicinal plants. *Phytoterapy Research* 13(2): 142-146.
- Abbott, W. S. 1925. A method of computing the effectiveness of an insecticide. *Journal of Economic Entomology* 18: 265-267.
- Abdallah, O. M., A. A. Ali and H. Itokowa. 1991. Cytotoxic activity of sesquiterpene lactones, isolated from *Ambrosia maritima*. *Pharmazie* 46(6): 472.
- Abe, F. and T. Yamauchi. 1979. Oleasides, novel cardenolides with an unusual framework in *Nerium oleander*. *Chemical Pharmacology Bulletin* 27(7): 1604-1610.
- Agrawal, R. and L. Kapadia. 1982. Treatment of piles with indigenous drugs - Pilex tablets and ointment along with Styplon. *Probe* 21(3): 201-204.
- Aguilar, A. and C. Zolla. 1982. Plantas tóxicas de Mexico. División de Información Ethnobotánica, Unidad de Investigación Biomédica en Medicina Tradicional y Herbolaria del Instituto Mexicano del Seguro Social, Mexico.
- Ahmad, V. U. and K. A. Alvi. 1987. Deacetoxybrachycarpone, a triterpenoid from *Cleome brachycarpa*. *Phytochemistry* 26(1): 626-638.
- Ahmed, B., T. Alam, M. Varshney and S. Khan. 2002. Hepatoprotective activity of two plants belonging to the Apiaceae and the Euphorbiaceae family. *Journal of Ethnopharmacology* 79(3): 313-316.
- Ahmed, S. M., S. Reza, S. Haider and A. Jabbar. 1994. Antimicrobial activity of *Cynodon dactylon*. *Fitoterapia* 65(5): 163-164.
- Alard, F., C. Stievenart, P. Vanparys, L. Thilemans and S. Geerts. 1991. Toxicity and mutagenicity of the molluscicidal plant *Ambrosia maritima* L. *Drug Chemical Toxicology* 14(4): 353-73.

- Alexiades, M. N. 1996. Collecting ethnobotanical data: an introduction to basic concepts and techniques. Pag. 53-88 *in* M. N. Alexiades, ed., Selected guidelines for ethnobotanical research: A field manual. The New York Botanical Garden, Bronx NY.
- Al-Hindawi, M., I. Al-Deen, M. Nabi and M. Ismail. 1989. Anti-inflammatory activity of some Iraqui plants using intact rats. *Journal of Ethnopharmacology* 26(2): 163-168.
- Ali, N., W. Juich, C. Kusnick and U. Lindequist. 2001. Screening of Yemeni medicinal plants for antibacterial and cytotoxic activities. *Journal of Ethnopharmacology* 74: 173-179.
- Alkire, B., A. Tucker and M. Maciarello. 1994. Tipo, *Minthostachys mollis* (Lamiaceae) and Ecuadorian mint. *Economic Botany* 48(1): 60-64.
- Amoros, M., B. Fauconnier and L. Girre. 1979. Antiviral properties of *Anagallis arvensis*, Primulaceae (constituents, virus inhibition tests) *Phytotherapy* 13(2): 122-133.
- Amoros, M. and R. L. Girre. 1987. Structure of two antiviral triterpene saponins from *Anagallis arvensis*. *Phytochemistry* 26(3): 787-791.
- Anwar, T., A. Jabbar, F. Khalique, S. Tahir and M. Shakeel. 1992. Plants with insecticidal activities against four major insect pests in Pakistan. *Tropical Pest Management* 38(4): 431-437.
- Areekul, S., P. Sinchaisri and S. Tiggavananon. 1987. Effects of Thai plant extracts on the Oriental fruit fly. *Natural Sciences* 21(4): 395-407.
- Arnason, J. T., T. Durst, M. Kobaisy, R. Marles, E. Szenasy, G. Guillet, S. Kacew, B. Hasspieler and A. Downe. 1995. Fate of phototoxic terthiophene insecticides in organisms and the environment. Pag. 144-151 *in* J. R. Heitz and K. R. Downum, ed., Light-Activated Pest Control. American Chemical Society, Washington D.C.
- Artizzu, N., L. Bonsignore, F. Cottiglia and G. Loy. 1996. Studies on the diuretic and antimicrobial activity of *Cynodon dactylon* essential oil. *Fitoterapia* 67(2): 174-176.
- Aswal, B., D. Bhakuni, A. Goel, B. Mehrotra and K. Mukherjee. 1984. Screening of Indian plants for biological activity: part X. *Indian Journal of Experimental Biology* 22(6): 312-332.

- Atal, C., J. Srivastava, B. Wali, R. Chakravarty, B. Dhawan and R. Rastogi. 1978. Screening of Indian plants for biological activity. *Indian Journal of Experimental Biology* 16: 330-349.
- Ayoub, S. and A. Babikera. 1984. Screening of plants used in Sudan folk medicine for anticancer activity. *Fitoterapia* 55(4): 209-212.
- Backhouse, N., C. Delporte, R. Negrete, P. Salinas, A. Pinto and S. Aravena. 1996. Antiinflammatory and antipyretic activities of *Cuscuta chilensis*, *Cestrum parqui* and *Psoralea glandulosa*. *International Journal of Pharmacology* 34(1): 53-57.
- Bader, G., V. Wray, U. Just and K. Hiller. 1998. Enzymatic hydrolysis of the cytotoxic triterpenoid glycoside virgaureasaponin I. *Phytochemistry* 49(1): 153-156.
- Badilla, B., G. Mora and L. Poveda. 1999. Anti-inflammatory activity of aqueous extracts of five Costa Rican medicinal plants in Sprague-Dawley rats. *Revista de Biología Tropical* 47(4): 723-727.
- Badwi, S. M., S. E. Adam and H. J. Hapke. 1995. Comparative toxicity of *Ricinus communis* and *Jatropha curcas* in Brown Hiss chicks. *Deutsche Tierärztliche Wochenschrift* 102(2): 75-77.
- Balint, G. A. 1974. Ricin: the toxic protein of castor oil seeds (*Ricinus communis*). *Toxicology* 2(1): 77-102.
- Barakat, A., H. Fahmy, M. Kandil and N. Ebrahim. 1985. Toxicity of the extracts of black pepper, cumin, fennel, chamomile and lupin against *Drosophila melanogaster*, *Ceratitis capitata* and *Spodoptera littoralis*. *Indian Journal of Agriculture* 55(2): 116-120.
- Barboni, L., A. Manzi, B. Bellomaria and A. Quinto. 1994. Alkaloid content in four *Spartium juncium* populations as a defensive strategy against predators. *Phytochemistry* 37(4): 1197-1200.
- Baslas, R. K. and N. Gupta. 1982. Chemical constituents of the bark of *Euphorbia tirucalli* India. *Indian Journal Pharmacological Science* 44(5): 113-115.
- Bazán, O. and J. López. 1991. Lenguaje y clasificación de los recursos naturales en la cultura Andina. PRATEC - PPEA (PNUMA), Lima. 147-163.
- Becker, B. 1988. Degradation and rehabilitation of Andean ecosystems -and example from Cajamarca. *Botanik* 62: 147-160.

- Becker, H., S. Chavadej, B. Tauscher, A. Pastor, E. Finner and F. Borchers. 1986. Monoene and diene-type valeportriates from *Phyllactis pulvinata*. *Phytochemistry* 25(5): 1250-1252.
- Bello, R., B. Beltran, L. Moreno, S. Calatayud, E. Primo-Yufera and J. Esplugues. 1998. In vitro pharmacological evaluation of the dichloromethanol extract from *Schinus molle* L. *PTR, Phytother-res* 12(7): 523-525.
- Benedict, W. F., N. Rucker, J. Faust and R. Kouri. 1975. Malignant transformation of mouse cells by cigarette smoke condensate. *Cancer Research* 35: 857.
- Benoit, P., H. Fong, G. Svoboda and N. Farnsworth. 1976. Biological and phytochemical evaluation of plants XIV. Antiinflammatory evaluation of 163 species of plants. *Lloydia* 39(2/3): 160-171.
- Berlin, B., E. Berlin, J. C. Fernández, L. García, D. Puett, R. Nash and M. González-Espinoza. 1999. The maya ICBG: Drug discovery, medical ethnobiology and alternative forms of economic development in the highland Maya region of Chiapas Mexico. *Pharmaceutical Biology* 37(Supplement): 127-144.
- Bermúdez, K., N. Robledo, J. Martínez, A. Tei and M. Wink. 1998. Alcaloides quinolizidinicos en semillas de *Lupinus montanus*. VI Congreso Latinoamericano de Botánica, XIV Congreso Mexicano de Botánica, Ciudad de México, UNAM.
- Bhakuni, D., M. Bittner, C. Maricorena, M. Silva, E. Weldt, M. Melo and R. Zemelman. 1974. Screening of Chilean plants for antimicrobial activity. *Lloydia* 37(4): 621-632.
- Bhattaral, N. 1992. Folk herbal remedies of Shinhupalchok district, Central Nepal. *Fitoterapia* 63(2): 145-155.
- Bilia, A., M. Fumarola, S. Gallori, G. Mazzi and F. Vincieri. 2000. Identification by HPLC-DAD and HPLC-MS analyses and quantification of constituents of fennel teas and decoctions. *Journal of Agricultural and Food Chemistry* 48(10): 4734-4738.
- Block, E., C. Guo and M. Thiruvazhi. 1994. Total synthesis of thiarubrine B (3-(3-buten-1-ynyl)-6-(1,3-pentadiynyl)-1,2-dithiin), the antibiotic principle of giant ragweed (*Ambrosia trifida*). *Journal of the American Chemical Society* 116: 9403-4.

- Blunden, G., M. H. Yang, G. Janicsak, I. Mathe and A. Carabot-Cuervo. 1999. Betaine distribution in the Amaranthaceae. *Biochemical Systematics and Ecology* 27(1): 87-92.
- Bocek, B. 1984. Ethnobotany of Costanoan Indians, California, based on collections by J. Harrington. *Economic Botany* 38(2): 240-255.
- Bohlmann, R., M. Grenz and C. Zdero. 1977. Naturally occurring terpene derivatives and constituents of the *Liabum* group. *Phytochemistry* 16: 285-286.
- Bories, C., P. Loiseau, D. Cortes, S. Myint, R. Hocquemiller, P. Gayral, A. Cave and A. Lauren. 1991. Antiparasitic activity of *Ammona muricata* and *A. cherimola* seeds. *Planta Medica* 57(5): 434-436.
- Bork, P. M., M. L. Schmitz, C. Weimann and M. Heinrich. 1996. Nahua indian medicinal plants (Mexico): inhibitory activity on NF-KB as anti-inflammatory model and antibacterial effects. *Phytomedicine* 3(3): 263-269.
- Bourke, C. A. 1995. The clinical differentiation of nervous and muscular locomotor disorders of sheep in Australia. *Australian Veterinary Journal* 72(6): 228-234.
- Brahmachari, G. and D. Chatterjee. 2002. Triterpenes from *Adiantum lunulatum*. *Fitoterapia* 73(5): 363-368.
- Brako, L. and J. L. Zarucchi. 1993. Catalogue of the Flowering Plants and Gymnosperms of Peru. The Missouri Botanical Garden Press, Saint Louis.
- Brown, D. 2001. Poisonous plants informational database, Animal Science at Cornell University. <http://www.ansci.cornell.edu/plants/toxicagents/toxagent.html> Access 12/08/02.
- Brush, S. B. 1976. Man's use of Andean ecosystem. *Human Ecology* 4(2): 147-166.
- Caceres, A., M. Giron and A. Martínez. 1987. Diuretic activity of plants used for the treatment of urinary ailments in Guatemala. *Journal of Ethnopharmacology* 19(3): 233-245.
- Cáceres, A., H. Menéndez, E. Méndez, E. Cohobon, B. Samayoa, E. Jauregui, E. Peralta and G. Carrillo. 1995. Antigonorrhoeal activity of plants used in Guatemala for the treatment of sexually transmitted diseases. *Journal of Ethnopharmacology* 48(2): 85-88.

- Cantin, A., C. Lull, J. Primo, M. Miranda and E. Primo-Yúfera. 2001. Isolation, structural assignment and insecticidal activity of (-)-(1S,2R,3R,4S)-1,2-epoxy-1-methyl-4-(1-methylethyl)-cyclohex-3-yl acetate, a natural product from *Mimhostachys tomentosa*. *Tetrahedron. Asymmetry* 12(4): 677-683
- Carlini, C. and J. Guimaraes. 1991. Plant and microbial toxic proteins as hemilectines emphasis on canatoxin. *Toxicon* 29(7): 791-806
- Castillo, J. 1995. Evaluation of botanical pesticides. Thesis, Biología, Universidad Nacional de Cajamarca. Cajamarca
- Cataluna, P. and S. Rates. 1997. The traditional use of the latex from *Euphorbia tirucalli* Linnaeus (Euphorbiaceae) in the treatment of cancer in South Brazil. Second World Congress on Medicinal and Aromatic Plants for Human Welfare, WOCMAP-2, Mendoza, Argentina, Acta-Horticulturae.
- Cavin, A., W. Dyatmyko and N. Hostettmann. 1999. Screening of Indonesian plants for antifungal and free radical scavenging activities. *Pharmaceutical Biology* 37(4): 260-268.
- Chakraborty, S., J. Siegenthaler and E. Buchi. 1995. Corneal edema due to *Asclepias curassavica*. *Archives of Ophthalmology* 113(8): 974-974.
- Chapin, M. 1991. Losing the way of the Great Father. *New Scientist* 131: 40-41.
- Chesney, M. and R. Adams. 1985. Co-evaluation of plant extracts as petrochemical substitutes and for biologically active compounds. *Economic Botany* 39(1): 74-86
- Chi, H. and S. Lee. 1981. Phytochemical screening of Korean medicinal plants. Seoul National University, Korea. 38-41.
- Chung, T. H., J. C. Kim, C. Y. Lee, M. K. Moon, S. C. Chae, I. S. Lee, S. H. Kim, K. S. Hahn and I. P. Lee. 1997. Potential antiviral effects of *Terminalis chebula*, *Sanguisorba officinalis*, *Rubus coreanus* and *Rheum palmatum* against duck hepatitis B virus (DHBV). *Phytotherapy Research* 11(3): 179-182.
- Ciccia, G., J. Coussio and E. Mongelli. 2000. Insecticidal activity against *Aedes aegypti* larvae of some medicinal South American plants. *Journal of Ethnopharmacology* 72(1-2): 185-189.

- Cichewicz, R. H. and P. A. Thorpe. 1996. The antimicrobial properties of chili peppers (*Capsicum* species) and their uses in Mayan medicine. *Journal of Ethnopharmacology* 52(2): 61-70.
- Cimanga, K., K. Kambu, L. Tona, S. Apers, T. D. Bruyne, N. Hermans, N. Totté, L. Pieters and A. Vlietinck. 2002. Correlation between chemical composition and antibacterial activity of essential oils of some aromatic medicinal plants growing in the Democratic Republic of Congo. *Journal of Ethnopharmacology* 79(2): 213-220.
- CIP. 2002. Andean Roots and Tubers Crops (ARTC's), Centro Internacional de la Papa <http://www.cipotato.org/org/org.htm> Access 10/06
- Consoli, R., N. Mendes, N. Pereira, J. Santos and M. Lamounier. 1988. Effect of several extracts derived from plants on the survival of larvae of *Aedes fluviatilis* (Lutz) (Diptera: Culicidae) in the laboratory. *Memorias Do Instituto Oswaldo Cruz* 83(1): 87-93.
- Crounse, R. G., J. Maxwell and H. Blank. 1962. Inhibition of growth of hair by mimosine. *Nature* 194: 694.
- Czernetzki, B., T. Thiele and T. Rosenbach. 1990. Immonoreactive leukotrienes in nettle plants (*Urtica urens*). *International Archives of Allergy and Applied Immunology* 91(1): 43-46.
- Damtonft, S., S. Jensen and B. Nielsen. 1979. Iridoids in *Verbena*. *Taxon* 25: 525-528.
- Darias, V., L. Bravo, E. Barquin, D. Herrera and C. Fraile. 1986. Contribution to the ethnopharmacological study of the Canary Islands. *Journal of Ethnopharmacology* 15(2): 169-193.
- Darsie, R. F. 1985. Mosquitoes of Argentina. Part I. Keys for identification of adult females and fourth stages larvae in English and Spanish (Diptera: Culicidae). *Mosquitoes Systematics* 17: 153-253.
- Davyt, D., E. Dellacassa, P. Ferreira, P. Menendez, P. Moyna and A. Vazquez. 1991. Phytochemical screening of Uruguayan medicinal plants. *Fitoterapia* 62(6): 519-521.
- De Bruyne, T., L. Pieters, H. Deelstra and A. Vlietinck. 1999. Condensed vegetable tannins: biodiversity in structure and biological activities. *Biochemical Systematics and Ecology* 27(4): 445-459.

- De la Vega, G. 1609. Comentarios Reales. Universidad Nacional del Cuzco, Cuzco
- De Moraes, C., M. Mark, J. Tumlinson and H. James. 2001. Caterpillar-induced nocturnal plant volatiles repel conspecific females. *Nature* 410(6828): 577-579.
- Deepak, M. and S. Handa. 2000. Antiinflammatory activity and chemical composition of extracts of *Verbena officinalis*. *Phytotherapy Research* 14(6): 463-465
- DeFeo, V., R. Aquino, A. Menghinla, E. Ramundo and F. Senatore. 1992. Traditional phytotherapy in the Peninsula Sorrentina Campania Southern Italy. *Journal of Ethnopharmacology* 36(2): 113-125
- Dei, G. S. 1993. Indigenous Africal knowledge systems: local traditions of sustainable forestry. *Singapore Journal of Tropical Geography* 14: 28-41
- Delgado, G., V. Tejeda, A. Salas, M. Chavez, S. Guzman, A. Bolanos, M. Aguilar, V. Navarro and M. Villarreal. 1998. New melampolides from *Schkuhria schkuhrioides*. *Journal of Natural Products* 61(9): 1082-1085.
- Del-V-Pacciaroni, A., V. Sosa, L. Espinar and J. Oberti. 1995. Sesquiterpene lactones from *Schkuhria pinnata*. *Phytochemistry* 19(1): 127-131
- Devehat, F., A. Bakhtiar, C. Bézivin, M. Amoros and J. Boustie. 2002. Antiviral and cytotoxic activities of some Indonesian plants. *Fitoterapia* 73(5): 400-405
- Dikshit, A., A. A. Naqvi and A. Husain. 1986. *Schinus molle*: a new source of natural fungitoxicant. *Applied Environmental Microbiology* 51(5): 1085
- Dillon, M. 1994. Bosques húmedos del Norte del Peru. *Arnaldoa* 2(1): 29-55.
- Doaigey, A. R. 1991. Occurrence, type, and location of calcium oxalate crystals in leaves and stems of 16 species of poisonous plants. *American Journal of Botany* 78(12): 1608-1616.
- Dobkin, M. 1968. *Trichocereus pachanoi* - A mescaline cactus used in folk healing in Peru. *Economic Botany* 22(2): 191-194.
- Dodds, C. J. 1996. The control of slug damage using plant-derived repellents and antifeedants. *Slug and Snail Pest in Agriculture*. Canterbury, UK, British Crop Protection Council.

- Duke, J. A. and R. Vasquez. 1994. Amazonian Ethnobotanical Dictionary. CRC Press. Boca Raton FL.
- Durand, R., J. Figueredo and E. Mandoza. 1999. Intoxication in cattle from *Cestrum diurnum*. Veterinary and Human Toxicology 41(1): 26-27.
- Ehattacharya, S. and B. Dasgupta. 1975. Central nervous system depressant activity of *Ipomea carnea* Jacq. Indian Journal of Pharmacology 7(4): 31-34.
- El-Emam, M. A., S. M. El-Amin and W. S. Ahmed. 1990. Molluscicidal properties of the plants *Cestrum parqui* (Fam. Solanaceae) and *Hedera canariensis* (Fam. Araliaceae). Egyptian Journal of Bilharziasis 12(1-2): 185-195.
- El-Gayar, F., A. El-Zhazli, S. Khafagy and W. Watson. 1975. Studies on the alkaloidal contents of *Nicotiana rustica* var. *Brasilia* (Aztec tobacco) and its insecticidal activity against *Culex pipiens* L. (Diptera: Culicidae) and *Spodoptera littoralis* Boisd. (Lepidoptera: Noctuidae). Z-Angew-Entomology 78(1): 49-55.
- Ellenberg, H. 1979. Man's influence on tropical mountain ecosystems in South America. Journal of Ecology 67: 401-416.
- Elliot, S. n.d. Bioresources database of ethnobiology: Guidance for contributors. Unpublished manuscript. Bioresources Ltd., London.
- El-Sayed, M. M., H. A. El-Nahas and L. A. Refahy. 1990. A study on the molluscicidal activity of *Calendula micrantha* (Officinals), *Anagallis arvensis* and *Agave filifera*. Egyptian Journal of Bilharziasis 12(1-2): 207-216.
- El-Shazly, M., M. Nassar and H. El-Sherief. 1996. Toxic effect of ethanolic extract of *Nerium oleander* (Apocynaceae) leaves against different developmental stages of *Musca stabulans* (Diptera-Muscidae). Journal of Egyptian Society of Parasitology 26(2): 461-473.
- EPA. 2002. Probit program. Cincinnati, Ecological Monitoring Research Division, U.S. Environmental Protection Agency.
- Erazo, S., V. González, M. Zaldivar and R. Negrete. 1997. Antimicrobial activity of *Psoralea glandulosa* L. International Journal of Pharmacognosy 35(5): 385-387.
- Escoubas, P., L. Lajide and J. Mizutani. 1994. Insecticidal and Antifeedant Activities of Plant Compounds. Pag. 551 in P. A. Hedin, J. J. Menn and R. M. Hollingworth, ed., Natural Engineered Pest Management Agents. ACS, Washington D.C.

- Evans, T. D. and K. Sengdala. 2002. The adoption of Rattan cultivation for edible shoot production in Lao PDR and Thailand -from non timber forest product to cash crop-. *Economic Botany* 56(2): 147-153.
- Fagbenro-Beyioku, A. F., W. Oyibo and B. Anuforom. 1998. Disinfectant/antiparasitic activities of *Jatropha curcas*. *East-African Medical Journal* 75(9): 508-511
- Fenny, A., G. Hunter and O. Chambliss. 2002. Inheritance of bitterness in *Cucurbita pepo* L., Department of Horticulture and Alabama Agricultural Experiment Station http://www.umresearch.umd.edu/CGC/cgc10/cgc10_39.htm Access 12/9/02
- Fernández, T., M. Wagner, B. Varela, R. Ricco, S. Hajos, A. Gurni and E. Alvarez. 1998. Study of an Argentine mistletoe, the hemiparasite *Ligaria cuneifolia* (R&P) Tiegh. (Loranthaceae). *Journal of Ethnopharmacology* 62(1): 25-34.
- Finney, D. J. 1952. Probit analysis. 2nd Cambridge University Press., Cambridge.
- Fournet, A., A. Rojas, B. Charles and J. Bruneton. 1996. Chemical constituents of essential oils of Muña, Bolivian plants traditionally used as pesticides, and their insecticidal properties against Chagas disease vectors. *Journal of Ethnopharmacology* 52(3): 145-149.
- Frank, A. A. and W. M. Reed. 1990. Comparative toxicity of coniine, an alkaloid of *Conium maculatum* (poison hemlock), in chickens, quails and turkeys. *Avian-Dis* 34(2): 433-437.
- Franquemont, C. 1988. Chinchero plant categories: an Andean logic of observation Thesis, Anthropology, Cornell. Ithaca.
- Freixa, B., R. Vila, L. Vargas, N. Lozano, T. Adzet and S. Canigueral. 1998. Screening for antifungal activity of nineteen Latin American plants. *Phytotherapy Research* 12(6): 427-430
- Friedman, J., Z. Yaniv, A. Dafni and D. Palewitch. 1986. A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev Desert, Israel. *Journal of Ethnopharmacology* 16: 275-287
- Gade, D. W. 1975. Plants, man and the land in the Vilcanota Valley of Peru. Dr. W. Junk B.V. Publishers, The Hague.

- Gaillard, Y. and G. Pepin. 1999. Poisoning by plant material: review of human cases and analytical determination of main toxins by high-performance liquid chromatography -(tandem) mass spectrometry. *Journal of Chromatography B*(733): 181-229.
- Galvez, J. M., B. Riedl and A. Conner. 1997. Analytical studies on tara tannins. *Holzforschung* 51(3): 235-243.
- Ganzer, U. and J. Jakupovic. 1990. Schkuhripinnatolides, unusual sesquiterpene lactones from *Schkuhria pinnata*. *Phytochemistry* 29(2): 535-539.
- Garg, S. K., R. Gupta and N. Sharma. 1979. Apiumoside, a new furanocoumarin glucoside from the seeds of *Apium graveolens*. *Phytochemistry* 18(10): 1764-1765.
- . 1979. Minor phenolics of *Apium graveolens* seeds. *Phytochemistry* 18(2): 352.
- Gava, A., L. Stolf, M. S. Varaschin, D. S. Neves, A. P. Tigre and F. Lesmann. 1996. Poisoning of cattle with *Cestrum intermedium* (Solanaceae). *Pesquisa Veterinaria Brasileira* 16(4): 117-120.
- Gebre-Amlak, A. and F. Azerefegne. 1993. Insecticidal activity of chinaberry, endod and pepper tree against the maize stalk borer (Lepidoptera: Noctuidae) in southern Ethiopia. *International Journal of Pest Management* 45(1): 9-13.
- Geerts, S., K. Blerk and L. Triest. 1994. Effect of *Ambrosia maritima* on *Anopheles stephensi* and *Aedes aegypti*. *Journal of Ethnopharmacology* 42: 7-11.
- Gerhard, H. and B. Wyk. 1991. Pyrrolizidine alkaloids from seeds of *Crotalaria capeis*. *Phytochemistry* 31(1): 369-371.
- Giron, L. M., V. Freire, A. Alonzo and A. Caceres. 1991. Ethnobotanical survey of the medicinal flora used by the Caribs of Guatemala. *Journal of Ethnopharmacology* 34(2/3): 173-187.
- Goeden, R. D. and D. W. Ricker. 1982. Poison hemlock, *Conium maculatum*, in southern California, an alien weed attacked by few insects biological control. *Annals of Entomology Society of America* 75(2): 173-176.
- Gonzales, E., I. Iglesias, E. Carretero and A. Villar. 1999. Gastric cytoprotection of Bolivian medicinal plants. *Journal of Ethnopharmacology* 70(3): 329-333.

- Gonzalez, A., F. Ferreira, A. Vazquez, P. Moyna and E. Paz. 1993. Biological screening of Uruguayan medicinal plants. *Journal of Ethnopharmacology* 39(3): 217-220
- Goun, E., V. Petrichenko, S. Solodnikov, T. Suhinina, M. Kline, G. Cunningham, C. Nguyen and H. Miles. 2002. Anticancer and antithrombin activity of Russian plants. *Journal of Ethnopharmacology* 81(3): 337-342
- Greinwald, R., P. Bachmann, L. Witte, J. Acebes and F. Cyszgan. 1992. Taxonomic significance of alkaloids in the genus *Adenocarpus* (Fabaceae-Genisteae). *Biochemical Systematics and Ecology* 20(1): 69-73
- Grierson, D. S. and A. J. Afolayan. 1999. Antibacterial activity of some indigenous plants used for the treatment of wounds in the Eastern Cape, South Africa. *Journal of Ethnopharmacology* 66(1): 103-106
- Grinspoon, L. and J. B. Bakalar. 1997. *Psychedelic Drugs Reconsidered*. The Lindesmith Center, New York City.
- Guardiola, V., G. Miguel and E. Primo. 1990. Repellents activity against *Blattella germanica* of components de *Schinus molle* L. *Revista de Agroquímica y Tecnología de Alimentos* 30(3): 341-346
- Guil, J. L., I. Rodriguez-Garcia and E. Torija. 1997. Nutritional and toxic factors in selected wild edible plants. *Plant Foods for Human Nutrition* 51(2): 99-107
- Guillen, M. E., J. Emim, C. Souccar and A. J. Lapa. 1997. Analgesic and antiinflammatory activities of the aqueous extract of *Plantago major* L. *International Journal of Pharmacognosy* 35(2): 99-104
- Gurib-Fakima, A., M. Swera, J. Gueho and E. Dullo. 1996. Medicinal plants of Rodrigues. *International Journal of Pharmacognosy* 34(1): 2-14
- Gyamfi, M. A., M. Yonamine and Y. Aniya. 1999. Free-radical scavenging action of medicinal herbs from Ghana: *Thonningia sanguinea* on experimentally-induced liver injuries. *General Pharmacology* 32(6): 661-7
- Halaweish, F., S. Kronberg, M. Hubert and J. Rice. 2001. Toxic and aversive diterpenes of *Euphorbia esula*, Agricultural Research Service.
<http://www.nal.usda.gov/ttic/tektran/data/000012/67/0000126739.html> Access 3/10

- Harborne, J. B. 1993. Introduction to Ecological Biochemistry. Academic Press Ltd., New York.
- Harraz, F. M., A. R. Ayad and J. Zagazig. 1994. Phytochemical and biological investigation of *Cleome amblyocarpa* Barr. et Murb. Journal Pharmacology 3(3A): 64-71.
- Hartzell, A. and F. Wilcoxon. 1941. A survey of plant products for insecticidal properties. Contributions Boyce Thompson Institute 12: 127-141.
- He, X., L. Lian, L. Lin and M. Nernart. 1997. High-performance liquid chromatography-electrography-electrospray mass spectrometry in phytochemical analysis of sour orange (*Citrus aurantium* L.) Journal of Chromatography 791(1/2): 127-134.
- Heggarty, P. 1999. Quechua.
http://www.shef.ac.uk/q/quechua/i_ISSUES.HTM#ThreeVowelsOrFive Access 3/5/03
- Hensold, N. 1999. Las Angiospermas endémicas del Departamento de Cajamarca, Peru. Arnaldoa 6(2): 141-184.
- Hermann, M. and J. Heller. 1997. Andean roots and tubers. Ahipa, arracacha, maca, yacon. Promoting the conservation and use of underutilized and neglected crops. Institute of Plant Genetics and Crop Plant Research, Gatersleben.
- Herrera, F. L. 1941. Plantas alimenticias domesticadas por los Inkas cuyo uso se encuentra poco generalizado. Chaski 1(3): 11-18.
- Hoet, P. 1980. The use of certain plants from the traditional pharmacopeia of Peru. Planta Medica 14(3): 193-201.
- Hudson, J. B., L. Harris, R. Marles and J. Arnason. 1993. The anti-HIV activities of photoactive terthiophenes. Photochemistry and Photobiology 58: 246-250.
- Hudson, R. A. 1993. Peru, a country study. Library of Congress, Washington D.C.
- Humphreys, D. J. 1969. The toxic factors of the seed of *Abrus precatorius*. Phytochemistry 8(12): 2397-2400.
- Ikawati, Z., S. Wahyuono and K. Maeyama. 2001. Screening of several Indonesian medicinal plants for their inhibitory effect on histamine release from RBL-2H3 cells. Journal of Ethnopharmacology 75(2): 249-256.

- Indacochea, A., B. Avolio, L. Bedoya, J. Carrillo, G. Negron, L. Sánchez and M. Santillana. 2001. *Cajamarca competitiva*. Saywa ediciones, Lima
- INEI. 1997. *Compendio de estadísticas sociales*. Instituto Nacional de Estadística e Informática, Lima.
- Innocenti, G., E. M. Cappelletti and G. Caporale. 1991. Furocoumarin contents in the vegetative organs of cultivated *Psoralea* species. *International Journal of Pharmacognosy* 29(4): 311-316.
- Innocenti, G., F. Dall'Acqua and G. Caporale. 1976. Investigations of the content of furocoumarins in *Apium graveolens* (celery) and *Petroselinum sativum* (parsley). *Planta Medica* 29(2): 165-170.
- Ioset, J., A. Marston, M. P. Gupta and K. Hostettmann. 2000. Antifungal and larvicidal cordiaquinones from the roots of *Cordia curassavica*. *Phytochemistry* 53(5): 613-617.
- Ippen, H. 1990. Contact allergy to *Phacelia* spp. (Hydrophyllaceae). *Dermatologic Clinics* 8(1): 67-71.
- Ishkuran, N. 1982. Flavonol glycosides in the flowers of *Hibiscus mutabilis* F. *versicolor*. *Agricola Biological Chemistry* 46: 1705-1706.
- Isman, M. B. 1999. Neem and Related Natural Products. Pag. 626 in J. J. Menn, and F. R. Hall, ed., *Methods in Biotechnology: Biopesticides, Use and Delivery*. Humana Press, Totowa, NJ.
- Jacinto, J., J. Lapa and S. Caden. 1988. Pharmacological studies on the crude extract from *Datura arborea* L. *Acta Amazonica Suplemento* 18(1-2): 135-143.
- Jakupovic, J., A. Schuster, F. Bohlmann and M. Dillon. 1988. Lumiyomogin, ferreyrantholide, fruticolide and other sesquiterpene lactones from *Ferreyranthus fruticosus*. *Phytochemistry* 27(4): 1113-1120.
- Janzen, D. H. 1980. When is it coevolution? *Evolution* 34: 611-612.
- Jennings, W. G. and R. A. Bernhard. 1975. Identification of components of the essential oil from the California pepper tree (*Schinus molle* L.). *Chemical Microbiology Technology Lebensm* 4(3): 95-96.

- Johns, T., J. O. Kokwaro and E. K. Kimanani. 1990. Herbal remedies of the Luo of Siaya District, Kenya: establishing quantitative criteria for consensus. *Economic Botany* 44(3): 369-381.
- Johns, T., E. B. Mhoru, P. Sanayaand and K. Kimanani. 1994. Herbal remedies of the Batemi of the Ngorongoro District. *Economic botany* 48(1): 90-95.
- Jorgensen, P. M. and S. León-Yáñez. 1999. Catalogue of the Vascular Plants of Ecuador. Missouri Botanical Garden Press, Saint Louis.
- Jossang, A., H. Jacquemin, J. L. Pouset and A. Cave. 1981. Alkaloids of *Borreria capitata*. *Plant Medical Journal Plant Research* 43(3): 301-304.
- Julkunen-Tiitto, R. 1989. Phenolic constituents of *Salix*: a chemotaxonomic survey of further sinnish species. *Phytochemistry* 28(8): 2115-2125.
- Karmegan, N., M. Sakthivadivel, V. Anuradha and D. Thilagavathy. 1997. Indigenous plant extracts as larvicidal agents against *Culex quinquefasciatus* Say. *Bioresource Technology* 59(2-3): 137-140.
- Kashiwada, Y., G. I. Nonaka, I. Nishioka, J. J. Chang and K. H. Lee. 1992. Antitumour agents, 129. Tannins and related compounds as selective cytotoxic agents. *Journal of Natural Products* 55(8): 1033-1043.
- Kavalali, G. and H. Tuncel. 1997. Anti-inflammatory activities of *Urtica pilulifera*. *International Journal of Pharmacognosy* 35(2): 138-140.
- Keeler, R. F., L. D. Balls, J. L. Shupe and M. W. Crowe. 1980. Teratogenicity and toxicity of coniine alkaloid of *Conium maculatum* in cows, ewes and mares. *Cornell Veterinary* 70(1): 19-26.
- Kher, A. and S. Chaurasia. 1977. Anti-fungal activity of essential oils of three medicinal plants (*Pongamia pinnata* pier, *Apium graveolens*, *Azadirachta indica*). *Indian Drugs* 15(3): 41-42.
- Kim, D. and A. Young. 2001. Contact and fumigant activities of constituents of *Foeniculum vulgare* fruit against three coleopteran stored-product insects. *Pest Management Science* 57(3): 301-306.
- Kinghorn, D. 1979. Characterization of an irritant 4-deoxyphorbol diester from *Euphorbia tirucalli*. *Journal of Natural Products* 42(1): 112-115.

- Kinjo, J., H. Uemura, M. Nakamura and T. Nohara. 1994. Two new triterpenoidal glycosides from *Medicago polymorpha* L. *Chem Pharm Bulletin* 42(6): 1339-41
- Knight, A. P. 1988. Oleander poisoning. *Compend-Contin-Educ-Pract-Vet* 10(2): 262-263.
- Knight, T. 2002. Poisonous plants affecting livestock on Colorado's Eastern Plains. Colorado State University
<http://www.colostate.edu/Depts/CoopExt/GPA/pplants.htm> Access 12/05/02
- Kokoska, L., Z. Polesny, V. Rada, A. Nepovim and T. Vanek. 2002. Screening of some Siberian medicinal plants for antimicrobial activity. *Journal of Ethnopharmacology* 82(1): 51-53.
- Kosuge, T., H. Ishida, M. Yokota and M. Yoshida. 1984. Studies on antihemorrhagic substances in herbs classified as hemostatics in Chinese medicine III on the antihemorrhagic principle in *Sanguisorba*. *Chemical Pharmacological Bulletin* 32(11): 4478-4481.
- Kramer, F. L. 1957. The pepper tree, *Schinus molle* L. *Economic Botany* 11(4): 322-326.
- Kulkarni, D. K., M. Kumbhojkar and D. Nipunage. 1990. Note on fish stupefying plants from western Maharashtra. *Indian Forester* 116(4): 331-333.
- Kumarasamy, Y., P. Cox, M. Jaspars, L. Nahar and S. Satyajit. 2002. Screening seeds of Scottish plants for antibacterial activity. *Journal of Ethnopharmacology* 83(1): 73-77.
- Kwon, H., K. Lee and O. Zee. 1997. Cytotoxic constituents of *Pilea mongolica*. *Archives of Pharmacological Research* 20(2): 180-183.
- La Torre, M. 1998. Etnobotanica de los recursos vegetales silvestres del caserio de Yanacancha, Dto de Chumuch, Provincia de Celendin, Dep. de Cajamarca. Thesis, Biologia, Universidad Nacional Agraria La Molina. Lima.
- Labbe, C., F. Faini, J. Coll and J. Connolly. 1996. Bakuchiol derivatives from the leaves of *Psoralea glandulosa*. *Phytochemistry* 42(5): 1299-1303.
- Lawrence, B. M. 1997. Progress in essential oils. *Perfumer and Flavorist* 22(5): 71-83.

- Lentz, D. L., A. Clark, C. Hufford, B. Meurer-Grimes, C. Passreiter, J. Cordero, O. Ibrahimi and A. Okunade. 1998. Antimicrobial properties of Honduran medicinal plants. *Journal of Ethnopharmacology* 63(3): 253-263.
- Lever, B. G. 1990. Crop protection chemicals. Ellis Horwood Ltd, Chichester.
- Levine, A. 1981. The Mexican plant zoapatle (*Montanoa tomentosa*) in reproductive medicine: past, present and future. *Journal of Reproductive Medicine* 26: 524-528.
- Lin, J. Y., T. Yan, L. Ting and T. Tung. 1976. Toxic and nontoxic lectins from *Abrus precatorius* and *Ricinus communis* (Castorbeans). International Symposium on Animal, Plant and Microbial Toxins.
- Lurz, G., R. Greinwald, L. Witte and F. Czygan. 1990. Quinolizidine alkaloids in *Spartium junceum*. *Planta Medica* 56(6): 522.
- Luteyn, J. L. 1999. Paramos. The New York Botanical Garden Press, New York.
- Maeda, H., T. Katsuki, T. Akaike and R. Ake. 1992. System and scavenging of alkyl peroxide radicals by various vegetable extracts. *JAP Journal Cancer Research* 89(9): 923-928.
- Makonnen, E., A. Rostom, G. Assefa and L. Zerihun. 1997. Antifertility effect of *Jatropha curcas* L. seed in guinea pigs. *Ethiopian Journal of Health Development* 11(2): 145-148.
- Manandhar, N. P. 1995. Inventory of some herbal drugs of Myagdi district, Nepal. *Economic Botany* 49(4): 371-379.
- Mantilla, O. 1994. Utilización de productos vegetales en la prevención de *Pagocerus frontalis* en maíz almacenado. Thesis, Biología, Universidad Nacional de Cajamarca. Cajamarca.
- Martin, G. J. 1995. Ethnobotany: A peoples and plants conservation manual. Chapman & Hall, New York.
- Matsuse, I. T., Y. Lim, M. Hattori, M. Correa and M. Gupta. 1999. A search for anti-viral properties in Panamanian medicinal plants. The effects on HIV and its essential enzymes. *Journal of Ethnopharmacology* 64(1): 15-22.
- McCaleb, R. 1998. Nettle leaf enhances effectiveness of anti-inflammatory drug. *HerbalGram* 42: 16-17.

- McLaughlin, J. L. and L. Rogers. 1998. The use of biological assays to evaluate botanicals. *Drug Information Journal* 32: 513-524.
- Mekkawi, A. G., M. S. Al-Said, J. S. Mossa, I. A. Al-Meshal, M. S. Hinawy and M. A. Yahaya. 1985. Aromatic plants of Saudi Arabia: essential oil of *Cleome chrysantha*, Decne. Saudi Biology Society, Riyadh, Saudi Arabia, Department of Pharmacology.
- Melek, F. R., T. Miyase, S. Abdel-Khalik, M. Hetta and I. Mahmoud. 2002. Triterpenoid saponins from *Oreopanax guatemalensis*. *Phytochemistry* 60(2): 185-195.
- Mellick, L. B., G. A. Makowski, G. Mellick and R. Borger. 1999. Neuromuscular blockade after ingestion of tree tobacco (*Nicotiana glauca*). *Annals of Emergency Medical* 34(1): 101-104.
- Meyer, P. 1989. Thiaminase activities and thiamine content of *Pteridium aquilinum*. *Onderstepoort Journal of Veterinary Research* 56(2): 145-146.
- Michael, G., S. Ahmed, W. Mitchel and J. Hylein. 1985. Plant species reportedly possessing pest control properties. University of Hawaii, Hawaii. 249.
- Misra, A. and S. Misra. 1965. Study on the toxic effect of *Ipomea carnea* in sheep, goats and cattle. *Indian Veterinary Journal* 42(9): 703-707.
- Mitchell, J. D. 1990. The poisonous Anacardiaceae genera of the world. *Advances in Economic Botany* 8: 103-129.
- Mitich, L. W. 1998. Poison-hemlock (*Conium maculatum* L.). *Weed Technology* 12(1): 194-197.
- Moerman, D. E. 1978. Symbols and selectivity: A statistical analysis of Native American medical ethnobotany. *Journal of Ethnopharmacology* 1: 111-119.
- Mohamed, S., S. Saka, S. El-Sharkawy, A. Manaf and S. Muid. 1996. Antimycotic screening of 58 Malaysian plants against plant pathogens. *Pesticide Science* 47(3): 259-264.
- Mohammad, H. Y., S. I. Husain and A. Al-Zarari. 1981. Effect of plant extracts of some poisonous plants of Iraq on mortality of citrus nematode, *Tylenchulus semipenetrans*, *Eminium introtum*, *Urtica urens*, *Cephaloria syriaca*. *Acta Botanica Indica* 9(2): 198-200.

- Mokkhasmit, M., K. Swatdimongkol and P. Satrawaha. 1971. Study on toxicity of Thai medicinal plants. *Bulletin of Department of Medicine* 12(2/4): 36-65
- Monasterio, M. 1980. *Estudios Ecologicos en los Paramos Andinos*. Ediciones Universidad de los Andes, Merida.
- Montoya, E. and G. Figueroa. 1990. *Geografia de Cajamarca*. Labrusa S.A., Lima, Peru
- Morgan, E. D. and I. D. Wilson. 1985. Methods and techniques for isolation of pesticides. Pag 3-12 *in* M. N. Bhushan, ed., *CRC series in naturally occurring pesticides* CRC Press, Boca Raton Fla.
- Morrow, K. 1997. Mejoramiento de la gestión de recursos naturales en Cajamarca, Perú. International Development Research Center.
http://www.idrc.ca/reports/read_article_english.cfm?article_num=165 Access 3/23/03
- Moulin-Traffort, J., R. Giordani and P. Régli. 1990. Antifungal action of latex saps from *Lactuca sativa* L. and *Asclepias curassavica* L. *Mycoses* 33(7): 383-392.
- Moussatché, M. and N. Daló. 1973. Algunas observaciones en caprinos alimentados con *Ipomea carnea* o *abutiloide*. V Seminario de Productos Naturales, Barquisimeto Venezuela.
- Muanza, D. N., K. Euler, L. Williams and D. Newman. 1995. Screening for antitumoral and anti-HIV activities of nine medicinal plants from Zaire. *International Journal of Pharmacognosy* 33(2): 98-106.
- Mukhopadhyay, S. K. and B. Duary. 1995. Ethnobotany of some common crop field weeds in a sub-humid agricultural tract of West Bengal. National Symposium on Sustainable Agriculture in Sub-humid Zone, Sriniketan, West Bengal, India, Visva-Bharati, Institute of Agriculture.
- Muller, A. A., J. Kufer, K. Dietl, J. Reiter, M. Grau and M. Weigend. 1999. Iriod glucosides chemotaxonomic markers in Loasoideae. *Phytochemistry* 52(1): 67-78
- Munoz, D., I. Urrudia, I. Leanizbarrutia and L. Fernandez. 1989. Contact dermatitis from plants in a geriatric nurse. *Contact Dermatitis* 20(3): 227-228.
- Muñoz-Collazos, S., J. Soriano-Ferrufino, G. Collin, F. Jean and H. Deslauriers. 1993. Variability in the composition of the essential oils of *Minthostachys andina* in central Bolivia. *Phytochemistry* 33(1): 123-127.

- Murphy, M. 1999. Plant products as antimicrobial agents. *Clinical Microbiology Reviews* 12(4): 564-582.
- Muzquiz, M., C. Cuadra, C. Cuadrado, C. Burbano, R. Calvo and C. Cuadra. 1994. Herbicide-like effect of *Lupinus* alkaloids. *Industrial Crops and Products* 2(4): 273-280.
- Nascimento, S. C., A. Chiappeta and R. Lima. 1990. Antimicrobial and cytotoxic activities in plants from Pernambuco, Brazil. *Fitoterapia* 61(4): 353-355.
- N'gouemo, P., M. Baldy-Moulinier and C. Nguemby-Bina. 1996. Effects of an ethanolic extract of *Desmodium adscendens* on central nervous system in rodents. *Journal of Ethnopharmacology* 52(2): 77-83.
- Nikol'skaya, B. S. 1954. Preparations of plant origin. *Biokhimikov Farmakologov Akad Nauk SSR* 2: 194-197.
- Novo, R. J., A. Viglianco and M. Nassetta. 1997. Repellents activity of different plant extracts on *Tribolium castaneum* (Herbst). *AgriScientia* 14: 31-36.
- OAS. 2002. Trade unit: Supporting the effort to expand trade and integration in the Americas, Organization of American States. <http://www.sice.oas.org/tunit/About.asp> Access 10/02.
- Oelrichs, P. B., C. Calanasan, J. MacLeod and A. Seawright. 1995. Isolation of a compound from *Eupatorium adenophorum* (Spreng.) [*Ageratina adenophora* (Spreng.)] causing hepatotoxicity in mice. *Natural Toxins* 3(5): 350-354.
- Oluwole, F. S. and A. F. Bolarinwa. 1997. *Jatropha curcas* extract causes anemia in rat. *Phytotherapy Research* 11(7): 538-539.
- Pande, A., Y. Shukla and A. Tripathi. 1995. Lipid constituents from *Stellaria media*. *Phytochemistry* 39(3): 709-711.
- Panter, K. E., T. D. Bunch and R. F. Keeler. 1988. Maternal and fetal toxicity of poison hemlock (*Conium maculatum*) in sheep. *American Journal of Veterinary Res.* 49(2): 281-283.
- Panter, K. E., L. James, B. Stegelmeier, M. Ralphs and J. Pfister. 1999. Locoweeds effects on reproduction in livestock. *Journal of Natural Toxins* 8(1): 53-62.

- Papachristos, D. and D. Stamopoulos. 2001. Repellent, toxic and reproduction inhibitory effects of essential oil vapors on *Acanthoscelides obtectus* Say (Coleoptera: Bruchidae). *Journal of Stored Products Research* 38(2): 117-128.
- . 2002. Toxicity of vapors of three essential oils to the immature stages of *Acanthoscelides obtectus* Say (Coleoptera: Bruchidae). *Journal of Stored Products Research* 38(4): 365-373.
- Papadoyannis, I., H. VanEgmond, A. Visconti, A. Boenke and G. Speijers. 1994. Determination of *Datura* alkaloids by using chromatographic techniques. *Mycotoxins and toxic plant components*, Lisbon, Portugal
- Parmar, V., S. Jain, S. Gupta, S. Talwar, V. Rajwanshi, R. Kumar, A. Azim, S. Malhotra, N. Kumar and R. Jain. 1998. Polyphenols and alkaloids from *Piper* species. *Phytochemistry* 49(4): 1069-1078.
- Peng, H., C. Qu, Z. Yang and Y. Liu. 1997. Studies on antiviral effect of extract from *Alternanthera philoxeroides* Griseb on epidemic hemorrhagic fever virus in vivo. *Antiviral Research* 34(2): 90.
- Perez, C. and C. Anesini. 1994. Inhibition of *Pseudomonas aeruginosa* by Argentinean medicinal plants. *Fitoterapia* 65(2): 169-172.
- Perez, R., G. Yescas and A. Walkowskia. 1985. Diuretic activity of Mexican *Equisetum*. *Journal of Ethnopharmacology* 12(2/3): 269-272.
- Pérez, R. M., G. Laguna and A. Walkowski. 1985. Diuretic activity of Mexican *Equisetum*. *Journal of Ethnopharmacology* 14(2-3): 269-272.
- Pérez Vidal, J. 1954. La antigua técnica azucarera en el Perú. *Tradición* 6(15): 91-95.
- Petrovic, S. D., M. S. Gorunovic, V. Vajs and M. Dermanovic. 1996. Triterpenoids from *Hieracium plumulosum* A. Kerner, L., Asteraceae. *Pharmazie* 51(12): 996-997.
- Petrovic, S. D., R. Loscher, M. Gorunovic and I. Merfort. 1999. Flavonoid and phenolic acid patterns in seven *Hieracium* species. *Biochemical Systematics and Ecology* 27(6): 651-656.
- Philbey, A. W., A. Hawker and J. Evers. 2001. A neurological locomotor disorder in sheep grazing *Stachys arvensis*. *Australian Veterinary Journal* 79(6): 427-430.

- Pieroni, A., V. Janiak, C. Durr, S. Ludeke, E. Trachsel and M. Heinrich. 2002. In vitro antioxidant activity of non-cultivated vegetables of ethnic Albanians in southern Italy. *Phytotherapy Research* 16(5): 467-473.
- Plotkin, M. J. 1988. The outlook for new agricultural and industrial products from the Tropics. Pag. 106-116 *in* E. O. Wilson, ed., *Biodiversity*. National Academy Press, Washington D.C.
- Popenoe, H., S. King, J. Leon and L. Kalinowski. 1989. Lost crops of the Incas: little-known plants of the Andes with promise for worldwide cultivation. National Academy Press, Washington D.C.
- Pothier, J., S. Cheav, N. Galand, C. Dormeau and C. Viel. 1998. A comparative study of the effects of sparteine, lupanine and lupin extract on the central nervous system of the mouse. *Journal of Pharmacy and Pharmacology* 50(8): 949-954.
- Prakash, A. and J. Rao. 1997. *Botanical Pesticides in Agriculture*. CRC, Boca Raton FL.
- PRATEC. 1989. Sorochocho, chacra campesina y saber andino. II Taller Regional Norandino de Tecnologías Campesinas, Sorochocho, Peru.
- Pushpalatha, E. and J. Muthukrishnan. 1995. Larvicidal activity of a few plant extracts against *Culex quinquefasciatus* and *Anopheles stephensis*. *Indian Journal of Malariology* 32(1): 14-23.
- Qasem, J. R. and H. Abu-Blan. 1996. Fungicidal activity of some common weed extracts against different plant pathogenic fungi. *Journal of Phytopathology* 144(3): 157-161.
- Rachlin, J. W. 1967. A study comparing the effectiveness of fish tissue in culture and whole animal studies as a means of assaying the effects of aquatic pollutants. Ph.D. Dissertation, Biology Department New York University, New York.
- Radford, D. J., A. Gillies, J. Hinds and P. Duffy. 1986. Naturally occurring cardiac glycosides. *The Medical Journal of Australia* 144(10): 540-544.
- Ralphs, M., K. Panter and L. James. 1990. Feed preferences and habituation of sheep poisoned by locoweed. *Journal of Animal Science* 68(5): 1354-1362.
- Ramirez, V., L. Mostacero, A. Garcia, C. Mejia and P. Pelaez. 1988. *Vegetales Empleados en Medicina Tradicional Norperuana*. Banco Agrario del Peru and Universidad Nacional de Trujillo, Trujillo, Peru.

- Rao, K., K. Sreeramulu, K. Gunasekar and D. Ramesh. 1993. Two new sesquiterpene lactones from *Celaena pentandra*. *Journal of Natural Products* 56: 2041-2045
- Ravn, H. and L. Brimer. 1988. Structure and antibacterial activity of plantamajoside, a caffeic acid sugar ester from *Plantago major* subsp. *major*. *Phytochemistry* 27(11): 3433-3437.
- Redwane, A., H. B. Lazrek, S. Bouallam, M. Markouk, H. Amarouch and M. Jana. 2002. Larvicidal activity of extracts from *Quercus lusitania* var. *infectoria* galls (Oliv.). *Journal of Ethnopharmacology* 79(2): 261-263
- Reher, G. and M. Budesinsky. 1992. Triterpenoids from plants of the Sanguisorbeae. *Phytochemistry* 31(11): 3909-3914.
- Reynolds, G. and E. Rodriguez. 1986. Dermatotoxic phenolics from glandular trichomes of *Phacelia campanularia* and *P. pedicellata*. *Phytochemistry* 25(7): 1617-1619.
- Riet-Correa, F. and M. Mendez. 1992. An introduction to the study of poisonous plants. *Veterinaria Montevideo* 28(118): 24-27.
- Rivas, M. 1986. Analisis quimico y modo de acción de cinco plantas para el control de plagas de la papa. Thesis, Biología, Universidad Nacional. Cajamarca
- Ross, S., M. S. D. Bishay and A. Awad. 1980. Studies for determining antibiotic substances in some Egyptian plants. *Fitoterapia* 51: 303-308.
- Rothwell, J. T. and D. J. Marshall. 1986. Suspected poisoning of sheep by *Anagallis arvensis* (scarlet pimpernel). *Australian Veterinary Journal* 63(9): 316.
- Ruberto, G., M. Baratta, S. Deans and H. Dorman. 2000. Antioxidant and antimicrobial activity of *Foeniculum vulgare* and *Crithmum maritimum* essential oils. *Planta Medica* 66(8): 687-693
- Ruiz, H. and J. Pavón. 1794. *Flora peruviana et chilensis*. Fundacion de Ciencias de la Salud, Madrid.
- Sadekar, R. D., A. G. Bhandarkar, S. D. Udasi, P. N. Deshmukh and B. S. Phadnaik. 1995. Toxicity of a winter crop weed *Anagallis arvensis* (blue pimpernel) in cattle and buffaloes. *Indian Veterinary Journal* 72(11): 1151-1153

- Saeed, A., W. El-Eraqy and Y. Ahmed. 1995. Flavonoids of *Urtica urens* L. and biological evaluation. *Egyptian Journal of Pharmaceutical Sciences* 36(1-6): 415-427
- Sagástegui, A. 1994. Flora endemica de los Andes Norperuanos. *Arnaldoa* 2(1): 43-63
- 1995. Diversidad florística de Contumazá. Universidad Antenor Orrego, Trujillo, Peru.
- Sagástegui, A., M. Dillon, I. Sánchez-Vega, S. Leiva and P. Lezama. 1999. Diversidad Florística del Norte de Perú. WWF, Fondo Editorial Universidad Privada Antenor Orrego, Trujillo, Perú.
- Sánchez-Vega, I. 1993. Las especies de Leguminosas del Valle de Cajamarca: una aproximación. Proyecto Piloto de Ecosistemas Andinos- Programa de las Naciones Unidas para el Medio Ambiente, Cajamarca, Peru.
- 1994. Recursos vegetales y desarrollo en el Norte del Peru. *Arnaldoa* 2(1): 145-168
- 1997. Aspectos florísticos de la Jalca y alternativas de manejo sustentable. *Arnaldoa* 4(2): 25-62
- Sánchez-Vega, I. and M. Tapia-Núñez. 1992. Estudio agrobotánico de los huertos familiares en Cajamarca. Proyecto Piloto de Ecosistemas Andinos, Cajamarca, Peru.
- Sarquis, J., N. Coria, I. Aguilar and A. Rivera. 2000. Glycoalkaloid content in *Solanum* species and hybrids from a breeding program for resistance to late blight (*Phytophthora infestans*). *American Journal of Potato Research* 77(5): 295-302.
- Sathiyamoorthy, P., H. Lugasi-Evgi, P. Van-Damme, A. Abu-Rabia and J. Gopas. 1997. Larvicidal activity in desert plants of the Negev and Bedouin market plant products. *International Journal of Pharmacognosy* 35(4): 265-273.
- Sato, M., S. Fujiwara, H. Tsuchiya, T. Fujii, M. Iinuma, H. Tosa and Y. Ohkawa. 1996. Flavones with antibacterial activity against cariogenic bacteria. *Journal of Ethnopharmacology* 54: 171-176.
- Sauerwein, M., F. Sporer and M. Wink. 1993. Insect-toxicity of phorbol from *Jatropha curcas* seed oil. 41st annual congress on medicinal plant research, Dusseldorf, Germany. *Planta Medica*.

- Saxena, J. S. and Basit. 1982. Inhibition of oviposition by volatiles of certain plants and chemicals of the leaf hopper *Amrasca devastans* Distant. *Journal of Chemical Ecology* 8(2): 329-338.
- Schemeda-Hirschmann, G., I. Razmilic, M. I. Gutierrez and J. I. Loyola. 1999. Proximate composition and biological activity of food plants gathered by Chilean Amerindians. *Economic Botany* 53(2): 177-187.
- Schjellerup, I. 1989. Children of the stone: a report on the agriculture in Chuquibamba, a District in Northeastern Peru. The Royal Danish Academy of Sciences and Letters, Commission for Research on the History of Agricultural Implements and field Structures, Copenhagen, Denmark.
- Schmeller, T., M. Sauerwein, F. Spore, M. Wink and W. Muller. 1994. Binding of quinolizidine alkaloids to nicotinic and muscarinic acetylcholine receptors. *Journal of Natural Products* 57(9): 1316-1319.
- Schulze-Tanzil, G., P. d. Souza, B. Behnke, S. Klingelhofer, A. Scheid and M. Shakibaei. 2002. Effects of the antirheumatic remedy hox alpha - a new stinging nettle leaf extract - on matrix metalloproteinases in human chondrocytes in vitro. *Histology and Histopathology* 17(2): 477-485.
- Seifert, R. 1990. Cajamarca: via campesina y cuenca lechera. Talleres gráficos Villanueva S. A., Lima, Peru.
- Sener, S. and I. Ozata. 1982. Biological activity and pharmacological properties of the leaves of *Nerium oleander* L. *Istanbul University Veterinary* 8(1): 9-14.
- Shantanova, L. 1998. Plant antioxidant remedies in kidney injuries. *Pathophysiology* 5(1): 86.
- Sharaf, M., M. A. El-Ansari and A. M. Saleh. 1997. Flavonoids of four *Cleome* and three *Capparis* species. *Biochemical Systematics and Ecology* 25(2): 161-166.
- Shin, T., K. Lee and S. Kim. 2002. Anti-allergic effects of *Sanguisorba officinalis* on animal models of allergic reactions. *Immunopharmacology and Immunotoxicology* 24(3): 455-468.
- Shoeb, H. A., J. Refahy, A. Saad and M. El-Motagaly. 1994. Screening of some dry powdered plants against *Biomphalaria alexandrinia* snails. *Egyptian Journal of Bilharziasis* 16(1-2): 189-200.

- Sidhu, O. P. and H. M. Behl. 1988. Antibacterial activity of acetone extracts of some latex bearing plants. *Indian Journal of Plant Pathology* 6(3): 139-143
- Singer, G. 2000. Pesticide Toxicology. <http://salinella.bio.uottawa.ca/BIO3323/Labs/Analysis.PDF> Access 11/02
- Slimestad, R., A. Marston, S. Mavi and K. Hostettman. 1995. Larvicidal constituents of *Melantheria albinervia*. *Planta Medica* 61(6): 562-563.
- Smith, L. J., D. C. Thill, R. H. Callihan and J. M. Lish. 1982. Poison hemlock, a threat to man and livestock (*Conium maculatum*, west Idaho. Current Information Service Idaho University Cooperative Extension Service 75(2): 173-176
- Smolenski, S., H. Silinis and N. Farnsworth. 1975. Alkaloid Screening. *Lloydia* 38(5): 411-441.
- Srinivasan, D., S. Nathan, T. Suresh and P. Perumalsamy. 2001. Antimicrobial activity of certain indian medicinal plants used in folkloric medicine. *Journal of Ethnopharmacology* 74: 217-220.
- Steinbauer, M. J. 1995. The insecticidal and repellents activity of *Schinus molle* L. (Anacardiaceae) against *Drosophila melanogaster* Meigen (Diptera: Drosophilidae) and *Tribolium confusum* Jacquelin Duval (Coleoptera: Tenebrionidae). *General and Applied Entomology* 26: 13-18.
- Steinberg, M. K. 2002. The globalization of a ceremonial tree: The case of cacao (*Theobroma cacao*) among the Mopan Maya. *Economic Botany* 56(1): 58-65
- Stopftaa.org. 2002. Continental days of resistance against the FTAA, Stopftaa organization. <http://stopftaa.org/new/Access> 10/10
- Sugavanam, B. and S. Tianjian. 1999. Developing countries. Pag. 45-54 in F. R. Hall and J. J. Menn, ed., *Biopesticides Use and Delivery*. Humana Press, Totowa
- Suhaila, M., S. Saka, S. El-Sharkawy, A. Ali, M. Sepiah, S. Mohamed, S. Saka and S. Muid. 1996. Antimycotic screening of 58 Malaysian plants against plant pathogens. *Pesticide Science* 47(3): 259-264.
- Tanaka, T., G. I. Nonaka and I. Nishioka. 1984. Tannins and related compounds. XVI. Isolation and characterization of six methyl glucoside gallates and a gallic acid glucoside gallate from *Sanguisorba officinalis* L. *Chemical Pharmacological Bulletin* 32(1): 117-121.

- Tanji, A. and F. Nassif. 1995. Edible weeds in Morocco. *Weed Technology* 9(3): 617-620.
- Taylor, R., F. Edel, N. Manandhar and G. Towers. 1996. Antimicrobial activities of southern Nepalese medicinal plants. *Journal of Ethnopharmacology* 50: 97-102.
- Taylor, W. E. and B. Vickery. 1974. Insecticidal properties of Limonin, a constituent of *Citrus* oil. *Journal of Agricultural Science* 7(1): 61-62.
- Thapliyal, P. N. and Y. L. Nene. 1970. Influence of growth stage of *Anagallis arvensis* on its fungitoxicity. *Economic Botany* 24(3): 283-285.
- Ticktin, T. and T. Johns. 2002. Chinanteco management of *Aechmea magdalenae*: implications for the use of TEK and TRM in management plans. *Economic Botany* 56(2): 177-191.
- Tokarnia, C. H., A. Armien, P. Peixoto, J. Barbosa, M. Brito and J. Dobereiner. 1996. Experimental study on the toxicity of some ornamental plants in cattle. *Pesquisa Veterinaria Brasileira* 16(1): 5-20.
- Tokarnia, C. H., J. Dobereiner and C. Canella. 1972. Experimental poisoning in cattle by *Asclepias curassavica*. *Pesquisa Agropecuaria Brasileira* 7: 31-39.
- Tosi, J. A. J. 1960. Zonas de vida natural en el Perú -Memoria explicativa sobre el mapa ecológico del Perú-. Instituto Interamericano de Ciencias Agrícolas de la OEA Zona Andina.
- Tripathi, A., V. Prajapati, K. Aggarwal and S. Kumar. 2000. Effect of volatile oil constituents of *Mentha* species against the stored grains pests, *Callosobruchus maculatus* and *Tribolium castaneum*. *Journal of Medicinal and Aromatic Plant Sciences* 22(1B): 549-556.
- Troll, C. 1986. Geo-Ecology of the Mountainous regions of the Tropical Americas. Bonn.
- Trostle-Neher, R. 1968. The ethnobotany of Tagetes. *Economic Botany* 22(4): 317-325.
- Trotter, R. T. and M. H. Logan. 1986. Informant consensus: A new approach for identifying potentially effective medicinal plants. Pag. 91-109 in N. L. Etkin, ed., *Plants in Indigenous Medicine and Diet*. Redgrave Publishing Company, Bedford Hills New York.

- Tsuzuki, K., A. Ohashi, Y. Arai, K. Masuda, A. Takano, K. Shiojima, H. Ageta and S. Cai. 2001. Triterpenoids from *Adiantum caudatum*. *Phytochemistry* 58(2): 363-367.
- Turan, K., K. Nagata and A. Kuru. 1996. Antiviral effect of *Sanicula europaea* L. leaves extracts on influenza. *Biochemical and Biophysical Research Communications* 225(1): 22-26.
- Turan, K., S. Ozbas-Turan and A. Kuru. 1999. Anti-influenza virus activity of water soluble extracts of *Sanicula europaea* L. rhizomes. *Turkish Journal of Biology* 23(3): 369-376.
- Turnock, J., S. Cowan, A. Watson, B. Bartholomew, C. Bright, Z. Latif, S. Sarker and R. Nash. 2001. N-trans-feruloyltyramine from two species of the Solanaceae. *Biochemical Systematics and Ecology* 29(2): 209-211.
- Umana, E. and O. Castro. 1990. Chemical constituents of *Verbena littoralis*. *International Journal of Crude Drug Research* 28(3): 175-176.
- Ushiki, J., Y. Hayakawa and T. Tadano. 1996. Medicinal plants for suppressing soil-borne plant diseases. I. Screening for medicinal plants with antimicrobial activity in roots. *Soil Science and Plant Nutrition* 42(2): 423-426.
- van der Lugt, J., P. Nel and J. Kitching. 1991. The pathology of *Cestrum laevigatum* (Schlecht.) poisoning in cattle. *Onderstepoort Journal of Veterinary Research* 58(3): 211-21.
- Van Thanh, T. and P. Thien. 2001. Study on chemical components of *Solanum mammosum* L. *Tap Chi Duoc Hoc* 8: 10-12.
- Vega, R., M. Gutierrez, C. Sanz, R. Calvo, L. Robredo, C. Cuadra and M. Muzquiz. 1996. Bactericide-like effect of *Lupinus* alkaloids. *Industrial Crops and Products* 5(2): 141-148.
- Veith, M., M. Lorenz, W. Boland, H. Simon and K. Dettner. 1994. A review of chemical secretions of Rove beetles (Coleoptera: Staphylinidae). *Tetrahedron* 50: 6859-6874.
- Vieira, R. 1976. Poisoning through the skin by the leaf of *Datura arborea*. *Revista da Associacao Medica Brasileira* 22(3): 90.

- Vijaya, K., S. Ananthan and R. Nalini. 1995. Antibacterial effect of theaflavin, polyphenon 60 (*Camellia sinensis*) and *Euphorbia hirta* on *Shigella* spp. - a cell culture study. *Journal of Ethnopharmacology* 49: 115-118.
- Vijayasaraty, V., L. Sharma and A. Prakash. 1981. Indigenous drug treatment for hemorrhoids. *Probe* 20(4): 463-467.
- Villalobos, P. 1998. Repellency, growth inhibition and toxicity of plant extracts to *Tribolium castaneum* Herbst. (Coleoptera: Tenebrionidae) larvae. *Boletín de Sanidad Vegetal* 24(1): 143-154.
- Villegas, L. F., I. Fernandez, H. Maldonado, R. Torres, A. Zabaleta, A. Vaisberg and G. Hammond. 1997. Evaluation of the wound-healing activity of selected traditional medicinal plants. *Journal of Ethnopharmacology* 55(3): 193-200.
- Vizconde, W. and E. Regalado. 1990. Reutilización de la chacra campesina. Pag. 41-77 ed., *Sociedad y naturaleza en los Andes*. Proyecto Andino de Tecnología campesina, Lima, Peru.
- Weberbauer, A. 1945. El mundo vegetal de los Andes Peruanos: estudio fitogeográfico. Ministerio de Agricultura, Lima.
- Wei, C. H. and C. Koh. 1978. Crystalline ricin D, a toxic anti-tumor lectin from seeds of *Ricinus communis* (Castorbeans). *Journal of Biological Chemistry* 253(6): 2061-2066.
- WHO. 1970. Instructions for determining the susceptibility or resistance of mosquito larvae to insecticides. World Health Organization, Geneva. 66-79.
- Wilhelm, H., B. Wilhelm and U. Schiefer. 1991. Mydriasis caused by plant contact. *Fortschritte Der Ophthalmologie: Zeitschrift Der Deutschen Ophthalmologischen Gesellschaft* 88(5): 588-591.
- Willaman, J. J. and B. G. Schubert. 1961. Alkaloid bearing plants and their contained alkaloids. USDA, Washington D C.
- Williams, C. and J. Harborne. 1972. Essential oils in the spiny-fruited Umbelliferae. *Phytochemistry* 11(6): 1981-1987.
- Wimalaratne, P., K. N. Slessor, J. H. Borden, L. J. Chong and T. Abate. 1996. Isolation and identification of house fly, *Musca domestica* L. repellents from pepper tree, *Schinus molle* L. *Journal of Chemical Ecology* 22(1): 49-59.

- Yamada, Y., K. Hagiwara and K. Iguchi. 1977. Structures of arvenin I and II, bitter principles from *Anagallis arvensis* (Primulaceae) new cucurbitacin glucosides. *Tetrahedron Letter* 24: 2099-2102.
- Ye, W., N. Ji, X. Zhao, H. Liu, T. Ye, M. McKervey and P. Stevenson. 1996. Triterpenoids from *Pulsatilla chinensis*. *Phytochemistry* 42(3): 799-802.
- Yesilada, E., E. Sezik, T. Fujita, S. Tanaka and M. Tabata. 1993. Screening of some Turkish medicinal plants for their antiulcerogenic activities. *Phytotherapy* 7(3): 263-265.
- Yesilada, E. and Y. Takaishi. 1999. A saponin with anti-ulcerogenic effect from the flowers of *Spartium juncum*. *Phytochemistry* 51(7): 903-908.
- Yesilada, E., O. Üstüna, E. Sezika, Y. Takaishib, Y. Onoc and G. Hondad. 1997. Inhibitory effects of Turkish folk remedies on inflammatory cytokines. interleukin-1, interleukin-1 and tumor necrosis factor. *Journal of Ethnopharmacology* 58(1): 59-73.
- Yoshimitsu, H., N. Makiko, Y. Mitsuko and N. Toshihiro. 2002. Four new 26-aminocholestane-type glycosides from *Solanum abutiloides*. *Chemical and Pharmaceutical Bulletin* 50(2): 284-286.
- Zaidi, S. M., A. Hanan and S. Babar. 1970. Some preliminary studies of the pharmacological activities of *Schinus molle* L. *Pakistan J. Sci. Indus.* 13(1/2): 53-58.
- Zdanevich, E. V. and G. A. Belodubrovskaya. 1997. *Conium maculatum* L.: chemical composition, useful and harmful properties. *Rastitel'nye-Resursy* 33(2): 108-113.
- Zeches, M., K. Mesbah, B. Richard, C. Moretti, J. Nuzillard, L. Men-Olivier and L. Le-Men-Olivier. 1995. Alkaloids from leaves and stems of *Vallesia glabra*. *Planta Medica* 61(1): 89-91.
- Zegarra, M. T. 1969. Las especies peruanas del género *Apurimacia*. *Raymondiana* 2: 73-114.
- Zygadlo, J. A., D. Maestri, A. Lamarque and C. Guzman. 1996. Essential oil variability of *Minthostachys verticillata*. *Biochemistry Systematics and Ecology* 24(4): 319-323.