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USE AND MANAGEMENT OF ETHNOVETERINARY MEDICINAL PLANTS BY INDIGENOUS PEOPLE IN 'BOOSAT', WELENCHITI AREA

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ABSTRACT: An ethnobotanical study on uses and management of traditional medicinal plants by indigenous people in 'Boosat' Wereda was conducted in Welenchiti area, East Shewa, Ethiopia, between July 2000 and March 2001. Five study sites were preferentially established and eighty informants were randomly selected. The traditional medicinal plants and the ethnomedicinal information were collected from the informants by applying semi-structured interview, observations, group discussions, and guided field walks. Twenty-nine ethnoveterinary medicinal plant species distributed in 28 genera and 22 families were documented; these include 59% shrubs, 14% herbs, 17% trees and 10% climbers. Leaves were the most frequently used plant parts (33%) of the preparations followed by roots (25%). The most widely used method of preparation is crushing, pounding and mixing with cold water to serve as a drench (37%). Preference ranking showed that the people chose some species over the others in treating the same livestock ailment. Traditional practices, various cultural and seasonal restrictions of collecting medicinal plants have contributed to the management and conservation of medicinal plants in the area. It is therefore, suggested that the traditional knowledge and practices be blended with the formal conservation approaches to ensure sustainable use, management and conservation of the important medicinal plants.

Key words/phrases: Ethnobotany; Ethnoveterinary medicine; Informant consensus.

INTRODUCTION

Ethnobotany is the study of direct interrelations between humans and plants (Farnsworth, 1994; Martin, 1995; Balick and Cox, 1996). It is an interdisciplinary and multidisciplinary science, which focuses on documenting, analysis and use of indigenous knowledge, beliefs and practices related to plant resources. Knowledge of management and conservation, generally known as indigenous knowledge system or traditional knowledge, develops and changes with time and space (Balick and Cox, 1996; Cotton, 1996).

Ethnopharmacology refers to the use of plants by humans as medicines, and ethnomedicine is the sum total of all non-mainstream medical practices,

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usually excluding western medicine (Farnsworth, 1994). However, despite the use of herbal medicines over many centuries, only relatively small numbers of plant species have been studied for possible medical applications (WHO, 1998). In Ethiopia, detailed descriptions of plants used medicinally are generally lacking (FAO, 1986; Dawit Abebe and Estifanos Hagos, 1991). Most of the plants used in traditional medicine are collected from the wild and few have been domesticated (FAO, 1983). Furthermore, there is a real danger of genetic erosion, which, in turn, calls for the need of collection, investigations, and conservation of these resources including the indigenous knowledge on them.

Much of the knowledge on traditional medicinal plants in most cases is available in rural communities and perpetuated by word of mouth within families and communities (Wilson and Woldu Gebremariam, 1979; FAO, 1986). These are fragile traditional skills that are likely to be lost when communities emigrate to towns or regions with a different flora, or if the local ecology is drastically altered. This is another challenge for ethnomedicinal research (Cunningham, 1993; Dawit Abebe and Ahadu Ayehu, 1993). This indigenous knowledge is also dynamic as the practitioners make every effort to widen their scope by reciprocal exchange of limited information with each other (Abbink, 1993; Mathias, 1996).

Another branch of folk medicine include traditional animal healthcare practices and beliefs generally called ethnoveterinary medicine which provides low cost alternatives in situations where modern drugs and veterinary services are not available or too expensive (ITDG and IIRR, 1996; Mathias, 1996). Ethnoveterinary medicine involves the use of medicinal plants, surgical techniques and livestock management practices to prevent and treat a range of animal diseases (ITDG and IIRR, 1996; Mathias, 1996). Stock raisers, both farmers and herders, have developed their own ways of keeping their animals healthy and productive (McCorkle and Mathias, 1996). Research findings have shown that, the fields of modern veterinary medicine and ethnoveterinary practices are complementary to each other (Yehenew Mekonnen, 1994; Taffese Mesfin *et al.*, 1995).

Study made in highlands of Ethiopia by Taffese Mesfin *et al.* (1995), on the anthelimintic value of some traditional herbs in sheep showed that chemotherapeutic responses were potentially effective. However, for resource poor and continuously moving pastoralists conventional veterinary services need to be complemented by ethnoveterinary medicine due to the

soaring cost, irregular availability of chemotherapeutic measures and uncontrolled grazing system. Therefore, integrating ethnoveterinary information and practices into research and extension services can make livestock development efforts more successful (Mathias, 1996).

In spite of its paramount importance as livestock healthcare system, the various traditional veterinary practices remained undocumented both in Africa as a whole (McCorkle and Mathias, 1996) while no in-depth study is available on the relation between medicinal plants and indigenous knowledge including sustainable management of plant resources of ethnoveterinary importance in Ethiopia (Dawit Abebe and Ahadu Ayehu, 1993). There is an enormous gap in knowledge and it is from this fact that the present study on the use and management of traditional medicinal plants by indigenous people in 'Boosat' Wereda ('Welenchiti' Area, East Shewa, Ethiopia) was initiated.

This study area was selected because the area, which is located in the arid Rift Valley, has been losing its native vegetation cover over the past years due to human and other biotic and natural causes (BWADO, 2000). The other reason is the fact that the local people heavily rely on traditional medicines obtained from plants to treat their livestock, but there is no sufficient documentation on the plants and the knowledge pertaining to them. Therefore, this study was initiated to investigate and document traditional medicine related to ethnoveterinary knowledge to evaluate plant uses and management by indigenous people in 'Boosat' Wereda, Welenchiti.

MATERIALS AND METHODS

The study area, 'Boosat' Wereda (Wereda = the lowest administrative unit) (Fig. 1), lies between 8°25' and 8°50' N and 39°16' and 39°50'E with a total area of about 151,406.66 hectares in the northeastern Rift Valley of Ethiopia (ESZPEDD, 1999). The altitude range of the wereda is between 1100 and 1800 m a.s.l. with hilly steep escarpments rising to an elevation of about 2447 m in the case of mount 'Boosat Gudda'. 'Boosat' is located in semi-arid climate zone of the Rift Valley System. The highest mean monthly rainfall has been recorded in the months of July to September. The highest rainfall was recorded in August (219.95 mm) and the lowest in December (4.5 mm). The amount of rainfall gradually increases from March to May and sharply falls from October to December. High mean monthly temperatures have been recorded from April to June. The highest monthly temperature was 23.3°C in June and the lowest annual mean was 18.9°C (average for the years 1969-2000).

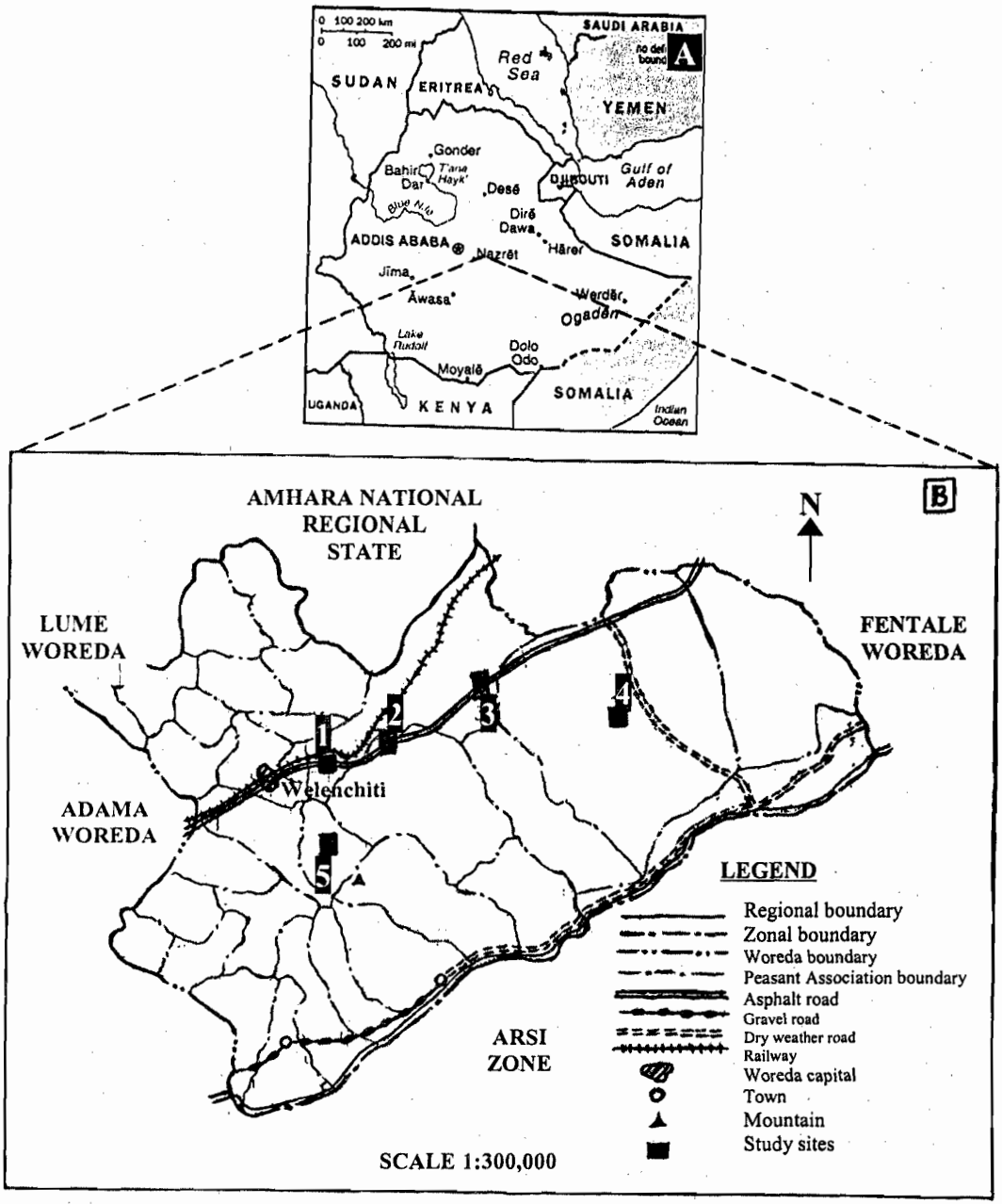

Fig. 1. Map of Ethiopia (A) and Boosat Wereda (B) showing the study area.

The vegetation of 'Boosat' falls in the *Acacia-Commiphora* woodland (small-leaved deciduous woodland) in Somali-Masai Regional center of

endemism (White, 1983; Ensermu Kelbessa *et al.*, 1992). The area can be described as a mixture of cultivated land, open grassland with some trees like *Acacia tortilis, Acacia senegal, Acacia seyal, Balanites aegyptiaca, Commiphora africana* and *Ziziphus spina-christi.* Since the area is dry for most of the months of the year, it is sensitive to overgrazing and browsing. According to BWADO (2000), the wereda possesses 432,374 livestock population consisting of 111,624 cattle, 50,686 sheep, 138,439 goats, 633 horses, 572 mules, 35,033 donkeys, 5,928 camels and 89,459 poultry. There are many animal disease problems and adequate veterinary health services lack in the area. The outbreak diseases include, anthrax and black leg which affect ruminants; sheep pox in sheep; and Newcastle ('fengil') in poultry. However, there are only three properly functioning conventional veterinary clinics in the area.

Five sampling sites were identified from areas where settled farmers and trans-human pastoralists are found. The names of the study sites are Feexo, Xaddacha Bal'aa, Hare Bona, Nura Heera area (Qawa Gaba Peasant Association), and Rukecho Bokure. Eighty informants (73 men and 7 women) between the ages of 15 and 75 were randomly selected to make 16 individuals from each sampling site. Only seven women who volunteered to answer questions and participate in the study were included. Thirty-one key informants were selected by taking 5-6 knowledgeable persons from each study site. The selection of key informants was made with the assistance of local farmers and development agents.

Ethnobotanical data were collected between August 2000 and March 2001 on four field trips made to the sites based on methods described by Hedberg (1993), Martin (1995), Maundu (1995) and Cotton (1996). Accordingly, semi-structured interviews, observations, group discussions and guided field walks with key informants were employed. The key informants included traditional medicine practitioners, selected knowledgeable elders and individuals from different age groups, sexes, settled farmers and trans-human pastoralists. Ethnomedicinal knowledge was gathered from the public and from knowledgeable members of the community.

The local names of medicinal plants, part(s) used, methods and conditions of gathering and preparation, disease treated, dosage used, route of application, adverse effects, uses other than medicine and the management of the plant by indigenous people as well as distribution in vegetation communities were carefully recorded. Local names of plants were studied by repeated inquiries at least three times, with same informants to check the

accuracy of information obtained. This information was recorded on the spot in the field notebook and summarized later (Appendix 1). Discussions were conducted with 10 to 15 informants and residents in seeking to understand the traditional medicinal system of the local people and its management to know how this knowledge is maintained in a family or community. The interviews and discussions were based on and around a checklist of topics or questions prepared beforehand (Appendix 2). Literature review and field notes on herbarium sheets of plant specimens housed at the National Herbarium, Faculty of Science, Addis Ababa University helped to substantiate the information obtained from local people. Voucher specimens for all the medicinal plants studied were collected and identified and stored at the National Herbarium. Plant species other than medicinal plants were also collected and identified (Appendix 3).

Preference-ranking technique (Martin, 1995) was employed where key informants ranked the medicinal plants based on the degree of their effectiveness in treating anthrax based on the community recommendation. Each rank is given an integer value of 1, 2, 3, 4 and 5 with the most effective one receiving the highest value (five), while the least important is assigned a value of one. Finally, these numbers were summed for all respondents, giving an overall rank for the species. By ordering according to choice, it was considered that the most favoured species was usually the most efficacious, at least in the context of the people who used them.

RESULTS

Distribution and Diversity of Medicinal Plants

The results of this study showed that most of the herbal medicines utilized by indigenous people were obtained from the natural vegetation. The total number of medicinal plants identified in each of the families is shown in Table 1. Most of the medicinal herbs were found in the natural vegetation of the area that is dominated by *Acacia albida-Ziziphus spina-christi* woodland. They were also collected from *Acacia tortilis-Balanites aegyptiaca*, *Acacia seyal-Acacia tortilis* and *Cissus quadriangularis* community in the grazing lands and at the borders of farmlands. Most of the shrubs were collected from woodlands, roadsides, rocky (stony) surfaces scattered in woody shrublands and secondary forests. Medicinal plants like *Nicotiana tabacum and Withania somnifera* were restricted to farmlands, farm borders, fences and home gardens.

Table 1 Families of medicinal plants and number of species used for livestock healthcare.

Family	Number of Species	Family	Number of Species
Acanthaceae	1	Fabaceae	1
Amaranthaceae	1	Lamiaceae	3
Anacardiaceae	1	Malvaceae	1
Asclepiadaceae	1	Meliaceae	1
Asteraceae	1	Olacaceae	1
Balanitaceae	1	Papaveraceae	1
Capparidaceae	2	Poaceae	1
Combretaceae	1	Sapindaceae	1
Cucurbitaceae	1	Solanaceae	4
Ebenaceae	1	Tiliaceae	1
Euphorbiaceae	2	Vitaceae	2
		Total	29

The majority of the 29 plant species of ethnoveterinary importance were collected from wild habitats, as identified by the indigenous people of 'Boosat' (Appendix 1). They represent 22 plant families (Table 1) and 28 genera. Shrubs accounted for 59%, trees 18.2%, herbs 14% and climbers 10%. Roots were the most widely used part accounting for 28% of the preparations followed by leaves (33%) and the whole parts of the plant (11%) (Table 2).

Table 2 Parts of plants used and habit of medicinal plants in specific medicine preparations.

Parts used	Habit and number of species					
	Herbs	Shrubs	Trees	Climbers	Total	% of the total
Seed	1	1	-	-	2	6
Leaf	2	9	1	-	12	33
Stem	-	1	1	-	2	6
Above ground	1	2	-	-	3	8
Root and stem	1		-	1	2	6
Root	1	6	2	-	9	25
Whole plant	-	1	1	2	4	11
Root and above ground	-	-	1	-	1	3
Root and leaf	-	1	-	-	1	3
Total	5	20	6	3	36	100
%	14	56	17	8	100	

Twenty-nine species used to treat 18 livestock diseases were recorded. Of these, 11 species were used to treat anthrax while seven species were reported to treat wounds of different origin in various livestock species (Table 3). Medicinal plants widely used by the community were revealed through results of those who have received informants' consensuses. These were briefly documented for features such as habits, parts used for medicine and how they are medicinally used to treat livestock diseases (Appendix 1).

Assessment of the preparation of the remedies showed that crushing, pounding and mixing with cold-water serving as a drench, chewing and spitting, spraying using tools and tying on amulets were reported.

Concerning the route of application, most of the remedies were given orally, which was recorded for 53%, followed by external application 35% of the medicinal preparations. Other routes of application included chewing and spitting (5%), tying on/put on affected parts as pastes (16%), herbal bath - boiling with water and washing the body (3%) and burying in cattle fence (3%) of the medicinal preparations (Table 4). Most of the remedies were measured in cup glasses or prescribed without any measurement by simply looking at the physical appearance of the sick animal, sometimes with no specific frequency.

Table 3 Major livestock disease types and number of ethnoveterinary plant species applied to livestock by indigenous people of 'Boosat'.

Disease/ health problem treated	Total no. of plant species used	% to the total ethnoveterinary species
Anthrax (abbasanga)	11	37.9
Wounds	7	24
Lymphatic swellings	3	10
Bloody urine in cattle (biira)	2	7
Mentally sick cattle	2	7
Urine retention	2	7
Running nose (ruusa)	2	7
Ectoparasite	1	7
Infected eye	2	7
Intestinal parasite	2	7
Evil eye	2	3
Retained placenta	1	3
Fertility and normal growth	1	3
Fattening (remove parasite)	1	3
Remove leeches	1	3
Blackleg (abbagorba)	1	3
Poison (kill enemies)	1	3
Infected *Sorghum bicolor* (dangaja)	1	3

Table 4 Methods of preparation of medicines used by the indigenous people of 'Boosat'.

Method of preparation	Total	%
Crushed, pounded and mixed with cold water	16	39
Put on affected part (rubbed, tie on swelling, add to wound, ceam)	8	16
Tie cattle under live tree preventing it from drinking water	1	2
Crushed and mixed with cold water and sprayed on /around	2	4
Role old cloth on stem and into cattle's mouth	1	2
Dry smoke to cattle's fence	2	4
Concoction	7	14
Herbal bath of the livestock	2	4
Chewed and spitted in/on affected parts	8	16
Burning with glowing stem	1	2
Shoot is eaten	1	2
Total	49	

Informants' Consensus

Key informants and interviewees explained that some medicinal plants were more popular than others. Accordingly, *Indigofera amorphoides, Solanum indicum* and *Withania somnifera* took the lead as each was cited by 75

informants (93.8%), *Cryptostegia grandiflora,* cited by 69 informants (86%), stood second while *Nicotiana tabacum and Balanites aegyptiaca* ranked third, being cited by 58 (72.5%). The remaining medicinal plants mentioned by two or more informants are summarized in Table 5.

Table 5 List of medicinal plants and the corresponding number of informants who cited the medicinal value of each species.

Scientific name	Number of informants	% of total informants
Acalypha fruticosa	16	20.0
Achyranthes aspera	18	22.5
Argemone mexicana	18	22.5
Azadirachta indica	30	37.0
Balanites aegyptiaca	58	72.5
Capparis cartilaginea	2	2.5
Capparis tomentosa	12	15.0
Cissus quadrangularis	22	27.2
Cryptostegia grandiflora	80	100.0
Chrysopogon plumulosus	69	86.3
Cyphostemma adenocaule	15	18.8
Datura stramonium	52	65.0
Dodonaea angustifolia	7	8.8
Grewia bicolor	2	2.5
Indigofera amorphoides	75	93.8
Jatropha curcas	16	20.0
Justicia caerulea	3	3.7
Kedrostis foetidissima	48	60.0
Lepidium sativum	60	75.0
Leucas abyssinica	14	17.5
Leucas inflata	2	2.5
Nicotiana tabacum	58	72.5
Ocimum gratissimum	4	5.0
Olea europaea ssp. *cuspidata*	55	68.8
Rhus vulgaris	2	2.5
Solanum indicum	75	93.8
Vernonia amygdalina	41	41
Terminalia brownii	4	5.0
Withania somnifera	75	93.8
Ximenia americana	22	27.5

Management and Conservation of Medicinal Plants

Indigenous people revealed that the gathering and processing of many medicinal plants were restricted to traditional medicinal practitioners and their trainees. At family level, it is restricted to the elders (men and women), followed by elder son or daughter or their trustworthy person when the father or mother is getting old or just about to die. Furthermore, people of 'Boosat' have been managing local vegetation not only to meet their needs of medicine but also to meet their other needs such as fodder, fruits, construction, spiritual, fuelwood and cultural issues at family and community level. Medicinal plants like *Balanites aegyptiaca* and *Withania somnifera,* which have multiple medicinal uses, were found in nearly most

family gardens and farm borders. The people have had the perception that they need not be devoid of such species from their vicinity.

The collection and application of some medicines required strict spiritual cleanliness. Special prayers were made to attain full healing power (efficacy) for the medicine and to ward off evil spirits during collecting the medicinal plant. The informants further revealed that, the healer or collector should not sleep with his/her partner (wife or husband) and sexual activity was not allowed for 24 hours before collection. In some cases, this can be for one-week time (the local people call it *'qoricha xaharan/ qulqulinan funaanu,'* meaning, be spiritually clean to collect traditional medicinal plants). There was strong common understanding among indigenous people that special care should be taken for the preservation of herbal medicines. Users hide drugs under roofs of houses or special containers so that spiritually unclean person could not reach them. This is locally known as *'gaddidu lagu'*. Otherwise, it was believed that the medicine would not be efficacious.

A major problem observed during the study was that knowledgeable persons kept their knowledge secret. The knowledge passes from individual to individual, from healer to healer on exchange bases to keep their knowledge up-to-date with the increasing search for new remedies. The informants and residents reported that none of their children has continued to practice the medicinal knowledge. One of the informants explained that one of her sons had attended secular education up to grade ten but failed to retain and practice traditional medicine after he inherited the knowledge from his mother by oath.

Preference Ranking

The preference ranking for five medicinal plants species used to treat anthrax showed that *Indigofera amorphoides* was the most preferred followed by *Achyranthes aspera*, *Azadirachta indica, Withania somnifera* and *Solanum indicum* (Table 6).

Table 6 Values for preference ranking based on their degree of treating anthrax for five selected medicinal plants in Boosat as perceived by informants.

List of medicinal plants	Key informants coded (A - J)											
	A	B	C	D	E	F	G	H	I	J	Total	Rank
Achyranthes aspera	5	5	4	3	2	4	4	5	4	5	39	2nd
Azadirachta indica	4	5	5	5	2	4	3	4	4	5	38	3rd
Indigofera amorphoides	5	5	5	5	4	4	2	4	5	5	44	1st
Withania somnifera	5	5	4	4	3	5	5	4	5	2	37	4th
Solanum indicum	4	2	5	4	2	4	5	4	4	3	36	5th

DISCUSSION

The study in 'Boosat' has yielded 81 medicinal plant species, of which 29 species are recognized as medicines for livestock diseases (Appendix 1). In a study made by Bayafers Tamene (2000) in Chaffa area (Welo), 83 species of medicinal plants for humans were reported. Abbink (1993), who studied medicinal knowledge of the Me'en people in south-western Ethiopia, in an area with better vegetation cover, reported 52 species of medicinal plants used by indigenous people. This study showed that there were still many medicinal plants available to the users although the area was losing its natural vegetation. There was also broad indigenous knowledge on the use of traditional medicinal plants.

However, many young people today are not knowledgeable about the variety and values of indigenous medicinal plants. Medicinal plant knowledge, use and transfer of knowledge to the young generation can be affected by religious beliefs, modernization, acculturation and environmental change (Cunningham, 1993; Caniago and Siebert, 1998). Those students who attended modern schools are showing unwillingness to learn from their parents, which is an evidence for the gradually disappearing traditional knowledge. Ethnomedicinal knowledge diminishes with the death of elderly knowledgeable members of society since only a few young people are willing to acquire the knowledge. With each succeeding generation, the chance of distortion or misrepresentation of the original plants or cures may increase and many mistakes may occur.

In cases where different species were prescribed for the same health problem, people showed preference of one to the others. Of the five species used against anthrax, the majority of the people that were interviewed favoured *Indigofera amorphoides*. From preference ranking, it could be understood that the most favoured species are usually the most efficacious, at least in the context of the people who use them.

The observation that leaves and roots provide most remedies indicates the possibility that use of plants as medicine may contribute to the destruction of the natural vegetation (Appendix 2). The popularity of roots, bark, rhizomes, stem and whole plants may also have negative consequences on biodiversity and sustainability of the medicinal plant species in the area. The scarcity of plants such as *Olea europaea* ssp. *cuspidata* (whole parts) and *Ximenia americana* (bark and leaf) in the area is perhaps an indication of the possibility that medicinal use may have contributed to their reduction. Collecting leaves alone could not pose a lasting danger to the continuity of

an individual plant compared with the collection of underground parts, roots, stem or whole plant.

About 81% of the traditional drugs in " Boosat" were made from single plant preparations for treating a particular ailment. Synergic interaction or potentiating effect of one plant on the other in prescription of multiple sources is well recognized in Ethiopian tradition medicinal practice (Dawit Abebe and Ahadu Ayehu, 1993). The results of this study showed that 14% of medicines were prepared from different plants. One of the many species used in this way is *Achyranthes aspera* concocted with roots *of Balanites aegyptiaca* and *W. somnifera* in cold water to treat anthrax in cattle.

Some of the preparations have spiritual and ritual values. Crushed leaves of *Acalypha fruticosa* were mixed with cold water and sprayed in livestock fence to protect cattle from anthrax and on flesh that is infected by anthrax probably with the hope of disinfecting it. Dry or fresh roots of *Leucas abyssinica* and *Achyranthes aspera* were buried inside, or placed in the gate or pens of cattle as preventive measure for anthrax and blackleg disease of cattle and sheep.

Lack of precision or specifying the doses in rough measurements is a major drawback of application of traditional medicinal plants studied. Informants reported that unless there was proper handling and care, some of the medicinal preparations could be poisonous to livestock. Special care is required to keep away the milky exudates of *Cryptostegia grandiflora* from domestic animals and humans. Most of the remedies for livestock were administered in higher quantities than that recommended for humans. The study showed that the leading route of application was oral administration.

Medicinal plants utilized by indigenous people of 'Boosat' were collected from the wild, only a few being found under cultivation. They were distributed in woodlands, shrublands, rocky hillsides, degraded woodlands, grazing and browsing lands, roadsides, farmlands, farm borders, and in ritually and spiritually protected trees as '*muka irrecha*' (a tree under which local people celebrate spiritual ceremonies). The fact that most of the remedies are found in the wild poses a big threat to their existence as long as destruction of their habitats continues. The situation resulted in the rarity of some medicinal plants. For instance, informants reported that medicinal plants such as *Olea europaea* ssp. *cuspidata* used for treating nervous disorders in cattle are rarely encountered in the area. Furthermore, they explained that the future fate of tree species like, *B. aegyptiaca* might be restricted to near settlements, in or at borders of individual farmlands, in

relic forests and at spiritually and ritually protected areas. The destruction of tree species will inevitably increase the pressure on shrubs and herbs. Some of the annual herbs became scarce during the dry season, and their spatial distribution was restricted to a few places making their collection and use difficult. These days, people are forced to take sick livestock to government clinics for modern medicines, which is unaffordable by the majority of the people. However, the informants expressed hope that if they get alternative livelihoods the area could be rehabilitated. The local people should preserve and conserve the plant diversity of the area, and the wide range of indigenous ethnobotanical information and cultural components to ensure the continuity of the traditional healthcare system. Martin (1994) directly connects this with biodiversity conservation, cultural survival and the search for new products, which are all intricately linked.

The existing heavy pressure on the natural vegetation due to biotic and natural pressures calls for urgent measures to be taken to rehabilitate and conserve the remaining vegetation. Governmental and non-government organizations, and scientists should direct their efforts towards the proper management and conservation activities by involving the local people. They need to cultivate positive attitudes towards traditional medicinal plants by integrating formal and non-formal education systems. Furthermore, the medicinal plants widely used to treat livestock should be given considerable attention for pharmacological investigation process.

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Appendix 1 Plants Used as Medicine for Livestock, Their Local Names, Habit, Part Used, Type of Disease, Mode of Application and Collection Number (Coll. NO.). Ha, Habit; H, herb; C, Climber; S, Shrub; T, tree; PP, plant part used; L, leaf; F, fruit; S, seed; Me, milky exudate; AG, above ground; S, L, seed and leaf; Ro, root; St, Stem; Tg, twig; Fl, flower; B, bark; Wp, whole plant; MA, mode of application; Ro, L, root and leaf; Ro, AG, root and above ground; B, L, Bark and leaf; St, L, stem and Leaf; St, L, stem and leaf Am. Amharic; Or, Oromiffa.

Scientific name	Family	Local name	Ha	PP	Disease treatment	Mode of application	Coll. No
Achyranthes aspera L.	Amaranthaceae	Darguarba (Or.)	S	Ro	Urine retention (Kidney problem)	Pieces of crushed root are mixed with crushed root of *Withania somnifera* in cold water and given to cattle in large amount for drink	DH.11
				L.	Anthrax (abbasanga)	Few fresh leaves are crushed and concocted with crushed roots of *Balanites aegyptiaca* and *Withania somnifera* in cold water, 1-2 glasses are given as a drink for 3 days	
Acalypha fruticosa L.	Euphorbiaceae	Ciri (Or.)	S	L	Anthrax	Crushed leaves are sprayed in livestocks fence, on infected meat to disinfect or boil with leaves.	DH.20
				L	Lymphatic swelling (Gofle)	Crushed fresh leaves are pounded, mixed with cold water, 1 glass is given as a drink for livestock	
Argemone mexicana L.	Papaveracae	Nacilabaashii (Or.)	H	Ro	Anthrax	Crushed leaves are mixed with roots of *Solanum indicum* in cold water, 1 glass is given as a drink for cattle.	DH. 40
Azadirachta indica A. Juss.	Meliaceae	Kininii (Or.); Neem (Eng.)	T	L	Anthrax	Freshly crushed leaves are mixed with cold water and given as a drink in large amount for cattle.	DH. 62
Balanites aegyptiaca (L.) Del.	Balanitaceae	Baddanno (Or.) Beddonno (Am.)	T	Ro	Mentally sick cattle (jinni)	Freshly crushed root is mixed with cold water, kept over night, 4-5 liters are given as a drink in the morning.	DH. 32
				L	Black-leg (Abbagora)	Freshly crushed leaves are mixed with cold water, 4-5 litres given as a drink for 2-3 days preventing it from drinking water. The animal is tied under shade of live tree.	
				St	Lymphatic swelling	Swollen part is burned with hot (glowing) stem)	
				L	Infected eye in cattle	Fresh leaves are chewed and the juice is spitted into the infected eye for many days.	
Capparis cartilaginea Decne.	Capparidaceae	Dalansiisa (Or.)	S	L	Fatten cattle by expelling intestinal parasites	Fresh leaves are crushed, 2 glass of the juice is served as a drink for 3 days.	DH. 76
Capparis tomentosa Lam	Capparidaceae	Harangama	S	S	Infected cattle's eye	Seed is cut into 2 halves and rubbed together; the foame is creamed into the infected eye	

Appendix 1 (Continued)

Scientific name	Family	Local name	Ha	PP	Disease treatment	Mode of application	Coll. No
Cissus quadrangularis L.	Vitaceae	Cophi (Or.)	C	Ro	Ulcer (Swollen) in cattle)	Fresh or dried root is crushed and tied on to the swelling to facilitate the bursting of the swelling	DH.25
				Ro	Hyena bitten wound in cattle	Fresh root is crushed and tied onto the wound	
				Ro, St	Ulcerated Wound (Nyaqarsa)	Root and fresh stem are crushed; the juice is added on to externally swollen wound by gently making scare on it.	
Cryptostegia grandiflora K. Br.	Asclepiadaceae	Hoqonqol (Or.)	S	Me	Kill Rodent, Snake and other insects	When milky exudate of stem and leaves is taken orally by chance or deliberately it kills rodent, snake and other insects	DH. 16
Chrysopogon plumulosus Hochst	Poaceae	Daremu (Or.)	H	Ag	Assist fertility and normal growth	Shoot is eaten to enhance growth and fertility. Remove intestinal parasite by initial stomach runaway.	DH. 39
Cyphostemma adenocaule Steud. ex A. Rich.	Vitaceae	Hidda laafaa (Or.)	C	WP	Protect pest	The whole fresh plant is cut and put in crop store (gumbii).	DH. 8
Datura stramonium L.	Solanaceae	Banji (Or.)	H	S	Skin wound in cattle	Crushed leaves are used to wash wound.	DH. 7
Dodonaea angustifolia L.f.	Sapindaceae	Ittacha (Or.)	S	L.	Wound in donkey	Dired leaves are pounded and sprayed on to external wound	DH. 63
Grewia bicolor A. Juss.	Tiliaceae	Harooresša (Or.)	S	St	Infected *Sorgham bicolor*	Old cloth is rolled on straight stem and inserted into the mouth of the cattle and pull out the infected *S. bicolour*.	DH. 72
Indigofera amorphoides Jaub and Spach.	Fabaceae	Henna Harre (Or.)	S	Wp	Anthrax	Freshly crushed whole plant is mixed with cold water, 1 bottle of juice is served as a drink.	DH. 10
Jatropha curcas L.	Euphorbiaceae	Abatabulk (Or.)	S	Ag	Intestinal parasite in Cattle	Shoot is crushed, pounded, mixed, with cold water, 1 glass is served as a drink.	DH. 1
Justicia, caerulea Forssk.	Acanthaceae	Dargu (Or.)	S	Ro	Anthrax	Crushed, pounded root is concocted with roots of *B. aegyptiaca, W. somnifera* leaves in cold water, 1 glass is given as a drink for 3 days. The residue is creamed to the whole body.	DH. 46
Kedrostis foetidissima (Jacq.) Cogn.	Cucurbitaceae	Saraja'-a (Or.)	C	Wp	Ectoparasite and evil eye in cattle	Whole plant is crushed and used to wash animal body for 3 days and given as a drink for 3 days.	DH. 27
Leucas abyssinica (Benth.) Briq.	Lamiaceae	Ashale (Or.)	S	L	Infected livestock eye	Green leaves are crushed and spitted into the infected eye for 3 days early in the morning.	DH. 51

Appendix 1 (Continued)

Scientific name	Family	Local name	Ha	PP	Disease treatment	Mode of application	Coll. No
Leucas inflata Benth.	Lamiaceae	Afa firashii (siree) (Or.)	S	Ro	Anthrax	Dry fresh roots are concocted with roots of *A. aspera* and buried in livestock fence as preventive measure of the transmission of anthrax.	DH. 68
Nicotiana tabacum L.	Solanaceae	Timbo (Or.)	H	L	Wound in Cattle	Dried, pounded leaves are added on to wound every two days.	DH. 60
				L	Expel leeches Urine retention	Dried, crushed and pounded leaves are mixed with cold water, 1 glass is served as a drink for cattle.	
Ocimum urticifolium Roth	Lamiaceae	Qoricha Michi (Or.)	S	L	Anthrax	Crushed roots and leaves are mixed with cold water, 1 bottle is served as a drink and the residue is creamed on the whole body.	DH.44
Olea europaea L. ssp. *cuspidata* (Viv.) P.S. Green.	Oleaceae	Ejersa (Or.) weyira (Am.)	T	Wp	Mentally sick livestock and Running nose	Whole plant is dry smoked into the fence; the goat and cattle inhale the dry smoke in cattle.	DH. 56
Rhus vulgaris Meikle	Anacardiaceae	Daboobessa (Or.) Mistayibelash (Am.)	T	Ro, Ag	(Anthrax) Abbasaga	Fresh leaves are ground and mixed with cold water kept on outer root of house and given for cattle as a drink in the morning	DH. 93
Solanum indicum L.	Solanaceae	Hiddii loonii (Or.)	S	Ro	(Anthrax) Abbasanga	Crushed roots are concocted with *Acokathra schimperi* and cold water, 1 glass is given as a drink for 1-3 days	DH. 2
				L	Wound of circumcision origin in ox	Crushed and pounded fresh leaves are sprayed on wound	
Vernonia amygdalina Del.	Asteraceae	Ebicha(Or.)	S	Ag	Clean evil spirit and evil work	Crushed young above ground with leaves sprayed on utensils with special ceremony	DH.124
Terminalia brownii Fresen.	Combretaceae	Bireecha (Or.)	T	B	Expel placenta in cattle	Crushed bark is concocted with crushed seeds of *Lepidium sativum* and mixed in 1 ½ glass of cold water and given for drink	DH.78
				B	Bloody urine (biira)	The above concotion is given as a drink	
Withania somnifera (L.) Dunal	Solanaceae	Wahalle; Bala (Or.)	S	Ro, L	Lymphatic swelling in cattle	Fresh roots and leaves are boiled and the vapour is smoked. Leaves and roots are crushed, mixed with cold water, a litre of juice or more is served as a drink.	DH.3
				Ro	Anthrax and running nose	Crushed fresh roots are mixed with cold water & 1bottle is served for livestock as a drink preventing it from drinking water	
Ximenia americana L.	Olacaceae	Hudha (Or.)	S	B	Infected wound	Dried piece of bark is crushed powdered and tied on wound by clean cloth for livestock.	
				L	Bloody urine	Pounded green leaves are mixed with cold water, 1 litre is given as a drink for cattle	

Appendix 2 Checklist of questions or items used as a basis for discussion and interview.

Information on respondents: name, age, occupation, educational status, religion and others as necessary
Local name of the medicinal plant
Habitat of the plant- where it grows in the study area, including vegetation type.
Habit of the plant: tree, shrub, herb, parasite, hemi parasite, liana, aqueous plant.
Size of the plant
Use of plant:
- The type of ailment treated by medicine from the plant
- What is the cause of the ailment if it is known?
- What is (are) the symptom(s) (if any)

Part/ parts of the medicinal plant collected for medicinal use;
Preparation of remedy: detailed account.
- Fresh, dried, crushed, pounded (powdered)
- Used alone, mixed with water or other materials
- Concoction and decoction if any

Amount used (dose)
Any noticeable side effect (Adverse effect) caused by the medicine if any.
Does the dose differ among males females, children, elders is/are) there antidotes for adverse effects?
Are there conditions that forbid taking the medicine such as pregnancy and others?
How is the medicinal plant (s) preserved (if any)?
Are there members of the community who frequently use the medicinal plant (if any)?
Are there economic groups who mostly or occasionally use these medicinal plants? Why?
Are there regimens in the use of medicinal plants?
Is (are) the medicinal plant (s) marketable?
How is the knowledge passed from elders to younger generations in family or at community level in the study area?
How does modernization interfere with traditional medicinal system?
Are there threats to the medicinal plants?, list out the main threats.
Are there traditional conservation methods used to conserve medicinal plants in the area? Include the management practices by indigenous people
Is the plant under cultivation in the study area?
Are there taboos in the utilization of some medicinal plants in the locality, sex, age, and so on?
Information on edibility and other uses if any of the plant besides its medicinal uses/value.
What are the reciprocal impacts of plant- human interactions?

Appendix 3 List of plants in local vegetation other than medicinal plants.

Plant species	Family	Local name (Oromifa)	Collection no.
Acacia mellifera Benth.	Fabaceae	Saphaz	DH. 45
Acacia senegal (L.) Willd	Fabaceae	Doddoti	DH.114
Acokanthra schimperi (DC.) Oliv	Apocynaceae	Qarao	DH. 50
Boswellia papyrifera (Del.) Hochst.	Bruseraceae	Muka ixanaa	DH.80
Combretum adenogonium Steud.ex A. Rich.	Combretaceae	Rukenssa	DH.101
Combretum molle G. Don.	Combretaceae	Ulushanka	DH.110
Grewia flavescens A. Juss.	Tiliaceae	Amurgi	DH.105
Grewia tembensis Fresen.	Tiliaceae	Damborash	DH.123
Grewia villosa Willd.	Tiliaceae	Ogumdi	DH.104
Indigofera articulata Gouan	Fabaceae	Hinna	DH.117
Leonotis neptifolia (L.) R. Br.	Lamiaceae	Haxxifachisa	DH.45
Macaranga capensis (Bill.) Sim	Euphrbiaceae	Qilinxo	DH.112
Melinis repens A. Juss.	Poaceae	Daggala	DH.103
Ocimum spicatum Delfers.	Lamiaceae	Qoricha michi	DH.121
Ozoroa insiginis Del.cf. ssp. *reticulata* (Bak f) J.B. Gillet	Anacardiaceae	Dhama'e	DH.116
Pavetta gardenifolia A.Rich.	Rubiaceae	Bunitii	DH.113
Pistacia falcata Becc.ex Martelli	Anacardiaceae	Hawas	DH.113
Rhus vulgaris Meik.	Anacardiaceae	Daboobessa	DH. 93
Solanum glabratum L.	Solanaceae	Hiddi qoree	DH.35
Tribulus cistodes L. Sp.	Zygophylaceae	Qumudo	DH.34
Zisiphus mucronata Willd	Rhamnaceae	Qurqura hadha	DH.49

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ISOZYME VARIATION AND NUTRITIONAL ANALYSIS IN FIELD PEA (*PISUM SATIVUM* L.) POPULATIONS FROM ETHIOPIA

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ABSTRACT: Isozyme variation and nutrient composition of 41 field pea (*Pisum sativum* L.) populations were analysed to determine the genetic and nutrient variability within and between the populations. The isozyme analysis showed that of the six loci (AAT-1, AAT-2, EST-1, EST-2, LAP-1, LAP-2) recorded, three were polymorphic (EST-1, EST-2, AAT-2). The mean number of alleles per locus for all populations was 1.4. The mean percentage of polymorphic loci and mean value of expected heterozygosity recorded was 39.8 and 0.132, respectively. The mean F_{ST} = 0.26 indicated the existence of moderate level of variation between populations, although most of the variation occurred within populations. Altitudinal class 4 (2601-2800 m a.s.l.) showed the highest mean heterozygosity (Ho = 0.017, He = 0.189). Higher genetic diversity was observed in Welo (Ho = 0.138, He = 0.201) followed by Tigray (Ho = 0.051, He = 0.189) regions though these regions were represented by relatively few samples. In addition to the isozyme variability within and between the populations, nutrient composition in association with region, altitude, soil texture and soil colour were also studied. The values, on dry weight basis, ranged from 22.82 to 27.90% for protein, 0.67 to 1.06% for fat, 7.37 to 8.77% for fibre, 2.54 to 3.24% for minerals, 7.75 to 9.05% for moisture and 59.85 to 65.12% for carbohydrate. Principal component analysis showed that the accessions that were collected from different regions had similar percentage of nutrient composition and the cluster analysis showed that there was little effect of soil texture, soil colour, altitude and geographical zones (regions) on nutrient composition.

Key words/phrases: Allelic frequency; Genetic diversity; Isozyme; Nutrition; *Pisum sativum*.

INTRODUCTION

Field pea, *Pisum sativum* L., (2n = 14) probably originated in south-western Asia, possibly north-western India, Pakistan or adjacent areas of the former USSR and Afghanistan and spread to the temperate zones of Europe (Kay, 1979; Makasheva, 1983). Important production areas of the world include France, Russia, Ukraine, Denmark and United Kingdom in Europe; China and India in Asia; Canada and USA in North America; Chile in South America; Ethiopia in Africa, and Australia (FAO, 1994). Based on genetic diversity, four centers of origin, namely, Central Asia, the Near East,

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