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# Study of ethnoveterinary medicinal plants in Aseko District, Arsi Zone, southeastern Ethiopia

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## Abstract

Ethnoveterinary medicine remains a vital component of livestock healthcare in rural Ethiopia. This study documents medicinal plants and associated indigenous knowledge in Aseko District, Arsi Zone, southeastern Ethiopia. Data were collected from 182 informants across seven kebeles representing three agroecological zones using semi-structured interviews, focus group discussions, guided field walks, preference ranking, and market surveys. A total of 66 ethnoveterinary medicinal plant species belonging to 49 families were recorded. Herbs dominated (42.4%), and most remedies used fresh plant material harvested from wild habitats (66.7%). Leaves were the most frequently used plant part (46.5%), and oral administration was predominant (67.5%). Gastrointestinal disorders, ecto-/endoparasitic infections, and dermatological diseases accounted for 68.2% of use reports. Informant Consensus Factor values ranged from 0.25 to 0.67, with highest agreement for reproductive disorders. Hagenia abyssinica, Embelia schimperi, and Zingiber officinale were top-ranked for treating diarrhea. Agricultural expansion (22.0%) and biomass extraction (19.8%) were the primary threats. This study highlights the resilience and vulnerability of ethnoveterinary knowledge in a biodiverse but understudied region.


## Introduction

Ethiopia is widely recognized as one of the world's centres of biological and cultural diversity, characterized by exceptionally rich flora and long-standing traditions of plant-based healthcare [1, 2]. Indigenous knowledge systems developed over generations have enabled rural communities to manage both human and livestock health using locally available medicinal plants, particularly in areas where access to modern veterinary services remains limited [3]. Livestock production plays a central role in Ethiopia's mixed farming and pastoral systems, contributing substantially to food security, household income, draught power, and sociocultural identity [4].

Ethnoveterinary medicine refers to the cumulative body of indigenous knowledge, practices, and beliefs used by local communities to maintain animal health through plant-based remedies, management strategies, and associated cultural practices. Across sub-Saharan Africa, including Ethiopia, ethnoveterinary systems remain a primary source of livestock healthcare in rural and pastoral areas where formal veterinary services are limited or economically inaccessible [5, 6]. The continued importance of traditional animal healthcare in Ethiopia is reinforced by the central role of livestock in rural livelihoods and national agricultural systems [7].

Numerous ethnobotanical and ethnoveterinary studies conducted across Ethiopia have documented a wide diversity of medicinal plant species used to treat livestock ailments, underscoring the resilience and practical relevance of indigenous veterinary knowledge systems [8–10]. However, traditional medicinal plant resources and the associated knowledge systems are increasingly under pressure. Agricultural expansion, deforestation, infrastructure development, and population growth have contributed to the degradation and fragmentation of natural habitats supporting medicinal plant diversity [11–13]. Concurrently, sociocultural change, formal education systems, and declining reliance on traditional practices have weakened intergenerational transmission of ethnoveterinary knowledge, particularly among younger community members [14, 15].

Despite extensive documentation efforts, important geographical gaps remain, and many studies emphasize species inventories without systematically evaluating cultural importance, informant agreement, or perceived efficacy of remedies [16, 17]. Quantitative ethnobotanical indices such as the Informant Consensus Factor (ICF) and Fidelity Level (FL) have therefore been recommended as robust tools for identifying culturally salient species, prioritizing conservation actions, and guiding future phytochemical and pharmacological investigations [18–20].

In this context, systematic documentation of ethnoveterinary medicinal knowledge in Aseko District is both timely and necessary. Unlike many previous Ethiopian studies that rely solely on vernacular or clinical disease terminology [9, 13, 17], the present study applies a bilingual (English/Afaan Oromoo) disease classification system to reduce diagnostic ambiguity and strengthen alignment between indigenous knowledge and veterinary science. The study was designed to: (i) comprehensively document medicinal plant species used to treat livestock ailments in Aseko District; (ii) record associated knowledge on plant parts used, preparation methods, routes of administration, and dosage practices; (iii) quantitatively evaluate informant agreement and cultural importance using established ethnobotanical indices; and (iv) assess local perceptions regarding availability, threats, and conservation of ethnoveterinary medicinal plants. By generating detailed and locally grounded evidence, this study aims to contribute baseline information for biodiversity conservation, sustainable use of medicinal plants, and future ethnoveterinary research in Ethiopia.

## Results

# Informant demographics

A total of 182 informants participated in the study, including 30 key informants (16.5%) and 152 household respondents (83.5%) selected from seven kebeles of Aseko District.

## Gender and age

Most participants were male (80.2%, n = 146), while females comprised 19.8% (n = 36).

Informant ages ranged from 28 to 96 years (mean 56.4 ± 14.8 years), with the largest proportion in the 51–65 year group (34.6%), followed by 36–50 years (29.7%), > 65 years (23.6%), and 20–35 years (12.1%).

## Education, religion, and ethnicity

The majority of informants were unable to read and write (65.4%), whereas 20.9% had elementary education, 9.3% secondary education, and 4.4% college-level training.

Most respondents were Muslim (72.0%) and Oromo (85.7%), with Christians (28.0%) and Amhara (14.3%) forming minority groups.

## Knowledge sources

Ethnoveterinary knowledge was transmitted mainly through family lineage (61.0%), followed by traditional healers (18.1%), religious learning (11.0%), and friends or relatives (9.9%), indicating strong reliance on oral intergenerational knowledge transfer.

## Diversity of ethnoveterinary medicinal plants

A total of 66 ethnoveterinary medicinal plant species belonging to **62 genera and 49 families** were documented in Aseko District (Table 1). Euphorbiaceae and Solanaceae were the most represented families (five species each), followed by Poaceae (three species). Apiaceae, Brassicaceae, Fabaceae, Lamiaceae, Myrtaceae, and Rutaceae each contributed to two species, whereas the majority of families (40 of 49; 81.6%) were represented by a single species.

Table 1
Diversity of ethnoveterinary medicinal plants documented in Aseko District

| Scientific name | Family | Local name | GF | Hb | PU |
|---|---|---|---|---|---|
| *Achyranthes aspera* L. | Amaranthaceae | Darguu | H | W | L |
| *Aeonium leucoblepharum* Webb ex A. Rich. | Crassulaceae | Harmaa gurraatti | S | W | L |
| *Agave sisalana* Perrine | Agavaceae | Algee | H | C | R |
| *Aloe vera* L. | Asphodelaceae | Hargiisa | H | C | L |
| *Allium sativum* L. | Amaryllidaceae | Qullubii-Adii | H | C | Bu |
| *Anethum graveolens* L. | Apiaceae | Koomana | H | C | R |
| *Asparagus africanus* Lam. | Asparagaceae | Sariitii | C | W | L, R |
| *Brassica nigra* (L.) Koch | Brassicaceae | Siinaficaa | H | C | Se |
| *Brucea antidysenterica* J.F.Mill. | Simaroubaceae | Jiloolaafaa | T | W | R |
| *Calpurnia aurea* (Ait.) Benth. | Fabaceae | Cekaa | T | W | L, R, Ba |
| *Capsicum annuum* L. | Solanaceae | Barberee | H | C | Fu |
| *Carissa spinarum* L. | Apocynaceae | Hagamsa | S | W | R |
| *Capparis tomentosa* Lam. | Capparaceae | Harangamaa | S | W | R |
| *Catha edulis* (Vahl) Endl. | Celastraceae | Jimaa | T | C | L |
| *Cissampelos mucronata* A.Rich. | Menispermaceae | Bishaan qal'ee | C | W | L |
| *Clutia abyssinica* Jaub. & Spach | Euphorbiaceae | Ulee foonii | S | W | L, R |
| *Croton macrostachyus* Del. | Euphorbiaceae | Makanisaa | T | W | L, La |
| *Cucumis ficifolius* A.Rich. | Cucurbitaceae | Araddoo gurraatti | H | W | R, L |
| *Cucurbita pepo* L. | Cucurbitaceae | Dubbaa / Dhobba | H | C | R, L + Ba |
| *Cynodon dactylon* (L.) Pers. | Poaceae | Coqorsa | H | W | Wp |
| *Dodonaea angustifolia* L.f. | Sapindaceae | Iticha | S | W | L, Se |
| *Discopodium eremanthum* Chiov. | Solanaceae | Mararo | S | W | L |
| *Dovyalis abyssinica* A.Rich. | Salicaceae | Kooshimo | T | W | L |
| *Embelia schimperi* Vatke | Primulaceae | Gurraa / Qorqoro | C | W | R |
| *Erythrina brucei* Schweinf. | Fabaceae | Walleensu | T | W | L, Ba |
| *Eucalyptus globulus* Labill. | Myrtaceae | Bargamo adii | T | C | L |
| *Euphorbia abyssinica* J.F.Gmel. | Euphorbiaceae | Adaami | T | W | L, Ba |
| *Hagenia abyssinica* (Bruce) J.F.Gmel. | Rosaceae | Heexoo | T | W | L |
| *Heteromorpha arborescens* (Spreng.) Cham. & Schltdl. | Apiaceae | Aliyaanqaa | T | W | R |
| *Hordeum vulgare* L. | Poaceae | Garbuu | H | C | Se |

| Scientific name | Family | Local name | GF | Hb | PU |
|---|---|---|---|---|---|
| *Hypericum revolutum* Vahl | Hypericaceae | Garambaa | S | W | L + R |
| *Juniperus procera* L. | Cupressaceae | Hindheessa | T | W | R |
| *Justicia schimperiana* (Hochst. ex Nees) T.Anders. | Acanthaceae | Dhumugaa / Sensel | S | W | L + R |
| *Lepidium sativum* L. | Brassicaceae | Fexo / Shuunfaa | H | C | Se |
| *Linum usitatissimum* L. | Linaceae | Talbaa | H | C | Se |
| *Maesa lanceolata* Forssk. | Primulaceae | Abbayyii | S | W | L, R, Fu |
| *Melia azedarach* L. | Meliaceae | Mim | T | C | Ba |
| *Musa × paradisiaca* L. | Musaceae | Muuzii | H | C | Sa |
| *Myrsine africana* L. | Primulaceae | Qacama | S | W | R |
| *Nigella sativa* L. | Ranunculaceae | Habsuda guracha | H | C | Se |
| *Nicotiana tabacum* L. | Solanaceae | Timbaho / Tamboo | H | C | L, R |
| *Ocimum lamiifolium* Hochst. | Lamiaceae | Damakasee | H | W | L |
| *Olinia rochetiana* A.Juss. | Oliniaceae | Gunaa | T | W | L |
| *Phoenix reclinata* Jacq. | Arecaceae | Meexxi | T | W | L + St |
| *Phytolacca dodecandra* L'Hér. | Phytolaccaceae | Handoodee | C | W | Ba, L + R |
| *Plantago lanceolata* L. | Plantaginaceae | — | H | W | R |
| *Podocarpus falcatus* (Thunb.) Mirb. | Podocarpaceae | Birbirsa | T | W | Ba |
| *Plumbago zeylanica* L. | Plumbaginaceae | Merxes | H | W | L, R |
| *Premna schimperi* Engl. | Lamiaceae | Urgessa | T | W | L, R |
| *Rhamnus prinoides* L'Hér. | Rhamnaceae | Geeshoo | S | W | L |
| *Ricinus communis* L. | Euphorbiaceae | Qobboo | S | W | R, L, Fu |
| *Rubus steudnerii* Schweinf. | Rosaceae | Dhukkoo | S | W | L |
| *Rumex nepalensis* Spreng. | Polygonaceae | Shaabbee | H | W | R |
| *Ruta chalepensis* L. | Rutaceae | Teenaadaama | S | C | L + Ba |
| *Solanum anguivi* L. | Solanaceae | Hidi-bude | S | W | Se |
| *Sorghum bicolor* (L.) Moench | Poaceae | Bisingaa caabbi | H | C | Se, R, L |
| *Syzygium guineense* var. | Myrtaceae | Baddessa | T | W | Ba |
| *Teclea nobilis* Del. | Rutaceae | Hadheesa | T | W | L, R |
| *Thymus schimperi* Ronniger | Lamiaceae | Xooshine | H | W | L |
| *Tragia cinerea* (Pax) | Euphorbiaceae | Laalessaa | H | W | L |

| Scientific name | Family | Local name | GF | Hb | PU |
|---|---|---|---|---|---|
| *Trichocladus ellipticus* Eckl. & Zeyh. | Hamamelidaceae | Dhadhaa | T | W | L |
| *Urera hypselodendron* (A.Rich.) Wedd. | Urticaceae | Haliilaa | S | W | Wp |
| *Verbascum sinaiticum* Benth. | Scrophulariaceae | Gurra Harree | H | W | L |
| *Vernonia amygdalina* Del. | Asteraceae | Ebicha | S | W | L |
| *Withania somnifera* (L.) Dunal | Solanaceae | Gizaawa / Uunjoo | S | W | R |
| *Zingiber officinale* Roscoe | Zingiberaceae | Zinjibila | H | C | Rh |

# Growth forms and habitat sources

Herbs constituted the dominant growth form (28 species; 42.4%), followed by shrubs (22 species; 33.3%), trees (13 species; 19.7%), and climbers (3 species; 4.5%) (Fig. 2). Most ethnoveterinary medicinal plants were harvested from **wild habitats (44 species; 66.7%)**, while **22 species (33.3%)** were obtained from **home gardens or farm margins**. Informants consistently reported a preference for preparing remedies from **fresh plant materials**.

## Livestock diseases and local terminology

Informants identified **33 distinct livestock ailments** described using both English and Afaan Oromoo terminology (**Supplementary Table S1**). Reported conditions included gastrointestinal disorders (e.g., diarrhea, bloat, constipation), parasitic infections (e.g., helminthiasis, tick and lice infestation), dermatological diseases (e.g., ringworm, mange, wounds), respiratory illnesses (e.g., cough, avian cholera), reproductive complications (e.g., retained placenta), and traumatic or toxic conditions (e.g., snake bite and hyena bite). The most frequently cited ailments were blackleg, bloat, diarrhea, and parasitic infestations. Diagnosis was primarily based on visual assessment of observable clinical signs combined with livestock-owner symptom descriptions.

## Plant parts used for remedy preparation

Across all reported remedies, **159 plant-part use citations** were recorded from **151 preparation events**, reflecting the use of multiple plant parts in some remedies. Leaves were the most frequently utilized plant part (73/159; 46.5%), followed by roots (30/159; 18.9%), bark (17/159; 10.7%), fruits (13/159; 8.2%), seeds (10/159; 6.3%), bulbs (8/159; 5.0%), whole plants (3/159; 1.9%), and other parts including rhizomes, latex, and stems (4/159; 2.5%) (Fig. 3).

# Modes of remedy preparation and material condition

Crushing or pounding followed by drenching represented the most common preparation method (52/151; 34.4%), followed by decoction (30/151; 19.9%) and direct topical application (28/151; 18.5%) (Fig. 4). Infusion accounted for 10 preparations (6.6%), while concoction and crushing–pasting–tying each represented eight preparations (5.3%). Smoke inhalation or fumigation was rarely reported (3/151; 2.0%). Most remedies were prepared from fresh materials (104/151; 68.9%), whereas 35 preparations (23.2%) used dried materials and 12 (7.9%) combined fresh and dried components.

# Routes of administration and dosage determination

Oral administration was the predominant route (102/151; 67.5%), followed by dermal or topical application (34/151; 22.5%), nasal administration (10/151; 6.6%), and ocular or auricular application (5/151; 3.3%) (Fig. 5). Dosage determination relied on healer experience and livestock characteristics such as species and body size. Local measurement units included cups, bottles, spoons, handfuls, and finger-sized quantities. No standardized dosage system was reported, and informants acknowledged variability in dose estimation.

**Major categories of livestock ailments treated.**

Grouping use reports by disease category indicated that gastrointestinal disorders accounted for the largest proportion (43/151; 28.5%), followed by ecto- and endoparasitic infections (37/151; 24.5%) and dermatological diseases (23/151; 15.2%) (Table 2). Wounds and musculoskeletal trauma represented 13.2% (20/151), respiratory infections 7.3% (11/151), reproductive disorders 4.6% (7/151), sensorial ailments 3.3% (5/151), and other conditions—including sudden sickness, evil eye, urine retention, and systemic weakness—3.3% (5/151).

Table 2
Ethnoveterinary use reports across livestock ailment categories

| Ailment category | Use reports | Percentage (%) | Key species (Fidelity Level, %) |
|---|---|---|---|
| Gastrointestinal disorders | 43 | 28.5 | Embelia schimperi (92), Zingiber officinale (88) |
| Ecto-/endoparasitic infections | 37 | 24.5 | Phytolacca dodecandra (85), Calpurnia aurea (80) |
| Dermatological diseases | 23 | 15.2 | Croton macrostachyus (89), Allium sativum (85) |
| Wounds and musculoskeletal trauma | 20 | 13.2 | Asparagus africanus (78), Ricinus communis (75) |
| Respiratory infections | 11 | 7.3 | Ocimum lamiifolium (88), Cissampelos mucronata (73) |
| Reproductive disorders | 7 | 4.6 | Aeonium leucoblepharum (68) |
| Sensorial ailments | 5 | 3.3 | Trichocladus ellipticus (81) |
| Other conditions (sudden sickness, evil eye, urine retention, weakness) | 5 | 3.3 | Withania somnifera (71) |
| Total | 151 | 100.0 | |

# Informant consensus factor (ICF)

ICF values ranged from **0.25 to 0.67**, indicating variable but generally **moderate to relatively high consensus** among informants regarding plant use within specific disease categories. The highest consensus occurred for reproductive disorders (ICF = 0.67), followed by dermatological diseases (0.64), respiratory infections (0.60), and ecto-/endoparasitic infections (0.58). Gastrointestinal disorders and wounds/musculoskeletal trauma showed moderate agreement (0.55 and 0.58, respectively), whereas other conditions exhibited low consensus (0.25). Sensorial ailments were excluded from ICF analysis because the number of species cited exceeded the number of use reports.

# Preference ranking of anti-diarrheal medicinal plants

Preference ranking of medicinal plants used to treat livestock diarrhea was conducted using **14 complete key-informant responses** to ensure statistical consistency of the ranking matrix. The recalculated rank sums demonstrated

clear variation in perceived therapeutic effectiveness among candidate species. *Hagenia abyssinica* retained the highest cumulative score and ranked first, followed by *Zingiber officinale* and *Embelia schimperi*, whereas *Dodonaea angustifolia* and *Rubus steudnerii* received the lowest overall scores (Table 3).

Table 3
Preference ranking of medicinal plants used to treat livestock diarrhea.

| Medicinal plant | A | B | C | D | E | F | G | H | I | J | K | L | M | N | Total | Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hagenia abyssinica* B. | 7 | 6 | 7 | 5 | 6 | 7 | 6 | 7 | 4 | 6 | 7 | 7 | 6 | 5 | 86 | 1st |
| *Zingiber officinale* Roscoe | 7 | 4 | 3 | 2 | 5 | 6 | 4 | 2 | 7 | 3 | 7 | 5 | 6 | 7 | 68 | 2nd |
| *Embelia schimperi* Vatke | 4 | 5 | 7 | 5 | 6 | 3 | 3 | 6 | 5 | 4 | 6 | 3 | 3 | 5 | 65 | 3rd |
| *Clutia abyssinica* Jaub. & Spach | 5 | 2 | 6 | 6 | 4 | 3 | 5 | 6 | 6 | 5 | 4 | 2 | 3 | 4 | 61 | 4th |
| *Ocimum lamiifolium* Hochst. | 4 | 6 | 4 | 5 | 2 | 1 | 4 | 4 | 5 | 6 | 5 | 3 | 2 | 6 | 57 | 5th |
| *Rubus steudnerii* Schweinf. | 3 | 2 | 1 | 4 | 5 | 2 | 1 | 5 | 4 | 3 | 5 | 2 | 3 | 4 | 44 | 6th |
| *Dodonaea angustifolia* L.f. | 1 | 3 | 2 | 4 | 3 | 5 | 1 | 2 | 4 | 5 | 4 | 4 | 3 | 2 | 43 | 7th |

# Fidelity level (FL) and frequently cited species

Several medicinal plant species exhibited high fidelity level (FL) values, reflecting strong agreement among informants regarding their use for specific livestock ailments. *Embelia schimperi* showed the highest FL for gastrointestinal disorders (92.3%), followed by *Ocimum lamiifolium* for diarrheal conditions (88.2%) and *Phytolacca dodecandra* for ecto-/endoparasitic infections (85.2%). Additional species with high FL values included *Croton macrostachyus*, *Rubus steudnerii*, and *Achyranthes aspera* High fidelity levels were observed for *Embelia schimperi* (92%) in gastrointestinal disorders and *Croton macrostachyus* (89%) in dermatological conditions (Table 2). *FL = (Number of informants citing the species for a specific ailment / Total informant citing the species for any ailment) × 100."*

# Multipurpose use and conservation priority of medicinal plants

Direct matrix ranking (DMR) was conducted with 12 key informants to assess multipurpose use pressure on eight widely used medicinal plant species across eight use categories (medicine, firewood, fodder, construction, food, fencing, tools, shade). Species were scored from 0 (not used) to 5 (highest utility), and composite use values were calculated as the sum of average scores across all categories (Table 4).

Table 4
Direct matrix ranking of multipurpose ethnoveterinary medicinal plants in Aseko District

| Species | Medicine | Firewood | Fodder | Construction | Food | Fencing | Tools | Shade | Total Use Value |
|---|---|---|---|---|---|---|---|---|---|
| *Hagenia abyssinica* | 4.8 | 3.2 | 2.1 | 4.5 | 1 | 3.7 | 2.9 | 4.3 | **26.5** |
| *Ruta chalepensis* | 4.5 | 2.8 | 1.9 | 4.2 | 0.8 | 3.5 | 2.7 | 4 | **24.4** |
| *Croton macrostachyus* | 4.3 | 3.9 | 2.6 | 3.8 | 1.2 | 3.4 | 2.5 | 3.1 | **24.8** |
| *Juniperus procera* | 4.1 | 4 | 1.5 | 4.7 | 0.5 | 2.8 | 3.6 | 2.9 | **24.1** |
| *Podocarpus falcatus* | 3.9 | 4.5 | 1.8 | 3.5 | 2 | 3 | 2.2 | 3.3 | **24.2** |
| *Ocimum lamiifolium* | 4.7 | 1.2 | 2.4 | 1 | 3.8 | 1.5 | 1 | 2.1 | **17.7** |
| *Phytolacca dodecandra* | 4.4 | 2 | 3.1 | 1.8 | 2.5 | 2.9 | 1.3 | 1.7 | **19.7** |
| *Withania somnifera* | 4.6 | 1.5 | 2.8 | 1.2 | 3 | 2 | 1.8 | 2 | **18.9** |

# Marketability of medicinal plants

Fifteen of the recorded medicinal plant species (22.7%) were reported to be sold in local markets. Among these, *Embelia schimperi*, *Hagenia abyssinica*, *Thymus schimperi*, and *Withania somnifera* were primarily purchased for medicinal purposes. Reported market prices were low, with a bundle of *Withania somnifera* roots costing approximately 30 Ethiopian Birr and a cup of dried *Thymus schimperi* leaves about 20 Ethiopian Birr.

# Knowledge transmission

Ethnoveterinary knowledge was transmitted orally, predominantly within family lineages. Healers commonly reported learning from parents or grandparents, and knowledge transfer was often restricted to selected family members—frequently elder sons—and characterized by secrecy. No practitioners reported maintaining written ethnoveterinary records.

# Threats to medicinal plants

Agricultural expansion was identified as the most significant threat to medicinal plants, accounting for **22.0%** of the total responses. This was followed by firewood and charcoal collection (**19.8%**) and climate-related factors, including drought and soil erosion (**18.7%**). Additional pressures included construction activities and timber extraction (**15.9%**), livestock grazing (**14.8%**), and pesticide use (**12.1%**) (Table 5).

Table 5
Major threats to medicinal plants in the study area

| Factors | R1 | R2 | R3 | R4 | R5 | R6 | R7 | Total | Percent | Rank |
|---|---|---|---|---|---|---|---|---|---|---|
| Agricultural expansion | 7 | 3 | 6 | 7 | 6 | 7 | 4 | 40 | 22.0 | 1st |
| Firewood & charcoal | 5 | 7 | 6 | 5 | 2 | 5 | 6 | 36 | 19.8 | 2nd |
| Climate change (drought & erosion) | 4 | 5 | 5 | 4 | 7 | 4 | 5 | 34 | 18.7 | 3rd |
| Construction & timber | 6 | 3 | 5 | 3 | 4 | 2 | 6 | 29 | 15.9 | 4th |
| Grazing | 5 | 3 | 3 | 5 | 4 | 5 | 2 | 27 | 14.8 | 5th |
| Pesticide | 3 | 1 | 4 | 5 | 4 | 3 | 2 | 22 | 12.1 | 6th |

# Conservation and management practices

Remnant forest patches containing medicinal plants were commonly associated with religious and cultural sites, including churches, mosques, and traditional Oromo gathering areas. Some community members also reported cultivating selected medicinal species—particularly *Hagenia abyssinica* and *Ruta chalepensis*—within home gardens and along farm boundaries, indicating localized **in situ and ex situ conservation practices**.

# Discussion

This study documents a high level of ethnoveterinary knowledge in Aseko District, evidenced by the identification of **66 medicinal plant species belonging to 62 genera and 49 families** (Table 1). This level of plant diversity is comparable to, or higher than, that reported from many ethnoveterinary studies conducted elsewhere in Ethiopia, reflecting the continued reliance of rural communities on plant-based remedies for livestock healthcare in areas with limited access to formal veterinary services [22, 24, 31]. The dominance of families such as Euphorbiaceae and Solanaceae, followed by Poaceae, Apiaceae, Fabaceae, Lamiaceae, Myrtaceae, and Rutaceae, aligns with their broad ecological distribution and documented medicinal versatility in Ethiopian and East African ethnoveterinary systems [24, 35].

Herbaceous species constituted the largest growth-form category, followed by shrubs, trees, and climbers (Fig. 2). This pattern has been consistently reported across Ethiopian ethnoveterinary studies and likely reflects the greater accessibility, abundance, and rapid regeneration of herbaceous plants in mixed farming landscapes [31, 32]. Similar dominance of herbaceous taxa has also been documented in ethnoveterinary inventories from South Asia and sub-Saharan Africa, suggesting that growth-form selection is driven primarily by ecological availability and ease of harvesting rather than taxonomic preference alone [26, 30, 38].

Most ethnoveterinary medicinal plants documented in Aseko District were harvested from wild habitats (**44 species; 66.7%**), while **22 species (33.3%)** were obtained from home gardens or farm margins. This strong reliance on wild plant resources parallels findings from other Ethiopian regions, where ethnoveterinary practices depend predominantly on natural vegetation rather than cultivated sources [24, 32]. Although this reliance reflects detailed ecological knowledge, it also exposes medicinal plant resources to increasing anthropogenic pressures. Informants identified agricultural expansion, fuelwood and charcoal collection, grazing pressure, construction activities, and climate-related stress as major threats to medicinal plant availability, consistent with reports from other parts of Ethiopia and broader African contexts [24, 26, 27, 37].

Livestock ailments treated using traditional remedies in Aseko District were dominated by gastrointestinal disorders, ecto- and endoparasitic infections, and dermatological diseases (Supplementary Table S1). This distribution reflects

common health challenges in smallholder livestock systems and closely mirrors ethnoveterinary findings from Ethiopia, East Africa, and South Asia [22, 32, 38]. Diagnosis was primarily based on observable clinical signs and livestock-owner experience, illustrating a structured indigenous diagnostic system developed through long-term interactions among humans, livestock, and their environment [26].

Leaves were the most frequently utilized plant part, followed by roots and bark (Fig. 3), a pattern widely documented in Ethiopian ethnoveterinary literature [31, 32]. The preference for leaves is often interpreted as a relatively sustainable harvesting strategy, as leaf collection is generally less destructive than root or bark removal. Nevertheless, repeated harvesting without management may still negatively affect plant regeneration, particularly for slow-growing or habitat-restricted species. Remedy preparation methods were predominantly simple, involving crushing or pounding followed by drenching, decoction, and topical application (Fig. 4), consistent with ethnoveterinary practices reported both in Ethiopia and globally [31, 36]. Informants consistently reported a preference for fresh plant materials, reflecting local perceptions that freshness enhances therapeutic efficacy.

Oral administration was the predominant route of remedy application, followed by dermal, nasal, and ocular or auricular routes (Fig. 5). This pattern mirrors ethnoveterinary practices reported across Ethiopia and other regions, particularly for internal ailments such as gastrointestinal and parasitic diseases [30, 32, 36]. The consistency of administration routes across diverse cultural settings suggests convergence toward empirically effective practices rather than purely symbolic traditions.

Quantitative analyses revealed moderate to relatively high informant consensus for major disease categories. Informant Consensus Factor (ICF) values were highest for reproductive disorders (ICF = 0.67), followed by dermatological (ICF = 0.58) and respiratory diseases (ICF = 0.52), indicating reliance on a limited number of culturally validated species for these ailments. High Fidelity Level (FL) values recorded for species such as *Embelia schimperi* (FL = 92.3%), *Ocimum lamiifolium* (FL = 88.2%), and *Phytolacca dodecandra* (FL = 85.2%) reflect strong agreement among informants regarding their therapeutic effectiveness. Preference ranking analysis further refined these findings by revealing differential perceived efficacy among antidiarrheal species: *Hagenia abyssinica* ranked first, followed by *Zingiber officinale* and *Embelia schimperi*. This divergence between FL (frequency-based) and preference ranking (efficacy-based) underscores the value of multi-metric validation in ethnoveterinary research. Collectively, these patterns are consistent with other Ethiopian and East African ethnoveterinary studies and highlight priority species that may warrant further phytochemical and pharmacological investigation [22, 32, 36].

Ethnoveterinary knowledge in Aseko District is transmitted predominantly through oral pathways within family lineages, often restricted to selected individuals. While this mode of transmission preserves cultural integrity, it also increases vulnerability to knowledge erosion under changing socio-economic conditions. Similar challenges have been reported across Ethiopia, Africa, and Asia, where modernization, formal education, and declining interest among younger generations threaten intergenerational knowledge transfer [26, 27, 38]. Although informants reported the presence of culturally protected forest patches and limited home-garden cultivation of medicinal plants, these practices remain insufficient to counterbalance the intensity of identified threats.

Table 6
Methodological advances of this study compared to typical Ethiopian ethnoveterinary research

| Feature | This study (Aseko District) | Typical Ethiopian ethnoveterinary study |
|---|---|---|
| **Disease classification** | Bilingual: English + Afaan Oromo (33 ailments) | Vernacular-only or clinical terms alone (20–25 ailments) |
| **Sampling design** | Stratified across 3 agroecological zones (highland, midland, lowland) | Single agroecological zone |
| **Quantitative analysis** | ICF + Fidelity Level (FL) + preference ranking | ICF only, or no quantitative indices |
| **Economic data** | Market prices reported for 15 species | No market or economic valuation |
| **Threat assessment** | Expert-ranked pressures with scoring (n = 7 senior healers) | General qualitative observations |

Overall, the findings confirm that ethnoveterinary medicine remains an integral and effective component of livestock healthcare in Aseko District. The documented plant diversity, preparation practices, routes of administration, and consensus patterns—together with the identified threats—underscore both the resilience and fragility of this indigenous knowledge system. Strengthening community-based conservation initiatives, promoting sustainable harvesting practices, and encouraging the cultivation of key ethnoveterinary species are essential to enhance the long-term viability of traditional livestock healthcare while contributing to biodiversity conservation. Similar integrative approaches have been widely advocated across Africa and globally to safeguard ethnoveterinary knowledge systems within sustainable development frameworks [26, 38, 40].

## Methods

# Study area

The study was conducted in **Aseko District**, Arsi Zone, Oromia Regional State, southeastern Ethiopia (Fig. 1). The district is located between **8°15'10"–8°41'00" N latitude** and **39°55'40"–40°16'20" E longitude**, approximately **160 km southeast of Addis Ababa** [34]. Aseko District covers an estimated area of **600–610 km²** and exhibits pronounced topographic heterogeneity, with elevations ranging from approximately **1,170 to 2,950 m above sea level** [34].

Agroecologically, the district comprises three major zones: **highland (> 2,500 m)**, **midland (1,800–2,500 m)**, and **lowland (< 1,800 m)**. These zones differ markedly in climate, vegetation structure, and land-use patterns, factors known to influence medicinal plant availability and ethnoveterinary practices. Accordingly, sampling was stratified across all three agroecological zones to capture ecological variation in plant use. Vegetation in Aseko District includes **dry evergreen Afromontane forest, shrublands, and grasslands**, which collectively support high medicinal plant diversity [34].

# Reconnaissance survey and study site selection

A reconnaissance survey was conducted in **June 2024** to assess vegetation types, accessibility, settlement patterns, and livestock production systems within the district. Preliminary consultations were held with **district agricultural officers, development agents, and community elders** to identify areas with active ethnoveterinary practice. Based on ecological variation, accessibility, and cultural representation, **seven kebeles** were purposively selected using a **multi-stage cluster sampling approach**, following established ethnobotanical fieldwork guidelines [49, 50].

# Informant selection

Informants were selected using a combination of **purposive and snowball sampling techniques**, which are widely applied in ethnobiological research to identify individuals possessing specialized indigenous knowledge [49, 50]. Traditional healers, elder livestock keepers, and community-recognized ethnoveterinary practitioners were identified with the assistance of local leaders and development agents.

A total of **30 key informants** were purposively selected across the seven kebeles. In addition, household respondents were selected using proportional sampling. Sample size was determined using the formula proposed by **Krejcie and Morgan** [48]:

$$n = \frac{NZ^2p(1-p)}{d^2(N-1) + Z^2p(1-p)}$$

1

where *N* is the total number of households (8,665), *p* is the estimated proportion of households using traditional medicine (0.80), *d* is the margin of error (0.08), and *Z* is the standard normal value at 95% confidence (1.96). Application of this formula yielded **152 household respondents**, resulting in a total of **182 informants** included in the study.

# Data collection

Ethnoveterinary data were collected between **July 2024 and February 2025** using **semi-structured interviews, focus group discussions, guided field walks, and local market surveys**, following established ethnobotanical research methodologies [40, 50]. Semi-structured interviews captured detailed information on medicinal plant species, plant parts used, preparation methods, routes of administration, and treated livestock ailments.

Focus group discussions were conducted in each of the seven kebeles to triangulate interview data and validate commonly reported ethnoveterinary practices [53]. Guided field walks with key informants enabled **in situ observation, documentation, and preliminary identification** of medicinal plant species occurring in natural vegetation, grazing lands, farmland margins, and home gardens, ensuring methodological consistency with comparable Ethiopian ethnobotanical studies [34,53].

All ethnoveterinary use reports are provided in **Supplementary Table S1**, which includes scientific names, local Afaan Oromoo names, plant parts used, livestock ailments treated, preparation methods, routes of administration, and informant citations for **151 use reports derived from 66 medicinal plant species**.

# Voucher specimen collection and taxonomic identification

Voucher specimens of all reported medicinal plant species were collected during guided field walks, pressed, dried, labeled, and preserved following standard herbarium procedures [43]. Species identification was conducted using the *Flora of Ethiopia and Eritrea* [1] and formally authenticated by **professional botanists at the Ethiopian Biodiversity Institute (EBI) National Herbarium**, Addis Ababa, in collaboration with taxonomic specialists from the **Wondo Genet College of Forestry and Natural Resources, Hawassa University**.

Authenticated voucher specimens were deposited in the **publicly accessible EBI National Herbarium**, Addis Ababa. Corresponding voucher accession numbers are provided in **Supplementary Table S1**, in accordance with **Index Herbariorum** guidelines [52], ensuring traceability and long-term scientific verification.

# Ethical considerations

Ethical clearance for this study was granted by the **Aseko District Administration and Aseko District Agricultural and Natural Resources Office, Arsi Zone, Oromia Regional State, Ethiopia**, in accordance with Ethiopian community-based research governance procedures applicable in areas where no formal institutional review board is established.

The research adhered to the ethical principles of the **International Society of Ethnobiology (ISE) Code of Ethics**. Prior to data collection, the objectives of the study were explained to all participants in Afaan Oromo, and **verbal informed consent** was obtained from each informant. Participation was entirely voluntary, and no personally identifiable information is included in this publication. No experimental procedures involving live animals were conducted.

Official written permission to collect medicinal plant specimens and conduct ethnobotanical field documentation was obtained from the **Ethiopian Biodiversity Institute (Permit No. EBI/RES/057/2024)**, the **Aseko District Administration**, and the **Aseko District Environment, Forest and Climate Change Office** prior to fieldwork. Plant collection complied with **Ethiopian national biodiversity conservation regulations**, institutional research governance requirements, and international best-practice standards. Sampling was restricted to the minimum quantity necessary for scientific identification and voucher preservation, and no plant material was collected for commercial or trade purposes.

All field research involving wild plant species complied with relevant **institutional, national, and international conservation legislation**. The study followed the **IUCN Policy Statement on Research Involving Species at Risk of Extinction** and respected the principles of the **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)**. No CITES-listed species were harvested for trade or destructive utilization.

# Quantitative ethnobotanical indices and analysis

Ethnobotanical data were analyzed using descriptive and quantitative methods. Frequencies and percentages summarized plant growth forms, plant parts used, preparation methods, and administration routes.

## Informant Consensus Factor (ICF)

Agreement among informants for medicinal plant use within livestock ailment categories was evaluated using the Informant Consensus Factor following Trotter and Logan [53]:

$$\mathrm{ICF} = \frac{n_{ur} - n_t}{n_{ur} - 1}$$

2

where $n_u$ is the number of use reports for a given ailment category and $n$ is the number of taxa used for that category.

Equation (2) quantifies the degree of shared knowledge, with values approaching **1** indicating high consensus.

# Fidelity Level (FL)

The specificity of medicinal plant use for particular ailments was determined using Fidelity Level [19]:

$$\mathrm{FL}{:}(\%) = \left(\frac{I_p}{I_u}\right) \times 100$$

3

where I is the number of informants independently citing a species for a specific ailment and $I_u$ is the total number of informants mentioning the species for any ailment.

Higher FL values from Eq. (3) indicate stronger ailment-specific cultural importance.

# Preference ranking

Preference ranking was conducted with **14 key informants** to identify the most effective medicinal plants used for treating diarrhea, following Cunningham [54]. Total preference scores were calculated as:

$$\text{Total Score} = \sum_{i=1}^{14} S_i$$

4

where $S_i$ represents the score (1–7) assigned by informant *i*.

Species with higher totals in Eq. (4) were considered more therapeutically preferred.

# Direct matrix ranking (DMR)

Direct matrix ranking assessed multipurpose use pressure on **eight widely used species** across **eight use categories** (medicine, firewood, fodder, construction, food, fencing, tools, and shade) [58].

Twelve key informants assigned scores from **0 (not used)** to **5 (highest utility)**. Composite cultural importance values were obtained by summing mean scores across categories to rank species according to overall use pressure.

All statistical analyses were performed using **Microsoft Excel 2019** and **SPSS version 26**.

## Declarations

# Acknowledgements

The authors thank the local communities of Aseko District for generously sharing their ethnoveterinary knowledge. We also acknowledge the support of local agricultural offices and development agents for facilitation during fieldwork. **All figures were created by the authors using ArcMap 10.8 (Esri, Redlands, CA, USA) and Microsoft Excel 2019.**

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No external funding was received for this study. The research was conducted using the authors' institutional and personal resources.

# Author contributions

J.S.J  conceived and designed the study, conducted field data collection, performed data analysis, and drafted the manuscript, M.M contributed to study design, data interpretation, and critically revised the manuscript, Z.G contributed to data analysis, methodological validation, and critical revision of the manuscript. All authors read and approved the final manuscript.

# Data availability

All **Data Availability Statement**

All data analyzed during this study are included in this published article and its Supplementary Information files. Ethnoveterinary use reports, species lists, and quantitative indices are provided in **Supplementary Table S1**. Voucher specimen accession numbers are available from the corresponding author upon reasonable request.

**LLM uses disclosure.**

A large language model (ChatGPT, OpenAI) was used solely to assist with language editing and structural refinement of the manuscript. The model was not used for data collection, analysis, or interpretation. All data verification, scientific interpretation, and conclusions are the sole responsibility of the authors.

# Competing interests

The authors declare no competing interests.

# Ethics declarations

**Ethics approval and consent to participate.**

This study involved human participants through interviews and group discussions. Ethical approval was obtained from the relevant administrative authorities of Aseko District prior to data collection. All procedures were conducted in accordance with recognized ethical guidelines for ethnobiological research. Verbally informed consent was obtained from all participants before participation, and involvement in the study was entirely voluntary.

**Consent for publication**

No  personally identifiable information of participants is included in this manuscript. Informed consent to participate and to publish anonymized information was obtained from all participants..

# Approval of animal experiments

Not applicable. This study did not involve experiments on live vertebrate or invertebrate animals.

# Supplementary information

Supplementary Information accompanies this paper and includes detailed species lists, ethnoveterinary use reports, quantitative indices, and additional tables supporting the findings of this study.

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## Figures

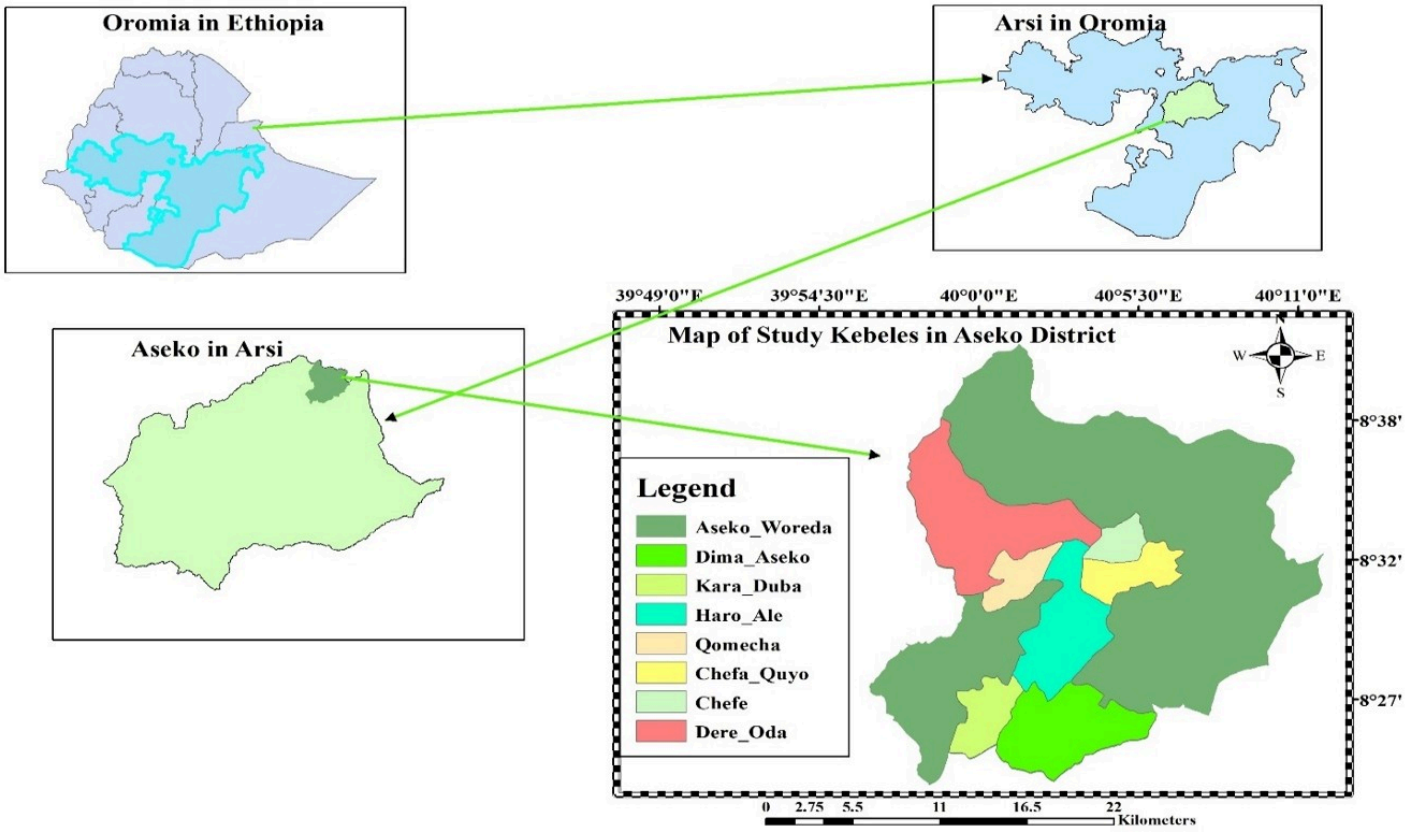



**Figure 1**

**Location map of Aseko District and study sites.** The map shows the geographical position of Aseko District within the Arsi Zone of Oromia Regional State, southeastern Ethiopia, and the locations of the seven kebeles surveyed.

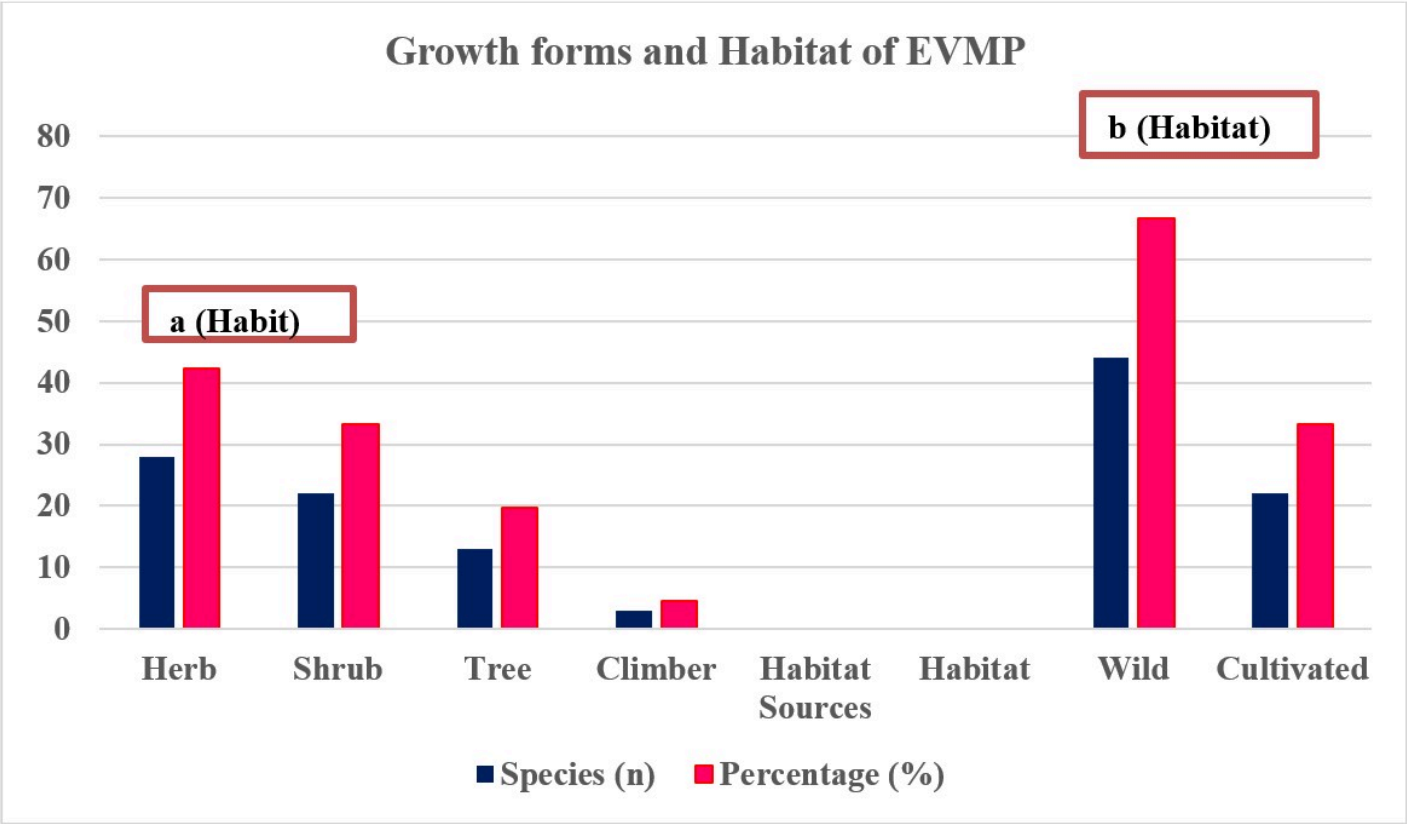



**Figure 2**

**Growth forms of ethnoveterinary medicinal plants used in Aseko District.** Herbs constituted the dominant growth form (42.4%), followed by shrubs (33.3%), trees (19.7%), and climbers (4.5%).

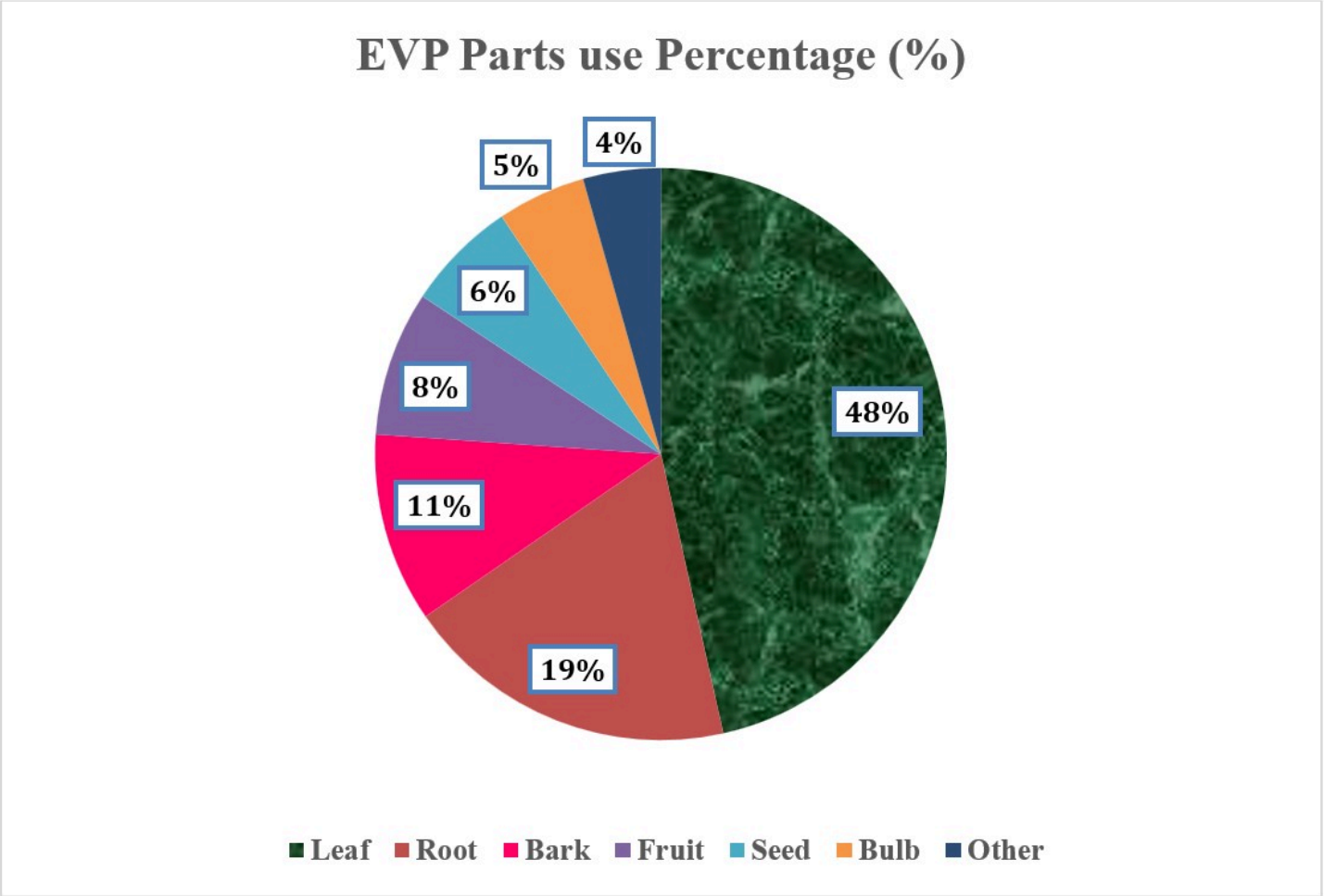



**Figure 3**

**Percentage distribution of plant parts used for ethnoveterinary remedies in Aseko District.** Leaves were the most frequently utilized plant part (46.5%), followed by roots (18.9%), bark (10.7%), fruits (8.2%), seeds (6.3%), bulbs (5.0%), and other parts including rhizomes, latex, and stems (4.4%).

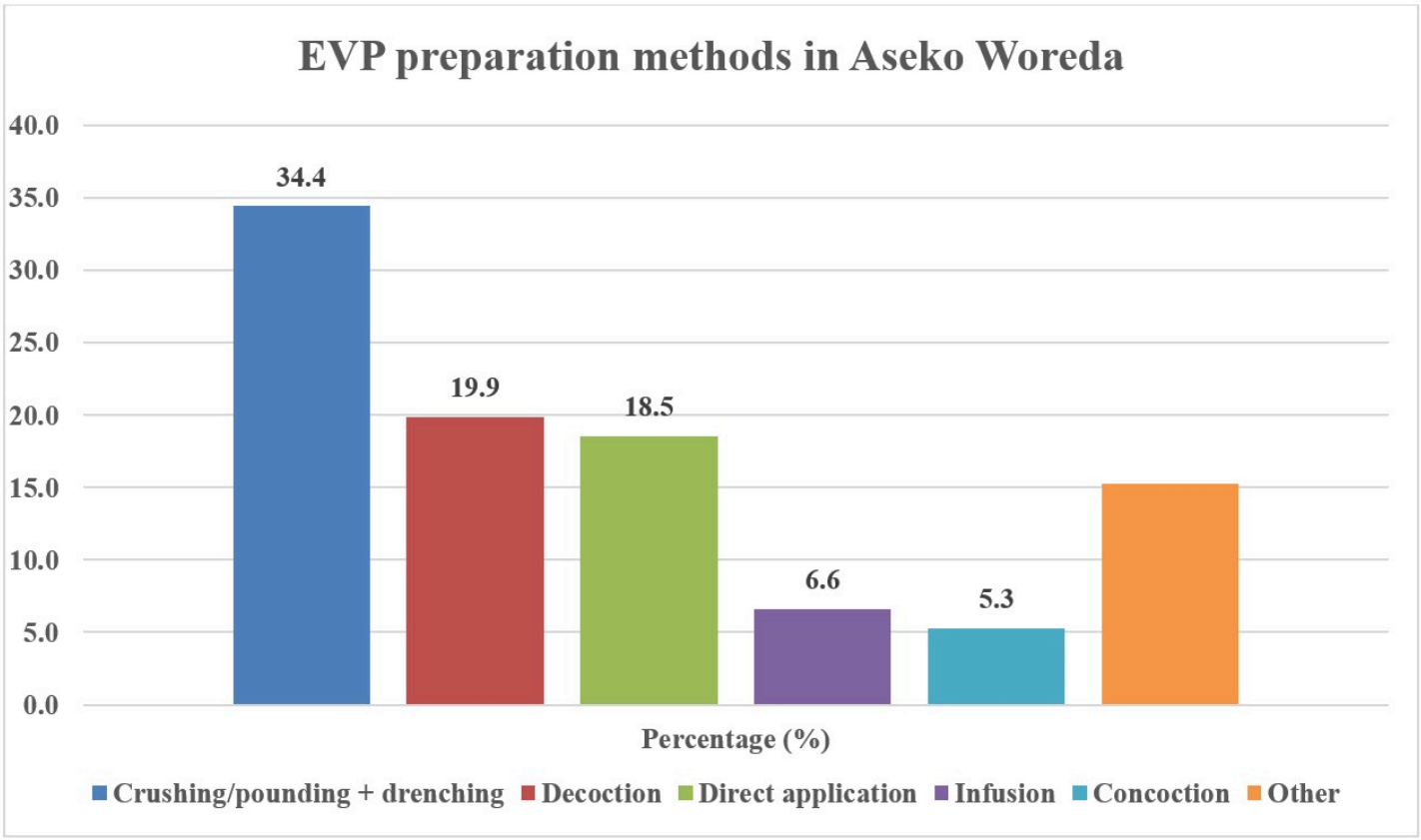



**Figure 4**

**Common methods of remedy preparation used by traditional healers in Aseko District.** Crushing or pounding followed by drenching was the most common method (34.4%), followed by decoction (19.9%) and direct topical application (18.5%).

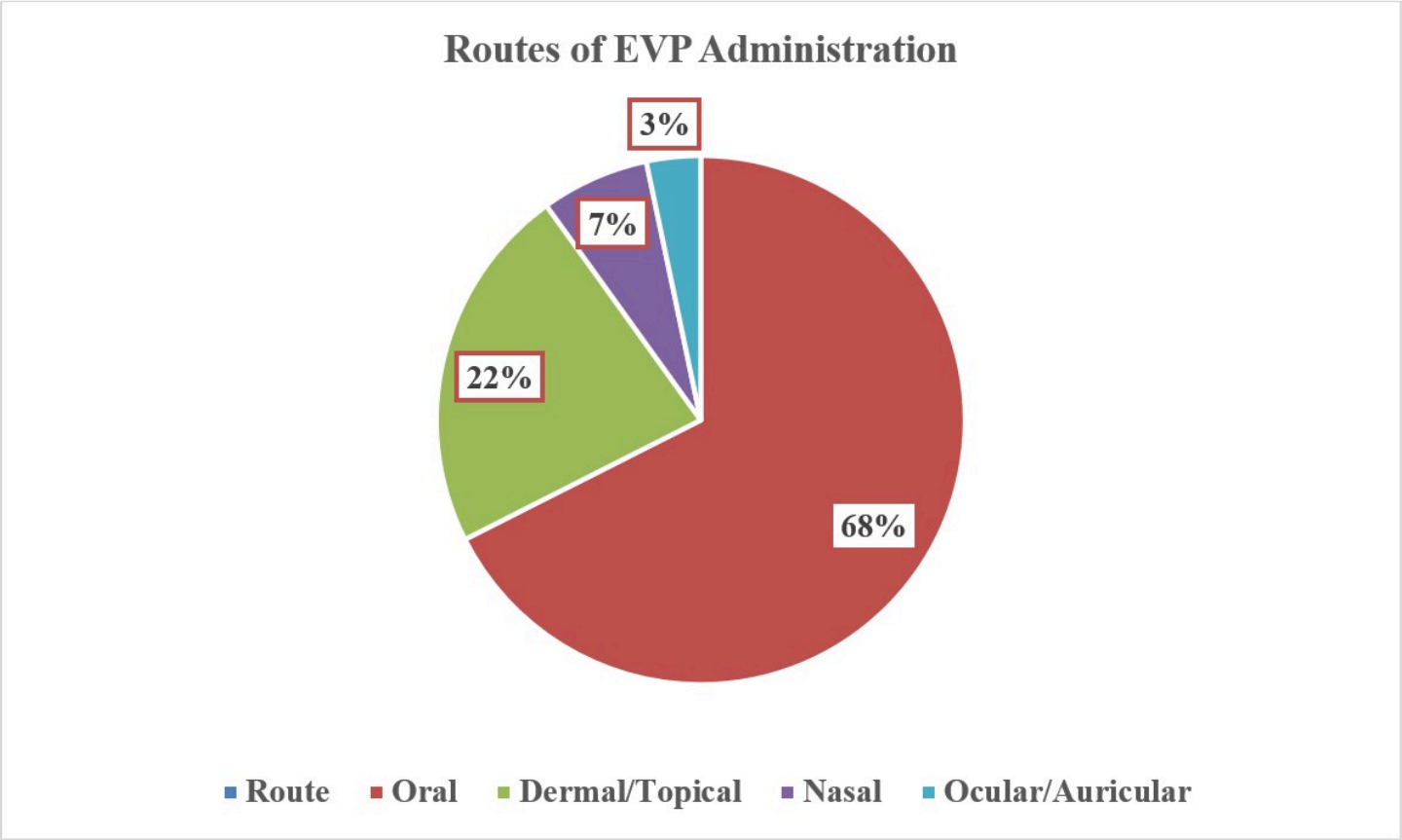



**Figure 5**

**Major routes of administration of ethnoveterinary remedies in Aseko District.** Oral administration was predominant (67.5%), followed by dermal/topical application (22.5%), nasal administration (6.6%), and ocular/auricular application (3.3%).

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryS1.pdf