# Medicinal Plants Used for the Treatment of Poultry Diseases in Zimbabwe: A Systematic Review

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## Abstract

Poultry farming represents an important sector for the livelihood of rural communities in Zimbabwe. Farmers raise poultry in order to meet demands on household food and as additional sources of income. However, the production of birds is hampered by a variety of diseases. The impact of diseases is severe for poor communities who have limited access to modern veterinary services and, therefore, rely on indigenous medicines for the treatment of livestock ailments. Here we review the medicinal plants that are used for the treatment of poultry diseases in Zimbabwe. A systematic web search and review was conducted on research literature relating to medicinal plants that are used for the treatment of poultry diseases in Zimbabwe. Data were collected from a total of 15 Zimbabwean studies meeting specific inclusion criteria. Data from published studies lacking information on study area, scientific names of plants and without information about plants that are used to treat poultry diseases were excluded. Relevant ethnoveterinary information was analysed and summarized in tables, bar graphs and pie charts. Fifty-three plants were used among the non-commercial poultry producers in Zimbabwe. Most of the plants used for treating poultry belonged to the Fabaceae family followed by Solanaceae. Cited in 14 studies, *Aloe* species were the most widely used plant. Leaves were the most widely used part of the plant for treatment. The most widely used method of preparing plant material for treatment was crushing. Geographical and cross-cultural linkage contributes to knowledge sharing. There is need to conduct more field surveys to document more plants used in different parts of the country. It would be useful to investigate the therapeutic effectiveness of the various plant materials under clearly defined experimental conditions. The ultimate aim would be to isolate and identify potentially useful compounds.

## Introduction

The term poultry describes domestic birds that are raised for their products including meat, eggs, and feathers and includes chickens, turkeys, guinea fowls, ducks and other species often considered game such as pigeons [1]. Chickens constitute about 90% of the poultry population and are, by far, the most important poultry species in all parts of the world [2]. The raising of poultry is increasing in importance globally, including in Sub-Saharan Africa [3]. The production of poultry offers potential economic and health benefits to economies of Sub-Saharan Africa and their populations including improved nutrition, incomes for poultry farmers; employment, reliable grain market for farmers and cheaper source of protein [4]. Although farmers may be aware of the need to keep their flocks in good health [5], conventional drugs or vaccines are either unavailable or too expensive. Inability to access conventional drugs or vaccines forces poor farmers to rely on herbal remedies. Conventional packages for treating poultry diseases are designed for the commercial sector and for up to thousands of birds whereas small-scale poultry farmers work with small flocks that have birds of mixed age groups. The flocks may be made up of different species [6]. Although rural farmers claim that ethno-veterinary practices are effective [5, 7], there is an urgent need for research to substantiate their assertions.

In Zimbabwe, medicinal plants and practices have always been part of the management of animal diseases and other health problems such as fractures [8]. Most rural societies [9] still rely herbal remedies to treat diseases affecting all livestock species. However, formal ethno-veterinary research is still an emerging field in the country with most studies to date focusing on documenting plants that are used in the management of various health problems of livestock [5, 8, 10, 11].

Medicinal plants can play a key role in the development and advancement of modern studies by serving as a starting point for the development of drugs. Although medicinal plants may be highly valued by a substantial section of the population destructive and illegal harvesting threaten the sustainability of their use. Lack of proper documentation of indigenous knowledge on medicinal plants has reduced broad research on indigenous information [12, 13], Increase of modern education has resulted in the younger generation to undervaluing the local indigenous knowledge on medicinal plants [12, 14]. The use of medicinal plants for the treatment of poultry diseases in Zimbabwe has been reported separately, the use of the medicinal plants and the diseases that the remedies are used to treat have not been reviewed. In this study, the objective was to review medicinal plants that are used for the management of poultry health in Zimbabwe, including the parts of the plant used, methods of preparing the remedies, and the methods of administration during use.

## Results

Of the articles that were reviewed, 60% dealt with the use of medicinal plants used for the treatment of different livestock species while 30% were concerned with the use of medicinal plants in the management of poultry health. The information gathered on herbal plants that are in the management of poultry diseases in Zimbabwe, parts of the plant used, methods used in preparing the medicines and the diseases or symptoms that are treated are summarized in Table 1.

Table 1

Medicinal plants used in the management of poultry health in Zimbabwe

| Author(s) | Family | Species name | Vernacular name | Plant parts used | Method of preparation | Disease or symptom treated |
|---|---|---|---|---|---|---|
| [15] | Agavaceae | *Agave sisalana*<br>Naturalised, Perennial | *Mukonje/ chikwengu* | Leaves | Pound the plant and add to drinking water | Coccidiosis<br>Coughing<br>Flu-like symptoms<br>Newcastle disease |
| [15] | *Amaranthaceae* | *Chenopodium ambrosioides*<br>Naturalised, Perennial | *Munhuwenhuwe* | Whole plant | Place crushed plant material in fowl runs | Ectoparasite control |
| [10] | Amaryllidaceae | *Allium cepa*<br>Introduced, Perennial | Onion | Bulb | 1. Place crushed bulb in drinking water<br>2. Crush bulb, ferment in water and sprinkle onto the birds and in the fowl run | Respiratory problems<br>Diarrhoea<br>Lice |
| [9, 10, 16] | | *Allium sativum*<br>Introduced, Perennial | Garlic | Tuber | Crush bulb and put in drinking water.<br>Crush bulbs, ferment in water and sprinkle onto the birds and the fowl run | Respiratory problems<br>External parasites<br>Diarrhoea |
| [15] | | *Crinum macowanii*<br>Introduced, Perennial | *Dururu* | Tuber | Suspend fresh tuber in drinking water | Helminthiasis |
| [17, 18] | Anacardiaceae | *Lannea stuhlmannii*<br>Native, Perennial | *Musosoti* | Bark | Crush bark, soak in clean water and administered orally | Coccidiosis,<br>prophylactic measure against poultry disease |
| [8, 19] | Apocyanaceae | *Adenium multiflorum*<br>Native, Perennial | *Chisvosve* | Sap | Sap from flower rubbed above animal's eyelid | Eye problems |
| [15] | | *Catharanthus roseus*<br>Naturalised, Perennial | *Tsuramatongo* | Roots | Pound the roots and mix with drinking water | Coccidiosis |
| [10] | | *Sarcostemma viminale*<br>Native, Perennial | *Chifure* | Leaves | Crush and put in drinking water | Coccidiosis<br>Diarrhoea |

| Author(s) | Family | Species name | Vernacular name | Plant parts used | Method of preparation | Disease or symptom treated |
|---|---|---|---|---|---|---|
| [8, 15, 17] | | *Sarcostemma viminale*<br>Native, Perennial | *Rusungwe/ Nyakadombo* | Stem | 1. Plant material dried, ground to powder, mixed with water and the mixture offered to birds to drink<br>2.Crush the fresh plant and mix the paste with poultry feed | Gastrointestinal problems<br>Endoparasites<br>Lethargic birds |
| [7, 8, 9, 10, 11, 15, 16, 17, 18, 19, 20, 21, 22, 23] | Asphodelaceae | *1. Aloe vera* Introduced, Perennial<br>*2. Aloe spicata* Introduced, Perennial<br>*3. Aloe greatheadii* Native, Perennial<br>*4. Aloe chabaudii* Native, Perennial<br>*5. Aloe babarbadensis* Introduced, Perennial<br>*Aloe aborescens* Native, Perennial | *Gavakava* | Leaves | 1. Grind fresh leaves and add to drinking water<br>2. Dry leaves are crushed and powder applied on wounds | Coccidiosis<br>Fowl typhoid<br>Newcastle disease<br>Wounds<br>Worms<br>Diarrhoea<br>General weakness<br>Weight loss<br>Lethargic birds<br>Coughing<br>Ectoparasites |
| [8, 11] | Asteraceae | *Venonia amygdalina*<br>Native, Perennial | *Muzhozho* | Leaves | Add ground fresh leaves to drinking water | Worms<br>General weakness<br>Respiratory problems |
| [15] | | *Aspilia pluriseta*<br>Native, Perennial | *Mukushamvura/Mumharadzi/ Ruhwati* | Whole plant | Char the plant and apply<br>the ashes on wounds | Wounds |
| [15] | | *Bidens pilosa*<br>Naturalised, Annual | *Guku/ tsine* | Leaves | Crush the leaves and apply aqueous extracts to wounds | Wounds |
| [15] | | *Vernonia adoensis*<br>Native, Perennial | *Musikavakadzi* | Leaves | Crush the leaves and apply aqueous extracts to wounds | Wounds |
| [8, 10, 17] | Chrysobalanaceae | *Parinaria curatellifolia* Native, Perennial | *Muchakata* | Bark | Animal made to drink bark powder and water mixture | Coccidiosis,<br>Fowl typhoid<br>Diarrhoea |
| [17] | Combretaceae | *Combretum heroense*<br>Native, Perennial | *Mutechani/ murovamhuru* | | | Coccidiosis |

| Author(s) | Family | Species name | Vernacular name | Plant parts used | Method of preparation | Disease or symptom treated |
|---|---|---|---|---|---|---|
| [8, 11] | Commelinaceae | *Aneilema hockii*<br>Native, Perennial | *Rutapatsikidzi* | Branches | Branches of plant herb, which attract fleas, are placed in fowl runs. | Fleas |
| [10] | Euphorbiaceae | *Euphorbia matabelensis*<br>Native, Perennial | *Murimbo* | Bark | Crush stem parts and place in drinking water | Respiratory problems<br>Diarrhoea |
| [15] | Fabaceae | *Bobgunnia madagascariensis*<br>Native, Perennial | *Mucherekese* | Pods | Grind the dried pods into a powder and suspend in drinking water | Coccidiosis<br>flu-like<br>symptoms<br>weight<br>loss, coughing,<br>Newcastle disease |
| [15] | | *Cassia abbreviata*<br>Naturalised, Perennial | *Muremberembe/ muvheneka* | Bark | Grind the dried bark and suspend in drinking water | Lethargic birds |
| [15] | | *Dalbergia nitidula*<br>Native, Perennial | *Mudima/ murima* | Bark | Dry the bark, grind into a powder and apply on wounds | Wounds |
| [10, 15] | | *Erythrina abyssinica*<br>Native, Perennial | *Mutiti* | Bark | 1. Crush fresh plant material and place in drinking water<br>2. Dry, grind and place suspend ground material in drinking water | Coccidiosis<br>Diarrhoea<br>wounds,<br>coughing, flu-like<br>symptoms, Newcastle<br>disease, blindness |
| [8, 15, 24] | | *Pterocarpus angolensis*<br>Native, Perennial | *Mubvamaropa* | Sap<br>Bark | 1. Sap from bark dropped in eyes<br>2. Pound the bark and apply the extract to wounds | Sore eyes<br>Wounds |
| [15] | | *Senna singueana*<br>Native, Perennial | *Munzungunzungu*<br>*Mudyanungu/Mukundanyoka* | Leaves | Pound fresh leaves and suspend in water | Coccidiosis, New castle<br>disease, coughing,<br>flu-like symptoms |
| [8, 11, 15, 19] | | *Xeroderris stuhlmannii*<br>Native, Perennial | *Murumanyama* | Bark | Animal made to drink crushed bark and water mixture | Diarrhoea<br>Coccidiosis<br>Lethargic birds |

| Author(s) | Family | Species name | Vernacular name | Plant parts used | Method of preparation | Disease or symptom treated |
|---|---|---|---|---|---|---|
| [15, 19] | Loganiaceae | *Strychnos cocculoides*<br>Native, Perennial | *Mutamba/ muzhumwi* | Fruit | Crush the unripe fruit and mix the contents with water and give the birds to drink | Coccidiosis, coughing,<br>Newcastle, fowlpox |
| [15] | Meliaceae | *Khaya anthotheca*<br>Native, Perennial | *Muvava* | Bark | Pound the bark and mix with drinking water | Lethargic birds<br>Fowl pox |
| [8] | Moraceae | *Ficus burkei*<br>Native, Perennial | *Mushavhi* | Root | Animal made to drink root powder and water mixture | Diarrhoea |
| [15] | Moringaceae | *Moringa oleifera*<br>Naturalised, Perennial | *Muringa* | Leaves | Crush the leaves and suspend in water | Coccidiosis<br>Coughing |
| [8, 9, 11, 15] | Musaceae | *Musa sapientum*<br>Introduced, Perennial | *Mubhanana* | Roots | Crush the roots and mix with Salt | Coccidiosis |
| [8, 17] | Myrothamnaceae | *Myrothamnus flabellifoilius*<br>Native, Perennial | *Mufandichimuka* | Root | Animal made to drink root powder and water mixture | Coccidiosis<br>Diarrhoea |
| [15, 24] | Olacaceae | *Ximenia caffra*<br>Native, Perennial | *Munhengeni/Mutsvanzva/ Mutunguru* | Leaves | Pound fresh leaves and extract sap | Wounds<br>Fowlpox |
| [9, 11] | Orchidaceae | *Bulbophylum spp.*<br>Native, Perennial | *Batanai* | Bark | Bark is tied around fracture as supporting pad. | Fractures |
| [15] | | *Tridactyle bicaudate*<br>Native, Perennial | *Paka* | Leaves | Pound the plant and suspend the material in drinking water | Coccidiosis, Lethargy,<br>flu-like symptoms,<br>Newcastle disease |
| [15] | Passifloraceae | *Passiflora edulis*<br>Introduced, Perennial | *Mugurandera* | Leaves | Pound fresh leaves and suspend them in water. | Coccidiosis, coughing,<br>head wounds |
| [15] | | *Adenia gummifera*<br>Native, Perennial | *Muhore* | Whole plant | Pound the plant and suspend in drinking water | Lethargic birds,<br>Coccidiosis, coughing,<br>flu-like symptoms,<br>Newcastle disease,<br>Blindness |
| [8, 9, 11] | Pedaliaceae | *Sesanum angustifolius*<br>Native, Annual | *Gusha* | Fruit | Crush fresh fruit and add to drinking water | New Castle Disease |
| [8, 9, 10, 11, 19] | Rubiaceae | *Psydrax livida*<br>Native, Perennial | *Muvengahonye* | Leaves | Fresh leaves are ground, water added and paste placed on wounds | Septic wounds |

| Author(s) | Family | Species name | Vernacular name | Plant parts used | Method of preparation | Disease or symptom treated |
|---|---|---|---|---|---|---|
| [15] | | *Vangueria infausta*<br>Native, Perennial | *Munzviru* | Leaves | Pound fresh leaves and prepare an infusion in water | Coccidiosis |
| [15] | Rutaceae | *Citrus limon*<br>Introduced, Perennial | *Mundimu* | Fruit | | Fowlpox |
| [8, 9, 10, 17] | Solanaceae | *Albizia gummifera*<br>*Albizia adianthifolia*<br>Native, Perennial | *Mucherenje/ Muwora* | Bark | Animal made to drink suspension of powdered bark in water | Coccidiosis<br>diarrhoea |
| [7, 9, 10, 15, 16, 17, 18, 19, 21] | | *Capsicum annum*<br>Introduced, Annual | *Mhiripiri* | Fruit | 1. Animal made to drink crushed fruit and water mixture<br>2. Crush the seeds and mix with sugar solution for the birds to drink | Coccidiosis<br>Internal parasites<br>Diarrhoea<br>coughing,<br>flu-like symptoms,<br>Newcastle disease |
| [15] | | *Datura stramonium*<br>Naturalised, Perennial | *Zavazava* | Leaves | Crush the leaves and apply extracts to wounds | Head wounds |
| [8, 10, 15, 17] | | *Lycopersicon esculentum*<br>Introduced, Annual | *Mutomatisi* | Leaves | Pound fresh leaves and extract sap | Eye problems<br>Wounds<br>Fowlpox |
| [7, 8, 19] | | *Nicotiana tabacum*<br>Introduced, Annual | *Fodya* | Leaves | Snuff mixed with soot is given to the animal in drinking water | Endoparasites<br>General weakness<br>Respiratory problems |
| [9, 11, 15, 19] | | *Solanum indicum*<br>Native, Annual | *Nhundurwa* | Fruit<br>Roots | 1. Fruit is crushed, fluid applied to the eye<br>2. Grind dried roots and suspend in drinking water | Eye problems<br>Wounds<br>Ectoparasites |
| [15, 19] | Verbenaceae | *Lippia javanica*<br>Native, Perennial | *Zumbani* | Leaves | Collect fresh leaves and place them in the fowl run | Ectoparasite control |
| [9, 10, 11, 17] | | Kitchen soot | *Chin'ai* | | | Coccidiosis<br>Respiratory problems |

A total of 53 medicinal plant species, shown in Table 1, were reported as being traditionally used to treat poultry diseases in Zimbabwe. The plants that were reviewed belonged to 26 different families. The most common families in this review were the Fabaceae with a frequency of 8 followed by Solanaceae with a frequency of 6 and are shown in Fig. 3. The most widely cited herbal plants were *Aloe* species all of which were

referred to by the local people as *gavakava*. One or more of the species (*Aloe vera, Aloe spicata*, *Aloe greatheadii*, *Aloe chabaudii*, *Aloe babarbadensis* and *Aloe aborescens)* were mentioned in 14 studies out of the 15 studies that were reviewed. *Capsicum annum* (*mhiripiri*), a common garden plant, was the second most cited herbal plant being mentioned in 9 corresponding articles. Twenty-one herbal plants were cited only in single articles.

Leaves were the most frequently used part of plants, accounting for 32% of all the plant parts that are used. Bark was the second most used part with a frequency of 22%. The least used plant parts were stems, branches and pods with frequencies of 2% each as shown in Fig. 1.

The methods used in preparing herbal plants for treating poultry are shown in Fig. 2. The most frequently used method of preparing plant material before treatment was crushing using grinding stone (40%) followed by pounding using mortar and pestle (26%). As shown in Fig. 2, mixing plant parts with other substances such as, salt and soot is the method of preparation least used preparation with a frequency of 4%. Figure 4 shows the origins of the medicinal plants used in the management of poultry health. Out of the 53 plant species that were reviewed, 34 of the plants were native while 12 were introduced and 7 were naturalised. An introduced plant species is a species living outside its native distributional range, has arrived there by human activity, directly or indirectly, and either deliberately or accidentally [25] whereas an naturalised plants are non-native species that are growing on their own in nature; they may have originated as a garden escape, an agricultural escape, or an accidentally introduced weed [26]. Eighty nine percent of the plants reviewed were perennial and 6% percent were annual.

Data obtained from the selected articles were categorized presenting information about the local names of plants, the study area, language, typology of the study participants in the selected studies (Table 2). The adopted categorization was made in order to divide the analyzed literature into groups, which had to be able to show variations in cultural variables.

Table 2
Cross-cultural analysis of the use of medicinal plants in the treatment of poultry diseases

| Author | Area of Study | Province | Language | Typology of study participants | Number of species used in poultry health mentioned |
|---|---|---|---|---|---|
| [18] | Takavarasha, Chivi | Masvingo | Shona | Farmers | 4 |
| [15] | Chipinge<br>Murehwa<br>Bindura | Manicaland<br>Mashonaland East<br>Mashonaland Central | Shona | Farmers (74% males) | 34 |
| [8] | Nhema | Midlands | Shona | Farmers (61% males)<br>Traditional healers | 19 |
| [10] | Gutu | Masvingo | Shona | Famers (63% males) | 14 |
| [11] | | Mashonaland East, Mashonaland West, Mashonaland Central | Shona | Household elders<br>Traditional healers<br>Herbalists | 9 |
| [23] | Zhombe | Midlands | Shona<br>Ndebele | Livestock farmers | 2 |
| [21] | Rushinga | Mashonaland Central | Shona | Willing poultry farmers | 5 |
| [17] | Mushagashe | Masvingo | Shona | Poultry farmers | 10 |
| [19] | Matobo<br>Kadoma<br>Muzarabani<br>Chiredzi | Matabeleland South<br>Mashonaland West<br>Mashonaland Central<br>Masvingo | Ndebele<br>Shona | Livestock farmers (78.5% males) | 5 |

An analysis of the cross-cultural agreement among languages in different study areas was done and we found a high degree of consensus for the language and typology of study participants. However, number of species used in poultry health varied significantly in the different areas of the country. The study by Jambwa and coworkers [15] in Manicaland, Mashonaland East and Mashonaland Central reported the highest

number (34) of plant species used in managing poultry health. A study by [23] in Zhombe, Midlands had the lowest number of plants that are used for treatment of poultry diseases. Except for only two studies [19, 23] where there were Ndebele speaking communities in addition to Shona speaking ones, in nearly all the areas of study the participants were Shona speaking. The study areas covered in this review included 7 of the 10 provinces of Zimbabwe.

A comparative analysis was done to investigate which plants and their uses were associated with which regions. The different uses of medicinal plants with the highest use values presented in Fig. 6 are presented against the different study areas reviewed and shown in Table 3.

Table 3
Reported cross-regional usage of plant species in poultry health management

| Plant species | | Use | Study area (Province) |
|---|---|---|---|
| Vernacular name | Scientific name | | |
| *Gavakava* | *Aloe spp.* | Diarrhoea | Midlands [8] |
| | | | Masvingo [18] |
| | | Ectoparasites | Matabeleland [19] |
| | | | Mashonaland [19] |
| | | | Masvingo [19] |
| | | | Midlands [8] |
| | | General weakness/ weight loss | Manicaland [15] |
| | | | Mashonaland [15] |
| | | | Midlands [8] |
| | | Respiratory infections | Midlands [8] |
| | | | Masvingo [10, 18] |
| | | | Manicaland [15] |
| | | | Mashonaland [15] |
| | | Septic wounds | Midlands [8] |
| | | | Mashonaland [11] |
| | | | Masvingo [10] |
| | | Endoparasites | Matabelelend [19] |
| | | | Mashonaland [11, 19] |
| | | | Masvingo [19] |
| | | New Castle Disease | Masvingo [17] |
| | | | Manicaland [15] |
| | | | Mashonaland [15] |
| | | Coccidiosis | Mashonaland [11, 15] |
| | | | Masvingo [[10, 17, 18] |
| | | | Manicaland [15] |
| *Rusungwe/ chifure* | *Sarcostema viminale* | Diarrhoea | Midlands [8] |
| | | | Masvingo [10, 17] |
| | | Coccidiosis | Manicaland [15] |
| | | | Mashonaland [15] |
| | | Endoparasites | Midlands [8] |
| *Murumanyama* | *Xeroderris stuhlmanni* | Diarrhoea | Matabeleland [19] |
| | | | Mashonaland [11, 15, 19] |
| | | | Masvingo [19] |
| | | Coccidiosis | Manicaland [15] |
| | | | Mashonaland [15] |
| | | Lethargic birds | Manicaland [15] |
| | | | Mashonaland [15] |

| Plant species | | Use | Study area (Province) |
|---|---|---|---|
| | | Endoparasites | Matabeleland [19] |
| | | | Mashonaland [19] |
| | | | Masvingo [19] |
| *Muvengahonye* | *Cissus succulenta* | Septic wounds | Midlands [8] |
| | | | Mashonaland [11] |
| | | | Masvingo [10] |
| *Mhiripiri* | *Capsicum annum* | Diarrhoea | Midlands [8] |
| | | | Masvingo [10] |
| | | Coccidiosis | Masvingo [10, 17] |
| | | | Mashonaland [15] |
| | | | Manicaland [15] |
| | | New Castle Disease | Masvingo [10] |
| | | | Mashonaland [15] |
| | | | Manicaland [15] |
| | | Respiratory diseases | Mashonaland [15] |
| | | | Manicaland [15] |
| | | Endoparasites | Matabeleland [19] |
| | | | Mashonaland [19] |
| | | | Masvingo [19] |
| *Nhundurwa* | *Solanum indicum* | Eye problems | Midlands [8] |
| | | | Mashonaland [11] |
| | | Wounds | Manicaland [15] |
| | | | Mashonaland [15] |
| *Mudomasi* | *Lycoperscon esculentum* | Eye problems | Masvingo [10, 17] |
| | | | Midlands [8] |
| | | Wounds | Manicaland [15] |
| | | | Mashonaland [15] |
| | | Fowlpox | Manicaland [15] |
| | | | Mashonaland [15] |
| *Muwora/ mucherenje* | *Albizia gummifera* | Coccidiosis | Masvingo [10, 17] |
| | | Diarrhoea | Midlands [8] |
| | | | Masvingo [10] |
| | | Respiratory diseases | Masvingo [10] |
| | | Wounds | Masvingo [18] |
| *Mubhanana* | *Musa sapientum* | Endoparasites | Mashonaland [11] |
| | | | Midlands [8] |
| | | Snakebites | Midlands [8] |
| | | Coccidiosis | Manicaland [15] |
| | | | Mashonaland [15] |

The use of *Aloe* species was common across all the 7 provinces that were in the publications reviewed followed by *Capsicum annum* which was included in 5 of the 7 provinces. The least common species was *Albizia gummifera* and was only found in 2 of the 7 provinces included in the reviewed articles.

## Discussion

In a previous study by [27] they concluded that herbaceous medicinal plants were the widely used for the treatment of various ailments followed by trees and shrubs and this is in agreement with the current review since both Solanaceae and Fabaceae families are characterised by trees, shrubs, herbs and vines.

The Fabaceae family is widely distributed, and is the third-largest land plant family in number of species. Fabaceae frequently contain alkaloids, which have a wide range of pharmacological activities [27] and this leads to their broad use in ethnoveterinary. Fabaceae is the second largest family of medicinal plants, containing over 490 medicinal plant species [29], most of which have been used as traditional medicines. All members of the Fabaceae family reviewed in the article are perennial plants that are available throughout the year, which may account for their common use. A study by [30] indicated that plants of family Fabaceae have medicinal values in leaves, pods stems bark and roots and this is in agreement with the current review where the plants under Fabaceae have their pods, bark, sap and leaves being used for treatment. In agreement with the current review, a study in Botswana by [31] reported the common use of Fabaceae plant species for the management of poultry diseases. The study by [31] identified *Colophospermum mopane*, *Senna italica* and *Cassia abbreviate*; all members of the Fabaceae family; to be used in the treatment of poultry diseases.

Most of the plants that had high use values were from the Solanaceae family and include *Capsicum annum, Lycoperscon esculentum, Solanum indicum* and *Albizia gummifera*. Solanaceae includes a number of agricultural crops, medicinal plants, spices, weeds, and ornamentals. The members of the Solanaceae are shrubs of small to medium size. *Nicotiana tabacum*, *Lycoperscon esculentum*, and *Capsicum annum* (Pepper) are either grown commercially or in household gardens. The remedies, therefore, would be expected to be more easily available than those obtained from the wild. Many members of the Solanaceae family contain potent alkaloids thus the wide use in treating diseases [32]. The Solanaceae family has a worldwide distribution, being present on all continents. Most Solanaceae plants in the review were annual plants since they are mostly cultivated species with the exceptions however, of *Albizia gummifera* and *Datura stramonium*. *Datura stramonium* is a naturalized species and a perennial that is common in damp places and river banks. According to [33], the origin of Datura Stramonium is disputed, it can be of Asiatic origin but some sources report a probable Central American origin, due to *Datura*'s habitation of most temperate and subtropical parts of the world. *Datura stramonium* is an important medicinal plant from which tropane alkaloids, amino acids, tannin, phytic acids, carbohydrates have been isolated and has diverse biological activities [32].

*Aloe* species are not always easy to tell apart and this can be the reason why all various *Aloe* species were cited as *gavakava* in the reviewed articles. As seedlings, aloes are relatively easy to tell apart but as plants mature it can be a bit difficult to tell from some of the other aloes when not in flowering stages [34]. On the African continent aloes occur over much of Sub-Saharan Africa, although they are mainly concentrated in the southern and eastern regions of the continent. Aloe species encompasses over 400 species in the world and around 34 taxa are documented as indigenous to Zimbabwe according to [36]. In a review done by [37] *Aloe* species were said to be widely used in ethnomedicine for treating various ailments which include antimicrobial, anti-inflammatory, antiplasmodial and anthelminthic providing a rationale for their wide use in traditional medicine.

Leaves were reported to be the plant parts most commonly used by traditional medicine practitioners in many African countries [38]. Leaves are responsible for synthesizing the majority of plant secondary metabolite and are an abundant source of active chemical entities, which can be extracted with relative ease [39] Regular harvest of leaves poses low threat to individual plants survival and encourages the frequent utilization of leaves in herbal preparations [38].

A study done in South Africa by [40] concluded that bark was the second mostly used part after leaves and this is in agreement with the current results. Bark contains the growing cells of the tree, as well as the cells required to transport water and sugar for photosynthesis on a cellular level [41]. Bark is always interacting with the rest of the tree, the surrounding trees, the mycorrhizae in the soil, and is constantly reading and responding to any changes in its surroundings [42]. Through the inner bark, (phloem), sap flows carrying the food of the tree produced in the leaves down to the trunks and roots. It is the phloem that contains biologically active substances, making it valuable medicinally [43]. There are risks however associated with using bark in traditional medicine; removing sections of the bark around the circumference of the trunk as this will prevent flow of nutrients from the leaves and result in death of the plant. There is need for sustainable bark harvesting in traditional medicines.

Plant roots can be rich sources of potent bio-active chemical compounds however, frequent usage of roots for herbal preparations can be risky to the survival of a plant species. Therefore, application of proper harvesting strategies and conservation measures is necessary to ensure

sustainable utilization of medicinal plant resources [38, 40]. Creating awareness among the communities is thus important in order to preserve the medicinal plant species.

During preparation of remedies, farmers prefer methods that are simple and that use simple equipment [39] and as such the justification on the common use of crushing in this current review. Yirga and coworkers [38] reported that crushing or grinding in wooden or stone-made mortar and pestle different parts of plants are common methods for drug extraction. Depending on the routes of application and the medical objective, methods of preparing ethnoveterinary medicine differ. Water has been used in most of the herbal preparation methods. Ethnoveterinary studies in different areas also have water being used as the common solvent [31]. Water is a cheaply available solvent that can be used for many plant metabolites. When it comes to herbal plants, water will extract many properties of plants with the exception of resins which require a high proof alcohol [44].

Perennial plants are always available throughout the year and annual plants may be unavailable in certain times of the year [45, 46]. Perennial plants may however lose their leaves in some parts of the year and this becomes a challenge if leaves are used for treatment. Most annual plants that were used in treating poultry diseases were cultivated species, which most of them can be grown at any time of the year like *Lycopersicon esculentum* (Solanaceae). Native plants are mostly used in the treatment of poultry diseases since they are locally available in the wild [47]. Introduced/ cultivated plants can also be easily grown in gardens to be used for treatment of certain ailments [48].

Traditional uses of plants may be affected by the cultural background of users, which can include the language of people [49]. We, therefore, used language as an indicator of cultural background. In the publications that are reviewed here, language, did not determine uses of medicinal plants as uses of different plants were common amongst Shona and Ndebele speaking communities. Cultures are geographically connecting providing opportunities for sharing plant resources and knowledge [50].

Geographical and cross-cultural linkage has contributed to knowledge sharing [51]. Chipinge, which was the focal study area for [15], has a wide diversity of plants since it is Natural Region 1 hence the high numbers of plants recorded to be used in the management of poultry health. Zimbabwe's plant diversity is a function of ecosystem characteristics that are attributable to the rainfall, geological, soil and temperature conditions within ecoregions [52].

The diversity of regional plants and people making their traditional knowledge are enormously diverse, therefore, to achieve a comprehensive documentation of such intellectual knowledge, we should rely on studies at local level. More field surveys need to be carried out to document more plants used in poultry health management in different parts of the country. Future research needs to focus on investigating the therapeutic effectiveness of the various plant materials under clearly defined experimental conditions. The ultimate goal would be to isolate and identify potentially useful compounds to be used in drug discovery.

## Materials And Methods

Search strategy

A web-based systematic literature search strategy was employed. Ethno-veterinary studies reporting on medicinal plants that are used for the treatment of poultry diseases in Zimbabwe were gathered. The search was done for articles published in journals using international scientific search tools including PubMed, Science direct, Web of Science, Google Scholar, Scopus, SciFinder and AJOL. The search terms were selected from key word indices from major ethno-veterinary journals including the Journal of Ethnobiology and Ethnomedicine. The search terms that were used included (ethno OR traditional OR folk) AND (herbal plants OR medicinal plants) AND (veterinary OR animal OR livestock OR farm OR poultry) AND (Zimbabwe). Information that was not in some studies, particularly local names and names of plant families, and misspelled scientific names were retrieved and confirmed from the ZimFlora website.

Screening and criteria

Screening of search outputs was performed in two stages. The title and abstract of identified articles were reviewed. Thereafter, articles that covered medicinal plants and their uses in management of livestock health in Zimbabwe were downloaded and critically inspected for inclusion in the review. Screening of the literature was based on the following inclusion and exclusion criteria.

Criteria for inclusion

Published ethno-veterinary studies in which plants used to treat poultry diseases conducted in Zimbabwe are reported without any specifics on year of study.

Exclusion criteria

Excluded from the analysis were

1. data from published studies lacking information on area in which the study was done, scientific names of the plants and without information about plants that are used to treat poultry diseases and
2. non-open access journal articles or partially accessed articles since we could not get any data that we required.

The review focused on open access articles since they are free for all, they have improved access for the general population and free access to scientific papers regardless of affiliation with a subscription library.

Analysis of data

Information about medicinal plants including names, species name, local names, used parts for the treatment of poultry and the methods used to prepare remedies are shown in Table 1. The cited plant parts, preparation methods, plant family groups, plant origins and descriptions are shown in Figs. 1 to 4. Graphs and charts were done using Microsoft Excel.

## Declarations


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### Conflicts of interests

The authors declare that they have no competing interests.

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## Figures

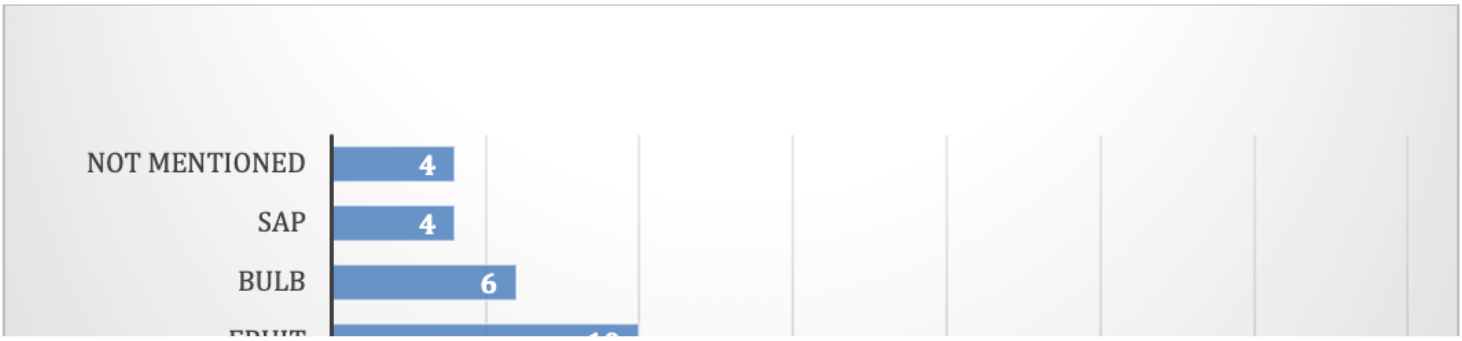


**Figure 1**

Parts of plants that were reported as being used for the treatment of poultry diseases in Zimbabwe. The frequency is expressed as a percentage of all the plants that were reviewed.

**Figure 2**

Frequency of the methods that were used for preparing herbal plants for the management of poultry in Zimbabwe. The frequency is expressed as a percentage of all the plants that were reviewed.

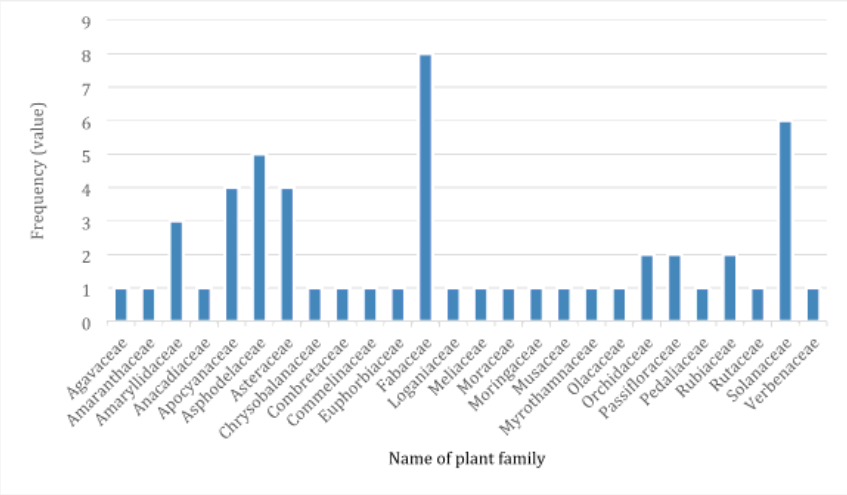


**Figure 3**

The families to which plants that were used for the management of poultry diseases belonged. The frequency is expressed as the number of plants that belonged to each family.

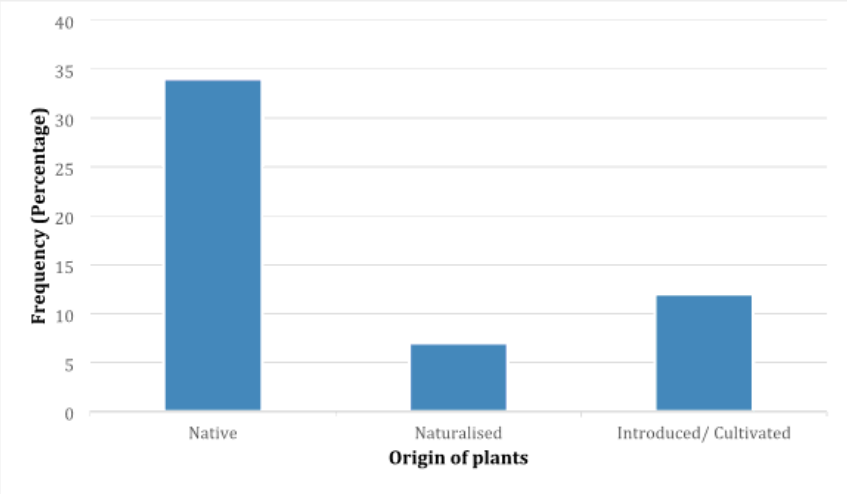


**Figure 4**

The origins from which the medicinal plants came from. The frequency is expressed as the number of medicinal plants under each origin.

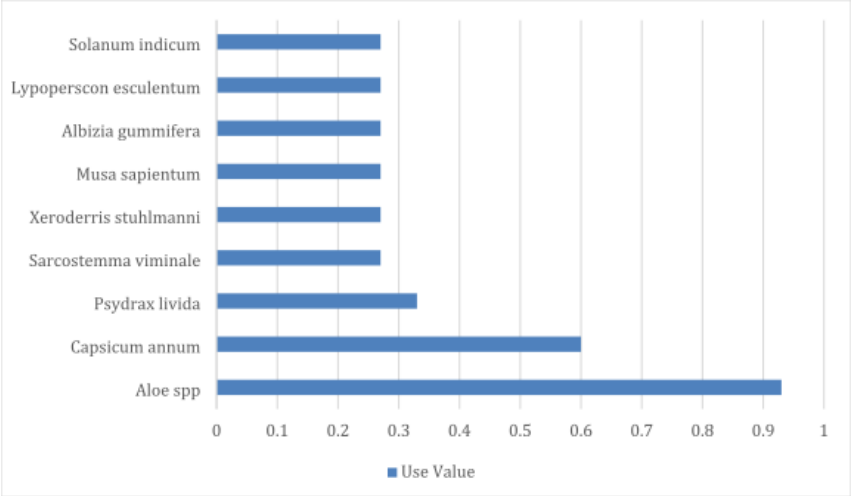


**Figure 5**

*Figure 5* shows the plant species with the highest use values. The use value was calculated by the formula UV= U/n where U is the sum total of citations by all papers for a given species and n is the total number of papers reviewed. This method evaluates the relative importance of each medicinal species based on its relative use among informants. *Aloe* species had the highest use value of 0.93 followed by *Capsicum annum* with 0.6.