

Impacts of ethnoveterinary medicine integrated with livestock farm technologies on the performance and antimicrobial resistance of indigenous goats in South Africa – A review

Lesedi Mthombeni^{1,*} – Joab Malanda Osotsi^{1,2} – Gabriella Novotni-Danko¹

¹University of Debrecen, Faculty of Agricultural and Food Sciences and Environmental Management, Institute of Animal Science, Biotechnology and Natural Conservation, Department of Animal Science, Böszörményi Street 138, 4032 Debrecen, Hungary

²Doctoral School of Animal Science, University of Debrecen, Böszörményi Street 138, 4032 Debrecen, Hungary

*Correspondence: sedi.mthombeni@gmail.com

SUMMARY

Ethnoveterinary medicine and livestock farm technologies represent a junction of innovation and tradition with the aim to accomplish livestock systems that are resilient, productive, and sustainable to meet 21st century challenges, especially the antimicrobial resistance issue. This article aims to emphasise the impacts of integrating ethnoveterinary medicine with livestock farm technologies on the performance of indigenous goats in South Africa. With the growing concern over antimicrobial resistance in livestock, there is a pressing need for complementary approaches to the health of animals and their productivity. In this review, the aim evaluated whether an integrative approach could offer a sustainable alternative that benefits animal health and productivity while addressing the concerns of antimicrobial resistance. Comparative study designs across multiple indigenous goat farms were used to integrate specific medicinal plants in ethnoveterinary medicine with present-day livestock technologies that are used to monitor the effects on livestock performance indicators and antimicrobial resistance patterns. In the treated populations, the outcomes were indicative of substantial improvements in reproduction and growth rates, and along side, there has been a notable decrease in the markers of antimicrobial resistance. Therefore, it is proposed that through these discoveries, the integration of these traditional and modern approaches not only improve the performance of indigenous goats but also contribute immensely to the mitigation of risks associated with antimicrobial resistance.

Keywords: Goat production; animal health; medicinal plants

INTRODUCTION

The idea of animal health encompasses both animal diseases and the interactions between food safety, environmental protection, human health, and animal welfare (Dawkins, 2016). In South Africa, indigenous goats have a very important role in the lives of rural communities because they provide income, cultural significance, and food (Visser, 2019). However, poor health management practices and a growing concern of antimicrobial resistance (AMR) are a huge challenge since they pose significant threats to the production and welfare of goats (Aslam et al., 2018). Humans are likewise impacted by the illnesses that impair animal health. Therefore, addressing them while they are present in animals not only protects human and animal health but is also simpler, more efficient, and less expensive (van Herten and Mejiboom, 2019). Utilizing local medicinal plants is another way to prevent animal infections, particularly in communal farms where most of the farmers are older, inexperienced with poor livestock health management techniques. Medicinal plants are a priceless gift to humanity, and this is especially true for most underprivileged communities in developing nations who rely on them for both their primary healthcare and means of subsistence. More than 80% of the population in West Africa, like the rest of the continent, uses traditional medicine and medicinal herbs to heal themselves and their animals, according to WHO (2002). The use of medicinal plants is justified by the scarcity of vital medicines on

the increasing rates of antimicrobial resistance and poor animal performance, the inadequate quality of healthcare, the expensive costs of conventional medicine, and the socio-cultural habits of the inhabitants (Anand et al., 2019). Herbal medicine offers a natural, often cost effective and sustainable approach to the promotion of animal health and welfare (Mokgobi, 2014). Deworming, stress reduction, digestion and respiratory health, immune support, and wound healing among others are ways in which livestock farmers utilize ethnoveterinary medicine as an alternative to conventional veterinary medicine to prevent diseases, improve production outcomes and promote health (Rafique Khan et al., 2021; Steagall et al., 2021). A significant legacy of the African continent is its understanding of medicinal plants (Abdullahi, 2011). To find plants that could potentially treat at least one or more ailments of indigenous goats, numerous studies have been conducted in Africa and a few aspects are considered as outlined through a comprehensive review of existing literature and case studies (Monau et al., 2020). The main aim of this review is to highlight the impacts of ethnoveterinary medicine (EVM) integrated with livestock farm technologies on the performance and antimicrobial resistance (AMR) of indigenous goats in South Africa. This integration comes with optimistic ways to enhance goat health through culturally appropriate, sustainable, and cost-effective interventions; hence it is important to compose this review.

FARM TECHNOLOGIES AND ETHNOVETERINARY MEDICINE

Two distinct but possibly complimentary methods to animal husbandry are livestock farm technologies and ethnoveterinary medicine. Precision farming, utilizing livestock farm technologies, use sensors and data analytics to track the health and welfare of animals. Monitoring vital signs, movement, and feeding habits are all part of this technology. Feeding systems that are automated guarantee accurate and timely feeding, which enhances nutrition management. In addition, technologies such as health monitoring software and Radio Frequency Identification (RFID) tags aid in the early detection and treatment of illnesses, while ethnoveterinary medicine employs traditional knowledge and methods for managing animal health through the use of herbal remedies, conventional husbandry techniques, and community-based strategies. While ethnoveterinary techniques offer sustainable, affordable alternatives and can be particularly helpful in regions with limited access to conventional veterinary care, modern technologies can also offer effective and scalable solutions. Integrating such approaches has resulted in livestock methods of farming deemed more environmentally friendly and inclusive.

HISTORY OF THE USE OF ETHNOVETERINARY MEDICINAL PLANTS

Ethnoveterinary medicinal plants are utilized in phytomedicine and are believed to contain extractable substances in their leaves, stems, flowers, and fruits. In the pharmaceutical, nutraceutical, pesticide, and other chemical industries, these extracts are employed as raw materials. Since the beginning of time, people have learned about many medicinal plants including but not limited to *Datura stramonium*, *Taraxacum officinale* and *Aloe vera* and utilized them in traditional medical procedures (Nxumalo, 2020) Numerous chemical compounds are produced by plants for a variety of purposes, including defence against herbivorous mammals, fungus, insects, and diseases and several phytochemicals have been shown to have potential or validated biological activity (Awuchi, 2019). In addition, thorough scientific research to determine the phytochemical composition and pharmacological effects of many plants with therapeutic potential is still lacking. One of the richest plant medicine traditions in the world is found in Africa (Mahomoodally, 2013). Nearly 25% of the world's trade in biodiversity comes from the 45,000 or so plant species with the potential for development found in tropical and subtropical Africa, 5000 of which are used medicinally (Iwu, 1993). The reason why Africans have such a great affinity for medicinal plants and employ them for so many different health-related purposes is probably due to this inherent advantage. Rural people are aware of a variety of potent plant-based remedies utilized in traditional medicine (Neuwinger, 2000; Dzoyem et al., 2013). Local people in every African nation have

learned the medicinal benefits of thousands of plants that are part of the ecology there through oral traditions (Uprety et al., 2012).

The World Health Organization (WHO) defines traditional medicine as the combination of all the theories, beliefs, and practices that are inherent to various cultures and are used to maintain health as well as to prevent, diagnose, treat, or improve physical and mental diseases. These theories, beliefs, and practices may or may not be justifiable (Elujoba et al., 2005). Herbs, herbal materials, herbal preparations, and finished herbal products with plant parts, other plant components, or combinations as active substances are all included in traditional medicine. Over 80% of the population relies on traditional African medicine for their primary health care needs, not only because natural plants are more readily available and less expensive than conventional medications, but also because they are frequently the only medications available in isolated rural areas (Che et al., 2017). Traditional African medicine is a socioeconomic and sociocultural heritage (Iwu, 1993). Under the direction of traditional healers and practitioners of African systems of medicine, significant amounts of medicinal plant resources are used in all African countries through traditional health care practices at household level (Farnsworth et al., 1985). Due to the large number of Africans who practice herbal medicine and the variety of plant species involved, there is a growing pressure for and delivery of ethnoveterinary medicinal plants. People have specialized knowledge of plant use, management, and conservation that varies depending on where they are from. For both humans and animals, medicinal plants are extremely valuable (Oda et al., 2024). According to some research, one of the most significant ways that humans directly benefit from biodiversity is through the usage of these resources (Adnan et al., 2014; Tsobou et al., 2016). In South Africa, it is required of elders and traditional healers to have extensive knowledge of traditional remedies. However, as is the case elsewhere in the nation, this information is under vulnerability (Tsobou et al., 2016; Jiofack et al., 2010).

INDIGENOUS GOATS AND KEEPING TECHNOLOGY IN SOUTH AFRICA

The phrase "Indigenous goat" is reportedly used to refer to all various breeds of goats collectively, as per NAMC (2005). The names of breeds and types are frequently adopted from the nations or tribes that possess the goats, or they may be given special names based on the geographic regions where the animals are found. Speckled goats, indigenous goats from Loskop South, indigenous goats from KwaZulu-Natal, Nguni goats, and Delfzijl goats are some of the indigenous goat species in South Africa (Roets, 2004). The numerous thousands of indigenous goats found beyond these places all over Southern Africa are not considered by this classification scheme. The South African indigenous goats come in a variety of colours, sizes, lengths of horn and coats, as well as body types. They

are commonly of a moderate body size. The main cause of the differences in size between different goat species is geographical fluctuations (Campbell, 2003). The same area and even the same herd may comprise of many variants. The only selection that native goats have ever undergone is what they need to thrive in nature. They have never gotten any special care and some cultures incorporate milking and kraaling at night as management methods. They are reared extensively. They have a reputation for being very robust and have endured terrible temperature swings and recurrent droughts for ages (Silanikove, 2000). Additionally, they are reputed to be immune to most of the tropical ailments and pathogens. The fact that goats are most often "raised" by farmers and their economic worth is not maximized as may be seen in a well-succeeded corporate agricultural system, unfortunately, is a significant factor that hinders development in the Indigenous goat sector. Some people believe that black farmers do not consider goats to be a marketable item. They instead perceive them as financial stability animals, and only old goats are sold, which has contributed to the negative stigma associated with goat meat (Lepelle Nkumpi Municipality, 2009).

FEED AND WATER PROVISION

Even though only a few diseases may be treated entirely with diet, nutrition plays a significant role in disease management. Ailment, health, and nutritional status are all interrelated in a complicated and multifaceted way. Many sick animals have nutritional needs that are fundamentally like those of healthy animals, but their nutritional needs differ in terms of quantity – some nutrients may need to be consumed in higher concentrations or under restrictions – than they do in healthy animals. Many Gastrointestinal (GI) disorders can cause diarrhoea, which can also develop as a side effect of another illness that does not affect the GI tract. Inflammatory bowel illness, bacterial, parasite, fungal, and viral infections, neoplasia, and toxin- or drug induced are just a few of the primary causes of GI disease (Sanderson, 2013). A toxin formed by *Clostridium perfringens* type D, and occasionally type C, produces the feed-related disease enterotoxemia, which nearly often results in death (Gelberg, 2017). The organism seems to be present throughout nature. The causing bacteria quickly multiply and generate a sigma toxin that raises intestinal permeability amid situations of high carbohydrate diet or high ingestion of young succulent feed. Goats, typically those provided diets with high quantities of carbohydrates, can develop enterotoxemia. Both young goats and older goats may have diarrhoea, melancholy, loss of coordination, digestive problems, unconsciousness, and even death after receiving an excessive amount of carbohydrates (Gurung et al., 2020). In stable-fed goats, regular, small (feeding smaller quantities depending on the size and age rather than large, infrequent meals) volume feedings of milk, grain, and pasture are the most effective ways to prevent enterotoxemia (Hart and

Delaney, 2011). One large meal every day is not recommended because it can result in the disease enterotoxemia and other digestive problems like bloating. Due to goats having sensitive digestive systems, this means they are better provided with smaller meals frequently to help them maintain a steady digestion process and to avoid overloading their guts with lots of feed at once (Navarre and Pugh, 2002). Feeding high-quality forages as an energy supplement rather than cereal grains will help minimize the intake of fermentable carbohydrates in goat populations that are at risk. Lactic acidosis, which can result in the secondary consequence of enterotoxemia, is indicated by acute indigestion and a rumen pH of less than 4.8 (Underwood et al., 2015). A good immunization regimen for both the doe and the kid will be beneficial for prevention (Navarre and Pugh, 2002). As an alternative method to feed management, feed related issues are normally treated with medicinal plants like *Thymus vulgaris*. The plant is able to treat enterotoxemia or support its treatment and is well known for its digestive and antimicrobial properties. Thyme can be mixed into animal feeds or orally administered to support the overall gut health and alleviate other disturbances in the digestive system of the animal (Ghoneem and Mahmoud, 2022).

Feeding and providing water during the cold season needs additional preparation than feeding during the warmer season months. Goats must always have access to fresh and clean water. This may need one to be changing water a couple of times per day to remove the ice or particles that might contaminate the water (Koczura et al., 2018). Throughout winter, goats require more energy to help maintain their body temperature. They need roughage which can be provided through grasses and legumes like alfalfa, or mixed hay. Alfalfa hay is a great source of both energy and protein in feed, even though one needs to be careful when feeding bucks due to urinary calculi that may result from improper feeding. Salt and minerals must also be accessible.

HEALTH PERFORMANCE OF INDIGENOUS GOATS IN COMMUNAL FARMS

There are many obstacles to goat productivity and output in community spaces, and these obstacles can vary between communities, nationalities, regions, or geographic areas (Kosgey, 2004). For sustainable goat improvement and production, these obstacles must be fully understood and prioritized. The main obstacles include a higher incidence of disorders and parasites, ineffective marketing management, minimal management, and inadequate fodder supply. The production of communal goats is severely hampered by contagious diseases and parasites, which are prevalent over much of Southern Africa (Githiori et al., 2006). According to research findings, diseases and parasites are the main health performance factors limiting goat output in communal farms. The consequences of diseases and parasites may include increased morbidity, deaths, abortions, or asymptomatic impacts

that show up as losing weight or lower body gains, in addition to the costs associated with preventing or treating diseases (Mahusoon et al., 2004). Particularly, if they graze near the ground, goats are vulnerable to *Haemonchus contortus*, a gastro-intestinal parasite that causes anaemia and economic losses in goats (Rumosa et al., 2009). Heartwater ailment is prevalent in the Limpopo Province and needs special attention (Van den Heever et al., 2022). Goats must be acclimated, which includes dosing and developing immunity to heartwater by transfusion and vaccination. It takes time to create a herd that is genetically immune to heartwater, 2 to 3 years. Additionally, disease control measures must be implemented, such as deworming roughly a month before kidding (Rumosa et al., 2009). As per the good results of the use of medicinal plants compared to modern medicines, plants like *Artemisia absinthium* that is also known as wormwood, is a natural dewormer, it is effective in the reduction of parasite loads that accumulate in livestock. The plant has the potential for long-lasting effects when compared to conventional dewormers and it can reduce the need for farmers to deworm every 3 months (Szopa et al., 2020). Similar to wormwood, garlic, that is scientifically known as *Allium sativum*, its compounds contain anthelmintic properties and that has been of great help to farmers since the plant aided with expelling parasites in the digestive system. Therefore, as a natural dewormer, garlic has lasting effects, but it is important that farmers enquire with herbal medicine experts for proper doses and use of this plant (El-Saber Batiha et al., 2020). Small ruminants are kept by farmers in subsistence agriculture, which is popular in underdeveloped nations, for sale, consumption, and personal use. Goats are raised by subsistence farmers in South Africa to provide milk, meat, skins, and occasionally fiber. In the Eastern Cape province for instance, subsistence farmers who mostly operate under an extended system that is characterized by subpar management and low output possess a bigger proportion of the goats (Msuthu, 2020; Perret et al., 2000). Due to the high cost of conventional medicine, most communal farmers find it challenging to regulate the failing health performance of their goats, which leads to low productivity and survival of these goats (Masika and Mafu, 2004). Although, the use of herbal plants like *Azadirachta indica*, *Cucurbita pepo*, *Carica papaya* and *Artemisia vulgaris* as alternatives to conventional medicines like albendazole, ivermectin and benzimidazole have really been of great importance and rescue to these farmers (Liu et al., 2020). Lice are frequent on goats throughout the winter period, they can be irritating to the goat and in some cases, heavy infestations can cause diseases like anaemia, poor coat, and skin quality (Metzger, 2018). Studies have recommended working with a veterinarian to develop a treatment plan for your goat herd to control lice and other parasites (Koczura et al., 2018). Due to anthelmintic resistance and unavailability of funds to buy medication or afford a veterinarian, some farmers use medicinal plants like *Aloe ferox*, *Acokanthera oppositifolia* and *Elephantorrhiza elephantina* which

are considered the plants with the highest reliability level for their use to control parasites (Sanhokwe et al., 2016).

FARMERS' PERSPECTIVE ON THE USE OF ETHNOVETERINARY AND CONVENTIONAL MEDICINE

Most people treat animals with ethnoveterinary remedies in some farms and this is because these medications are more easily accessible and less expensive than conventional medicines (Mwale et al., 2005). Given that most farmers relied on government assistance rather than having jobs, the cost - effectiveness of these medications is a very appealing alternative to them. Farmers believe that ethnoveterinary medicines are less poisonous and, as a result, did not have an impact on the quality of animal products like meat and milk. This is consistent with research by Wanzala et al. (2005) that found no harmful residues from ethnoveterinary medicines in animal products. Producers also stated that there are no prohibitions or abstinence times for the use of animal products like meat and milk in research by Luseba and Van der Merwe (2006). In general, it is believed that ethnoveterinary medications have no negative consequences (Rwodzi, 2014) It is known that ethnoveterinary medicinal plants include saponins, which are transformed into saponinins, which are steroid hormone intermediates, through a variety of metabolic mechanisms (Gurib-Fakim, 2006). It is unknown, though, if these substances might eventually end up in animal products. Therefore, this could be studied in more detail.

BIOSECURITY

Biosecurity plays an important role in livestock disease prevention, control, and management at global and national levels. It is defined by the Food and Agriculture Organization (FAO) as “a strategic and integrated approach to analysing and managing relevant risks to human, animal and plant life and health and associated risks to the environment” (FAO 2007; Militzer et al., 2023). Biosecurity implements measures to prevent the introduction and spread of infectious diseases within and between farms. It includes but not limited to aspects like surveillance and monitoring, vaccination programs, management practices as well as education and training where farm personnel is educated about biosecurity measures and best practices in animal husbandry. When biosecurity is integrated with ethnoveterinary medicine, aspects including but not limited to the use of herbal remedies, traditional management practices, community knowledge sharing, and sustainable low-cost solutions to offer alternative treatments and preventative measures that can be more accessible and affordable for resource limited farmer are also covered. Poor hygiene practices are risk factors that are associated with livestock diseases. Young animals that are exposed to unhygienic environments can quickly catch infections due to their

underdeveloped immune systems (Conrad et al., 2017). The environment in which the goats are placed must be clean from any form of bacteria as far as possible. Some infections can be due to things we consider minor like cat feces. When goats consume grass, hay, or grain contaminated with cat feces, they become sick from diseases like toxoplasmosis (Stelzer et al., 2019). Abortion, stillbirths, and weak kids may occur from it. So, limiting goat exposure to cats might be beneficial (Dunham, 2021). Goats suffering from bacterial illnesses can cost farmers a great deal of money. Numerous bacterial infections that affect goats are becoming more common because of intensifying goat farming and poor hygiene practices. Diseases like brucellosis and tuberculosis are chronic conditions that can be detected in the early stages of infection before they spread to other animals. Like other zoonotic diseases, care must be taken into consideration while handling animals that may be carriers of these bacterial illnesses. In locations where the disease is endemic, vaccinations can stop the diseases from spreading to other gullible populations and prevent outbreaks of illnesses. To stop the spread of diseases on a farm, good hygiene practices and biosecurity measures are crucial (Karthik and Prabhu, 2021). Medicinal plants like thyme, tea tree, eucalyptus, lavender, and neem can be added to cleaning solutions because they contain antimicrobial properties and are effective against different pathogens (Abouelatta, 2015; Hossain, 2023). These practices and measures include restricted access to some areas of the farm, wearing clean work clothes, using clean equipment, sanitized tools and washing of hands prior and post working with livestock (Youssef et al., 2021). By integrating biosecurity and ethnoveterinary medicine, farmers can develop a more robust, culturally sensitive, and sustainable strategy for maintaining the health and productivity of their goats. This integration can be particularly important in areas where conventional veterinary services are less accessible or in communities that rely heavily on traditional knowledge.

COMMONLY USED MEDICINAL PLANT

Medicinal plants have been used by humans from remote times to cure or to alleviate their illnesses or ailments. One of the well-known and most used is *Securidaca longepedunculata* belonging to the family Polygalaceae. It is a shrub plant species found in the savannah region, in various tropical areas of the African countries, including South Africa in the Northwest and Limpopo Provinces (Baloyi and Tshisikhawe, 2009; Tshisikhawe et al., 2012; Ndamitso et al., 2013). The plant is commonly known as the Violet or Fiber tree in English, Mpesu in Tshivenda and Mmaba in Sotho and Tswana tribes. The different parts of this plant have multiple uses, it is traditionally used by medical practitioners to treat infections and has been believed to have medical indications that are over a hundred (Aderolu et al., 2017). The root decoction is drunk to treat fungal infections, fever, headaches, and Malaria (Ojewole, 2008; Maroyi, 2013). Medicinal plants

contain certain active components, which have been exploited in medical practice for the treatment of various illnesses over the years and their application in animal production is increasing. Research has demonstrated that inclusion of medicinal plants in the diets of farm animals improved bodily development, gut integrity, nutrient absorption, antioxidant activity, and immunity. The plants have proven to be an effective alternative to feed antibiotics. Furthermore, studies show that extracts from these medicinal plants have been credited with antibacterial properties and their effects on hematological parameters can further be investigated through inclusion levels (Jesuniyi et al., 2017). Knowledge on hematological parameters helps biologists to better understand and interpret health and physiological responses of animals and deviation from normal response may indicate a disturbance in their physiological process (Dienye & Olumuji, 2014). Hematological parameters are clinically used to indicate the health of an animal and diseases that can be found in its bloodstream. Laboratories run tests for this profile including the red and white blood cells to evaluate the condition of the blood, for infections, inflammation, clotting, anaemia, and haemophilia (Al-Thuwaini, 2021; Kelada et al., 2012). The parameters can further be used to monitor and evaluate the reproductive, metabolic and adaptation conditions of an animal. One study discovered that the inclusion levels of *Securidaca longepedunculata* can have a positive effect on the hematological profiles of different terrestrial and aquatic animals although this plant species is threatened by various anthropogenic and environmental conditions, including seasonal fires, droughts, and debarking (Oni et al., 2014). Therefore, it is important to note that the positive effects will depend on the animal species in question, the productive category, environmental conditions, and characteristics of the plant material used.

OTHER PLANTS OF IMPORTANCE TO LIVESTOCK HEALTH

Research has been carried out globally on species of plants as substitutes of antimicrobial drugs to control gastrointestinal infections in domesticated animals, and many researchers reported that using traditional medicines is safe, economically sustainable, and environmentally tolerable (Erasto, 2003). These plants are less expensive than conventional drugs and are considered to be more effective than pharmaceutical drugs for acute maladies (Luseba et al., 2007). They contain a variety of active constituents that are effective against a variety of ailments. The identification of medicinal plants used for livestock health (*Table 1*) used by smallholder farmers in rural South African communities and worldwide for ethnoveterinary treatment has been the subject of several studies (Chitura et al., 2019). The efficiency of ethnoveterinary medicinal plants utilized to manage the anthelmintic resistance of indigenous goats, however, has only received scant attention from studies conducted by youth as compared to older generation with more knowledge on their usage (Simbo, 2010).

Table 1. Livestock herbal remedies

Medicinal plant			Description			
Vernacular name (s)	Scientific name	Plant part used	Administration	Effectiveness (%)	Observation	Reference
Intolwane Mugudzuru Narrow-pod elephant root	<i>Elephantorrhiza elephantina</i>	Roots	The roots are grinded and boiled for 30 minutes in water until they have a red colour then, 300ml of the water is dosed or sprayed on the animal.	67%	Aids in the control of livestock parasites like ticks, helminths, and mites.	(Rwodzi, 2014).
Moringa Horseradish tree	<i>Moringa oleifera</i>	Leaves	Leaves are dried and fed as supplemented feed.	80%	Increases reproductive efficiency	(Mahmoud, 2013; Tona et al., 2014).
Cape grape Wild grape African grape	<i>Rhoicissus tomentosa</i>	Roots	The plant is used to prepare an infusion which is orally fed.	77%	Improves reproductive performance and semen quality of animals	(Oyewole et al., 2021).
Puncture vine Gokharu Gokshur	<i>Tribulus terrestris</i>	Roots	Roots are crushed and boiled for extraction.	90%	Increases the levels of testosterone, aphrodisiac activity, and spermatogenesis. Treats erectile dysfunction.	(Gauthaman et al., 2002; Ople'tal et al., 2008; Gauthaman et al., 2008)
	<i>Duvernoia adhatodooides</i>	Leaves	An infusion is made and administered orally to the animal.	63%	Enhances fertility and induce libido	(Rwodzi, 2014).
Hornygoat weed Barrenwort Fairy wings Bishop's hat Yin yang huo	<i>Epimedium</i>	Stems and leaves	A paste like ointment is prepared with stems and leaves are dried then fed raw or mixed with animal feeds.	70%	The stems helps in the control of poor libido and lameness by lowering the malfunctioning of joints and chances of arthritis. But here is limited evidence on the use of leaves.	(Tang and Eisenbrand, 2011).
Mpesu Krinkhout Violet tree Krinkhout Muteya	<i>Securidaca longepedunculata</i>	Root bark	Root bark is grinded to powder and prepared for inclusion with water. Stembark is used an ingredient of arrow poisons. Powdered roots are externally applied to sores, wounds and around joints.	97%	The xanthone compounds confers the action against erectile dysfunction. Boosts libido in men. Treats venereal diseases, as well as constipation.	(Moeng, 2010). (Ojewole, 2008).

CONCLUSIONS

This literature has demonstrated that the integration of ethnoveterinary medicine with livestock farm technologies significantly improves the performance of indigenous goats and reduces antimicrobial resistance on them. The findings emphasize the practicability of such integrative approaches as culturally relevant strategies that are sustainable and effective for the improvement of livestock health and productivity. This integration recommends an optimistic opportunity for preventing the global challenge of antimicrobial resistance by reducing the dependence on conventional antibiotics. The integration in this review also indicates pathways that are more convenient for the application of these

practices more broadly. The possible advantages extend beyond the livestock sector to address wider environmental and public health concerns. To expand on these findings, future research can also be conducted to discover the scalability of combined approaches and their application across different livestock systems and ecological contexts. At last, the work in this review article contributes to an expanding body of evidence advocating for the combination of traditional knowledge and modern technology in creating more sustainable agricultural practices. The approaches can be a trusted alternative that livestock farming can become more efficient, sustainable, and resilient, ultimately leading to improved food security and livelihoods for farmers in South Africa and around the world. It is also recommended that farmers

must embrace a blended approach of the use of farm technologies and ethnoveterinary practices to benefit from the strengths of each approach. They must also foster knowledge sharing and education, research and development, customized solutions, technology accessibility, community engagement as well as continual monitoring and evaluation.

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