CHAPTER 32

Phytotherapeutic Approaches for the Treatment of Animals in Pakistan: A One Health Perspective

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SUMMARY

Phytotherapeutic means treating animals and humans with medicinal plants. In Pakistan, the tradition of treating humans and animals with beneficial natural plants has been practiced for centuries. Medicinal plants are advantageous for treatment due to their easy availability, minimal side effects, low cost, and ease of use for animals. The world is increasingly shifting towards natural products, given their minimal side effects, with a recent advancement being the one-health approach. This approach addresses issues related to human, animal, and environmental health. Various researchers in Pakistan have published different phytotherapeutic treatments, detailing the medicinal plants, their locations, and therapeutic effects. This chapter aims to identify the research conducted on herbal medicine in Pakistan and its application in veterinary practices. Additionally, it focuses on the current potential of phytotherapeutic approaches for animal care in Pakistan from a one health perspective. It is crucial to take serious action to encourage the sharing of traditional knowledge. The use of local herbal medicinal plants is not only economical but also greatly facilitates local farmers. However, more research is needed to systematically explore the methods for practically implementing such therapeutic approaches. Further investigation is necessary to develop effective strategies for the widespread application of these methods in practice.

INTRODUCTION

Herbal therapeutic approaches have been practiced for centuries to treat animals and humans. In Pakistan, the use of medicinal plants has long traditions; these natural therapeutic plants are widely used in veterinary practice. Pakistan being a country possessing a large population of livestock, providing adequate healthcare for animals is a big challenge for the country (Leibler et al., 2009). Herbal therapeutic approaches involve the use of medicinal plants to prevent and treat diseases in both animals and humans. Such remedies include essential oils, plant extracts, and herbal formulations that have been widely used for centuries in traditional medicine practices (Hosseinzadeh et al., 2015). The treatment by use of medicinal plants has gained popularity in recent years as people are seeking alternative and complementary treatments to conventional medicine (Van-Andel & Carvalheiro 2013). In veterinary medicine, herbal therapeutic approaches are used to treat a wide range of diseases like digestive disorders, respiratory diseases, skin problems, and infections (Mills & Bone 2000).

Herbal medicines are widely used in countries like Pakistan, where herbal medicines have a long history and are widely accepted. The efficacy and safety of phytotherapeutic approaches are still being studied; however, their use should be guided by veterinary doctors and herbal experts. The side effects of these natural remedies are less than conventional medicine and are the best alternative for animal healthcare. Phytotherapy being used as a one health approach is also gaining importance worldwide. By using such remedies, we can reduce the harmful

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effects of synthetic drug that can harm our environment like antibiotic resistance (Martinez, 2009).

One health is an interdisciplinary approach that recognizes the interconnectedness of human, animal, and environmental health (Conrad et al., 2013). It emphasizes the importance of collaboration between human health, animal health, and environmental professionals in addressing health challenges (Barrett et al., 2011). The one health concept acknowledges that human health is closely linked to the health of animals and the environment. For example, many diseases that affect humans, such as avian influenza and ebola, have animal origins. Similarly, environmental factors such as pollution and climate change can have significant impacts on human and animal health. The one health approach aims to address these complex health challenges by bringing together experts in various fields, including human medicine, veterinary medicine, public health, environmental science, and agriculture (Zinsstag et al., 2011). By working together, these professionals can develop and implement integrated strategies to prevent and control diseases, reduce environmental risks, and promote health and well-being. In recent years, the one health approach has gained attraction worldwide, as it offers a holistic and collaborative approach to addressing some of the most pressing health challenges facing our planet (Cunningham *et al.*, 2017). It has been used to tackle a range of issues, from zoonotic diseases and food safety to emerging infectious diseases and antimicrobial resistance (Nguyen-Viet et al., 2022).

This chapter addresses the identification of areas for future research and the need for further integration of phytotherapeutic approaches in veterinary practice in Pakistan. However, it provides a comprehensive overview of the current status and potential of phytotherapeutic approaches for animal healthcare in Pakistan from a One Health perspective, emphasizing the importance of collaboration between various health professionals.

MEDICINAL PLANTS IN PAKISTAN AND THEIR THERAPEUTIC USE

Pakistan has a rich diversity of medicinal plants that have been used for centuries to treat various diseases (Khan et., 2023). The country's diverse topography, ranging from high-altitude mountain ranges to tropical forests, provides a favorable environment for a wide range of plant species with medicinal properties. In the wider Cholistan Desert of Pakistan, 35 plant species were collected and are being utilized to cure a variety of bovine diseases (Ahmed & Murtaza 2015; Malik et al., 2015). Phyto-therapeutic techniques for the treatment of parasitic infections in cattle have been documented (Klausen et al., 2020). *Azadirachta indica* leaves and fruits have been shown to have strong anti-parasitic and anti-coccidal activity when tested on animals (Oli & Gautam 2022). The local population heavily relies on herbal remedies to cure a variety of illnesses, and according to a survey, 24 plant species with ethnoveterinary significance are beneficial for treating a range of livestock illnesses such gastrointestinal disorders, fever, cough, infections of the respiratory tract, urinary tract diseases, encourage lactation, wound healing, placenta removal, deworming, carminative, and flatulence in the Arab medical system (Ahmed & Murtaza 2015). The main characteristics of the plant species employed in their usage were their roots, rhizomes, bark, leaves, and stems, and the main preparation techniques were decoctions and infusions (Mthi et al., 2018; Supiandi et al., 2019; Islam et al., 2021; Sharun et al., 2021).

Medicinal plants compete with synthetic drugs due to bio-compatibility, cost-effectiveness, and lesser or no side effects (Arora et al., 2013). As evolving times novel diseases are emerging in animals and human beings by irrational uses of antibiotics and increasing industrialization. Nowadays it is the need of the hour to work more extensively on the plants in the larger interest of humanity. Due to high biotic pressure the important medicinal plants were disappearing rapidly in the study areas. Medicinal plants are utilized for handling the health care system and in preventing a variety of diseases. The photo-therapeutic studies explore the information regarding diseases and their control, remedies and clinical practices for treatment and prevention, management, feeding, breeding strategies, and the human resources that carry information and experiences (Ahmed & Murtaza 2015).

THE PLANTS USED FOR THE TREATMENT OF ANIMAL DISEASES

The plants are widely used in veterinary practice, particularly in rural areas, where access to conventional medicine is limited. Here are some of the plants commonly used for the treatment of animal diseases in Pakistan *i.e. Rumex nepalensis, Berberis lycium* royle, *Cannabis sativa, Azadirachta indica, Bergenia ciliata, Ipomoea nil, Zea mays, Allium cepa, Matricaria chamomilla, Allium sativum, Bunium persicum, Oryza sativa, Zingiber officinale, Acacia arabica, Cordia oblique* and belongs to the family Polygonaceae, Berberidaceae, Cannabaceae, Meliaceae, Saxifragaceae, Convolvulaceae, Gramineae, Amaryllidaceae, Ranunculaceae, Asteraceae, Amaryllidaceae, Umbelliferae, Poaceae, Zingiberaceae, Leguminosae, Boraginaceae, and their common names are Hulla, Sumbal, Bhang, Neem, Zakhm-e-Hayat, Kala dana, Jawar, Piyaz, Black seed, Chamomile, Lehsan, Black cummin, Chawal, Ginger, Kikar and Lasora respectively (Deeb et al., 2009; Sindhu et al., 2010; Abbasi et al., 2013; Ahmed & Murtaza 2015; Aziz et al., 2020; Khan et al., 2021). These plants contain the beneficial compounds quinone, beta-sitosterol, glucopyranos, and galactopyranoside. The decoction method is

employed in ethnoveterinary medicine. The entire plant is employed to get the desired medicinal effect. Herbal medicines are used to cure animal cases of dysuria, red urination, hepatitis, malaria, and fever (Ahmed & Murtaza 2015).

COMMONLY USED MEDICINAL PLANTS IN PAKISTAN

Keeping animals and maintaining the quality and quantity of animal products are key components of our economy, as we know agriculture is one of Pakistan's main sources of income. The main animal products that are consumed by humans are milk and milk products, and cattle are the responsible animals. Pakistan has a very large population of livestock, which is made up of a variety of regional varieties that are well suited to the climate there (Rafique et al., 2021). Pakistan is home to an estimated 74 million chickens, 27 million buffaloes, 30 million cattle, 27 million sheep, 54 million goats, 1 million camels, 0.3 million horses, 4 million asses, and 0.2 million mules. Specifically, particularly, phytotherapeutics frequently serve as the major mode of treatment in rural veterinary care because allopathic modalities are still unavailable, particularly in developing countries (Ahmed & Murtaza 2015).

The world's oldest practice of medicine is phytotherapy Fig 1. It has been used for thousands of years to cure both people and animals. In reality, plants had developed remedies for ailments long before humans did. The advancement of contemporary civilization has included the use of herbal medicine. The facts on which phytotherapy is based have frequently been gathered at a cost in human lives and are based on the experiences of many generations, frequently of several centuries. Most farmers and livestock owners in Pakistan reject using allopathic medications in favor of their own customary ethno-veterinary practices. Since crops are a seasonal source of revenue, animals may be a reliable source of income for farmers (Sindhu et al., 2010).

Pant-based medications are respected today, particularly in impoverished nations with little access to modern healthcare Tab 1. Indigenous treatments are becoming more and more popular in both rural and urban regions because they are safer, more effective, and less expensive.

Most versatile and used veterinary plants of the 89 recorded plant species, frequently applied plant species against veterinary ailments included: *Adhatoda vasica, Calotropis procera, Melia azedarach, Rumex nepalensis, Cannabis sativa, Allium cepa, Citrullus colocynthis, Rumex hastatus, and Aesculus indica*. The most often reported species was *Adhatoda vasica*, followed by *Brassica campestris, Trachyspermum ammi, and Zanthoxylumarmatum var. armatum, Brassica campestris with Allium cepa*. The Polygonaceae family was discovered to have the broadest use based on the variety of disorders addressed by plants in each family, with 8 recipes for the treatment of 17 veterinary conditions (Oli & Gautam 2022).

Owing to its Biological zones, climate, and geography, Pakistan is endowed with a large variety of medicinal plants. Traditionally employed medicinal herbs in Pakistan may range between 400-600. A number of medicinal plants from the arid region provide pharmacological and dietary benefits. To treat a variety of infectious disorders, there are about 350 conventional herbal remedies (Ashfaq et al., 2019). The most used medicinal plants are discussed below.

CURCUMA LONGA

Distribution and chemical composition

Curcuma longa is frequently utilized as a seasoning in various Indian food items and is indigenous to Southeast Asian nations. It belongs to the family Zingiberaceae. Its chemical composition contains tumerin, turmeran-D (antitumorigenic). essential oil (3-5%), diarypeptanoids, ukonan-A, carotenoids, and minerals as nutritional components. Carbohydrates sesquiterpenes, proteins, caffeic acid, and resins are also present in turmeric (Mughal, 2019). The first component of turmeric to be extracted was curcumin, that was discovered in 1815. Its chemical makeup was identified in 1977. Main component in curcuma longa is curcumin.

Medicinal properties

Turmeric's, carbohydrate (67.38%), crude protein (9.40%), moisture (8.92%), fat (6.85%), crude fiber (4.60%), and ash (2.85%) compositions are taken into account while analyzing its nutritional profile. Metabolic disorders like diabetes mellitus and hypercholesterolemia can be prevented by using the fiber component of C. longa, as it gives heft to the food and reduces the consumption of too many complex carbohydrates. Antibacterial agent and anti-inflammatory activity is accounted for by the curcumin essential oil present in turmeric. Ukonan-D and Ukonan-A are responsible for anti-carcinogenic and enhance white blood cell activity. However, alkaloids, flavonoids, phytic acid phenols, tannins, saponins, and sterols are also present and used to treat conditions like anemia, hypertension, sex hormone enhancement, and intestinal condition improvement. Curcumin shows poor intestinal absorption (Mughal, 2019). Owing to its antiviral effects turmeric has been used for the treatment of COVID-19 as curcumin variants have long been used for treating respiratory tract conditions (Gupta et al., 2020).

GINKGO BILOBA

Distribution and chemical composition

In the order Ginkgoales, which initially arose more than 290 centuries ago, it is the last surviving subspecies. It belongs to the family Gingkgoaceae. It is indigenous to China and is often called the maidenhair tree. *Ginkgo biloba* is regarded to have a multitude of medicinal properties. The presence of flavonoids, terpenoids, alkyl phenols, lignin, alkyl phenolic acids, carboxylic acid, polysaccharides, and others constitutes the chemical makeup of this plant. According to some theories, the biologically active components are flavonoids and terpenoids (Singh et al., 2019).

Medicinal properties

The variety of diverse phytochemical constituents exhibit, a broad range of medicinal and therapeutic activity such as antidementia, antiplatelet, antilipidemic, antidepressant, anticancer, antiaging, and antidiabetic. It typically treats neurodegenerative, circulatory, and pulmonary conditions such as autonomic dysfunction and has neuroprotective properties (Tabassum et al., 2022). G. biloba extract is the most widely employed alternative treatment for curing Alzheimer's disease and a well-liked nutritional supplement used by the elderly to enhance cognition and prevent age-related mental impairment (Singh et al., 2019). Owing to the large genome size ginkgo offers fresh perspectives to gymnosperm genome emergence (Liu et al., 2021a).

ANDROGRAPHIS PANICULATA

Distribution and chemical composition

It is one of the most significant medicinal plants, native to India and Sri Lanka, and belongs to the family Acanthaceae. The sourest chemicals discovered are neoandrographolide, deoxyandrographolide, and andrographolide. A variety of diterpenoid derivatives with comparable carbon skeletons have also been recovered from Andrographis. One of the most significant medicinally active phytochemicals in the plant is the presence of andrographolide in the highest concentration about 2.39% in leaves (Verma et al., 2019).

Medicinal properties

Kalmegh possesses bactericidal, antiplatelet, anti-inflammatory, and immunological effects. The herb is utilized in Malaysian traditional medicines to treat diabetes and high blood pressure. The intriguing pharmacophore andrographolide exhibits anti-tumor, anti-hepatotoxic, hypoglycemic, protozoacidal, anti-HIV, and hypotensive properties. Its pharmacological effects also include the treatment of upper respiratory tract infections (Goswami et al., 2020).

***ALLIUM SATIVUM* L.**

Distribution and chemical composition

It belongs to the family Amaryllidaceae. Although humans have been consuming garlic for at least a few centuries, it is a native of Central Asia as well as northern Iran and has long been a popular condiment all over the world. It has been used as a flavor enhancer and a natural remedy since the time of the ancient Egyptians. Almost 80% of the global supply of garlic comes from China (Ejeta et al., 2022). Allicin, diallyl sulfide, diallyl disulfide, diallyl trisulfide, ajoene, alliin, and S-allyl-cysteine are only a few of the many bioactive substances found in garlic. Garlic has intriguing uses in the creation of nutraceuticals and is an excellent natural source of sulfur-containing phytochemical compounds (Shang et al., 2019).

Medicinal properties

It has promising physiological effects such as antiviral, anticancer activity, antimicrobial, fungicidal, antiprotozoal, anti-inflammatory, antioxidant, radioprotective, hepatoprotective, cardioprotective, hypolipidemic, purgative, and gastrointestinal action and is employed to cure a variety of illnesses and ailments (Sanjay et al., 2019). The pungent herbaceous plant known as garlic is used both as a diet and a conventional treatment for a number of illnesses (Oh, 2022). In remedies, it has been shown to have a number of biological qualities, including anti-carcinogenic, antioxidant, antidiabetic, renoprotective, anti-atherosclerotic, antibacterial, antifungal, and antihypertensive actions (Batiha et al., 2020).

TRIBULUS TERRESTRIS

Distribution and chemical composition

This plant belongs to the Zygophyllaceae family. This is most common in South Africa, Australia, India, and Europe. The Greek word "tribolos," which means spike fruit, is where the term Tribulus originates. The fruits are employed to cure a variety of ailments in herbal medicine in Bulgaria, Ayurvedic medicine in India, and traditional Chinese medicine. The T. terrestris extract contains a wide range of components, a number of which have been discovered. In particular, steroidal saponins, flavonoids, tannins, terpenoids, polyphenol carboxylic acids, and alkaloids have all been shown to be present. Many variables, including the technique of separation and whether roots, leaves, or fruits were employed, influence the makeup of T. terrestris concentrate. The biologically derived ancestors of the spiro conjugates are thought to be the furostanol saponins. Almost 70 chemical treatments have been found in Tribulus (Ștefănescu et al., 2020).

Medicinal properties

The results of numerous investigations revealed the presence of potential of *T. terrestris* compounds and various constituents that function as antioxidant, anti-inflammatory, anticancer, antidiabetic, androgens, cardiac, nephro- and hepato-protecting compounds (Gunarathne et al., 2022). It has been demonstrated that it causes hepatocellular carcinoma to proliferate less and induce cell death. Its pharmacological function is linked to steroidal saponins by triggering an apoptotic pathway in breast

Fig 1. Diagrammatic representation of different medicinal plants and their medicinal effect in view of one health triad

cancer cells. It has been demonstrated that trans-N-feruloyl-3-hydroxytyramine and trans-N-feruloyl-3-ethoxytyramine cause leukemic cells to undergo death (Khalid et al., 2022).

EFFECT OF PHYTOTHERAPY ON ONE HEALTH TRIAD

Phytotherapy, also known as herbal medicine or plant-based medicine, is a form of alternative medicine that uses plant extracts to promote healing and improve health. What and how plants are used is determined by cultural practices (Teixidor et al., 2018). One of the widest types of plants utilized extensively in many cultures across the world is medicinal plants. (Kunwar et al., 2022; Turpin et al., 2022).

The use of phytotherapy can have a positive impact on the One Health triad Fig 2., which encompasses the interconnectedness of human, animal, and environmental health (Avetisyan et al., 2019). The use of plant-based remedies reduces the risk of pharmaceuticals, risk of adverse drug reactions in the health care system (Capasso et al., 2023). Many plant-based treatments have long been used to treat animal illnesses, and veterinary medicine is showing an increasing amount of interest in their use. Phytotherapy can improve animal health by reducing the need for antibiotics and other medications, decreasing the likelihood of antibiotic resistance, and improving animal welfare (Chen et al., 2020). Phytotherapy can have a positive impact on the environment by reducing the use of synthetic pesticides and herbicides. Plants used in phytotherapy can also be grown sustainably, which can help promote soil health and biodiversity. By supporting healthy ecosystems, phytotherapy can have a positive impact on human and animal health. Overall, phytotherapy has the potential to support the one health triad by promoting health and healing using natural, plant-based remedies that can benefit human, animal, and environmental health (Naraki et al., 2021).

Effect of phytotherapy on animal health

Since ancient times, phytotherapy has been utilized in veterinary medicine to support animal health and treat a variety of ailments. Depending on the particular herbs or plant extracts used, the dosage and frequency of administration, as well as the needs and health status of each individual animal, the effects of phytotherapy on animal health can vary (Davidovic et al., 2012).

Poisonous plants lead to significant economic losses for the livestock firm (Jayathilakan et al., 2012; Neto et al., 2018). The health issues, reduced profitability, aberrant progeny, and shorter lifetimes all contribute to these economic losses. Animals exposed to toxic plants may exhibit a variety of symptoms, including skin irritability from touch, internal poisoning through ingestion, dermal absorption, and inhalation through their lungs (Inthavong et al., 2013; Oladosu et al., 2016). Animals are frequently haphazardly poisoned by poisonous plants due to the drought season and excessive grazing in pastures (Onyeyili et al., 2018; Ahmad et al., 2020), and seeing as nomads and villages are unfamiliar with potentially deadly plants while they are feeding their livestock fodder. (Leong et al., 2017). The quantity and types of plants consumed, the environmental circumstances in which they grow, and the stage of blooming all affect how harmful plants are to animals as well (Anadon et al., 2018).

Many plants have anti-inflammatory properties and can help reduce inflammation in the body, which can be beneficial for animals with conditions such as arthritis, allergies, or gastrointestinal inflammation. Certain herbs and plant extracts have antimicrobial properties, which can help fight bacterial, viral, or fungal infections in animals (Abdallah et al., 2019). Some plants are believed to stimulate the immune system and improve overall immune function, which can help animals fight off infections and recover from illness more quickly. Many

plants can help support healthy digestion and relieve digestive discomfort in animals. Some herbs and plant extracts are believed to have calming properties and can help reduce stress and anxiety in animals (Blanco-Penedo et al., 2018).

Lack of diet and nutrition as well as unexpected plant exposure are the main causes of plant poisoning in animals. Due to a lack of food, animals are forced to graze plants known to contain high levels of hazardous metabolic chemical substances (Pardon et al., 2012), which results in decreased productivity, sickness, and even death in the animals (Nielsen et al., 2019). The origin and surrounding environmental factors have an impact on the harmful secondary metabolite's characteristics (Kara et al., 2019). Plants use tannins, phenolics, alkaloids, phytohemagglutinins, terpenes, cyanogenic glycosides, and oxalates as their main defense mechanisms against herbivores (Karabourniotis et al., 2020).

With the advent of new approaches, and the development of methods, concepts, and knowledge, plant toxicity science is advancing day by day. Since plant-related poisoning has seen very little study to date, it is unclear how plants really poison people. Random intake of seeds, fruits, pollen, trichomes, and other plant components is mostly to blame for plant poisoning. Every organ system might potentially be harmed by toxic plants, putting animal production and health at risk (Ahmad et al., 2017).

It is important to note that while phytotherapy can be beneficial for animal health, it should always be used under the guidance of a trained veterinary professional. Some plants can be toxic to certain animals, and improper use or dosing can cause adverse effects or interactions with other medications (Serda, 2017).

Effect of phytotherapy on Human Health

The relationship between the plants and native peoples have become better understood due to ethnobotanical study conducted across the world (Kassa et al., 2020; Kutal et al., 2021). Such research, which primarily deals with bringing information regarding important indigenous plant species, also strongly contributes to the preservation of biodiversity and traditional knowledge (Jessen et al., 2022).

The effects of phytotherapy on human health can vary depending on the specific herbs or plant extracts used, the dosage and frequency of administration, and the individual's health status and needs (Mishra et al., 2020). Many plants have anti-inflammatory properties and can help reduce inflammation in the body, which can be beneficial for conditions such as arthritis, asthma, and inflammatory bowel disease. Certain herbs and plant extracts have antimicrobial properties, which can help fight bacterial, viral, or fungal infections (Enioutina et al., 2017). Some plants are believed to stimulate the immune system and improve overall immune function, which can help prevent and fight off infections and diseases. Some plants have been shown to have beneficial effects on heart health, such as improving blood flow, reducing cholesterol levels, and lowering blood pressure. Some herbs and plant extracts are believed to have calming properties and can help reduce stress and anxiety (Sabiu et al., 2019).

Therapeutic landscaping is attributable to the high diversity of medicinal plants, which signifies their important significance in organic medical practices to tackle fundamental primary healthcare requirements. The development of the modern healthcare system, increased urbanization, and loss of biodiversity all bring potential hazards to knowledge retention. To reduce poverty, end hunger, improve healthcare, comprehend climate change, preserve biodiversity, and deal with challenges connected to biodiversity, traditional knowledge must be exploited (Peters et al., 2012).

It is important to note that while phytotherapy can be beneficial for human health, it should always be used under the guidance of a trained healthcare professional.

Effect of Phytotherapy on the Environment

Both beneficial and negative effects on the environment can result from phytotherapy. On the plus side, phytotherapy can support biodiversity preservation and plant species preservation. The use of plant-based remedies has the potential to advance both traditional medical knowledge and the growth and preservation of medicinal plants. In addition to protecting endangered species, this can aid in the preservation and restoration of natural habitats. Nevertheless, overharvesting medicinal plants can result in biodiversity loss and natural resource depletion. Additionally, unsustainable harvesting methods can result in soil erosion, water pollution, and habitat

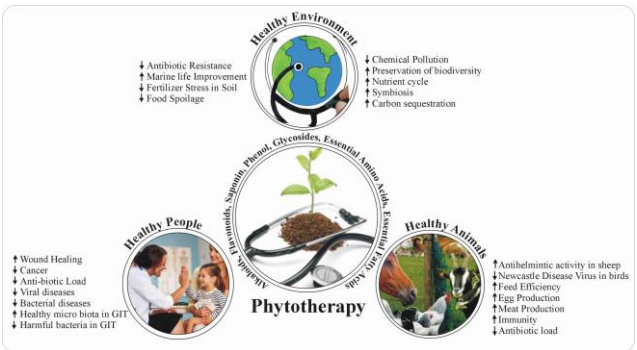

Fig 2. Schematic diagram illustrating the effect of phytotherapy on one health triad

Tab 1. Medicinal plants

Common Name	Botanical Name	Locality	Compound Present	Treatment Effect and Species	References
Neem	*Azadirachta indica*	Pakistan, India, Nepal, and Bangladesh	2-pentanol, acetate (9.72%), decane (8.96%); 11-oxa-dispiro [4.0.4.1] undecan-1-ol (6.56%), nonanoic acid, 9-(3 hexenylidenecyclopropylidene), 2-hydroxy-1-(hydroxymethyl) ethyl ester (7.13%), quinoline-4-carboxamide, 2-phenyl-N-n-octyl- (9.79%), nonacosane (44.27%) and tetratriacontane (13.43%)	↑ Antihelmintic activity: in sheep ↓ Newcastle Disease Virus: *in-ovo* evaluation	Iqbal et al., 2012; Mahmood et al., 2018; Khan & Javaid 2021
Garlic	*Allium sativum*	Gujranwala, Jaranwala, Kasur Sheikhupura	9-hexacosene, 2-(([2-ethylhexyl]oxy)carbonyl)benzoic acid, clionasterol, 4-methyl-2-phenyl pyrimidine	↓ MRSA ↓ *Streptococcus* ↓ *Escherichia coli* ↓ *Pseudomonas aeruginosa* ↓ *Klebsiella pneumonia*: *in-vitro* ↑ Growth, ↑ Feed efficiency, ↑ Egg production and quality: in poultry	Khan et al., 2012; Ata et al., 2013; Liu et al., 2021b; Oh, 2022
Ginger	*Zingiber officinale*	Ayurvedic, Siddha, Chinese, Arabic, African, and Caribbean	Essential oils, terpenes, phenol compounds such as gingerol (23-25%) and shogaol (18-25%)	↑ Thermogenesis ↑ Lipolysis ↓ Lipogenesis ↓ Intestinal fat absorption	Syafitri et al., 2018; Attari et al., 2018; Mubaraki et al., 2023
Turmeric	*Curcuma longa*	Wah Kharaan, Changa Manga, Kasur District, Punjab and all over Pakistan	Curcumin, Demethoxycurcumin and Bisdemethoxycurcumin	↑ Antioxidants ↑ Immunity: Broiler	Kiamahalleh et al., 2016; Hussain et al., 2018; Limay et al., 2018
Aloe vera	*Aloe barbadensis*	Nara desert, Achro Thar, and arid regions of the Kirthar range, Tharparker, Umerkot, Mirpur Khas, Badin in Sindh and all over Pakistan	alkaloids, flavonoids, saponin, phenol, glycosides and tannins	↑ Anti-inflammatory, ↑ Antioxidant, ↑ Antimicrobial ↑ Anti-helminthic ↑ Antifungal ↑ Aphrodisiac ↑ Antiseptic	Lanka, 2018; Yaseen et al., 2019; Ikpe et al., 2019

↑: Increase ↓: Decrease MRSA: Methicillin-resistant *Staphylococcus aureus*

destruction. Certain plant species may become extinct as a result of overexploitation (Chong et al., 2020).

Furthermore, the environment may suffer if fertilizers and pesticides are used in plant cultivation. These substances have the potential to pollute air, water, and soil, harming human health as well as wildlife. To minimize the negative effects of phytotherapy on the environment, it is important to use sustainable harvesting practices and promote organic farming and the use of non-toxic alternatives to chemical fertilizers and pesticides. It is also essential to protect natural habitats and promote the conservation of endangered plant species through regulation and education (El-Hack et al., 2018).

ADVANTAGES OF PHYTOTHERAPY IN ANIMAL HEALTHCARE

In veterinary medicine, phytotherapy is gaining popularity after being utilized for centuries in human medicine. With this method, plant-based medications are used to cure and stop animal diseases. Due to its lower toxicity and fewer side effects as compared to traditional treatment, phytotherapy is becoming increasingly popular in the field of animal healthcare. Many uses for phytotherapy are available in animal healthcare. There are several plants that have been discovered to have medicinal qualities that may be used to cure a variety of ailments, ranging from moderate to severe. This makes it a flexible and adaptable method for managing problems with animal health (Hoffmann, 2003). We discuss here a few advantages of phytotherapy in animals.

Easy to administer

Animals may easily be given plant-based products used in phytotherapy since they can be given to them in a variety of formats, including teas, tinctures, and powders. This is especially helpful for animals that are resistant to or difficult to treat with regular drugs. Formulations can be utilized as well as manufactured into paste, powder, decoction, and juice. For consistent therapy doses and durations as well as formulations that can be stored for a long time without losing efficacy (Kumar et al., 2012).

Cost-effective

Phytotherapy costs are less than traditional medication. Several plants and herbs used in phytotherapy may be cultivated at home or are easily found in nature, making them a more cost-effective choice for pet owners. This is crucial for those who wish to provide their animals the finest care possible but have limited cost. Isolated plant phytochemicals have demonstrated potent antibacterial activity against the bacteria that cause mastitis. These chemicals have the capacity to improve the antibacterial activity against a range of bacteria either alone or in combination with antibiotics. Plant-based medications are less expensive and have fewer side effects (Kovacevic et al., 2023).

Improve immune System

Animals' immune systems can be strengthened and improved with the use of phytotherapy. Several herbal medicines have substances that boost the immune system of animals. This enhances the animal's general health and helps it fight off illnesses more successfully. According to a study that provides proof for comprehending inflammation in Aeromonas hydrophila infections, may regulate the innate immune response and disease resistance (Wang et al., 2022).

Natural and sustainable

Phytotherapy is a natural and sustainable approach to animal healthcare. Unlike conventional medicine, which often relies on synthetic compounds, phytotherapy uses natural plant extracts that can be grown and harvested sustainably. This makes it a more environmentally friendly approach to animal healthcare (Malabadi et al., 2023).

Holistic approach

Phytotherapy takes a holistic approach to animal healthcare, focusing on the whole animal rather than just the symptoms of a specific condition. This means that it can be used to improve overall health and well-being, rather than just treating individual health issues (Park et al., 2023).

LIMITATIONS OF PHYTOTHERAPY IN ANIMAL HEALTHCARE

Lack of scientific evidence

The absence of scientific data to demonstrate the usefulness of phytotherapy in animal healthcare is one of its main disadvantages (Stanossek & Wehrend 2022). Despite the fact that many plant-based medicines have been used for a variety of diseases. However, there is frequently less scientific evidence to support their usage. Little knowledge of the qualities of herbal components has a detrimental impact on the usage of herbal products and diminishes their significance (Vijayaraghavan et al., 2011). Because of this, it is challenging to determine whether they are efficient or secure for usage in animals.

Lack of standardization:

The composition of plant-based products used in phytotherapy can vary widely, and there is often a lack of standardization. This makes it difficult to determine the correct dose and to ensure the product's efficacy (Oluyemisi et al., 2012). The lack of standardization can result in unpredictable outcomes and make it difficult to determine the most appropriate treatment plan (Ducrot et al., 2022).

Variable quality and potency

The quality and potency of plant-based treatment can vary greatly depending on the source and preparation method. This makes it difficult to ensure that the product being used is of high quality and contains the correct active ingredients. This can impact the effectiveness and safety of the remedy (Kabir et al., 2012). The key elements discovered in various research include a lack of precise standards on the evaluation of safety and efficacy, quality control, safety monitoring, and understanding of traditional medicine. To promote and advance the use of herbs in traditional medicine, proper validation must be done (Mukherjee et al., 2022).

Limited availability

Some plants used in phytotherapy may not be readily available in certain regions, making it difficult for owners to access the remedies they need. This can limit the range of conditions that can be effectively treated using phytotherapy. According to a study conducted in Pakistan's Khyber Pakhtunkhwa province's district Malakand, because of overgrazing and the abundance of plant species that were once utilized for treatment and cure, the availability of medicinal plants has declined over the past 30 years. Older locals said that there were many therapeutic plants in the area (Khan et al., 2023).

Potential for interactions with conventional medicine:

Some plant-based remedies may interact with conventional medicine, either reducing the effectiveness of the medication or causing harmful side effects. This makes it important to consult with a veterinarian before using phytotherapy alongside conventional medicine (van Wyk & Prinsloo 2020).

CONCLUSION

Phytotherapy is an important aspect of one health because it can be used to promote the health of humans, animals, and the environment. By using plant-based remedies, we can improve health outcomes while also promoting sustainability and reducing the risk of antibiotic resistance. It is important to take action to encourage the sharing of traditional knowledge. On the basis of the protection of biodiversity, it is also necessary to facilitate the sustainable use of medicinal plants in order to enhance local economic growth.

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