MEDICINAL PLANTS USED IN THE TREATMENT OF ANIMAL DISEASES- A REVIEW ON VETERINARY MEDICINE

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Abstract

Introduction/Background: The health of animals plays a pivotal role in ensuring worldwide food security, fostering economic prosperity, and safeguarding public health. The presence of contagious and parasitic ailments can exert substantial repercussions on the welfare of animals, resulting in considerable financial setbacks for farmers and livestock custodians across the globe. The global impact of animal diseases encompasses animal fatalities, reduced output, and the expenses associated with veterinary care. These factors collectively impinge upon food availability and the livelihoods of rural communities. Vital sectors of the food industry, such as meat, dairy, and egg production, heavily rely on the well-being of animals to meet the escalating demand for sustenance. Contagious diseases in animals, in particular, represent a substantial economic menace, precipitating declines in productivity, efficiency, and revenue. Conventional pharmaceuticals have traditionally served as the primary avenue for treating animal diseases. Nevertheless, the utilization of natural products in animal health has garnered increasing attention due to their potential therapeutic attributes and advantages.

Materials and Methods: Natural products are derived from various sources, including plants, animals, and microorganisms, and have been used for centuries to treat human and animal diseases. The use of natural products in animal medicine has been shown to have fewer adverse effects, less likelihood of drug resistance, and cost-effectiveness. This review article was conducted by searching for relevant literature using electronic databases such as PubMed, Science Direct, and Google Scholar. Articles published between 2010 and 2022 were included, and the search terms used included "natural products," "animal medicine," "animal health," "herbal medicine," and "traditional medicine." The articles were reviewed, and the relevant information was extracted and synthesized.

Results and Discussion: The use of natural products in animal medicine offers several advantages and benefits. Natural products have a range of therapeutic benefits, including anti-inflammatory, anti-bacterial, anti-fungal, and anti-viral properties. They have been used to treat conditions such as pain, anxiety, arthritis, and skin infections, among others. Additionally, some natural products have been found to have immunomodulatory effects, meaning they can enhance the immune system's ability to fight off diseases. Natural products are also used to prevent and control diseases in animals. Garlic and oregano, for example, are natural products that have been shown to have anti-bacterial and anti-viral properties, making them useful in preventing and treating infections. The applications of natural products in animal medicine are vast, and they are commonly used in both traditional and modern veterinary practices. *Aloe vera* is used topically to treat wounds and burns, while turmeric is used as an anti-inflammatory agent in the treatment of arthritis. Other natural products such as chamomile, lavender, and valerian root are used to reduce anxiety and promote relaxation in animals. In addition to their therapeutic properties, natural products have a safety profile that is generally better than synthetic drugs. Unlike synthetic drugs, natural products are generally safe and have few to no adverse effects when used correctly. They also have a lower risk of developing resistance, which is a significant problem with many synthetic drugs.

Conclusion: The use of natural products in animal medicine offers several advantages and benefits, including fewer adverse effects, less likelihood of drug resistance, and cost-effectiveness. The therapeutic properties of natural products can be used to treat a wide range of conditions, and their applications are likely to increase in the future. As such, natural products continue to be an important area of research in animal medicine. However, it is important to note that the use of natural products should be done with caution, and it is recommended to consult with a veterinary professional before administering any natural product to an animal.

Keywords: Animal health, natural products, veterinary practices, food security etc.

I. INTRODUCTION

Animal health is a crucial aspect of food security, public health, and economic growth. Infectious and parasitic diseases have a severe impact on animal health, leading to significant economic losses for farmers and livestock keepers globally. The use of natural products in animal medicine has been recognized as a viable alternative to traditional pharmaceuticals due to their potential therapeutic properties, safety profile, and cost-effectiveness [1]. This study examines the applications and benefits of natural products in animal medicine, drawing on existing literature and research. The research design is based on a qualitative review of relevant studies, with a focus on the therapeutic properties, safety profile, and efficacy of natural products in animal health.

Natural products offer a range of therapeutic benefits, including anti-inflammatory, anti-bacterial, anti-fungal, and anti-viral properties in animal's related issues. They have been used to treat conditions such as pain, anxiety, arthritis, and skin infections, among others. Additionally, some natural products have been found to have immunomodulatory effects, meaning they can enhance the immune system's ability to fight off diseases. Natural products also have a lower risk of developing resistance, which is a significant problem with many synthetic drugs. The applications of natural products in animal medicine are vast, and they are commonly used in both traditional and modern veterinary practices [2].

The World Organization for Animal Health (OIE) is an intergovernmental organization responsible for improving animal health worldwide. It was created in 1924 and is headquartered in Paris, France. The OIE develops and publishes international standards for animal health and welfare, provides scientific expertise to support the control and eradication of animal diseases, and facilitates international cooperation in animal health. The OIE works with member countries to- Prevent and control animal diseases, including zoonoses (diseases that can be transmitted from animals to humans); Improve animal welfare; Ensure the safety of international trade in animals and animal products [3]. Other organizations that work on animal health and related issues include the Food and Agriculture Organization (FAO) of the United Nations, the World Health Organization (WHO), and various non-governmental organizations (NGOs) such as the World Wildlife Fund (WWF) and the Humane Society International (HSI) [4].

The importance of good health of animals cannot be overstated, and it has a significant impact on many aspects of society. Some of the key reasons why animal health is important include-

1. **Food Safety and Security:** Ensuring the health of animals is of utmost importance to maintain food safety and security. The health status of animals determines the quality of the food they produce, and diseases and other health issues in animals can have a detrimental impact on food safety. Sick animals are more likely to carry pathogens, which can contaminate the food products they produce. This can lead to food borne illnesses and outbreaks, posing a risk to public health. Moreover, if animal diseases are not detected and treated in a timely manner, it can lead to loss of livestock and a decrease in the overall food supply. This, in turn, can lead to food insecurity and shortages in certain regions, affecting the availability and affordability of food products. Therefore, maintaining good animal health is crucial to ensure the production of safe and high-

quality food products, which can contribute to improving food security and public health [5, 6, 7].

2. **Public Health:** The health of animals is closely linked to public health because many diseases that affect animals can also affect humans. These diseases are known as zoonoses and can be transmitted through direct contact with infected animals, consumption of contaminated food products, or exposure to environmental contaminants. For example, diseases like avian influenza, *Salmonella*, and *E. coli* can be transmitted from animals to humans, causing illness and sometimes even death. By maintaining good animal health, the risk of zoonotic diseases can be reduced, thereby protecting public health. This can be achieved through various measures, such as regular veterinary checks, vaccination programs, and proper hygiene and sanitation practices on farms and in food processing facilities. Overall, ensuring the good health of animals is an essential aspect of protecting public health and preventing the spread of zoonotic diseases [8, 9, 10].

3. **Economic Impact:** The livestock industry plays a crucial role in the global economy by providing a source of livelihood and income for millions of people worldwide. The industry contributes significantly to global food security by providing a steady supply of meat, dairy, and other animal products. However, the economic impact of the industry is not limited to the direct benefits of livestock production. Good animal health is essential for the sustainability and profitability of the livestock industry. By maintaining healthy animals, livestock farmers can reduce the risk of disease outbreaks, which can lead to significant economic losses. The cost of treating sick animals and the potential loss of production due to illness can have a significant impact on the bottom line of a livestock operation. Moreover, the livestock industry is interconnected with many other sectors of the economy, including feed production, transportation, processing, and retail. The industry's performance can have a ripple effect on other businesses, particularly in rural areas where livestock farming is a significant source of income. Therefore, maintaining good animal health is not only critical for the livestock industry but also for the wider economy [11, 12, 13].

4. **Environmental Sustainability:** Animal health is closely linked to environmental sustainability. One of the biggest environmental challenges we face today is the impact of livestock production on the environment. The livestock industry requires large amounts of land, water, and other resources, and it is a major contributor to greenhouse gas emissions, deforestation, and water pollution. However, healthy animals are more productive and efficient in converting feed into food, which can reduce the environmental impact of livestock production. Moreover, animal waste can be a valuable resource when properly managed, as it can be used to fertilize crops and generate energy. On the other hand, when not managed properly, animal waste can pollute water sources and contribute to greenhouse gas emissions. Thus, good animal health practices and proper waste management are critical to reducing the environmental impact of livestock production. Furthermore, the environmental impact of livestock production has implications for future generations, as it can affect the availability of resources and the sustainability of our planet. Therefore, it is important to ensure that animal health practices are sustainable and promote the long-term health of both animals and the environment [14, 15, 16].

5. **Animal Welfare:** Good animal health is essential for the welfare of animals. It refers to the physical and mental well-being of animals and their ability to engage in natural behaviors in their environments. Good animal health is essential for animal welfare, as sick or injured animals are likely to experience pain and suffering. Maintaining good animal welfare is important not only from an ethical standpoint but also because it can have an impact on the productivity and profitability of the livestock industry. There are several factors that contribute to good animal welfare, including access to adequate food, water, and shelter, as well as appropriate medical care and management practices. Good animal welfare also involves providing animals with sufficient space to move and express natural behaviors, such as grazing, nesting, and socializing with other animals. Animal welfare is an important consideration in modern agriculture, and many countries have established regulations and guidelines for the treatment of animals in agricultural production. The use of natural products in animal medicine can also contribute to good animal welfare by providing effective and safe treatments for a range of health conditions. Overall, promoting good animal welfare is an important ethical consideration and can have significant benefits for both animals and the livestock industry as a whole [17, 18].

II. THE ECONOMIC BURDEN OF ANIMAL HEALTH ISSUES WORLDWIDE

The economic burden of animal health in the United States has varied in recent years, with factors such as disease outbreaks, market conditions, and regulatory changes impacting the agricultural sector. The COVID-19 pandemic has had a significant impact on the livestock industry, leading to supply chain disruptions, reduced demand, and increased costs for biosecurity measures [19, 20]. Outbreaks of African swine fever and avian influenza in Asia have also impacted US producers, with losses estimated in the billions of dollars. While some events, such as increased prices for pork exports due to African swine fever, have benefited US producers, the overall economic impact of animal health issues can be substantial and underscores the importance of preparedness and collaboration among farmers, veterinarians, and policymakers [21, 22]. The economic burden of animal health issues worldwide is substantial. Infectious and parasitic diseases are among the main factors that contribute to this burden, as they can have a severe impact on animal health and lead to significant economic losses for farmers and livestock keepers globally. For example, according to the Food and Agriculture Organization of the United Nations (FAO), animal diseases cause an estimated $300 billion in losses to the global economy each year [23]. These losses are due to factors such as reduced productivity, decreased market access, and increased costs of disease control and treatment. Animal health issues can also have indirect economic impacts, such as affecting trade and food prices, and can have a particularly severe impact on the livelihoods of small-scale farmers and rural communities. Addressing animal health issues is therefore essential for promoting sustainable and equitable economic development, particularly in low- and middle-income countries where the livestock sector is a significant source of income and food security.

The World Organization for Animal Health (OIE) has highlighted the significant economic burden of animal health issues worldwide. According to the OIE, animal diseases have a major impact on the global economy, with estimated losses of up to USD 2.4 trillion per year [24]. According to a report by the Food and Agriculture Organization of the United Nations (FAO) animal diseases have a significant economic impact worldwide, with losses estimated at billions of dollars annually. For example, in 2017, the economic losses due to

foot-and-mouth disease (FMD) in Southeast Asia were estimated at $2.9 billion. The losses due to African swine fever (ASF) in China were estimated at $141 billion between 2018 and 2020. Other diseases such as avian influenza and bovine tuberculosis also have a significant economic impact on the livestock industry. The report also notes that the impact of animal diseases goes beyond just economic losses, as it can also have social and environmental consequences [25].

The economic impact of animal health issues is felt in various ways [11, 26, 27], including-

1. **Loss of Productivity:** Animal diseases can lead to decreased productivity in livestock and other animals, resulting in reduced production of food, fiber, and other products.

2. **Trade Restrictions:** Animal diseases can lead to trade restrictions on animal products, which can have a significant impact on the economies of countries that rely on exports of animal products.

3. **Control and Prevention Costs:** The cost of controlling and preventing animal diseases can be significant, including the cost of surveillance, vaccination, treatment, and other measures.

4. **Human Health Costs:** Some animal diseases can also affect human health, resulting in additional costs associated with medical treatment and public health measures.

The OIE has emphasized the importance of investing in animal health as a means of reducing the economic burden of animal diseases. This includes promoting disease prevention and control measures, improving veterinary services and capacity, and enhancing global cooperation in animal health issues [28].

III. VETERINARY MEDICINE

Veterinary medicine is a branch of medicine that deals with the diagnosis, treatment, and prevention of diseases and injuries in animals. This includes a wide range of species, from domestic pets and livestock to wildlife and zoo animals. Veterinary medicine is a vital field that helps to ensure the health and well-being of animals, which can also have an impact on human health. Veterinarians use a variety of techniques and tools, such as physical exams, diagnostic tests, and medical treatments to provide care for animals. Some areas of specialization within veterinary medicine include surgery, internal medicine, dermatology, oncology, cardiology, and more. Veterinary medicine can be practiced in a variety of settings, such as private clinics, animal hospitals, research facilities, and government agencies. Overall, veterinary medicine is a critical field that plays an essential role in maintaining the health and welfare of animals, as well as contributing to public health and safety [29,30].

1. **Natural Products as Veterinary Medicine:** Natural products have gained significant attention in veterinary medicine due to their potential to offer safe and effective remedies for various animal health issues. Many natural products have been used for centuries in traditional veterinary medicine, such as herbal remedies, homeopathy, and acupuncture. These products are derived from natural sources, including plants, animals, and minerals, and have been used to treat a variety of conditions in animals, such as anxiety, arthritis,

and digestive disorders. In addition, probiotics and essential oils have been used to promote digestive health and alleviate skin problems, respectively. However, it is important to use natural products under the guidance of a veterinarian to ensure their safety and effectiveness. While natural products can offer promising alternatives to conventional treatments, more research is needed to determine their efficacy and potential adverse effects. Nonetheless, natural products continue to play a significant role in veterinary medicine, providing animal owners with a range of options to help manage their pets' health [31, 32, 33].

2. **Demand for Natural Veterinary Medicine:** The demand for natural veterinary medicine has been steadily increasing over the past few years. Pet owners are becoming more aware of the potential benefits of natural products, such as herbal remedies, essential oils, and probiotics, in promoting their pets' health and well-being. The global market for natural veterinary products is expected to grow significantly in the coming years, driven by the increasing pet population, rising disposable income, and growing awareness about natural and organic products. According to a report by Grand View Research (2021), the global market for animal health products, including natural products, was valued at USD 41.9 billion in 2020 and is expected to grow at a CAGR of 5.3% from 2021 to 2028. This growth is attributed to the increasing demand for natural products, as well as the growing focus on preventive healthcare and the need for safe and effective alternatives to conventional treatments. Overall, the market demand for natural veterinary medicine is expected to continue to grow as pet owners increasingly seek out safe and natural solutions for their pets' health concerns [6].

IV. PLANTS AS VETERINARY MEDICINE FROM INDIAN TRADITIONAL MEDICINE

Plants have long been used as traditional medicines in many cultures, including in India, where Ayurvedic medicine has a rich history of using plant-based remedies for various ailments. In recent years, there has been renewed interest in the use of plants as veterinary medicine in India, with research focusing on identifying and validating the efficacy of various plants and plant extracts for treating a range of animal health issues [31]. *Aloe barbadensis* has been used for centuries for its medicinal properties and is now widely recognized for its potential benefits in animal medicine. Aloe vera gel, derived from the leaves of the plant, has been shown to be effective in treating various skin conditions in animals, including wound healing and skin irritation [34]. In addition, a study published in the journal "Veterinary World" supports the use of *Aloe vera* gel in treating skin lesions in dogs [35]. *Boswellia serrata*) is commonly used to manage pain and inflammation in horses, dogs, and cats. Its anti-inflammatory effects are thought to be due to the presence of boswellic acids in the resin of the plant. Boswellia is also used as a natural alternative to nonsteroidal anti-inflammatory drugs (NSAIDs) in animals with joint pain or arthritis. Additionally, Boswellia has been used to improve respiratory function in horses with heaves, a condition similar to asthma in humans [34]. *Matricaria chamomilla* Chamomile has been traditionally used as a natural remedy for various conditions, including anxiety, digestive disorders, and inflammation. Chamomile is known for its anti-inflammatory, antioxidant, and sedative effects, which make it a potential treatment option for animals with anxiety or inflammatory conditions such as arthritis [36]. *Echinacea purpurea*) is an herbaceous flowering plant belonging to the daisy

family, commonly known as coneflower. It is native to North America and has been used traditionally for its medicinal properties by indigenous people for hundreds of years.

The roots, leaves, and flowers of the plant are used in herbal medicine for their immune-boosting properties and have been studied for their potential therapeutic effects in both humans and animals. In animal medicine, Echinacea is commonly used as a natural immune booster and has been shown to stimulate the immune system in dogs, cats, horses, and other animals. It is used to prevent and treat respiratory infections, skin infections, and other infectious diseases in animals. Additionally, Echinacea is used topically to help heal wounds and relieve skin irritations in animals. It is available in various forms, including dried herb, tincture, extract, and capsules. However, it is important to note that the effectiveness and safety of Echinacea in animals may vary depending on the species and the condition being treated, and consulting with a veterinarian is recommended before use [37]. *Allium sativum* is a plant commonly used in human and animal medicine. It is known for its antimicrobial, anti-inflammatory, and immune-modulating properties. In animal medicine, garlic is often used as a natural flea and tick repellent and to support immune function. Some scientific studies have reported positive effects of garlic in animal medicine. For example, a study published in the Journal of Veterinary Pharmacology and Therapeutics found that garlic extract can have an antimicrobial effect against certain types of bacteria that cause infections in dogs [38, 39].

In Indian traditional medicine, several species of plants are used in the treatment of animal disease and disorders such as *Abrus precatorius, Abrus precatorius, Acalypha indica, Allium sativum, Alove vera, Aristolochia indica, Aristolochia indica, Azadirachta indica, Azadirachta indica, Bambusa arundinacea, Carica papaya, Citrullus colocynthis, Citrullus colocynthis, Citrus limon, Curcuma longa, Datura metel, Datura metel, Delonix elata, Justicia adhatoda, Justicia adhatoda, Lannea coromandelica, Lawsonia inermis, Leucas aspera, Leucas aspera, Morinda citrifolia, Musa paradisiaca, Musa paradisiaca, Ocimum sanctum, Oryza sativa, Pedalium murex, Phyllanthus amarus, Piper betle, Pongamia pinnata, Psidium guajava, Solanum trilobatum, Syzygium cumini, Tamarindus indica, Vitex negundo, Vitex negundo, and Zingiber officinale* etc. [40].

V. MARKETED HERBAL PREPARATIONS USED IN THE TREATMENT OF ANIMAL DISEASES

Herbal preparations have long been used in the treatment of animal diseases. Many of these preparations are derived from plants and have been used for centuries by traditional healers to treat a variety of ailments [40]. Garlic, for example, is commonly used as an antiparasitic and immune booster in animals. It is believed to help expel worms and other parasites from the digestive tract, and also has antibacterial and antiviral properties [41].. Turmeric, another popular herbal remedy, is a natural anti-inflammatory and can be used to treat a range of conditions in animals [42]. Other commonly used herbs in the treatment of animal diseases include ginger, chamomile, echinacea, and milk thistle [43]. While many of these remedies have not been scientifically studied, anecdotal evidence suggests that they can be effective in treating certain conditions and supporting overall animal health. However, it is important to consult with a veterinarian before using any herbal preparations on your pets. Some marketed herbal preparations used in the treatment of animal diseases discussed here. Adaptil is formulated with synthetic pheromones that replicate those naturally emitted by

lactating female dogs, aiming to provide a sense of calm and comfort to puppies [46]. Canna-Pet is made from hemp and is promoted as a holistic alternative to pharmaceuticals for addressing pain, anxiety, and inflammation in dogs and cats [47].

Composure features a blend of herbs and essential nutrients intended to alleviate anxiety in dogs and cats [48]. Zylkene includes alpha-casozepine, a milk protein believed to have soothing effects on dogs and cats [49]. Phycox comprises a fusion of natural elements, including phycocyanin (a type of blue-green algae), glucosamine, and turmeric, and is presented as a joint supplement for dogs [50]. Rescue Remedy combines a variety of flower essences, including cherry plum, clematis, impatiens, rock rose, and star of Bethlehem, and is marketed as a natural remedy for relieving stress in dogs and cats [51]. Slippery Elm, an herb traditionally used to alleviate digestive distress and manage diarrhea in dogs and cats, can be found in various forms like capsules, powders, and teas [52]. Milk Thistle, an herb frequently employed to support liver health in dogs and cats, is available in multiple formats, including capsules, powders, and tinctures [53]. ProQuiet contains a blend of natural constituents, such as L-tryptophan and chamomile, and is marketed as a calming aid for dogs and cats [47]. Yucca has traditionally been used to alleviate joint pain and inflammation in dogs and horses and is available in various forms like capsules, powders, and extracts [54]. However, it is important to consult with a veterinarian before using any herbal preparations or supplements for the treatment of animal diseases.

VI. WAYS TO ENHANCE ANIMAL WELL-BEING

Improving animal health involves several different strategies and approaches that should be taken into consideration. The first step is to ensure that animals are receiving proper nutrition. This means providing them with a balanced and healthy diet that includes the right combination of proteins, carbohydrates, fats, vitamins, and minerals. Additionally, good hygiene and sanitation practices are crucial for preventing the spread of diseases and infections. It's important to keep animal housing, feeding and watering areas, and equipment clean and regularly maintained. Regular veterinary care is also essential for maintaining animal health. This includes scheduling routine check-ups and preventative care with a qualified veterinarian who can detect and treat health issues before they become more serious. Vaccinations are also an effective way to prevent many common animal diseases. Consult with your veterinarian to develop a vaccination schedule that's appropriate for your animals. In addition to proper nutrition and medical care, providing animals with opportunities for exercise and environmental enrichment can help improve their physical and mental health. Avoiding overcrowding and ensuring that animals have enough space to move around comfortably is also critical for their wellbeing. Lastly, implementing biosecurity measures, such as quarantine and animal movement restrictions, can help prevent the introduction and spread of diseases within and between animal populations, and protect animal health [44, 45].

VII. CONCLUSION

The field of animal medicine has witnessed a growing interest in natural products for treating various health conditions in animals. These products, which are derived from plants, minerals, or other natural sources, offer several advantages over conventional medications, such as minimal adverse effects, lower chances of drug resistance, and cost-effectiveness.

Natural products have been found to possess a broad spectrum of therapeutic properties, making them useful in treating a variety of conditions in animals, including skin diseases, digestive disorders, respiratory ailments, and more. Additionally, they are often more readily available and affordable than synthetic drugs, which makes them an appealing option for many animal owners. Despite the many benefits, it is essential to exercise caution when using natural products in animal medicine. Some natural products can interact with other medications or have adverse effects in certain animals, so it is recommended to seek the guidance of a veterinary professional before administering any natural product to an animal. Overall, natural products remain an important area of research in animal medicine, offering a promising avenue for the development of effective, safe, and sustainable therapies for animals.

REFERENCES

[1] Reynolds, L. P., Wulster-Radcliffe, M. C., Aaron, D. K., & Davis, T. A. (2015). Importance of Animals in Agricultural Sustainability and Food Security. The Journal of nutrition, 145(7), 1377–1379. https://doi.org/10.3945/jn.115.212217.

[2] Yeung, A. W. K., Aggarwal, B. B., Barreca, D., Battino, M., Belwal, T., Horbanczuk, O. K., ... & Atanasov, A. G. (2018). Dietary natural products and their potential to influence health and disease including animal model studies. Animal Science Papers and Reports, 36(4), 345-358.

[3] World Organisation for Animal Health. (n.d.). About the OIE. Retrieved March 14, 2023, from https://www.oie.int/en/about-us/

[4] Thiermann, A. B. (2005). Globalization, international trade and animal health: the new roles of OIE. Preventive Veterinary Medicine, 67(2-3), 101-108.

[5] McElwain, T. F., & Thumbi, S. M. (2017). Animal pathogens and their impact on animal health, the economy, food security, food safety and public health. *Revue scientifique et technique (International Office of Epizootics)*, *36*(2), 423.

[6] Noordhuizen, J. P. T. M., & Metz, H. M. (2005). Quality control on dairy farms with emphasis on public health, food safety, animal health and welfare. *Stočarstvo: Časopis za unapređenje stočarstva*, *59*(1), 39-55.

[7] Vaarst, M., Padel, S., Hovi, M., Younie, D., & Sundrum, A. (2005). Sustaining animal health and food safety in European organic livestock farming. *Livestock Production Science*, *94*(1-2), 61-69.

[8] Ng, V., & Sargeant, J. M. (2016). Prioritizing zoonotic diseases: differences in perspectives between human and animal health professionals in North America. *Zoonoses and public health*, *63*(3), 196-211.

[9] Rabinowitz, P., & Conti, L. (2013). Links among human health, animal health, and ecosystem health. *Annual Review of Public Health*, *34*, 189-204.

[10] Belay, E. D., Kile, J. C., Hall, A. J., Barton-Behravesh, C., Parsons, M. B., Salyer, S., & Walke, H. (2017). Zoonotic disease programs for enhancing global health security. *Emerging infectious diseases*, *23*(Suppl 1), S65.

[11] Otte, M. J., & Chilonda, P. (2000). Animal health economics: an introduction. *Animal Production and Healthy Division (AGA), FAO, Rome, Italy*, *12*.

[12] Dijkhuizen, A. A., & Morris, R. S. (1997). Animal health economics. *Principle and applications, University of Sidney, Sidney*.

[13] Rushton, J., Viscarra, R., Otte, J., McLeod, A., & Taylor, N. (2007). Animal health economics where have we come from and where do we go next?. *CABI Reviews*, (2007), 10-pp.

[14] Kaasschieter, G. A., De Jong, R., Schiere, J. B., & Zwart, D. (1992). Towards a sustainable livestock production in developing countries and the importance of animal health strategy therein. Veterinary Quarterly, 14(2), 66-75.

[15] Noordhuizen, J. P. T. M., & Welpelo, H. J. (1996). Sustainable improvement of animal health care by systematic quality risk management according to the HACCP concept. Veterinary quarterly, 18(4), 121-126.

[16] Koytcheva, M. K., Sauerwein, L. K., Webb, T. L., Baumgarn, S. A., Skeels, S. A., & Duncan, C. G. (2021). A systematic review of environmental sustainability in veterinary practice. Topics in Companion Animal Medicine, 44, 100550.

[17] O'Connor, A. M., & Sargeant, J. M. (2014). An introduction to systematic reviews in animal health, animal welfare, and food safety. *Animal health research reviews*, *15*(1), 3-13.
[18] De Simone, F. I., & Serratosa, J. (2005). Biotechnology, animal health and animal welfare within the framework of European Union legislation. *Revue scientifique et technique (International Office of Epizootics)*, *24*(1), 89-99.
[19] Vincent, A., Mamzer, H., Ng, Z., & Farkas, K. J. (2020). People and their pets in the times of the COVID-19 pandemic. *Society Register*, *4*(3), 111-128.
[20] Gebru, A. A., Birhanu, T., Wendimu, E., Ayalew, A. F., Mulat, S., Abasimel, H. Z., ... & Hailu, D. (2021). Global burden of COVID-19: Situational analyis and review. *Human antibodies*, *29*(2), 139-148.
[21] Uwishema, O., Chalhoub, E., Zahabioun, A., David, S. C., Khoury, C., Al- Saraireh, T. H., ... & Onyeaka, H. (2022). The rising incidence of African swine fever during the COVID- 19 pandemic in Africa: efforts, challenges and recommendations. *The International journal of health planning and management*, *37*(1), 561.
[22] Weaver, T. R., & Habib, N. (2020). Evaluating losses associated with African swine fever in the People's Republic of China and neighboring countries.
[23] Food and Agriculture Organization (FAO). (2020). Animal health and welfare: Global and regional costs and benefits. Retrieved on 03 April, 2023 from http://www.fao.org/3/ca6030en/ca6030en.pdf
[24] Washio, T., Ohashi, T., & Saijo, M. (2020). What promotes intention? Factors influencing consumers' intention to purchase animal-welfare friendly beef in Japan. In Knowledge Discovery, Knowledge Engineering and Knowledge Management: 11th International Joint Conference, IC3K 2019, Vienna, Austria, September 17-19, 2019, Revised Selected Papers 11 (pp. 536-549). Springer International Publishing.
[25] Food and Agriculture Organization (FAO). (2019). Animal Production and Health. Retrieved from http://www.fao.org/animal-production/en/
[26] Mohan, C. V., & Bhatta, R. (2002). Social and economic impacts of aquatic animal health problems on aquaculture in India. *FAO Fisheries Technical Paper*, 63-75.
[27] Wanapat, M., Cherdthong, A., Phesatcha, K., & Kang, S. (2015). Dietary sources and their effects on animal production and environmental sustainability. *Animal nutrition (Zhongguo xu mu shou yi xue hui)*, *1*(3), 96–103. https://doi.org/10.1016/j.aninu.2015.07.004.
[28] World Organisation for Animal Health. (n.d.). Animal diseases. Retrieved on 03 April 2023 from https://www.oie.int/en/what-we-do/animal-health-and-welfare/animal-diseases/
[29] American Veterinary Medical Association [AVMA]. (n.d.). About us. Retrieved on 14 February 2023 from https://www.avma.org/About
[30] Dunlop, R. H., & Williams, D. I. (1996). *Veterinary medicine: an illustrated history*. Mosby-Year Book, Inc.
[31] Rastogi, S., Pandey, M. K., Prakash, J., Sharma, A., & Singh, G. N. (2015). Veterinary herbal medicines in India. Pharmacognosy reviews, 9(18), 155–163.
[32] Bullitta, S., Re, G.A., Manunta, M.D.I. et al. (2018). Traditional knowledge about plant, animal, and mineral-based remedies to treat cattle, pigs, horses, and other domestic animals in the Mediterranean island of Sardinia. J Ethnobiology Ethnomedicine 14, 50.
[33] Kumar, Muneendra & Sidhu, Vinod Kumar & Roy, Debashis & Kushwaha, Raju & Vaswani, Shalini. (2014). Application of Herbal Feed Additives in Animal Nutrition -A Review. International journal of livestock research. 4. 1-8.
[34] Wynn, S. G., & Fougere, B. (2007). Veterinary herbal medicine. Mosby/Elsevier.
[35] Kamr, A., Arbaga, A., El-Bahrawy, A., Elsify, A., Khaled, H., & Hassan, H. (2020). The therapeutic efficacy of Aloe vera gel ointment on staphylococcal pyoderma in dogs., 13(11), 2371.
[36] Srivastava, J. K., Shankar, E., & Gupta, S. (2010). Chamomile: A herbal medicine of the past with bright future. Molecular medicine reports, 3(6), 895–901. https://doi.org/10.3892/mmr.2010.377.
[37] Jones, K. (2017). Echinacea as a natural remedy in animal medicine. Natural Medicine Journal, 9(3), 1-5.
[38] Saastamoinen, M., Särkijärvi, S., & Hyyppä, S. (2019). Garlic (Allium sativum) supplementation improves respiratory health but has increased risk of lower hematologic values in horses. Animals, 9(1), 13.
[39] Mehl, M. L. (2019). Garlic (*Allium sativum*) use in Veterinary Medicine - potential benefits and concerns. Journal of the American Holistic Veterinary Medical Association, 55(1), 8-16.
[40] Jayakumar, S., Baskaran, N., Arumugam, R., Sathiskumar, S., & Pugazhenthi, M. (2018). Herbal medicine as a live practice for treating livestock ailments by indigenous people: A case study from the Konar community of Tamil Nadu. *South African Journal of Botany*, *118*, 23-32

[41] Imo, C., & Za'aku, J. S. (2019). Medicinal properties of ginger and garlic: A review. *Curr. Trends Biomed. Eng. Biosci*, *18*, 47-52.
[42] Epstein, J., Sanderson, I. R., & MacDonald, T. T. (2010). Curcumin as a therapeutic agent: the evidence from in vitro, animal and human studies. *British journal of nutrition*, *103*(11), 1545-1557.
[43] O'Hara, M., Kiefer, D., Farrell, K., & Kemper, K. (1998). A review of 12 commonly used medicinal herbs. *Archives of family medicine*, *7*(6), 523.
[44] Dawkins, M. S. (2008). The science of animal suffering. *Ethology*, *114*(10), 937-945.; Stringer, A. (2014). Improving animal health for poverty alleviation and sustainable livelihoods. *Veterinary Record*, *175*(21), 526-529;
[45] Nicholas, P., & Jasinska, A. (2008). Animal health and welfare planning-a review. *CORE Organic project nr. 1903-ANIPLAN*.
[46] Adaptil. (n.d.). Adaptil: Dog Calming & Comfort. Adaptil. Retrieved on 03 April, 2023 from https://www.adaptil.com/
[47] Animal Health Options. (n.d.). ProQuiet®. Animal Health Options. Retrieved on 03 April, 2023 from https://animalhealthoptions.com/ProQuiet%C2%AE_p_16.html https://canna-pet.com/
[48] VetriScience. (n.d.). Composure® Long-Lasting Calming Supplement for Dogs. VetriScience Laboratories. Retrieved on 03 April, 2023 from https://www.vetriscience.com/composure-153-long-lasting-calming-supplement-for-dogs.html
[49] Vetoquinol UK Ltd. (n.d.). Zylkene®: The natural choice for pet relaxation and behavior support. Zylkene®. Retrieved on 03 April, 2023 from https://www.zylkenepet.co.uk/
[50] Dechra Veterinary Products. (n.d.). Phycox® HypoAllergenic HA Small Bites. Dechra-US. Retrieved on 03 April, 2023 from https://www.dechra-us.com/our-products/us/companion-animal/dog/non-prescription/phycox#HypoAllergenic-HA-Small-Bites
[51] Rescue Remedy. (n.d.). Rescue Remedy. Bach Flower Remedies. Retrieved on 03 April, 2023 from https://www.rescueremedy.com/
[52] WebMD. (2022, January 12). Slippery Elm. WebMD. Retrieved on 03 April, 2023 from https://www.webmd.com/vitamins/ai/ingredientmono-978/slippery-elm
[53] WebMD. (2022, February 15). Milk Thistle Benefits and Side Effects. WebMD. Retrieved on 03 April, 2023 from https://www.webmd.com/digestive-disorders/milk-thistle-benefits-and-side-effects
[54] NHV Natural Pet Products. (n.d.). Yucca: Natural Appetite Stimulant for Dogs. NHV Natural Pet Products. Retrieved on 03 April, 2023 from https://www.nhvnaturalpetproducts.com/yucca-appetite-stimulant-for-dogs
[55] Grand View Research. (2021). Animal Health Market Size, Share & Trends Analysis Report By Product (Pharmaceuticals, Vaccines, Feed Additives), By Animal Type (Production, Companion), By Distribution Channel, and Segment Forecasts, 2021 - 2028. Retrieved from https://www.grandviewresearch.com/industry-analysis/animal-health-market

