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Future Trend to Replace Chemical Products with Nutraceutical Food / Feed Additive: A Mini Review

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ABSTRACT

Since thousands of years, herbal products were used for medical purposes in old cultures. The present trend to re-discover the medical potential of herbs started to grow with the general awareness of the medical hazards of several chemical pharmaceutical preparations. Similarly, for several decades, antibiotics, Coccidiostat and other chemical feed additives were massively used in animal husbandry. However, due to their negative impact on consumer health, they were banned in many countries. The present work discusses some natural alternative available for use in human and veterinary medical fields. The number of commercially available herbal products increases rapidly in the markets worldwide and are expected to overtake the number of pharmaceuticals of chemical origin in food sector in the future.

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INTRODUCTION

In traditional medicine of old cultures like Egypt, China, India, and Greece, the use of medical plants to control human and animal diseases was well established (**El-Sayed and Kamel, 2021**). The cumulative experience over decades and centuries provides us with thousands of herbs/ foodstuffs that possess medical/health benefits (called nutraceuticals). These include plant active substances (plant secondary metabolites) such as alkaloids, polyphenols, steroidal compounds (saponins), glycosides, aromatic compounds (alcohols, ketones, etheric oils), flavonoids, in addition to trace elements, vitamins and minerals **(Othman *et al.*, 2019; El-Sayed *et al.*, 2021a)**. One of the most commonly used herbs is garlic which was and still being commonly used in herbal medicine due to its high content of organosulfur compound mainly Allicin (*S*-allyl-L-propene thiosulfinate).

Allicin is a potent *anti-inflammatory*, *antibacterial*, antioxidant, and immunostimulant substance (**Frankic *et al.*, 2009; Alam *et al.*, 2018**), and broccoli is rich in sulforaphane, used for the prevention of cancer and atherosclerosis, and for the treatment of Alzheimer's disease, and the improvement of the situation of autism. Table 1 is presenting other herbs which are also known to be potent antioxidants such as genistein (present in soybeans), epigallocatechin (green tea), resveratrol (grapes), melatonin (grapes and nuts), curcumin (Curcuma), indole (cruciferous vegetables), lycopene (grapefruits), and garcinol (Garcinia indica fruit) (**El-Sayed *et al.*, 2021a**).

However, the use of herbal medications became less popular in the last century with the development of chemical pharmaceuticals. This is attributed to many factors related to the vegetation ecology such as the differences in the concentration of secondary plant metabolites in response to differences in water & soil nature, climatic conditions (temperature & humidity), altitude, subspecies of the used herb, method of extraction, harvesting & storage conditions. Moreover, the presence of several active ingredients in one plant complicates the complete understanding of the mechanism of action and interactions of herbal preparations. Furthermore, in addition to the previously mentioned factors, the inactivation of several active substances by light or the short shell life of volatile & essential oils all these factors favoured the use of chemical substances (**Soni *et al.*, 2015; Zhao *et al.*, 2016; Yang *et al.*, 2018).**

Table 1: Examples for investigated nutraceutics which exert their action via epigenetic modulations:

Herbal Sources	Nutraceutical Active ingredient	Medical Effects	References
Leguminous plant foods Soybeans, chickpeas, lupin, fava beans, barley meal, broccoli, cauliflower, sunflower, caraway kudzu, psoralea	Genistein	antioxidant, anti-cancer, improve bone health, antilipogenic, hepato - protector	(Borradaile *et al.*, 2002; Reinwald *et al.*, 2010; Paul *et al.*, 2017; Hanedan Uslu *et al.*, 2019).
Grapes , nuts, pepper, tomato, germinated seeds, soybean	Melatonin	antioxidant, hepato -protector, anti-inflammatory	(Meng *et al.*, 2017; Hanedan Uslu *et al.*, 2019).
Red clover, soy, alfalfa sprouts, Cicer arietinum, peanuts, chickpea,	Biochanin A	antioxidant, anti- cancer, neuro-protective, A prevents adipogenesis, , anti-bacteria for healthy bone formation	(Su *et al.*, 2013; Hanski *et al.*, 2014)
Curcuma longa	curcumin	Antioxidant, immunomodulator, anti-inflammation, anti-cancer, protective effect against chemotherapy induced side effects	(Catanzaro *et al.*, 2018; Liu *et al.*, 2018; Akter *et al.*, 2019).
Echinacea purpurea, E. pallida or E. angustifolia)	caffeic acid derivatives (phenolic compounds)	immunomodulator	(Catanzaro *et al.*, 2018)
Green / white tea	epigallocatechin-3-gallate	Hepato-protector, anti-atherogenic, anti-oxidant, anti-cancer	(Pastoriza *et al.*, 2017; Li *et al.*, 2018; Rangi *et al.*, 2018)
Cruciferous vegetables (rutabaga, turnip, *Brussels*, broccoli, cabbage, *sprouts*, cauliflower, *collard greens*, kale, radish,	Indole-3-carbinol	Antioxidant, hepato-protector, anti-atherogenic, anti-inflammatory, anti-arthritic, anti-cancer	(Lee *et al.*, 2018).
Cruciferous vegetables (broccoli, cabbage, cauliflower, kale)	3,3′-diindolylmethane	Antioxidant, anti-angiogenic , anti-cancer, treatment of septic cardiomyopathy and side effects unduced by irradiation therapy., reno-protective	(Lanza-Jacoby and Cheng, 2018; Xia *et al.*, 2018; Lu *et al.*, 2019).
Cruciferous vegetables such as broccoli, Brussels sprouts or cabbages in addition to papaya seeds, moringa,	Benzyl isothiocyanate	Antioxidant, anti-cancer, prevents obesity / fatty liver, and insulin resistance	(Alsanea & Liu, 2017).
Cruciferous vegetables such as broccoli, Brussels sprouts or cabbages	Sulforaphane	anti-cancer, anti-Helicobacter activity, prevents Alzheimer's Disease, protects from cardiovascular and neurodegenerative diseases and diabetes, reduces signs of Autism	(Kim & Park, 2016; Yang *et al.*, 2016; Lynch *et al.*, 2017).
Grapes, Vitis vinifera, labrusca, mulberries, peanuts.	Resveratrol	Antioxidant, anti- atherogenic, anti-cancer, For the treatment of neurological disorders, cardiovascular diseases, skin disorders, metabolic diseases (obesity. Diabetes and non-alcoholic fatty liver disease)	(Markus and Morris, 2008; Ndiaye *et al.*, 2011; Berman *et al.*, 2017; Kim *et al.*, 2017).
Tomatoes and other red fruits / vegetables (red grapefruits, red carrots, guava watermelons, papayas)	Lycopene	Antioxidant, protect cardiovascular system (antiatherosclerotic, anti-hypertensive, protective endothelial effects, antioxidant, anti-inflammatory, anti-apoptotic.	(Mozos *et al.*, 2018)

Garcinia indica fruit	Garcinol	Anti-inflammation, antioxidant, prevention of cardiovascular diseases, diabetes, allergy, and neurodegenerative diseases also anti-cancer, anti-bacterial,	(Behera *et al.*, 2016).
parsley, celery, artichokes	Apigenin	anti-inflammation, anti-cancer, neuroprotective, nephroprotective	(Nabavi *et al.*, 2017; Wu *et al.*, 2017).
Galega officinalis (galega, goat's-rue, French lila)	Metformin	Anti-diabetes, anti-cancer, weight reduction	(Rozengurt *et al.*, 2010; Li *et al.*, 2015)
Nigella sativa	Thymoquinone	Anti-epileptic, renoprotective, analgesic, anticonvulsant, hepato-protective, anti-inflammatory, antioxidant, anti-cancer	(Khader & Eckl, 2014; Shaterzadeh-Yazdi *et al.*, 2018).
Rheum palmatum, buckthorn, rhubarb, Japanese knotweed	Emodin	Anti-bacterial, anti-cancer	(Chukwujekwu *et al.*, 2006; Hsu & Chung, 2012).
Thunder God Vine, Tripterygium wilfordii	Triptolide	Immunosuppression, anti-inflammation, anti-cancer,	(Vispé et al., 2009; Meng *et al.*, 2014).
Plumbago, Drosera, Nepenthes, black walnut drupe	Plumbagin	Anti-inflammation, immunological adjuvant, anti-microbial, anti-coagulant, anti- atherosclerosis, anti-malarial, anti-cancer	(Cao *et al.*, 2018).
Ginkgo biloba	ginkgolic acids	anti-oxidant, anti-cancer, improve cerebral circulation	(Chang *et al.*, 2018).
Grean tea	Catechins (mainly the Epigallocatechin gallate (EGCG))	anti-cancer, antioxidant, improve metabolism and cardiovascular diseases.	(Wolfram, 2007; Wang et al., 2018).
coffee	coffee polyphenols	Antioxidants, prevents Metabolic syndrome / Type 2 Daibetes and atheriosclerosis.	(Yamagata, 2018).
Garlic	*Allicin*	Anti-inflammatory, anti-bacterial, anti-cancer	(Huang *et al.*, 2011).

Another reason why the use of herbal preparations became less popular is the lack of understanding of their mode of action which remains unknown and needs to be elucidated in most herbal products. There are many reasons for this in opposite to chemical preparations. For instance, while conventional drugs are prepared and studied as single agents, herbal preparations contain several plant metabolites which exert their effect in combination or synergistic way **(Bhikha and Glynn 2018).**

Herbal products can exert their effect directly through the modulation of epigenomic activities, or indirectly through their effect on microbiome (prebiotic effect). For instance, microbial metabolites such as short chain fatty acids (SCFAs) are microbial by-products of ingested fibres. The SCFAs can support the mucosal immune response in the gut, utilized as energy source by intestinal epithelium, regulate the gut motility and reduce local inflammation by downregulating responsible genes (**El-Sayed *et al.*, 2021a**).

The diet has a great influence on the naturally inhabitant micro-organisms (the gut microbiota). Their number and composition of change continuously in response to the nutritional status and certain medications. As an example, receiving high doses of antibiotics or changes in the dietary life style will dramatically change the number and composition of gut microbiome (**El-Sayed *et al.*, 2021b**).

At present, due to the growing interest in phytogenic feed additives to replace chemicals, several herbal commercial products became available for therapeutic and prophylactic purposes. New technologies enabled the exact estimation of the content of the active ingredients. Presently, at least 25% of all drugs prescribed worldwide have a herbal origin (**Rastogi *et al.*, 2015**). The growing interest in green farming and to replace the chemical products with natural product has many reasons such as the legal restrictions aiming to ban using antibiotics as feed additive growth promotor, growing resistance of pathogens against antibiotics and coccidiostats, the

chemical residues in the feed which harmfully affect the health of consumer, herbal products do not need withdrawal time as in most chemical preparations, the high safety of herbal products on animal health, and finally the absence of negative effect on the environment as many chemicals will be later excreted in manure to the environment to pollute soil and ground water (**Rastogi *et al.*, 2015; Mund *et al.*, 2017; Okocha *et al.*, 2018**). While, some commercial products contain herb extracts, many manufacturers prefer to use the whole plant parts to supply the consumer with the full spectrum of the valuable active ingredients in the herb which usually interact in a synergetic way together (**Rasoanaivo *et al.*, 2011**). For instance, the antimicrobial effect of *Juglans regia* (walnut) and *Camellia sinensis* (tea plant, tea shrub) increases when both substances are combined and can even eliminate multiple-resistance bacteria (**Farooqui *et al.*, 2015**). Similarly, the antioxidant and anti-inflammatory effect of curcumin clearly increases when mixed with capsaicin (**Setiawan *et al.*, 2021**).

Moreover, the involvement of many plants in one product aims usually to exert the required effect via several mode of actions and to overcome possible development of resistances (**Rasoanaivo *et al.*, 2011**). In addition, mixing several plants together with the same effect and synergetic mode of actions in one product avoids the use of high amounts from one single plant in order to provide the same potential of the therapeutic effect. The use of a single plant or a selected part or a plant in large amounts not only enhances the development of resistance (as it has only one mode of action compared with multiple modes of actions upon using several plants) but may also to refuse the feed and change in the taste of the milk due to the excretion of plant metabolites in the milk. This can be seen when using the leaves of neem tree as immunostimulant or as growth promotor in cattle (**Joint, 2006; Lakhani *et al.*, 2019)**.

1. Herbal products in human medicine

At least 15,000-20,000 herbs are known for their therapeutic properties in India (**Bedi *et al.*, 2016**). They are mainly used to protect the heart, kidney, liver and nervous system from pathological disorders. Other plants can be used to treat infectious diseases as parasitic infestation or metabolic disorders such as diabetes type 2. The fields of their application include different ways. Firstly, the protection of heart (cardio-protective) (e.g. the herbs diosgenin, isoflavones, sulforaphane, carotinized, catechin, and quercetin) (**Shah *et al.*, 2019**). Secondly, for supporting of the kidney functions (Reno-protectors). The old Chinese medical school used the roots of *Astragalus membranaceus* or *Astragalus Mongholicus* to treat renal disorders. Recent research revealed the presence of than 60 medical components in the plant roots (**Zhong *et al.*, 2013)**. Thirdly, supporting liver performance (hepato-protectors). Herbs including Silymarin (Silybum marianum or milk thistle), *Andrographis paniculata, Solanum nigrum, Ocimum sanctum,* and *Phyllanthus niruri* are the most commonly used herbal hepato-protectors worldwide. Their ability to revitalize exhausted liver cells is well documented (**Saller *et al.*, 2001; Pradhan and Girish, 2006; Bedi *et al.*, 2016)**. Fourthly, Neuroprotective herbs such as Tianma (*Gastrodia elata Blume*) can be applied either to support patients following stroke or to improve the general performance of the nervous system (**Kim, 2005; Manavalan *et al.*, 2012)**. Fifthly, other herbal products such as *origanum majorana, ferula persica willd, paeonia officinalis, ferula gummosa boiss, lavandula stoechas, cedrus deodara loudon, ferula asafoetida, caesalpinia bonducella roxb, bryonia alba, cuscuta epithymum murray,* and *coriandrum sativum* are characterized by their anticonvulsant effects and therefore can be used as Antiepileptics **(Liu *et al.*, 2017).**

Sixthly, for the treatment of parasitic infestation, in sub-Sahara African countries, several herbs are used to treat malaria infestation including *Tapinanthus dodoneifolius, Lophira lanceolata, Combretum collinum, Anthocleista nobilis, Celtis integrifolia, Ficus capraefolia, Oppilia celtidifolia, Securinega virosa, Terminalia avicenoides,* and *Cordia myxa*. Others are common for the treatment of Trypanosomiasis such as (*Striga spp., Lannea kerstingii, Cassytha spp, Securidaca longepedunculata, Terminalia avicenoides, Anchomanes difformis, Parkia clappertioniana, Khaya senegalensis,* and *Piliostigma reticulatum*), or against Schistosomiasis (e.g. *Solanum nodiflorum, Apodytes dimidiata, Swartzia madagascariensis, Balanites maughamii, B. aegyptiaca, Combretum imberbe, C. molle, Warburgia salutaris, W. ugandensis, Euclea natalensis, Jathropha curcas, Sapindus saponaria, Gardenia thunbergia, Phytolacca dodecandra,* and *Berkheya speciosa*) **(Mwangi *et al.*, 2017)**. Seventhly, supporting the uro-genital system as diuretic such as *amatymbica Eckl. & Zeyh., Carum carvi L., Coriandrum sativum L., Foeniculum vulgare L., Foeniculum vulgare Mill, Petroselinum hortense Hoffm, Petroselinum sativum Hoffm, Steganotaenia araliacea Hochst, Apocynum venetum L., Carissa edulis Vahl, Achyrocline satureioides DC., Artemisia thuscula Cav., Bidens odorata Cav., Centaurea phyllocephala Boiss., Cichorium endivia L., Helichrysum ceres, Hieracium pilosella L.,* and *Mikania glomerata Spreng* (**Wright et *al.*, 2007**), other herbs are known to have Antilithiatic activity (such as Kalanchoe pinnata and Rotula aquatica) (Gilhotra et al.,), and even for the treatment of prostatic hyperplasia in men by Pumpkin seed oil

and saw palmetto oil **(Hong *et al.*, 2009).** Eighthly, Helping patients suffering from metabolic disorders as Diabetes mellites Type 2 to recover their normal / physiological metabolic activities. Several herbal plants exert a potential hypoglycemic effect such as *Bauhinia forficata, Gymnema sylvestre, Ricinus communis, Swertia punicea, Combretum micranthum, Sarcopoterium spinosum, Parinari excelsa, Vernonia anthelmintica, Elephantopus scaber,* and *Liriope spicata* and therefore are used for the control of blood sugar level in traditional medicine (**Rao *et al.*, 2010)**.

Ninthly, herbal products were even found efficient in controlling tooth caries. Commercial neem and tea tree oil toothpastes could prevent the multiplication of caries inducing bacteria *Lactobacillus casei, Candida albicans, and Streptococcus mutans* (**Srichan *et al.*, 2021**).

2. Applications in veterinary sector

With the boom of research in the field of herbal medical feed additives, key companies like BIOMIN Holding GmbH (Austria), Delacon Biotechnik GmbH (Austria), Cargill Incorporated (USA), and Life Circle Nutrition AG (Switzerland) became the major global players in providing potential phytogenic feed additives and feed preparations. For instance, Herb-All COCC-X® (Life Circle Nutrition AG, Switzerland) provided better performance than chemical coccidiostats and could efficiently reduce the severity of the intestinal lesions and the number of sporulated oocysts in the dropping of the poultry. Moreover, the potency of Herb-All COCC-X® in controlling coccidial infestation increased with time and there was no need for rotation **(Fayed and Rüegge, 2022).** The addition of herbal feed additives may aim to treat a present disease, increase production and farm profitability or control diseases and prevent their emerge in the herd. In addition, herbal feed additives can also be added to bind mycotoxins (e.g. green algae), as anti-oxidant agents (e.g. green tea), as stomachic to increase appetite (e.g. chilli), and to support liver (silymarin) **(Surai, 2015).**

2. 1. The therapeutic applications of herbs include

Therapeutic application of herbs can be summerized as follow:

(1) antimicrobial activity (e.g. *Azadirachta indica* (neem plant) and *Origanum vulgare*) even against multiple resistant bacteria. The neem extract is commercially available as soap, oil, spray or capsules.

(2) support the digestion and anti-diarrhoea (e.g. *Myristica fragrans* (nutmeg), *Elettaria caramomum* (Caradamon), *Coriandum sativum L* (Coriander) and *Cinnamomum zeylanicum* (Cinnamon)) **(Tipu *et al.*, 2006).** Commercial herbal anti-diarrheal preparations such as Diaroak®, Salcochek® (Ayurvet Limited) and Herb-All GUT® (Life Circle Nutrition) are now available in the market and can be efficiently used to treat non-specific diarrhea in calves (**Ranaut *et al.*, 2018**).

(3) liver support: Several plants are known for their hepato-protection such as *Boerhaavia diffusa, Silymarin, Yakrifit Bolus viz. Andrographis paniculata, Eclipta alba, Phyllanthus niruri, Tephrosia purpurea,* and *Picrorhiza kurroa*. They support normal physiological functioning of liver and decrease the harmful effect of chemical feed contaminants as mycotoxins, or pesticides **(Hadiya *et al.*, 2010)**.

(4) anti-parasitic effect (anthelmintic and coccidiostats): Herbal anthelmintics are known since long time and are still in use in traditional medicine such as *Allium sativum (*Lillaceae*), Acacia albida (*Fabaceae*), Adhatoda vesica (*Acanthaceae*), Alangium lamarckii (*Alangiaceae*), Albizia anthelmintica, Artemisia mesatlantica (*Asteraceae*), Bixa orellana (*Bixaceae*), and Butea monosperma* (Fabaceae) **(Jain *et al.*, 2013).** Recently, commercial herbal coccidiostats like Herb-All COCC-X® (*Holarrhena antidysenterica* and *Alium sativum*) were developed. They showed more coccidiostat efficiency than chemical coccidiostats in poultry and rabbits (**Jung *et al.*, 2021; Fayed and Rüegge, 2022**). The presence of a mixture of herbs in one commercial product is very important to prevent the development of resistance (**Mushtaq *et al.*, 2017)**. Similar results were achieved in another study where ZeeCox delivered the same anticoccidial effect as ionophores **(Palavesam *et al.*, 2021).**

(5) Treatment of mastitis: As several herbal products possess antimicrobial potential, they were applied in mastitis therapy. The herbs can be applied topically or via intramammary infusion. They delivered superior results in comparison to antibiotics and could reduce the somatic cell count in milk (SCC) (**Mushtaq *et al.*, 2017)**.

At present commercial herbal products for the treatment of mastitis are available such as the intramammary infusion Phyto-Mast® (herbal IMM, Bovinity Health LLC, Narvon) **(Mullen *et al.*, 2014).** The therapeutic application in veterinary field is also well documented. Treatment of mastitis in dairy cattle can be achieved by the topical application or intramammary infusion of several plants such as garlic, *Taraxacum mongolicum, Viola patrinu, Scutellaria baicalensis, Folium isatidis, Lonicera japonica, Angelica dahurica, Angelica dahurica, Coptis chinensis, Phellodendron amurense,* and *Rheum officinale* are also used for the treatment of bovine mastitis in old China **(El-Sayed and Kamel, 2021).** (6) stimulating innate immunity in

farm animals (e.g. cinnamon (*Cinnamomum cassia*), mustard (*Brassica juncea),* dandelion (*Taraxacum officinale*), and safflower (*Carthamus tinctorius*)) **(Lillehoj *et al.,* 2018).** Among the commonly used commercial herbal in the last years the immunostimulant Winters® (by PDN GmbH, Germany) which contains a large cocktail of essential oils including Anise, Eucalyptus, Ginger tincture, Oreganum oil, Peppermint oil, Rosmarin extract, Caraway oil, Tea tree oil, Thyme oil, Artichoke tincture, and Silybum marianum tincture (according to the homepage of manufacturer). (7) Treatment of none-infectious diseases such as urolithiasis especially in poultry. Supplementation of commercial products which consist of both herbal and inorganic ingredients such as Fetorin® could improve the redox status, renal function, immune and anti-inflammatory responses in diseased poultry (**El-Sebaei *et al.,* 2021**).

2. 2. Application for the increase of farm profitability

In addition to their therapeutic potential, herbs can also be used to increase animal production, for instance herbal galactagauge are herbs which can be supplemented to increases milk production such as *Cuminum cyminum* (Cumin), *Curcuma aeruginosa, Curcuma zeodharia, Curcuma mangga, Cyterus rotundus, Pulraria tuberose, Withania somnifera, Arundo donax, Asparagus racemosus, Cissampelos pareira, Eclipta alba, Solanum nigrumon, Foeniculum vulgare, Ipomea digitata, Lepidium sativum, Glycyrrhiza glabra, Tribulus terrestri, Foeniculum vulgare, Leptadenia reticulata, and Nigella sativa* **(Nurdin *et al.,* 2011; Behera *et al.,* 2013).**

Moreover, herbal feed additives can be used as alternative of antibiotic growth promoters in feedlots and broilers. They improve feed conversion ratio (FCR), and body weight gain. Field trial reports carried out in Switzerland revealed that the herbal hepato-protector Herb-All LIVER® could not only protect the liver cells against the harmful effects of chemicals but could also aid in re-vitalization and detoxification of exhausted liver cells **(Mahanta *et al.,* 2016).**

In poultry, herbal feed additives are added to increase egg production in laying hens. Traditional medical plants in China as *A. membranaceus* dried root (*Radix Astragali*), *Salvia miltiorrhiza Bunge*, and *Cnidium monnieri* fruit (Cnidii Fructus) are commonly used for this purpose **(Xiao *et al.,* 2019).**

2. 3. Supplementation to prevent/ control diseases

Commercial herbal products can also be supplemented to prevent or to decrease the prevalence of certain diseases in the farm. For instance, (1) herbal teat dips which are commonly used to control mastitis (e.g. Cinnatube (teat sealant, New AgriTech Enterprises, Locke) and Phyto-Mast (herbal IMM, Bovinity Health LLC, Narvon)) **(Mullen *et al.,* 2014).** (2) Herbal insect repellents and insecticides: the most famous example worldwide is the neem tree. The use of insect repellents and insecticides helps to control insect-borne diseases in farm animals, prevents the loss of blood due to blood sucking insects, and decrease the negative effects of stress resulting from the insect bites **(Tipu *et al.,* 2006)**. (3) Herbal mycotoxin binders: while some herbal products can be used to support the liver cells and to minimize the effect of mycotoxins present in the feed, other commercial products tend to combine herbal extracts with non-organic mycotoxin binders such as Mycofix (Biomin GmbH) which combines (according to the manufacturer) inorganic substances (bentonite and diatomous earth), enzymes (fumzyme), yeast and living bacteria (Eubacterium strain BBSH 797) to maximize the binding potential **(Pietri *et al.,* 2009)**.

CONCLUSION

Since centuries, herbal medicine was used to treat man and animal diseases. However, herbal products lost their position due to several factors such as the improper standardization of their content of active ingredients. Recently, due to public health hazards, several countries started to restrict the use of certain pharmaceutical preparations in human medicine. Similarly, several chemical feed additives are banned to be used in farm animals worldwide for the same reason. Based on the cumulative experience in traditional medicine, current research focused on the construction of novel synergetic herbal formulations, and to develop -in parallel- advanced laboratory tools for their standardization. This, in turn, brought old herbal formulations back to life to provide an efficient alternative to chemical preparations. The current work describes the medical application of herbal products in human and veterinary medicine.

Declaration of Conflicting Interests

The authors revealed that there is no potential conflicts of interest.

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