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Bioactive Compounds Sources through Aromatic Plants

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Abstract

Aromatic plants, also called herbs and spices, have been used as folk medicine and as food preservatives since ancient times in. The most famous aromatic plants such as oregano, rosemary, sage, anise, basil, etc. come from the Mediterranean region. They contain many biologically active compounds, mainly polyphenols, which have been found to possess antimicrobial, antioxidant, antiparasitic, antiprotozoal, antifungal and anti-inflammatory properties. Currently, the demand for these plants and their derivatives has increased because they are natural, ecological products and are generally recognized as safe. Therefore, aromatic plants and their extracts have the potential to become new generation substances for human and animal nutrition and health. The purpose of this review is to provide an overview of the literature on the in vivo and in vitro use of aromatic plants.

Key words: aromatic plants; bioactive compounds; polyphenolics

1. Introduction

Growing consumer interest in substances of natural origin, as well as growing concerns about potentially harmful synthetic additives, have led to the use of aromatic plants, their extracts and essential oils as functional ingredients in the pharmaceutical, food and feed industries. These industries are currently looking for effective, safe and cost-effective substances with clearly defined modes of action and proven benefits. Plant-based components have significant potential to meet these requirements. Although there is still a lack of knowledge, especially regarding the consistency of in vivo test results and the mechanisms of action of various components in aromatic plants, they could be used as new generation compounds for human and animal health and nutrition. It is also important to note that better animal health can lead to higher food safety and quality, which benefits the consumer.

2. Aromatic Plants

Aromatic plants, also called herbs and spices, have been cultivated in the Middle East since , around 5000 BC. BC, used. for its preservative and medicinal properties as well as for improving the aroma and taste of foods. Its use continues today and according to the World Health Organization (WHO), almost 80% of the world's population, especially in developing countries, still rely on herbal medicines for their medical care. In addition, herbal feed additives, also called phytogens, phytobiotics or botanicals, can be included in animal nutrition to improve its productivity and the properties of the resulting feed and animal products [8]. Among these natural additives, aromatic plants, their extracts and essential oils were examined for their advantages over antibiotics as growth promoters. They contain no residues and are generally considered safe (GRAS).

Currently, there is a growing interest in the use of herbs and spices in animal nutrition with the aim of replacing the use of antibiotics and ionophore anticoccidia, especially after the ban on antibiotic feed additives in the countries of the European Union in 2006 and the discussions to restrict them. its use outside Europe.

Many herbs and spices are found around the world, many of which come from the Mediterranean region, either wild or cultivated, such as rosemary, oregano, sage, thymus, mint and garlic. They contain chemicals such as polyphenols, quinines, flavonols/ flavonoids, alkaloids, polypeptides or their oxygen-substituted derivative. Some of these substances can act synergistically and thereby improve their bioactivity. Some bioactive compounds exhibit therapeutic value, such as antioxidant and antiseptic effects. Therefore, they can reduce the risk of cancer or cardiovascular diseases and can be used as treatments to cure or control a variety of ailments such as respiratory and gastric diseases or inflammatory diseases [16]. In general, bioactive components of aromatic plants have the ability to protect the body from damage caused by free radical-induced oxidative stress by quenching singlet oxygen and inducing cytochrome or other enzymes. In addition, herbs and spices can inhibit oxidative rancidity and delay the appearance of off-flavors in some products.

3. Essential Oils

Aromatic plants contain fragrant, volatile, hydrophobic and highly concentrated compounds called essential oils (or volatile or essential oils). These are obtained from various parts of the plant, such as flowers, buds, seeds, leaves, twigs, bark, wood, fruits and roots. Essential oils are complex mixtures of secondary metabolites consisting of phenylpropenes and low-boiling terpenes. The most important families from the perspective of essential oils are: Asteraceae or Compositae, Lamiaceae or Labiateae and Apiaceae or Umbelliferae. A detailed analysis of the composition of volatile compounds in oils can be obtained by gas chromatography-mass spectrometry. It has been found that there are valuable mixtures of mainly terpenoids such as linalool, geraniol, borneol, menthol, thujanol, citronillol, α-terpineol and a variety of low molecular weight aliphatic hydrocarbons such as phenols (thymol, carvacrol, eugenol, gaiacol and aromatic aldehydes (cinnamaldehyde, cuminal and felandral. Oils are commonly obtained by steam distillation, while currently the use of supercritical carbon dioxide extraction is becoming increasingly popular. Depending on the type and concentration, essential oils have a cytotoxic effect on living cells, but not a genotoxic effect. The cytotoxic activity of essential oils is mainly due to the presence of phenols, aldehydes and alcohols. This cytotoxic activity is of great interest for applications against some human or animal pathogens and parasites as well as for the preservation of agricultural and marine products. It has been known for centuries that aromatic plants mainly their oils or essential components can act against a variety of organisms, including bacteria, viruses, fungi, protozoa, parasites and insects. In addition, essential oils can exhibit hypolipidemic, antioxidant, digestive stimulating and antitoxic activities, and also contribute to odor and ammonia control. There are over 3000 plants used for their essential oils, of which around 300 are used commercially as flavors and fragrances. The food industry uses the oils in soft drinks, confectionery, etc., and the cosmetic industry uses them in perfumes, skin and hair care products, aromatherapy, etc., while the pharmaceutical industry uses them for their functional properties.

4. Modes of action

4.1. Antimicrobial activity

As already mentioned, the antimicrobial properties of aromatic plants are partly attributed to their essential oils. The hydrophobicity of essential oils and their components is thought to be an important property that allows essential oils to accumulate in the lipid bilayer of the bacterial cell membrane and mitochondria, altering cell structures and making them more permeable. In addition, the antimicrobial mechanism of some essential oils is to alter cellular homeostasis, resulting in inhibition of cell growth and death. However, it has been suggested that the chemical structure of, such as the presence of the hydroxyl functional group (–OH) and the aromaticity of, are also responsible for the antibacterial activity.

The antimicrobial activity of essential oils has been investigated in studies against gram-negative bacteria and demonstrated high antimicrobial capacity. Clinical studies with essential oils are rare. were mainly tested topically on the skin and mucous membranes. Furthermore, there is little information regarding the safety of oral administration of essential oils. Currently, essential oils represent a source of natural antimicrobial substances that can be used in the food industry as biopreservatives to prevent food spoilage and extend the shelf life of products. In addition, essential oils could reduce the side effects caused by the use of chemical preservatives.

It is generally accepted that phenolic compounds in which the hydroxyl group is attached to a phenyl ring, have the highest antimicrobial activity among the secondary metabolites found in essential oils. Such examples are the monoterpenes carvacrol and thymol and the phenylpropene eugenol. In addition, nonphenolic secondary metabolites in essential oils exhibit different antimicrobial effects. Some researchers reported that the antimicrobial activity of the p-cymene and γ-terpinene monoterpenes appears to be limited compared to phenolic monoterpenes, while others reported that cinnamaldehyde, a nonphenolic phenylpropene, is a exhibits strong antimicrobial activity.

The chemical composition of essential oils can be influenced by the natural origin of the plant, environmental and genetic factors, species and subspecies, geographical location, harvest time, plant parts used and isolation method.

It has been reported that some aromatic plants and their extracts stimulate the growth of certain bacteria, i.e. have a prebiotic-like effect. Prebiotics are known for their ability to increase endogenous intestinal populations of Lactobacillus and Bifidobacterium, resulting in beneficial health effects. In general, there are very few in vivo studies on the prebiotic effects of aromatic plants. However, they have been used in ruminants to manipulate rumen metabolism.

4.2. Antioxidant Activity

Aromatic plants and their essential oils are good sources of natural antioxidants, such as: B. phenolic compounds, e.g. eugenol, thymol, carvacrol. Polyphenols generally occur as glycosides, although the bioactivity is attributed to aglycone structures and mainly catechol in aglycones. The antioxidant activity of these compounds is believed to be due to their high redox properties and chemical structure, which may be responsible for neutralizing free radicals, chelating transition metals, and quenching singlet and triplet oxygen through delocalization or decomposition of peroxides. The above properties are related to the health-promoting functionality of phenolic antioxidants as they contribute to the delay of many diseases related to oxidative stress, such as: E.g. cardiovascular diseases, cancer, diabetes and Alzheimer's disease.

Furthermore, plant phenols exhibit antioxidant activity in vitro and inhibit lipid peroxidation by acting as scavengers of chain-breaking peroxyl- radicals. Therefore, they may play a protective role for highly unsaturated lipids in foods from oxidative damage and partially replace the use of α-tocopheryl acetate or preservatives. Lipid oxidation in foods is considered one of the main factors limiting product quality and acceptance due to the production of reactive oxygen species (ROS) and off-flavors from polyunsaturated fatty acids.

Essential oils can also influence lipid metabolism in animal tissues by having positive effects on the activity of antioxidant enzymes (superoxide dismutase and glutathione peroxidase) as well as on the composition of polyunsaturated fatty acids. Consequently, flavonoids are important substances in the diet, although they are generally considered non-nutrients. Flavonoids can also act as pro-oxidants, particularly those compounds that possess multiple hydroxyl groups. After penetrating the inner cell membrane,

flavonoids can be oxidized by ROS and converted into pro-oxidants, which can oxidize lipids, proteins and DNA. This mechanism can lead to late apoptosis or necrosis of damaged cells and thus plays a "protective" role by eliminating possible mutants.

5. Conclusions

Aromatic plants, their extracts and essential oils contain a variety of functional bioactive compounds that have potential applications in the food, animal, pharmaceutical and cosmetics industries. However, aromatic plants and their extracts must be standardized and properly controlled in their extraction and composition for the study of these plants to provide meaningful data. For, in vivo studies with standardized extracts should be completed prior to in vivo experimental testing to confirm the efficacy of the extracts. In this way, viable alternative methods can be developed to improve the yield or the shelf life of animal products and thus meet consumer demands for natural, safe and high-quality foods.

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