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Sage (Salvia officinalis L.)-applications in functional foods

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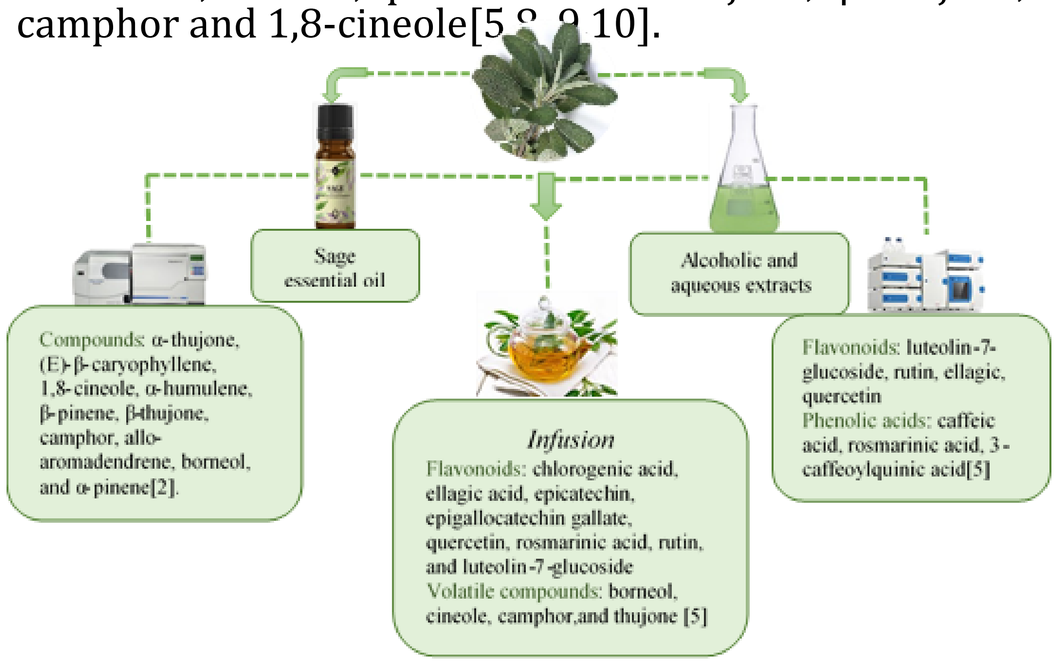
Abstract: Sage is an aromatic plant widely spread in Europe, used for many years in various food preparations, but also in the treatment of several conditions such as ulcers, hyperglycemia, bronchitis, insomnia, dizziness, etc. Due to its bioactive compounds, sage is a good antioxidant, antimicrobial and preservative. In the food industry, *Salvia officinalis* is used to prepare homemade mayonnaise, to improve olive oil, in the composition of some teas, to obtain some salmon products, to prepare some chinese-style sausages, to prepare some chicken meatballs, etc. Natural sage extracts represent a possible substitute for synthetic antioxidants and antimicrobials in foods.

• Introduction

Salvia officinalis L. or sage is part of the *Lamiacea* family, the genus *Salvia* with approximately 1000 species and is native to the Mediterranean area, being very widespread on the European continent. Since the time of ancient Rome and Greece, sage (especially its leaves) was used to treat several conditions due to the bioactive compounds it contains, but also in various food preparations. The leaves of the sage plant are greenish-gray in color, elongated and pointed at the tip, and the flowers can be blue, white or purple. Although the most used part of sage is the leaves, its flowers can also be consumed [1,2,3].

• Chemical composition

Sage is a rich source of phytochemical compounds that have been identified from different parts of the plant such as the stem, leaf and flower. Sage contains a variety of substances including fatty acids, flavonoids, volatile compounds, tannins, terpenes, carbohydrates (arabinose, galactose, manzanose, galactose, xylose, uronic acids and rhamnose), etc. Most of these phytochemical compounds have been isolated, especially from the essential oil of S. officinalis (being the most analyzed in terms of chemical composition), but also from various extracts (alcoholic extract, aqueous extract) and infusion.
More than 120 compounds have been identified in the essential oil from the aerial parts of sage, of which the most important are: borneol, caryophyllene, elemene, humulene, ledene, pinene and α-thujone, β-thujone, camphor and 1,8-cineole[5,8, 9,10].



• Application in food

Today, people are much more attentive to the foods they buy, the health benefits they bring, being much more aware of the relationship between food and health. The challenges in the food industry are to ensure quality, safety and to avoid the main causes that lead to oxidation and microbial spoilage, to create new packaging and fortified food products [16,17].
Due to its aroma but also its preservative properties, *S. officinalis* has long been used in food preparation, to obtain various spices and natural flavors, being recognized and accepted by the FDA (Food and Drug Administration) as safe for consumption [10].
Today, sage can be used in the meat industry to preserve and improve the quality of certain meat food products, in obtaining flavored oil, in certain types of cakes and ice cream, in chicken and beef patties, in salmon or beef burgers, etc. Such foods have been the subject of several studies, which have had favorable results regarding the addition of sage extract (it has gained popularity in the meat industry along with other plant extracts), essential oil, infusion or sage powder [19,20].
Over time, several plants have been studied that have the capacity to preserve, because their constituents have a strong antimicrobial and antioxidant effect. Among the plants studied is *Salvia officinalis* L, which has demonstrated in several research studies that it has a variety of bioactive compounds that are the basis of its medicinal properties and not only [18].

• Conclusions

Following the results of several research studies, it is demonstrated that the addition of sage, in different forms (essential oil, alcoholic extracts, aqueous extracts, powder, infusion) to a variety of food products led to the slowing down of lipid oxidation and the increase of the shelf life.
Also, extracts and essential oils of sage showed antimicrobial activity at certain concentrations and improved certain sensory aspects.
However, this may be limited due to the intense aroma of sage and the smell which added in larger quantities can modify certain organoleptic parameters of foods.
Both the essential oil but especially the sage extract can be used as antioxidant, antimicrobial and natural preservative agents, being successfully applied in the food industry.