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Natural antioxidants for foods: Herbs and spices

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Abstract
Herbs and spices have been utilized for flavor, variety, and smell for over 2000 years. They have additionally been utilized for the protection of food varieties and refreshments fundamentally because of their phytochemicals. The oxidative responses limit the timeframe of realistic usability of new and handled food items and are a serious worry in the food business. The free extreme arrangements prompting the oxidation of biomolecules are ensnared in a few illnesses. Numerous food sources are turning out to be more defenseless to oxidative rancidity because of endeavors to make food varieties better by expanding polyunsaturated unsaturated fats and more practical by presenting lightweight oxygen-porous and light infiltrating bundling. The utilization of engineered cell reinforcements, for example, butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) have been utilized generally for a long time to impede lipid oxidation, yet current worry about their security, along with expanding buyer inclination for normal items, has brought about an expanded interest for normal cancer prevention agents. Because of normal cell reinforcement parts, flavors, and spices are extraordinary wellsprings of cell reinforcements for food conservation. Subsequently, the utilization of flavors and spices presents a preferable decision over manufactured cell reinforcements, which have become famous furthermore, broadly acknowledged by customers.

Keywords: Butylated hydroxyanisole, culinary herb, synthetic antioxidants and flavonoids

Introduction
Antioxidants are chemicals that stop other molecules from oxidizing. Combining an element or compound with oxygen is one of the traditional definitions of oxidation, which is how the name "oxidation" came to be used. It's a translation of the French term oxidizer. Guyton de Morveau and Antoine Lavoisier, two French scientists, created the term oxide in 1787 by combining oxygen and acidity. Lipid oxidation results in oxidative stress, which leads to rancidity, disagreeable tastes and odors, color changes, and nutritional value losses (Darughe *et al*., 2012) [5]. A significant factor in food quality degradation is oxidative rancidity, which produces unfavorable odors and flavors, color deterioration, and harmful chemicals (Frankel, 2012) [8]. When manufacturing and storing goods containing lipids, the initiator and promoter ingredients can be removed to control oxidation. For millennia, people have utilized herbs and spices to preserve food and enhance its flavor (Shahidi, 2015) [23]. Herbs are made from a plant's leaves whose above-ground stem never turns woody. Any other part of the plant, frequently dried, can be a spice. Typically, a culinary herb is described as the leaf of a plant when used in cooking. According to Brewer (2011) [3] and Kaefer and Milner (2008) [14], spices may be made from blossoms (clove), bulbs (garlic, onion), fruits (cumin, red chili, black pepper), stems (coriander), bark (cinnamon), roots (ginger), berries (peppercorns), fragrant seeds (cumin), and other plant components.
Depending on their flavor or taste and the portion of the plant they come from, several groupings of spices and herbs can be identified. Different kinds of spices and herbs, including essential oils, aqueous or methanolic extracts, resins, whole, and oleoresins in food, are employed as antioxidants (Peter, 2001) [20]. The Ebers Papyrus lists spices including anise, mustard, saffron, cinnamon, and cassia and dates the usage of spices and herbs to around 1550 BC.
As evidence of the long history of safe usage of spices and plants, the spice trade dates back at least 3500 years (Shahidi, 2015; Suhaj, 2006) [23, 26]. Natural components are those that are "extracted directly from plants or animal products as opposed to being produced synthetically," according to the U.S. Food and Drug Administration (FDA) (Carlsen *et al*., 2010; Suhaj, 2006) [4, 26].

Antioxidative Compounds

Antioxidants are substances that prevent or postpone the onset of oxidation and can be either natural or artificial (Shahidi & Zhong, 2010) [24]. A rise in consumer preference for natural products, clean labels, and a decrease in the use of food additives in food products have all contributed to an increase in the demand for natural antioxidants. This demand is also being driven by safety concerns regarding synthetic antioxidants. Flavonoids (quercetin, catechin, naringenin, kaempferol, epicatechin, gallate, epigallocatechin gallate, and rutin), volatile oils (eugenol, carvacrol, thymol, menthol, safrole, 1,8-cineole, -terpineol, cinnamaldehyde, myristicin, and piperine), phenolic acids. Spices and herbs are excellent sources of antioxidants for food preservation due to their naturally occurring antioxidant components. Utilizing natural antioxidants from spices and herbs has added benefits. These include the fact that they are healthy and that the body can easily ingest them. They may also bear clean labels for spices or natural tastes. On the other hand, synthetic antioxidants could have negative impacts on people and not provide any additional nutritional advantages.

Mechanism of Action

In order to prevent oxidation, antioxidants are protective (Amorati, Foti, & Valgimigli, 2013) [28]. The presence of oxygen and transition metal ions, moisture, heat, and light are some of the several elements that have an impact on lipid oxidation. Oxygen and metal catalysts must be eliminated or sequestered to make them inert if lipid oxidation is to be prevented, reduced, or slowed down. Food that is prone to oxidation has to be kept at low temperatures and/or protected from light. It is necessary to eliminate or sequester oxygen and metal catalysts to make them inert in order to avoid, minimize, or decrease the rate of lipid oxidation. Food that is prone to oxidation needs to be kept at low temperatures or covered from light. Antioxidants function effectively to stop oxidation by intervening at many phases of lipid oxidation, including initiation, propagation, and termination (Shahidi, 2015) [23].

Phenolic compounds are bioactive molecules that are extensively found in herbs and spices. Most of the time, they serve as metal chelators and radical scavengers. These substances have thus been regarded as promising contenders for possible protection against lipid oxidation. One of the quickest methods to slow down fat oxidation is the presence of an antioxidant (Abdullahi, 2011) [1].

Applications

Meat, fish, dairy products, baked goods, oil, edible films, and packaging films have all been reported to use extracts and essential oils (EO) of herbs and spices.

Meat Products

In a Singh *et al*. (2014) [25] investigation, clove powder, ginger paste, and raw chicken flesh emulsion were added. The shelf life of four separate batches of chicken meat emulsion, designated as C = Control (without natural preservatives), T_1 = 0.2% clove powder, T_2 = 3% ginger paste, and T_3 = 2% garlic paste, was examined during a 9-day period of refrigeration (41 °C) with aerobic packing. Till the end of storage, 0.2% of the clove powder retained the lowest TBA value. The T_1 batch considerably outperformed the control in terms of DPPH and ABTS radical scavenging activities (P 0.05). It was determined from this comparative study of natural preservatives that 0.2% clove powder may be used successfully as an antioxidant in raw chicken meat emulsion.

Fish Products

Citrus grandis (Pomelo) peel flavonoids were identified by Zarina and Tan (2013) [27], as well as their ability to prevent the oxidation of lipids in fish tissue. They examined the fish tissue for flavonoid activity towards lipid oxidation and discovered a decrease in peroxide value, indicating that the fish treated with pomelo peel had inhibited lipid oxidation.

According to Normah *et al*. (2005) [16], ginger and coriander may be able to prevent cooked mackerel patties from oxidising during storage in the refrigerator. Fish alone served as the control. The other three treatments included fish with coriander (1%), ginger (1%), and coriander (0.5%). According to this study, the antioxidant activity rose in the following order: coriander, ginger, coriander, and ginger. It was determined from the observation for 12 days of cold storage (4 °C) that rancidity increased with storage time. Coriander > Ginger + Coriander > Ginger was in sequence of increasing rancidity.

Dairy Products

According to Parmar *et al*. (2013) [18], ethanolic extract of Arjuna bark prolonged the shelf life of ghee when stored at 8 °C compared to the control sample. Additionally, their research indicated that freshly made ghee from cow milk combined with Arjuna bark has a strong potential to function as a free radical scavenger. Bandyopadhyay *et al*. (2007) [2] tested the antioxidant properties of beetroot (Beta vulgaris), mint (*Mentha spicata* L.), and ginger (*Zingiber officinale* L.) before and after they were fortified with sandesh. Ginger the combination of ginger and mint among the natural sources showed outstanding effectiveness. Natural sources (beetroot, mint, and ginger) can be used instead of BHA and BHT, either separately or in combination.

Gandhi *et al*. (2013) [9] assessed the antioxidative qualities of the ethanolic extract of vidarikand in ghee and found that it was more efficient in halting the formation of conjugated diene and peroxide values in ghee during storage. In comparison to the control ghee sample, the Vidarikand ethanolic extract demonstrated a longer induction duration. When coriander extract was added to ghee, it improved the oxidative stability of the fat during storage when compared to the control sample, according to Patel *et al*.'s (2013) [19] assessment of the antioxidant activity of coriander extract in ghee. However, they also made the argument that BHA is a more potent antioxidant for ghee.

Bakery Products

During 28 days of room temperature storage, the peroxide value, thiobarbituric acid, and free fatty acid contents of cakes were measured in order to assess the antioxidant impact of clove essential oil (CEO). According to the findings (Ibrahim *et al*., 2013) [13], the CEO was able to slow the pace of oxidation and reduce the amount of generated oxidation products in cakes. Garlic, coriander, sumac, fennel, marjoram, thyme, and cardamom were some of the medicinal and aromatic herbs Hinar *et al*. (2014) [12] studied to see if adding them to bread would affect its natural antioxidant content. Antioxidant activity was greater in all bread samples than in controls.

Oil

Delre and Jorge (2010) [6] prepared soybean oil with oleoresins of oregano (*Oreganum vulgare* L.), basil (*Ocimum basilicum* L.), and thyme (*Thymus vulgaris* L.). Oleoresins at varying quantities (500, 1000, 1500, 2000, 2500, and 3000 mg kg^{-1}) were applied. The oxidative stability of thyme and oregano oleoresins was highest at 3000 mg kg^{-1}. Ozcan (2003) [17] combined extracts of sumac, sage, and rosemary with peanut oil. To peanut oil that had been kept at 80 °C for 24 hours, methanolic extracts (at a weight-to-volume ratio of 4%) were added. Sage and sumac (peroxide value) were the two that worked the best. Sumac extract is therefore suggested as a natural antioxidant source. Aframomum danelli spice was employed in palm and soybean oil by Fasoyiro *et al*. (2001) [7]. Different concentrations of rosemary and sage extract were used to compare the activity of *A. danielli* extract. Palm and soybean oil decreased the rate of peroxide generation at 2 ppm and 3 ppm.

Edible Film

By mixing ginger essential oil with uwi starch (*Dioscorea alata* L), an edible film was created. To determine the film's level of antioxidant activity, DPPH scavenging test was employed. The films' DPPH scavenging activity considerably increased as the concentration of essential oil did. According to Herlina and Masril (2013) [11], the greatest antioxidant occurs in 3% essential oil with a 31.5% decrease in DPPH.

Packaging Film

After 8 weeks of storage, soybean oil samples in cellulose-based pouches devoid of antioxidants (control) had a maximum peroxide value of 558 meq kg^{-1}. After 8 weeks of accelerated storage, the peroxide values of soybean oil samples packed in cellulose-based pouches containing BHA, cinnamon oil, and clove oil were 517, 484, and 530 meq kg^{-1}, respectively. When compared to the control, the equivalent inhibition rates were 7.2%, 13.3%, and 4.8%, respectively. Additionally, cinnamon oil's antioxidant effects were greater to those of BHA. Upon reaching a maximum FFA level of 1.37 mg KOH g^{-1} after 8 weeks of storage, soybean oil samples packaged in antioxidant-free cellulose-based pouches (control) did so. The FFA of soybean oil samples packaged with BHA, cinnamon oil, and clove oil were 1.42, 1.38, and 1.23 mg KOH g^{-1}, respectively. The antioxidant properties of clove oil produced a 10.6% inhibition rate after 8 weeks under accelerated storage conditions. According to this study (Phoopuritham *et al*., 2012) [21], cinnamon and clove oil might be used as plant extracts that serve as antioxidants in food packaging.

Foods have been preserved using whole or ground herbs and spices. Extracts and essential oils can also be used to prevent the oxidation of lipids and the development of microorganisms in meat and fish. Selected studies that used different types of spices and herbs to prevent or postpone the commencement of lipid oxidation and the development of rancidity in meals. According to these studies, spices and herbs are helpful in lowering the formation of harmful compounds like heterocyclic amines (HCAs) as well as lipid oxidation (Gibis, 2007; Rounds, Havens, Feinstein, Friedman, & Ravishankar, 2012) [10, 22].

Conclusion

Natural ingredients are becoming more popular to use in meals and beverages. Due to worries about the negative health consequences of synthetic raw materials, notably some synthetic antioxidants, consumers are favouring food items with natural components more and more. Foods can become unappealing and unsatisfactory due to lipid oxidation's numerous negative impacts, including colour fading, browning or colour deterioration, and the development of rancid taste and off notes. Additionally, lipid oxidation reduces the nutritional value of food and offers health hazards since it releases peroxides, which can harm living cells through oxidation. Malondialdehyde (MDA), a lipid peroxide, and other aldehydes can also cause mutagenesis and carcinogenesis as by products of lipid oxidation. In this regard, spices and herbs have been utilised for thousands of years as preservatives, flavouring agents, and sources of scent and colour in food. They include potent antioxidants that have been shown to be successful in preventing lipid oxidation or postponing the start of food rancidity. Spices and herbs include antioxidants, which are advantageous due to their natural origins, non-GMO status, and clean label ingredients (i.e., the ability to be classified as a spice, herb, or flavouring). Compounds from spices and herbs have been found to have antioxidant activities and capabilities, and these findings have been extensively documented in the scientific literature.

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