INTERNATIONAL JOURNAL ON ADVANCED TECHNOLOGY, ENGINEERING, AND INFORMATION SYSTEM
(IJATEIS)
VOLUME 1 ISSUE 1 (2022)

# APPLICATION OF GINGER ESSENTIAL OIL IN THE FOOD SECTOR

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**Abstract**
*This study aims to determine the usage of spice essential oils, specifically ginger, in the food sector. This study is a literature study. The source of the article writing library were taken from Google Scholar and www.scimagojr.com with relevant study. According to the findings, essential spice oils, especially ginger, can be used as seasonings in the food sector which can extend the shelf life and enhance the taste of a product. This is supported by the chemical nature of ginger essential oil, which contains compounds. Therefore, food additives can be added to the food manufacturing process. Since the main principle of adding food additives is to prevent the growth, oxidation and unwanted chemical changes of bacteria, so that food looks good as well as its tastes, hence food can be consumed safely.*

Keywords: *Ginger Essential Oil, Food Sector, Shelf Life*

## 1. INTRODUCTION

The provision of natural, safe, and high-quality food is a major challenge for food producers. Another alternative is to replace chemicals in food formulations with natural substances, which would limit the use of chemicals. Natural food additives originating from vegetable products with functional benefits, such as spices, are rapidly being explored. The use of spices as preservatives in natural foods has received a lot of attention, both in fresh and processed foods. Some of this research include the use of ginger to preserve wet bananas (Kawiji et al., 2011), the use of fresh ginger paste as an antibacterial for smoked catfish (Kumolu-Joh & Ndimele, 2011), and cheese preservation with ginger extract ((Belewu et al., 2005).

In its application, spices can be utilized in the form of essential oils. Essential oil is a product that is currently more popular and has a higher selling value than the raw material because it has more useful properties, including being more hygienic and more stable if stored for a relatively long time. However, the problem with the use of essential oils in food is the organoleptic changes (flavor and taste) of the product to which it is applied. The use of various essential oils causes essential oils to become one of the export commodities that generate high foreign exchange for Indonesia. Global consumption of essential oils and their derivatives increases by about 810% in every year. Besides that, the demand for essential oils is increasing due to the tendency of consumers to switch from synthetic lifestyle to natural lifestyle. In addition, essential oil processed products cannot be replaced with synthetic ingredients (Julianto, 2016).

One of the essential oil-producing plants is ginger. Ginger is a popular spice in Indonesian society because of its health benefits. The chemical content of ginger is 23% essential oil, gum starch, organic acid, malic acid, oxalic acid and ginger (Sayuti & Yenrina, 2015). Ginger essential oil has various colors from clear yellow to dark yellow. Mardiansyah et al. (2016) reveal that the main components of ginger essential oil that give rise to the distinctive aroma of ginger are zingiberene, gingerol, shogaol, and sap. There are 40 types of monoterpenoid hydrocarbons, including 1,8-cineole, linalool, borneol, neral, and geraniol. According to the above description, the researchers are conducting this study with the goal of determining the usage of spice essential oils, specifically ginger, in the food sector.

## 2. RESEARCH METHOD

This research method is a literature study. The source of the article writing library is taken from Google Scholar and www.scimagojr.com.

**Inclusion Criteria**

1) Published from 2010-2022
2) Indexed articles
3) Can be accessed and full text

**Exclusion criteria**

The main focus is related to "Application of Ginger Essential Oil in the Food Sector". Therefore, any document that irrelevant are excluded.

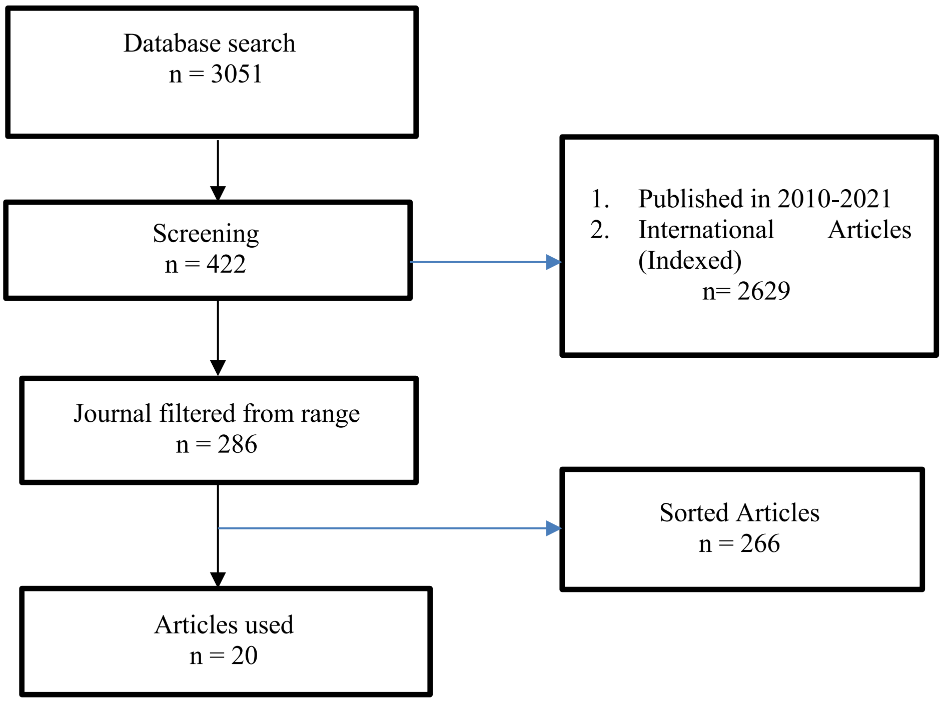


**Figure 1** Process of sorting relevant articles

After excluding some articles from consideration, the researchers found up to 20 relevant studies that were then analyzed and discussed in detail in the next section of this study.

## 3. RESULT AND DISCUSSION

**Table 1** Application of Ginger Essential Oil in the food sector

| Researcher | Application of Ginger Essential Oil Spices | | | |
|---|---|---|---|---|
| | Extend Shelf Life | | Improve Taste | |
| | Indirectly to the product | Directly to the product | Indirectly to the product | Directly to the product |
| (Atarés et al., 2010) | ✓ | - | - | - |
| (Metwalli, 2011) | - | ✓ | - | - |
| (Annamalai et al., 2015) | ✓ | - | - | - |
| (Alexandre et al., 2016) | ✓ | - | - | - |
| (Alwani et al., 2016) | - | ✓ | - | ✓ |
| (J. Zhang et al., 2016) | ✓ | - | - | - |
| (Kavas et al., 2016) | ✓ | - | - | - |
| (Wang et al., 2017) | ✓ | - | - | - |
| (Xu et al., 2017) | - | ✓ | - | ✓ |
| (J. Zhang et al., 2016) | ✓ | - | - | - |
| (L. Zhang et al., 2017) | ✓ | - | - | - |
| (Noori et al., 2018) | ✓ | - | - | - |
| (Pires et al., 2018) | ✓ | - | - | - |
| (Silva et al., 2018) | ✓ | - | - | - |
| (Souza et al., 2018a) | ✓ | - | - | - |
| (Khaledian et al., 2019) | ✓ | - | - | - |
| (Mattje et al., 2019) | - | ✓ | - | ✓ |
| (Nair, 2019) | - | - | - | ✓ |
| (Amalraj, Haponiuk, et al., 2020) | ✓ | - | - | - |
| (Pais et al., 2020) | ✓ | - | - | - |

Essential oils are complex compounds composed of the chemical composition of various natural plants. Essential oils contain an average of 80,400 compounds. This compound is the result of secondary metabolism and is stored in plants for biological processes. Aromatic compounds in essential oils are formed from hydrocarbon bonds and combine to form a circular structure. Oxygen, hydrogen, sulfur, and other carbon atoms combine at different points in the chain to form different aromatic compounds. The chemical structure of essential oils can be divided into two main groups: terpenoids and phenylpropranoids. Terpenoids are very diverse and are recognized by various carbon skeletons and various oxygenated derivatives such as alcohols, esters, aldehydes, ketones, ethers, peroxides and phenols. Terpenes are classified based on the amount of isoprene contained in the structure into hemiterpenes (1 unit), monoterpenes (2 units), sesquiterpenes (3 units), diterpenes (4 units), etc. The common terpenes in essential oils are monoterpenes and sesquiterpenes (Zuzarte & Salgueiro, 2015). Phenylpropanoids contained in essential oils are phenol or phenol ether. Besides that, the identification of chemical compounds in essential oils and spice oleoresins can use the chromatographic method (Peter & Shylaja, 2012).

Phytochemical compounds that play a role in the aroma of ginger include arcurcumene; bisabolen; sesquiphellandrene. While those that play a role in the spicy taste of ginger are gingerol, shagoal and zingerone (Santos-Sánchez et al., 2017; Vasala, 2012). The nature of ginger essential oil is that it contains high sesquiterpenes such as zingiberene, arcurcumene, bisabolene, and sesquiphellandrene (Kubra & Rao, 2012). Ginger essential oil contains only the scent of ginger. Research on the composition and chemical components of ginger as well as essential oils and oleoresins has been widely carried out and obtained very varied results. Variations in the outcomes are influenced by ginger varieties, geographical conditions, variations in maturity levels, variations in procedures for obtaining essential oils and variations in analytical tools (Bailey-Shaw et al., 2008). Based on market demand, ginger is more often used because of its aroma. This is because the spicy taste of ginger is relatively mild, so when consumers need a spicy taste, they will look for other ingredients such as capsicum (Govindarajan & Connell, 1983).

Further, ginger essential oil and oleoresin were tested for antioxidant activity using the DPPH and FRAP methods. The DPPH test showed that fresh ginger essential oil had lower antioxidant activity than dry ginger essential oil. Meanwhile, the FRAP test showed that the antioxidant activity of ginger essential oil and oleoresin depended on the dose used. The antioxidant activity of fresh ginger essential oil and dry ginger essential oil did not show a significant difference. Antioxidant activity is influenced by the content of camphene, pusineol, borneol, terpineol, zingiberene compounds (El-Ghorab et al., 2010). Another publication found that ginger essential oil had the ability to suppress carotene discoloration due to suppression of added linoleic acid. However, in this publication, ginger essential oil has the lowest antioxidant activity compared to cinnamon essential oil and various synthetic antioxidants (Singh et al., 2008a). Antioxidant activity is influenced by sesquiferrandrene (25.16%) and caryophyllene (15.29%), which have a synergistic effect with one or more compounds (El-Baroty et al., 2010). When the antioxidant activity of dry ginger essential oil and oleoresin was tested by the ABTS method, it was found that the radical 2,2´azinobis bis (3-ethylbenzenthiazoline-6-sulphonic) could be removed at higher concentrations of ginger essential oil. Antioxidant activity is caused by phenolic compounds such as eugenol, shogaol, zingerone, zingerdiol, gingerol (Bellik, 2014).

Moreover, another publication explained that ginger essential oil has antioxidant activity when testing superoxide scavengers, hydroxyl scavengers and lipid oxidation. In the FRAP, DPPH, and ABTS tests, ginger essential oil showed moderate antioxidant activity. The antioxidant potential of ginger essential oil is due to the presence of compounds from the phenol group (Jeena et al., 2013). Ginger essential oil from Germany also showed antioxidant activity in tests with DPPH, ABTS, hydroxyl radical scavenging and oxygen scavenging, due to the presence of zingiberene (17.4%), camphene (7.8%), sesquiphellandrene (6.7%), bisabolene. (5.8%), limonene (1.3%) 1.8cineole (3.6%), terpineol (0.5%), and linalool (0.5%). In testing with linoleic acid and lipid oxidation, ginger essential oil showed inhibition of the fat oxidation process, due to the presence of zingiberene, camphene, sesquiphellandrene bisabolene, limonene, terpinolene and terpinene compounds (Höferl et al., 2015). The essential oil and ginger oleoresin from India were calculated for the peroxide value, TBA number and anisidin number. The results showed that there was an inhibition of the lipid oxidation process in the mustard oil samples. Ginger essential oil and oleoresin have been shown to prevent free radicals in the DPPH test.

Phenolic compounds, namely eugenol, shogaol, zingerone, gingerdiol and gingerol in essential oils and ginger oleoresin are involved in antioxidant activity (Singh et al., 2008b).

Additionally, ginger essential oil has been used to make nanofilms from tilapia gelatin. Fresh pork was packed at 4°C for 9 days using nanofilm and tested for its antioxidant and antibacterial activity. The test results showed the presence of antibacterial and antioxidant activity that inhibited the lipid oxidation process. Overall, ginger essential oil can extend the shelf life of fresh pork under these conditions (L. Zhang et al., 2017).

Another publication stated that the chitosan film was added with ginger essential oil and used to wrap pork slices at 4°C for 9 days. The tests carried out were antioxidant activity and antimicrobial activity. The test results showed that antioxidant activity inhibited lipid oxidation, antimicrobial activity inhibited microbial growth and increased meat pH. Application of ginger essential oil as a whole can extend shelf life (Wang et al., 2017). However, the chitosan film and ginger essential oil used to pack fresh poultry meat for 15 days at 5°C showed weak antimicrobial activity. But overall, the shelf life of meat is still longer when compared to unprocessed meat (Pires et al., 2018). The same thing was seen in gelatin-based films, where the antibacterial activity was weak, but the addition of ginger essential oil increased the properties and antioxidant activity of the films (Alexandre, Lourenco, Bittante, Moraes & Sobral, 2016).

According to Souza et al. (2018b) another effect that ginger essential oil could inhibit microbial growth in fresh chicken coated with a chitosan-based film. According to research by Amalraj, Raj, et al. (2020), microbial growth that an be inhibited by the combination of chitosan film, gum arabic, polyethylene glycol and ginger essential oil, among others, Bacillus cereus, Staphylococcus aureus, Escherichia coli and Salmonella typhimurium. The manufacture of an emulsion from nano-sized sodium caseinate that is safe for consumption is also added with ginger essential oil, and is used to coat the chicken breast. The samples were then tested for antimicrobial activity and antioxidant activity. Overall application of ginger essential oil can extend shelf life, because it inhibits lipid oxidation and inhibits the growth of S. typhimurium and L. monocytogenes bacteria (Noori et al., 2018). The same was seen in films made from casein sodium and ginger essential oil. This film can suppress the lipid oxidation of sunflower oil (Atarés et al., 2010). Ginger essential oil is coated with ready-to-eat grilled chicken using citric acid and nano-sized cellulose fibers. The results showed that ginger essential oil could inhibit the growth of microorganisms compared to fried chicken that was ready to eat without treatment. In addition, the sensory experiences obtained are also favored by consumers for aspects such as taste, smell and texture (Khaledian et al., 2019). Films made from a mixture of whey protein isolate, alginate and ginger essential oil were applied to Kashar cheese stored at 4 °C for 30 days. Next, we investigated the microbial growth of Kashar cheese. Result by Kavas et al. (2016) showed that the film could inhibit the growth of Staphylococcus aureus and E. coli. The same thing happened to the film made from protein isolate, polyethylene oxide, zein, and ginger essential oil. The film was applied to Minas cheese and the cheese was stored at 4°C for 12 days. Observation of antibacterial activity showed that ginger essential oil content could inhibit the growth of Listeria monocytogenes (Silva et al., 2018).

In the other side, ginger essential oil can also be encapsulated with cyclodextrin. The encapsulation results were applied to yogurt and produced yogurt with good antioxidant activity. However, more research is needed on sensory evaluation (Pais, Pereira, Paz, Cardoso, & Braga, 2020). In another publication, ginger essential oil was added to fish oil encapsulations made from fish gelatin and maltodextrin. The results showed that ginger essential oil could inhibit the lipid oxidation of fish oil at refrigerator temperature storage (Annamalai et al., 2015).

Ginger essential oil was applied directly to fresh chicken meat which was stored for 15 days at 5°C. Fresh chicken meat was then subjected to sensory evaluation including odor, color, texture and levels of mucus produced during storage. The results showed that ginger essential oil has the potential to extend the shelf life of fresh chicken meat up to 6 days at a temperature of 5°C (Alwani et al., 2016). In addition, ginger essential oil can be applied directly to Kareish cheese which is stored for 30 days at 4°C. The results showed that ginger essential oil could increase the shelf life of cheese up to 30 days at 4°C, as well as improve cheese quality (Metwalli, 2011). The same thing was also stated in the addition of ginger essential oil to fish fillets stored in aseptic polyethylene packaging for 20 days at 4°C. Ginger essential oil can inhibit bacterial growth and degradation of fish protein, thereby prolonging the shelf life of fish fillets under these storage conditions (Xu et al., 2017),ginger can control the microbial growth of raw fish at 5°C (Yoo et al., 2006). Ginger essential oil applied directly to meat, not only inhibits lipid oxidation but also improves product safety (Dzudie et al., 2004). However, different things were found in the application of ginger essential oil on fish burgers. The results showed that ginger essential oil was not very effective in suppressing lipid oxidation. However, ginger essential oil can enhance the taste (Mattje et al., 2019).

In Nair (2019) ginger essential oil is widely used in the food industry to add flavor to meat products, seafood, and various vegetable preparations. Additionally, ginger essential oil can be used in baked goods, confectionery, beverages, alcoholic beverages, hot sauces, and more. The recommended dose of ginger for applying essential oil is: (1) 17ppm for soft drinks. (2) 20ppm for ice cream products. (3) 14 ppm for candy; (4) 47 ppm for baked goods. (5) 13 ppm for taste; (6) 12 ppm for meat products.

Based on the results of a review above, it can be conclude that food additives can be added to the food manufacturing process. Since the main principle of adding food additives is to prevent the growth, oxidation and unwanted chemical changes of bacteria, so that food looks good as well as its tastes, hence food can be consumed safely (Santos-Sánchez et al., 2017). Basically, ginger and essential oils can be used in the food sector and can be said to have a positive effect on health.

## 4. CONCLUSION

Essential spice oils are used as seasonings in the food sector which can extend shelf life and enhance taste. This is supported by the chemical nature of ginger essential oil, which contains compounds such as zingiberene, ARcurkumen, Sesquiferandrene, Bisabolen, Camphene, Phellandrene, 1,8-Cineol, Shagor, and zingeron are examples of compounds that have antibacterial activities that limit the growth of infections and spoilage, as well as antioxidant capabilities that inhibit the oxidation of the product.

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