

Overview of Processing Technique, Health Benefits, and Potential Applications of Clove

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SUMMARY

Cloves are basically the flower buds with pleasant aromatic flavour and an excellent source of natural nutrients. Clove is a rich source of several health beneficial phenolic compounds like eugenol and eugenol acetate, quercetin, kaempferol. Eugenol is a pale yellow colored bioactive compound primarily found in essential oils of clove. It also exhibits a potential flavouring and natural food preservation activities.

INTRODUCTION

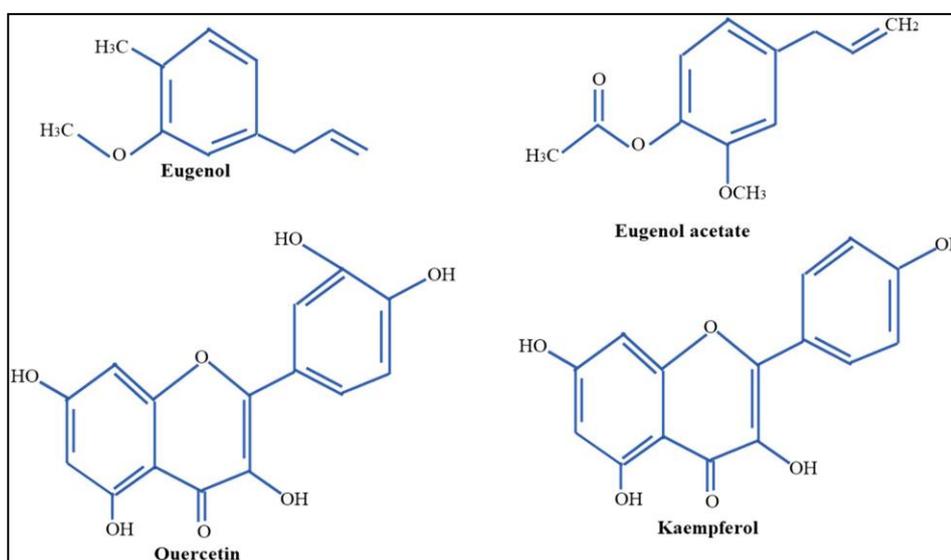


Fig.1 Chemical compounds of cloves

(Source: Idowu *et al.*, 2021)

Processing of clove spices

Encapsulation is one of the most common processes used for incorporating the nutrients of clove into the food matrix. Now days, extensive studies have been conducted for the encapsulation of clove essential oils into the food and dairy products in order to enhance the nutritional quality as well as the functional attributes of the formulated product. Processing of clove spices are include the following techniques:

- Drying
- Solvent extraction
- Microwave assisted extraction,
- Supercritical carbon dioxide extraction
- Ultrasound assisted extraction and
- Microencapsulation.

Hence, the microencapsulation and nano-encapsulation technologies are the most widely accepted methods. In the process of microencapsulation, the clove nano components are incorporated into micro-particles of less than one micron size by means of following techniques such as:

- Liposomal entrapment
- Freeze-drying
- Spray drying
- Complex inclusion technique

Health benefits of cloves**Anti microbial activity of clove**

Clove exhibits antimicrobial activities against *Aspergillus niger*, *Mycobacterium sp.*, *Bacillus substilis*, *Streptococcus aureus*, *Escherichia coli*. (Gora et al., 2005). Therefore, due to its antimicrobial attributes it is having a great potential to be used in dairy and food products at an acceptable level without affecting the sensory attributes. Further, studies have revealed that cloves compounds showed ability to prevent the contagion during epidemics of plague.

Antioxidant activities of clove

Clove oil shows antioxidant activity. Podlewski et al., (2010) conducted an experiment on the antioxidant activity of clove oil. For this purpose, they prepared both aqueous and alcoholic extract of clove. These extracts showed inhibition of lipid oxidation of linoleic acid, where the alcoholic extracts of clove oil showed better results than the aqueous extracts. The outcome of the experiment proved that cloves are a convenient source of natural antioxidants that could be used as food and pharmaceutical industries as raw ingredients.

Clove –Anti stress agent

Clove oil is known to have anticonvulsant effects. Scientific studies have revealed the anti-stress activity of eugenol, the primary component of clove oil. Therefore, it is used for treatment in epilepsy.

Applications of clove**In pharmaceutical industries****Application of clove in dentistry**

Eugenol is also widely accepted as a raw ingredient in the field of dentistry. It is used as a substrate for the production of dental analgesic formulations.

- Zinc-eugenol paste is a good for filling of dental canal. The complex prepared from clove nano compounds i.e. eugenol in combination with zinc oxide is used to fill cavities in teeth.
- Further, clove oil also utilized in mouthwash, toothpastes, and preparations of disinfectants. Furthermore, the clove eugenol-ZnO paste acts as an antiseptic formulation.
- Clove derived nano-components help in our digestion system, therefore in pharmaceutical industries its used to prepare those medicine that controls human digestive system.
- Clove oil components are used is medicines that reduces the toothache.
- Clove oil deal with breathing problems and neuralgia. Its also used as inhaler in treatment of sore throat and inflammation of the mucous membranes of the mouth.

Application of clove in food

“Who has the pain that roars in his head as if he were deaf, should often eat the cloves” Saint Hildegard. In spite of being a rich source of nutrients, the application of clove is not as vast as expected. Cloves are one of the oldest spices ever found in the world and for centuries, the utilization of cloves was limited in the household level only, since the industrial application of clove is still confined. Clove and its derivatives offer a wide array of health benefits to a human being. The clove oil is a natural source of antibacterial agent that has a potency to be used in dentistry formulations, pharmaceutical industries and food and dairy beverage industries. Different aspects of possible food applications of clove are under mentioned.

- The mixture of clove and cinnamon oils (1:1) inhibits the growth of mold, yeast and microbes present in foods.
- Cinnamic aldehyde of cinnamon and eugenol of clove have the abilities to damage the cell walls of bacteria. These properties make those nano components of clove able for shelf life enhancement of food and dairy products.
- Clove oil can also be used as an antioxidant agent in those foods where fat oxidation is a major issue. In addition to this, it does not affect the color and appearance of of the finished products if applied at a concentration range of 50 - 1200 ppm (Park et al., 2009)

- Clove oil and eugenol are also known to exhibit antifungal action that makes it able to use in foods as an antifungal agent especially in bakery industries. Food products that are prone to fungal attack, spices like cloves are used to inhibit those problems, since ancient times (Omidbeyg et al., 2007)

Application in Dairy Products

Dairy products are an excellent carrier of photochemical with high nutrition value and thereby it helps to improve the nutritional health of a human body. The incorporation of cloves components as flavouring and antioxidant agent in dairy foods could create a better nutraceutical effects upon a major population of our society, since dairy products are consumed by a larger population of the country. Hence the valorisation of clove could be possible to a greater extent. Incorporation of clove oil at high concentrations may adversely affect the sensory characteristics of dairy and food products. Small concentrations of clove oil are enough to ensure food safety as far as the bacterial effect is concerned (Menon and Garg, 2001).

- The clove oil and its extracts or in powdered form of cloves have been incorporated into several dairy products such as butter, clarified butterfat, cheese, yoghurt and ice-cream. Addition of cloves in these dairy products resulted in enhanced preservation actions. (Hamid et al., 2012, Behrad et al., 2009)
- Incorporation of cloves nano components in dairy products improved their oxidative stability, antioxidant properties, thus it resulted in shelf life enhancement.
- Clove essential oils are known to have antimicrobial activity against the *Listeria monocytogenes* in semi-skimmed milk. (Cava et al. (2007)
- Clove oil at 0.5 to 1% concentrations significantly decreased the growth of *Listeria monocytogenes* in cheese.
- Bakheit and Foda (2012) studied the effect of incorporating cloves components on Mudaffara cheese and determined the antioxidant activity of the final product using (DPPH) free radical scavenging assay. This study concluded that the addition of clove into cheese was responsible for enhanced shelf life and better quality of the finished product.

CONCLUSION

On the basis of several in vivo and in vitro studies of cloves and its derivatives that revealed the bioactive properties such as antioxidant properties, anti-glycation and antimicrobial properties, the cloves components can be easily be declared as a potential nutraceutical agent of natural source. Further, it can be concluded that there is a need of an easy, economic and sustainable technique to be developed so that easy extraction and incorporation of these health beneficial components of clove could be possible and thus it may create a new horizon for the food and dairy industrial sector.

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