

Ginger Physico Chemical Properties and It's Consumer Products processing: A Review

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ABSTRACT

Ginger (*Zingiber officinale*) is rhizomatous perennial plant. It has extensively used in the herbal medicine to cure of numerous ailments including vomiting, indigestion, cold induce syndrome and also useful to alleviate diabetes. It can accelerate blood circulation, stimulate the secretion of gastric juice and excite intestinal motility. It has antioxidant and antimicrobial properties, which may prevent generation of free radicals. These essential compounds have been reduced during postharvest storage and processing mainly due to thermal treatment. Many ginger condiments are available in the market to meet the large number of consumers' requirement such as powdered ginger, crystallized ginger, ginger juice, candy, beer etc. Various product of ginger have unique attributes and processing methods. In this review article discussed various ginger based product processing aspects and physicochemical attributes of ginger.

Keywords: Beer, Candy, Juice, Oil, Nutritional properties. Paste, Powder, Wine.

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INTRODUCTION

Ginger (*Zingiberofficinale Roscoe*) belongs to the family *Zingiberaceae* and genus *Zingiber*. Other names of ginger are African ginger, Black ginger, Cochin ginger, *Gan Jiang*, Gegibre and Ingwer. Turmeric, cardamom, and galangal are other notable members of the ginger family. The English botanist William Roscoe (1753- 1831) gave the plant the name *Zingiber*, derived from a Sanskrit word *singabera* which means horn-shaped due to the protrusions on the rhizome [1-3].

It is widely cultivated in the tropical regions of world such India, as Nigeria, Bangladesh, Taiwan, Jamaica & the U.S.A. India is the largest producer of the ginger about 1109 thousand tons in the world according to Food and Agriculture Organization report 2016. Ginger rhizomes contains 79 % water, 18 % carbohydrate, 2 % protein and 1% fat yet its prominently valued for typical fragrance and medicinal properties due to volatile oils compose of 1-3% [2,4-5]. The zingerone, shogalos and gingerol are main bioactive pungent compounds principally 6 gingerol. The various characteristics of it have wider application in the food and pharmaceutical industries as product or as an additive in foods, beverages and medicines. Ginger based various products popularizing day by day due distinct pungent flavour.

It most widely used spices worldwide due to its universal appeal and the easiness with which ginger rhizome has spread to most tropical and subtropical countries. The powder syrup, volatile oil & oleoresin are processed by rhizome. Most of the nutrients like carbohydrates, fats, protein, fibre, water & volatile oil are present in rhizome [6]. The various ginger condiments like ginger powder, oil, wine and juice are often available in the market[1]. This should be added to extensive variety of the food products [7-8]. The various ginger products processing description articles have not found. So, that in this article

revived various authors work related to the ginger attributes and product processing parameters.

Ginger Rhizomes:

Ginger is rhizomatous perennial plant, the height, up to 90 cm in under cultivation. Rhizomes have strong aroma, thick lobed, pale yellowish in colour. Leaves are long up to 3 cm broad with sheathing bases, the blade gradually pointed. Flowers are rare, rather small, calyx [9-10]. The ginger rhizomes were digging out when ginger plant gets matured and the leaves colour are yellowish.

resh ginger contains 5-deoxy derivative of ginger called paradol. The active constituent present in ginger due to which ginger has many benefits is called gingerol [11-12]. It contain antioxidant and antimicrobial compounds such as gingerol and shogaol responsible for immunomodulatory, antitumorigenic, antilipidemic antiemetic, antiapoptotic and, antihyperglycemic activity [13].



Fig.01: Ginger Rhizomes

The Table:1 and 2, shows the rhizomes physical and chemical properties respectively.

Table1: Physical properties of ginger rhizomes:

| PARAMETERS | AVERAGE VALUE |
|------------------|---------------|
| Colour | Light brown |
| Fruit weight (g) | 38.6 |
| Diameter (cm) | 3.98 |
| Length (cm) | 4.8 |
| Pulp weight (g) | 33.86 |
| Pulp (%) | 88 |
| Peel weight (g) | 4.86 |
| Peel (%) | 12 |

Sources:[14-15]

Table2: Chemical properties of ginger rhizomes:

| Chemical properties (%) | Average value |
|-------------------------|----------------|
| Moisture | 36.6 |
| Fat | 2.98 |
| Protein | 4.37 |
| Carbohydrate | 48.86 |
| Fiber content | 3.80 |
| Titrateable Acidity | 0.42 (mg/100g) |
| Ascorbic acid | 9.33 (mg/ml) |
| Ash | 3.38 |
| Gingerol | 9.32 |

Sources:[16]

Ginger products:

Now days the attractiveness of ginger-based products demand increasing day by day due to its characteristics flavour and medicinal value. Its commonly available ginger products processing are listed below:

Dry ginger:

Dried ginger is used to make powdered ginger. For transport & storage purpose the ginger roots are dried. The rhizome of ginger are dried up to less than 10% moisture content by different drying methods such as sun, tray, solar, fluidised bed drying etc.. Ginger rhizomes are sliced to increase the surface area for decrease the drying time. The rhizome dried under

a solar tunnel drier or sun were commonly used to retained the maximum essential oil and oleoresin content 13.9% and 42.5m/g of dry ginger respectively. [11].

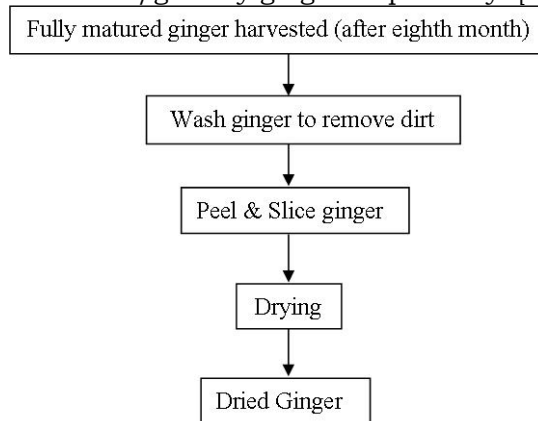


Fig.02: Process flow diag. of Ginger drying

Ginger powder:

Dry ginger powder is also known as “Sonth”. Ginger powder made of dehydration rhizomes and convert in to fine particles. It contain less moisture content less than 10% varies depend on the producer. Fine powder appears white colour has strong aroma and pungent flavour. It is used in spices & masala for gravies, curries and baked dishes, etc. The powder is help in digestion and absorption of consumed food [17].

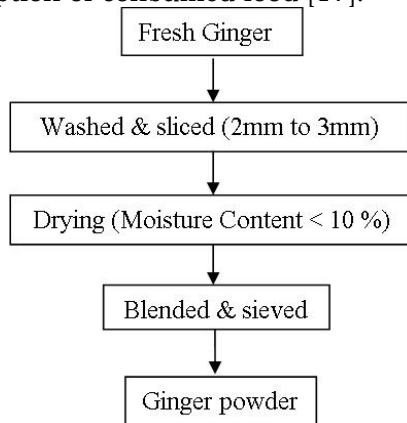


Fig.03: Process flow dia. of ginger powder

Fresh matured ginger has received and then washes on running water to remove soil and dust foreign particles. Washed ginger cut/ sliced to make 2m to 3mm flakes. The sliced ginger dried by the Sun drying (10-12 Moisture content dry basis); Oven Drying 75 °C for 20 hrs up to moisture content 9-11%; sun drying for one day at (28±2) °C and then oven drying at 75 °C for 10 hrs up to moisture content 8-9%).

Ginger oil:

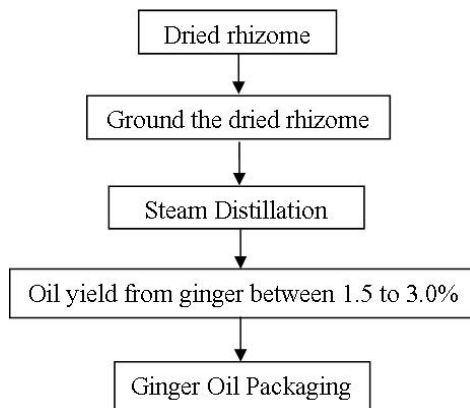


Fig.04: Process flow dia. of ginger oil

Ginger oil may be from fresh or dried rhizomes by steam distillation. The oil possesses an aroma and flavour that are cultivar specific. Oil from dried rhizomes will have less of the low boiling point volatile compounds since they tend to evaporate during the drying process [19]. Cultivars with intrinsically high volatile oil and a good aroma and flavour are the best choice. It is used for its antiseptic, aphrodisiac, laxative, stimulant and tonic properties and is often blended with other essential oils to produce many different mixtures for many different ailments. [20-21].

Ginger wine:

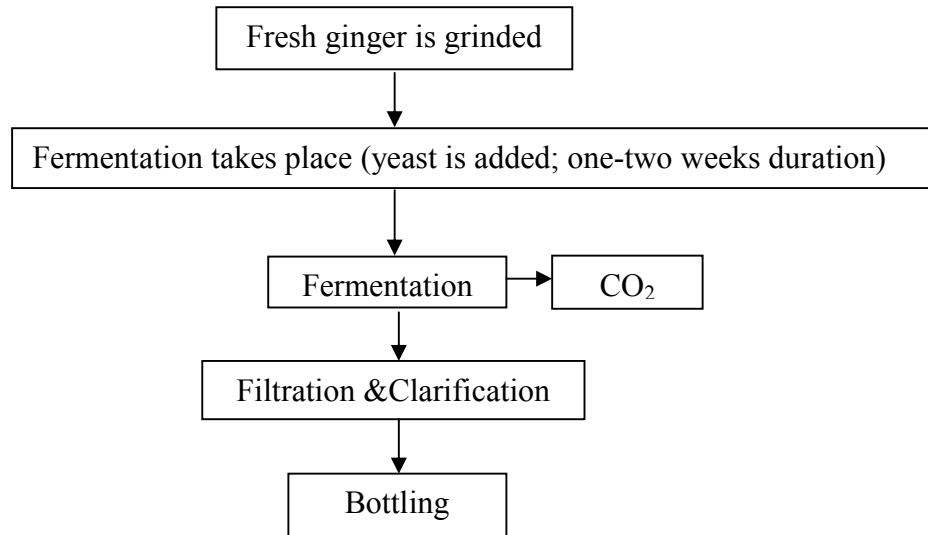


Fig.05: Process flow dia. of ginger wine

Ginger wine is an alcoholic beverages made from a fermented blend of ground ginger & raisins fermenting by the yeast, *Saccharomyces cerevisiae*. It is a popular beverage in Europe. For flavouring wine, ginger is used. It has many health benefits. Ginger wine can be taken by blending ginger with whisky, brandy or rum. [22-23].

Ginger paste:

Ginger paste is used as a spice in many food products for giving flavour & smell of ginger. It is used as an alternate of ginger. It can be stored for a long period of time without alteration in freshness & flavour [24-25].

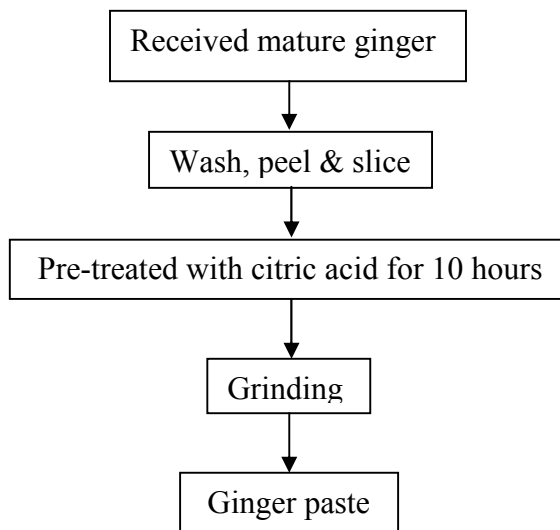


Fig.06: Process flow dia. of ginger paste

Ginger candy

Ginger candy or crystallized gingers, ginger in brine or syrup are the main types of preserved ginger. For this purpose less fibrous with mild pungency tendered ginger is best suited. Ginger candy is very popular in Australia and Japan [26-27]. It is also a favourite form of ginger in India as well like in northern part of country “*murabba*”.

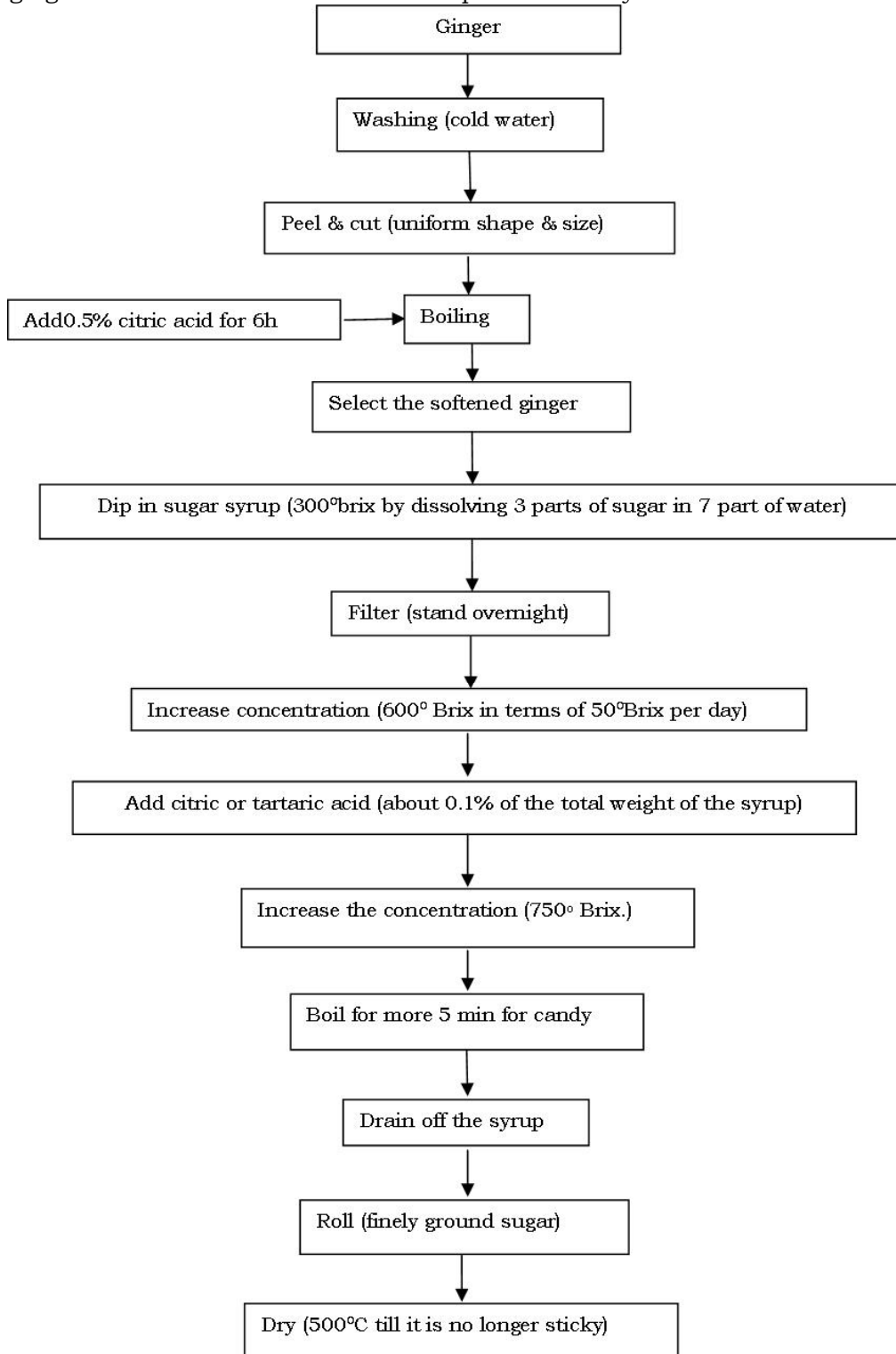


Fig.07: Process flow dia. of ginger candy

Ginger beer:

Ginger beer is carbonated, sweetened beverages produced in two types: alcoholic brewed ginger beer or carbonated soft drink flavoured with ginger and sweetened with sugar or artificial sweetener. The ginger beer soft drink is mixed with beer to make one type of with

dark rum to make a drink [28-29]. The most perfect small beer which has the similar in taste to the best champagne with sparkling bubbles in liquid.

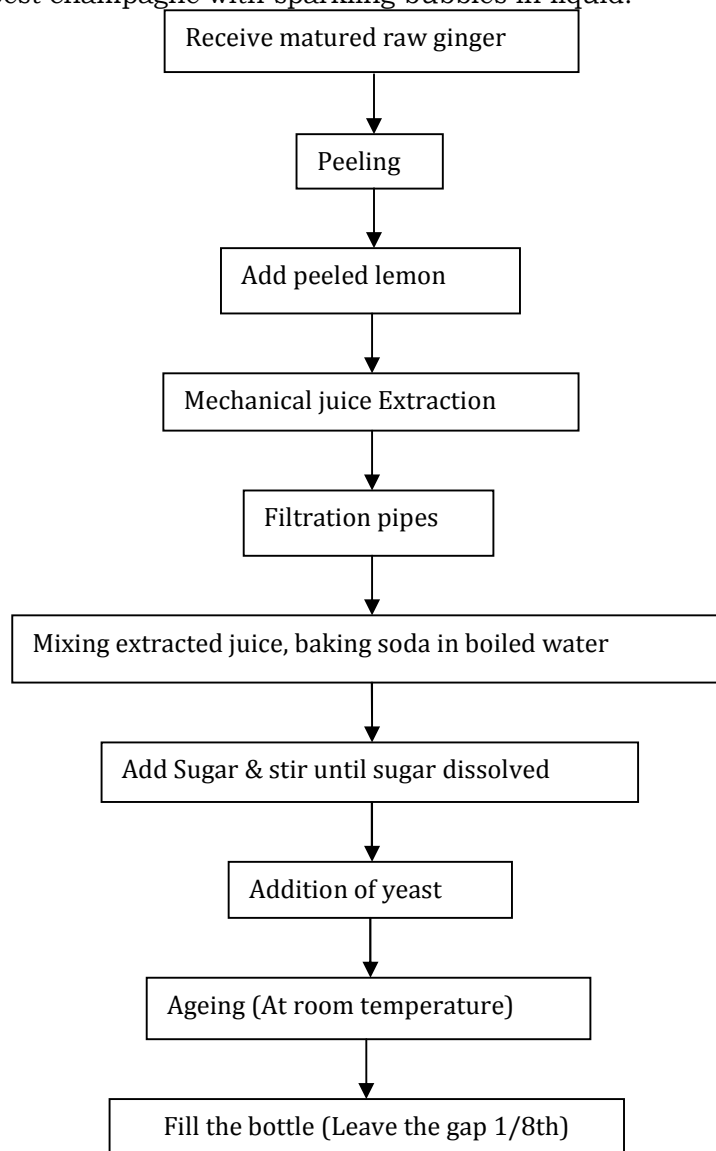


Fig.08: Process flow dia. of ginger beer

Ginger juice:

Ginger juice was used for storage studies at room temperature (25°C-27°C) from 0-4 months. The effect of storage time on physical properties such as colour, flavour and pungency of the juices. All the samples of ginger juice were in good condition up to 4 months of storage. The average analysis of ginger juice were analysed for moisture 94.97%, protein 1.08%, fat 1.17%, ash 0.71%, vitamin C(ascorbic acid) 15.67%, acidity 0.13% respectively [30].

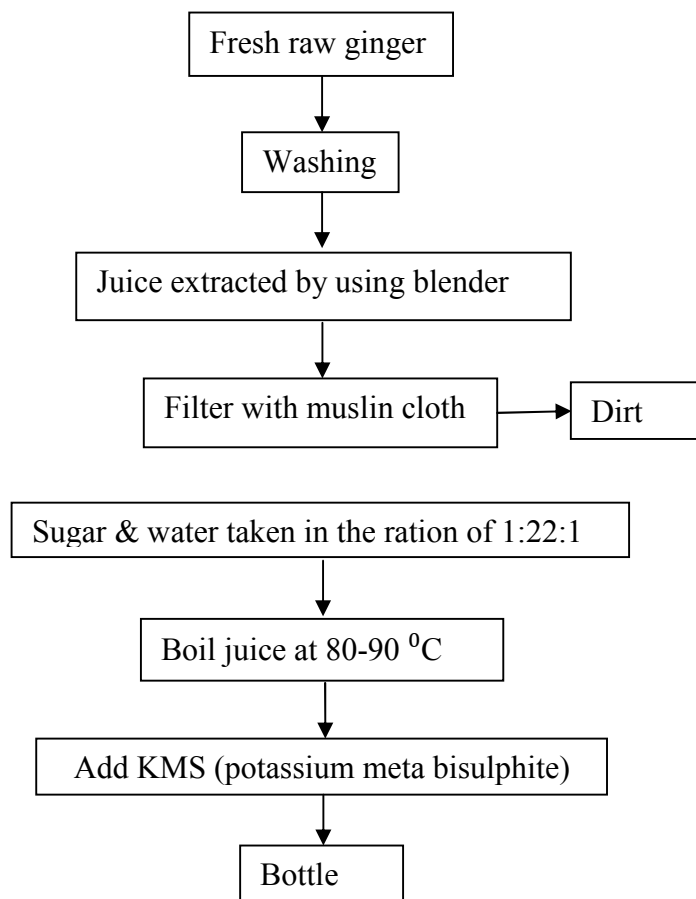


Fig.09: Process flow chart of ginger juice

CHEMICAL STRUCTURE OF ACTIVE CONSTITUENTS

Zingerone:

It is also called vanillylacetone. It is responsible for pungency taste in ginger & gives the sweet flavour of cooked ginger [31]. It has many biological activities such as Anti-oxidant activity, anti-inflammatory action, anti-bacterial properties, etc.

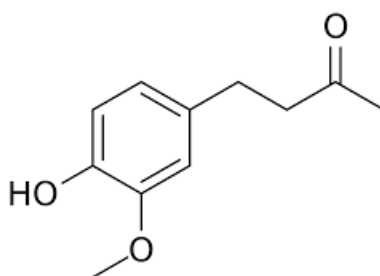


Fig.10: Zingerone chemical structure

Shagols

It possesses pungent properties of ginger. Shagol is obtained when dried or cooked. It is present in the form of [6]-shagol [31]. It has biological properties like Anti-oxidant & anti-inflammatory activity, [6]-shagol shows anti-cancer activity through the inhibition of cell invasion reduction of matrix, metalloproteinase-9 expression, anti-proliferation activity & anti-invasion.

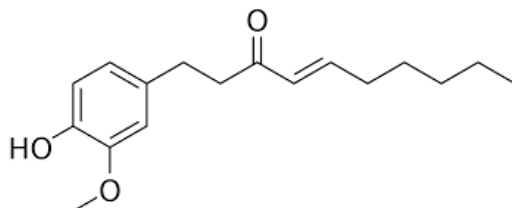


Fig.11: Shagols chemical structure

Paradol

Paradol, a natural constituent of ginger, is a potent COX-1 inhibitor and restricts platelet aggregation in human whole blood.[32] It possesses biological properties like Anti-oxidant, anti-canceroles, anti-microbial activities.

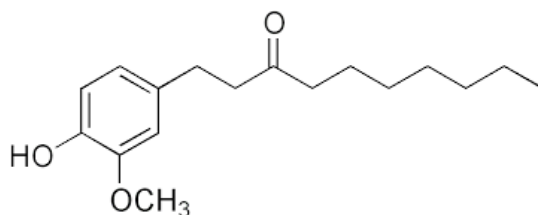


Fig.12: Paradol chemical structure

Gingerol

It is a active constituent of ginger & imparts less pungent & spicy sweet aroma. Gingerol is available as 8-gingerol, 10-gingerol, and 12-gingerolin ginger [33]. It is responsible for biological activities such as Anti-oxidant activity, anti-tumour activity, anti-inflammatory, anti-analgesic, anti microbial activity, hepato protective activity.

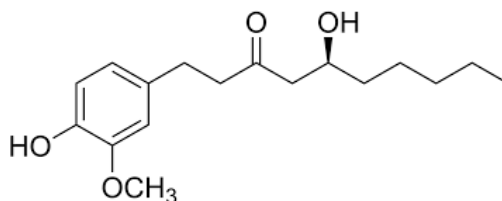


Fig.13: Gingerol chemical structure

1-dehydro-10-gingerdione

It is one of the compounds for pungency of ginger that mediates its suppression of NF- κ B-regulated expression of inflammatory genes linked to toll-like receptor (TLR)-mediated innate immunity [34]. It helps in regulation of inflammatory genes.

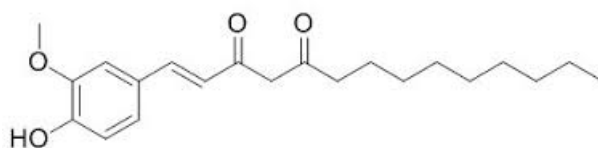


Fig.14:-dehydro-10-gingerdione

Terepnoids

It is a compound responsible for aroma, flavour & fragrance in ginger. It induces apoptosis by activation of p53.

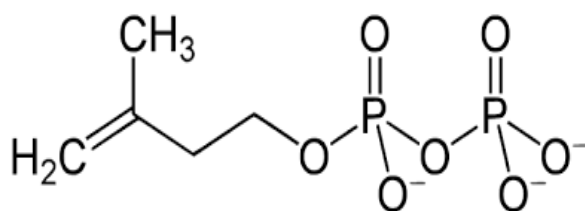


Fig.15: Terepnoid chemical structure

HEALTH BENEFITS OF GINGER

1. Arthritis: It reduces inflammatory eicosanoids without the side effects of other anti-inflammatory drugs and NSAIDS.
2. Heart and circulatory problems: The hormone responsible for blood clotting is bad eiconoids. The ginger inhibits this hormone which results in protection from stroke & heart attack. Its anti oxidant property makes the cardiac muscles strong & lowers the cholesterol.
3. Fever reducer: It can assist in lowering a fever. Its antibacterial/antiviral effects help to reduce the incidence of colds altogether.
4. Digestive problems: Ginger has the ability to absorb & neutralizes toxin in stomach. It improves the production & secretion of bile from the liver & gall bladder. It is recommended as alternative to aspirin, who cannot take aspirin [35].

MEDICINAL ASPECT OF GINGER

Ginger has many medicinal aspects in our daily life. It is used as carminative, pungent and stimulant spice under the conditions of indigestion, stomach-ache, malaria, fever, etc. Ginger forms an important part of many pharmacopoeia Ayurveda (Indian system of medicine) formulations. The ginger also has pharmacological activities in it. Some of the pharmacological activities of ginger are listed below:

Anti-inflammatory activity:

Gingerol and shogaol can also inhibit synthesis of pro-inflammatory cytokines[36]. In macrophages,[6] shogaol can down-regulate inflammatory inos and COX-2 gene expression.[37]. Ginger is showing anti-inflammatory effect by suppression of PG synthesis and also interference in cytokine signalling[38]. It is useful in treating inflammation and rheumatism according to Ayurveda[39]. Ginger powder is as effective as ibuprofen in the management of postsurgical sequelae. Ginger and coriander contain many chemical constituents which have anti-inflammatory effect against inflammation caused by gamma radiation [37-38, 40].

Antioxidant actions

Ginger and some specific constituents have demonstrated antioxidant effects in several cell culture systems [41]. Antioxidant helps to prevent all kind of disease and it also slower downs the aging process. Ginger was ranked number one among the five richest food sources of antioxidants, including berries, walnuts, sunflower seeds, and pomegranates. Test-tube and animal researches have shown that ginger inhibits the production of free radicals. Ginger also enhances the body's internal production of antioxidants [37, 42-43].

Anti microbial activity

Ginger well known of its antimicrobial activity against both gram positive and gram negative bacteria and some extent to antifungal due to gingerol, paradol, shogaols, zingerone [44,45-48]. It inhibits the growth of *Escherichia coli*, *Proteus sp*, *Staphylococci*, *Streptococci* and *Salmonella* [46]. Ginger has strong antibacterial activity and to some extent antifungal properties [48]. So that, it capable to retard the growth of *Aspergillus* sp, a fungus which produce aflatoxin. A carcinogen [47].

Gastrointestinal effect:

The bioactive compounds are accelerating the digestion, absorption vitamin; relieve constipation due to increasing muscular activity in the digestive tract. The 940 mg of ginger has effective in motion sickness that study was carried out in patient who suffered constipation [49]. The stomach acid production increases, due to gastro protective properties comes due to presence of shogaol and gingerol [50].

Storage

Ginger shelf life depend on the types of ginger variety, maturity, types of product, and the storage conditions such as relatively humidity, temperature of storage and place sanitation etc. The significant storage conditions and shelf life are listed below on the basis of product to be storage:

Fresh ginger

Fresh ginger should be stored in a cold and humid environment. However, cold storage may not always be available in the producing areas. Fresh ginger rhizome shelf life may be extended by storage at 10-12°C and high humidity.

CONCLUSION

This review tells about a general characterization of ginger. The various value added products available in the markets such as candy, wine, beer, powder, dried flakes and their processing aspect with flow diagram discussed. They have essential oil which also depict wide range of medicinal values. The refreshing pungent flavour and remedial property of ginger make it an vital ingredient of food processing throughout the world. It is one of the convenient food ingredients in the some beverage, catering and pharmaceutical industry such as hotel, restaurant, canteens, medicines etc. The review is helpful for research scholars, scientist and academicians those who working on ginger processing and value addition.

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