



PM Formalisation of Micro Food Processing Enterprises Scheme

Processing of Ginger Powder



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CHAPTER 1

INTRODUCTION

1.1. Status and Market Size

India is called as “spice bowl of the world” for its production of variety and superior quality spices. Ginger (*Zingiber officinale*) is a member of the family of plants that includes cardamom and ginger. Growing of spices for various purposes has been famous since the ancient times. There are records about its various properties in Vedas as early as 6000 BC. India is known for trade since the exploration of sea routes. Ginger is grown primarily in Asia and tropical areas and, in addition to its culinary function, has been used since ancient times for a variety of conditions, including colds, fevers, and digestive problems, and as an appetite stimulant. All these attracted the foreigners to India and this was the key reason why India invaded by European countries and was imperialized. To such an extent India was famous for the spices. According to the Bureau of Indian Standards (BIS), spices are grown in India. The spices are grown throughout the country from tropical to temperate climate. India has highest number of spice varieties in the world. Ginger has been used for centuries to treat a variety of maladies, particularly in non-Western cultures. Today, ginger is used around the world as a dietary supplement and food ingredient. The strong aroma of ginger is the result of pungent ketones including gingerol, the extract that primarily has been used in research studies. The consumed portion of the ginger plant is the rhizome, often called “ginger root,” although it is not actually a root. The rhizome is the horizontal stem of the plant that sends out the roots.

1.1.1. Socioeconomic importance

Ginger is consumed worldwide as spice, flavoring agent, garnish, medicine, and food preservative and is used either fresh, in a fresh paste, or dry, in a dry powder. Fresh ginger can be substituted for dried ground ginger, although the flavors of fresh and dried ginger are somewhat different. Powdered dry ginger is typically used as a flavoring for recipes such as gingerbread, cookies, crackers and cakes, ginger ale, and beer. The fragrance of ginger is penetrating and aromatic. It tastes spicy, hot, and biting and is an integral part of almost all the cuisines of the world. The pungent, spicy sweetness of ginger adds a unique taste to many recipes ranging from sweet to savory. In the subcontinents (India and Pakistan) ginger is called Adrak(local name) and is an essential ingredient of

many dishes. Fresh ginger is one of the main spices used for making pulse, vegetable curries and meat preparations. Fresh as well as dried ginger is used to spice tea and coffee, especially in winter. Traditional uses in India include to improve digestion, to improve intestinal flora, to eliminate worms, to relieve gas, to cleanse and strengthen the liver and gallbladder, to normalize menstruation, for relief of arthritis and swelling, as a blood purifier, to warm and promote proper metabolism correcting both excesses and deficiencies, for local application on sprains, for soothing action in cough and asthma, as antibacterial and anti-fungus, and in any condition of weakness or debility.

1.1.2. Commercially grown varieties

Several cultivars of ginger are grown in different ginger growing areas in India and they are generally named after the localities where they are grown. Some of the prominent indigenous cultivars are Maran, Kuruppampadi, Ernad, Wayanad, Himachal and Nadia. The exotic cultivar 'Rio - de - Janeiro' have also become very popular among cultivators. The improved varieties of ginger and their salient features are given below. The variety IISR Varada is suited for fresh ginger, dry ginger and making candy while, IISR Rejatha is rich in essential oil.

Table 1: Yield characteristics of improved Ginger varieties

Variety	Fresh mean yield (t/ha)	Maturity (days)	Dry recovery (%)	Crude fibre (%)	Oleoresin (%)	Essential oil (%)
Indian Institute of Spices Research, Kozhikode, Kerala						
IISR Varada	22.6	200	20.7	4.5	6.7	1.8
IISR Mahima	23.2	200	23.0	3.3	4.5	1.7
IISR Rejatha	22.4	200	19.0	4.0	6.3	2.4

High Altitude Research Station, Orissa University of Agriculture and Technology, Orissa						
Suprabha	16.6	229	20.5	4.4	8.9	1.9
Suruchi	11.6	218	23.5	3.8	10.0	2.0
Suravi	17.5	23.5	23.5	4.0	10.2	2.1
Subhada	18.0	210	22.4	3.4	10.4	2.0
Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan						
Himagiri	13.5	230	20.6	6.4	4.3	1.6
Kerala Agricultural University, Thrissur, Kerala						
Athira	21.0	220 - 240	22.6	3.4	6.8	3.1
Karthika	19.0	220 - 240	21.6	3.7	7.2	3.2
Aswathy	23.0	220 - 240	19.7	3.5	7.5	3.3

1.1.3. Cultivation Scenario

It cultivated by all tropical and subtropical countries in the world, much of it is produced in India. By almost 30 percent to 40 percent of world production is produced in India. In India, states like Kerala, Arunachal Pradesh, Orissa, Meghalaya, West Bengal are widely cultivated and, Tamil Nadu, Andhra Pradesh and Karnataka are cultivated in the lower area. In Tamil Nadu highly rain fall districts like Kanyakumari and lower Palani hills where the ginger cultivated.

The ginger family is a tropical group, especially abundant in Indo-Malaysian region, consisting of more than 1200 plant species in 53 genera. The area under cultivation in India is 107.54 thousand ha and the total production of the country is 385.33 thousand tons.

The total production of ginger in the world is 1683.00 thousand tons with the total acreage of 310.43 thousand ha. China, India, Nepal and Thailand are the major producers of ginger in the world, having production of 396.60 thousand tons, 385.33 thousand tons, 210.79 thousand tons and 172.68 thousand tons respectively. India and Indonesia have the largest area under cultivation.

1.1.4. Production status of Ginger

India is the largest producer and consumer of ginger contributing about 31% of total global production followed by China, Nepal, Indonesia, Nigeria, and Thailand. India produces 6,83,000 tons of ginger per annum that is almost 1/3rd of world's total production. 30 per cent of total production of ginger in India is transferred to dry ginger, 50 per cent is taken as fresh or green ginger and the rest part is used as seed materials. Kerala is the largest producer of dry ginger in India, which has taken a major share in export

Table 2: Area, production and productivity of Ginger in India

Years	Area (In ' 000 Hectare)	Production (In ' 000 MT)	Productivity (In MT/Hectare)
1997-98	75.60	252.10	3.3
1998-99	77.80	265.30	3.4
1999-2000	77.50	281.50	3.6
2000-01	83.40	303.40	3.6
2001-02	84.60	317.90	3.8
2002-03	85.90	307.40	3.6
2003-04	85.10	301.90	3.5
2004-05	95.30	359.00	3.8
2005-06	110.60	391.20	3.5
2006-07	106.10	393.40	3.7
2007-08	104.10	382.60	3.7
2008-09	143.90	610.40	4.2
2009-10	142.10	679.30	4.8
2010-11	167.40	702.00	4.2
2011-12	155.10	755.60	4.9
2012-13	136.30	682.60	5.0
2013-14	132.60	655.10	4.9
2014-15	141.70	760.30	5.4
2015-16	164.00	1109.00	6.8
2016-17	168.00	1076.00	6.4

Source: Spices Board, India & Ministry of Agriculture and Farmers Welfare, Go

1.1.5. Production and yield of Ginger in major states in India

Orissa, Kerala, Karnataka, Arunachal Pradesh, West Bengal, Sikkim and Madhya Pradesh are the major ginger producing states in India. Among which Kerala contribute 33 per cent to the total production by which it becomes the largest ginger producing state in India. Cochin ginger and Calicut ginger are the popular Indian ginger varieties in the world market.

Table 3: State-wise share in area and production

State	Area	Percent share	Production	Percent share
Assam	18733	11.36	166536	15.40
Gujarat	6500	3.94	100500	9.29
Karnataka	29285	17.76	109340	10.11
Madhya Pradesh	7650	4.64	56575	5.23
Meghalaya	9936	6.03	66366	6.14
Sikkim	12300	7.46	55900	5.17
Orissa	14200	8.61	34230	3.17
Mizoram	8207	4.98	59994	5.55
West Bengal	13000	7.89	138000	12.76
Uttaranchal	2055	1.25	19599	1.81
Kerala	4500	2.73	20000	1.85
Andhra Pradesh	509	0.31	1770	0.16
Telangana	2500	1.52	12340	1.14
Others	35475	21.52	240280	22.22
Total	164850	100.00	1081430	100.00

1.1.6. Composition & Nutritive Value of Ginger

Table 4: Composition of Ginger (100 g edible portion), fresh weight basis

Nutrients	Quantity per 100g
Energy	69(Kcal)
Moisture	80.9(g)
Protein	2.3 (g)
Fat	0.9 (g)

Ash	1.2(g)
Crude fibre	2.4(g)
Carbohydrate	12.3 (g)
Calcium	20 (mg)
Phosporous	60 (mg)
Iron	3.5(mg)

Source: NIN,2019

Table 5: Nutritive value of Ginger

Vitamins		
Nutrient	Amount	DV
Choline	28.8 mg	
Folate	11.00 mcg	
Folic acid	0.00 mcg	
Niacin	0.750 mg	5 %
Pantothenic acid	0.203 mg	4 %
Riboflavin	0.034 mg	3 %
Thiamin	0.025 mg	2 %
Vitamin A	0.00 IU	0 %
Vitamin A, RAE	0.00 mcg	
Carotene, alpha	0.00 mcg	
Carotene, beta	0.00 mcg	
Cryptoxanthin, beta	0.00 mcg	
Lutein + zeaxanthin	0.00 mcg	
Lycopene	0.00 mcg	
Vitamin B12	0.00 mcg	0 %
Vitamin B12, added	0.00 mcg	
Vitamin B6	0.160 mg	12 %
Vitamin C	5.0 mg	6 %
Vitamin D	0.00 mcg	0 %
Vitamin E (alpha-tocopherol)	0.26 mg	1 %
Vitamin E, added	0.00 mg	
Vitamin K	0.1 mcg	0 %
Minerals		
Calcium, Ca	16.00 mg	1 %
Copper, Cu	0.226 mg	25 %
Iron, Fe	0.60 mg	3 %
Magnesium, Mg	43.00 mg	11 %
Manganese, Mn	0.229 mg	10 %

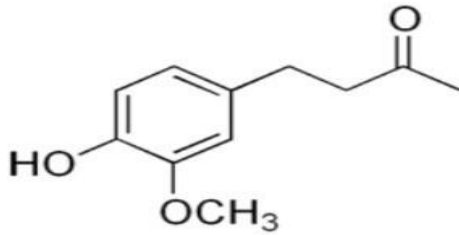
Phosphorus, P	34.00 mg	5 %
Potassium, K	415.00 mg	9 %
Selenium, Se	0.7 mcg	1 %
Sodium, Na	13.00 mg	1 %
Zinc, Zn	0.34 mg	3 %
Proteins and Aminoacids		
Protein	1.82 g	4 %
Alanine	0.031 g	
Arginine	0.043 g	
Aspartic acid	0.208 g	
Cystine	0.008 g	
Glutamic acid	0.162 g	
Glycine	0.043 g	
Histidine	0.030 g	4 %
Isoleucine	0.051 g	4 %
Leucine	0.074 g	3 %
Lysine	0.057 g	3 %
Methionine	0.013 g	
Phenylalanine	0.045 g	
Proline	0.041 g	
Serine	0.045 g	
Threonine	0.036 g	3 %
Tryptophan	0.012 g	4 %
Tyrosine	0.020 g	
Valine	0.073 g	4 %
Phenylalanine + Tyrosine	0.065 g	4 %
Methionine + Cysteine	0.013 g	1 %

Source: USDA National Nutrient Database

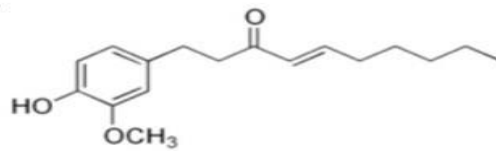
Phytochemical composition

The main pungent compounds in fresh ginger are gingerols, whereas the pungency of dry ginger is mainly due to shogaols, for example shogaol, which are dehydrated forms of gingerols. Most abundant gingerol found in ginger is-gingerol. Other gingerols with different chain lengths are also present in comparatively small quantities. they have identified 51 compounds on organically grown fresh ginger, 31 compounds were previously reported as constituents of ginger and additional 20 are yet to be characterized. The identified compounds included gingerols, shogaols, paradols, dihydroparadols, dihydroshogaols, acetyl derivatives of gingerols,

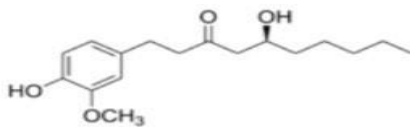
gingerdiols, mono- and di-acetyl derivatives of gingerdiols, 1-dehydrogingerdiolones, diarylheptanoids, zingiberene, phellandrene and methyl ether derivatives of some of these compounds. In addition to gingerol, gingerol were identified. the substituents on the alkyl chain of gingerol and related compounds might contribute to antioxidant properties. Over 50 components in ginger oil have been characterized and these are mainly monoterpenoids and sesquiterpenoids.



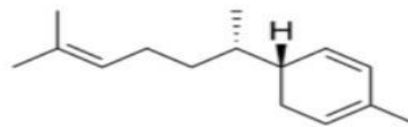
Gingerone



Shogaol



Gingerirole



Gingerbene

1.1.7. Health benefits of Ginger

1. Reduces Cold and Flu

Winter is the best climate to sip a hot cup of ginger tea and this will automatically stabilize your body condition and keep you warm. It enables to sweat once consume it and this is said to be good for our body. So, if you are suffering from a bad cold and flu all need to do is to prepare some ginger tea and feel better in no time.

2. Good for Heart

Ginger is good for heart such that it reduces cholesterol and lowers risk of having any sort of blood clots. Most importantly, it regulates blood sugar levels. Ginger can in future become an integral medicine for treating diabetes and heart diseases.

3. Treats Inflammation

Inflammation is said to be the process wherein white blood cells protects from infection and viruses. But sometimes this may go wrong and cause severe joint pain and so forth. In this process, our bodies immune system begins to cause damage to

its own tissues thus resulting in inflammation. Ginger consists of anti-inflammatory components and antioxidants that can cure inflammation.

4. Prevents Cancer

Ginger was very effective in blocking prostate cancer cells and their growth. However, due to its anti-inflammatory properties, it is able to reduce the risks of cancer.

5. Improves Brain Functionality

The anti-inflammatory properties available in ginger helps in good brain functionality. It basically increases the presence of mind. Ginger root can improve cognitive function.

6. Treats Severe Indigestion

Severe indigestion is also called chronic digestion or dyspepsia that involves re-emerging pain and severe discomfort in the upper part of stomach. If stomach does not empty itself soon, it causes indigestion and this scenario ginger empty the stomach faster and prevent indigestion.

7. Protects the Liver

Ginger protects the liver from harmful chemicals. It also reduces the risks of liver from ageing. There are heavy metal and drugs that get sedimented on liver. Most importantly it protects the liver from damaging and scaring.

8. Reduces Cholesterol Levels

Ginger reduces cholesterol that is linked to having a high risk of heart diseases.

9. Treats Osteoarthritis

Osteoarthritis is commonly found among most old people wherein people suffer from severe joint pain and stiffness in the joints. Ginger prevent the bone damage.

1.1.8. Medicinal properties of Ginger

1. Digestive System

Gastrointestinal Relief

Historically, ginger has a long tradition of efficacy in alleviating symptoms of gastrointestinal disorders. In herbal medicine, ginger is regarded as an excellent carminative (a substance which promotes the elimination of intestinal gases) and intestinal spasmolytic (a substance which relaxes and soothes the intestinal tract). It reduces colon spasms and cramps, is excellent for nausea,

vomiting, and motion sickness, stimulates production of digestive juices, helps bowel disorders, and acts as a colon cleanser. Ginger has a sialagogue action, stimulating the production of saliva, which makes swallowing easier. In addition to that, it acts as an appetizer and stomachic. The main stomachic constituents present in ginger are zinzibereine and gingeirol. A famous Ayurvedic drug trikatu, which is used against digestive disorders, contains ginger as the main constituent. Ginger acts as a purgative. Fresh ginger helps to remove constipation while dry ginger powder is a fecal astringent, meaning it dries up the watery portion of the feces and causes constipation.

Dyspepsia

Ginger stimulates the flow of saliva, bile, and gastric secretions and therefore is traditionally used to stimulate appetite, reduce flatulence, colic, and gastrointestinal spasms, and generally act as a digestive aid. Gingerols inhibit the growth of *Helicobacter pylori* associated with dyspepsia, peptic ulcer disease, and the development of gastric and colon cancer.

Anti-ulcerogenic

Ginger is a cytoprotective and anti-ulcerogenic agent. The main anti-ulcerogenic constituents present in ginger are 6 gingesulfonic acid, 6 gingerol, 6 shogol, beta-sesquiphellandrene, beta-bisabolene, gingesulfonicacid, curcumene, and 6 gingglycoprotein A, B and C. Of the anti-ulcerogenic constituents, 6 gingesulfonicacid is the most potent. These constituents protect gastric mucosa against alcohol, non-steroidal anti-inflammatory drugs, and hydrochloric acid. In mice, zingiberene and gingerol significantly reduced gastric ulceration experimentally induced by ethanol and hydrochloric acid.

2. Respiratory System

Ginger can be used for throat infections and to relieve congestion in sinusitis. It reduces fever in colds and flu and suppresses a dry, irritating cough in laryngitis by increasing human bronchial smooth muscle cell migration and proliferation and reversing phthalate ester-mediated airway remodeling. Moreover, (6)-shogaol, (6)-gingerol, (8)-gingerol, and (10)-gingerol, which are major bioactive compounds present in ginger, suppress phthalate ester-

mediated airway remodeling, which shows that ginger is capable of preventing phthalate ester-associated asthma.

3. Circulatory System

Ginger stimulates circulation, may help prevent heart attacks, has natural blood thinning properties, lowers blood cholesterol levels, cleanses and stimulates blood supply, prevents internal blood clots, may prevent mini strokes, acts therapeutically to reduce hypertension, and prevents oxidation of LDL which contributes to cholesterol deposits on artery walls. Ginger has a tonic effect on the heart, and may lower blood pressure by restricting blood flow in peripheral areas of the body. Ginger can lower cholesterol levels by reducing cholesterol absorption in the blood and liver.

4. Cardiovascular Effect

Fresh ginger exhibits hypotensive properties by endothelium dependent (cholinergic) and endothelium-independent vasodilator pathways. Fresh ginger extract lowers blood pressure through cholinergic and calcium blocking properties and possesses a combination of cardio-suppressant and cardio-stimulant action in experimental animals. Cholinergic compounds are known to cause a fall in blood pressure by activation of muscarinic receptors located on the epithelium of blood vessels. Furthermore, the pungent components of ginger, namely 6-gingerole, 8-gingerole, 10-gingerole and 6-shogaol, exhibit a vasodilator effect through a combination of a nitric oxide releasing and calcium antagonist mechanism. Ginger also contains saponins, terpenoids, flavonoids, amino acids/peptides, secondary amines, and alkaloids. These compounds demonstrate hypotensive and vasodilator properties and could be the causative agents in the reduction in blood pressure.

5. Antithrombotic Activity

Ginger has been shown to exhibit antithrombotic activity because it inhibits platelet aggregation and thromboxane. Shogaol appeared to be a preferential inhibitor of 5-HETE formation, while gingerol and dehydroparadol favored the inhibition of cyclooxygenase.

6. Nervous System

Alzheimer's Disease

6-Gingerol attenuates amyloid-induced oxidative cell death via fortifying cellular antioxidant defense systems. Amyloid is involved in the formation of senile plaques, the typical neuropathological marker for Alzheimer's disease and to cause apoptosis in neurons via oxidative and/or nitrosative stress. 6-Gingerol pre-treatment can protect cytotoxicity. Gingerol is also known to suppress intracellular accumulation of reactive oxygen and/or nitrogen species and to restore depleted endogenous antioxidant glutathione levels.

7. Anti-Inflammatory Properties

Ginger is useful in treating inflammation, pain, and rheumatism. The anti-inflammatory properties of ginger have been known and valued for centuries . It is believed that consuming ginger regularly can reduce pain level and increase mobility in osteoarthritis or rheumatoid arthritis patients. Although no one single constituent seems to be responsible for the anti-inflammatory effects of ginger, shogaol has exhibited the most potent antioxidant and anti-inflammatory properties which can be attributed to the presence of its alpha,beta-unsaturated ketone moiety. The carbon chain length has also played a significant role in making 10-gingerol the most potent among all the gingerols. An acetone extract containing gingerols, shogaols, and minor compounds like gingerenone A, [6]-gingerdiol, hexahydrocurcumin, and zingerone have anti-inflammatory effects.

1.2. Indian Market Outlook

Currently, India is the major producer of Ginger, and it is also the major user of its own production. Nowadays, with rising health-consciousness, consumers across the globe are preferring nutrition-rich food products, which is providing a boost to the growing popularity of processed ginger. In the food industry, the powdered form of ginger is widely used as a condiment or flavoring agent in salad dressings, tomato ketchup and sauces, pickles, gravies, meat sausages and curry dishes. Other than this, ginger powder is regarded as an excellent carminative ingredient that reduces intestinal gas. As a result, they are used in the treatment of a number of disorders in ayurvedic medicines. Also, the regular consumption of processed ginger products reduces the risk of diabetes, obesity, heart diseases, resulting in

increased energy, reduced weight and a healthy complexion. Ginger powder is also utilized for adding fragrance in soaps and personal care products. Moreover, the oil obtained from ginger is mainly employed in the flavoring of beverages, confectioneries and perfumes.

India holds fifth to seventh position in Global ginger export market, on an average. Our nation ranks number one in production globally. The traditional exports markets for India are Pakistan and Bangladesh, Saudi Arabia, the United Arab Emirates, Morocco, the United States, Yemen Republic, the United Kingdom, and the Netherlands. More than 50% of total ginger production is contributed from states of North East, Uttarkhand and Sikkim. Most of ginger in North Eastern states is produced under organic conditions.

Nearly 10 per cent of India's production of 1.5-2 mt is converted into dry ginger, which is estimated to be close to 1.9 lakh tonne. A large share of dry ginger is exported.

Absence of adequate number of post harvest processing units to absorb marketable surplus (which is nearly 70per cent) forces the cultivators to sell the produce as fresh only. Unorganised marketing system is another constraint determining the low adoption of improved production packages and enhancing the productivity system. Establishment of processing units is needed to absorb the market surplus and produce value added products that have longer shelf life. The need of the hour is also to have a simplified and affordable organic certification system

1.3. Value added products from Ginger

1.3.1. Primary products

a. Dried ginger

Dried ginger is the most important product in terms of trade after fresh ginger. Dried ginger is the raw material to make ginger powder and also for ginger oil and oleoresin extraction. It is obtained by drying of fully matured rhizomes, harvested at an age of 8 to 9 month. At this age the rhizomes have fully developed flavor, aroma and pungency. By converting in to dried form, ginger can be preserved for longer time. Dried ginger can be exported in two different forms, one is as whole peeled and other one is as sliced unpeeled. Chinese dried ginger has more export potential than

Indian ginger because of its bright color and more fibrous characteristics. The volatile oil and fiber content, the pungency level, aroma and flavor are need to be assessed for quality assurance of the dried form of ginger. Lower grades of coated whole, clean peeled, split and sliced types are used for blending in the preparation of powdered mixed spices. Varieties with high dry recovery percentage (>20 %), bold fingers and low fiber content (<4 %) are required for dry ginger production. Cochin and Calicut dry ginger exported from Kerala are two popular variety of India, produced from local cultivars, i.e. Kuruppampady, Cheranad, Erenad and Wayand local. Dried ginger can be used directly as a spice after grinding and also used for the extraction of ginger oleoresin and ginger oil. The yield of dry ginger is 16-25% of the green ginger. Dried ginger is available in different forms like the whole dried ginger, splits or slices and its quality greatly depends on the method of drying.

b. Ginger powder

Ginger powder is rarely used in its pure form but it is an important ingredient of curry powder. It is also used in ginger wine, ginger beer and baked goods. Ginger powder can be found after grinding the dry ginger. So for ginger powder the main raw material is dry ginger. Ginger powder can be used as pharmaceuticals and used for the production of herbal medicines. It also used as food additive. Ginger powder also has a very good export market.

1.3.2. Secondary products

a. Ginger paste

Select good quality ginger, cut it into pieces and blend into a thick paste. Add vegetable oil (60 ml in 1 kg of paste) to the paste. Cook it for 5 minutes with continuous stirring. After it the ginger paste should packed in sterilized jar leaving a headspace of 5-10 mm. Before sealing ensure to add one teaspoon of warm oil on the surface of paste. Then the packed ginger paste should be pasteurized at 85-90°C for 10 min. Finally cool, level and store the ginger paste in a dry and cool place. In India a ginger-garlic paste is very popular which is generally made with 50% macerated and sliced ginger, 35% garlic and 15% salt in traditional procedure. Nowadays, it is available to the consumers in suitable packing with improved shelf-life of 12 month.

c. Ginger syrup

Ginger syrup can be made by using tender rhizomes. It can be used as an antiemetic agent and recommended for pregnant women. Using ginger syrup we can make soda by adding lemon juice in to it. It is also widely used as a flavoring agent in many food and beverages

d. Ginger oil

Oil can be obtained from ginger mainly by two methods that are steam distillation and solvent extraction; steam distillation method is mostly used. Oil is contained in epidermal tissue of ginger and the odor in the oil is due to the presence of essential oils which posses aroma and flavor but not pungency. The oil is commercially produced in all around the world by major spice producing countries notably in China, India, Australia, Jamaica and Indonesia. It has reported that the essential oil from fresh ginger is of better quality than that from dry ginger with respect to fragrant flavor. It is also stated Shogaol and gingerol are useful in foods, medicines, quasi-drugs, and cosmetics. Gingerols can be separated with high purity from zinger by high-speed counter-current chromatography using stepwise elution. The oil can also be obtained from the ginger peel. The color content of the oil is generally yellowish and green in color with characteristic aroma and flavor. Ginger oil is used as a flavorant in food processing, pharmaceuticals and also in perfumery.

e. Ginger oleoresin

Oleoresin is the extract of ginger containing both volatile oil and pungent components. The Normally 15 to 35% of volatile oil is present in ginger oleoresin. Commercially it is known as gingerin. The average yield of oleoresin from ginger is 6.5% which may be ranging from 3.9 to 9.3%.

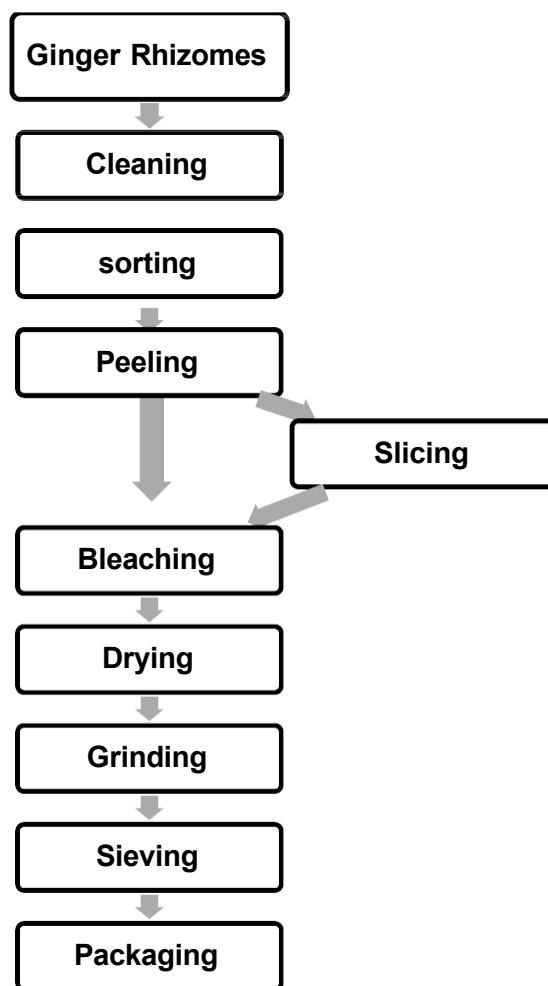
f. Preserved ginger

Ginger candy or crystallized ginger, ginger in brine or syrup is the main types of preserved ginger. For this purpose less fibrous with mild pungency tendered ginger is best suited. Preserved ginger is very popular in Australia and Japan. It is also a favorite form of ginger in India as well like in northern part of country murabba is a choice of many. In India the quality of ginger used for preparation of preserved ginger is not satisfactory even if it is the largest country as per the production is concern. Dipping in brine or syrup with dissolving sugar is the best method has been adopted in India for making preserved ginger

CHAPTER 2

Processing of Ginger Powder

2.1. Process Flow chart for Production of Ginger Powder



2.2. Harvesting

Ginger attains full maturity in 210-240 days after planting. Harvesting of ginger for vegetable purpose starts after 180 days based on the demand. However, for making dry ginger, the matured rhizomes are harvested at full maturity i.e. when the leaves turn yellow and start drying. Irrigation is stopped one month before harvest and the rhizome clumps are lifted carefully with a spade or digging fork. In large scale cultivations, tractor or power tiller drawn harvesters are also used. The dry leaves,

roots and soil adhering on the rhizomes are manually separated. Late harvest is also practiced, as the crop does not deteriorate by leaving it for some months underground. In India, domestic market prefers fresh green ginger for culinary use while two types of dried ginger i.e. bleached and unbleached are produced for export purpose. The most important criteria in assessing the suitability of ginger rhizomes for particular processing purposes is the fibre content, volatile-oil content and the pungency level. The relative abundance of these three components in the fresh rhizome is governed by its state of maturity at harvest.

Stage of harvest of ginger for various end uses

End use	Stage of harvest (months after planting)
Vegetable purpose and preparation of ginger preserve, candy, soft drinks, pickles and alcoholic beverages	5-6
Dried ginger and preparation of ginger oil, oleoresin, dehydrated and bleached ginger	7-8

2.3. Cleaning and Washing

The fingers and mothers are separated and ginger washers are used to clean the ginger. Cleaning of harvested rhizomes should be necessary to remove debris, shoots and roots. Thorough cleaning of rhizome required immediately after harvest if ginger intended for export or for long-term storage. Killing of rhizome was being followed by traditional method, in which rhizomes were dipped in boiling water for 10 min. This method is useful in inactivation of enzymatic processes. In ginger washer water is sprayed from the top of the washer to remove the impurities.

2.4. Sorting

Sorting is the process of grouping according to size, shape, weight, image and color. So in this process all the damaged and injured rhizomes got separated and the rhizomes are kept separated depending upon the similarity in size and shape. Clean,

brown-yellow and bright colored ginger should prefer. Ruptured or blot skin with bacterial or fungal infected rhizome are not recommended

2.5. Peeling

Peeling serves to remove the scaly epidermis and facilitate drying. Peeling of fully matured rhizomes is done by scrapping the outer skin with bamboo splits having pointed ends and this accelerates the drying process. Deep scraping with knives should be avoided to prevent the damage of oil bearing cells which are present just below the outer skin. Excessive peeling will result in the reduction of essential oil content of the dried produce. The peeled rhizomes are washed before drying. The dry ginger so obtained is valued for its aroma, flavour and pungency. Indian dried gingers are usually rough peeled when compared to Jamaican gingers, which are clean peeled. The rhizomes are peeled only on the flat sides and much of the skin in between the fingers remains intact. The dry ginger so produced is known as the rough peeled or unbleached ginger and bulk of the ginger produced in Kerala are of this quality.

2.6. Bleaching

The scrapped fresh ginger is dipped in a slurry of slaked lime, Ca(OH)_2 , (1 kg of slaked lime/120 kg of water) followed by sun drying. As the water adhering to the rhizomes dry, the ginger is again dipped in the slurry. This process is repeated until the rhizomes become uniformly white in colour. Dry ginger can also be bleached by the similar process. Liming gives ginger a better appearance and less susceptibility to the attack of insect pests during storage and shipping.

2.7. Drying

The moisture content of fresh ginger at harvest is about 80-82 per cent which is brought down up to 10 per cent for its safe storage. The yield of dry ginger is about 19-25 per cent of fresh ginger depending on the variety and climatic zone.

Generally ginger is sun dried in a single layer in open yard or clean bamboo mats or on a concrete floor which takes about 8 to 10 days for complete drying (final moisture content of 10 %). The sun dried ginger is brown in colour with irregular wrinkled surface.

In rainy conditions, a mechanical drier such as a tray drier should be used to accelerate the drying process. Using a mechanical drier will result in a better colour and a higher quality product. There are several different types of mechanical drier that are suitable for drying Ginger. These include the tray drier, cross flow air tunnels, solar driers and cabinet driers.

The optimum drying temperature is 60°C temperature higher than this result in a darker coloured product. Sliced ginger pieces take only 5-6 hours to dry when a hot air drier is used. Whole peeled ginger rhizomes take about 16-18 hours to dry in a mechanical drier. It is important to monitor the air flow and temperature during drying.

The rhizomes may be sliced before drying to reduce the drying time and improve the quality of the final product (it is easier to achieve a lower final moisture content in small pieces of rhizome without spoiling the appearance of the product). The rhizomes are traditionally sliced by hand, but there are small machines available to carry out this process.

2.8. Milling/ grinding

Grinding is one of the most common operations used to prepare Ginger powder for consumption and resale. The main aim of particular spice grinding is to obtain smaller particle sizes, with good product quality in terms of flavour and color. There are different ambient grinding mills and methods available for this process; such as hammer mill, attrition mill and pin mill. In India, traditionally, plate mills and hammer mills are used for Ginger grinding.

CHAPTER 3

Packaging of Ginger Powder

3.1. Deteriorating factors

In order to select a suitable packaging material/ type of package for Ginger powders, it is essential to know the factors which affect the quality of Ginger powder.

3.1.1. Moisture Content

Ginger powder is hygroscopic in nature and picks-up moisture from the atmosphere resulting in sogginess and caking/ lumping of the powder. Pick-up of moisture also results in loss of free-flowing nature of the Ginger powder.

3.1.2. Loss of Aroma / Flavour

Ginger powder contains volatile oils, which impart the characteristic aroma/flavour to the product. Losses in the volatile oil content or oxidation of some aromatic compounds result in aroma and flavour loss.

3.1.3. Discolouration

Ginger powders contain natural pigments. Light can affect the pigments resulting in loss or fading of colour and deterioration.

3.1.4. Insect Infestation

Ginger powder is prone to spoilage due to insect infestation, which can be further accelerated due to high humidity, heat and oxygen.

3.1.5. Microbial Contamination

In high humidity condition of 65% and above, moisture absorption occurs. Beyond a certain level of moisture content, spoilage due to microbial growth sets in.

3.2. Packaging requirements of Ginger powder

In order to maintain the quality of the Ginger powder during handling, transportation, storage and distribution, the packaging material to be used is to be selected with care, keeping in mind the functional as well as the marketing requirements.

The packaging requirements for Ginger powder, in general, are listed below:

- To protect the product from spillage and spoilage.
- To provide protection against atmospheric factors such as light, heat, humidity and oxygen. The selected packaging materials should have high water vapour and oxygen barriers.
- The packaging material should have a high barrier property to prevent aroma/flavour losses and ingress of external odour.
- The volatile oil present in the spice product has a tendency to react with the inner/ contact layer of the packaging material, at times leading to a greasy and messy package with smudging of the printed matter. The packaging material should therefore be grease and oil resistant and compatible with the product.
- Besides the above functional requirements, the packaging material should have good machinability, printability and it should be easily available and disposable.

3.3. Packaging materials for Ginger powder

3.3.1. Bulk packaging

In bulk packaging, the current trend is to use Flexible Intermediate Bulk Containers (FIBCs) commonly known as Jumbo bags. These bags have a capacity of up to 1 tonne. In general these bags are made from cloth, but at present mainly from plastic (PP) fabric, which can be laminated or provided with an inner plastic liner bag. The PP fabric is stabilized against UV degradation. The bags are provided with filling and discharge spouts and slings for hanging during loading/ unloading operations.

The FIBCs offer various advantages such as:

- Bags are flexible, collapsible and durable
- Can be used for packaging of granules, powder, flakes and any free flowing material
- Product wastage / spillage and tampering can be avoided
- Since the handling is mechanised, less labour is required
- Saving in time for loading and unloading

- Bags are light in weight and, therefore, freight costs are reduced

3.3.2. Institutional packages

Institutional packs of capacities ranging from 2kg to 10kg are also used. The traditional materials that were used such as tinplate containers and jute bags are currently being replaced by materials such as laminated flexible pouches and plastic woven sacks. The sacks are usually BOPP multicolor Printed laminated PP Woven bags. These bags may be gusseted and have window and micro perforation.

3.3.3. Consumer Packages

The options available to the traders/exporters of Ginger powder in the selection of a consumer pack for domestic and export market are quite wide. However, the selection/choice of the packaging material/ system depends upon a number of factors, which are broadly listed below:

- Shelf-life period i.e. the degree of protection required by the product against moisture pick-up, aroma retention, discolouration etc. (this is more critical in case of powdered Ginger powder)
- Climatic conditions during storage, transportation and distribution
- Type/ sector of market
- Consumer preferences
- Printability and aesthetic appeal

The package types generally used as consumer packs are:

- Glass bottles of various sizes and shapes with labels and provided with metal or plastic caps. The plastic caps have added inbuilt features of tamper evidence, dispensing, grinding etc.
- Printed tinplate container with/without dispensing systems
- Composite containers with dispensers

- Plastic containers with plugs and caps with dispensing and tamper evidence features
- Printed flexible pouches - pillow pouch, gusseted pouch, stand-up pouch.
- Lined cartons

The printed flexible pouches have recently become very popular due to their easy availability, excellent printability, light weight, machinability and cost-effectiveness. Also, depending upon the functional and marketing requirements, the laminate/film can be tailor made to serve a specific need.

The printed flexible pouches are generally laminates of various compositions. Some of the commonly used laminates are:

- Polyester/ metallised polyester/LDPE
- BOPP/LDPE
- BOPP/ metallised polyester/LDPE
- Polyester/Al foil/LDPE

3 ply laminates such as 12 μ PET/ Print/ 12 μ Met. PET/ PE can avoid delamination and prevents smudging and de-figuring of the print.

Polyester and BOPP based laminates are generally more popular for spice packaging due to certain advantageous characteristics of each of these two films.

Polyester used for lamination is generally 10 or 12 μ thick. The film is highly transparent with excellent clarity, gloss and printability thus enhancing the sales appeal. The film has very low moisture and gas permeability and, therefore, ensures prolonged shelf life of the contents with aroma, flavour and taste retention. The very high mechanical strength (tear, puncture, burst and flex) minimises damage to the contents during handling and transportation. The film has good machinability as well as printability. The latest printing technologies help in improving sales promotions. The film is free from additives and, therefore, does not impart any odour or taint to the sensitive spice product that is packed.

BOPP films may be heat sealable or non heat sealable. The film has high yields, is stable under climatic changes and has excellent moisture barrier. This film is smooth, glossy, crystal clear and has high mechanical strength and non-contamination property for food contact applications.

The following table shows the packaging specifications for flexible packs of ground consumer spices, framed by the Indian Institute of Packaging.

Laminates/Co-extruded films (up to 500 grams capacity)	Laminates/Co-extruded films (up to 1000 grams capacity)
12 μ PET / 37.5 μ LD-HD (30% HD)	12 μ PET/50 μ LD-HD (30% HD)
12 μ MET PET / 37.5 μ LD-HD (30% HD)	12 μ MET PET / 50 μ LD-HD (30% HD)
12 μ PET / 50 μ PP	12 μ PET / 62.5 μ PP
12 μ MET PET / 50 μ PP	12 μ MET PET / 62.5 μ PP
10 μ PET / 9 μ Al. foil / 37.5 μ LD-HD (30% HD)	10 μ PET / 9 μ Al. foil / 50 μ LD-HD (30% HD)
12 μ Al. foil / 37.5 μ LD-HD (30% HD)	12 μ Al. foil / 50 μ LD-HD (30% HD)
25 μ BOPP / 37.5 μ LD-HD (30% HD)	25 μ BOPP / 50 μ LD-HD (30% HD)
25 μ MET BOPP / 37.5 μ LD-HD (30% HD)	25 μ MET BOPP / 50 μ LD-HD (30% HD)
35 μ BOPP / 25 μ BOPP	35 μ BOPP / 35 μ BOPP
30 μ LD - 7.5 μ Tie - 25 μ PA - 7.5 μ Tie - 30 μ LD-HD (30% HD)	30 μ LD - 7.5 μ Tie - 30 μ PA - 7.5 μ Tie - 40 μ LD-HD (30% HD)
The LD or LD-HD layer could also be LLD (outer) or LLD-HD (inner or outer) or EAA layer (outer)	The LD or LD-HD layer could also be LLD (outer) or LLD-HD (inner or outer) or EAA layer (outer)

The types of sealing of pouches from flexible plastic based materials could be variable:

- Centre seal formation
- Three sides seal formation

- Four sides seal formation
- Strip pack formation

The vital link in the performance of the pouch is the seal integrity. The performance of the heat seal layer is very important. Even if the film structure has been designed with exceptional properties, with excellence in interlayer lamination, if the sealing of the pouch fails, the product may get contaminated and in some cases become unfit for consumption.

CHAPTER 4
Food Safety Regulations & Standards

According to the FSSAI standards, Ginger (Sonth, Adrak) powder means the powder made by grinding dried rhizomes or bulbous roots of *Curcuma Longa L.* The powder shall have characteristic odor and flavour of Ginger.

The standards of Ginger (Sonth, Adrak) powder:

(i) Moisture	Not more than 12.0 percent by weight
(ii) Total ash on dry basis (a) Unbleached (b) Bleached	Not more than 8.0 percent by weight Not more than 12.0 percent by weight
(iii) Calcium as Calcium oxide on dry basis (a) Unbleached (b) Bleached	Not more than 1.1 percent by weight Not more than 2.5 percent by weight
(iv) Volatile oil content on dry basis	Not less than 1 percent
(v) Water soluble ash on dry basis-	Not less than 1.7 percent by weight
(vi) Acid insoluble ash on dry basis	Not more than 1.0 percent by weight
(vii) Alcohol (90% v/w) soluble extract on dry basis	Not less than 5.1 percent by weight
(viii) Cold water soluble extract on dry basis	Not less than 10.9 percent

Ginger as a whole or Powder shall be free from mustiness or other foreign odors.

The products must be free from mold, living and dead insects, insect fragments, and rodent contamination.

They shall be free from any added coloring matter and morphologically extraneous matter including foreign starch.

The bottom line is the standards will guide the food business operators of Ginger and maintain the quality of Ginger available in the market.

The Microbial standards for Ginger powder are as follows:

S.No	Parameter	Requirements
1.	Total Plate Count	-
2.	Coliform Count	-
3.	E.Coli	-
4.	Salmonella	Absent in 25gm
5.	Shigella	-
6.	Staphylococcus aureus	-
7.	Yeast and Mould Count	-
8.	Anaerobic Spore Count	-
9.	Listeria monocytogenes	-

Manufacturers List of Food Processing Machineries

S.no	Name of the company	Machineries
1.	<p>MMM Buxabhoy& Co 140 Sarang Street 1st Floor, Near Crawford Market Mumbai India Tel: +91 22 2344 2902 Fax: +91 22 2345 2532 yusufs@vsnl.com; mmmb@vsnl.com; yusuf@mmmb.in</p>	Packaging and labelling machines
2.	<p>Acufil Machines S. F. No. 120/2, Kalapatty Post Office Coimbatore - 641 035 Tamil Nadu India Tel: +91 422 2666108/2669909 Fax: +91 422 2666255 Email : acufilmachines@yahoo.co.in</p>	Dryer; Packaging and labelling machines
3.	<p>Bombay Engineering Works, 1 Navyug Industrial Estate 185 Tokersey Jivraj Road Opposite Swan Mill, Sewree (W) Mumbai 400015 India Tel: +91 22 24137094/24135959 Fax: +91 22 24135828</p>	Dryer
4.	<p>Planters Energy network (PEN) No 5, Power House 3rd Street N R T Nagar Theni 625531 Tamil Nadu India Tel: +91 4546 255272 Fax: +91 4546 25527</p>	Dryer
5.	<p>Premium Engineers Pvt Ltd Plot No 2009, Phase IV, GIDC Vatva, Ahmedabad 382445 India Tel: +91 79 25830836 Fax: +91 79 25830965</p>	Dryer; Milling & grinding machinery
6.	<p>Central Institute of Agricultural Engineering, Nabi Bagh Berasia Road Bhopal 462 038 Madhya Pradesh India Tel: +91 755 2737191 Fax: +91 755 2734016</p>	Slicing machinery; Cleaning machinery; Milling & grinding machinery

7.	Gardners Corporation 158 Golf Links New Delhi 110003 India Tel: +91 11 3344287/3363640 Fax: +91 11 3717179	Slicing machinery; Cleaning machinery; Milling & grinding machinery; Packaging and labelling machines
8.	Rajan Universal Exports Post Bag no 250 162 Linghi Chetty Street Chennai 600 001 India Tel: +91 44 25341711/25340731/25340751 Fax: +91 44 25342323	Cleaning machinery; Milling & grinding machinery
9.	Gurdeep Packaging Machines Harichand Mill compound LBS Marg, Vikhroli Mumbai 400 079 India Tel: +91 22 2578 3521/577 5846/579 5982 Fax: +91 22 2577 2846	Packaging and labelling machines
10.	Rank and Company A-p6/3, Wazirpur Industrial Estate Delhi – 110 052 India Tel: +91 11 7456101/ 27456102 Fax: +91 11 7234126/7433905 E-mail: Rank@poboxes.com	Dryers
11.	Soorya Kitchen Equipments Thammanam, Kochi, Ernakulam, Kerala 08045329361	Peeler



Contact Us

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