

# Processing and Medicinal Uses of Cardamom and Ginger – A Review

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## Abstract

Spices and herbs have played a dramatic role in civilization and in the history of nations. Spices, seasonings and condiments are mostly used to enhance taste, improve nutritional content, and improve colour, texture or shelf life of foods and beverages. In addition, they are reputed to possess several medicinal and pharmacological properties and hence find position in the preparation of a number of medicines. Cardamoms are used as flavorings and cooking spices in both food and drink, and as a medicine. Cardamom seeds whole or in powdered form are regarded as one of the most valuable spices, often employed in the preparation of curry powder, pickles, sausages, cakes and confectionery. Ginger produces a hot, fragrant kitchen spice. Ginger has been shown to be effective for pregnancy-induced and postoperative nausea and vomiting. This review presents some information about the most common and most-used two spices like cardamom and gingers processing, pharmacological and medicinal properties, and describes their isolation of antioxidant properties.

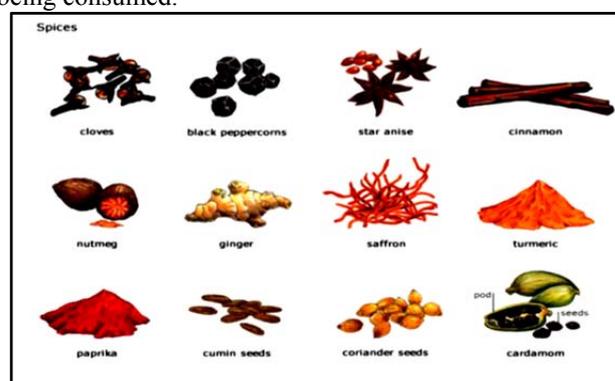
**Keywords:** Spices, Processing, Cardamom, Ginger, Antioxidants, Medicinal Properties.

## INTRODUCTION

**Food** is one of the essential fundamental elements needed for human survival<sup>1</sup>. Food comprises edible plant parts (such as fruit, nuts, corms, leaves) and animal tissues which may be cooked or eaten raw depending on the cultural orientation of the population. Whether eaten raw or prepared into delicious delicacies, food provides: energy and nutrients for proper nourishment of the body, maintains the body, repairs worn-out tissues and promotes growth of the body<sup>1,2</sup>. Food is not only consumed for its nutritional benefits, but individuals' preference for a given food is mainly inspired by their cultural values, sensory qualities such as taste, texture, palatability, mouth feel and even physical appearance. Food service professionals therefore use seasonings, flavourings and flavour enhancers to help enhance the flavour of natural foods<sup>3</sup>.

**Spices** are used for flavour, colour, aroma and preservation of food or beverages. Spices may be derived from many parts of the plant: bark, buds, flowers, fruits, leaves, rhizomes, roots, seeds, stigmas and styles or the entire plant tops is shown in figure 1. The term 'herb' is used as a subset of spice and refers to plants with aromatic leaves. Spices and food herbs are only slightly different, and for the purposes of this chapter no distinction will be made. Spices serve as one of the major ingredients in food preparation and processing throughout the world<sup>4</sup>. Seasoning is a comprehensive term applied to aromatic ingredients that improve the flavour of food products<sup>5</sup>. They are compounds, containing one or more spices, or spice extractives, which when added to a food during its manufacturing, preparation or before it is served, enhance the natural flavour of the food and increase its acceptance by consumers<sup>5</sup>. Seasonings include spices and other

substances of vegetable origin that are added during the cooking process<sup>6</sup>. Condiments are prepared food compounds<sup>7</sup>. They are a mixture composed of one or more spices or spice extracts that are added to food when food is being consumed.



**Figure 1: Commercial Spices**

A food herb is generally defined as the leaf of a plant when used in cooking, but any other part of the plant, often dried, can be a spice. Spices can be the buds (cloves), bark (cinnamon), roots (ginger), berries (peppercorns), aromatic seeds (cumin) and even the stigma of a flower (saffron). Many of the aromatic seeds known as spices are actually gathered from plants when they have finished flowering. A familiar example would be coriander, with the leaves being referred to as an herb, and the dried seeds as a spice. Spices, seasonings and condiments are mostly used to enhance taste, improve nutritional content, and improve colour, texture or shelf life of foods and beverages<sup>4</sup>. Some also perform antioxidant, antimicrobial, nutritional and medicinal functions and are traditionally credited with a

wide range of pharmacological and preservative properties<sup>8,9</sup>. Plants used as spices, seasonings and condiments are usually aromatic and pungent<sup>10</sup>.

#### Cardamom

Cardamom is a valuable spice that is obtained from the seeds of a perennial plant (*Elettaria cardamomum*). Cardamom originates from the coastal area of India. It is now grown in Guatemala, Tanzania, Sri Lanka, El Salvador, Vietnam, Laos and Cambodia. India is the main exporter of dried cardamom. Cardamom is known as the “Queen of Spices”. It is one of the most highly priced and exotic spices in the world. It is a perennial tropical herb plant belonging to the ginger family (*Zingiberaceae*) and grows from a thick rootstalk up to around 6-10 feet is shown in figure 2. It is indigenously grown in the evergreen forests of the Western Ghats in South India.



Figure 2: Cardamom

#### Types of cardamom

There are two main types of cardamom:

- Small green cardamom (*Elettaria cardamomum*)
- Large red/black cardamom (*Amomum subulatum* Roxb)

The most common type is the small green cardamom while large cardamom is mainly grown in India, with some in Nepal and Bhutan is shown in figure 3. They both come from the *Zingiberaceae* family of plants.



Figure 3: Small and Large Cardamom

#### Global Scenario - Demand and Supply

Cardamom is generally produced in the tropical regions of the world. Guatemala is the largest cardamom producing country followed by India. The total world production of this spice is around 35,000 MT per annum<sup>11</sup>. Consumption of cardamom has sharply increased throughout the world during the last two decades. The major consuming countries of cardamom are the Middle Eastern countries, India, Pakistan, European countries, the US, and Japan. Middle Eastern countries such as Saudi Arabia and the United Arab Emirates, and South-East Asian countries such as India, etc., account for more than 60% of the world's consumption<sup>11</sup>.

India is the largest producer of large cardamom (*Amomum subulatum* Roxburgh), with an annual production of 4000 MT, followed by Nepal (2500 MT) and Bhutan (1000 MT)<sup>12</sup>. More than 85% of the production within India is from Sikkim. An estimated 4000 t of large cardamom, valued at about Rs. 1.60 billion, is produced annually in

Sikkim alone, which constitutes nearly 80% of total production from India. It is also called greater Indian or Nepal cardamom, which is a native of the Eastern Himalayan region<sup>12</sup>. Large cardamom is the most important perennial cash crop of the region and is widely cultivated with Himalayan alder (*Alnus nepalensis*) as a shade tree<sup>13</sup>. Large cardamom is also known as ‘black cardamom’. The pods are used as a spice, in a manner similar to the green Indian cardamom pods, but it has a drastically different flavour, so it cannot be substituted in the same recipes, unless a different flavor is acceptable. Unlike green cardamom, this spice is used rarely in sweet dishes. Its strong, smoky flavour and aroma are derived from the traditional drying procedure, which involves drying over open flames<sup>13</sup>.

#### Indian Scenario - Demand and Supply

Till 2000, India used to be the largest producer of Cardamom, and thereafter, Guatemala pushed her to the second position. Cardamom cultivation is concentrated on the Western Ghats in the country; and the Western Ghats are also known as “Cardamom Hills”. In 2012-13, as per provisional trade estimates, India's production is around 12,000 MT. Following states are the major producers of cardamom in India:

- ❖ Kerala – 70%
- ❖ Karnataka – 20%
- ❖ Tamil Nadu – 10%

Idukki district in Kerala is the major cardamom-producing area and places such as Udumbancholataluka, Peermedetaluka and Devikulamataluka are important centres in Idukki district.

Cardamom is traded as a bulk and graded produce. The 7 mm and above grade with fancy green colour commands a premium over other grades. Cardamom finds its place in every kitchen in the world. Cardamom goes into tea, coffee, snacks, sweet dishes, rice preparations, soft drinks - almost all favorite food items of the world. Guatemala produces around 25,000 MT yearly; the largest in the world, accounting for almost 66% of the total global production.

#### Harvesting - Cardamom

Harvesting at the correct stage of maturity is essential to produce high quality cardamom capsules. The fruits should only be harvested once they are fully ripe and mature. A ripe capsule has black seeds inside. An immature capsule has white seeds. When a cardamom capsule is ripe it can be easily removed from the stem of the plant without too much force. The harvester should start harvesting at the base of each stem and move up the stem, taking off any capsules that easily fall off without pulling. The capsules that do not fall off easily should be left on the plant to ripen.

#### Cleaning

The crop should be cleaned before processing. The first stage is to remove dust and dirt using a winnowing basket. This can be made locally from bamboo, palm or other leaves. A worker who is used to doing this can clean up to 100kg of cardamom in an eight hour day. Small machines are available for cleaning, but they are often not cost effective.

After winnowing the capsules are washed in clean water. Two or three large plastic buckets (15 litre capacity) are sufficient for small amounts but for large quantities, it may be better to use a sink with a drainage hole. Only water that is safe to drink should be used. It should be changed regularly to prevent contamination. After washing, the stalks are removed from the cardamom capsules by hand. The capsules can be soaked in a solution of sodium bicarbonate (2-5%) for ten minutes to help retain the green colour. This is an optional step. A 2% solution of sodium bicarbonate is prepared by dissolving 20g (about 4 tea spoons) of sodium bicarbonate in 1 litre of water.

### **Drying**

This is the most important part of the process as it affects the quality of the final product. It is important to dry the cardamom capsules as soon after harvest as possible to prevent the loss of flavour. It is also important that the drying process is as short as possible so that mould does not grow on the capsules and the bright green colour is retained. The drying temperature should not be above 50°C as this affects the colour and delicate flavour of the final product. In most places, cardamom capsules with a good green colour can be sold for a premium price.

The moisture content of a fresh cardamom capsule is about 85%. This needs to be reduced to 10% in the dried product so the cardamom capsules can be stored. There are several options available to the small scale processor, depending upon the size of the business and the local weather conditions at the time of processing. Each method has different advantages and disadvantages:

#### ✓ **Sun drying**

Traditionally, cardamom capsules are spread on a concrete floor to dry using the natural heat from the sun. The capsules should be placed away from direct sunlight to preserve the green colour (strong sunlight will make the colour fade). This is the simplest and cheapest method, but does not produce the highest quality product. It is only successful in places where the climate is dry and hot. During drying, the capsules may be contaminated by dirt and dust from their surroundings.

#### ✓ **Solar drying**

The use of a solar dryer should improve the quality of the dried capsules as it is a cleaner, more controlled environment. The solar dryer is really only useful in dry hot sunny climates. The capsules should be placed in the dryer, out of direct sunlight, and dried until they have a final moisture content of 10%. In places with high humidity the solar dryer can only be used together with an extractor fan to remove the humid air.

#### ✓ **Wood-fired dryer**

In India, cardamom capsules are traditionally dried in curing houses, using wood to provide the heat. This method puts a huge demand on firewood. The smoke from the fire can give the capsules an unpleasant smoked flavour. The processor must ensure that the capsules closest to the heat source are not burnt or

scorched. Cardamom capsules dried by this method are not of the highest quality.

#### ✓ **Humidity-controlled drying**

The cardamom capsules are placed in the drying chamber, which is at a temperature of 50°C. During the first two hours of drying, the humidity builds up within the chamber. This allows the cardamoms to 'cook' and at the same time destroys the enzymes that break down the chlorophyll (chlorophyll gives the pods their green colour). No light is allowed into the drying chamber. After two hours the humid air is blown out of the chamber and the humidity reduced. The capsules are left in the chamber to dry until they have a final moisture content of 10%.

### **Grading**

Cardamom is graded by colour and size. The deeper the green colour and the larger the capsule size, the higher the grade.

### **Grinding**

Cardamom capsules are usually sold whole. Grinding can be a method of adding value to a product. After grinding, spices are more vulnerable to spoilage. The flavour and aroma compounds are not stable and will quickly disappear from ground products. The storage life of ground spices is much less than for the whole spices. It is very difficult for the consumer to judge the quality of a ground spice. Therefore most consumers, from wholesalers to individual customers, prefer to buy whole spices.

### **Packaging**

Cardamom capsules can be packaged in polythene bags of various sizes according to the market demand. The bags should be sealed to prevent moisture entering. Attractive labels should be applied to the products. The label needs to contain all relevant product and legal information – the name of the product, brand name (if appropriate), details of the manufacturer (name and address), date of manufacture, expiry date, weight of the contents, added ingredients (if relevant) plus any other information that the country of origin and of import may require (a barcode, producer code and packer code are all extra information that is required in some countries to help trace the product back to its origin).

### **Storage**

Dried cardamom capsules must be stored in moisture-proof containers away from direct sunlight. For long term bulk storage, polythene-lined gunny bags inside wooden boxes are used. The polythene bags help to preserve the green colour of the pods. It is essential that the capsules are fully dry before they are placed in the gunny bags for storage. Any moisture within the bags will cause the capsules to rot. The stored cardamoms should be inspected regularly for signs of spoilage or moisture. If they have absorbed moisture, they should be re-dried to a moisture content of 10%. The storage room should be clean, dry, cool and free from pests.

### Indian Scenario – Production & Consumption

India consumes almost 90% of the domestic production with almost 45% of the demand coming from the western part of the country followed by the northern India with 35%. As India's production is capable of satisfying the domestic consumption demand, it does not import any cardamom from outside countries. However, cheaper Guatemalan cardamom finds its way into the country and is preferred for low value uses like pan masala. The leftover cardamom produce is exported every year. India exports 5-8% of its total production, mostly the premium grade. India also exports by-products of cardamom such as cardamom oil and oleoresins to European countries.

### Medicinal and Pharmacological Uses

Cardamom possesses the following medicinal properties: antiseptic (pulmonary), antispasmodic (neuromuscular), aphrodisiac, expectorant, anthelmintic, antibacterial (variable), cephalic, cardiogenic, diuretic, emmenagogue, sialogogue and stomachic.

#### ➤ Anti-inflammatory

In India, the spice is used broadly to treat infections in teeth and gums, to prevent and treat throat troubles, congestion of the lungs and pulmonary tuberculosis, inflammation of eyelids and also digestive disorders. Species in the genus *Amomum* are also used in traditional Indian medicine.

#### ➤ Antidote to snake venom

Reportedly, the spice is also used as an antidote for both snake and scorpion venom.

#### ➤ Hepatoprotective

The components in the volatile oil, e.g. 1,8-cineole, terpinene, terpinol, sabinene,  $\alpha$ -pinene and limonene, act as a tonic for the heart and liver, an appetizer, promote the elimination of bile and help reduce congestion of the liver.

#### ➤ Anti-ulcerogenic

Large cardamom fruit, commonly known as 'Heel kalan' or 'Bari Ilaichi', is used in the Unani system of medicine to treat gastrointestinal disorders. A crude methanolic extract and its different fractions, e.g. essential oil, petroleum ether (60–80°C), ethyl acetate and methanol fractions, were studied in rats for their ability to inhibit gastric lesions induced by aspirin, ethanol and pylorus ligation. A direct protective effect of ethyl acetate fraction on the gastric mucosal barrier was seen. The decrease observed in gastric motility brought about by essential oil and petroleum ether fractions suggests the gastroprotective action of the spice. These investigations validate the use of large cardamom in gastrointestinal disorders by Unani physicians<sup>14</sup>.

### Other Uses

Cardamom is the dried fruit of a perennial herbaceous plant. Its quality characteristics are different from those of small cardamom. It is valued for its acceptable taste, flavour and aroma. Large cardamom has a fresh and spicy aroma. By virtue of the traditional drying procedure over open flames, the spice also acquires a smoky flavour. Large cardamom also possesses curative properties in the

Ayurvedic and Unani systems of medicine<sup>15,16,17</sup>. It is also used to flavour cardamom cola, prepared by blending citric acid and carbonating mixture.

Large cardamom can also be put to a variety of industrial uses<sup>18</sup>. The globous fruit stalks, usually discarded by farmers, can be used as a base of agarbathis<sup>19,20</sup>.

### Ginger

Ginger is one of the earliest known oriental spices and is being cultivated in India for both as fresh vegetable and as a dried spice. Ginger is obtained from the rhizomes of *Zingiber officinale*, is shown in figure 3.



Figure 3: Ginger - *Zingiber officinale*

Ginger, the rhizome of *Zingiber officinale* Roscoe, one of the most widely used species of the family *Zingiberaceae*, is a common condiment for various foods and beverages. 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<sup>21</sup>.

Ginger has been used traditionally for varied human ailments, to aid digestion and to treat stomach upset, diarrhoea and nausea. The ginger plant has a perennial, tuberous root or rhizome: the stems are erect, oblique, round, annual and invested by smooth sheaths of leaves, approximately 1 m in height. In many countries, especially in India and China, fresh ginger is used to prepare vegetable and meat dishes and as a flavouring agent in beverages and many other food preparations<sup>22</sup>. Ginger is a natural dietary component which has antioxidant and anticarcinogenic properties<sup>23</sup>.

### Global Scenario

India and Indonesia have the largest area under cultivation and also leading ginger producing countries is shown in figure 4.

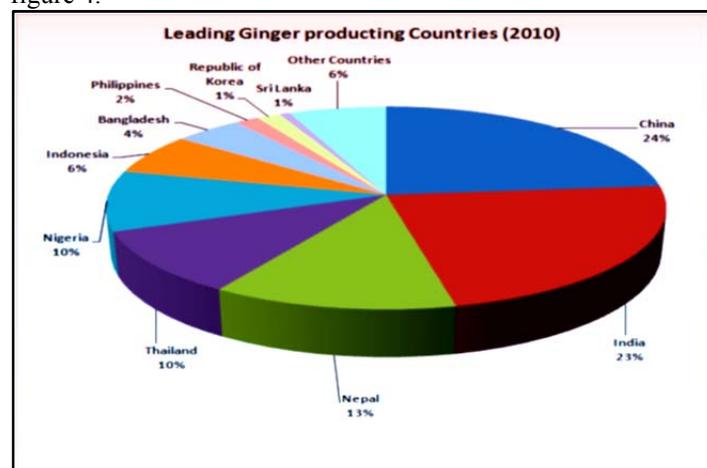


Figure 4: Leading Ginger Producing Countries in 2010

### Indian Scenario – Production

There is only marginal increase in acreage from 108.64 thousand ha in 2008-09 to 149.10 thousand ha in 2010-11<sup>24</sup>. The production, however has increased from 380.10 thousand tons in 2008-09 to 702.00 thousand tons in 2010-11.

### Harvesting - Ginger

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.

### Processing of ginger

Processing of ginger to produce dry ginger basically involves two stages- peeling of the ginger rhizomes to remove the outer skin and sun drying to a safe moisture level.

### 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. The peeled rhizomes are washed before drying.

### 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. Generally ginger is sun dried in a single layer in open yard which takes about 8 to 10 days for complete drying. The sun dried ginger is brown in colour with irregular wrinkled surface.

### Polishing, cleaning and grading

Polishing of dried ginger is done to remove the dry skin and the wrinkles developed on the surface during drying process. It is generally done by rubbing against hard surface. Cleaning of dry ginger is done manually to remove the extraneous matter and the light pieces.

### Storage

Dry ginger, packaged in gunny bags are highly susceptible to infestation by insects like *Lasioderma serricorne* (cigarette beetle) during storage. Fully dried rhizomes can be stored in airtight containers such as high density polyethylene or similar packaging materials. Long term storage for more than two years would result in deterioration of its aroma, flavour and pungency.

### Medicinal and Pharmacological Properties

#### ➤ Anticancer properties

Ginger, a natural dietary component, has been known to have antioxidant and anticarcinogenic properties. <sup>23</sup>demonstrated the chemopreventive efficacy of ginger in colon cancer. They had investigated the effect of ginger on the initiation and post-initiation stages of 1,2- dimethyl hydrazine (DMH)-induced colon carcinogenesis in male Wistar rats. The number of tumours, as well as the incidence of cancer, was decreased significantly on treatment with ginger.

<sup>22</sup>attributed the anticancer properties to the presence of pungent vallinoids, e.g. [6]-gingerol and [6]-paradol, shogaols, zingerone, etc.

#### ➤ Anti-inflammatory effect

Ginger contains pungent phenolic substances with pronounced antioxidative and anti-inflammatory activities. The antitumour - promoting activity of [6]-gingerol, a major pungent principle, was investigated using a two-stage mouse skin carcinogenesis model<sup>25</sup>.

#### ➤ Antiplatelet effect

<sup>26</sup>Antiplatelet effect of gingerol isolated from *Z. officinale*. Gingerol (0.5–20 μM) concentration dependently inhibited the aggregation and release reaction of arachidonic acid and collagen-induced rabbit platelets, but not those induced by platelet-activating factor U46619 and thrombin.

#### ➤ Antioxidant effect

Antioxidant activity of ginger extract. Total phenols of the alcoholic ginger extract are about 870.1 mg/g dry extract. 2,2-Diphenyl-1-picryl hydrazyl radical (DPPH) scavenging reached 90.1% and exceeded that of butylated hydroxyl toluene (BHT). The antioxidant activity in a linoleic acid/water emulsion system determined by means of thiobarbituric acid-reactive substances (TBARS) was highest at 37°C – 73.2 and 71.6% when the formation of conjugated dienes was inhibited. Ginger extract inhibited hydroxyl radicals by 79.6% at 37°C and 74.8% at 80°C, which showed a higher antioxidant activity than quercetin<sup>27</sup>. <sup>28</sup>demonstrated the antioxidant property of Gingerol-related compounds and diarylheptanoids from common ginger.

#### ➤ Anti-ulcer principles

Gastrointestinal motility-enhancing effect of ginger and its active constituents. Powdered rhizome of ginger was extracted with acetone and the extract was evaporated to dryness at < 40°C to give a residue (yield 3.4%), which included volatile oils and bitter substances<sup>29</sup>. <sup>30</sup>elucidated structures of antifungal diarylheptenones, gingerenones A, B, C and isogingerenone B, which were isolated from the rhizomes.

#### ➤ Anticonvulsive and analgesic effect

Ginger is known to warm the body, curing chills caused by the common cold. An acetone extract of ginger rhizomes inhibited serotonin-induced hypothermia and serotonin-induced diarrhea significantly<sup>31</sup>.

#### ➤ Cardiovascular effect

Gingerols, the pungent constituents of ginger, were assessed as agonists of the capsaicin-activated vanilloid receptor (VR1). [6]-Gingerol and [8]-gingerol evoked capsaicin-like intracellular Ca<sup>2+</sup> transients and ion currents in cultured dorsal root ganglion neurons. These effects of gingerols were blocked by capsazepine, the VR1 receptor antagonist. The potency of gingerols increased with the increasing size of the side-chain and with the overall hydrophobicity in the series. It is concluded that gingerols represent a novel class of naturally occurring

VR1 receptor agonists that may contribute to the medicinal properties of ginger, which have been known for centuries<sup>32</sup>.

### Other Uses

Dried ginger traditionally has been traded internationally in the whole or split forms and is ground in the consuming centres. The major use of ground dried ginger on a worldwide basis is for domestic culinary purposes, while in the industrialized Western countries it also finds extensive use in the flavouring of processed foods<sup>33</sup>.

Ginger oil, obtained by steam distillation of the rhizome of *Z. officinale* Roscoe, is used in the beverage and fragrance industries<sup>34</sup>. This product possesses the aroma and flavour of the spice but lacks the pungency. It finds its main application in the flavouring of beverages and it is also used in confectionery and perfumery. The efficacy of ginger oil as a repellent to *Bemisia argentifolii* (Homoptera: Aleyrodidae) on tomato<sup>35</sup>.

### CONCLUSION

Spices produce a vast and diverse assortment of organic compounds, the great majority of which do not appear to participate directly in growth and development. The present review sought to document and comment on the publications that have appeared on ginger and cardamom processing and some of the properties like pharmacological and medicinal properties. Ginger and many of its chemical constituents have strong anti-oxidant actions. The spice has diversified uses in the fields of medicine and industry. Development of high-yielding superior varieties, combined with sustainable production, will definitely enhance the export value of the spice. However, the natural quality degrades during the extraction process, storage and postharvest handling.

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