

Unlocking entrepreneurial potential of ginger through value addition

Ginger (*Zingiber officinale*), a vital spice and medicinal crop, holds immense potential for value addition and entrepreneurship in India. With an annual production of 2.43 million metric tonnes (2023–24), India contributes one-third of global ginger output. This paper explores the value chain of ginger from cultivation to the development of diversified products through primary, secondary, and tertiary processing. Key value-added products include dry ginger, powder, flakes, salted ginger, ginger candy, squash, pickle, and high-end extracts like ginger oil and oleoresin. The study highlights the scope for creating sustainable rural enterprises, generating employment, and improving farmer income.

GINGER, the subterranean rhizome of *Zingiber officinale*, is a vital commercial crop cultivated for its aromatic rhizomes, which serve diverse purposes as a vegetable, spice, and medicinal ingredient. India's ginger production was estimated to be 2.43 million metric tonnes during the year 2023–24, contributing to one-third of global output. Ginger is grown across most states in India, of which Kerala, Meghalaya, Arunachal Pradesh, Mizoram, Nagaland, and Odisha collectively account for 70% of the nation's total production. Ginger is primarily used as a condiment to enhance the flavour of various dishes and also acts as a carminative and gastric stimulant in numerous medicinal preparations. As a condiment, it adds zest to mayonnaise, tomato ketchup, sauces, salads, meat sausages, chutneys, pickles, biryani, fried rice, and more. Additionally, it is widely utilized in the pharmaceutical industry for producing herbal remedies to treat cold, fever, and other ailments.

There is a huge market for both fresh and dried ginger. The peculiar hot and pungent taste of ginger is attributed to the presence of an acrid compound called gingerol. Powdered ginger has very good domestic as well as export market and is used for fragrance in soaps and cosmetic industries. Ginger oil obtained by the steam distillation of the dried

ginger is mainly used in the flavouring of beverages, confectionery, perfumes, etc. The demand of ginger oil is also ever increasing and it has good export and domestic demand. Consumer preference for ginger based products is increasing and there is a huge potential for ginger based value added commodities. Thus, entrepreneurship in this area has become quite prospective and new entrepreneurs can well be ventured in to this field.

Harvesting of ginger

Ginger reaches full maturity in 210–240 days, but harvesting for vegetable use can begin after 180 days based on demand. Fully mature rhizomes are harvested when leaves turn yellow and dry. Irrigation stops a month before harvest, and rhizomes are carefully lifted using a spade, digging fork, or tractor-drawn harvesters in large-scale operations. Dry leaves, roots, and soil are manually removed. In India, fresh green ginger is preferred for culinary use, while bleached and unbleached dried ginger are produced for export. The suitability of ginger for processing depends on its fibre content, volatile oil, and pungency, which are influenced by its maturity at harvest.



Cleaned and separated rhizomes for peeling

Post-harvest processing of ginger

The processing of ginger to produce dry

ginger primarily involves two key stages: peeling the rhizomes to remove the outer skin and sun-drying them to achieve a safe moisture level.

Peeling

Peeling removes the scaly epidermis, facilitating faster drying. For fully mature rhizomes, the outer skin is scraped off using bamboo splints with pointed ends, which accelerates the drying process. Care must be taken to avoid deep scraping with knives, as this can damage the oil-bearing cells located just beneath the skin, reducing the essential oil content of the dried product. After peeling, the rhizomes are washed to prepare them for drying. The resulting dry ginger is prized for its aroma, flavour, and pungency. In India, particularly in Kerala, ginger is typically rough-peeled, with only the flat surfaces scraped, leaving much of the skin between the fingers intact. This produces rough-peeled or unbleached ginger, distinct from the clean-peeled Jamaican variety.

Drying

Fresh ginger has a moisture content of 80–82% at harvest, which must be reduced to 12% for safe storage. Typically, ginger is spread in a single layer in an open yard for sun-drying, a process that takes about 10 days.



Ginger field ready for harvest



Cleaning of ginger clumps

The dried ginger develops a brown colour and an irregular, wrinkled surface. The yield of dry ginger ranges from 19–25% of the fresh weight, depending on the variety and climatic conditions.

Polishing

Polishing removes residual dry skin and wrinkles formed during drying by rubbing the rhizomes against a hard surface. Cleaning is done manually to eliminate extraneous matter and lighter pieces. The cleaned ginger is then graded by hand based on rhizome size, colour, shape, and for bleached ginger, the presence of residual lime.

Storage

Dry ginger stored in gunny bags is prone to infestation by insects, such as the cigarette beetle (*Lasioderma serricorne*). To prevent this, fully dried rhizomes should



Manual peeling of ginger rhizomes



Close up view of ginger peeling



Sun drying of ginger

be stored in airtight containers, such as high-density polyethylene or similar materials. Long-term storage beyond two years may lead to a decline in aroma, flavour, and pungency.

Value-added products from ginger: From farm to market

Ginger is a low-risk, high-reward crop for entrepreneurs. It grows in various climates, requires moderate investment, and has a year-round demand. Value-addition transforms raw ginger into demand driven, shelf stable and profitable products. Ginger undergoes various processing stages to enhance its shelf life, usability, and market value. These stages are classified as primary, secondary, and tertiary processing, each transforming the rhizome into products suited for culinary, medicinal, or industrial applications. Primary processing involves basic post-harvest treatments to prepare ginger for storage, immediate sale, or further processing. The goal is to clean, preserve, and stabilize the rhizome while retaining its natural properties. Secondary processing transforms primary processed ginger (fresh or dried) into semi-finished or consumer-ready products through additional mechanical or chemical treatments. These products are often used in households, restaurants, or as ingredients in food industries. Tertiary processing involves advanced extraction techniques to isolate concentrated components of ginger, primarily for industrial applications in food, pharmaceutical, and cosmetic sectors. These products are high-value and require specialized equipment.

Primary processed products from ginger

Whole dried ginger: To produce dry ginger, rhizomes are harvested at full maturity, typically after 210–240 days. The process involves two key steps: peeling to remove the outer skin and sun-drying to reduce moisture to a safe level of 11–12%. Peeling, essential for many value-added products, is traditionally done by scraping with sharpened bamboo sticks due to ginger’s irregular shape, making it a labour-intensive task. While mechanical peelers exist, they often cause rhizome breakage, limiting their use. Indian ginger, especially from Kerala, is typically rough-peeled and sun-dried for 10–12 days, yielding 19–25% dry recovery depending on variety and climate. Dry ginger is used to produce ginger powder, oil, and oleoresin.



Whole dried ginger

Secondary processed products from ginger

Sliced ginger/ginger flakes: Fresh ginger is washed, lightly peeled, and sliced into 5–8 mm thick pieces using a mechanical slicer. These slices are dried in mechanical tray dryers at 55–60°C to a moisture content of about 6%, then cooled and packed in moisture-proof packaging for further processing or sale.



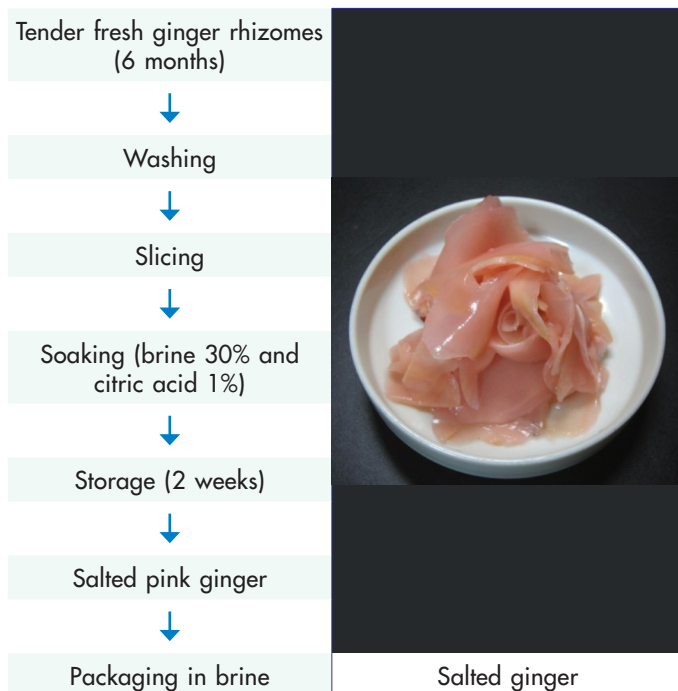
Process flowchart for production of dry ginger flakes

Ginger powder: Dry ginger is pulverized to a fine powder (50–60 mesh size) using traditional hammer mills or cryogenic grinding. Ginger powder is a key ingredient in curry powders and other spice blends, valued for its versatility in culinary applications.



Process flowchart for production of dry ginger powder

Salted ginger: Tender ginger, harvested at 170–180 days with low fiber content, is washed, sliced, and soaked in a 30% salt solution with 1% citric acid for 14 days. The resulting salted ginger can be refrigerated for extended storage and use.



Process flowchart for production of salted ginger

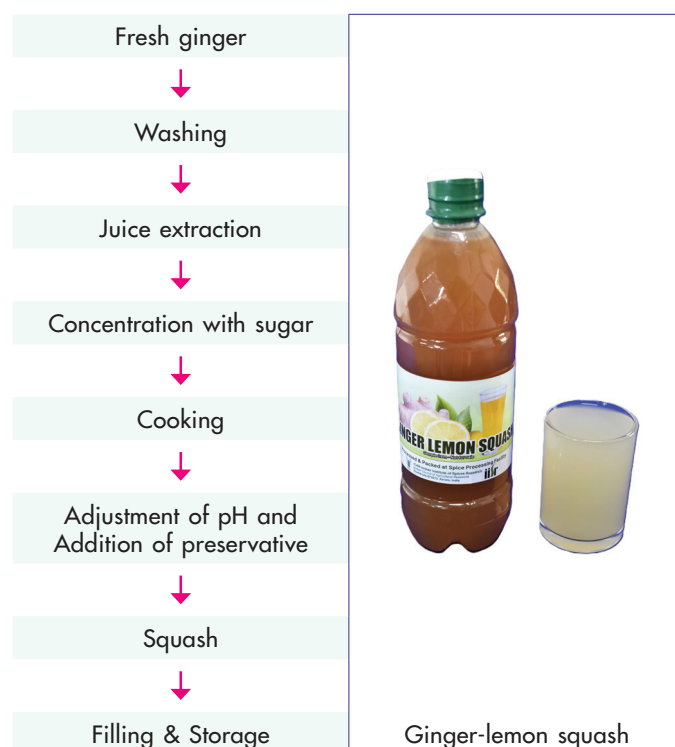
Ginger candy: Ginger candy is produced through osmotic dehydration in sugar syrup. Tender ginger is sliced thinly, boiled for 60 min, cooled, and then simmered in a 3:1 sugar-water syrup for an hour. After an overnight soak, water in the ginger is replaced by sugar via osmosis. The slices are filtered and dried in a hot air oven or low-flame pan, yielding a sweet, ginger-flavoured treat.



Process flowchart for production of ginger candy

Ginger lemon squash: Ginger squash, a concentrated non-alcoholic beverage, is made by boiling ginger juice with water, lemon, and sugar, often with added food colouring or flavouring. The mixture is concentrated in

open kettles, cooled, and bottled, ready for dilution with water at consumption. Its spicy, aromatic profile comes from pungent compounds with antiseptic properties.



Process flowchart for production of ginger squash

Ginger-garlic paste: Ginger (60%) and garlic (40%) are chopped into pieces. It is then made to a fine paste by grinding it in a colloidal mill. The paste is added to an open pan with oil, salt is added and boiled till it thickens. The contents are cooled and citric acid and KMS is added to it for preservation.



Process flowchart for production of ginger paste

Ginger pickle: To produce ginger pickle, fresh ginger rhizomes are first washed thoroughly and peeled to remove the outer skin. The ginger is then finely chopped or sliced into small pieces to ensure even flavour absorption. A spice mix is prepared by combining roasted fenugreek, roasted mustard, Kashmiri chili powder, turmeric powder, red chili powder and asafoetida powder. The chopped ginger is mixed with this spice blend, along with salt and oil, and cooked in an open pan until the mixture thickens. Citric acid and potassium metabisulfite (KMS) are added as preservatives to enhance shelf life. The final product is cooled, packed in airtight containers, and stored for consumer use.



Ginger pickle

Ginger conserve: When ginger is abundant, it can be preserved as a conserve. Fresh ginger is cut into pieces, soaked in cold water for 30 min, drained, boiled until soft, and cooked in sugar syrup for 2 min before storage.



Ginger conserve

Process flowchart for production of ginger conserve

Bleached ginger: Peeled ginger rhizomes are soaked in a 2% slaked lime (CaO) solution, drained, and resoaked until uniformly white. Sun-drying follows, producing shiny, pest-resistant ginger with an extended shelf life.



Bleached ginger

Tertiary processed ginger

Spray dried ginger lime juice powder: Spray-dried ginger lime juice powder is an innovative value-added product that combines the flavour of ginger and lime into a shelf-stable, versatile powder. This product leverages the growing consumer demand for natural, health-focused ingredients, offering entrepreneurs an opportunity to tap into culinary, beverage, and nutraceutical markets. The production process involves spray drying, a technique that transforms liquid mixtures into fine powders while preserving flavour, aroma, and nutritional properties, making it ideal for ginger-based applications.

The process starts with preparing a feed solution by blending ginger juice, lime juice, and maltodextrin in a precise ratio of 1:1.5:0.4. Maltodextrin acts as a carrier to enhance encapsulation and stability during drying. The mixture is homogenized to ensure uniformity and then fed into a spray dryer. Optimal drying conditions include an inlet air temperature of 156°C, a maltodextrin concentration of 26.91%, and a blower speed of 2200 rpm. These parameters yield a powder with an encapsulation efficiency of 74.98% and a low moisture content of 6%, ensuring good shelf life and product stability. The resulting powder is collected and packaged in airtight, moisture-proof containers to maintain quality.

Spray-dried ginger lime juice powder retains the pungent, spicy notes of ginger, derived from compounds like gingerol, and the tangy, citrusy flavour of lime, making it a versatile ingredient. Its low moisture content (6%) ensures long-term storage without spoilage, while the high encapsulation yield preserves bioactive compounds, enhancing its appeal in health-focused products. The powder is lightweight, easy to transport, and reconstitutes readily in water, making it suitable for both domestic and export markets.



Spray dried ginger-lime juice powder and reconstituted ginger-lime juice

Ginger oil: Ginger essential oil, characterized by its pale yellow colour and warm, spicy, woody aroma with lemony notes, yields 1.5–2.5% from dry ginger via steam distillation. The oil's primary component, zingiberene, contributes to its distinctive scent. Yields vary by cultivar, harvest stage, and extraction method, averaging 0.85–2% on a dry weight basis.



Ginger oil

Ginger oleoresin: Dry ginger powder, treated with organic solvents like acetone, alcohol, or ethyl acetate, yields a viscous oleoresin (4–10% content) containing gingerol, the spice's primary non-volatile compound. Advanced techniques now allow oleoresin extraction from fresh ginger. The North East region's cooler climate enhances oleoresin recovery by reducing starch synthesis.



Ginger oleoresin

The value addition of ginger presents a significant opportunity for enhancing entrepreneurship by transforming a traditional spice into diverse, high-demand products such as ginger powder, oil, candies, and health supplements. By leveraging innovative processing techniques, entrepreneurs can tap into growing markets, cater to consumer preferences for natural and health-focused products, and create sustainable business models. The scalability of ginger-based ventures, coupled with its global demand and versatility, empowers entrepreneurs to generate employment, boost local economies, and contribute to sustainable agricultural practices. Embracing value addition not only maximizes profitability but also fosters creativity and resilience, positioning ginger as a catalyst for entrepreneurial success in both local and international markets.

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