

Turmeric: Golden spice to value-added treasure

Turmeric (*Curcuma longa*), renowned as the 'golden spice', is gaining global recognition for its culinary, medicinal, and industrial value. Rich in bioactive compounds like curcumin, turmeric exhibits antioxidant, anti-inflammatory, and antimicrobial properties. This paper explores the growing potential of value-addition in turmeric, from primary processing to tertiary products such as essential oils, oleoresins, and nutraceuticals. Innovations like freeze-drying and product diversification (e.g., golden milk, turmeric flakes, and cosmetics) enhance shelf life and market appeal.

TURMERIC, often known as the 'golden spice', is a cornerstone of Indian cuisine and traditional medicine. Native to Southeast Asia and primarily cultivated in India, this rhizome from the ginger family (*Curcuma longa*) is celebrated for its culinary versatility and health benefits. Beyond its role as a spice, the active compound present in turmeric namely curcumin, offers anti-inflammatory, antioxidant, and antimicrobial properties, making it a powerhouse in both food and pharmaceutical industries. With the global turmeric market expanding, value addition is transforming raw turmeric into high-value products which presents immense opportunities for farmers, entrepreneurs, and industries.

Turmeric has numerous molecular constituents, each possessing a variety of biological activities. For instance, there are a minimum of 20 molecules that are antibiotic and 14 of its constituents have known cancer preventive activity. Also, 12 of its molecules are antitumor, and the other 12 molecules have anti-inflammatory effects. It contains at least 10 molecular constituents with antioxidant properties, too. Overall, 326 biological activities of turmeric are identified. Three of the constituents that are widely researched in turmeric are gold-coloured alkaloids curcuminoids, namely, curcumin, bisdemethoxycurcumin, and demethoxycurcumin.

Value-added products from turmeric

The value-added products in turmeric can be divided into three levels based on the level of value addition to the fresh turmeric. It includes:

- Primary processed value-added products which includes hygienically cured processed and dried turmeric including polished turmeric rhizomes
- Secondary processed value-added products which includes turmeric powder, spice blends, flakes, etc.
- Tertiary processed value-added products which includes turmeric oil, turmeric oleoresin, curcumin powder, etc.

- Diversified non-food products which include soaps, body lotions, facial creams, etc.

Primary processing of turmeric

Well managed turmeric crop is ready for harvest in seven to nine months depending on the variety and time of sowing. The crop is generally harvested during January to March. On maturity, the leaves turn dry and are light brown to yellowish in colour. Harvesting is done either manually or by using a tractor. In case of manual harvesting, the land is ploughed, the clumps are carefully lifted with spade and the rhizomes are gathered by hand picking. Harvesting with a tractor attached to a turmeric harvester is followed when the raised beds are taken using a tractor. The harvested rhizomes are collected manually and all the extraneous matter adhering to them is cleared.

Instability in the price is the major constraint faced by the farmers. The retailers of turmeric are facing stiff competition in the market. The highest degree of value is found to be added by the processors. At present, the value chain is not integrated and is dominated by small scale players and thus there is huge scope for companies to enter value chain with integrated approach.

The harvested turmeric rhizomes before entering into the market is to be converted into a stable commodity through a number of post-harvest processing operations like boiling, drying and polishing. Boiling of turmeric is taken up within 3 or 4 days after harvest. The fingers and bulbs (or mother rhizomes) are separated and are cured separately, since the latter take a little longer to cook. Curing of turmeric is done by cooking of fresh rhizomes in boiling water for 45 to 60 min or by passing steam to about 30 min. The rhizomes are then spread and dried under sun for about 12-14 days. The dry recovery of the different turmeric varieties varies widely ranging from 19 to 23%. The dried rhizomes are properly packaged in gunny bags at 10% moisture content. The value-added primary products include:

Polished turmeric rhizomes

Dried turmeric rhizomes are poor in appearance with rough and dull outer surface covered with scales and root bases. Appearance is improved by smoothening and polishing the outer surface by mechanical rubbing in rotary drum. Polishing of turmeric is effected by abrasion of the surface of turmeric rhizomes on the mesh and also by mutual rubbing of rhizomes. The degree of polish varies from 3-5% in single polished turmeric rhizomes and in case of double polished turmeric, it goes up to 9%.

Turmeric flakes

Slicing of fresh turmeric rhizomes to flakes is done after thorough washing of harvested rhizomes. The process of flaking is performed, if turmeric rhizomes are to be ground immediately after drying. The rhizomes are sliced to a thickness of 3-8 mm and dried with or without cooking. Another advantage is that sliced rhizomes dry faster than whole rhizomes. Generally, drying of flakes



Polished turmeric rhizomes

Turmeric flakes

is done in a mechanical dryer or in a solar tunnel dryer covered with a UV stabilized sheet to protect it from external contamination.

Processing of turmeric involves cooking, drying, grading and storing of turmeric cooking of turmeric. Cooking of turmeric is done by any of the following three methods based on the quantity being handled.

- Water cooking
- Steam cooking in improved turmeric boiler (TNAU model, capacity-100 kg)

Water cooking of turmeric rhizomes: In the traditional method, a vessel made of galvanized iron sheet is used for turmeric boiling. Boiling of turmeric rhizomes is carried out till froth forms and white fumes come out of the pan with a characteristic odour. Boiling is considered complete by pressing a pointed stick in to the rhizomes with slight pressure. The other indications of the completion of boiling process are softness and easy breaking of rhizomes when pressed between the fore finger and thumb and a yellow interior instead of red one. An effective cooking time of 45 to 60 min for fingers and 90 min for mother rhizomes is considered essential. Overcooking and under cooking are found to affect the quality of the rhizome.

Steam cooking in improved turmeric boiler (TNAU model, capacity 100 kg): Improved turmeric boiler using steam boiling technique is followed when large quantities of turmeric are to be cured. The TNAU



Water boiling by traditional method



Frothing during cooking of turmeric

model of improved steam boiler consists of an outer drum, four numbers of inner drum made of welded mesh and lid for the outer vessel. The outer drum is made of 18 SWG thick mild steel to a size of 122 × 122 × 55 cm. A lid with hooks is provided for the outer vessel for easy lifting and is also provided with an inspection door. Four numbers of inner drum of size 48 × 48 × 45 cm size are provided inside the outer drum. The capacity of each drum is 25 kg of fresh turmeric and the total capacity is 100 kg. The inner drums are provided with a leg for a height of 10 cm, so that the rhizomes will not come in contact with water filled for about 6-8 cm depth in the outer drum. The outer drum is placed with more than half of its depth below the ground level by digging a pit, which serves as a furnace. This furnace is provided with two openings, one for feeding the fuel and the other one for removing the ash and unburnt.

After placing the turmeric boiler in the furnace, about 75 litres of water is added (6-8 cm depth). About 25 kg washed rhizome is taken in each inner vessel and placed in the boiler and the lid is placed in position. Using the available agricultural waste materials, mostly, the turmeric leaves, fire is put in the furnace. During the boiling process, it takes about 25 min to produce steam and boil the initial batch of rhizomes and 10-15 minutes for the subsequent batches. Through the inspection door, the stage of boiling of the rhizome is assessed by pressing the rhizomes with a hard pin / needle.

Using a long pole, the lid is removed and the inner drums are lifted one by one. For the next batch, about 20 litres of water is added to the outer drum, depending on



Inner drum with turmeric



Arrangement of inner drums in outer drum



Boiling of rhizomes by covering with lid



Unloading of the inner vessel



Sun drying of cooked rhizomes



Turmeric polisher

the water lost by evaporation. The next batch of rhizomes is loaded in all the drums and heating is continued. At the end of the boiling process, all the drums need to be cleaned free of mud and soil to avoid damage and enhance the life of the gadget. The capacity of the boiler is about 100 kg per batch and the fuel requirement is 70–75 kg of agricultural waste materials.

Solar tunnel dryer for turmeric: Solar tunnel driers covered by UV stabilized semi-transparent polyfilm sheet of 200 microns thickness can also be used for drying of turmeric. The solar radiation is transmitted through plastic sheet, which has a transmissivity of 90%. The UV sheet is transparent to the short-wave radiations and opaque to long wave radiations. During the sunshine hours the short-wave

radiations are entrapped through the UV sheet, heated by the black absorber at the bottom and is converted into long wave radiation. This conversion of shortwave radiation to long wave radiation causes an increase in the temperature inside the drier. Heat is transferred from the absorber to the air above the absorber. The heated air from the bottom while passing over the products absorbs the moisture. Solar radiation which passes through the transparent cover of the drier, also heats the products in the drier. This enhances the temperature and drying rate of the produce inside the drier than in the ambient conditions.



Solar tunnel drier of size 12 × 4 m

Production of turmeric flakes: The first operation in the production of turmeric flakes is thorough cleaning in a mechanical washer. The washer consists of a rotating perforated drum and a central shaft provided with nylon bristles. Water for washing is supplied through the water inlet. The drum is provided with an outer cover. Washing is continued for about 10-15 minutes and the washed rhizomes are removed by opening the door provided on the rotating drum. The washed turmeric rhizomes are collected at the bottom.

The washed turmeric rhizomes are sliced in a turmeric slicer, where the rhizomes are cut into slices of 5-6 mm or more depending on the blades provided. The sliced rhizomes are spread on perforated trays and placed in the tray dryers for complete drying. Drying is continued till a constant mass is obtained. The dried slices are then packaged in gunny bags lined with polyethylene and stored under proper storage condition.

Secondary processing of turmeric

For the production of secondary processed value added products, the primary processed turmeric rhizomes



Mechanical washer for turmeric

Mechanical slicer



Tray dryer

Sliced turmeric

or flakes serve as the raw materials and is converted into a more readily available food product. This includes:

Turmeric powder

Rhizomes are ground to approximately 60-80 mesh (250–177 microns) particle size. Since curcuminoids, the color constituents of turmeric, deteriorate with light and to a lesser extent, under heat and oxidative conditions, it is important that ground turmeric be packed in a light protective packaging and stored.

Mixed masala powder

Turmeric is such an important ingredient in masala powder blends. The turmeric content in curry powder blends ranges from 10-15% to up to 30%.

Freeze dried turmeric flakes

Freeze-dried turmeric flakes, from fresh *Curcuma longa* rhizomes, retained the the potentail bioactive compounds, including curcuminoids, through advanced freeze-drying technology. Unlike sun-dried or hot-air-dried turmeric, which accounted loses in curcumin, freeze-dried flakes preserved flavor, color, and health benefits like anti-inflammatory, antioxidant, and antimicrobial properties with minimal degradation. . Sliced into 3–8 mm flakes, they offered convenience for culinary uses in teas, smoothies, and seasonings, as well as applications in supplements and cosmetics, boasting a shelf life exceeding two years when stored properly. Despite higher production costs, their versatility and market demand for natural, functional foods make them a promising value-added product for entrepreneurs and health-conscious consumers.



Freeze dried turmeric flakes

Freeze dried turmeric juice powder

Golden milk: Golden Milk is a ready-to-drink beverage designed to deliver health benefits through a blend of natural ingredients. With a shelf life of 3 months, this product is packaged in 180 ml cans, making it convenient for single servings. The formulation includes double-toned milk, sugar, and natural extracts of turmeric, ginger, and cinnamon, which contribute to its distinct flavor and potential health benefits. Each 180 ml serving contains 15 mg of natural curcuminoids, the active compounds derived from turmeric, known for their anti-inflammatory and antioxidant properties. Priced at Rs. 35 per can, Milma Golden Milk offers a cost-effective option for consumers seeking a functional beverage with bioactive components. The technology was commercialized to Kerala Cooperative Milk Marketing Federation Ltd (MILMA), Kozhikode.



Golden milk

Golden milk mix

Golden milk mix: Milma Golden Milk Mix is a powdered beverage mix formulated for easy preparation and extended shelf life. Packaged in 250 g units, this product has a shelf life of 6 months, ensuring long-term usability. The mix comprises milk solids, sugar, and natural extracts of turmeric, ginger, and cinnamon, providing a balanced flavor profile with functional benefits. Each 25 g serving delivers 16 mg of natural curcuminoids, bioactive compounds recognized for their anti-inflammatory and antioxidant effects. Priced at 200/pack, Milma Golden Milk Mix is an economical choice for consumers who prefer customizable preparation while retaining the health benefits of curcuminoids. The technology was commercialized to Kerala Cooperative Milk Marketing Federation Ltd (MILMA), Kozhikode.

Tertiary processing of turmeric

Turmeric essential oil

Turmeric essential oil is obtained by water or steam distillation, or by supercritical fluid extraction using liquid



Turmeric essential oil

carbon-di-oxide of the powdered rhizome. Dried turmeric rhizomes contain 5-6% oil. The major compounds found in turmeric oil are turmerone, ar-turmerone, curlone etc.

Turmeric oleoresin

Turmeric rhizomes contain about 7-14% oleoresin and are extracted by solvent extraction of the powdered rhizome. This can be extracted using organic solvents such as acetone, alcohol, ethyl acetate etc. Turmeric oleoresins is brownish-orange viscous oil, containing 37-55% colouring pigment (curcuminoids) and up to 25% volatile oil. It is used in food preparation and pharmaceutical products.

Curcumin

The major colouring principle of turmeric is curcumin. The curcumin content in turmeric varieties vary from 3-9%. It is a mixture of three pigments, curcumin, demethoxy curcumin and bis-de methoxy curcumin. Curcumin is an orange-yellow crystalline powder obtained by solvent extraction. This yields oleoresin with colouring matter content of 25-35% along with volatile oils and other resinous extractives. The oleoresin so obtained is subjected to further solvent washing using selective solvents that can extract the curcumin pigment from the oleoresin. This process yields a powdered, purified food colour, known as curcumin powder, with over 90% colouring matter content and very little volatile oil and other dry matter of natural origin. The solvents used for washing may be ethyl acetate, isopropanol, acetone etc.

Other diversified non-food products

Turmeric has curcumin which is a powerful medicinal compound that helps in treating many skin related issues. This has been used for its cosmetic benefits. It helps in removing pigmentation and sun tan. It's anti-inflammatory and anti-bacterial properties helps in protecting or skin from any sort of infection and also helps to treat acne. The various products in which turmeric is one of the important ingredients in its preparation includes soaps, body lotions, facial creams, face masks, skin softeners etc.

Value addition of turmeric presents a transformative opportunity to enhance its economic viability and sustainability, benefiting farmers, processors, and consumers alike. By adopting innovative processing techniques such as freeze-drying, extraction of curcuminoids, and development of diverse products like turmeric powder, oleoresin, and health supplements, the shelf life, nutritional value, and market appeal of the spice are significantly improved. These advancements addresses key challenges such as post-harvest losses, price volatility, and limited awareness of cultivation practices, while creating new revenue streams through high-demand applications in food, cosmetics, and pharmaceuticals. Encouraging training programs, infrastructural support, and market linkages will empower stakeholders to fully capitalize on turmeric's potential, ensuring a prosperous and resilient value chain.

For further interection, please contact:
ICAR-Indian Institute of Spices Research
Kozhikode, Kerala 673 012