PM Formalisation of

Micro Food Processing Enterprises Scheme

# HANDBOOK OF PROCESSING OF TAMARIND SAUCE

**AATMANIRBHAR BHARAT**

**Indian Institute of Food Processing Technology**
Ministry of Food Processing Industries
Pudukkottai Road, Thanjavur, Tamil Nadu 613005
Website: http://www.iifpt.edu.in
Email: info@iifpt.edu.in
Call: +91 4362 228155

## TABLE OF CONTENTS

# CHAPTER 1

# INTRODUCTION

## 1.1. Status and Market Size

Tamarind is botanically known as *Tamarindus indica* L. and belongs to the family Leguminaceas (Caesalpiniaceae). Tamarind however originated from dry savanna region of tropical Africa. India is the largest producer of tamarind fruits, and one of the only nations growing tamarinds on a commercial scale. No oversight body makes it difficult to know precise figures of production.

In southern part of India, tamarind is a basic ingredient in diet and different recipes. In India it is known as Imli. The word tamarind is originated from the Arabic word 'Tamar-u'l-Hind' because the dark brown pulp of the fruit was thought to resemble dried dates. It was therefore called the Tamere-hindi or 'Date of India. It is called Indian date because of the colour of its dry pulp. In Indian state of Tamil Nadu, it is being extensively cultivated in Dharmapuri, Morappur, Krishnagiri, Anjatti and Hosur areas. It is widely cultivated in Karnataka, Madhya Pradesh, Andhra Pradesh and Telangana as well. In India it is rarely cultivated and majority of the trees are grown in the backyard and homestead. Tamarind production on a micro level is a bit of an oddity in India—few in the villages gather tamarinds because they're likely the low-priced, low-demand sour variety. Furthermore, the disorganized nature of the market makes it difficult to effectively price and distribute tamarinds outside of the villages.

Tamarind has potential to grow even in barren lands. Tamarind can grow, flower and fruit profusely even as an avenue tree. It is a major crop for agro-forestry system in India. The tree has a very big life span and hence can be very economical once planted. Tartaric acid is the main constituent which serves as an acidulant and hence utilized in preparation of various Indian dishes. The best part of the fruit tree is that it can grow and sustain even in harsh semi-arid climate. It can grow in barren land as well.

### 1.1.1. Socioeconomic importance

Tamarind pulp is used in numerous culinary preparations; the usage in daily cooking is more prevalent in Southern part of India. It is also a raw material for the preparation of wine like beverages. The tamarind kernel powder is found to be extensively used for its sizing properties, in textile, confectionary, cosmetics and

pharmaceutical industries. The testa is used in dyeing and tanning industry. The tender leaves and flowers are used as vegetables. In medicine, it is used as appetizing, laxative, healing and anti-helmintic. It is also used against fluorosis.

Fruit pulp used as snack, preservative, and to prepare several culinary dishes, chutney, tamarind juice concentrate, pulp powder, pectin, jams, syrups, candy, and for making souring porridge, tartaric acid, alcohol, summer refreshing drink, seasoning, and flavoring.

The ripe fruit of tamarind tree is used as a condiment. It is a moderate size to large, evergreen tree, up to 24 metres high and 7 metres in girth. Bark is brown or dark gray, longitudinally and horizontally fissured. Leaves are paripinnate up to 15 cm long, leaflets are 10-20 pairs, oblong, 8-30 mm. Flowers are small, yellowish with pink stripes, pods are 7.5-20 cm long, 2.5 cm broad, 1 cm thick, more or less constricted between seeds, slightly curved, brownish coloured. Seeds are 3-12 oblong compressed, 1.5 cm, dark brown shining. Endocarp is light brownish, sweetish or acidic, edible pulp, traversed by branched ligneous strands. The outer cover of the pod is fragile and easily separable.

### 1.1.2. Commercially grown varieties

In India basically most cultivated trees are sexually propagated and are not uniform. Hardly there is any big orchard of tamarind. Some varieties of tamarind grown in India are:

1. PKM-1: It's a clonal selection of any seedling type. It usually fruits early and yields about 263 kg pods per year per tree.
2. Urigam: Pod size is long with sweet pulp.
3. Pratisthan: Variety is developed from Maharashtra with acidic-sweet pulp.
4. Yogeshwari: The variety is high yielding type with red coloured pulp.
5. Raktichinch: absolute red coloured pulped fruit.
6. Makhanwaan, Secthong, Manila sweet: Sweet varieties
7. Cumbum: High yielding variety.
8. Jagdish: Sweet sour high yielding variety from Maharashtra
9. DTS I and DTS II: High yielding regular varieties released from Dharwad, Karnataka.
10. Goma Prateek: This variety is released from CIAH which have short juvenile period of 3-4 years.

### 1.1.3. Cultivation Scenario

Tamarind requires semi-arid, tropical conditions in which to grow. States and regions growing the fruit include Bihar, Orissa, Karnataka, Andhra Pradesh, Madhya Pradesh, Kerala, Uttar Pradesh, Maharashtra, Tamil Nadu, and the lower Himalayas. India is the largest producer of fruits, and one of the only nations growing tamarinds on a commercial scale.

Often in competition with Thailand, India exports some of its production ships to the US, Europe, and other parts of Western Asia. Only a fraction of the yearly tamarind yield gets distributed as fresh fruit; most of it goes to plants to make ready-made pulp; a key ingredient in several Indian chutneys and curries.

Tamarind production on a micro level is a bit of an oddity in India—few in the villages gather tamarinds because they're likely the low-priced, low-demand sour variety. Furthermore, the disorganized nature of the market makes it difficult to effectively price and distribute tamarinds outside of the villages.

Tamarind season depends on the region. The south gets tamarinds first and the season slowly extends to the north. Karnataka and Andhra Pradesh yield tamarinds in January; Maharashtra in February; and northern states like Madhya Pradesh and Uttar Pradesh in late February.

### 1.1.4. Production status of Tamarind

As stated by the spice board of India, the tamarind area was 74.20 (000' ha), production was 309.44 (000' MT) and the productivity was 4.0 (MT/ha) in 2017-18. India is the chief producer and consumer of tamarind in the world. It is estimated that, India produces about 3,00,000 MT of fruits and export tamarind products, worth about Rs.50.0 Crores per annum. About 258.70 (000'MT) to 272.85 (000'MT) of tamarind is allotted for value addition products to processed and lot of labor is engaged in this processing in India. Even though, traditional processing is widespread, its commercial uses are unknown and underdeveloped.

**Table 1: Area and production of Tamarind in India**

| S. No | States/UTs | 2014-15 | | 2015-16 | | 2016-17 (Provisional) | |
|---|---|---|---|---|---|---|---|
| | | A | P | A | P | A | P |
| 1 | Karnataka | 16.80 | 87.00 | 14.90 | 72.15 | 15.00 | 70.50 |
| 2 | Tamil Nadu | 15.65 | 48.81 | 15.91 | 49.66 | 15.40 | 48.10 |
| 3 | Kerala | 11.24 | 37.30 | 11.24 | 37.30 | 11.00 | 38.30 |
| 4 | Andhra Pradesh | 4.58 | 11.45 | 4.83 | 11.10 | 4.80 | 13.90 |
| 5 | Telangana | 0.44 | 5.32 | 0.24 | 12.49 | 2.00 | 12.50 |
| 6 | Maharashtra | 5.70 | 11.40 | 5.70 | 11.40 | 0.70 | 7.20 |
| 7 | Mizoram | 0.01 | 0.03 | 0.01 | 0.03 | | |
| 8 | Others | 0.06 | 0.35 | 0.06 | 0.28 | 0.10 | 0.30 |
| | Total | 54.48 | 201.66 | 52.89 | 194.41 | 49.00 | 190.80 |

*Source:* Horticulture Statistics Division, Department of Agriculture, Cooperation & Farmers Welfare

**Table 2: State-wise productivity**

| S.No. | States/UTs | 2014-15 | 2015-16 | 2016-17 (Provisional) |
|---|---|---|---|---|
| 1 | Maharashtra | 2.00 | 2.00 | 10.29 |
| 2 | Telangana | 12.09 | 52.04 | 6.25 |
| 3 | Karnataka | 5.18 | 4.84 | 4.70 |
| 4 | Kerala | 3.32 | 3.32 | 3.48 |
| 5 | Tamil Nadu | 3.12 | 3.12 | 3.12 |
| 6 | Andhra Pradesh | 2.50 | 2.30 | 2.90 |
| 7 | Mizoram | 3.00 | 3.00 | Not available |
| 8 | Others | 5.83 | 4.67 | 3.00 |
| | **Total** | **3.70** | **3.68** | **3.89** |

*Source:* Horticulture Statistics Division, Department of Agriculture, Cooperation & Farmers Welfare

### 1.1.5. Composition & Nutritive Value of Tamarind

Tamarind is an enormous source of nutrients and medicinal property. Tamarind is a prominent source of dietary antioxidants and abundant in total phenolics.

**Table 4: Nutritive value of Tamarind**

| Constituent | Dry pulp (range in %) | Raw fruit (%) |
|---|---|---|
| Energy (from 100g) | 115-216 kcal | 239 kcal |
| Moisture | 15-30 | - |
| Proteins | 2 to 9.10 | 2.8 |
| Fats/oil/lipids, crude | 0.5 to 3.10 | 0.6 |
| Carbohydrates, total | 56.7 to 82.6 | 62.5 |
| Invert sugar | - | 30-41 |
| Fibre, crude | 2.2 to 18.3 | 5.1 |
| Cholesterol | 0 | 0 |
| Tartaric acid, total | 56.7 to 82.6 | 8-23.8 |
| Reducing sugars | 25-45 | - |
| Total ash | 2.10-3.3 | - |
| Pectin | 2-4 | > 4 |
| Cellulosic residue | 19.40 | - |
| Albuminoids | 3-4 | - |
| Total available carbohydrates | 41.77 | - |
| Alcohol insoluble sugars | 22.7 | - |
| Water insoluble sugars | 20.50 | - |
| Non-reducing sugars | 16.52 | - |
| Total sugars | 41.20 to 58.7 | - |
| Starch | 5.7 | > 6 |
| Tannin (mg) | 600 | - |
| Ascorbic acid (mg) | 3 to 9 | 0.7 to 3.5 |
| Vitamin A (IU) | 15 | 30,000 |
| Beta carotene equivalent (µg) | 10-60 | 18 |

| | | |
|---|---|---|
| Thiamine (mg) | 0.18 to 0.22 | 0.43 |
| Riboflavin (mg) | 0.07-0.09 | - |
| Vitamin E (mg) | | 0.1 |
| Vitamin K (µg) | | 2.8 |
| Niacin (mg) | 0.6 to 0.7 | 1.94 |
| Folates (µg) | - | 14 |
| Pantothenic acid (mg) | - | 0.14 |
| Pyridoxine (mg) | - | 0.07 |
| Sodium (mg) | 24 | 28 |
| Potassium (mg) | 116 to 375 | 628 |
| Calcium (mg) | 35 to 170 | 74 |
| Copper (mg) | 21.8 | 0.86 |
| Iron (mg) | 1.3 to 10.9 | 2.8 |
| Magnesium (mg) | 72 | 92 |
| Phosphorous (mg) | 54 to 160 | 113 |
| Selinium (µg) | | 1.3 |
| Zinc(mg) | 1.1 | 0.10 |

*Source: USDA National Nutrient Database*

### 1.1.6. Health benefits of Tamarind

Various plant parts of tamarind including seed and leaves are highly nutritious, though fruit pulp is the prime part of this review. The biochemical components of medicinal value and phytochemicals of a preservative role controlling various human or animal infections or diseases are summarized below

1. Tamarind fruit is anti-helminthic (expels worms), antimicrobial, antiseptic, antiviral, sunscreen and astringent and to promote wound healing, asthma, bacterial skin infections, boils, chest pain, cholesterol metabolism disorders, colds, colic, conjunctivitis, constipation (chronic or acute),diabetes, diarrhea,

dry eyes, dysentery, eye inflammation, fever, gallbladder disorders, gastrointestinal disorders, gingivitis, hemorrhoids, indigestion, jaundice, keratitis, leprosy, liver disorders, iron deficiency, nausea and vomiting (pregnancy related- generally eat raw unripe sour fruits), saliva production, skin disinfection/ sterilization, sore throat, sores, sprains, swelling (joints) and urinary stones.

**2.** Fruit pulp is used as cooling agent during fever, as pain reliever, to protect skin damage from Sun's ultraviolet rays, muscle relaxation via calcium channel blockage, decreases plasma fluoride concentration and reduces fluoride induced liver and kidney damages, regulatory effect on neutrophils due to presence of polyphenols to treat bile disorders and constipation. Tamarind fruit extract is an effective drinking water cleaning agent for fluorine, nickel and lead toxicities. Fruit pulp is laxative and carminative and its extract is antimicrobial in action for many secondary bacterial infections of human. The purified xyloglucan from tamarind were in use for eye surgery and fruit extracts enhancing bioavailability of ibuprofen as a promising achievement in medical history.

3. A raw or partially ripe fruit is used as an anti-scorbutic, heal inflammations, to treat asthma, cough, sore throat by hydrolysis of phospholipids, due to the presence of polyphenols and flavonoids.

4. Antibacterial activity was observed against *Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Salmonella paratyphi, Salmonella typhi, Bacillus subtilis, Burkholderia pseudomallei, Klebsiella pneumonia* due to presence of lupeol content. Potential antifungal activity was observed against *Aspergillus niger, Candida albicans*. The fungicidal activity observed was mainly due to the brown odorless liquid bitter principle ‘tamarindienal’, identified as 5-hydroxy 2-oxo-hexa3,5-dienal identified in the tamarind pulp. Extracts from tamarind fruit pulp showing anti-malarial and molluscicidal activity against *Bulinus trancatus* snails due to the activity of saponins.

## 1.2. Indian Market Outlook

Currently, India is the major producer of Tamarind. The production in India is concentrated in the drier south Indian states and the produce is collected by the villagers and sold in the open market. Since ancient times, India has been exporting processed tamarind pulp to the western countries, mainly Europe and the Arab countries and the United States of America. India is the only country to produce tamarind as fruit of commercial crop. It has been marketed widely about 5.50 million tonnes within the country and about 70,000 tonnes exports annually. ndia is the world's top producer, exporting several thousands of tonnes of seed, seed powder and fruit pulp each year. Tamarind, which comes under the fruit category in the US, is largely cultivated in Karnataka, Tamil Nadu and Kerala.

## 1.3. Value added products from Tamarind

Tamarind is an enormous source of nutrients and medicinal property. Tamarind proves out to be a prominent source of dietary antioxidants and abundant in total phenolic. This is the reason why it can be widely used for domestic and industrial purposes. The shelf life of tamarind is as low as 1 month and hence it can be preserved by optimum processing and value addition. The value-added products include concentrated pulp, juice, concentrate, powder, pickles and paste.

### 1.3.1. Jellose

Jellose is incomplete pectin which is extracted from tamarind seed devoid of galacturonic acid. Jellose is prepared by adding huge amount of concentrated tamarind kernel powder to boiling water. Then citric and tartaric acid is added to it at a concentration of 0.2% each. It is stirred in boiling water for 30-40 minutes. The solution is kept over-night and filtered properly. The paste thus formed is dried in drum drier. The mixtures thus formed have 5% viscosity and is slightly thicker than corn starch. The product thus formed is an important ingredient and can replace corn starch industrially.

### 1.3.2. Tamarind kernel powder (TKP)

White coloured tamarind kernel is obtained by crushing tamarind seed and extracting white coloured kernel. The paste prepared from TKP is a good adhesive

after being boiled with water. The defatted TKP have a good shelf life and does not become rancid after contact with air.

### 1.3.3. Dried fruit block

Tamarind has a considerable amount of weight in its shell. Tamarind export and long-distance transport need convenience which is attained by creating tamarind fruit bars / blocks of large size. Either seeded or deseeded tamarind pulp is dried and compressed for commercial transport to distant places. The resultant fruit block is usually sold per kg or per quintal rate in distant places.

### 1.3.4. Toffees and Candies

Tamarind candy is one of the most liked products by consumers because of its natural sour-sweet blend. Candies are prepared after boiling tamarind pulp with sufficient amount of sugar and cooking it with very less amount of water

### 1.3.5. Puree or Paste

Tamarind puree/ paste is prepared after separating seeds and fibres from tamarind pulp by using little amount of water coupled with little heating. The paste thus prepared has a TSS of more than 68°B.

### 1.3.6. Tamarind Sauce

Tamarind sauce is prepared by boiling tamarind pulp in sufficient sugar and acid. Tamarind sauce is brownish-black coloured and is of delicious texture

### 1.3.7. Tamarind jam

Tamarind jam is prepared by boiling tamarind pulp with sufficient amount of sugar for 10 minutes. The seeds are separated and sufficient amount of sugar is ensured so as to maintain sugar-acid-pectin ratio. The jam prepared from tamarind has a shelf life of up to 9-12 months.

### 1.3.8. Tamarind pulp powder (TPP)

Tamarind pulp powder is prepared after drying and dehydrating the pulp. TPP is known to be dense enough to hold a TSS of 18.6-25.0°B and acidity of 8.7-11%.

The TPP produces an excellent beverage after mixing with water and contain a perfect acidity and sour-sweet blend. TPP is also prepared by dehydrating puree and extracting fine powder for use as chief acidulant. TPP is a natural resource of tartaric acid of 8-18 per cent, starch, minerals like calcium and potassium [35].

### 1.3.9. Tamarind Pickle

Tamarind pickle is prepared from matured and ripened fruit without its shells, fibres and seed. Tamarind pickle is prepared by mixture of spices and salt. The pickles thus prepared have a life of 1-1.2 years. The pickle has a hot spicy sour sweet taste. Fruits are harvested and pulp is extracted

### 1.3.10. Tamarind chutney

Tamarind chutney is a low duration processed product which is prepared from green immature fruits. The fruits have sufficient nutrient and is rich in antioxidants. Generally, tamarind chutney is cooked with spices and salts and is consumed with south Indian dishes like idly and dosa.

### 1.3.11. Fruit juice concentrate

Fruit juice concentrate is prepared by squeezing the ripe fruits after soaking in water and removing fibrous material. It is a dense juice which has its own preservative property.

### 1.3.12. Tamarind beverage

It is diluted form of tamarind fruit concentrate. Tamarind pulp is extracted from seeds, fibres and shell and around 1 litre water is mixed with 1.5-2.0 g tamarind pulp. Spices like ginger, clove and pepper is added to it. Slight amount of sugar is also added to it. The mixture is stirred properly and is separated with a muslin cloth. The juice thus prepared can be stored up to 2-3 months in sterilized bottles after pasteurization at 95°C for 8-10 minutes. The nutritional quality is not hampered in this method

## 1.4. Post harvest Processing of Tamarind

### 1.4.1. Harvesting

Tamarinds may be left on the tree for as long as 6 months after maturity so that the moisture content will be reduced to 20% or lower. Fruits for immediate processing are often harvested by pulling the pod away from the stalk which is left with the long, longitudinal fibers attached. In India, harvesters may merely shake the branches to cause mature fruits to fall and they leave the remainder to fall naturally when ripe. Pickers are not allowed to knock the fruits off with poles as this would damage developing leaves and flowers. To keep the fruit intact for marketing fresh, the stalks must be clipped from the branches so as not to damage the shell.

### 1.4.2. Yield

A mature tree may annually produce 330 to 500 lbs (150-225 kg) of fruits, of which the pulp may constitute 30 to 55%, the shells and fiber, 11 to 30 %, and the seeds, 33 to 40%.

### 1.4.3. Post – harvest handling and marketing

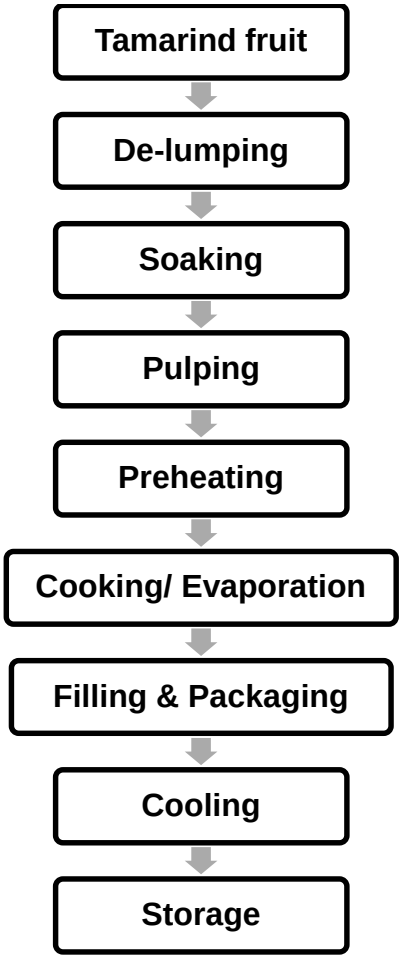
After harvest pods are spread on ground and cut for 6-7 days. The shell and seeds as well as the fibrous material are removed and the pulp is collected, the pulp can be stored for a period of 6-12 months after properly drying in the sun. Many times trees or entire plantation is auctioned to the traders who manage harvesting as well as marketing.

To preserve tamarinds for future use, they may be merely shelled, layered with sugar in boxes or pressed into tight balls and covered with cloth and kept in a cool, dry place. For shipment to processors, tamarinds may be shelled, layered with sugar in barrels and covered with boiling syrup. East Indians shell the fruits and sprinkle them lightly with salt as a preservative. In Java, the salted pulp is rolled into balls, steamed and sun-dried, then exposed to dew for a week before being packed in stone jars. In India, the pulp, with or without seeds and fibers may be mixed with salt (10%), pounded into blocks, wrapped in palm leaf matting, and packed in burlap sacks for marketing. To store for long periods, the blocks of pulp may be first steamed or sun-dried for several days.

# CHAPTER 2

# Processing of Tamarind Sauce

## 2.1. Process Flow chart for Production of Tamarind Sauce




## 2.2. Fruit Selection

Fresh mature but unripe tamarind fruits are usually selected and fruits that are ripe, over-ripe, infected or damaged are to be discarded. The fruits are rinsed well in clean water. The pods are cracked by hand and pulp separated from the broken shells. The fibers are peeled and removed; shell pieces and seeds are also removed from the pulp.

.

## 2.3. De-lumping and soaking

The Tamarind is de-lumped manually for proper soaking. Then the tamarind is soaked for 3-4 hr at 55ºC in 1000 litre capacity tanks. Water is used in the ratio of 1:2.

## 2.4. Pulping

Pulp extraction process involves 3 stages of operations as follows

a. De-stoner is used for removing seeds and large size fibers & extracting pulp from soaked tamarind. It has 6mm sieve size
b. Pulper (with 2mm sieve size) - In pulper, there is rotating body, below it there is a sieve of size 2mm; the particle which have lesser than 3mm penetrates through the filter. The remaining unwanted waste such as seed, fibre and skin are separated automatically.
c. Finisher/ refiner - The Finisher is similar to pulper but there is a sieve of 1mm.

## 2.5. Pre-heating

The pulp is heated by indirect contact of steam at 85+/-2 ºC. Pre-heating process also pasteurizes the pulp by inactivating bacterial activity. Tubular heat exchanger is particularly suited to the thermal treatment of products with a high viscosity range as well as products containing solids, pulps or fibrous products.

## 2.6. Cooking/ Evaporation

Evaporation of the pulp along with other ingredients is preferably done in large open pan, in low heat. An open pan is best as it allows moisture to evaporate more quickly. Sugar should be added and heat should be low to dissolve it, before increasing the heat to boil the mixture. The pulp is then is mixed with other ingredients and continuous stirring/ scraping should be done. The end stage of boiling – using a refractometer and the desired end stage for sauce/ puree is 25º brix.

Sugar, salt and spices are the additives used in tamarind sauce making. Sugar is added at the rate of 1 kg per kg pulp, while salt is usually at the level of 30g per kg pulp.

Spice usage can be a customised formula. This needs to be standardized. Spices used should be clean and in good condition. Some need to be roasted before use. The common spices used are Cumin, Cloves, Mace, Black pepper, Cinnamon, dry ginger powder, red chilli powder, etc. A basic standard spice mix includes red chilli powder, roasted cumin powder and dry ginger powder.

Preservative such as Sodium Benzoate and Pottassium metabisulphite can be added to sauces to help preserve the products after the bottle has been opened.

## 2.7. Filling & Packaging

If glass jars are used for packaging, then they need to be hot-filled with the sauce. If the glass jars are cold, there is the risk of breaking when the hot liquid is added. Glass jars with screw-on lids are preferable. Alternatively plastic jars covered with foil lids can also be used or the sauce can be cooled and filled into polyethylene bags or pouches which are heat sealed.

The containers must be sterilized properly to avoid spoilage due to microbial contamination. Glass bottles need to be sterilized using boiling water and PET containers using chlorinated water.

## 2.8. Pasteurization

This step is optional and is done only for glass containers. This can ensure/ enhance the shelf life of the packed sauce. The glass containers are placed in a water bath that is at the same temperature as the bottles. The water must cover the jars. Then the bottles are pasteurized in boiling water for 45 minutes from the time that the water starts to boil. Then the bottles are removed the water bath from the heat and are gradually cooled by adding cold water to slowly cool the water bath. The bottles may also be cooed by leaving in the water bath until the following day. Then they are dried and labeled.

## 2.9. Possible process defects & control

- Improper maturity, improper harvest and post-harvest practices will affect the final product quality.
- Poor quality raw materials (tamarind as well as spices) will yield poor quality product. - Use only spices of good quality and free of mould or adulteration.
- Uncontrolled boiling may cause undesirable taste and colour of the product. Improper stirring will result in charred product. - Monitor the boiling stage to ensure a consistent product from each batch.
- Inconsistent process control will result in highly variable and non-standard products.Weigh all ingredients to the correct formulation
- Adding too much preservative, especially benzoate gives the product a bad taste – have a proper process control to eliminate use of preservatives.
- If the glass jars are cold during filling, there is the risk of breaking when the hot product is added.
- Improperly sterilised containers will result in product spoilage, shortening shelf life. If using re-usable bottles pay special attention to their quality.
    - Clean them with a solution of chlorinated water (100ppm).
    - They have to be checked for cracks and washed thoroughly before using.
    - Remove the jars and turn upside down so that the water can all drain out.
    - Pre-sterilise all jars and bottles and use only new lids for sealing.
- . Entrapped air will cause product spoilage - Check the correct fill-weight before sealing the jars/bottles. Ensure that no air bubbles are trapped in the product

# CHAPTER 3

## Packaging of Tamarind Sauce

Sauces are liquids, made from pulped fruit and/or vegetables with the addition of salt, sugar, spices and vinegar. They are pasteurized to give the required shelf-life, but the basic principle of preservation is the use of vinegar, which inhibits the growth of spoilage and food poisoning micro-organisms. Other ingredients such as salt and sugar contribute to the preservative effect and the correct Preservation Index ensures that the product does not spoil after opening and can be used little at a time. Some sauces may contain a preservative such as sodium benzoate, but this is not necessary if an adequate Preservation Index is achieved.

Sauces should contain 3 per cent acetic acid (to ensure its storing quality) and 15 per cent to 30 per cent sugar according to the kind of sauce made from fruits and vegetables.

### 3.1. Source of Contamination

The major source of sauce contamination is micro-organisms. The microbial load on the product before and after storage should, therefore, be carefully studied in order to avoid deterioration of product. Bacterial flora, fungal growth and yeast are some of the microorganisms frequently observed in packed sauces. As it is an acidic product, ketchup and sauces do not spoil easily. In order to maintain the product's quality more effectively, it is suggested that sauces (and any other processed food) be refrigerated after opening because refrigeration retards spoilage.

### 3.2. Criteria for packaging material

Packaging enhances the life span of many perishable food items. The package should offer sufficient barrier against light, moisture, gases, and other environmental factors. Apart from this, it should also protect the organoleptic characteristics (quality attributes) of sauces viz. colour, flavour, taste and overall acceptability. The package should prevent emission of off-flavours. The package must be "chemically clean and inert", and it should be able to perform at high processing speeds. In order to protect leaching out of powerful flavour ingredients through film structures thereby causing de-lamination, chemical resistant adhesives and primers can be used to assure packaging integrity.

### 3.3. Types of Packaging for Sauces

Presently, sauces are widely available in glass bottles, small flexible pouches (sachets), standuppouches and plastic bottles, generally, PET bottles are being used. The glass bottles are heavy and costly and are being replaced by plastic bottles of HDPE and PET, which are lighter, hygienic and cost effective.

### 3.4. Latest Developments

#### 3.4.1. Flexible Sachets

One of the recent developments in this field is the introduction of a film/foil packet structure for a green pepper sauce. This packet structure is one of the first applications featuring a polyester-based extrusion coating on a film. This structure combines reverse printing, adhesive lamination, extrusion lamination and co-extrusion coating processing techniques to create an entirely new flexible material. The portion controlled packet prevents emission of off-flavours in the green sauce, scalping or leaching, as well as de-lamination that would occur with other films.

It is an easy-tear packet with structure of multi-layer polyester/co-extrusion coated polyester blend sealant/aluminium foil/polyester, reverse printed flexographically in three colours on the outermost polyester layer. The co-extrusion coated polyester sealant technology is revolutionary in that it is not only convenient and cost-effective, but also “chemically clear and inert”. The pack’s foil layer acts as a barrier, while an opaque white film layer provides a suitable background for printing and for a proprietary, polyester-based, chemical-resistant sealing layer that is co-extrusion coated.

The chemical-resistant sealant layer protects the foil and offers a durable, hermetic heat seal. Product-compatibility issues associated with the aggressive, spicy pepper composition of the sauce could potentially have their way with packaging films. The powerful flavour ingredients have been known to leach through film structures and delaminate them after filling. Chemical-resistant adhesives and primers also help ensure packaging integrity. Bonding is important between the pack layers. The multi-layer structure is put together in such a way so as to ensure a proper bond between all the

layers and to work well with the pepper sauce.

### 3.4.2. PP/EVOH/PP Bottle

A new barbecue sauce is introduced in a co-extruded multi-layer bottle. An Ethylene Vinyl Alcohol Copolymer material is sandwiched and blow moulded in a controlled density for proper product protection for extending shelf-life of products by locking out oxygen and other gases, while preventing moisture losses.

The lightweight, squeezable bottle also features a liner-less PP dispensing closure of proprietary design. The screw on the base, features a restricted orifice, which serves as the dispensing spout. The matching over-cap has a moulded plug in its centre, which fits into the dispensing orifice as it snaps into place and reseals the sauce.

The bottle is available in a variety of shapes and can be designed for squeezing and dispensing thick products, said to be ideal for products subject to flavour losses in conventional plastic bottles. The barrier layer provides protection against oxygen permeation and helps to lock in flavour and aromatics. The material has a strong tolerance to heat and does not lose its properties at elevated temperatures.

The co-extrusion technology allows a variety of lower cost material including PP and HDPE or LDPE to be combined with more expensive barrier middle layer depending upon the product requirement.

### 3.4.3. Heat Set Tomato Sauce Bottle

This is an exciting and innovative packaging development - a unique new product in the European packaging market. The 250ml heat set PET sauce container is believed to be the first small container of its kind for high temperature hot-fill process conditions. The container has a crystallized neck and base, suitable for hot-filling up to a maximum temperature of92°C followed by immediate cooling, and has a maximum pasteurization process temperature of 75°C.The pack, which is produced using a standard preform, weighs 35 grams and has a 43mmcrystallized neck. It utilizes standard heat set blowing at 850 bph/mould and features basethermal crystallization.The container is ideal for children - particularly because it is unbreakable.

### 3.4.4. Pinched-grips, Easy-grip PET Container

A polyethylene terephthalate pinched-grip jar (PET), injection stretch/blow-molded, the jar has a 63-mm finish. The jars have an induction-sealed foil membrane that comes inside an injection-molded polypropylene liner-less closure. A special coating is developed for the foil so that it would provide a reliable hermetic seal at “near 90°C” temperatures. Also significant is the edge-seal feature moulded into the closure that keeps water from being drawn between the container’s neck finish and the closure during cooling.

### 3.4.5. Stand-up pouches

Introduction of stand-up pouch for sauce packing is one of the innovations in the packaging field. This type of packing was designed with the objective to provide a cost effective and consumer friendly alternative to lay flat pouches with easy-pour-out and re-closing facilities.

Some important features of the stand-up pouch are:

• Value addition through packing

• An easy to use pack, which incorporates easy pourability and re-closing in its design

• Unique stand-up format providing greater display capabilities and brand imaging

• Automatic packing

The stand-up pouches are usually made of multi colour reverse printed laminate structure of a 10µ PET / 120µ-3 layer PE film, structurally providing the pack contents with physical, chemical and biological protection.

# CHAPTER 4
# Food Safety Regulations &Standards

**Regulation 5.3.18 Tamarind Pulp/Puree and Concentrate:**

1. Tamarind Pulp/ Puree and Concentrate means the unfermented product which is capable of fermentation, obtained from fresh or dried tamarind, by boiling with water and sieving it, and preserved either by thermal processing or by using permitted preservatives.

2. The Tamarind Concentrate is the product obtained from tamarind pulp/ puree from which water has been removed by evaporation to achieve appropriate concentration.

3. **FSSAI standards and guidelines for Tamarind Pulp**

| Product | Minimum TSS Percent | Minimum Acidity Percent | Ash Insoluble in dilute HCL Percent (Maximum |
|---|---|---|---|
| Tamarind Pulp/ Puree | 32 | 4.5 | 0.4 |
| Tamarind Concentrate | 65 | 9.0 | 0.8 |

**4.** The container shall be well filled with the product and shall occupy not less than 90.0 percent of the water capacity of the container, when packed in the rigid containers. The water capacity of the container is the volume of distilled water at 20ºC which the sealed container is capable of holding when completely filled.

**Regulation 5.3.28 Culinary Pastes / Fruits and Vegetable Sauces Other Than Tomato Sauce and Soya Sauce 1.**

Culinary Pastes / Fruits and Vegetable Sauces Other Than Tomato Sauce and Soya Sauce means a culinary preparation used as an adjunct to food, prepared from edible portion of any suitable fruit/vegetable including, roots, tubers & rhizomes, their pulps/purees, dried fruits, singly or in combination by blending with nutritive sweeteners, salt, spices and condiments and other ingredient appropriate to the product.

**Fruit & Vegetable Sauce**

- Total Soluble Solids (Salt free basis) (m/m) - Not less than 15.0 percent
- Acidity % (as acetic acid) - Not less than 1.2 percent

**Additive standards & Recommended maximum levels**

| | |
|---|---|
| Acesulfame potassium 1,000 mg/kg | Sunset yellow FCF 100 mg/kg |
| Aspartame 350 mg /kg | Tertiary butylhydroquinone (TBHQ) 200 mg/kg |
| Indigotine (indigo carmine) 100 mg/kg | L-Tartaric acid GMP |
| Allura red AC 100 mg/kg | Dimethyl polysiloxane GMP |
| Butylated hydroxyanisole (BHA) 200 mg/kg | Propylene glycol alginate 200 mg/kg |
| Butylated hydroxytoluene (BHT) 100 mg/kg | Ascorbyl Esters 500 mg/kg |
| Benzoates 1,000 mg/kg | Beta-Carotenes vegetable 2,000 mg/kg |
| Brilliant blue FCF 100 mg/kg | Ethylene Diamine Tetra Acetates (EDTA) 75 mg/kg |
| Carotenoids 500 mg/kg | Grape skin extract 300 mg/kg |
| Chlorophylls And Chlorophyll, Copper Complexes 100 mg/kg | Annatto GMP |
| Canthaxanthin 30 mg/kg | Steviol glycosides 350 mg/kg |
| Caramel III - ammonia caramel 50,000 mg/kg | Paprika oleoresin GMP |

| | |
|---|---|
| Caramel IV – sulfite ammonia caramel 30,000 mg/kg | Lauric arginate ethyl ester 200 mg/kg |
| Guaiac resin 600 mg/kg | Neotame 70 mg/kg |
| Hydroxybenzoates, Para1,000 mg/kg | PHOSPHATES 2,200 mg/kg |
| Iron oxides 75 mg/kg | POLYSORBATES 5,000 mg/kg |
| Phosphates 300 mg/kg | SORBATES 1,000 mg/kg |
| Ponceau 4R 50 mg/kg | SULFITES 300 mg/kg |
| Propyl gallate 200 mg/kg | Sucralose 450 mg/kg |
| Riboflavins 350 mg/kg | Sucroglycerides 10,000 mg/kg |
| Saccharins 160 mg/kg | PHOSPHATES 300 mg/kg |

**Microbial standards**

| S.No | Parameter | Limit |
|---|---|---|
| 1. | Total plate count | Positive in not more than 40.00 percent of the field examined |
| 2. | Coliform Count | - |
| 3. | E.Coli | - |
| 4. | Salmonella | - |
| 5. | Shigella | - |
| 6. | Staphylococusaureus | - |
| 7. | Yeast and spores | Not more than 125 per 1 / 60 c.m.m |
| 8. | Anaerobic Spore Count | - |
| 9. | Listeria monocytogenes | - |

## Manufacturers List of Food Processing Machineries

| S.no | Name of the company | Machineries |
|---|---|---|
| 1. | MMM Buxabhoy& Co<br>140 Sarang Street 1st Floor,<br>Near Crawford Market<br>Mumbai India<br>Tel: +91 22 2344 2902<br>Fax: +91 22 2345 2532<br>yusufs@vsnl.com; mmmb@vsnl.com;<br>yusuf@mmmb.in | Packaging and labelling machines |
| 2. | 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 | Dryer; Packaging and labelling machines |
| 3. | Bombay Engineering Works,<br>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 | Dryer |
| 4. | 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 | Dryer |
| 5. | Premium Engineers Pvt Ltd Plot No 2009, Phase IV, GIDC Vatva, Ahmedabad 382445 India Tel: +91 79 25830836 Fax: +91 79 25830965 | Dryer; Milling & grinding machinery |
| 6. | Central Institute of Agricultural Engineering, Nabi Bagh Berasia Road Bhopal 462 038 Madhya Pradesh India Tel: +91 755 2737191 Fax: +91 755 2734016 | 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<br>Harichand Mill compound LBS Marg,<br>Vikhroli<br>Mumbai 400 079 India<br>Tel: +91 22 2578 3521/577 5846/579 5982 Fax: +91 22 2577 2846 | Packaging and labelling machines |
| 10. | Rank and Company<br>A-p6/3, Wazirpur Industrial Estate<br>Delhi – 110 052 India<br>Tel: +91 11 7456101/ 27456102<br>Fax: +91 11 7234126/7433905<br>E-mail: Rank@poboxes.com | Dryers |
| 11. | Soorya Kitchen Equipments<br>Thammanam, Kochi, Ernakulam, Kerala<br>08045329361 | Peeler |

Contact Us

**Director,**

**Indian Institute of Food Processing Technology (IIFPT)**

(Ministry of food processing industries, Government of India)

Pudukkottai Road, Thanjavur 613005, Tamil Nadu.

Phone No:+91-4362-228155, Fax No:+91 4362 227971

Email: director@iifpt.edu.in ▪ Website:www.iifpt.edu.in