

# Tuna and Tamarind: Functional Foods

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**Abstract:** Tuna comes from the prickly pear cactus, which is grown in infertile soils and severely drought-stricken conditions. Its nutritional properties are little known and its cost is very affordable. Tamarind grows in warm, semi-dry climates; it can withstand drought and seasonal flooding. The seeds, leaves, flowers, fruits, and even the wood can be harvested. It has nutritional properties.

**Key words:** Tuna, tamarind, functional foods.

## 1. Introduction

### 1.1 Prickly Pear

Prickly pear is the fruit of the Nopal (*Opuntia ficus-indica*), a member of the Cactaceae family. It is native to Mexico, where it was domesticated.

It has a lignified primary stem averaging 2.5 m in height. It also develops cladodes, modified stems from which the prickly pear's spines and flowers emerge.

Prickly pear is common in xerophytic areas with severe drought conditions, infertile soils, and where the average annual rainfall is 326 mm or less. It does not tolerate salinity or low temperatures [1].

The seed germination rate is high, and they can remain viable for up to 12 years. However, they require scarification to break dormancy.

Prickly pear plants begin to produce fruit 2 to 3 years after establishment, reaching a peak yield at 6 to 8 years. The fruits ripen 80 to 100 days after flowering, with rapid growth in the first 20 to 30 days, which then slows to 59 to 90 days after anthesis. Fruit production lasts for 20 to 30 years, although this depends on the variety and management. The fruits are consumed by several species of birds, which spread the seeds to new territories.

### 1.2 Tamarind

Tamarind, scientifically known as *Tamarindus indica*, comes from the legume family. It is considered of great

importance for its high content of vitamins such as ascorbic acid, niacin, and riboflavin, among others. Additionally, it contains minerals such as phosphorus, iron, and calcium, which are important for the human body. It is found on three continents and is cultivated in approximately 54 countries, native to 18 and naturalized in 36 countries [2]. Tamarind fruit production begins approximately 7 to 10 years after seed production and 3 to 4 years after vegetative reproduction. The pods may remain on the tree for several months [3].

## 2. Materials

### 2.1 Prickly Pear

The prickly pear is an oval berry with a large seed content and a semi-hard, spiny shell. Approximately 23 varieties of edible prickly pear are recognized in Mexico.

See Table 1 for taxonomy of the prickly pear.

The chemical composition of prickly pear consists of 85% water, 14% sugars, and 1% protein. The pulp of the prickly pear is considered to constitute between 30% and 40% of the total weight, and the remainder corresponds to the shell, which is used as a source of various products (See Table 2).

The bioactive compounds found in the greatest quantities in the pulp are vitamins C, E, and polyphenols; some amino acids found in the pulp are proline, glutamine,

**Table 1 Taxonomy of the tuna.**

Kingdom	Plantae
Subkingdom	Viridiplantae
Infrakingdom	Streptophyte
Superdivision	Embryophyte
Division	Tracheophyte
Subdivision	Euphylophytin
Infradivision	Lignophyte
Class	Spermatophyte
Subclass	Magnoliophyta
Superorder	Caryophyllanae
Order	Caryophyllales
Family	Cactaceae
Subfamily	Opuntioideae
Genus	Opuntia
Species	<i>Opuntia ficus-indica</i> (Linnaeus)

Source: Ref. [4].

**Table 2 Chemical and nutritional composition of tuna pulp.**

Nutritional facts for pearl of tuna	Values
Water	87.55 g/100g
Energy	41 kcal/100g
Protein	0.73 g/100g
Total lipids (fat)	0.51 g/100g
Ash	1.64 g/100g
Carbohydrates	9.57 g/100g
Total dietary fiber	3.60 g/100g
Minerals	
Calcium	56 mg/100g
Iron	0.30 mg/100g
Magnesium	85 mg/100g
Phosphorus	24 mg/100g
Potassium	220 mg/100g
Sodium	5 mg/100g
Zinc	0.12 mg/100g
Copper	0.08 mg/100g
Selenium	0.60 mg/100g
Vitamins	
Vitamin C	14 mg/100g
Thiamine	0.014 mg/100g
Riboflavin	0.06 mg/100g
Niacin	0.46 mg/100g
Vitamin B-6	0.06 mg/100g
Vitamin A	2 µg/100g

Sourced: Ref. [6].

and, in greater quantities, taurine. In addition, it has high amounts of minerals such as calcium and magnesium,

pigments, and polyphenols, which together could play an important role if it were considered a functional food [5].

## 2.2 Tamarind

Tamarind (*Tamarindus indica* L.) is a tropical tree whose fruits are pods in the form of bags with a hard, brownish shell, ranging in length from 15 to 17 cm [2].

Due to the high nutritional value of tamarind, leaves, flowers, fruits, seeds, and wood can be used due to its favorable characteristics [7].

*Tamarindus indica*, native to East Africa, is a tropical shrub and is the only species in the genus *Tamarindus*. It belongs to the Fabaceae or Leguminosae, and is part of the subfamily Caesalpinioideae, where its fruits are edible. Its taxonomic classification is as follows (see Table 3).

Tamarind is one of the fruits, after dried figs and dates, with the highest potassium content, containing 570 mg per 100 g.

Tartaric acid is what gives tamarind its characteristic acidic flavor, which is another valuable ingredient in the fruit. It also contains many vitamins, including C, B1, B2, B3, B5, K, and B6; it also contains minerals such as phosphorus, iron, folate, zinc, selenium, copper, calcium, sulfur, and magnesium.

In addition, this fruit also provides carbohydrates, soluble fiber, vegetable protein, and organic acids. Consuming this fruit requires a total of 287 calories (See Table 4).

**Table 3 Taxonomy of tamarind.**

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Rosidae
Order	Fabales
Family	Fabaceae
Subfamily	Caesalpinioideae
Tribe	Detarieae
Genus	<i>Tamarindus</i> L.
Species	<i>T. indica</i> L., Sp.

Source: Ref. [8].

**Table 4** Nutritional value in 100 g of tamarind.

<i>Nutrition</i>	<i>Content</i>
Carbohydrates	62.5 g
Sugars	57.4 g
Dietary fiber	5.1 g
Fats	0.6 g
Proteins	2.8 g
Thiamine (Vit. B1)	0.428 mg
Riboflavin (Vit. B2)	0.152 mg
Niacin (Vit. B3)	1.938 mg
Pantothenic acid (Vit. B5)	0.143 mg
Vitamin B6	0.066 mg
Folic acid (Vit. B9)	14 µg
Vitamin C	3.5 mg
Vitamin E	0.1 mg
Vitamin K	2.8 µg
Calcium	74 mg
Iron	2.8 mg
Magnesium	92 mg
Phosphorus	113 mg
Potassium	628 mg
Sodium	28 mg
Zinc	0.1 mg

Source: Ref. [7].

### 3. Results

#### 3.1 Prickly Pear

In addition to its nutritional value, the prickly pear pulp is considered to constitute between 30% and 40% of the total weight, while the peel represents the remainder. The latter could be used as a source of various products. A recent study on the characterization of prickly pear peel reported that it contains a good source of polyunsaturated fatty acids and natural antioxidants such as vitamin E, tocopherols, and vitamin C [6]. Therefore, this prickly pear byproduct may constitute an interesting source of phytochemicals, which can be extracted and potentially used in the preparation of high-value-added products [9].

#### 3.2 Tamarind

The pulp constitutes 30%-50% of the ripe fruit, the peel and fiber represent 11%-30%, and the seed approximately 25%-40%. Its color is bright brown, and its shape is oval and slightly flattened, held together by

the fiber found in the fruit pulp. There are approximately 2,000 to 2,500 seeds in one kilogram [10]. Dried tamarind pulp contains tartaric acid and reducing sugars, of which 70% is glucose and 30% fructose [11].

Tamarind has a wide variety of uses due to its nutrients and minerals, including culinary and medicinal uses. Its pulp is used in numerous dishes when unripe for its acidic flavor, and when ripe, in juices, preserves, sauces, ice cream, soft drinks, desserts, and even in natural medicine.

The tamarind fruit pulp is widely used in South Indian cuisine, as well as in the preparation of jams and ice cream. In Mexico, it is used to make sweets and flavorings.

### 4. Conclusions

#### 4.1 Prickly Pear

In addition to its nutritional value, it has potential use as a raw material in industrial sectors such as pharmaceuticals and cosmetics. Studies are being conducted on the antioxidant activity of prickly pear varieties produced in various states with the goal of producing functional foods with high added value; this seeks to diversify their marketing and increase production.

#### 4.2 Tamarind

The tamarind tree is adaptable to acidic climates and can be grown in humid and dry regions. It is very sensitive to frost. The optimal rainfall requirement is 750-1,900 mm, but it can thrive in regions with low annual rainfall of 500-750 mm. Tamarind (*Tamarindus indica* L.) is one of the common fruit trees found cultivated, mostly under rainfall conditions. Tamarind pulp has excellent keeping quality when properly dried; it is rich in glucose, D-mannose, and D-maltose; the bitter taste of the pulp is attributed to tartaric acid along with malic and citric acids. The fruit is a good source of phosphorus, calcium, and iron. The young leaves and flowers are also edible.

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