DEVELOPMENT AND EVALUATION OF PRESERVED FOODS FROM *TAMARILLO* FRUIT

SUGANYA A

(16PFN022)

A THESIS SUBMITTED TO THE

AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND

HIGHER EDUCATION FOR WOMEN

COIMBATORE-641043

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR

THE DEGREE OF

MASTER OF SCIENCE IN FOOD SCIENCE AND NUTRITION

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SIGNATURE OF THE SUPERVISOR

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INTRODUCTION

The tamarillo or is a small, fast growing tree cultivated for its edible fruit. Tamarillo fruit can be consumed in many ways such as eaten raw as a dessert fruit, in salad, as an appetizer or prepared in a number of other ways. (Bakshi, 2016)

Fruits and vegetables provide colour, flavour and nutrients to our diets. They are more often most attractive and health-promoting when used as fresh. However, majority of people are not capable of keeping gardens that could supply the daily servings year round. Tomato is a fleshy berry regarded as very popular perishable fruit as well as vegetable grown throughout the tropical and temperate regions of the world . Harvesting itself separates the fruit or vegetable from its source of nutrients. In many cases, fresh tomato has a shelf life of only days before they are unsafe or undesirable for consumption. (Christine*et al*, 2007).

The tree tomato (*Solanumbetaceum or Cyphomandrabetacea)* can reach up three meters of height and belongs to the Solonaceae family, which is the same family of potato and tomato. Its fruits are fleshy, oval or elliptic shaped and yellow, orange or purple and red in color with a pleasant-tasting, slightly acidic, aromatic pulp, rich in vitamins and minerals. (Acosta, 2013).

Solanum betaceum is a shrub native to the Andes, specifically in Peru, Ecuador, and Colombia, that belongs to the Solanaceae family. The fruits are oval, covered by a thick, smooth, and shiny peel, with a red, orange, or yellow flesh, depending on the variety. Inside, its texture is firm, and juicy, with a bitter-sweet taste. In the center of the fruit, there are a large number of flat seeds surrounded by a smooth pulp. This fruit is source of vitamins A, B6, C, and E, and is also rich in calcium, iron, and phosphorus. Yellow fruits are considered promising because of their intense flavor, but some characteristic residual bitter and astringent flavors are undesirable by the consumers. (Osorio, 2016).

Tamarillo types are distinguished according to their fruit skin colors: solid deep-purple, blood-red, orange or yellow, or red-and-yellow, and may have faint dark, longitudinal stripes. The ripe fruit is ovoid in shape and smooth-skinned. It has a length of 4–10 cm, a diameter of 3–5 cm, and contains many small seeds; it elicits a slightly sour and astringent taste with a delicate and characteristic aroma and is generally consumed fresh or used in various culinary preparations such as salads, sauces, soups, jellies, ice creams, juices and liqueurs.

The exotic fruit is low in fat and calories and has high nutritional value providing significant amounts of micronutrients such as vitamins, minerals and bioactive components such as anthocyanins, carotenoids and flavonoids (Osorio et al., 2012).

The levels of vitamins B_6, C and E and the levels of trace elements such as iron, magnesium, copper and potassium present in one tamarillo fruit may supply over 5% of the RDI (recommended daily intake) of these nutrients (Lister et al, 2005).

Coronary heart diseases, cancer, and other health problems related to the aging process have been associated with free radicals such as reactive oxygen species (ROS). The oxidation of the cell by ROS contributes to the cell degeneration which causes some chronic diseases such as cancer and Alzheimer's disease. However, the oxidation process by ROS can be reduced by antioxidants.

It presents a smooth shell with generally red or orange color when it is ripe. The pulp is juicy and acidic, with numerous seeds. For every 100 grams the tomato of tree alone contributes 35 Kcal. In general it provides a great variety of nutrients iron, potassium, magnesium, phosphorus and vitamins A, C, B_6 and E. The benefits and properties of tree tomato prevents aging, provide proteins, are sources of carbohydrates, prevents constipation, provides vitamin B and iron. (Bindels, 2015).

Natural and synthetic antioxidants have been added to food and function to extend the shelf life of the products. In addition to that, the most important function of antioxidants in the human body is to combat ROS which help to control oxidation of cells in the human body. Synthetic antioxidants have been shown to possess carcinogenic activity, hence natural antioxidants which are shown to be safer and have been comprehensively shown by researchers to possess antiviral, antimutagenic, antiinflammatory, anticancer, antitumor, and hepatoprotective properties.

Tamarillo is packed with vitamins A, C, E and pro-vitamin A. It has a good source of B-complex vitamins such as niacin, thiamine, and riboflavin. Other nutrients in tamarillo are carbohydrates, protein, fat, calcium, potassium and sodium. It also contains minerals such as, phosphorus, manganese, magnesium, copper, zinc and iron. It is fortified with many nutrients that help improve the immune system. (Sonia, 2015).

Plant-based products made from vegetables, cereals, grains, and fruits have been shown to contain a large amount of natural antioxidants. In addition to that, fruit and vegetable juices play an important role in delaying the onset of Alzheimer's disease especially among those who are at high risk for the disease. The state of Sabah which is situated in Borneo Island has tropical rain forest is that contain a rich biodiversity of fruits and vegetables. One of the fruits which is still underutilized is *Cyphomandra betacea* that can grow naturally in the higher-humidity and low-temperature area.

The flowers of tree tomato are pink in colour. The fruit of *C. betacea* is reddish-brown to orange-red in colour depending on the fruit's maturity with the diameter of about 9–12 cm. 87 percent of its total weight is made up by the flesh and seeds while the rest of its total weight is contributed by the skin of the fruit.

The fruit is juicy and has smooth skin with egg-like shape. The fruit has like tomato-taste and ripe fruit of *C. betacea* is usually eaten raw by local community.

This fruit can also be eaten with sugar to enhance the taste of the fruit. In addition to that, the fruit can also be processed to make juices, jams, jellies, desserts, and ice-cream toppings. (Hassan, 2013).

The tamarillo (*Cyphomandrabetacea*) was formerly known as a 'tree tomato' because its flesh closely resembles that of a tomato. It is available in both red and yellow varieties, with the red being more popular and more common. It is an egg-shaped bright red fruit with yellow-orange flesh and black seeds that are surrounded by purple gelatin. The red colour is due to pigments called anthocyanins while the yellow-orange colour is due to carotenoids. Several components are of particular significance in terms of contribution to daily intake of nutrients.

It is beneficial for people who want to lose weight. Consumed raw, sprinkled with herbs or in the form of salads, the juice of tamarillo acts as a detoxifier when consumed. Its acidic properties help cut down fat. Exercising, in addition, can accelerate the results of weight loss. Anthocyanin, phenols and flavonoids protect the skin from oxidative stress, pollution. Tamarillo also helps in anti-aging. Just as regular tomatoes, these can be used in home remedies for various skin problems. The chlorogenic acid present in tamarillo helps lower blood sugar levels in Type-II Diabetes mellitus. (Sonia, 2015).

Tamarillo contains excellent antioxidants, which can reduce oxidative stress in organs such as the pancreas and the liver. Eating the pulp of tamarillo, or consuming its juice on a light stomach would ensure better results. Increase the intake of tamarillo lower the levels of high blood pressure. Loaded with good sources of minerals and potassium, this fruit helps control blood pressure. (Sonia, 2015).

It provides magnesium for the proper functioning of the cardiovascular system. Also, tamarillo contains high fiber content that helps restrain absorption of bad cholesterol in the body. Due to its excellent antioxidant properties, it helps reduce oxidative stress that may otherwise lead to stroke.

Tamarillo fruits are also very good for maintaining healthy eyesight. Vitamin A restores the moisture of the membranes of the eyes which act as a barrier to bacteria and viruses. It protects the eyes from infections, and reduces the damage of eye disorders such as cataract and macular degeneration Anthocyanins contained in the darker tamarillo have potent antioxidants, which help combat free radicals that cause cancer. They also have anti-microbial and anti-inflammatory properties that stave off cancerous outbreaks. (Sonia Mehta, 2015)

The tree tomato is the fruit of a shrub of 3 to 4 meters of height, with gray bark and perennial foliage that belongs to the species *Solanumbetaceum* Of the Solanaceae family. The fruit is ovoid of 4 to 10 cm long x 3 to 5 cm wide.

Various classes of flavonoids have anticancer, antimutagenic, immune-stimulating, anti-allergic and antiviral effects. There is a lack of data on the antioxidant composition of tamarillos, although there are a few papers on their anthocyanin composition (anthocyanins are the red pigments). Amongst the major groups of antioxidants, tamarillo contains vitamins C and E, phenolics (including anthocyanins and other flavonoids) plus carotenoids. Various research groups have screened a variety of fruit for their antioxidant activity but none appear to have included tamarillo.

Tree tomato contains a variety of antioxidants such as vitamin C, β-carotene, anthocyanins and vitamin E. These tree tomato data as an antioxidant place it as a good anti-inflammatory and anticancer. (Stewart, 2015)

Although the tree tomato alone provides about 100 grams approximately 2.5 grams of protein, it can be a good complement to a salad accompanied with a serving of meat. The required daily values of protein vary according to the age between men and women, but generally after 19 years women need 46 g daily and men 56 g daily. (Cottrell, 2013).

Tomato is consumed in diverse ways, including raw, as an ingredient in many dishes, sauces, salads, and drinks. While tomatoes are botanically berry-type fruits, they are considered culinary vegetables as an ingredient or side dish for savory

meals. Numerous varieties of tomato are widely grown in temperate climates across the world, with greenhouses allowing its production throughout the year. The plants typically grow to 1–3 meters (3–10 ft) in height and have a weak stem that sprawls. It is a perennial in its native habitat, and cultivated as an annual. Fruit size varies according to cultivar, with a width range of 0.5–4 inches (1.3–10.2 cm)

The exotic fruit is low in fat and calories and has high nutritional value providing significant amounts of micronutrients such as vitamins, minerals and bioactive components such as anthocyanins, carotenoids and flavonoids (Osorio *et al*, 2012).

In folk medicine, the leaves and fruits of tamarillo are used in the treatment of sore throat, inflamed tonsils and gums (Bohs, 1989). However, there are no studies seeking to identify the components of tamarillo responsible for these apparent anti-inflammatory and analgesic actions.

The levels of vitamins B_6, C and E and the levels of trace elements such as iron, magnesium, copper and potassium present in one tamarillo fruit may supply over 5% of the RDI (recommended daily intake) of these nutrients (Lister *et al*, 2005).

With respect to the content of carbohydrates, the fruits of tamarillo contain low levels of sugars (fructose, glucose and sucrose) compared to other tropical fruits and they contain approximately 3% of fiber (Boyes&Strubi, 1997). However, there are no reports in the literature concerning the structure of the polysaccharides present in this tropical exotic fruit. In this context, we describe here the chemical structure and an evaluation of the antinociceptive and anti-inflammatory effects of a galactoarabinoglucuronoxylan polysaccharide isolated from the edible pulp of tamarillo (*S. betaceum*) fruits.

The tree tomato, an evergreen with shallow roots and brittle wood, grows from 10 to 18 feet high. A wind gust can blow it over and break its limbs. In the Andes, it thrives in elevations between 5,000 and 10,000 feet high. It likes temperatures above 50 degrees Fahrenheit. Frost will kill foliage, small branches, seedlings and cuttings,

but mature tree will recover if the frost is not prolonged or repeated. It can be grown as a houseplant and in northern greenhouses. (Richard, 2017).

Tamarillos offers good amount of protein, dietary fiber, vitamins and minerals. It is rich in carotenoid pigments – β-carotene, β-cryptoxanthin, ζ-carotene, lutein and zeaxanthin, all of them show provitaminA activity. Together they offer Vitamin A value of 2475 IU (50% of daily requirement) for 100 g of edible fruit. Other vitamins include Vitamin C, Vitamin B6 and Vitamin E. Together with Vitamin C, Vitamin A content in tamarillos make it very good antioxidant.

Phytonutrients in tamarillo are mainly Phenolics, Anthocyanin, Carotenoid and Flavonoid. Together they make tamarillo high in antioxidant activity. The color of the fruit differs according to phytochemicals present. Red variety offer more anthocyanins while yellow variety is rich in carotenoid. Apart from these, tree tomato contains citric acid and malic acid which enhance its acidic tangy flavor. Various other bioactive chemicals have been isolated from tree tomatos that are of nutritional and industrial importance.

C. betacea is a semiwoody shrub with the tree up to 2-3 m high. The flowers are pink in colour. 87% of its total weight is made up by the flesh and seeds while the rest of its total weight is contributed by the skin of the fruit. The fruit is juicy and has smooth skin with egg-like shape. The fruit has like tomato-taste and ripe fruit of *C. betacea* is usually eaten raw by local community. This fruit can also be eaten with sugar to enhance the taste of the fruit. In addition to that, the fruit can also be processed to make juices, jams, jellies, desserts, and ice-cream toppings. This study was conducted to investigate the phytochemicals, antioxidant, and anticholinesterase potential of different parts of the fruit (i.e., skin and flesh). (Hassan, 2013).

Antioxidants protect against the harmful effects of free radicals and other reactive oxidants. There are numerous diseases in which free radicals have been implicated, including the universal degenerative diseases of aging such as cancer, heart disease and cataracts, and diseases with more specific causes such as

Parkinson's disease and pancreatitis. Vitamin C, vitamin E and β-carotene (provitamin A). (Brighenti*et al*, 2003).

Flowering and fruit set in the tamarillo *(Cyphomandrabetacea*) were examined using both field-grown and glasshouse-grown plants. Tamarillo plants in the field had an extended flowering season from November until April, with individual inflorescences having open flowers for up to a month. The length of the flowering season is due to the growth habit of the plant and to the sequential flowering pattern within an inflorescence. Twelve percent of the flowers formed set fruit, but only 3% of all flowers developed into mature fruit *(Lewis*et al*., 2010).*

Tamarillo (Solanumbetaceum Cav.) is an underutilised fruit in Malaysia. The fruit, however, contains good proportions of soluble fibre, protein, starch, anthocyanins and carotenoids. Amongst the fruits, only tamarillomesocarp contains both polar (anthocyanins) and non-polar (carotenoids) pigments. The ability to retain both polar and non-polar pigments in the mesocarp could be related to the unique properties of its hydrocolloids. To understand the pigment-hydrocolloid interaction in the fruit, information on the physicochemical characteristics of the hydrocolloids is required. Therefore, hydrocolloids from the anthocyanin-rich seed mucilage fraction of the tamarillo and its carotenoid-rich pulp fraction were extracted and characterized. (Muhammad, 2015).

With this in view the study was conducted with the following objectives

To

- Analyse the nutrient content, phytochemical constituents and antioxidant activity of fresh Tamarillo fruit.
- Develop, standardize and evaluate preserved foods using Tamarillo fruit.
- Analyse nutrient, phytochemical constituents and antioxidant activity of preserved foods of Tamarillo fruit.

REVIEW OF LITERATURE

The review of literature pertaining to the study entitled "**Development and Evaluation of Preserved foods from *Tamarillo* fruit**" has been discussed under the following headings:

A. Introduction of Tamarillo fruit
B. Nutritive value of Tamarillo fruit
C. Antioxidant properties of Tamarillo fruit
D. Therapeutic properties of Tamarillo fruit
E. Preserved foods from Tamarillo fruit

A. INTRODUCTION OF TAMARILLO FRUIT

Tree tomato (Tamarillo) is a small tree native to South America. It is grown for its edible fruit, which can be prepared in many different ways. Interest in the Tamarillo as a potential new crop is increasing in many other frost-free climatic areas all around the world. There are three known types in the Andean region: red, yellow and purple. Tamarillo requires a sub-tropical climate, and can be grown in regions where citrus crops are cultivated. (Fernando, 2010).

Tamarillo is a fast growing tree cultivated for its edible fruit. Tamarillo fruit can be consumed in many ways such as eaten raw as a dessert fruit, in salad, as an appetizer or prepared in a number of other ways. In 1967, the first's commercial name was officially changed from the tree tomato to tamarillo to avoid confusion with the common garden tomato. Although it has been a relatively unexploited species, growing and shipping of tamarillo is increasing. (Prohens, 2016).

Flowering and fruit set in the tamarillo (Cyphomandra betacea (Cav.) were examined using both field-grown and glasshouse-grown plants. Tamarillo plants in the field had an extended flowering season from November until April, with individual

inflorescences having open flowers for up to a month. Twelve percent of the flowers formed set fruit, but only 3% of all flowers developed into mature fruit. (Lewis, 2010).

The tamarillo (*Cyphomandrabetacea*) was formerly known as a 'tree tomato' because its flesh closely resembles that of a tomato. It is available in both red and yellow varieties, with the red being more popular and more common. It is an egg-shaped bright red fruit with yellow-orange flesh and black seeds that are surrounded by purple gelatin. The red colour is due to pigments called anthocyanins while the yellow-orange colour is due to carotenoids. (Brighenti*et al*, 2003).

The amount of red skin pigment increased with age from 15 weeks, but harvesting of immature fruits appeared to stop red pigment development. Fruits harvested at 12–19 weeks or younger shrivelled in storage. Respiration studies showed tamarillo fruits to be non-climacteric, and only traces of ethylene were produced until final senescence. Ethylene treatment increased the respiration rate and hastened senescence of harvested fruits of all ages. The yellow strain behaved similarly to the red and had a somewhat longer storage life. (Michael, 2012).

Tamarillo start to bear fruits within 18 months of planting and come into full production within 3 or 4 years. Powdery mildew can cause serious defoliation. Better management of the plants and better handling of the fruits would enhance this crop's prospects. (Siddick, 2015).

Cyphomandrabetacea is a semiwoody shrub with the tree up to 2-3 m high. The flowers are pink in colour. 87 percent of its total weight is made up by the flesh and seeds while the rest of its total weight is contributed by the skin of the fruit. The fruit is juicy and has smooth skin with egg-like shape. The fruit has like tomato-taste and ripe fruit of *C. betacea* is usually eaten raw by local community. This fruit can also be eaten with sugar to enhance the taste of the fruit. In addition to that, the fruit can also be processed to make juices, jams, jellies, desserts, and ice-cream toppings. (Hassan, 2013).

B. NUTRITIVE VALUE OF TAMARILLO FRUIT

Tamarillo is packed with vitamins A, C, E and pro-vitamin A. It has a good source of B-complex vitamins such as niacin, thiamine, and riboflavin. Other nutrients in tamarillo are carbohydrates, protein, fat, calcium, potassium and sodium. It also contains minerals such as, phosphorus, manganese, magnesium, copper, zinc and iron. It is fortified with many nutrients that help improve the immune system. (Sonia, 2015).

Tamarillo is a promising crop for many frost free, mild temperate areas throughout the world. Although it has been a relatively unexploited species, growing and shipping of tamarillo is increasing (Prohens and Nuez, 2001). Today, the fruit demand for the fruit remains strong due to an increasing awareness of its unique flavour and nutritional qualities. Tamarillo has interesting nutritional properties for the health conscious consumer as they are low calorie fruit rich in vitamins A and C. (Prohens, 2016).

Tree tomato (Cyphomandrabetacea) is appreciated for its excellent nutritional qualities, being considered a good source of antioxidants compounds, calcium, phosphorus, potassium and iron, sugars, organic acids, pectins and flavonoids. Physical parameters (weight, size, compression strength and humidity) and chemical (degrees Brix, titratable acidity, pH, protein, dietary fiber, ash, minerals and their bioaccesibility, pectin, antioxidants compounds) of the fruit from the Aragua State, as a contribution to stimulate and diversify the consumption of the tree tomato were evaluated in a study. (Torres, 2012).

Tamarillo provides a great amount of dietary fiber, protein, minerals and vitamins. It has high content of carotenoid pigments such as β-carotene, zeaxanthin and lutein. Besides this, it also includes vitamins such as Vitamin B6, Vitamin C and Vitamin E. Vitamin A and Vitamin C content found in tamarillo makes a very good antioxidant. It also contains phytonutrient such as anthocyanin, phenolics, flavonoids and carotenoid. Fruit color varies according to the presence of phytochemicals. The

variety of red provides more anthocyanins and variety yellow have high content of carotenoid. Besides these, tamarillo possesses malic acid and citric acid that promote its acidic tangy flavor. (Stewart, 2015).

Tamarillo (Solanumbetaceum) is an underutilised fruit in Malaysia. The fruit, however, contains good proportions of soluble fibre, protein, starch, anthocyanins and carotenoids. Amongst the fruits, only tamarillomesocarp contains both polar (anthocyanins) and non-polar (carotenoids) pigments. The ability to retain both polar and non-polar pigments in the mesocarp could be related to the unique properties of its hydrocolloids. (Muhammad, 2015).

Tamarillo produces edible fruits with a high content of vitamins, minerals, phenolic and carotenoids compounds as well as low carbohydrate content. One hundred grams of tamarillo fruit pulp has 1.5g-2.5g of protein, 1.4-6.0g of fiber.. They have vitamin A (0.32-1.48 mg/100g), C (30-45 mg/ 100 g) and E (1.85 mg/100 g), pro-vitamin A, mineral elements like potassium (290-347 mg/100g), phosphorous (33.9-65.5 mg/100g), calcium (3.9-11.3 mg/ 100g), magnesium (19.7-22.3 mg/100g), iron (0.4-0.94 mg/100g) and low in carbohydrates (4.7 g/100 g) and in calories about 28 Kcal/100g. Fruits have soluble solid content of 10.0-13.5 brix, water 81-87 per cent, fat 0.05-1.28 mg/100g, total acidity 1.0-2.4 mg/100g, ascorbic acid 19.7-57.8 mg/100g, lycopene 1.22 mg/100g, Phenolic compounds 1.39 mg GAE/g, anthocyanin 0.29 mg cyanidin/g and tannins 0.40 mg catechin/ 100g. (Torres, 2012).

Proximate analysis showed that the fruit is also rich in nutritive property, which can provide all the nutrients needed for the body. The development of value added product which is also rich in antioxidant and nutritive properties will be a good source to gain nutrient as well as antioxidant property, which could also generate an additional income to the farming community. (Nallakurumban, 2015).

Tree Tomato are excellent sources of provitamin A (carotene 150 International Units per 100 g), vitamin B6, vitamin C (25 mg per 100 g), vitamin E, iron, calcium,

and phosphorus; it contains high levels of protein, pectin and fibre that helps to prevent constipation, reduces the rate of cholesterol in the blood and control sugar levels of people with diabetes. Tree Tomato is rich in carotenoids and polyphenols, leading to high antioxidant activity. These compounds are linked with possible health benefits, such as reducing the risk of cancer and cardiovalcular disease. Both varieties have a high phenolic content, providing high provitaminA activity. They are low in carbohydrates meaning an average fruit contains less than 40 calories. (Mertz, 2009).

Total phenolics in the golden-yellow and purple-red varieties were 125 and 187 mg gallic acid equivalents/100 g fresh weight, respectively. The golden-yellow variety had weaker anti-DPPH radical activity than the purple-red variety. Flavonols were only found in the peel of both varieties, while hydroxycinnamic acid derivatives were found in peel and pulp. (Catalina, 2009).

Proximate, mineral and vitamin analysis conducted on three samples of canned tomato paste and fresh tomato show that, the fresh tomato has high percentage composition of moisture (93.8±3.00) and fat (0.62±0.08) than the three canned tomato. However, it has the least percentage composition of carbohydrate (2.52±0.01), protein (1.00±0.49), crude fibre (1.21±0.99) and ash (0.85±0.01) compared to canned tomato ($p<0.05$). When Mineral analysis was conducted, it indicate that sodium, potassium, and calcium concentrations are significantly higher in canned tomato ($p<0.05$), while the iron was found to be significantly higher in fresh tomato ($p<0.05$). Vitamin A content of fresh tomato is higher while that of vitamin C is higher in canned tomato. (Abdullahi, 2016).

The characterization showed that the fruits were at the ripening stage for consumption (degrees Brix 10.51, pH 3.5, acidity 0.02 g/100ml and 4.32 Kgf/cm2 compression strength) gave a yield of 74% pulp. The analytical results of the ripped pulp showed a content of 30 Kcal/100 g, dietary fiber (4.10 g/100 g), and minerals such as phosphorous, calcium, magnesium, potassium and iron (331.32, 21.25, 21.18, 17.03 and 7.44 mg/100 g, respectively). Bioaccesibility values of 6.71 and

1.86% were reported for calcium and iron. The extracted pectin (1.00 g/100 g) was classified as high methoxyl with high degree of esterification. (Torres, 2012).

C. ANTIOXIDANT PROPERTIES OF TAMARILLO FRUIT

Cyphomandrabetacea (Cav.) Sendtn. (Solanaceae) is commonly known as 'Tree Tomato'. It is a common shrub, which widely grows in the Darjeeling Himalaya. The fruits are good sources of provitaminA, vitamin C, B6, E and iron. The antioxidant activities of methanol extracts from five different parts (placenta, endocarp,epicarp, seed and mesocarp) of this fruit were evaluated by DPPH (2,2 diphenyl 1picryllhydrazyl) radical, nitric oxide (NO), hydroxyl radical (OH), superoxide scavenging activity, metal chelating, reducing power (RP) and anti lipid peroxidation. (Ghosal, 2012).

Antioxidants may represent an important role in defence against certain diseases outlined the necessity of determining their contents in tamarillo (Cyphomandrabetacea), cherry tomato (Solanumlycopersicumvar. cerasiforme), and tomato (Lycopersiconesculentum). The antioxidant capacity, total phenolic content and total flavonoid content in tamarillo, yellow cherry tomato, red cherry tomato, and tomato in 70% ethanol and water extracts. The ethanol extract showed the highest scavenging activity, ferric reducing activity, phenolic and flavonoid contents, whereas, the water extract showed higher value for antioxidant activity in β-Carotene bleaching assay. (Atiqah, *2014).*

Antioxidants are extremely important substances that possess the ability to protect the body from damage caused by free radical induced oxidative stress. Antioxidants are derived from dietary sources, such as fruits, vegetables, and beverages.

The radical scavenging properties on 2,2-diphenyl-1-picrylhydrazyl, superoxide anion, hydroxyl radical, lipid peroxidation, nitric oxide, and reducing power as well as the flavonoids, phenolics, lycopene, and total carotene contents of methanolic extracts of the fruits were determined. All fruit extracts, mainly the mature

red fruit of purple-red variety exhibited strong scavenging activity towards all radicals tested due to the presence of relatively high total phenol, flavonoids, and lycopene as well as total carotene contents. The findings suggested that purple red variety of C. betacea fruit is endowed with antioxidant phytochemicals, which could provide protection against oxidative stress induced diseases. (Ghosal, 2013).

Cyphomandrabetacea is one of the underutilized fruits which can be found in tropical and subtropical countries. This study was conducted to determine the antioxidant activity and phytochemical contents in different parts (i.e., flesh and peel) of the fruits. Antioxidants were analyzed using DPPH and ABTS free radical scavenging assays as well as FRAP assay. (Hawa, 2013).

Total phenolic and total flavonoid content were higher in the peel with the values of 4.89 ± 0.04 mg gallic acid equivalent (GAE)/g and 3.36 ± 0.01 mg rutin equivalent (RU)/g, respectively. Total anthocyanin and carotenoid content were higher in the flesh of the fruit with the values of 4.15 ± 0.04 mg/100 g and 25.13 ± 0.35 mg/100 g. The anticholinesterase was also higher in the peel of *C. betacea*. The same trends of phytochemicals, antioxidant, and anticholinesterase were also observed in the distilled water extracts. (Hawa, 2013).

Christian Mertz et al., (2009) reported that tamarillo has higher carotenoid content. According to Bobbio et al., (1983); Wrolstad and Heatherbell, (1974) Anthocyanins were detected in the tree tomato. Rodriguez Amaya et al., (1983), observed the presence of Carotenoids in tree tomato. Olson,(1996) revealed that, except for the well-known provitaminAactivity of some carotenoids, they could be involved in protective effects against degenerative or cardiovascular diseases and are known for having antioxidant capacity. (Hassan *el al*, 2013).

C. betacea has a significant amount of phenolics, flavonoids, anthocyanin, and carotenoid which contribute to the antioxidant activity of the fruit extracts. The acceptable amount of phytochemicals in the fruits showed that C. betacea is one of the richest sources of antioxidant phytonutrients and has anti-cholinesterase properties that can enhance human health. (Karpagapandi*et al*, 2015).

Antioxidants may represent an important role in defence against certain diseases outlined the necessity of determining their contents in tamarillo (*Cyphomandrabetacea*), cherry tomato (*Solanumlycopersicum*var. *cerasiforme*), and tomato (*Lycopersiconesculentum*). The antioxidant capacity, total phenolic content and total flavonoid content in tamarillo, yellow cherry tomato, red cherry tomato, and tomato in 70% ethanol and water extracts. The ethanol extract showed the highest scavenging activity, ferric reducing activity, phenolic and flavonoid contents, whereas, the water extract showed higher value for antioxidant activity in β-Carotene bleaching assay. Tamarillo showed the highest antioxidant activity, scavenging activity, ferric reducing activity, phenolic content edible portion and flavonoid content in ethanol and water extracts respectively. (Atiqah *et al*, *2014).*

D. THERAPEUTIC PREOPERTIES OF TAMARILLO FRUIT

Wild fruits available in plenty with rich sources of various vitamins, minerals, fibers, polyphenols provide various health benefits that reduce the risk of several diseases like diabetes, cancer, coronary heart disease, neurodegenerative ailment, were not properly utilized by the people. (Nallakurumban, 2015)

Golden-yellow and purple-red tamarillos (Solanumbetaceum Cav.) cultivated in Ecuador were studied for their physical properties, proximate composition, pH, Brix, acidity, sugars, organic acids, minerals, vitamin C and β-carotene content in the edible part. Results were compared with those for Spanish fruits. Due to its high antioxidant content, tree tomato may have desirable properties to struggle against vascular diseases and cancer, among other illnesses (Kadir, 2015).

The antioxidant capacity of the ripped pulp (EC50 of 165.00 g/g DPPH and reducing power of 0.07 mmol Fe +2/100 g), could be attributed to the presence of ascorbic acid (23.32 mg/100 g), lycopene (1.22 mg/100 g), and phenolic compounds (1.39 mg GAE/g), anthocyanins (0.29 mg cyanidin/g) and tannins (0.40 mg catechin/100 g).The results obtained encourage the nutritional benefits and suggest applications as a functional ingredient in food product development. (Torres, 2012).

Anthocyanin, phenols and flavonoids present in *Tamarillo* protect the skin from oxidative stress, pollution. Tamarillo also helps in anti-aging. Just as regular tomatoes, these can be used in home remedies for various skin problems. The chlorogenic acid present in tamarillo helps lower blood sugar levels in Type-II Diabetes mellitus andIncrease the intake of tamarillo lower the levels of high blood pressure. (Sonia, 2015).

E. PRESERVED FOODS FROM TAMARILLO FRUIT

The antioxidant activity for both the tamarillo and the tamarillo sauce was reported as 208 and 211 mg AA eq /100g and the other proximate analysis showed that the fruit is also rich in nutritive property, which can provide all the nutrients need for the body. The development of value added product which is also rich in antioxidant and nutritive properties will be a good source to gain nutrient as well as antioxidant property, which could also generate an additional income to the farming community. (Nallakurumban, 2015).

Many forms of preserved tomato are today available in the market. They range from dried, canned juiced and some other forms. These are to ensure nonstop supply of the fruit throughout the year and to prevent spoilage. However, in many cases when a food item is subjected to preservation techniques, they tend to lose some nutrients compared to the fresh food item. (Nasiru, 2016).

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development of value added product which is also rich in antioxidant and nutritive properties will be a good source to gain nutrient as well as antioxidant property, which could also generate an additional income to the farming community. (Nallakurumban, 2015).

The odor-active volatile compounds of yellow tamarillo fruit (S. betaceum Cav.) were identified and quantified by using a sensomics approach, combining a gentle volatile extraction (solvent-assisted flavor evaporation (SAFE), gas chromatography-mass spectrometry (GC-MS), and sensory analyses (gas chromatography-olfactometry (GC-O) and aroma extract dilution analysis (AEDA). The medium-term purpose of this work is to evaluate the change of odor-active volatiles during processing. Thus, (Z)-3-hexenal, hexanal, and ethyl butanoate were identified as key aroma compounds of yellow tamarillo. (Juliana, 2016).

The tamarillo fruits can be eaten raw or cooked in sauce, jams, chutneys, Sambar, rasam, savoury dishes and can be used wherever ordinary tomatoes are used. Tamarillo is an excellent source of provitaminA, vitamin B6, vitamin C (25 mg per 100 g), vitamin E and iron. Tamarillo are easily propagated from seed or cuttings, require fertile, light, well-drained soil and cannot tolerate prolonged drought, nor waterlogged soils or standing water.

Tamarillos being high in pectin, to make good jellies, jams, preserves, or chutneys. The fruit freeze well, either whole (peeled) or pureed, and can be stored more than a year. Horticultural and scientific attention is needed to introduce tree tomato as an alternate to tomato in Indian dish. Tamarillo a nutrient rich, indigenous, cultivable crop alternative to tomato for hilly regions of Tamil Nadu. (Siddick, 2015).

Many forms of preserved tomato are today available in the market. They range from dried, canned juiced and some other forms. These are to ensure nonstop supply of the fruit throughout the year and to prevent spoilage. However, in many cases; when a food item is subjected to the preservation techniques, they tend to lose some nutrients compared to the fresh food item. (Abdullahi, 2016).

METHODOLOGY

The methodology pertaining to the study "**Development and Evaluation of preserved foods from *Tamarillo* fruit**" is presented as follows:

PHASE I

A. Collection of fruits

PHASE II: Analysis of fresh Tamarillo fruit

A. Nutrient content of fresh Tamarillo fruit
B. Phytochemical Constituents of fresh Tamarillo fruit
C. Antioxidant activity of fresh Tamarillo fruit

PHASE III: Development of preserved foods using Tamarillo fruit

A. Preparation of preserved foods using Tamarillo fruit
B. Standardization and sensory evaluation of preserved foods of Tamarillo fruit

PHASE IV: Analysis of preserved foods.

A. Nutrient content of preserved foods of Tamarillo fruit
B. Phytochemical Constituents of preserved foods of Tamarillo fruit
C. Antioxidant activity of preserved foods of Tamarillo fruit

The research design is presented in Figure I.

RESEARCH DESIGN

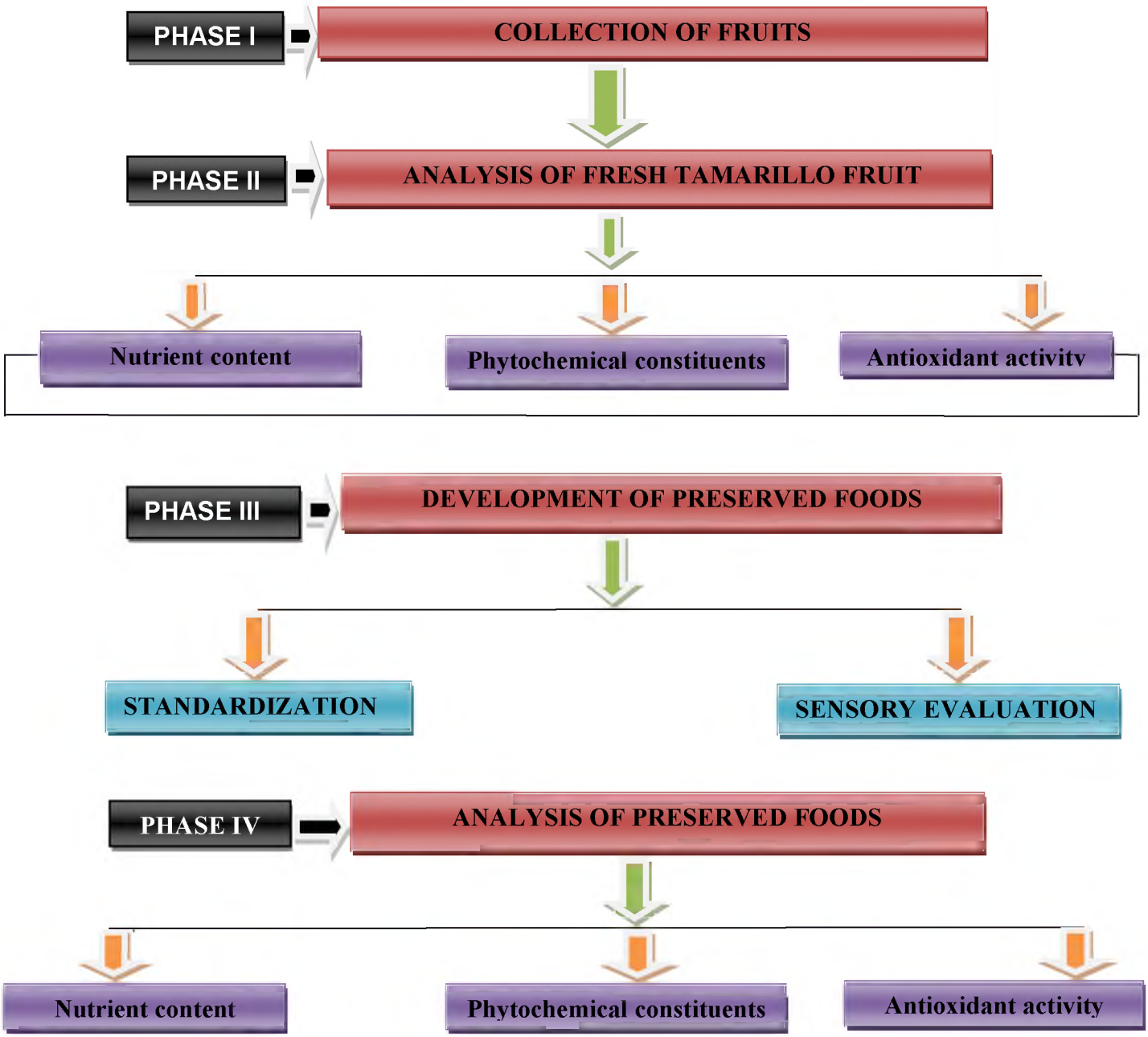


FIGURE I

PHASE I

A. Collection of fruits

Tamarillo fruits (Solanumbetaceum) were purchased from local shops at Ooty, Nilgiris District, Tamilnadu. Fully matured and ripe fruits were collected from the shops. Country Tomatoes were collected from the local shops from Coimbatore for the preparation of standard preserved foods using tomatoes.

PHASE II

ANALYSIS OF FRESH TAMARILLO FRUIT

A. Nutrient Content of Fresh Tamarillo Fruit

The different nutrients namely ash, moisture, carbohydrate, protein, crude fiber, fat, calcium, iron, phosphorus, vitamin C, thiamine and β carotene of fresh Tamarillo fruit was analysed in the Nutrition Laboratory, Department of Food Science and Nutrtion, Avinashilingam Institute for Homescience and Higher Education for Women.

a) Estimation of ash content

The ash of the sample was determined by the method described by Hart and Fisher. A sample of five gram was ashed in an electronic muffle furnace at 500^{o} to 600^{o}C and the ash is dissolved by using concentrated hydrochloric acid. The ash content was expressed as percentage.

b) Estimation of moisture

The moisture content of the sample was estimated by Shimadzu moisture balance and was expressed as percentage.

c) Total energy (Calorific value)

Energy was determined according to the method described by Sukkar (1985) using the Atwater factor. By this determination, 1g of carbohydrate provides 4kcal; 1g of protein provides 4kcal and 1g fat provides 9kcal.

d) Total Carbohydrate

In hot acidic medium glucose is dehydrated to hydroxyl methyl furfural. This forms a green coloured product with phenol and has absorption maximum at 490nm. (www.biocyclopedia.com)

e) Estimation of Protein

Protein was analyzed by the amount of nitrogen available in the sample by Micro Kjedhal, Method Hart and Fisher (1971). Point five gram of sample was transferred into 250ml of digestion flask along with three grams of catalyst mixer, porcelain tile and 15 ml of concentrated sulpuric acid. The sample was digested until the solution become colourless. The digested sample was placed in the distillation unit for ammonia recovery. The solution was distilled and the ammonia was collected in the receiver solution. The solution was titrated against the 0.1N hydrocholoic acid for the end point, until the colour changes. The same procedure was repeated to get the blank titre value and the nitrogen content of the sample can be calculated. The nitrogen value multiplied by factor 6.25 gives the crude protein content of the sample in per cent. Estimation of protein is presented in Plate I.

f) Estimation of Fat

The fat content of the sample was estimated by using soxplus apparatus. The lipid in the sample was extracted with petroleum ether (60-80°) in soxplus apparatus for two hours. Then the solvent was evaporated and the remaining residue was weighed. The fat content was expressed as percentage. Estimation of fat is presented in Plate II.

g) Estimation of crude fibre

The dried sample was taken in a beaker and 200 ml of boiling 0.255N H_2SO_4 was added and boiled for 30 minutes. The contents were filtered through muslin cloth and washed with distilled hot water until washings are no longer acidic. The residue was transferred into the same beaker and boiled with 0.313N NaOH for 30 minutes and filtered through a muslin cloth, washed with 50 ml of distilled hot water till free from alkali and 25 ml of alcohol. The residue was transferred into a pre weighed crucible,

dried for 2-4 hours at 130^{0}C and cooled and weighed. The difference in the weight represents the weight of the fibre. Estimation of fibre is presented in Plate III.

h) Estimation of Ascorbic acid

Pipetted out 5 ml of the working standard solution into a 100ml conical flask. Add 10ml of 4% oxalic acid and titrate against the dye (V1M1). End point is the appearance of pink colour which persists for a few minutes. The amount of dye consumed is equivalent to the amount of ascorbic acid. Extract the sample (0.50 – 5g depending on the sample) in 4% oxalic acid and make up to known volume (100ml) and centrifuge. Pipette out 5 ml of this supernatant and 10 ml of 4% oxalic acid and titrate against the dye (V2Ml). The estimation of ascorbic acid content was done by using dye (2,6-dichlorophenol indophenol) method.

ESTIMATION OF PROTEIN

PLATE I

ESTIMATION OF FAT

PLATE II

DETERMINATION OF FIBRE

PLATE III

B. IDENTIFICATION OF PHYTOCHEMICAL CONSTITUENTS IN FRESH TAMARILLO FRUIT

i) Preparation of aqueous extracts of fresh Tamarillo fruit

The fresh Tamarillo fruits were dried using cabinet dryer at 100° C for 3days. After complete drying the fruits were ground and powdered in a food processor. Preparation of aqueous extracts : 5g of fresh fruit powder were crushed in 25ml of sterile water, then heat at 50-60° and it was filtered using whatman filter paper no.1. Then filterate was centrifuged at 2500 rpm for 15 minutes and filterate was collected in sterile bottles and was stored by refrigeration at 5°C until use. (Gogoi&Islam, 2012).

ii) Preparation of Methanol and Ethanol Extracts of fresh Tamarillo fruit

50g of fresh tamarillo fruits was taken in two different beaker containing 500ml of methanol and ethanol kept for around 48 hours after covering the mixture with Aluminium foil and the extracts was then filtered using handmade filter paper. After extraction, each extracts were air dried thoroughly before being subjected to analysis. The filterates were evaporated to dryness at 60° C in a water bath and stored at 4°C. (Jayachitra*et al., 2012*).

a) Tannins

Ferric chloride test: Extracts of fresh tree Tamarillo fruits was taken and treated with ferric chloride solution. Appearance of blue colour indicates hydrolysable tannins and green colour indicates the presence of condensed tannins. (Rajrana, 2015).

b) Flavanoids

Alkaline reagent test: To the test solution of fresh tamarillo fruits sample and few drops of sodium hydroxide was added to each solution and few drops of dilute hydrochloric acid. Appearance of yellow colour indicates the presence of Flavanoids. (Ramya*et al.*, 2011).

c) Saponins

5ml extracts of fresh Tamarillo fruit sample was taken in a test tube shaken vigorously to obtain a stable persistent froth. The frothing was then mixed with 3drops of olive oil and observed for the formation of emulsion, which indicated the presence of saponins. (Anjali *et al., 2011*)

d) Steroids

Extracts of fresh Tamarillo sample was taken and treated with few drops of concentrated sulphuric acid, red colour at lower layer indicates the presence of steroids. (Sanjay *et al., 2011*).

e) Quinones

To 1ml of extracts of fresh Tamarillo fruit samples, 1ml of concentrated sulphuric acid was added. Formation of red colour indicates the presence of quinines. (AOAC, 2005).

f) Coumarins

To 1ml of the extracts of fresh Tamarillo fruit, 1ml of 10% NaoH was added. Formation of yellow colour indicates the presence of coumarins (AOAC, 2005).

g) Alkaloids

1ml of 1% HCl was added to 3ml of extracts of fresh Tamarillo fruit was taken in a test tube. The mixture was then heated for 20 minutes, cooled and filtered. Add about 2 drops of Mayer's reagent to 1ml of the extract. A creamy precipitate indicated the presence of alkaloids. (Onuekwusi, 2014).

h) Glycosides

10ml of 50% Sulphuric acid was added to 1ml of extracts of fresh Tamarillo fruit was taken in a test tube and the mixture heated in boiling water bath for about 15 minutes. 10ml of Fehling's solution was then added and the mixture boiled. A brick red colour indicated the presence of glycosides. (Akanya*et al.*, 2014).

i) Terpenoids

Salkowski test: Fresh Tamarillo fruit extracts was taken and treated with few drops of concentrated sulphuricacid , formation of yellow coloured lower layer indicated the presence of terpenoids. (Indira *et al.*, 2011).

PHASE III

A. DEVELOPMENT OF PRESERVED FOODS FROM TAMARILLO FRUIT

(i) Preparation of preserved foods using Tamarillo fruit

Jam, pickle and sauce were prepared using Tamarillo fruit and the method of preparation is given as follows;

I. PREPARATION OF TAMARILLO JAM

Ingredients:

- ½ kg Tamarillo
- ¼ cup water
- 300g sugar
- ½ teaspoon of citric acid
- 1 teaspoon of gelatin powder

Method of preparation

- Collect quality and ripe fruits.
- Wash the fruit blanch the fruits for 5minutes.
- Put the boiled fruits into cool water.
- Remove the outer skin of Tamarillo.
- Grind the boiled Tamarillos to make pulp.
- Filter the pulp to remove the seeds.
- Cook the pulp to remove the off flavor.
- Add sugar and stir well.
- Add citric acid and gelatin powder.

- Continue boiling jam until set (allow around 45-55 minutes for the jam to set). Remove from heat. Discard foam.
- Immediately pour the hot jam into the jars.
- Store this in cool place.

II. PREPARATION OF TAMARILLO PICKLE

INGREDIENTS:

Tamarillo-500g

Gingelly oil-250ml

Mustard- as needed

Chilly Powder-50g

Salt-as needed

Asafoetida powder-2g

Fenugreek powder-2g

Cumin seeds-2g

Method of preparation

Pre-preparation:

1. Wash the Tamarillo fruits and peel the outer skin of Tamarillo.
2. Cut the Tamarillo and soak with salt for 2-3 weeks.
3. Roast fenugreek and cumin seeds and powder it.

Seasoning:

1. Take the pan and heat the gingelly oil.
2. Add mustard when it sputters add asafetida powder and sauté well.

3. Then add chilly powder and saute.
4. Add soaked Tamarillo and saute it.
5. Finally add fenugreek and cumin seeds powder.
6. When the oil separate from the pan off the fire.
7. Cool it and bottle the pickle.

III. PREPARATION OF TAMARILLO SAUCE

Ingredients

- 500g of Tamarillo
- ½ cup of water
- 100g sugar
- 20g salt
- 20g chili powder
- Spice bag (cinnamon, cardamom, cumin seeds, cloves, pepper).

Method of preparation:

- Collect the mature and ripe Tamarillo fruits.
- Wash the fruits.
- Prepare the Tamarillos for blanching 5minutes.
- After blanching remove the skin of the Tamarillo.
- Grind the Tamarillos to make puree. Filtrate the puree to remove the seeds.
- Cook the puree for 5 minutes with continuous stirring.
- Add sugar, salt and chili powder together and cook this.

- Addition of spice bag into this and press the spice bag.
- Remove this from fire when it is thicken.
- Pour this into bottle, crown corking and store it in cool place.

The preparation of the jam, pickle and sauce is presented in Plates IV, V, VI, VII and Figure II, III, IV.

Pre-preparation for pickle

PLATE IV

Preparation of pickle

Preparation of sauce

PLATE V

TOMATO SAUCE AND TAMARILLO SAUCE

TOMATO SAUCE

TAMARILLO SAUCE

PLATE VI

TOMATO JAM AND TAMARILLO JAM

TOMATO JAM

TAMARILLO JAM

PLATE VII

PREPARATION OF TAMARILLO JAM

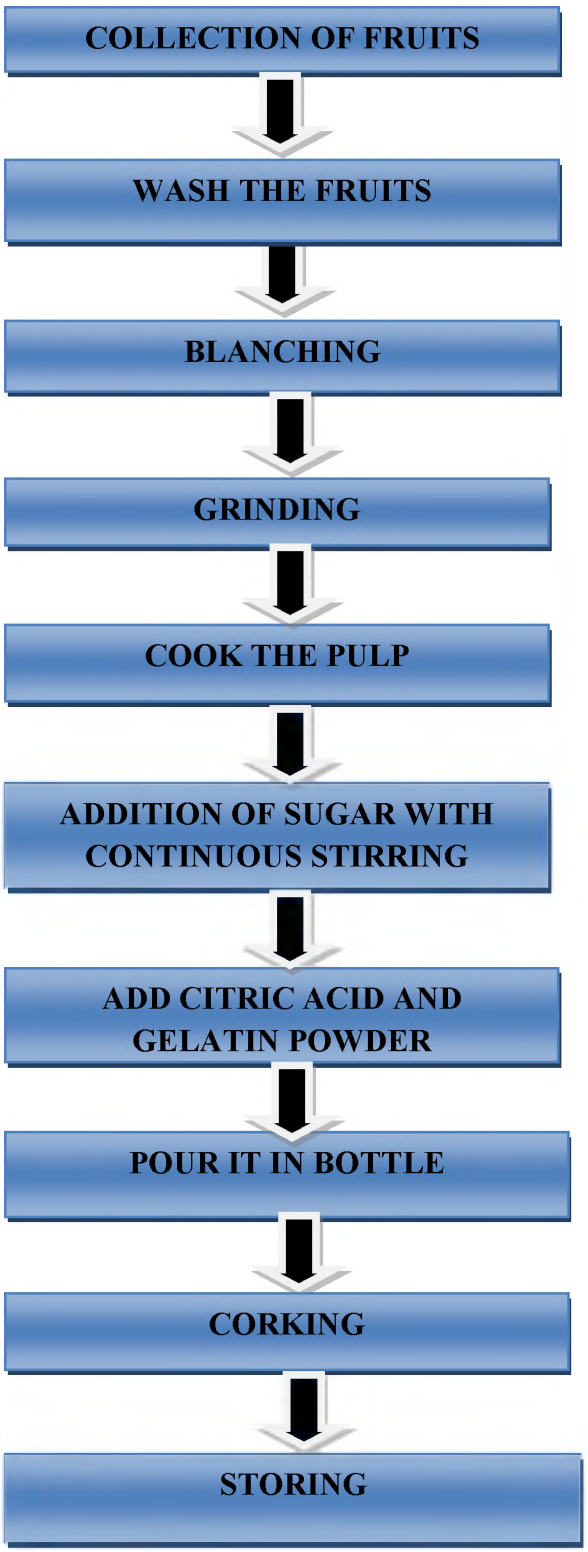


FIGURE II

PREPARATION OF TAMARILLO PICKLE

FIGURE III

PREPARATION OF TAMARILLO SAUCE

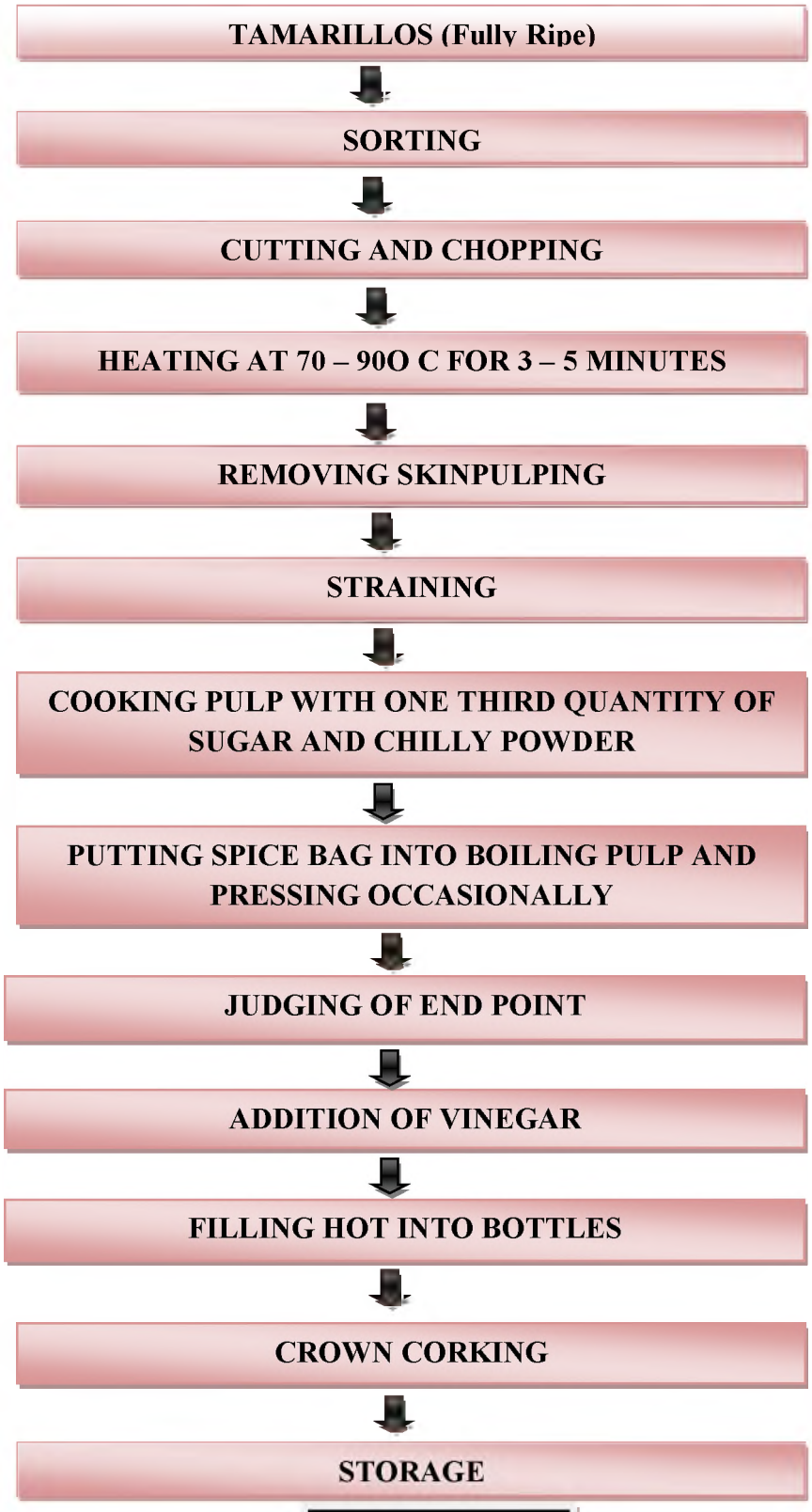


FIGURE IV

ii) Standardization and Sensory Evaluation of preserved foods

In order to standardize the preserved foods with tomato and Tamarillo, they were evaluated organoleptically in comparision with the respective standard preserved foods a score card prepared using the guidelines of numerical scoring method.

Sensory evaluation is a scientific tool that used the human senses, smell, sight, taste, touch and hearing to examine the properties which influence the quality of the products (Mc. Dermoth and Murray, 2007).

Sensory evaluation of the preserved food products were carried out by the following steps:

1. Selection of Venue
2. Selection of Panel Members
3. Formulation of Score Card
4. Conduct palatability test

1. Selection of venue

The selection of evaluation room is an essential requisite for sensory evaluation. Foods Laboratory in the Department of Food Science and Nutrition, Avinashilingam Institute for Home Science and Higher for Women, Coimbatore was selected as the venue for sensory evaluation. During evaluation, each panel member was given a score card. The preserved foods were displayed along with a spoon and a glass of water to rinse the mouth between tasting.

2. Selection of Panel members

Thirty semi-trained panel members were selected based on their health, co-operation, willingness and knowledge of quality characteristics and sensory analysis of foods. Research scholars, Project Associates and members of the Department of Food Science and Nutrition acted as panel members for the evaluation of the products.

3. Formulation of score card

Score card is a tool which helps in evaluation through direction degree of judgement using suitable defined scores. Scoring is a form of rating of the preparation of preserved food items using a numerical scale where the numbers form an internal or ratio scale (Manay and Shadaksharaswamy, 2017).

Numerical scoring test for one or more samples are presented to each panelist in random order or according to a statistical design. The panelist evaluates each sample on a specific scale for a particular characteristic indicating the rating of the sample. The panelist are trained to follow the sensory characteristics corresponding to the agreed quality descriptions and scores. (Srilakshmi, 2010).

Numerical scoring test evaluation card ranging from a maximum score of five to minimum of one was used for the evaluation. Thirty evaluation cards prepared separately for each preserved foods. Scoring of preserved foods is presented in Plate VIII.

4. Conduct palatability test

The standard tomato and preserved Tamarillo products such as pickle, jam and sauce were evaluated for palatability. The prepared score card was used for the palatability test. From the scores obtained overall acceptability was calculated.

All the three products were presented to the panel members for sensory evaluation at different points of time. To prevent any changes in their quality due to storage, temperature changes and reheating products were evaluated immediately after preparation. The portion sizes for all the products were kept consistent and uniform.

Overall acceptability of three preserved food products were determined from the sensory characteristics of the preserved foods such as appearance, colour, texture, flavor and taste. The mean of overall acceptability was tabulated and analysed and results were interpreted with statistical appraisal.

An evaluation sheet with allowed codes and details of the attributes and number of samples to be evaluated were prepared and given to each panel member. The scores obtained through sensory evaluation of the product by the members were recorded and the mean scores were calculated for each recipe. The overall acceptability and mean scores for each products were analyzed and the products which obtained the highest mean score were considered to be the best acceptable.

SENSORY EVALUATION OF PRESERVED FOODS

PLATE VIII

PHASE IV

ANALYSIS OF PRESERVED FOODS OF TAMARILLO FRUIT

A. NUTRIENT CONTENT OF PRESERVED FOODS OF TAMARILLO FRUIT

The different nutrients namely ash, moisture, carbohydrate, protein, crude fiber, fat, calcium, iron, phosphorus, vitamin C, thiamine and β carotene of preserved foods of tree Tamarillo fruit was analysed in the Nutrition Laboratory, Department of Food Science and Nutrtion, Avinashilingam Institute for Homescience and Higher Education for Women.

All the three preserved foods with Tamarillo were analysed for its nutrient content. Ash, moisture and Crude fibre were carried out by using Association of Analytical Chemists International (AOAC) procedure.

Carbohydrate estimation was done by phenol sulphuric acid method. The amount of protein present was estimated by Macrokjeldhal's method. The iron and phosphorus content was estimated by Colorimetric method and Vitamin C was estimated using Dye method and calcium by using Titrimetric method. Fat was estimated by Soxplus apparatus. Thiamine was estimated and read by using digital flouorometer.

The energy content of the preserved foods were calculated by multiplying the total amount of carbohydrate, fat and protein by their calorific value.

B. IDENTIFICATION OF PHYTOCHEMICAL CONSTITUENTS OF PRESERVED FOODS OF TAMARILLO FRUIT

Preparation of aqueous Extracts of preserved foods of Tamarillo

The phytochemical constituents of preserve foods analysed only by using aqueous extract, because aqueous extract shows more presence in the fresh Tamarillo fruits.

The preserved foods of Tamarillo were dried using cabinet dryer at 100° C for 5days. After complete drying the preserved foods were ground and powdered in a food processor. Preparation of aqueou extracts. 5g of preserved foods were crushed in 25ml of sterile water, then heat at 50-60° and it was filtered using whatman filter paper no.1. Then filtrate was centrifuged at 2500 rpm for 15 minutes and filterate was collected in sterile bottles and was stored by refrigeration at 5°C until use. (PronobGogoi&Islam, 2012). (Platee IX, X).

Qualitative analysis of phytochemicals in Tamarillo pickle

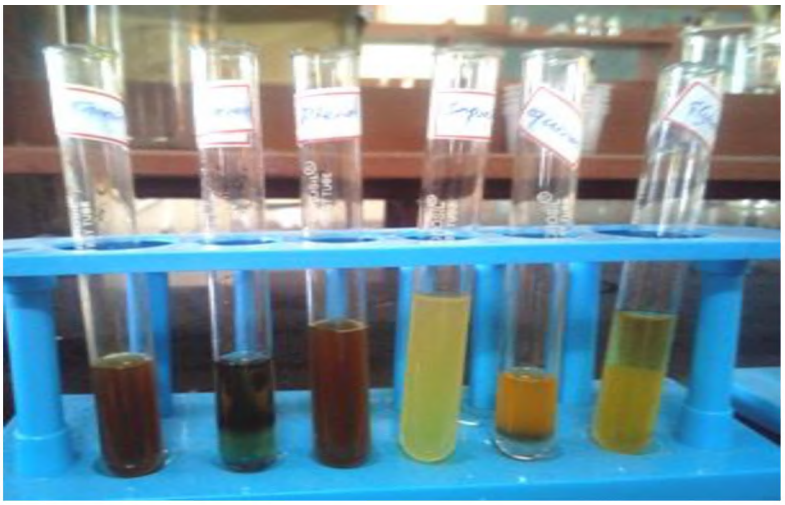


PLATE IX

Qualitative analysis of phytochemicals in Tamarillo Sauce

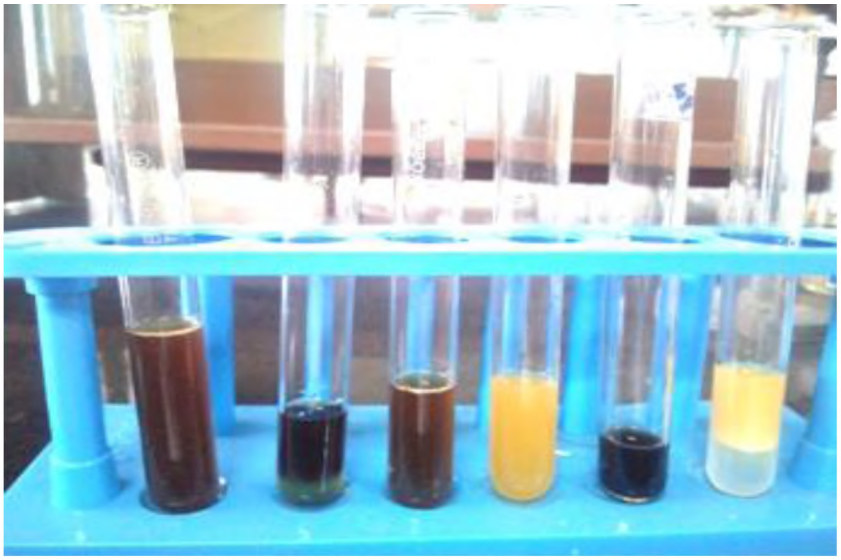


PLATE X

A. ANTIOXIDANT ACTIVITY OF PRESERVED FOODS OF TAMARILLO FRUIT

Estimation of DPPH Scavenging Activity (Mensor*et al.*, 2001)

Principle

DPPH(2,2-diphenyl-1- picrylhydrazyl), a stable free radical, when acted upon by an antioxidant is converted into diphenyl- 2- picryl hydrazine with a colour change from deep violet to light yellow colour. This can be quantified Spectrophotometrically at 518nm to indicate the extent of DPPH scavenging activity by the plant extract.

Reagents

1. DPPH (0.3mμ in methanol)
2. Methanol

Procedure

The extracts of sample(25μl) and 0.48ml of methanol were added to 0.5ml of methanolic solution of DPPH. The mixture was allowed to react at room temperature for 30 minutes. Methanol alone served as blank and DPPH in methanol, without the plant extracts served as positive control. After 30 minutes of incubation, the discolouration of the purple colour was measured at 518nm. The radical scavenging activity was calculated as follows.

$$\text{Scavenging activity (\%)} = \frac{\text{A518(sample)- A518(control)} \times 1oo}{\text{A518 (control)}}$$

DPPH (2,2-diphenyl-1- picrylhydrazyl) assay was performed by measuring the OD against the standard (Ascorbic acid), which is measured at 517 nm by UV-Spectrophotometer to find out the antioxidant activity of fresh fruit of Tamarillo and Preserved foods of Tamarillo fruit such as Pickle, Jam, Sauce. **(Aurelia and Gheorghe PetreNegulescu, 2016).**

RESULTS AND DISCUSSION

The results of the study on the topic, **"Development and evaluation of preserved foods from Tamarillo fruit**" is discussed under the following headings;

a. Nutrient content and Phytochemical constituents of fresh Tamarillo fruit.
b. Sensory evaluation of preserved foods of tomato and Tamarillo fruit.
c. Nutrient content of preserved tomato and Tamarillo fruit.
d. Phytochemical constituents preserved foods of Tamarillo fruit.
e. Antioxidant activity of fresh Tamarillo fruit and preserved foods of Tamarillo fruit.

A. Nutrient content of fresh Tamarillo fruit

Fresh Tamarillo fruit was analyzed to find out the nutrient content such as ash, moisture, energy, carbohydrate, protein, fat, fibre, iron, calcium, phosphorus, Vitamin-C, β carotene and thiamine. The details of the analysis are presented as follows.

1. Nutrient content of freshTamarillo fruit

The nutrient content of fresh Tamarillo fruit is presented in Table I and Figure V to X.

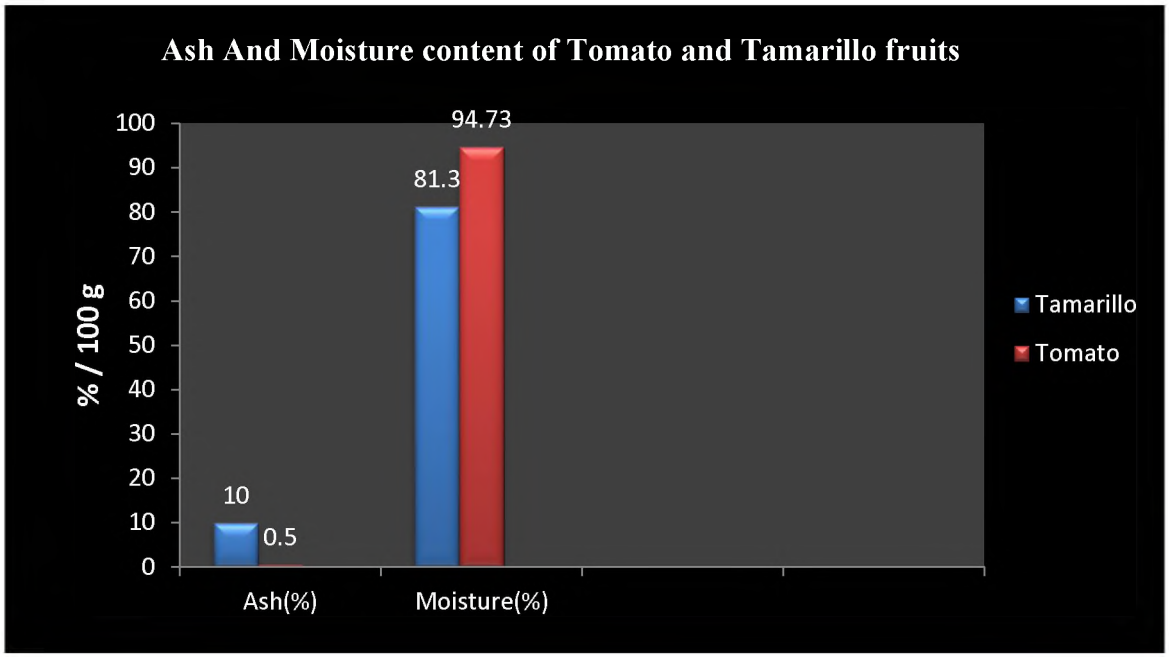
TABLE I

NUTRIENT CONTENT OF FRESH TAMARILLO FRUIT AND TOMATO

S.NO	Nutrients	Tamarillo per 1000g	Tomato per 100g
1	Ash (%)	10	0.50
2	Moisture (%)	81.3	94.73
3	Energy(kcal)	262.8	469.8
4	Carbohydrate (g)	7.3	13.05
5	Protein (g)	0.75	0.9
6	Fat (g)	0.4	0.2
7	Crude Fibre (g)	20	8.3
8	Iron (mg)	4.3	0.45
9	Calcium (mg)	8.68	7
10	Phosphorus (mg)	52.2	24
11	Vitamin C (mg)	29	14
12	β carotene (µg)	5000	449
13	Thiamine (mg)	0.85	0.09

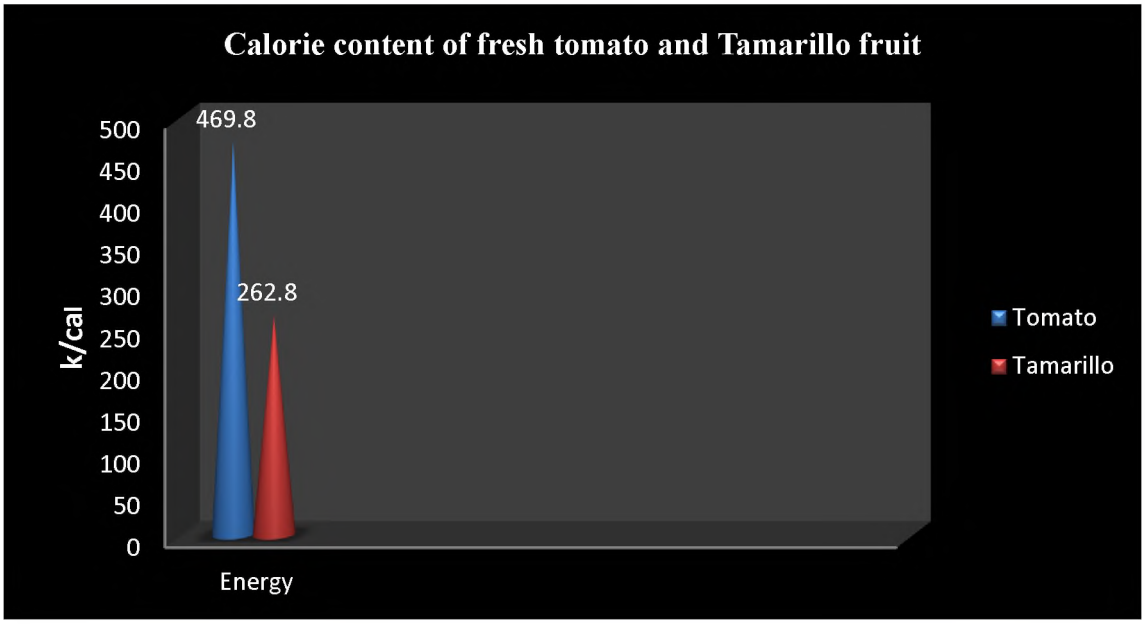
From the above table, it was revealed that the tomato contains higher moisture content than Tamarillo. Tamarillo fruit has low in calories compared to tomato. The amount of carbohydrate content of fresh Tamarillo fruit was found to be low 7.3g per 100g which is compared to tomato, it contains 13.05g. The amount of protein content is

low in Tamarillo compared to tomato. Tamarillo contains high fiber content than tomato. The protein, fat content of tree tomato were found to be 0.75g, 1.4g respectively. The iron content of Tamarillo was high 4.3mg compared to tomato 0.45mg. Calcium and phosphorus content were found to be 8.68mg and 52.2mg respectively. Tamarillo contains high vitamin C 29mg compared to tomato 14mg. The amount of β carotene was very high in Tamarillo, it has 5000 µg compared to tomato. Thiamine content was high in Tamarillo fruit than tomato.



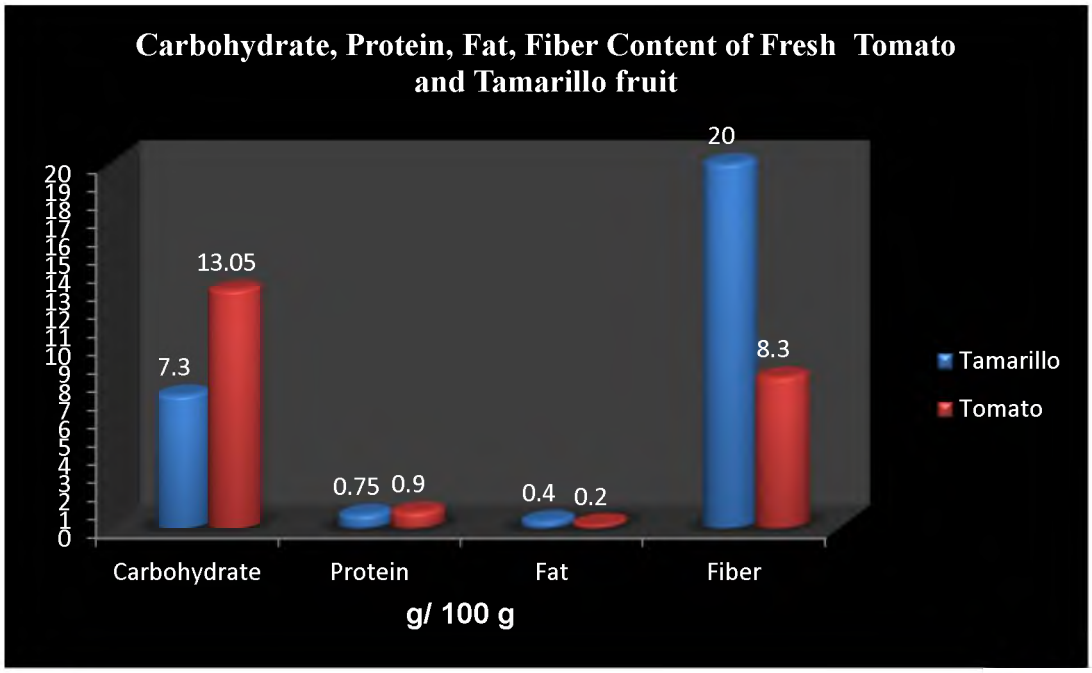
ASH AND MOISTURE CONTENT OF FRESH TAMARILLO FRUIT AND TOMATO

FIGURE V



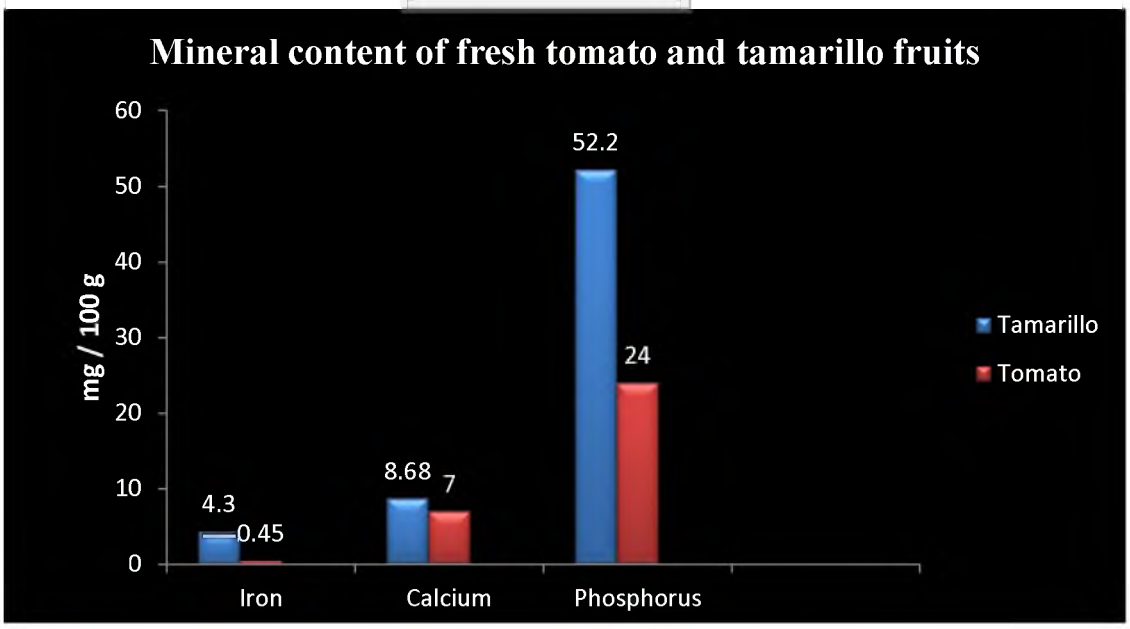
CALORIE CONTENT OF FRESH TOMATO AND TAMARILLO FRUIT

FIGURE VI



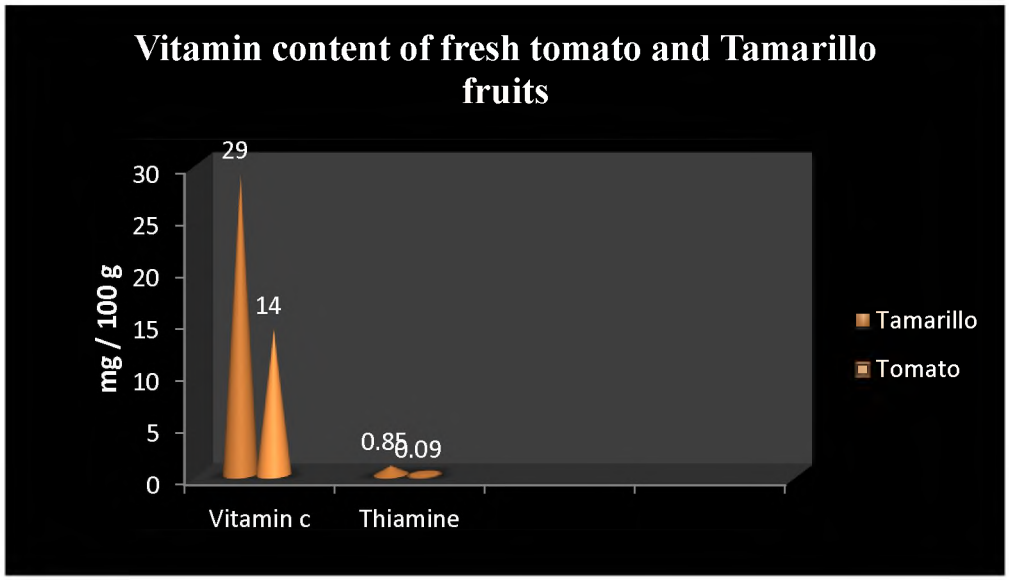
CARBOHYDRATE, PROTEIN, FAT AND FIBER CONTENT OF FRESH TOMATO AND TAMARILLO FRUIT

FIGURE VII



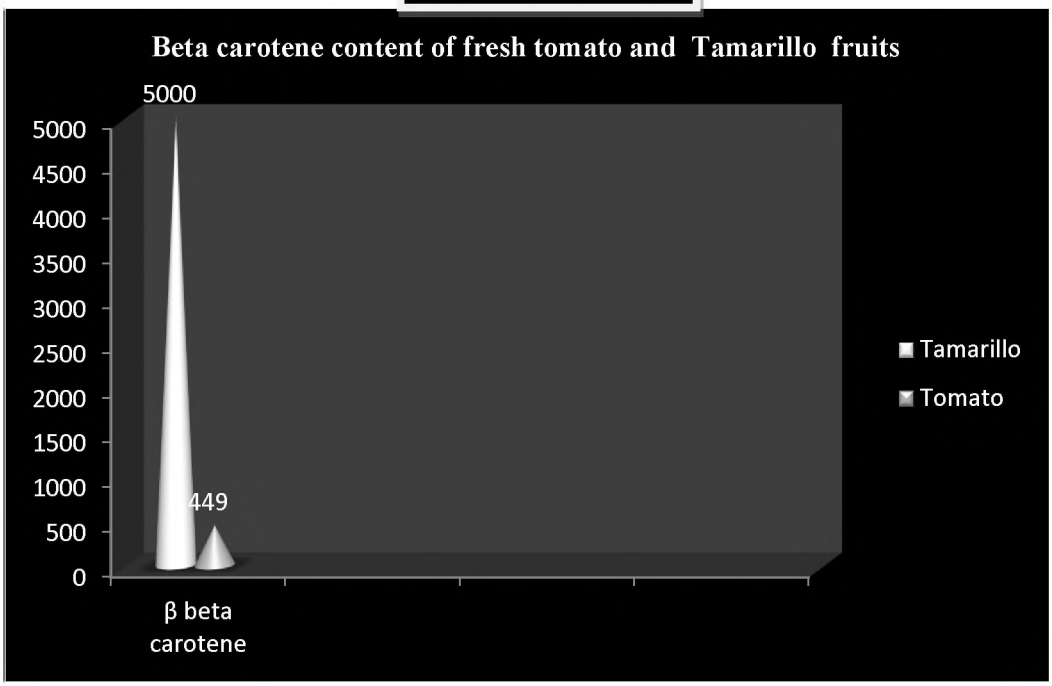
MINERAL CONTENT OF FRESH TOMATO AND TAMARILLO FRUIT

FIGURE VIII



VITAMIN CONTENT OF FRESH TOMATO AND TAMARILLO FRUIT

FIGURE IX



BETA CAROTENE CONTENT OF FRESH TOMATO AND TAMARILLO FRUITS

FIGURE X

PHYTOCHEMICAL CONSTITUENTS OF FRESH TAMARILLO FRUIT

Qualitative analysis of fresh Tamarillo fruit is presented in Table II.

TABLE II

S.NO	PHYTOCHEMICAL CONSTITUENTS	AQUEOUS EXTRACT	ETHANOL EXTRACT	METHANOL EXTRACT
1	Alkaloids	+	++	++
2	Coumarins	-	++	++
3	Flavanoids	+++	+++	+++
4	Glycosides	+++	++	++
5	Quinones	+++	+++	+++
6	Terpenoids	+++	+++	+++
7	Tannins	++	-	-
8	Steroids	+++	+	+
9	Anthraquinone	+	-	-
10	Saponin	-	-	-

(+++)= Appreciable amounts, (++) = moderate levels (-) = complete absence

Phytochemical constituents such as alkaloids, flavanoids ,anthraquinones , coumarins glycosides, quinones, tannins, terpenoids, steroids and saponins were analysed. Flavanoids, quinone, terpenoid and glycosides were present in appreciable amounts in aqueous, ethanol and methanol extracts of tamarillo. Saponins were completely absent in all extracts of tamarillo. Terpenoids have been found to be useful in the prevention and therapy of several diseases, including cancer. Flavonoids are also present in tamarillo which prevent oxidative cell damage .It also helps in managing diabetes. Steroids are responsible for cholesterol-reducing properties. Steroids also help in regulating the immune response. Glycosides are known to exert a beneficial

action on immune system by increasing body strength and hence are valuable as dietary supplements.

B. Sensory evaluation of preserved tomato and Tamarillo fruit

The preserved foods namely jam, pickle and sauce were developed using tomato as standard and Tamarillo.The developed products were evaluated for their sensory attributes of appearance, colour, texture, flavor and taste. The overall acceptability and mean scores of all the preserved foods are presented as follows.

1. Tamarillo pickle

The overall acceptability and mean scores of standard tomato and Tamarillo pickle are presented in Table III.

TABLE III

SENSORY ATTRIBUTES AND OVERALL ACCEPTABILITY OF TOMATO AND TAMARILLO PICKLE

Parameters	Standard tomato pickle Mean ± S.D	Tamarillo pickle Mean ± S.D
Appearance	4.53±0.53	5±0
Colour	4.56±0.50	5±0
Texture	4.73±0.44	4.785±0.498
Flavour	4.06±0.69	4.755±0.518
Taste	4.63±0.49	4.755±0.44
Overall acceptability	4.3±0.47	5±0

From the above table, it is revealed that the appearance and colour of Tamarillo pickle got more scoring than standard tomato pickle. The texture, flavor and taste had similar scoring for both tomato and Tamarillo pickle. Tamarillo pickle received a score of 4.78 out of 5 in comparision with the standard tomato pickle with a score of 4.73. The flavour of Tamarillo pickle received score of 4.06 out of 5 followed by standard tomato pickle. Taste of Tamarillo pickle received a score of 4.75 out of 5 followed by the

standard tomato pickle of 4.63. The mean score shows Tamarillo pickle had better acceptability.

2. Tamarillo Jam

The overall acceptability and mean scores of standard tomato jam and Tamarillo jam are presented in Table IV.

TABLE IV

SENSORY ATTRIBUTES AND OVERALL ACCEPTABILITY OF STANDARD TOMATO JAM AND TAMARILLO JAM

Parameters	Standard Tomato jam Mean ± S.D	Tamarillo jam Mean ± S.D
Appearance	4.735±0.52	4.93±0.25
Colour	4.63±0.55	4.83±0.37
Texture	4.53±0.68	4.76±0.43
Flavour	4.4±0.56	4.56±0.50
Taste	4.66±0.56	4.76±0.43
Overall acceptability	4.8±0.40	4.93±0.25

From the above table, it was revealed that the Tamarillo jam received a score of 4.93 out of 5 followed by the standard tomato jam with a score of 4.83 for appearance. In terms of colour, the standard tomato jam received a score of 4.63 out of 5 followed by Tamarillo jam with a score of 4.83 with reference to texture, the Tamarillo jam received the score of 4.76 out of 5 followed by the standard tomato jam with a score of 4.53.The flavour of Tamarillo jam received score of 4.56 out of 5 followed by standard tomato jam with a score of 4.4. For taste Tamarillo jam received a score of 4.76 out of 5 followed by the standard tomato jam with a score of 4.66. The overall acceptability of standard jam was 4.8 out of 5 followed by Tamarillo jam was scored as 4.93. Tamarillo jam had a better appearance and colour which was indicated in the difference of mean.

3. Tamarillo Sauce

The overall acceptability and mean scores standard tomato sauce and Tamarillo sauce are presented in Table V.

TABLE V

SENSORY ATTRIBUTES AND OVERALLACCEPTABILITY OF STANDARD TOMATO SAUCE AND TAMARILLO SAUCE

Parameters	Standard Tomato sauce Mean ± S.D	Tamarillo sauce Mean ± S.D
Appearance	4.6±0.56	4.86±0.34
Colour	4.36±0.61	4.8±0.40
Texture	4.4±0.72	4.6±0.56
Flavour	4.3±0.74	4.4±0.67
Taste	4.6±0.56	4.56±0.62
Overall acceptability	4.63±0.49	4.76±0.43

From the above table, it was revealed that the Tamarillo sauce received a score of 4.86 out of 5 followed by the standard tomato sauce with a score of 4.6 for appearance. In terms of colour, the standard tomato sauce received a score of 4.36 out of 5 followed by Tamarillo sauce with a score of 4.8. With reference to texture, the Tamarillo sauce received the score of 4.6 out of 5 followed by the standard tomato sauce with a score of 4.4. The flavour of Tamarillo sauce received score of 4.4 out of 5 followed by standard tomato sauce was scored as 4.3. For taste Tamarillo sauce received a score of 4.56 out of 5 followed by the standard tomato sauce as a score of 4.6. When overall scores of standard sauce was 4.63 out of 5 followed by overall acceptability of Tamarillo sauce was scored as 4.76. Tamarillo had more scoring for colour than the tomato sauce.

C. NUTRIENT CONTENT OF PRESERVED FOODS OF TAMARILLO

1. NUTRIENT CONTENT OF TAMARILLO PICKLE

The nutrient content of Tamarillo pickle is given in Table VI and Figure XI to XVI.

TABLE VI

NUTRIENT CONTENT OF TAMARILLO AND TOMATO PICKLE

S.NO	NUTRIENTS	TAMARILLO PER 100g	TAMARILLO PER 100g
1	Ash (%)	8	12
2	Moisture (%)	70	66.8
3	Energy(kcal)	540	1010
4	Carbohydrate (g)	15	23
5	Protein (g)	0.25	0.5
6	Fat (g)	6	6.09
7	Crude Fibre (g)	10	6.3
8	Iron (mg)	2	2.8
9	Calcium (mg)	6.1	19
10	Phosphorus (mg)	32	30
11	Vitamin C (mg)	17.4	19.3
12	β carotene (µg)	3500	1346
13	Thiamine (mg)	0.52	0.4

From the above table, it was revealed that Tamarillo pickle gives low calories. The amount of carbohydrate content of fresh Tamarillo fruit was found to be 15g per 100g. The protein, fat and fibre content were found to be 0.25g, 6g and 10g

respectively. The iron, calcium and phosphorus content were found to be 2mg, 6.1mg and 32mg respectively. The content of thiamine, vitamin c and β carotene was found to be 0.52mg, 17.4mg and 3500µg respectively. Tamarillo pickle shows high fiber and beta carotene content than tomato. The content of moisture was 70 percent and the ash content was 8 percent.

2. NUTRIENT CONTENT OF TAMARILLO AND TOMATO JAM

The nutrient content of Tamarillo and tomato pickle are given in Table VII and Figure XI to XVI.

TABLE VII

NUTRIENT CONTENT OF TAMARILLO AND TOMATO JAM

S.NO	NUTRIENTS	TAMARILLO PER 100g	TOMATO PER 100g
1	Ash (%)	4	0.12
2	Moisture (%)	40	22.4
3	Energy	1368	2052
4	Carbohydrate (g)	38	57
5	Protein (g)	0.43	1.5
6	Fat (g)	3	0.69
7	Crude Fibre (g)	4	2.8
8	Iron (mg)	1.3	1.25
9	Calcium (mg)	6.8	0.08
10	Phosphorus (mg)	20	17
11	Vitamin C (mg)	23.2	19.2
12	β carotene (µg)	2500	1440
13	Thiamine (mg)	0.61	0.09

From the above table, it was revealed that the amount of carbohydrate content of fresh Tamarillo fruit was found to be 38g per 100g. The protein, fat and fibre content were found to be 0.43g, 3g and 4g respectively. The iron, calcium and phosphorus content were found to be 1.3mg, 6.8mg and 20mg respectively. The content of thiamine, vitamin c and β carotene was found to be 0.61mg, 23.2mg and 2500µg respectively. The content of moisture was 40 percent and the ash content was 4 percent. Tamarillo jam shows high beta carotene content than tomato.

3. NUTRIENT CONTENT OF TAMARILLO SAUCE

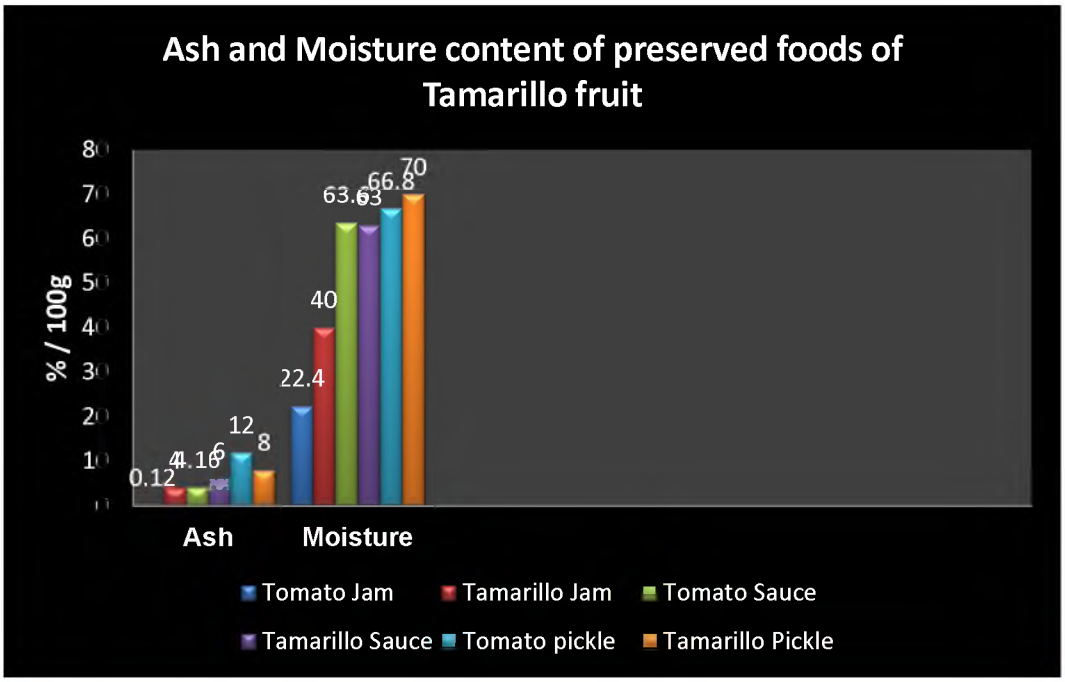
The nutrient content of Tamarillo pickle is given in Table VIII and Figures XI to XVI.

TABLE VIII

NUTRIENT CONTENT OF TAMARILLO SAUCE

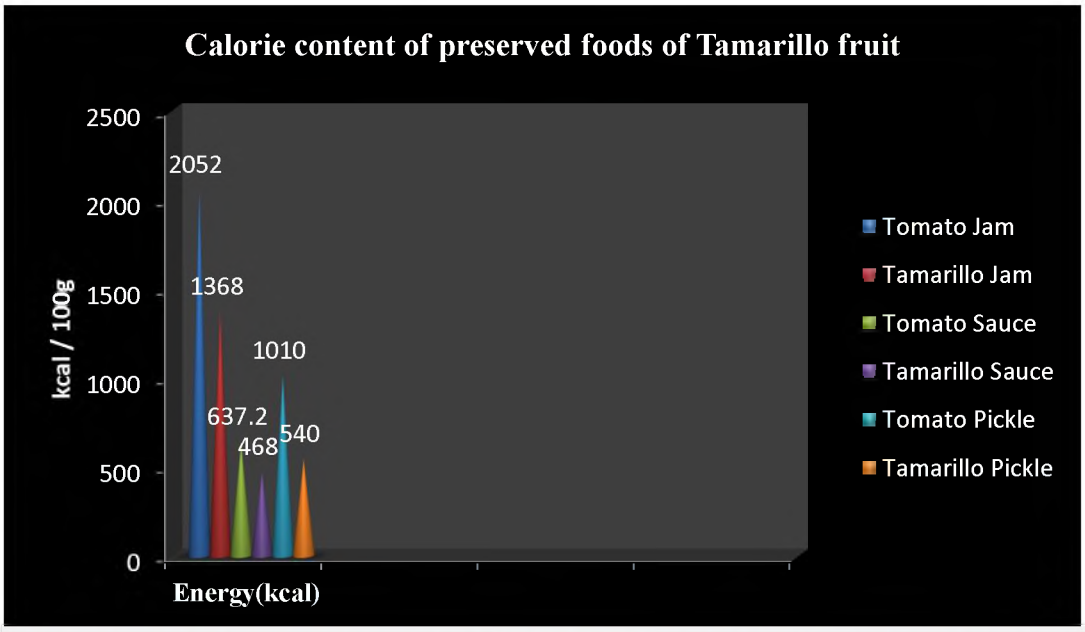
S.NO	Nutrients	Tamarillo per 100g	Tomato per 100g
1	Ash (%)	6	4.16
2	Moisture (%)	63	63.6
3	Energy (kcal)	468	637.2
4	Carbohydrate (g)	13	17.7
5	Protein (g)	0.6	0.82
6	Fat (g)	2	0.7
7	Crude Fibre (g)	4	3.4
8	Iron (mg)	5	8.5
9	Calcium (mg)	7.8	41.5
10	Phosphorus (mg)	40	17
11	Vitamin C (mg)	25.6	21
12	β carotene (µg)	5000	2403
13	Thiamine (mg)	0.76	0.2

From the above table, it was revealed that the amount of carbohydrate content of fresh Tamarillo fruit was found to be 30g per 100g. The protein, fat and fibre content were found to be 0.60g, 2g and 4g respectively. The iron, calcium and phosphorus content were found to be 5mg, 7.8mg and 40mg respectively. The content of thiamine, vitamin c and β carotene was found to be 0.76mg, 25.6mg and 5000µg respectively. Tamarillo sauce shows low in calorie, high in beta carotene and thiamine compared to tomato sauce.



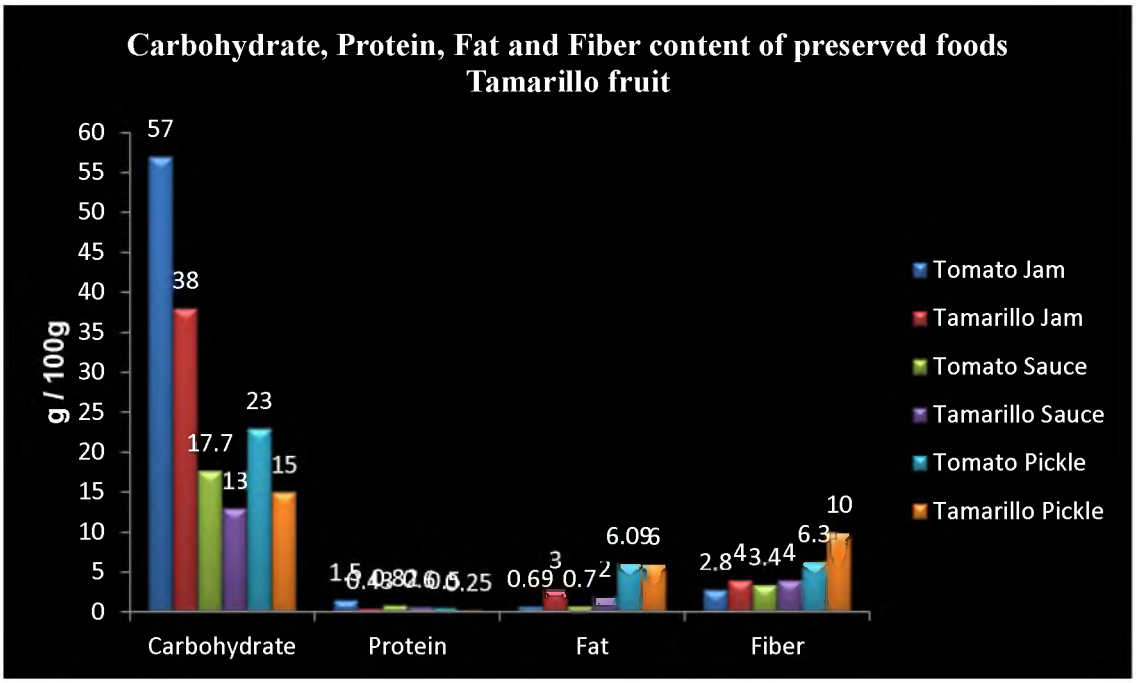
ASH AND MOISTURE CONTENT OF PRESERVED FOODS OF TAMARILLO FRUIT

FIGURE XI



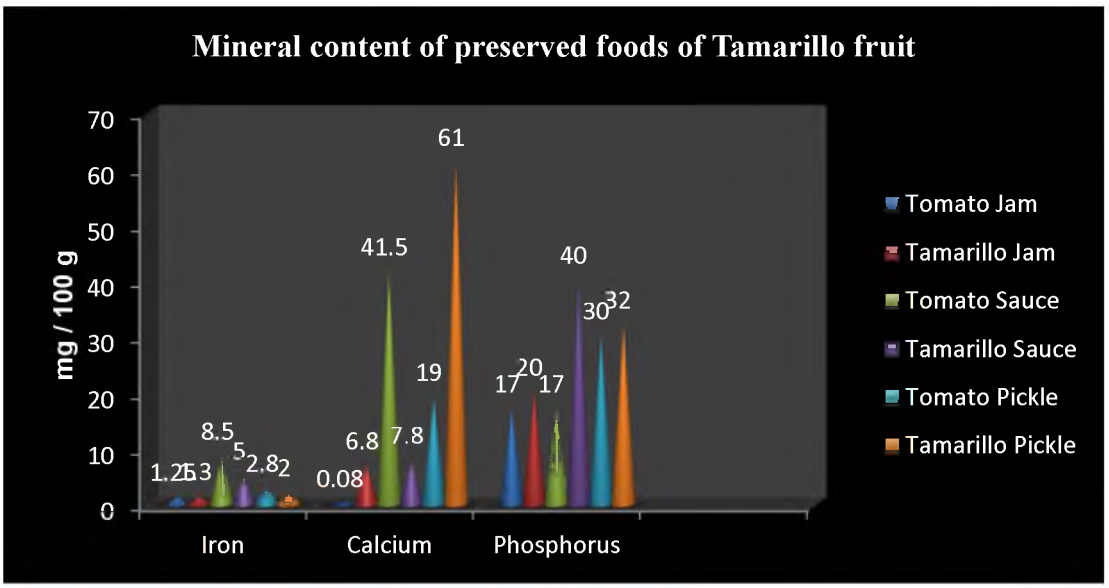
CALORIE CONTENT OF PRESERVED FOODS OF TAMARILLO FRUIT

FIGURE XII



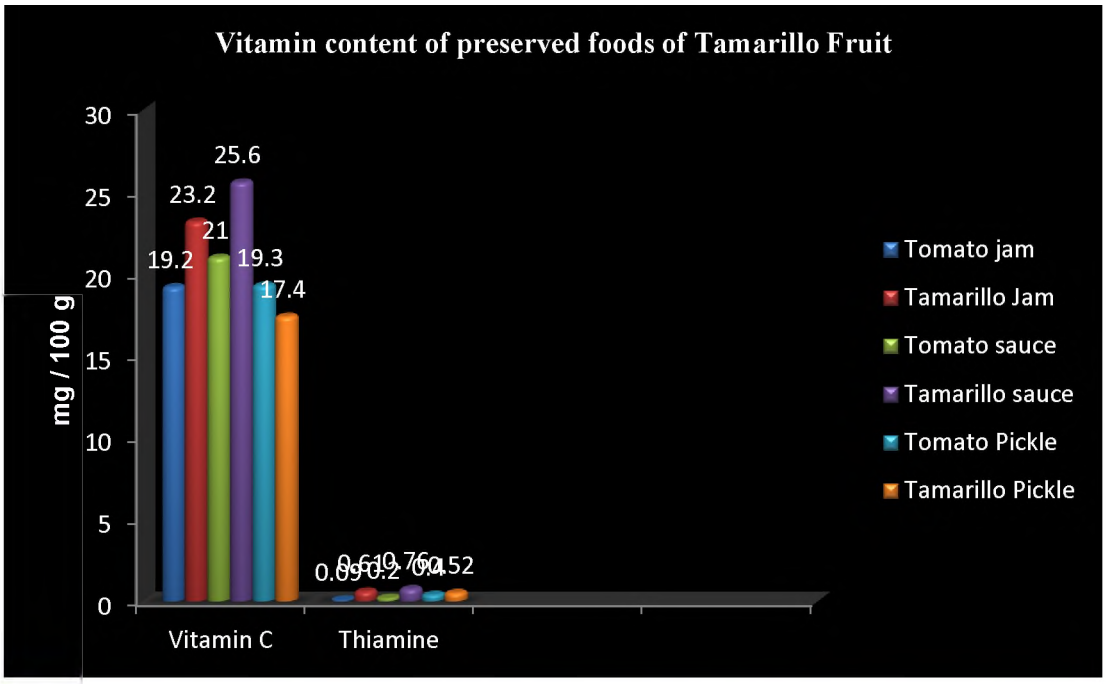
CARBOHYDRATE, PROTEIN, FAT AND FIBER CONTENT OF PRESERVED FOODS OF TAMARILLO

FIGURE XIII



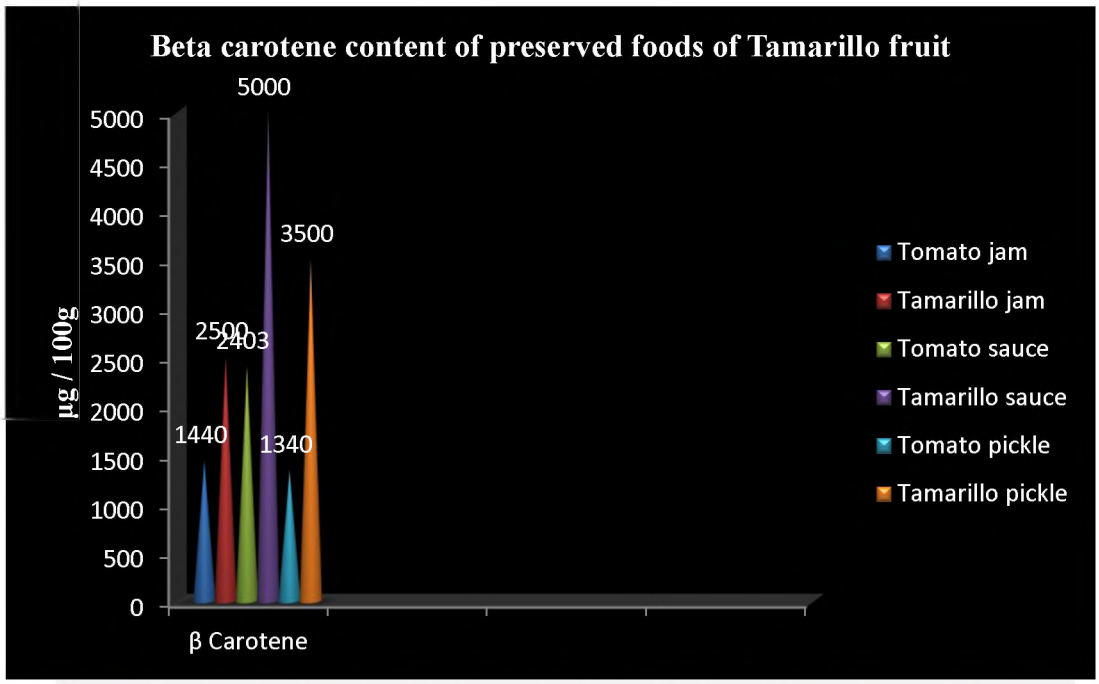
MINERAL CONTENT OF PRESERVED FOODS OF TAMARILLO FRUIT

FIGURE XIV



VITAMIN CONTENT OF PRESERVED FOODS OF TAMARILLO FRUIT

FIGURE XV



BETA CAROTENE CONTENT OF PRESERVED FOODS OF TAMARILLO FRUIT

FIGURE XVI

Comparision of fresh Tamarillo fruit and preserved foods of Tamarillo and tomato is presented in Table IX.

TABLE IX

S.No	Nutrients	Tomato	Tamarillo	Tomato Jam	Tamarillo Jam	Tomato Sauce	Tamarillo Sauce	Tomato Pickle	Tamarillo Pickle
1	Ash (%)	0.50	10	0.12	4.0	4.16	6	12	8
2	Moisture (%)	94.73	81.3	22.4	40	63.6	63	66.8	70
3	Energy (kcal)	469.8	262.8	2052	1368	637.2	468	1010	540
4	Carbohydrate (g)	13.05	7.3	57	38	17.7	13	23	15
5	Protein (g)	0.9	0.75	1.5	0.43	0.82	0.6	0.5	0.25
6	Fat (g)	0.2	0.4	0.69	3	0.7	2	6.09	6
7	Fiber (g)	8.3	20	2.8	4	3.4	4	6.3	10
8	Iron (mg)	0.45	4.3	1.25	1.3	8.5	5	2.8	2
9	Calcium (mg)	7	8.68	0.08	6.8	41.5	7.8	19	6.1
10	Phosphorus (mg)	24	52.2	17	20	17	40	30	32
11	Vitamin C (mg)	14	29	19.2	23.2	21	25.6	19.3	17.4
12	βCarotene (µg)	449	5000	1440	2500	2403	5000	1346	3500
13	Thiamine(mg)	0.09	0.85	0.09	0.61	0.2	0.76	0.4	0.52

From the above table it is revealed that, the ash content of fresh fruit that Tamarillo fruit had high ash content (10%) than tomato (0.5%). In preserved foods Tamarillo pickle contains high percentage of ash (12%) compared to Tamarillo jam andTamarillo sauce.Preserved foods shows more ash content of Tamarillo.

Moisture content of the fresh tomato had high moisture content (94.73%) thanTamarillo fruit (81.3%) and in the preserved foods of tamarillo pickle had high moisture content (70%) than tomato jam and Tamarillo sauce (40), (22.4%)respectively.

Energy (Kcal) content of the fresh Tamarillo fruit contain low calorie content (262.8kcal) than the tomato (469.8kcal).The preserved foods Tamarillo contain low calorie content compared to preserved foods of tomato.

Carbohydrate (g) content of the fresh fruits of tomato had high carbohydrate content (13.05) than Tamarillo fruit (7.3) and in the preserved foodstamarillo contains low carbohydrate content than the preserved foods of tomato.

Protein (g) content of the fresh fruits of tomato had high Protein (0.9) than tamarillo fruit (0.75) and in the preserved foods tomato jam had high Protein (1.5) than tamarillo jam (0.43) in Sauce tomato Sauce had high Protein (0.82) than tamarillo Sauce (0.6) in pickle tomato pickle had high Protein (0.5) than tamarillo pickle (0.25).

Fat (g) content of the fresh fruits that tamarillo fruit had (0.4g) and tomato contain (0.2).Preserved foods tamarillopickle contains high fat content than preserved jam and sauce, because pickle contains more oil content.

Fiber (g) content of the fresh Tamarillo fruit had high Fiber content (20g) than tomato (8.3g) preserved foods of Tamarillo.

Iron (mg) content of the fresh Tamarillo fruit had high Iron content (4.3mg) than tomato (0.45) and in the preserved foods Tamarillo sauce had higher Iron content of (5mg) compared to Tamarillo jam and Tamarillo pickle (1.3mg), (2mg) respectively.

Calcium (mg) content of preserved foods contains high calcium content than the fresh Tamarillo fruit. Compared to tomato, Tamarillo had low calcium content. Tamarillo contains (7mg), tomato (8.68mg).

Phosphorus (mg) content of the fresh Tamarillo fruit had high Phosphorus content (52.2mg) than tomato (24mg). The preserved foods Tomato jam and Tomato sauce had similar in Phosphorus content (17mg).Tamarillo sauce contains high Phosphorus content (41.5mg) compared to Tamarillo jam and Tamarillo pickle (20), (32) respectively.

Vitamin C (mg) content of the fresh Tamarillo fruit had high Vitamin C (29mg) than tomato (14mg). Preserved foods of Tamarillo sauce contains high vitamin C content (25.6mg) compared to Tamarillo jam, Tamarillo pickle (23.2mg), (17.4) respectively and preserved foods of tomato.

Fresh Tamarillo fruit contains higher in β carotene content than tomato. Compared to preserved foods Tamarillo sauce had similar β carotene content (5000µg).

The fresh Tamarillo fruit had high Thiamine (mg) content (0.85mg) than tomato (0.09mg). Comparing to preserved foods fresh Tamarillo fruit contains high Thiamine content than the preserved foods of Tamarillo.

PHYTOCHEMICAL CONSTITUENTS OF PRESERVED FOODS OF TAMARILLO FRUIT

The phytochemical constituents of preserved foods of Tamarillo fruit is presented in Table X.

TABLE X

S.NO	PHYTOCHEMICAL CONSTITUENTS	TAMARILLO PICKLE	TAMARILLO JAM	TAMARILLO SAUCE
1	Alkaloids	+	++	++
2	Coumarins	-	++	++
3	Flavanoids	+++	+++	+++
4	Glycosides	++	++	+++
5	Quinones	+++	+++	+++
6	Terpenoids	+++	+++	+++
7	Tannins	++	-	-
8	Steroids	++	+	+++
9	Anthraquinone	+	-	-
10	Saponin	-	-	-

(+++)= Appreciable amounts, (++) = moderate levels (-) = complete absence

Phytochemical constituents were identified by using aqueous extracts, because aqueous extracts of fresh fruits revealed best values. Phytochemical observations such as alkaloids, flavanoids ,anthraquinones , coumarins glycosides, quinones, tannins, terpenoids, steroids and saponins were done. Sauce contains appreciable amount of Flavanoids, glycosides, quinines, terpenoids and steroids compared to pickle and jam. Saponins were completely absent in all products of Tamarillo fruit.

D. ANTIOXIDANT ACTIVITY OF FRESH TAMARILLO FRUIT AND PRESERVED FOODS OF TAMARILLO FRUIT

Antioxidant activity of fresh Tamarillo fruit and preserved foods of Tamarillo is presented in Table XI and Figure XVII.

TABLE XI

OD VALUE OBTAINED USING DPPH METHOD

S. No	Ascorbic acid	Aqueous Extracts	DPPH(µg/mL)
1	1.13 µg/ml	Fresh fruit	1.98 µg/ml
2		Tamarillo pickle	0.65 µg/mL
3		Tamarillo jam	1.70 µg/mL
4		Tamarillo sauce	1.16 µg/mL

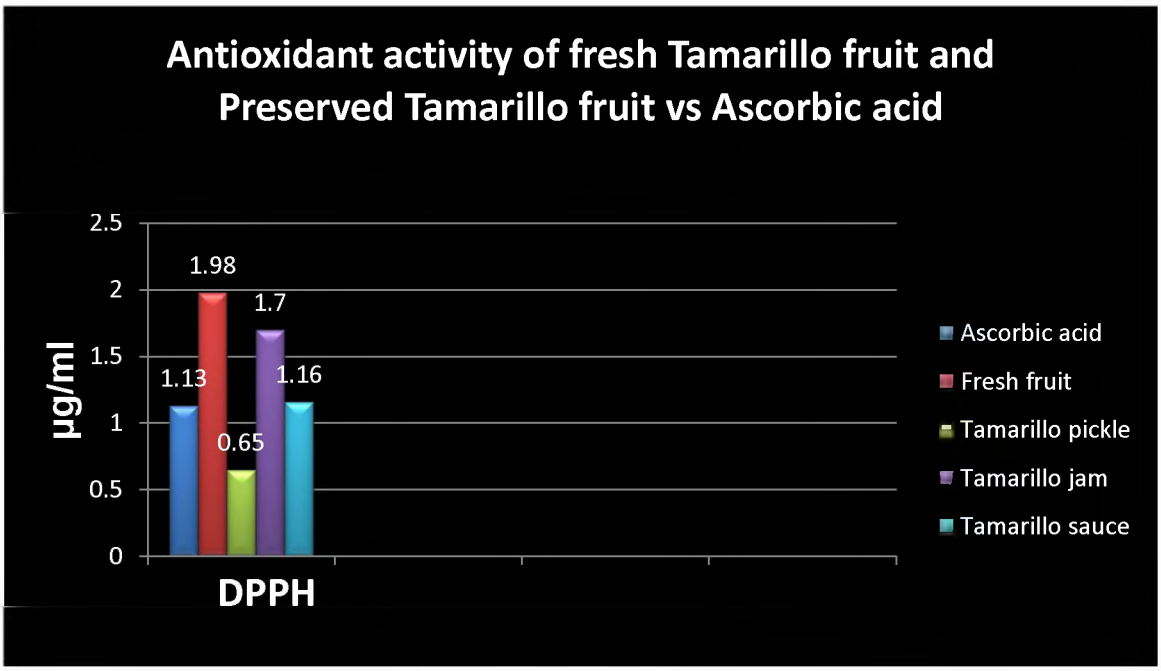


FIGURE XVII

DPPH (2,2-diphenyl-1- picrylhydrazyl) assay was performed by measuring the OD against the standard (ascorbic acid) at 517 nm using UV-Spectrophotometer. The above graphical representation showed that the aqueous extract show more antioxidant activity fresh fruit than preserved foods. According to Zhenyu Qiu et al ., (2014) on his study in Antioxidant activities of aqueous extracts from Tamarillo fruit and preserved foods of Tamarillo had a high antioxidant activity.

The 1,1diphenylhydrazyl radical antioxidant assay showed the reactivity of the test compound with a stable free radical. DPPH gives a strong absorption band at 517nm in visible region. The degree of reduction in absorbance measurement is indicative of the radical scavenging potential of the extract. The IC 50 value of the fresh Tamarillo fruit and preserved Tamarillo fruit products were found to be tree tomato show that the DPPH assay value is 49.5.Tree tomato jam shows higher free radical scavenging activity (42.5µg/mL) compare to other preserved foods such as, Tree tomato pickle shows 16.5µg/mL and Tamarillo Sauce shows 29µg/mL and the Ascorbic acid standard was found to be 1.13g/ml. This revealed that the Tamarillo posses antioxidant and free radical scavenging activity.

SUMMARY AND CONCLUSION

- Tamarillo is an excellent food because it has an enormous amount of biomolecules that are essential for health and are part of our daily nutritional requirements. A great advantage that has the Tamarillo is that it only contributes 262 Kcal per 100 g. Thus, the low calorific value contrasted with its high amount of nutrients, make that the Tamarillo is an excellent food.

- Ash content of fresh fruit that Tamarillo fruit had high ash content (10%) than tomato (0.5%). In preserved foods Tamarillo pickle contains high percentage of ash (12%) compared to Tamarillo jam and Tamarillo sauce. Preserved foods shows more ash content of Tamarillo.
- Moisture content of the fresh tomato had high moisture content (94.73%) than Tamarillo fruit (81.3%) and in the preserved foods of Tamarillo pickle had high moisture content (70%) than tomato jam and Tamarillo sauce (40), (22.4%) respectively.
- Energy (Kcal) content of the fresh Tamarillo fruit contain low calorie content (262.8kcal) than the tomato (469.8kcal).The preserved foods Tamarillo contain low calorie content compared to preserved foods of tomato.
- Carbohydrate (g) content of the fresh fruits of tomato had high carbohydrate content (13.05) than Tamarillo fruit (7.3) and in the preserved foods Tamarillo fruit contains low carbohydrate content than the preserved foods of tomato.
- Protein (g) content of the fresh fruits of tomato had high Protein (0.9) than Tamarillo fruit (0.75) and in the preserved foods tomato jam had high Protein (1.5) than Tamarillo jam (0.43) in Sauce tomato Sauce had high Protein (0.82) than Tamarillo Sauce (0.6) in pickle tomato pickle had high Protein (0.5) than Tamarillo pickle (0.25).
- Fat (g) content of the fresh fruits that Tamarillo fruit had (0.4g) and tomato contain (0.2). Preserved foods Tamarillo pickle contains high fat content than preserved jam and sauce, because pickle contains more oil content.
- Fiber (g) content of the fresh Tamarillo fruit had high Fiber content (20g) than tomato (8.3g) preserved foods of Tamarillo.

- Iron (mg) content of the fresh Tamarillo fruit had high Iron content (4.3mg) than tomato (0.45) and in the preserved foods Tamarillo sauce had higher Iron content of (5mg) compared to Tamarillo jam and Tamarillo pickle (1.3mg), (2mg) respectively.
- Calcium (mg) content of preserved foods contains high calcium content than the fresh Tamarillo fruit. Compared to tomato, Tamarillo had low calcium content. Tamarillo contains (7mg), tomato (8.68mg).
- Phosphorus (mg) content of the fresh Tamarillo fruit had high Phosphorus content (52.2mg) than tomato (24mg). The preserved foods Tomato jam and Tomato sauce had similar in Phosphorus content (17mg). Tamarillo sauce contains high Phosphorus content (41.5mg) compared to Tamarillo jam and Tamarillo pickle (20mg), (32mg) respectively.
- Vitamin C (mg) content of the fresh Tamarillo fruit had high Vitamin C (29mg) than tomato (14mg). Preserved foods of Tamarillo sauce contains high vitamin C content (25.6mg) compared to Tamarillo jam, Tamarillo pickle (23.2mg), (17.4) respectively and preserved foods of tomato.
- Fresh Tamarillo fruit contains higher in β carotene content than tomato. Compared to preserved foods Tamarillo sauce had similar β carotene content (5000µg).
- Fresh Tamarillo fruit had high Thiamine (mg) content (0.85mg) than tomato (0.09mg). Comparing to preserved foods fresh Tamarillo fruit contains high Thiamine content than the preserved foods of Tamarillo.
- Phytochemical observations such as alkaloids, flavanoids ,anthraquinones , coumarins glycosides, quinones, tannins, terpenoids, steroids and saponins were done.Flavanoids, quinone, terpenoid and glycosides were present in appreciable amounts in aqueous, ethanol and methanol extracts of tamarillo. Saponins were completely absent in all extracts of tamarillo. Terpenoids have been found to be useful in the prevention and therapy of several diseases, including cancer. Flavonoids are also present in tamarillo which prevent oxidative cell damage .It also helps in managing diabetes. Steroids are responsible for cholesterol-reducing properties. Steroids also help in regulating the immune response. Glycosides are known to exert a beneficial action on immune system by increasing body strength and hence are valuable as dietary supplements.

- Phytochemical constituents were identified by using aqueous extracts, because aqueous extract gives more presence. Phytochemical observations such as alkaloids, flavanoids ,anthraquinones , coumarins glycosides, quinones, tannins, terpenoids, steroids and saponins were done. Tamarillo Sauce contains appreciable amount of Flavanoids, glycosides, quinines, terpenoids and steroids compared to Tamarillo pickle and jam. Saponins were completely absent in all preserved foods of Tamarillo.

- On the basis of the result obtained from the study, aqueous extracts showed the highest antioxidant activity when determined by the DPPH assay.

- The 1,1diphenylhydrazyl radical antioxidant assay showed the reactivity of the test compound with a stable free radical . DPPH gives a strong absorption band at 517nm in visible region. The degree of reduction in absorbance measurement is indicative of the radical scavenging potential of the extract. The IC 50 value of the fresh Tamarillo fruit and preserved Tamarillo fruit products were found to be Tamarillo show that the DPPH assay value is 49.5.Tamarillo jam shows higher free radical scavenging activity (42.5µg/mL) compare to other preserved foods such as, Tamarillo pickle shows 16.5µg/mL and Tamarillo Sauce shows 29µg/mL and the Ascorbic acid standard was found to be 1.13g/ml. This revealed that the Tamarillo posses antioxidant and free radical scavenging activity.

From the study it is evident that Tamarillo fruit is rich in nutritional and phytochemical components. It has better antioxidant properties and can be consumed as a fruit with low glycemic index for Diabetic people. Due to its high beta carotene and vitamin C content it can be included for preschool children to prevent Vitamin A deficiency. The products developed such as jam, pickle and sauce had better nutrient content and sensory characteristics when compared to the standard tomato products available.

Recommendations

1. Further studies on the shelf life of the prepared preserved foods can be undertaken.
2. Supplementation study on vitamin A deficient preschool children can be carried out.
3. Tamarillo products prepared can be marketed to the alternative tomato products available.

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INSTITUTIONAL HUMAN ETHICS COMMITTEE

Avinashilingam
Institute for Home Science and Higher Education for Women
University
(Estd. u/s 3 of UGC Act 1956)

19th March 2018

To
Ms. Suganya. A
Department of Food Science and Nutrition
Avinashilingam Institute for Home Science and
Higher Education for Women
Coimbatore – 641 043

Dear Suganya,

Ref: Your proposal No. IHEC/17-18/FSN/19 "Development and Evaluation of Preserved Foods of Tree Tomato" submitted for approval of the IHEC on 14th December.

The Institutional Human Ethics Committee of our University hereby grants approval to your research proposal No. IHEC/17-18/FSN/19 "Development and Evaluation of Preserved Foods of Tree Tomato" submitted by you. The Approval number for the same is AUW/ IHEC/ FSN -17-18/XPD/19.

We wish you all the best in your research endeavours.

Regards.

S. Uma Mageshwari
Dr.S.Uma Mageshwari
Member Secretary

Institutional Human Ethics Committee

DEVELOPMENT AND EVALUATION OF PRESERVED FOODS FROM TAMARILLO FRUIT

SCORE CARD FOR STANDARD TOMATO JAM

NAME:

DEPARTMENT:

CHARACTERISTICS	5	4	3	2	1
APPEARANCE					
COLOUR					
TEXTURE					
FLAVOUR					
TASTE					

SCORE CARD FOR TAMARILLO JAM

CHARACTERISTICS	5	4	3	2	1
APPEARANCE					
COLOUR					
TEXTURE					
FLAVOUR					
TASTE					

DEVELOPMENT AND EVALUATION OF PRESERVED FOODS FROM TAMARILLO FRUIT

SCORE CARD FOR STANDARD TOMATO SAUCE

NAME:

DEPARTMENT:

CHARACTERISTICS	5	4	3	2	1
APPEARANCE					
COLOUR					
TEXTURE					
FLAVOUR					
TASTE					

SCORE CARD FOR STANDARD TAMARILLO SAUCE

CHARACTERISTICS	5	4	3	2	1
APPEARANCE					
COLOUR					
TEXTURE					
FLAVOUR					
TASTE					

DEVELOPMENT AND EVALUATION OF PRESERVED FOODS FROM TAMARILLO FRUIT

SCORE CARD FOR STANDARD TOMATO PICKLE

NAME:

DEPARTMENT:

CHARACTERISTICS	5	4	3	2	1
APPEARANCE					
COLOUR					
TEXTURE					
FLAVOUR					
TASTE					

SCORE CARD FOR STANDARD TAMARILLO PICKLE

CHARACTERISTICS	5	4	3	2	1
APPEARANCE					
COLOUR					
TEXTURE					
FLAVOUR					
TASTE					