ORIGINAL ARTICLE

# Nutrient Retention and Antioxidant Activity of Preserved Foods of Tamarillo (*Cyphomandra betacea*)

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**ABSTRACT** Tamarillo (*Cyphomandra betacea*) is a subtropical fruit origin of South America and is also cultivated in hill areas at the Nilgiris Districts of Tamil Nadu. It is a small but fast growing tree harvesting for its edible fruit. The fruits are eat fresh or used for cooking preparations such as salads, sauces, soups, jellies, juices and liqueurs. The fruit has a good amount of nutrient content and providing bioactive components. The objectives of the study is to prepare jam, sauce and pickle with tamarillo and analyse nutrient content and assess the nutrient retention percentage, identify the phytochemical constituents and analyse the antioxidant activity of fresh fruit and preserved foods. Aqueous, ethanol and methanol extraction was taken for qualitative analysis. Antioxidant activity of the fruit was found by DPPH assay method by measuring the OD against ascorbic acid as a standard at 517 nm using UV-Spectrophotometer. The findings revealed that the fruit had appreciable amounts of flavanoids, glycosides, quinones and terpenoids. The aqueous extract of the fruit showed a higher antioxidant value of 1.98 µg/ml whereas compared to preserved foods such as jam, sauce and pickle 1.70 µg/ml, 1.16 µg/ml, 0.65 µg/ml respectively. Since the fruit is an underutilized fruit with a good nutrient content and antioxidant activity.

**Keywords:** Tamarillo fruit, *Cyphomandra betacea*, Nutrient retention, Phytochemicals, Antioxidant activity

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## INTRODUCTION

Plant food has rich sources of dietary antioxidants. Tamarillo is a small tree bearing bunches of fruits. *Cyphomandra betacea* or *Solanum betaceum* is the binomial name of this fruit. This fruit contains more seeds inside and flesh is juicy, sweet and tangy in taste. The peel of the fruit is bitter in taste. It is packed with a good amount of iron, vitamin C, fibre and Carotene and also it has bioactive components such as anthocyanin, flavonoids, carotenoids and polyphenols. The antioxidant content of the fruit improves immunity, helps to cure ulcer, prevents the formation of kidney stones and also treat metabolic diseases, maintains the blood pressure and glucose level and it may prevent free radicals. Antioxidants are chemicals that prevent metabolic diseases. The aim of the present study is to prepare preserved foods from Tamarillo and analyse the proximate principles and nutrient retention, identification of phytochemicals and antioxidant activity of the preserved foods and fresh fruit of tamarillo.

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## MATERIALS AND METHODS

### Sample Preparation

Tamarillos were collected by checking their size, colour and maturity of the fruit from local markets of Ooty, Nilgiris District of Tamil Nadu. The fruits were stored at room temperature. Fruits washed and cut into pieces and kept in a cabinet dryer for drying at 96 °C for 48 hours. After drying the fruits were ground to make a powder. Then the powder was stored in the freezer for further examination.



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## Development of Preserved Foods

Fully grown and ripened fruits were taken for preparing the preserved foods. For preparing pickle, the fruits were cleaned, washed and cut into pieces. The fruits were soaked for 2 weeks with added salt. After that the mixture is seasoned with mustard oil to make pickles. For the preparation of jam, fruits were ground to make a pulp. The fruit pulp was cooked with sugar and citric acid. Tamarillos were blanched to separate the peel. Then the peeled fruit is ground and made into puree. The puree is cooked with sugar, salt, chilli powder and a spice bag until it reaches the thickness. All these preserved foods were bottled and stored in the refrigerator.

## Analysis of Nutrients

Proximate and nutrient such as ash and moisture content, carbohydrate, protein, fat, crude fibre, Calcium, iron, Phosphorus, Vitamin C, Thiamine and β Carotene were analysed. The analyses were done in triplicate samples and carried out in the Nutrition Research Laboratory, Department of Food Science and Nutrition, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore.

## Nutrient Retention in Preserved Foods of Tamarillo

The nutrient retention in preserved foods of tamarillo was calculated by USDA table of nutrient retention factors, U.S Department of Agriculture, December, 2007.

$\%TR = Nc \times Gc/Nr \times Gr \times 100$

*TR* = True Retention, *Nc* = Nutrient content per g of cooked food, *Gc* = g of cooked food, *Nr* = Nutrient content per g of raw food, and *Gr* = g of food before cooking.

The nutrient retention can be calculated by analysing the nutrient content of preserved foods of tamarillo and also assess the difference in weight for preserved foods before and after cooking.

## Sample Extraction

The powdered sample was used for the sample extraction in three different extractions comparatively aqueous, ethanol and methanol. 2 g of sample taken in a conical flask and mixed with 80% of 50 ml of solvent. The flask is covered with an aluminium foil sheet to prevent oxidation. Then the mixture was kept in a shaking centrifuge for 1 hour. Then filtered the extract using filter paper and the residue was stored in the refrigerator for further use.

## Identification of Phytochemicals and Antioxidant Activity

The phytochemicals were identified by qualitative analysis using standardised procedure. Antioxidant activity was analysed by the method of 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 518 nm to indicate the extent of DPPH scavenging activity by the sample extract. The radical scavenging activity was calculated as follows (Aurelia *et al.*, 2016).

Scavenging activity(%) = A518(sample) – A518(control)/ A518(control) x 100

## Statistical Analysis

Nutrient retention calculation is presented as percentage and p-value given for antioxidant activity. Pearson Product Moment Correlation test was applied using Sigma Plot Statistical software 14.5 version for the nutrient retention and antioxidant activity. Significant values were expressed as ($p > 0.050$).

# RESULTS AND DISCUSSION

## Weight Changes in Preserved Foods

Tamarillo fruits were used to prepare jam, sauce and pickle. A change in weight before and after cooking of preserved foods were observed and ststed in Table 1.

Three different preserved foods were prepared in triplicate. 50 g of fruits were taken for preparing preserved foods. After cooking tamarillo jam increased its weight (55.8 g) that may be the addition of sugar concentration. The weight of tamarillo sauce (34.4 g) reduced because of filtering the puree

**Table 1: Weight of Foods Before and After Cooking**

| Preserve Foods | Weight of Foods | | Mean ± SD |
|---|---|---|---|
| | Before Cooking | After Cooking | |
| Tamarillo Jam | 50 g | 55.8 g | **53.76 ± 1.91** |
| Tamarillo Sauce | 50 g | 34.4 g | **33.96 ± 2.47** |
| Tamarillo Pickle | 50 g | 23.7 g | **23.5 ± 1.21** |

for making sauce. Addition of salt and soaking of fruit for pre-preparation of pickle before seasoning causes dehydration and it reduces the weight of tamarillo pickle (23.7 g). Table 1 depicted that the maximum nutrient retention was observed in tamarillo jam.

## Percentage of Nutrient Retention in Preserved Foods of Tamarillo

The percentage of nutrient retention was identified for prepared preserved foods namely tamarillo jam, sauce and pickle using standardised formula and also the data are specified in Table 2.

The above Table 2 shows that there was a minimum loss in the Tamarillo jam than sauce and pickle and the overall nutrient retention is 59%. Tamarillo sauce had a moderate loss compared to the tamarillo pickle and the overall nutrient retention is 45%. There was a maximum loss in the pickle and overall nutrient retention is 43%.

## Percentage of Nutrient Retention for Proximate Principles

The nutrient retention percentage for proximate principle is given in Figure 1.

The nutrient retention varies from different proximate and for three different prepared preserved foods. Among the preserved foods tamarillo jam has the maximal percentage of ash and moisture content. Tamarillo pickle exhibited the highest percentage of energy 97% and carbohydrate 97% than other preserved foods. The nutrient retention for protein and fat was a maximal amount in tamarillo jam compared to others. The percentage of retention in tamarillo sauce was only higher in protein when compared with other preserved foods.

## Nutrient Retention Percentage for Vitamins and Minerals

Percentage of nutrient retention for Vitamins and Minerals is given in Figure 2.

Tamarillo jam had a high percentage of nutrient retention in Calcium 87%, Vitamin C 89% and Thiamine 78%. Moderate nutrient retention percentage in every vitamin and mineral for tamarillo sauce. Tamarillo pickle had very low nutrient retention than others among the nutrients. The loss may be due to dehydration and oxidation of vitamin C while the pre preparation and pickling process.

## Phytochemical Constituents of Fresh and Preserved Foods of Tamarillo

Qualitative analysis of fresh tamarillo was conducted to find the presence of phytochemicals.

Alkaloids, flavonoids, anthraquinones, coumarins, glycosides, quinones, tannins, terpenoids, steroids and saponins were

**Table 2: Percentage of Nutrient Retention**

| S. No | Nutrients | Percentage of Nutrient Retention (%) | | |
|---|---|---|---|---|
| | | Tamarillo Jam | Tamarillo Sauce | Tamarillo Pickle |
| 1 | Ash (%) | 44 | 41 | 37 |
| 2 | Moisture (%) | 54 | 53 | 40 |
| 3 | Energy (Kcal) | 58 | 12 | 97 |
| 4 | Carbohydrate (g) | 58 | 12 | 97 |
| 5 | Protein (g) | 64 | 55 | 15 |
| 6 | Fat (g) | 83 | 34 | 71 |
| 7 | Crude Fibre (g) | 22 | 13 | 23 |
| 8 | Iron (mg) | 29 | 68 | 19 |
| 9 | Calcium (mg) | 87 | 61 | 33 |
| 10 | Phosphorus (mg) | 42 | 52 | 29 |
| 11 | Thiamine (mg) | 78 | 61 | 29 |
| 12 | Beta carotene (µg) | 55 | 68 | 33 |
| 13 | Vitamin C (mg) | 89 | 60 | 34 |

**Figure 1: Percentage of Nutrient Retention for Proximate Principle**

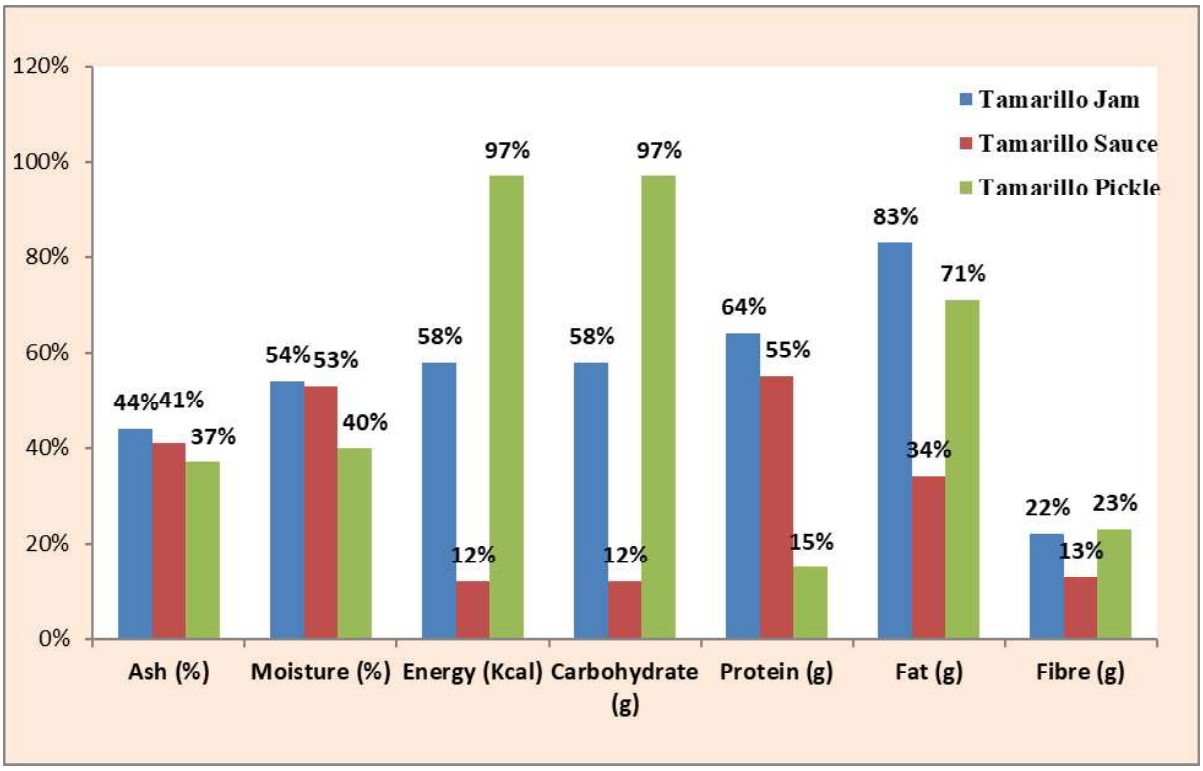


**Figure 2: Percentage of Nutrient Retention in Vitamins and Minerals**

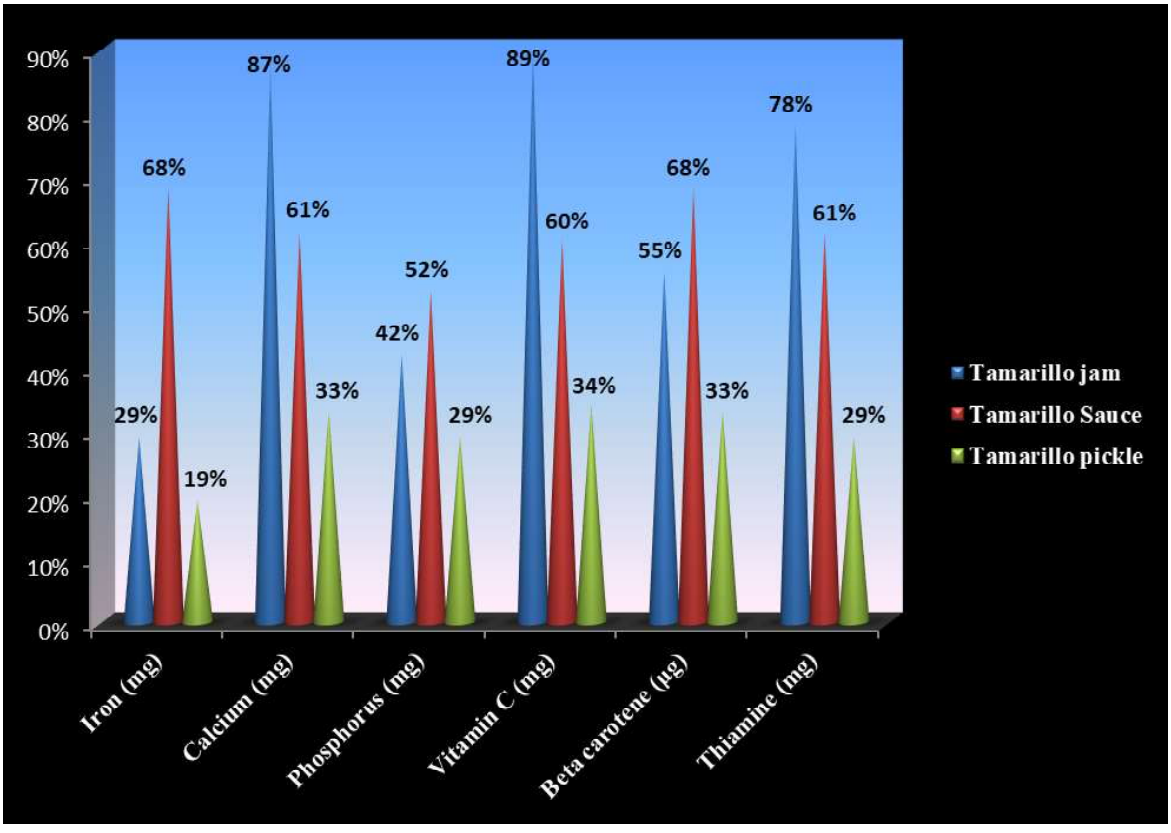

**Table 3: Phytochemical Analysis of Fresh and Preserved Foods of Tamarillo**

| S. No. | Phytochemical Constituents | Fresh Tamarillo | | | Aqueous Extract of Preserve Food | | |
|---|---|---|---|---|---|---|---|
| | | Aqueous | Ethanol | Methanol | Tamarillo Pickle | Tamarillo Jam | Tamarillo Sauce |
| 1 | Alkaloids | + | ++ | ++ | + | ++ | ++ |
| 2 | Coumarins | - | ++ | ++ | - | ++ | ++ |
| 3 | Flavonoids | +++ | +++ | +++ | +++ | +++ | +++ |
| 4 | Glycosides | +++ | ++ | ++ | ++ | ++ | +++ |
| 5 | Quinones | +++ | +++ | +++ | +++ | +++ | +++ |
| 6 | Terpenoids | +++ | +++ | +++ | +++ | +++ | +++ |
| 7 | Tannins | ++ | - | - | ++ | - | - |
| 8 | Steroids | +++ | + | + | ++ | + | +++ |
| 9 | Anthraquinones | + | - | - | + | - | - |
| 10 | Saponins | - | - | - | - | - | - |

**Note:** (+++) = Appreciable amounts, (++) = moderate levels (-) = complete absence.

**Table 4: Vitamin C and Antioxidant Activity of Fresh and Preserved Foods of Tamarillo**

| S. No. | Ascorbic Acid | Aqueous Extracts | IC50 DPPH (µg/mL) | Vitamin C (mg) | *p*-value |
|---|---|---|---|---|---|
| 1 | 1.13 µg/ml | Fresh fruit | 1.98 µg/ml | 29 mg | 0.050 NS |
| 2 | | Tamarillo pickle | 0.65 µg/mL | 17.4 mg | |
| 3 | | Tamarillo jam | 1.70 µg/mL | 23.2 mg | |
| 4 | | Tamarillo sauce | 1.16 µg/mL | 25.6 mg | |
| | | p-value | 0.999 NS | 0.984 NS | |

**Note:** Correlation between Vitamin C and antioxidant activity response variables involved in the study. NS - Non significance level.

analysed. Flavonoids quinnes, terpenoids and glycosides were present in appreciable amounts in aqueous, ethanol and methanol extracts of fresh tamarillo. Saponins were completely absent in all extracts of tamarillo. Terpenoids are useful in the prevention of several diseases, including cancer. Flavonoids are also present in tamarillo which prevent oxidative cell damage. It also helps in managing diabetes. Steroids are helps to reduce cholesterol and regulating the immune response. Glycosides are helps to boosts immune system. (*Maisarah et al.*, 2016).

Phytochemical constituents of preserved tamarillo foods were identified by using aqueous extracts, because aqueous extracts of fresh fruits revealed best values. Sauce contains appreciable amounts of Flavonoids, glycosides, quinines, terpenoids and steroids compared to pickle and jam. Saponins were completely absent in all products of tamarillo.

## Vitamin C and Antioxidant Activity of Fresh Tamarillo and Preserved Foods of Tamarillo

Vitamin C and antioxidant activity of fresh and preserved foods of tamarillo are presented in Table 4.

Results from Pearson Product Moment Correlation reveal with a positive correlation coefficient. DPPH assay was performed by measuring the OD against the standard (ascorbic acid) at 517 nm using UV-Spectrophotometer. The above table showed that the aqueous extract showed more antioxidant activity in fresh fruit than preserved foods. According to Zhenyu Qiu *et al.* (2014) antioxidant activities of aqueous extracts from tamarillo and preserved foods of tamarillo had a good antioxidant activity.

## CONCLUSION

The findings of the study is that fresh tamarillo has

appreciable amount of fibre, iron, vitamin C and beta carotene than preserved foods. Nutrient retention and weight changes were observed in preserved foods after cooking. A positive correlation between vitamin C and antioxidant activity was seen but there was a non significant level in fresh and preserved foods of tamarillo. Hence, tamarillo as salad or juice can be recommended for human consumption to prevent degenerative diseases. Since preserved foods of tamarillo jam can retain nutrients. Preserved foods of tamarillo can be stored and made available all over the year because tamarillo is a seasonal and an underexploited fruit and marketed with economically low cost.

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