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Comparative Study of Ripe Tamarind Pulp and Spray Dried Tamarind Pulp Powder for Compositional Analysis

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ABSTRACT

The present study was aimed to study the compositional properties of Ripe Tamarind Pulp and spray dried tamarind pulp powder. Proximate analysis of ripe tamarind pulp revealed 23.30% moisture, 2.97%, protein, 5.49% crude fiber, 2.19 % ash, 65.95% carbohydrate and 0.10% fat while spray dried tamarind pulp powder showed 2.62% moisture, 21.69%, protein, 3.64% crude fiber, 1.69% ash, 70.28% carbohydrate and 0.08 % fat. Mineral analysis of ripe tamarind pulp revealed high potassium content (777.20 mg/100g) followed by calcium (234.36 mg/100g), phosphorous (159.41 mg/100g), magnesium (87.16 mg/100g) and sodium (62.25 mg/100g) while spray dried tamarind pulp powder showed 582.31 mg/100g potassium, 182.26 mg/100g calcium, 117.82 mg/100g phosphorous, 65.95 mg/100g magnesium and 42.67 mg/100g sodium. Ripe tamarind pulp showed 338.56 mg GAE/100g total phenolic content and 84.58% radical scavenging activity while tamarind pulp powder possessed 204.53 mg GAE/100g total phenolic content and 49.27% radical scavenging activity.

Keywords: Tamarind pulp, Spray dried tamarind pulp powder, Proximate analysis, Protein, Total phenolic content.

I.INTRODUCTION

Tamarind is an arboreal fruit of *Tamarindus indica* L. which belongs to family Leguminosae or Caesalpiniaceae. The tree is native to Eastern Africa, including parts of the Madagascar dry deciduous forests (Lim, 2012). It is almost found throughout the tropics and subtropics of the world and has become naturalized at many places particularly in India, South East Asia, tropical America, the Pacific Islands and the Caribbean. The major production areas are the Asian countries including India and Thailand. India is the world's largest producer of tamarind with an average production of about 191750 Tonnes in the year 2013-2014 (Spice Board of India).

Tamarind tree is a multipurpose tree of which almost every part finds at least some use, either nutritional or medicinal (Kumar and Bhattacharya, 2008). The most valuable and commonly used part is the fruit which yields acidic pulp (Jyothirmayi *et al.* 2006). A typical tamarind fruit contains about 55% pulp, 34% seeds, and 11% shell and fibres (De Caluwe *et al.* 2010). The pulp of the fruit contains tartaric acid, reducing sugars, pectin,

protein, fiber and cellulosic materials. The percentage of the constituents varies from sample to sample with tartaric acid ranging from 8–18%, reducing sugars 25-45%, pectin 2-3.5% and protein 2-3% (Obulesu and Bhattacharya, 2011). Besides being a rich source of sugars, tamarind pulp is an excellent source of B-vitamins and exhibit high antioxidant capacity that appear to be associated with a high phenolic content. The fruit pulp is a good source of minerals especially potassium, calcium, phosphorous magnesium and sodium (Almeida *et al.* 2009). Nevertheless, the proximate composition of the tamarind pulp depends on locality (El-Siddig *et al.* 2006). Tamarind pulp in powder form has other benefits and economic potentials. In powder form it offers low logistic expenditures due to reduced weight and volume, and easy to use in different food formulations compared with squeezing of pulp from tamarind fruit. Besides this, in case of tamarind pulp powder there is no need to bother about disposal of the residue as is the case when whole tamarind fruit is used (Jittanit *et al.* 2011).

The present study was undertaken to study the Compositional Properties of Ripe Tamarind Pulp and spray dried Tamarind Pulp Powder

II.MATERIALS AND METHODS

2.1 Materials

Fresh and fully ripened tamarind pods (sour variety) were purchased from local market (Sangrur, India) and were stored in refrigerator until needed for the experiment. Soya protein isolate purchased from Nutrimed Health Care Private Ltd. (Delhi, India) was used as a drying aid.

2.2 Sample preparation and spray drying

Tamarind pulp extracted under optimized conditions as determined in our previous study was mixed with of soya protein isolate (SPI, as drying aid) in a laboratory type blender until the protein dissolved completely [17]. The mixture was then spray dried in a tall type laboratory scale spray dryer (S.M. Scientech, Calcutta, India) under optimum spray drying conditions including 170 °C inlet air temperature, 400 mL/h feed flow rate, and 25% concentration of drying aid (Muzaffar and Kumar, 2015). After completion of spray drying, powder was recovered from the cyclone and cylindrical parts of dryer chamber by lightly sweeping the chamber. The powder was then packed in laminated pouches and stored in desiccator for further analysis.

2.3 Characterization of tamarind pulp and spray dried tamarind pulp powder

2.3.1 Proximate analysis

The proximate composition of tamarind pulp powder was determined according to AOAC method (2000).

2.3.1.1 Moisture content (%)

Moisture content of the pulp was measured in accordance with AOAC (2000). Approximately 5g of the pulp was taken in previously dried and weighed petridish. The sample was then dried in a vacuum oven at a temperature of 70 °C until a constant weight was obtained. The sample was analyzed in triplicates and the mean was recorded. The percent moisture content was calculated as:

$$\text{Moisture content } (\%) = \frac{(w_2 - w)}{(w_1 - w)} \times 100 \qquad (1)$$

where,

W = Weight of empty petridish;

W_1 = Weight of petridish with sample before drying;

W_2 = Weight of petridish with sample after drying to constant weight.

2.3.1.2 Ash content (%)

For determination of ash content of TPP, standard method of AOAC (2000) was followed. Approximately 2 g of the powder sample was weighed, transferred in pre-weighed porcelain crucible and charred using gas flame till smoke ceases. The crucible was then transferred to muffle furnace maintained at 550±5 °C and incinerated until light grey ash was obtained. The crucible was then cooled in dessicator and weighed.

The percent ash content was calculated as:

$$\text{Ash } (\%) = \frac{W_3 - W_2}{W_1} \times 100 \qquad (2)$$

where,

W_1 = Weight of the sample

W_2 = Weight of empty crucible

W_3 = Weight of crucible + ash

2.3.1.3 Crude fat (%)

For determination of crude fat content AOAC method (2000) was followed. Dried sample remaining after moisture determination was transferred to a thimble and the top of a thimble was plugged with a wad of fat free cotton. The thimble was then placed in a fat extraction tube of Soxhlet apparatus which was attached to a Soxhlet flask. Approximately 75 ml of anhydrous ether was poured through the sample in the Soxhlet apparatus and the sample was refluxed for about 10 h. At the end of the extraction period, thimble was removed from the apparatus and distilled off most of the ether by allowing it to collect in the Soxhlet tube. Poured off the ether when the tube was nearly full. When the ether level in Soxhlet flask had reached to a small volume, poured it into a previously weighed dry beaker. The ether was evaporated on a steam bath at low heat and the beaker containing ether soluble material was dried at 100 °C for 1 h, cooled and weighed.

The crude fat content was calculated by using the following equation:

$$\%\ \text{Crude fat} = \frac{\text{Weight of ether soluble material}}{\text{Weight of sample taken}} \qquad (3)$$

2.3.1.4 Protein content (%)

Crude protein content of TPP was estimated by Kjeldhal method using Kjeldal apparatus (KELPLUS-SUPRA LX, Pelican, Chennai, India). About 5g of digestion mixture (Potassium sulphate (4.17 gm) and Copper sulphate (0.83 gm) in the proportions of 5:1), 1g (dry weight) of sample and 15 ml of sulphuric acid (H_2SO_4) in a digestion tube were kept at about 350 °C for approximately 1 hour. Then it was kept for another 1-2 hours at 450 °C until the solution become colorless or clear. The digest was cooled and 20 ml of distilled water was added to it. The digest was then steam distilled after addition of 40% NaOH. After distillation, the liberated ammonia was trapped in the 15 ml of 4% boric acid containing 4-5 drops of mixed indicator [1% bromocresol green + 0.1% methyl Red (1:2)]. The color of the boric acid changes from purple to bluish green with entrapment of liberated ammonia. Then boric acid solution was titrated with 0.1N HCl and the color of the boric acid again changes to light purple**.** The nitrogen percent was calculated by the following formula:

$$\textbf{Nitrogen}\ (\%) = \frac{(\textbf{Sample titre} - \textbf{Blank titre}) \times 14 \times \textbf{N} \times 100}{\textbf{W} \times 1000} \qquad (4)$$

where,

N = normality of standard HCl solution;

W = weight of sample

Protein content was estimated by conversion of nitrogen percentage to protein as follows:

$$\textbf{Protein}\ \% = \textbf{N}\% \times \textbf{conversion factor}\ (6.25) \qquad (5)$$

2.3.1.5 Crude fiber

Crude fiber was estimated by following the standard AOAC method (2000). 2 g fat free dried sample was transferred to conical flask. Then 200 ml of 1.25 % sulphuric acid was boiled in a beaker. The whole of the boiling acid was transferred to the flask containing fat free sample, connected with reflux water condenser and heated, so that contents of the flask begin to boil within one minute. The flask was rotated frequently and boiling was continued for 30 minutes. The flask was then removed and the content was filtered through ash less filter paper in a funnel and washed with boiling water. The residue was then returned back into the flask with 200 ml of 1.25 per cent NaOH. The flask was immediately connected with reflux condenser and boiled for 30 minutes. After this flask was removed and the content was filtered through ash less filter paper. Residue was washed thoroughly with water, transferred to the silica crucible and dried at 105±1 °C in hot air oven to constant weight. After cooling in dessicator, the weight of crucible with residue was recorded. The crucible was then transferred to muffle furnace at 550 °C until all carbonaceous matter was burnt. After ashing, crucible was cooled in dessicator and reweighed.

Crude fiber was estimated by the following formula:

$$\textbf{Crude fiber}\ (\%) = \frac{\mathbf{W_1} - \mathbf{W_2}}{\mathbf{W}} \times 100 \qquad (6)$$

where , W = Weight of sample

W_1 = Weight of the crucible + weight of treated sample after oven drying.

W_2 = Weight of the crucible + weight of sample after ashing.

2.3.1.6 Total carbohydrate

Total carbohydrate was calculated by deducing the sum of the values for moisture, crude protein, crude fat, crude fibre, ash in 100 (Raghuramulu *et al.*, 1983).

2.3.2 Mineral analysis

Minerals were analyzed by the method given by Food and Agriculture Organization of the United Nations (FADA/SIDA) (1983) with slight modifications. Briefly, 2 g of sample was placed in Kjeldahl tubes and freshly prepared nitric acid-sulfuric acid mixture (25 mL) in the ratio of 1.5:1 was added. The sample was digested at 250 °C for 2–3 h or until a clear solution was obtained. After cooling, the solution was diluted with 100 mL deionized water and the residue was filtered through an ashless filter paper. The mineral content of the sample was determined by atomic absorption spectroscopy (ICE 2000, Thermo Scientific, Waltham, MA) with air acetylene flame for Ca, P, Mg, Na and K.

2.4 Antioxidant properties

2.4.1 Determination of total phenolic content

Total phenolic content of spray-dried tamarind pulp powders was estimated by Folin-Ciocalteu method followed by Vasco *et al.* (2008) with slight modifications. Briefly, 100 mg of the sample was mixed with 15 ml of methanol and centrifuged for 10 min. Then 0.5 ml of supernatant was added to 2.5 ml Folin Ciocalteau reagent (0.2N) and allowed to stand for 5 min for reaction. After this, 2 ml of 7.5% sodium carbonate was added to the reaction mixture and diluted to 25 ml using distilled water. The mixture was then incubated for 2 h at room temperature and the absorbance was measured at 760nm against methanol as blank using DR6000 UV-vis spectrophotometer (Hach Lange, Germany). The total phenolic content was determined by comparing with the standard curve using gallic acid (0–100 µg/mL). The results were expressed as mg of gallic acid equivalents per 100 gram (GAE mg/100g) of the sample.

2.4.2 DPPH radical scavenging activity

Hydrogen donating or radical scavenging activity of the sample was determined by the method followed by Moon and Shibamoto (2009) with some modifications. About 100 mg of the sample was mixed with 15 ml of methanol and centrifuged for 10 minutes. Aliquot (1 ml) of the supernatant was added to 3 ml of a DPPH-methanolic solution (0.0635 mM). The reaction mixture was incubated at room temperature for 40 min and the absorbance was measured at 515 nm using double UV-visible spectrophotometer (DR6000, Hach Lange). Methanol was used as the control. DPPH radical scavenging activity of the sample was calculated as:

$$\text{DPPH radical scavenging activity}\ (\%) = \frac{(\text{Abs control} - \text{Abs sample})}{\text{Abs control}} \times 100 \qquad (3.8)$$

where Abs control is the absorbance of control and Abs sample is the absorbance of sample.

2.4 Statistical analysis

All the analysis was carried out in triplicates and the results were presented as mean values with standard deviations.

III. RESULTS AND DISCUSSION

3.1 Proximate composition

Results of proximate composition and mineral analysis of ripe tamarind pulp and spray-dried tamarind pulp powder are shown in Table 1. Ripe tamarind contained high moisture content of 23.30% while powder showed low moisture content of 2.62 %. Protein content of the powder was high (21.69%) as compared to ripe pulp (2.97), which can be attributed to the soya protein isolate added during spray-drying. Ripe pulp showed 5.49±0.49 crude fibre and 2.19±0.10 ash content while powder was having 3.64% crude fibre and 1.69% ash content. Fat content of the ripe pulp and powder was very low, 0.10% and 0.08%, respectively. Carbohydrate content of the ripe tamarind pulp and powder was 65.95% and 70.28%, respectively.

3.2 Mineral Analysis

The major minerals of tamarind pulp and powder were potassium (777.20 and 582.3 mg/100g), calcium (234.36 and 182.26 mg/100g), phosphorous (159.41 and 117.82 mg/100g), magnesium (87.16 and 65.95 mg/100g) and sodium (62.25 and 42.67 mg/100g).

3.3 Antioxidant properties

Total phenolic content and DPPH radical scavenging activity of spray dried tamarind pulp powder was 204.53 GAE mg/100g and 49.27%, respectively, which was less than that of ripe tamarind pulp, showing 338.56 GAE mg/g total phenolic content and 84.58 % DPPH radical scavenging activity.

Table 1 Proximate, mineral analysis and antioxidant activity of ripe tamarind pulp and spray dried tamarind pulp powder

Parameters	Ripe tamarind pulp	Spray dried TPP
Moisture (%)	23.30±0.98	2.62±0.05
Protein (%)	2.97±0.32	21.69±2.79
Fat (%)	0.10±0.03	0.08±0.01
Ash content (%)	2.19±0.10	1.69±0.30
Crude fiber (%)	5.49±0.49	3.64±0.73
Carbohydrate (by difference) (%)	65.95	70.28
Potassium (mg/100g)	777.20±2.98	582.31±3.92
Calcium (mg/100g)	234.36±2.13	182.26±2.54
Phosphorous (mg/100g)	159.41±3.51	117.82±1.72
Magnesium (mg/100g)	87.16±1.67	65.95±1.23
Sodium (mg/100g)	62.25±2.31	42.67±1.05

Total phenolic content (mg GAE/100g)	338.56	204.53±2.59
DPPH radical scavenging activity (%)	84.58	49.27±1.82

Values were expressed as the average of triplicates ± standard deviation.

IV. CONCLUSIONS

The study revealed that ripe tamarind pulp and its powder form developed by spray drying showed good nutrient profile with high antioxidant activity, thus suggesting that it might enhance the nutrient profile besides being acting as a souring agent in different food formulations.

REFERENCES

[1.] T. K. Lim, Edible Medicinal and Non-Medicinal Plants (Springer press, Netherland, 2012, pp. 879-905).

[2.] Spice Board of India, Spice wise area and production in the year 2013-14, cited from http://www.indianspices.com/pdf/Major_spicewise_area_production.pdf.

[3.] C.S. Kumar, and S. Bhattacharya, Tamarind Seed: Properties, Processing and Utilization, Critical Reviews in Food Science and Nutrition, 48, 2008, 1-20.

[4.] T. Jyothirmayi, G.N. Rao and D.G. Rao, Studies on instant raw tamarind chutney powder, Journal of Food Service, 17, 2006, 119-123.

[5.] E. De Caluwe, K. Halamov and P. Van Damme, Tamarind (Tamarindus indica L.): A review of traditional uses, phytochemistry and pharmacology. In H.R. Juliani, J. E. Simon, & Chi-Thong Ho (Eds.), African Natural Plant Products: Discoveries and Challenges in Quality Control (2010, pp. 85–110). ACS Symposium Series 1021. Washington DC: American Chemical Society.

[6.] M. Obulesu and S. Bhattacharya, Color Changes of Tamarindus indica L. pulp during fruit development, ripening and storage, International Journal of Food Properties, 14, 2011, 538-549.

[7.] M.M.B. Almeida, P.H.M. De Sousa, M.L. Fonseca, C.E.C. Magalhaes, M.dF.G. Lopes, T.L.G. De Lemos, Evaluation of macro and micro-mineral content in tropical fruits cultivated in the northeast of Brazil. Ciencia e Tecnologia Alimentos, 29, 2009, 581-586.

[8.] K. El-Siddig, H.P.M. Gunasena, B.A. Prasa, D.K.N.G. Pushpakumara, K.V.R. Ramana, P. Vijayanand. and J.T. Williams, Tamarind – Tamarindus indica L. Fruits for the future 1, (Southampton Centre for Underutilized Crops, Southampton, UK, 2006, 188p)

[9.] W. Jittanit, M. Chantara-In, T. Deying and W. Ratanavong, Production of tamarind powder by drum dryer using maltodextrin and Arabic gum as adjuncts, Songklanakarin Journal of Science Technology, 33, 2011, 33- 41.

[10.] K. Muzaffar and P. Kumar, Parameter optimization for spray drying of tamarind pulp using response surface methodology, Powder Technology 279, 2015, 179–184.

[11.] AOAC, Official method of analysis, Association of Official Analytical Chemists, Gaithersburg, MD, USA, 17th edn 2000.

[12.] Food and Agriculture Organization of the United Nations (FADA/SIDA), Manual Method in Aquatic Environment Research, Part 9, Analysis of Metals and Oregano-Chlorine in Fish, Section 2, pp. 14–20, F.A.O. Fish Technical Paper, 212, Rome, 1983.

[13.] C. Vasco, J. Ruales, A. Kamal-eldin, Total phenolic compounds and antioxidant capacities of major fruits from Ecuador. Food Chemistry, 111, 2008, 816-823.

[14.] J. K. Moon and T. Shibamoto, Antioxidant assays for plant and food components. Journal of Agriculture and Food Chemistry, 57, 2009, 1655-66.