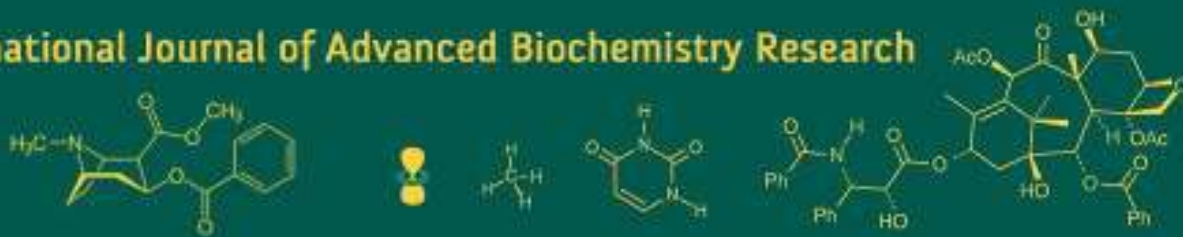


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
 ISSN Online: 2617-4707
 IJABR 2024; SP-8(7): 963-967
www.biochemjournal.com
 Received: 14-05-2024
 Accepted: 15-04-2024

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Effect of concentration of foaming agent and whipping time on foam mat drying of sapota pulp

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DOI: <https://doi.org/10.33545/26174693.2024.v8.i7S1.2766>

Abstract

Freshly available sapotas were procured, washed, peeled, seeds were removed, and pulp was prepared. The pulp was mixed up with different albumin concentrations (5%, 10% and 15%) and mixed with 4.41% of methyl cellulose and whipped for different times (10, 20 and 30 min). The extracted pulp was subjected to foam mat drying at a temperature of 60°C in tray dryer. The yield of sapota pulp was 63.12%. Foam density was lowest and foam expansion was highest at 15% concentration and 10 minutes whipping time. Foam stability was highest at 15% concentration and 30 minutes whipping time. The moisture content, pH, acidity, ascorbic acid and TSS of control sample sapota powder after drying were 7.04% w.b., 6.1, 68.25%, 9.8765 mg/100g powder and 7.1°Brix respectively. Similarly, the lowest moisture content was observed for the T7 sample. The pH, acidity, ascorbic acid and TSS were observed to be good for the T9 sample. Slight variation was observed among the physico-chemical properties of treated and untreated sapota powder. Finally it was concluded that Foam dried sapota pulp dried faster than the control sample.

Keywords: Sapota pulp, foaming density, foaming stability, moisture content, yield of sapota pulp

1. Introduction

Sapota (*Achras zapota*) belongs to family sapotaceae and a popular tropical fruit commercially grown in India. It is popularly known as chikku. Sapota fruit is known for its sweet delicious taste and possesses a delicate characteristic aroma when fully ripe. The fruit is a good source of digestible sugar (12 to 18%) and appreciable source of protein, fat, fibre and minerals like calcium, phosphorous and iron (Chadha, 2001) [1]. Sapota is one of the most important fruits available throughout the year and containing higher percentage of ascorbic acid. It is considered as one of the most important energy producing food and having high nutritive value.

The shelf life of sapota fruit is very short (2-3 days). After harvesting, if not handled properly, it becomes over mature within a day or two days at ambient temperature. The postharvest losses are high in tropical country like India range between 25 to 30% (Salunkhe and Desai, 1984) [4]. Owing to these changes sapota fruits have poor shelf life compared to other climacteric fruits. So, value addition through processing is important for economic utilization. Several efforts have been made in past for preparation of value-added products such as sapota powder, sapota pulp, sapota jam and RTS beverage.

Drying is traditionally defined as that unit operation which converts a liquid, solid or semi-solid feed material into a solid product of significantly lower moisture content. In most cases, drying involves the application of thermal energy, which causes water to evaporate into the vapor phase. In the traditional drying methods, it is difficult to control the temperature. We cannot dry the produce when it rains or after sun set.

Foam mat drying technique can be successfully employed for drying a variety of fruit juice concentration and pulps. The dried powders have good reconstitution characteristics. The fresh sapotas have limited shelf life. Therefore, it is necessary to utilize them for making different products to increase its availability over an extended period by foam mat drying. In view of the above discussion, the present study is taken up to prepare a foam mat dried sapota powder, to study the effect of concentration and whipping time on sapota pulp and to study the physico-chemical parameters of prepared sapota powder.

2. Materials and Methods

Fresh, fully matured and good quality sapota fruits were collected from the local market, Bapatla. The sapotas without any spoilage from environment or any other means were selected, washed with running water and manually peeled. The seeds were separated from the peeled Sapotas by opening them manually. The peeled and deseeded sapotas were blended in a mixer for about 2-3 minutes for making the sapota pulp. Three different concentrations of egg albumin (EA) such as 5%, 10% and 15% were added as foaming agent to the sapota pulp for developing foam which increases surface area due to air incorporation and methyl cellulose is added as a foam stabilizer. Then add water in 1:2 ratio (pulp to water). Sapota pulp was whipped by hand blender for 10, 20 and 30 min in order to mix the ingredients uniformly and to incorporate air for foaming. The foaming parameters such as foam density, foam expansion and foam stability were measured for the following samples. T1 (5% EA and 10 min whipping time), T2 (5% EA and 20 min whipping time), T3 (5% EA and 30 min whipping time), T4 (10% EA and 10 min whipping time), T5 (10% EA and 20 min whipping time), T6 (10% EA and 30 min whipping time), T7 (15% EA and 10 min whipping time), T8 (15% EA and 20 min whipping time), T9 (15% EA and 30 min whipping time).

2.1 Foam density

Foam density was determined by filling in a graduated cylinder with sapota foam and height of foam was measured and then weighed. By measuring the volume of the foam, foam density was calculated and expressed in g/cc

$$\text{Foam density} = \frac{\text{Foam weight}}{\text{Foam volume}}$$

2.2 Foam stability

Sapota foam was allowed to stand for 60 min at room temperature and after which the volume is decreased. Then the initial volume and the final decreased volume were read directly on the measuring cylinder. The per cent foam stability (FS) was calculated as follows:

$$\text{Foam stability (\%)} = \frac{V_f}{V_i} \times 100$$

Where

V_f = Foam volume at 60 min and V_i = Initial volume of foam including the liquid volume without foaming.

2.3 Foam expansion

Foam expansion was determined by measuring the difference in volume of sapota pulp before and after foaming by using the following equation.

$$\text{Foam expansion (\%)} = \frac{V_1 - V_0}{V_0} \times 100$$

where V_0 is the volume of sapota pulp before foaming (cm^3) and V_1 is the volume of the sapota pulp after foaming (cm^3).

2.3.1 Preparation of Sapota Powder by Foam MatDrying

The drying of the sapota foam was conducted in a tray drier (Plate 3.4) with forced air circulation. The sapota foam was

spread evenly in aluminum trays (rectangular trays measuring 78 cm in length and 38 cm width) with 3mm height foam and dried at 60 °C drying temperature. The dried samples thus obtained were grinded in grinder to produce the required sapota powder. To obtain the drying curves, each tray with foam was weighed at 1 hour interval till a constant weight was reached.

The procedure for making up of sapota powder consisted of a series of unit operations as shown in the following flowchart (Fig.3.1).

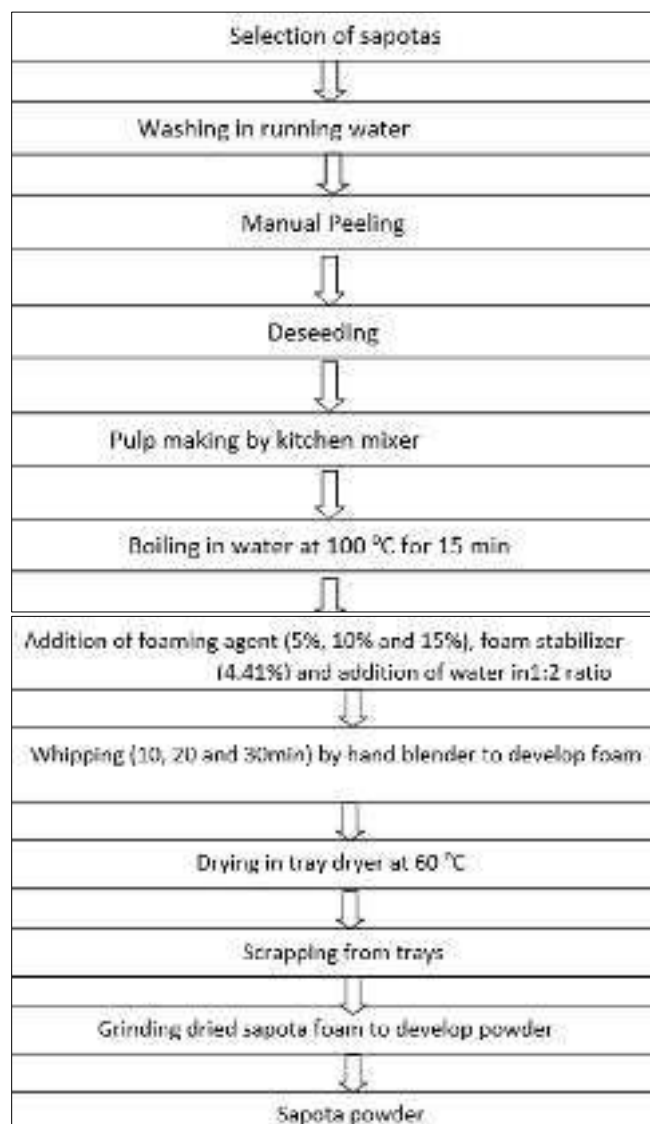


Fig 1: Flowchart for the preparation of sapota powder

2.4 Determination of Physico-chemical Properties of Sapota Pulp and Powder

Physio-chemical properties such as moisture content, pH, acidity, TSS, foam density, ascorbic acid of the sapota pulp and powder was carried out in the laboratory.

2.4.1 Moisture content

$$\text{Moisture content (wb \%)} = \frac{W_1 - W_2}{W_1} \times 100$$

Moisture content of sapota pulp and powder was determined by oven drying method. No. of samples was weighed in triplicate and dried for about 24 hours in hot air oven at 105

°C (AOAC, 1984) [1]. The observations were recorded, and moisture content was computed by using following formula.

Where

W_1 = Initial weight (sample before drying + dish)

W_2 = Final Weight (Sample after drying + dish)

2.4.2 pH

pH was measured using digital pH meter. pH is the logarithm of the reciprocal of hydrogen ion concentration is a measure of active acidity which influence the flavor or palatability of a product and also affects its processing requirements. The pH of the sapota pulp and powder sample was determined using a digital pH meter (HI-98107, Hanna).

2.4.5 Total soluble solids

Total soluble solids (TSS) of sapota juice was determined by using refractometer (Make: ATAGO, model no: ATG53) (Plate 3.7). A total soluble solid of samples was measured by placing a drop of the juice on the prism of the digital refractometer and reading was expressed in terms of degree Brix (Seema 2016) [5].

2.4.6 Ascorbic Acid

The main principle of ascorbic acid reduces the 2, 6 – dichloro phenol indophenol dye (AOAC, 2005) [2] to a colorless leuco-base. The ascorbic acid gets oxidized to dehydro ascorbic acid. Though the dye is a blue colored compound, the end point is the appearance of pink color. The dye is pink colored in acid medium. Oxalic acid used as titrating medium.

Materials

- Oxalic acid 4%
- Dye solution: Weighed 42mg sodium bicarbonate into a small volume of distill water.
- 52 mg 2, 6 – dichlorophenol indophenol was dissolved in it and made up to 200 mL with distilled water.
- Stop standard solution: 100 mg ascorbic acid was dissolved in a 100 ml of 4% oxalic acid solution standard flask (1 mg/mL).
- Working standard: 10 mL of stock solution was diluted to 100 mL with oxalic acid.
- The concentration of working standard is 100 µg/mL.

Procedure

5 mL working standard solution was pipette out into a 100 mL conical flask. 10 mL of 4% oxalic acid was added and titrated against dye solution (V_1 mL). End point is the appearance of pink colour which persists for few minutes. The amount of dye consumed is equivalent to the amount of ascorbic acid. The sample Extracted in 4% oxalic acid make up to known volume (100 mL) and centrifuged. 5 mL of the supernatant was pipette out, added 10 mL of 4% oxalic acid and titrated against the dye (V_2 mL).

Calculation

$$\begin{aligned} \text{Amount of Ascorbic Acid} &= \frac{\text{mg}}{100\text{g}} \text{ sample} \\ &= \frac{0.5 \text{ mg}}{V_1 \text{ mL}} \times \frac{V_2}{15 \text{ mL}} \times \frac{100 \text{ mL}}{\text{wt. of the sample}} \\ &\times 100 \end{aligned}$$

2.5 Titratable acidity

Titratable acidity of sapota pulp and powder was determined by AOAC (2005) [2]

Materials

1. 0.1 N Sodium hydroxide solution
2. phenolphthalein indicator

Procedure

10 ml of fruit juice was taken into a beaker and make up to 100 ml by using distill water. 10 ml of diluted juice was taken from 100ml. Added 4 to 5 drops of phenolphthalein indicator to 10 ml juice. Titrated against 0.1 N NaOH solutions, until colorless changes to pink color.

$$\% \text{Acid} = \frac{N \times V_1 \times \text{Eq. Wt}}{V_2 \times 10}$$

Where

N = Normality of titrant

V_1 = Volume of titrant

V_2 = Volume of sample

3. Results and Discussion

3.1 Yield of Sapota Pulp

Physically matured, fully ripen fruits were found suitable for preparation of sapota pulp. The average yield of sapota pulp was 63.12% and the remaining 36.88% has gone waste in the form of seeds and peel.

3.2 Effect of albumin concentration and whipping time on foam density of sapota pulp

The effect of different concentrations of the egg albumin (5%, 10%, 15%) and different whipping times (10, 20, and 30min) on the foam density was analyzed. As the concentration of the egg albumin increased, the foam density decreased at constant whipping time (Fig 3.1). The reduction in the foam density is due to the migration of foaming agent from the aqueous phase to the air liquid interface which has induced the reduction of the surface tension and increase the surface area which results in improving the foaming ability with increase in albumin concentration. As the whipping time increased, the foam density also decreased. The foam density varied between 1.0847 to 0.974 g/cc. However, foam density increased again after 20min at constant concentration, due to mechanical deformation and collapse of the bubble structure. The lowest foam density was observed at 15% concentration 10 min whipping time i.e in T_7 sample.

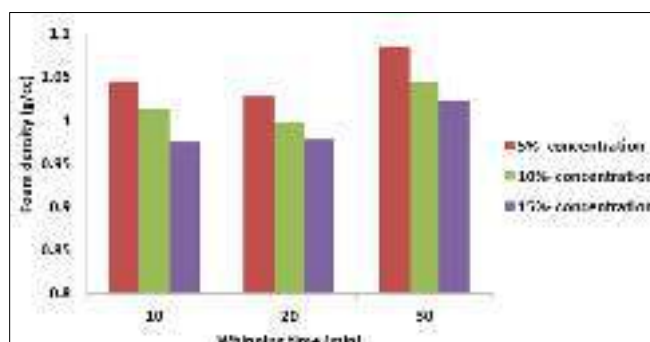


Fig 1: Effect of albumin concentration and whipping time on foam density of sapota pulp

3.3 Effect of albumin concentration and whipping time on foam expansion of sapota pulp

The effect of different concentrations of the egg albumin (5%, 10%, 15%) and different whipping times (10, 20 and 30 min) on foam expansion was analyzed. As the concentration of the egg albumin and whipping time increased, the foam expansion also increased (Fig 3.2). The increase in foam expansion with whipping time is due to the air bubbles captured during whipping. The pulp showed higher foam expansion of 22% at 15% albumin concentration for 10 min whipping time. Further increase in the whipping time resulted in lower foam expansion due to mechanical deformation and collapse of bubble structure.

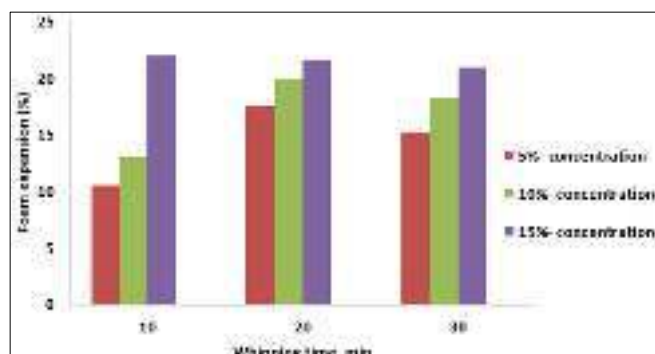


Fig 2: Effect of albumin concentration and whipping time on foam expansion of sapota pulp

3.3 Effect of albumin concentration and whipping time on foam stability of sapota pulp

The effect of different concentrations of the egg albumin (5%, 10%, 15%) and different whipping times (10, 20 and 30 min) on the foam stability was analyzed. As the concentration of the egg albumin and the whipping time increased, the foam stability also increased. The foam stability varied between 97.47% to 98.57%. The stability of the foam is mainly due to the interaction effect of foaming agent with foam stabilizer. At 5% concentration the interaction was lower resulting in lower stability compared to other concentrations. The foam stability was higher at 15% EA concentration for 30 min whipping time i.e in T₉ sample.

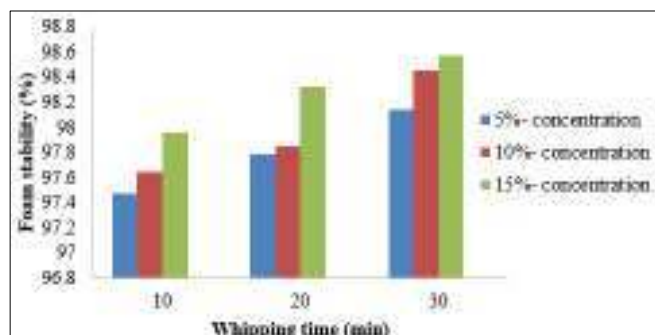


Fig 3: Effect of albumin concentration and whipping time on foam stability of sapota pulp

Effect of drying time on moisture content of sapota foam

The moisture content of the sapota pulp decreased with drying time. The initial moisture content of the normal sapota pulp and foamed sapota pulp were different. The initial moisture content of the ripened sapota pulp is 75.89% (w.b.). When the sapota pulp was dried at 60 °C, the time required for reducing the moisture content of foamed sapota

pulp was less as compared to control sample (Fig.3.4). During foaming, air was incorporated, and the surface area was increased, and this resulted in more area exposed to drying. Due to this more moisture was removed within short time than that of control sample. Results also showed that time required for reducing moisture content in samples was less at 15% EA concentration for 10 min whipping time.

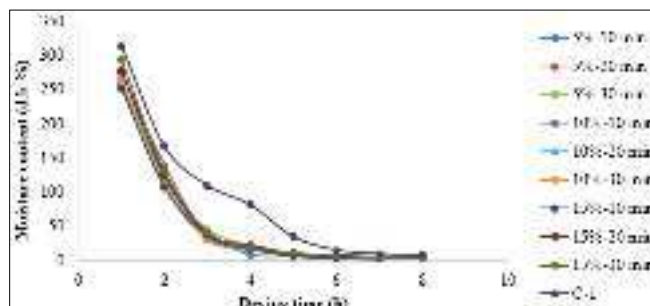


Fig 4: Effect of drying time on moisture content of sapota foam

3.5 Yield of Sapota Powder

The yield of sapota powder was different for control and treatment. Powder yield was 24.02% which was highest (of all the treatments) at 15% albumin concentration for 30 min whipping time and dried at 60 °C drying temperature and for the control sample, the powder yield was 24.28%.

3.6 Physio-chemical Properties of Sapota Pulp and Sapota Powder

The different physio-chemical properties of sapota powder namely, moisture content, pH, acidity, TSS, ascorbic acid were determined in the laboratory.

3.6.1 Effect of albumin concentration and whipping time on moisture content of sapota powder

It was observed that the moisture content of sapota powder for control and treatment ranged between 7.04 -1.75% w.b. Moisture content of non-foamed sapota powder was more than that of the foamed sapota powder. The foaming caused a greater exposure of surface area and hence the moisture content decreased in treatment. Compared to all samples, very less moisture content of 1.75% was observed for T₇ sample.

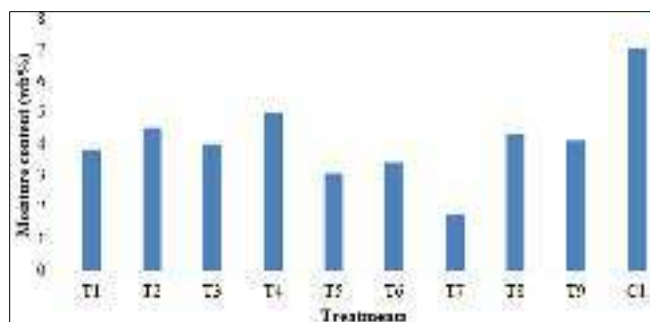


Fig 5: Effect of albumin concentration and whipping time on moisture content of sapota powder

3.6.2 pH

The pH value of the powder prepared from foamed sapota pulp was more than that of the powder prepared from non-foamed sapota pulp. The pH values varied between 6.1 to 6.9. This rise in the pH could be contributed to the influence

of alkali of egg white. Compared to all samples, highest pH of 6.9 was observed in T₉ sample.

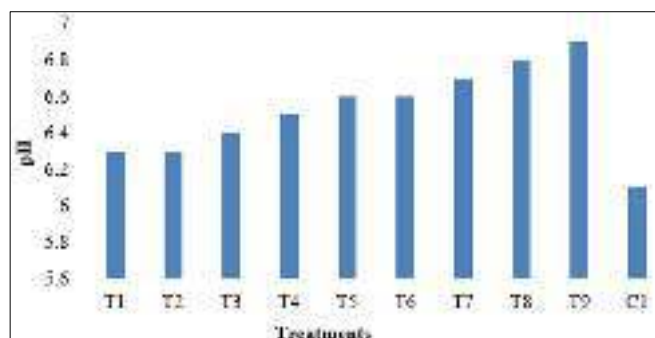


Fig 6: Variations of pH in different sapota powder samples

3.6.3 Titratable Acidity

Sapota powder without egg albumin (control) was found to have 0.682 of acidity content while the percentage of acidity content in the foam mat dried sapota powder varied between 0.675 to 0.51. In this study, acidity of sapota powders was decreased with increase in egg albumin concentration due to the heat sensitive nature of organic acids and the properties of egg albumin that have low acidity.

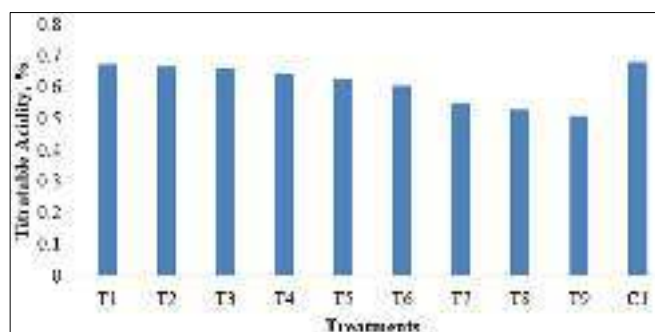


Fig 7: Variations of Acidity in different sapota powder samples

3.6.4 Total soluble solids

Total soluble solids (TSS) of control sample was 7.1 °Brix. The values of total soluble solids for the foam dried and non-foam dried samples were in the range 7.3°Brix to 8.4°Brix. The foaming agent had some significant effect on the total soluble solids. TSS of sapota powder has a increasing trend with increase in Egg albumin concentration and whipping time. Highest TSS values were observed at T₇ and T₉ samples.

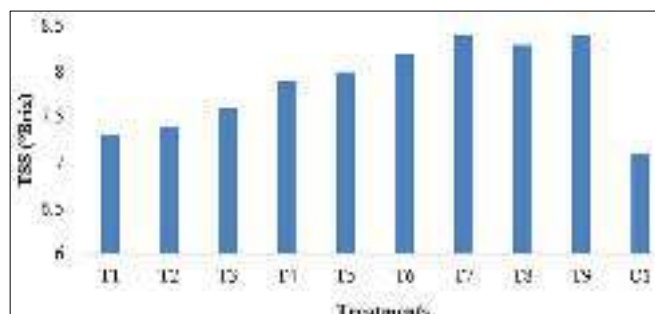


Fig 8: Variations of TSS in different sapota powder samples

3.6.5 Ascorbic Acid

The ascorbic acid of sapota powder values for the foam dried and non-foam dried samples at were in the range of

9.8765 to 19.753 mg/100g powder. As the foaming agent increased, the ascorbic acid content showed a reduction in its values. The losses experienced in ascorbic acid could be due to the heat sensitive nature of vitamins and water-soluble nature of ascorbic acid (i.e. some ascorbic acid could have escaped along with the moisture during the drying operation).

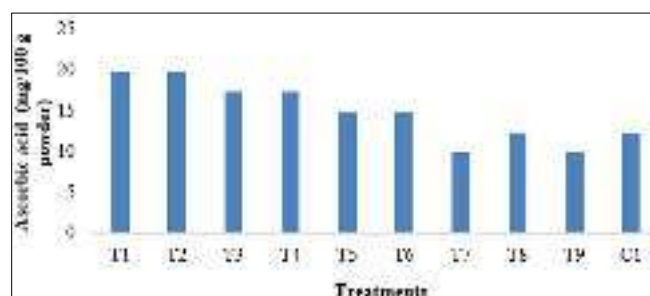


Fig 9: Variations of Ascorbic Acid in different sapota powder samples

4. Conclusion

Freshly available sapotas were procured, washed, peeled, seeds were removed, and pulp was prepared. The pulp was mixed up with different albumin concentrations (5%, 10% and 15%) and mixed with 4.41% of methyl cellulose and whipped for different times (10, 20 and 30 min). The extracted pulp was subjected to foam mat drying at a temperature of 60°C in tray dryer. The yield of sapota pulp was 63.12%. Foam density was lowest and foam expansion was highest at 15% concentration and 10 minutes whipping time. Foam stability was highest at 15% concentration and 30 minutes whipping time. The moisture content, pH, acidity, ascorbic acid and TSS of control sample sapota powder after drying were 7.04% w.b., 6.1, 68.25%, 9.8765 mg/100g powder and 7.1°Brix respectively. Similarly, the lowest moisture content was observed for the T₇ sample. The pH, acidity, ascorbic acid and TSS were observed to be good for the T₉ sample. Slight variation was observed among the physico-chemical properties of treated and untreated sapota powder. Finally it was concluded that Foam dried sapota pulp dried faster than the control sample.

5. References

1. AOAC. Official Methods of Analytical Chemists. Washington, USA; c1984.
2. AOAC. Official Methods of Analytical Chemists. 18th ed. Gaithersburg, USA: Association of Official Analytical Chemists; c2005.
3. Chadha KL. Handbook of Horticulture. New crops. ICAR publication. Director of Horticulture, Gandhinagar, Gujarat. 2001;1(10):308.
4. Salunkhe DK, Desai BB. Post-harvest biotechnology of vegetables. Department of Technology and Engineering; 1984;1:1-232.
5. Seema K, Kranthi KN, Jyothi J, Lakshmi LJ, Swarnalatha I. Study on drying behavior of sapota (*Manilkara achras*) in solar tray dryer and hot air cabinet dryer. J Environ Sci Technol. 2015;10(4):40-64.