International Journal of Advanced Biochemistry Research

**ISSN Print:** 2617-4693
**ISSN Online:** 2617-4707
IJABR 2024; SP-8(1): 277-285
www.biochemjournal.com
Received: 02-10-2023
Accepted: 06-11-2023

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# Standardization of process formulation for shelf life extension of sapota [*Manilkara achras* (Mill.) Fosberg] Milkshake

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**DOI:** https://doi.org/10.33545/26174693.2024.v8.i1Se.348

**Abstract**
Present investigation entitled “Standardization of process formulation for shelf life extension of sapota [*Manilkara achras* (Mill.) Fosberg] MILKSHAKE" was aimed to study the effect of sapota pulp and potassium sorbate on physico-chemical quality of sapota milkshake during storage. For preparation of sapota milkshake, an experiment was carried out with nine treatment combinations comprised of three different levels of sapota pulp ($A_1$- 8, $A_2$- 10 and $A_3$- 12 percent) and three levels of potassium sorbate ($B_1$- 0 ppm, $B_2$- 75 ppm and $B_3$- 150 ppm). Each treatment in the experiment was carried out with three repetitions using completely randomized design with factorial concepts. The prepared milkshake was stored for a period of 2 month to analyze the quality attributes at 15 days intervals. The results of the investigation revealed that TSS, pH, total sugars, non-reducing sugars, potassium content and protein values of sapota milkshake decreased significantly and acidity, non-reducing sugars increased significantly while sodium and calcium contents decreased non-significantly up to 2 months storage. The TPC of all treatments increased in storage but the value was below the acceptable limit with minimum TPC in $A_1B_3$. Overall findings of investigation revealed that sapota milkshake with better nutritional attributes can be prepared by using 8 percent sapota pulp ($A_1$) and 150 ppm potassium sorbate ($B_3$). Thus, the developed technology can commercially be adopted by the food processing industry for the production of sapota milkshake.

**Keywords:** Sapota, milkshake, microbial, nutrition and storage

## Introduction
Sapota [*Manilkara achras* (Mill.) Fosberg] is a tropical fruit that belongs to family Sapotaceae and class Dicotyledonae. It is also known as sapodilla, chiku or bully in India. Gujarat is one of the leading milk-producing states in India, with a well established dairy industry. Milk is an excellent source of several essential nutrients. Firstly, milk is rich in calcium, which is crucial for building and maintaining strong bones and teeth. Secondly, milk is a good source of high-quality protein that plays an essential role in building and repairing tissues in the body. Additionally, many types of milk are fortified with vitamin D, which is crucial for bone health and immune system function. Milkshake is a product of western origin which is obtained by preparing mix containing milk, skim milk powder, stabilizer and sugar and speed mixing the product in mixer to make it pourable and generate foam in it. (Ubale *et al.*, 2014) [9] It has low fat and sugar content than ice-cream. The milkshakes that are commonly sold in the Indian sub-continent consist of sweetened cold milk added with colouring and flavouring agents without freezing but vigorously shake. The processed products of sapota, particularly fruit drinks are not available in market due to development of off flavour in processed products of sapota or due to grity nature of fruit pulp. Thus, utilization of the sapota fruits for preparation of milkshakes would not only minimize the wastage of fruits, but also would provide value added, more nutritious and palatable fruit based milk beverage.

## Materials and Methods
The present investigation was conducted at the Department of Post Harvest Technology, ASPEE College of Horticulture, Navsari Agricultural University, Navsari, Gujarat during

2021-22. With the objectives to study effect of formulation on quality of sapota milkshake and storage stability of sapota milkshake. There were 9 treatment combinations with two factors like A: Sapota pulp ($A_1$ - 8%, $A_2$ - 8% and $A_3$ - 8%) and B: Potassium sorbate ($B_1$- Control, $B_2$ - 75 ppm and $B_3$ - 150 ppm) which are mentioned below:

| | |
|---|---|
| A1B1 | 8% sapota pulp without preservatives |
| A1B2 | 8% sapota pulp preserved with 75 ppm potassium sorbate |
| A1B3 | 8% sapota pulp preserved with 150 ppm potassium sorbate |
| A2B1 | 10% sapota pulp without preservatives |
| A2B2 | 10% sapota pulp preserved with 75 ppm potassium sorbate |
| A2B3 | 10% sapota pulp preserved with 150 ppm potassium sorbate |
| A3B1 | 12% sapota pulp without preservatives |
| A3B2 | 12% sapota pulp preserved with 75 ppm potassium sorbate |
| A3B3 | 12% sapota pulp preserved with 150 ppm potassium sorbate |

**Recipe for making Sapota Milkshake**

Selection of sapota
↓
Sorting and washing
↓
Extraction of pulp
↓
Adding of sapota pulp (As per treatment) with milk (15%) & sugar syrup (final TSS 15º Brix)
↓
Heat Processing of milkshake with continuous stirring at 96±1 °C for 5 min, adding of potassium sorbate (As per treatment) and 0.1% sodium alginate
↓
Filling in glass bottles by keeping 1.0-1.2 cm head space
↓
Retorting at 121±1 °C for 30 min for sterilization
↓
Storage at room temperature

**Fig 1:** Principal steps for processing of sapota milkshake

## Results and Discussion

### Physico-chemical Parameters of ripe sapota fruits and milk (Amul Gold Brand)

**Table 1:** Proximate parameters of ripe sapota fruits and milk used for experimentation

| Sr. No. | Parameters | Sapota | Milk (Amul Gold Brand) |
|---|---|---|---|
| 1. | Total soluble solids (˚Brix) | 20.0 | 12.0 |
| 2. | Acidity (%) | 0.153 | 0.16 |
| 3. | pH | 5.9 | 6.5 |
| 4. | Total sugars (%) | 21.6 | 8.0 |
| 5. | Reducing sugar (%) | 17.4 | 8.0 |
| 6. | Non-reducing sugar (%) | 4.2 | 0 |
| 7. | Potassium (ppm) | 193 | 140 |
| 8. | Sodium (ppm) | 8 | 46 |
| 9. | Calcium (ppm) | 21 | 130 |
| 10. | Protein (%) | 0.44 | 3.1 |

**Total soluble solids (˚Brix)**

The perusal of data pertaining to TSS of sapota milkshake has been presented in Table 2. Data showed that minimum decrease in TSS from 15.07 to 14.86 ºB ($A_1B_3S_1$ to $A_1B_3S_5$) in milkshake prepared using 8 percent sapota pulp and preserved with 150 ppm potassium sorbate.

During storage decrease in TSS (°Brix) might be due to increase in microbial population. Similar results were reported by Zinzala *et al.* (2016) [11] who studied effect of UV light on preservation of Aloe vera, bitter gourd, aonla and guava blend nectar.

**Acidity (%)**

Minimum increase in acidity from 0.051 to 0.132 ($A_1B_3S_1$ to $A_1B_3S_5$) in milkshake prepared using 8 percent sapota pulp and preserved with 150 ppm potassium sorbate and maximum increase in acidity from 0.051 to 0.192 percent ($A_3B_1S_1$ to $A_3B_1S_5$) in milkshake prepared using 12 percent sapota pulp and contain no preservative (Table 3). Increase in acidity might be due to the growth of micro-organisms in beverages during storage or due to the conversion of lactose into lactic acid by ascorbic acid present in the juice. The conversion of proteins into amino acids could also be the reason for increased acidity during storage. Similar results were reported by Baljeet *et al*. (2013) [1] and Hassan *et al.* (2015) [2].

**Table 2:** Effect of different treatments on TSS (˚Brix) of sapota milkshake during storage

| Storage (S) | Sapota pulp (A) | Total Soluble Solids (˚Brix) | | | | |
|---|---|---|---|---|---|---|
| | | Potassium sorbate (B) | | | Mean (A×S), (S) | Mean (A) |
| | | B1-Control | B2-75 ppm | B3-150 ppm | | |
| S1-Initial | A1- 8% | 15.01 | 15.03 | 15.07 | 15.04 | |
| | A2- 10% | 14.99 | 15.03 | 15.03 | 15.02 | |
| | A3- 12% | 15.02 | 15.00 | 15.03 | 15.02 | |
| | Mean (B×S) | 15.01 | 15.02 | 15.05 | S1: 15.02 | A1:14.91 |
| S2-15 Day | A1- 8% | 14.94 | 15.02 | 15.03 | 15.00 | |
| | A2- 10% | 14.92 | 15.01 | 15.02 | 14.98 | |
| | A3- 12% | 14.90 | 14.99 | 15.00 | 14.96 | |
| | Mean (B×S) | 14.92 | 15.00 | 15.02 | S2: 14.98 | |
| S3-30 Day | A1- 8% | 14.85 | 14.94 | 15.00 | 14.93 | |
| | A2- 10% | 14.83 | 14.90 | 14.99 | 14.90 | |
| | A3- 12% | 14.79 | 14.87 | 14.97 | 14.88 | A2:14.88 |
| | Mean (B×S) | 14.82 | 14.90 | 14.99 | S3:14.90 | |
| S4-45 Day | A1- 8% | 14.75 | 14.83 | 14.94 | 14.84 | |
| | A2- 10% | 14.73 | 14.81 | 14.90 | 14.81 | |
| | A3- 12% | 14.68 | 14.80 | 14.89 | 14.79 | |
| | Mean (B×S) | 14.72 | 14.81 | 14.91 | S4: 14.81 | |
| S5-60 Day | A1- 8% | 14.63 | 14.70 | 14.86 | 14.73 | |
| | A2- 10% | 14.60 | 14.68 | 14.83 | 14.70 | A3:14.86 |
| | A3- 12% | 14.56 | 14.65 | 14.81 | 14.67 | |
| | Mean (B×S) | 14.60 | 14.68 | 14.83 | S5: 14.70 | |
| | Mean (B) | 14.81 | 14.88 | 14.96 | | |
| A×B | A1- 8% | 14.84 | 14.91 | 14.98 | | |
| | A2- 10% | 14.81 | 14.88 | 14.96 | | |
| | A3- 12% | 14.79 | 14.86 | 14.94 | | |

| | | A | B | A×B | S | A×S | B×S | A×B×S |
|---|---|---|---|---|---|---|---|---|
| | SEm± | 0.007 | 0.016 | 0.028 | 0.069 | 0.120 | 0.120 | 0.208 |
| | CD at 5% | 0.041 | 0.041 | NS | 0.195 | NS | NS | NS |
| | CV% | 0.73 | | | 2.42 | | | |

**Table 3:** Effect of different treatments on acidity (%) of sapota milkshake during storage

| Storage (S) | Sapota Pulp (A) | Acidity (%) | | | | |
|---|---|---|---|---|---|---|
| | | Potassium sorbate (B) | | | Mean (A×S), (S) | Mean (A) |
| | | B1-Control | B2-75 ppm | B3-150 ppm | | |
| S1-Initial | A1- 8% | 0.048 | 0.048 | 0.051 | 0.049 | |
| | A2- 10% | 0.048 | 0.048 | 0.051 | 0.049 | |
| | A3- 12% | 0.051 | 0.051 | 0.053 | 0.052 | |
| | Mean (B×S) | 0.049 | 0.049 | 0.052 | S1: 0.050 | A1:0.100 |
| S2-15 Day | A1- 8% | 0.078 | 0.069 | 0.057 | 0.068 | |
| | A2- 10% | 0.075 | 0.069 | 0.060 | 0.068 | |
| | A3- 12% | 0.081 | 0.072 | 0.061 | 0.071 | |
| | Mean (B×S) | 0.078 | 0.070 | 0.059 | S2: 0.069 | |
| S3-30 Day | A1- 8% | 0.111 | 0.096 | 0.087 | 0.098 | |
| | A2- 10% | 0.117 | 0.093 | 0.093 | 0.101 | |
| | A3- 12% | 0.121 | 0.096 | 0.093 | 0.103 | A2:0.103 |
| | Mean (B×S) | 0.116 | 0.095 | 0.091 | S3: 0.101 | |
| S4-45 Day | A1- 8% | 0.141 | 0.126 | 0.108 | 0.125 | |
| | A2- 10% | 0.147 | 0.129 | 0.114 | 0.130 | |
| | A3- 12% | 0.153 | 0.135 | 0.117 | 0.135 | |
| | Mean (B×S) | 0.147 | 0.130 | 0.113 | S4: 0.130 | |
| S5-60 Day | A1- 8% | 0.186 | 0.165 | 0.132 | 0.161 | |
| | A2- 10% | 0.189 | 0.168 | 0.138 | 0.165 | A3:0.106 |
| | A3- 12% | 0.192 | 0.177 | 0.138 | 0.169 | |
| | Mean (B×S) | 0.189 | 0.170 | 0.136 | S5: 0.165 | |
| | Mean (B) | 0.116 | 0.103 | 0.090 | | |
| A×B | A1- 8% | 0.113 | 0.101 | 0.087 | | |
| | A2- 10% | 0.115 | 0.101 | 0.091 | | |
| | A3- 12% | 0.120 | 0.106 | 0.092 | | |

| | | A | B | A×B | S | A×S | B×S | A×B×S |
|---|---|---|---|---|---|---|---|---|
| | SEm± | 0.0009 | 0.0009 | 0.0015 | 0.0012 | 0.0020 | 0.0020 | 0.0035 |
| | CD at 5% | 0.0026 | 0.0026 | NS | 0.0033 | NS | 0.0056 | NS |
| | CV% | 7.20 | | | 5.97 | | | |

**pH**

Data for pH of sapota milkshake has been presented in Table 4. Minimum decrease in pH from 6.81 to 5.94 ($A_1B_3S_1$ to $A_1B_3S_5$) in milkshake prepared using 8 percent sapota pulp and preserved with 150 ppm potassium sorbate. During storage there was significant decrease in pH it might be due to slight growth of micro-organisms and their metabolites. Decrease in the pH may also be due to production of organic acids and amino acids due to the action of ascorbic acid on sugar and protein content of the beverages. Similar results were reported by Baljeet *et al.* (2013) [1] and Hassan *et al.* (2015) [2].

**Table 4:** Effect of different treatments on pH of sapota milkshake during storage

| Storage (S) | Sapota Pulp (A) | pH | | | | |
|---|---|---|---|---|---|---|
| | | Potassium sorbate (B) | | | Mean (A×S), (S) | Mean (A) |
| | | B1-Control | B2-75 ppm | B3-150 ppm | | |
| S1-Initial | A1- 8% | 6.81 | 6.82 | 6.81 | 6.81 | |
| | A2- 10% | 6.81 | 6.80 | 6.81 | 6.80 | |
| | A3- 12% | 6.79 | 6.79 | 6.78 | 6.79 | |
| | Mean (B×S) | 6.80 | 6.80 | 6.80 | S1: 6.80 | A1: 6.42 |
| S2-15 Day | A1- 8% | 6.70 | 6.71 | 6.75 | 6.72 | |
| | A2- 10% | 6.70 | 6.70 | 6.75 | 6.72 | |
| | A3- 12% | 6.66 | 6.70 | 6.73 | 6.70 | |
| | Mean (B×S) | 6.69 | 6.70 | 6.74 | S2: 6.71 | |
| S3-30 Day | A1- 8% | 6.51 | 6.55 | 6.63 | 6.56 | |
| | A2- 10% | 6.48 | 6.54 | 6.62 | 6.55 | |
| | A3- 12% | 6.45 | 6.54 | 6.61 | 6.53 | A2: 6.41 |
| | Mean (B×S) | 6.48 | 6.54 | 6.62 | S3: 6.55 | |
| S4-45 Day | A1- 8% | 6.08 | 6.24 | 6.37 | 6.23 | |
| | A2- 10% | 6.05 | 6.22 | 6.35 | 6.21 | |
| | A3- 12% | 6.00 | 6.18 | 6.30 | 6.16 | |
| | Mean (B×S) | 6.04 | 6.21 | 6.34 | S4: 6.20 | |
| S5-60 Day | A1- 8% | 5.63 | 5.79 | 5.94 | 5.79 | |
| | A2- 10% | 5.60 | 5.76 | 5.92 | 5.76 | A3: 6.38 |
| | A3- 12% | 5.58 | 5.72 | 5.88 | 5.73 | |
| | Mean (B×S) | 5.60 | 5.76 | 5.91 | S5: 5.76 | |
| | Mean (B) | 6.32 | 6.40 | 6.48 | | |
| A×B | A1- 8% | 6.34 | 6.42 | 6.50 | | |
| | A2- 10% | 6.33 | 6.40 | 6.49 | | |
| | A3- 12% | 6.30 | 6.39 | 6.46 | | |

| | | A | B | A×B | S | A×S | B×S | A×B×S |
|---|---|---|---|---|---|---|---|---|
| | SEm± | 0.0117 | 0.0117 | 0.0202 | 0.0092 | 0.0159 | 0.0159 | 0.0276 |
| | CD at 5% | 0.034 | 0.034 | 0.060 | 0.026 | 0.044 | 0.044 | 0.077 |
| | CV% | 1.20 | | | 0.74 | | | |

**Total Sugars**

Minimum decrease in total sugars from 13.91 to 13.35 percent ($A_1B_3S_1$ to $A_1B_3S_5$) in milkshake prepared using 8 percent sapota pulp and preserved with 150 ppm potassium sorbate and maximum decrease in total sugars from 13.91 to 12.72 percent ($A_3B_1S_1$ to $A_3B_1S_5$) in milkshake prepared using 12 percent sapota pulp and contain no preservative (Table 5). Similar trend of decreasing in total sugars was reported by Sakhale *et al.* (2012) [5], Zinzala *et al.* (2016) [11] and Hassan *et al.* (2015) [2]. It might be due to the conversion and breakdown of high molecular weight polysaccharides and increase in population of micro-organism leads to consume total sugar for their growth.

**Reducing Sugars**

Data for reducing sugars of sapota milkshake has been presented in Table 6. Interaction of pulp, potassium sorbate and storage found to have non significant differences. Increase in reducing sugar during storage in present investigation are line with the observation reported by Sangani *et al.* (2021) [7]. It might be due to the conversion of sugars into reducing sugars in presence of acid. Similar results were reported by Sakhale *et al.* (2012) [5], Zinzala *et al.* (2016) [11], Hassan *et al.* (2015) [2].

**Non-reducing sugars**

Data for reducing sugars of sapota milkshake has been presented in Table 7. Interaction of pulp, potassium sorbate and storage found to have non significant differences. Increase in reducing sugar during storage in present investigation are line with the observation reported by Sangani *et al.* (2021) [7]. Related results were reported by Zinzala *et al.* (2016) [11] and Vaghashiya *et al.* (2015) [10].

**Table 5**: Effect of different treatments on total sugars (%) of sapota milkshake during storage

| Storage (S) | Sapota pulp (A) | Total sugars (%) | | | | |
|---|---|---|---|---|---|---|
| | | Potassium sorbate (B) | | | Mean (A×S), (S) | Mean (A) |
| | | B1-Control | B2-75 ppm | B3-150 ppm | | |
| S1-Initial | A1- 8% | 13.90 | 13.89 | 13.91 | 13.90 | |
| | A2- 10% | 13.91 | 13.90 | 13.92 | 13.91 | |
| | A3- 12% | 13.91 | 13.90 | 13.93 | 13.92 | |
| | Mean (B×S) | 13.91 | 13.90 | 13.92 | S1: 13.91 | A1: 13.54 |
| S2-15 Day | A1- 8% | 13.74 | 13.80 | 13.79 | 13.78 | |
| | A2- 10% | 13.70 | 13.81 | 13.79 | 13.77 | |
| | A3- 12% | 13.67 | 13.82 | 13.81 | 13.77 | |
| | Mean (B×S) | 13.70 | 13.81 | 13.80 | S2: 13.77 | |
| S3-30 Day | A1- 8% | 13.49 | 13.58 | 13.68 | 13.59 | |
| | A2- 10% | 13.45 | 13.55 | 13.69 | 13.57 | |
| | A3- 12% | 13.40 | 13.53 | 13.69 | 13.54 | A2: 13.52 |
| | Mean (B×S) | 13.45 | 13.56 | 13.69 | S3: 13.57 | |
| S4-45 Day | A1- 8% | 13.05 | 13.35 | 13.55 | 13.32 | |
| | A2- 10% | 13.00 | 13.29 | 13.53 | 13.28 | |
| | A3- 12% | 12.95 | 13.27 | 13.49 | 13.24 | |
| | Mean (B×S) | 13.00 | 13.31 | 13.53 | S4: 13.28 | |
| S5-60 Day | A1- 8% | 12.80 | 13.15 | 13.35 | 13.10 | |
| | A2- 10% | 12.75 | 13.12 | 13.33 | 13.07 | A3: 13.50 |
| | A3- 12% | 12.72 | 13.09 | 13.28 | 13.03 | |
| | Mean (B×S) | 12.76 | 13.12 | 13.32 | S5: 13.07 | |
| | Mean (B) | 13.36 | 13.54 | 13.65 | | |
| A×B | A1- 8% | 13.40 | 13.56 | 13.66 | | |
| | A2- 10% | 13.36 | 13.54 | 13.66 | | |
| | A3- 12% | 13.33 | 13.53 | 13.64 | | |

| | | A | B | A×B | S | A×S | B×S | A×B×S |
|---|---|---|---|---|---|---|---|---|
| | SEm± | 0.0625 | 0.0625 | 0.1082 | 0.0187 | 0.0324 | 0.0324 | 0.0560 |
| | CD at 5% | NS | 0.185 | NS | 0.052 | NS | 0.091 | NS |
| | CV% | 3.10 | | | 0.72 | | | |

**Table 6:** Effect of different treatments on reducing sugars (%) of sapota milkshake during storage

| Storage (S) | Sapota pulp (A) | Reducing sugars (%) | | | | |
|---|---|---|---|---|---|---|
| | | Potassium sorbate (B) | | | Mean (A×S), (S) | Mean (A) |
| | | B1-Control | B2-75 ppm | B3-150 ppm | | |
| S1-Initial | A1- 8% | 5.41 | 5.43 | 5.38 | 5.41 | |
| | A2- 10% | 5.39 | 5.41 | 5.42 | 5.41 | |
| | A3- 12% | 5.40 | 5.38 | 5.43 | 5.40 | |
| | Mean (B×S) | 5.40 | 5.40 | 5.41 | S1: 5.40 | A1: 5.48 |
| S2-15 Day | A1- 8% | 5.43 | 5.45 | 5.39 | 5.42 | |
| | A2- 10% | 5.41 | 5.42 | 5.44 | 5.42 | |
| | A3- 12% | 5.42 | 5.41 | 5.45 | 5.43 | |
| | Mean (B×S) | 5.42 | 5.43 | 5.43 | S2: 5.42 | |
| S3-30 Day | A1- 8% | 5.47 | 5.50 | 5.43 | 5.47 | |
| | A2- 10% | 5.45 | 5.46 | 5.48 | 5.46 | |
| | A3- 12% | 5.47 | 5.46 | 5.47 | 5.47 | A2: 5.48 |
| | Mean (B×S) | 5.46 | 5.47 | 5.46 | S3: 5.47 | |
| S4-45 Day | A1- 8% | 5.53 | 5.55 | 5.49 | 5.52 | |
| | A2- 10% | 5.51 | 5.51 | 5.54 | 5.52 | |
| | A3- 12% | 5.53 | 5.53 | 5.52 | 5.53 | |
| | Mean (B×S) | 5.52 | 5.53 | 5.52 | S4: 5.52 | |
| S5-60 Day | A1- 8% | 5.58 | 5.63 | 5.56 | 5.59 | |
| | A2- 10% | 5.58 | 5.58 | 5.62 | 5.59 | A3: 5.48 |
| | A3- 12% | 5.60 | 5.60 | 5.59 | 5.60 | |
| | Mean (B×S) | 5.59 | 5.60 | 5.59 | S5: 5.59 | |
| | Mean (B) | 5.48 | 5.49 | 5.48 | | |
| A×B | A1- 8% | 5.48 | 5.51 | 5.45 | | |
| | A2- 10% | 5.47 | 5.48 | 5.50 | | |
| | A3- 12% | 5.48 | 5.48 | 5.49 | | |

| | | A | B | A×B | S | A×S | B×S | A×B×S |
|---|---|---|---|---|---|---|---|---|
| | SEm± | 0.0221 | 0.0221 | 0.0383 | 0.0128 | 0.0222 | 0.0222 | 0.0384 |
| | CDat 5% | NS | NS | NS | 0.036 | NS | NS | NS |
| | CV% | 2.70 | | | 1.21 | | | |

**Table 7:** Effect of different treatments on non-reducing sugars (%) of sapota milkshake during storage

<table>
<tr><th rowspan="3">Storage (S)</th><th rowspan="3">Sapota pulp (A)</th><th colspan="7">Non-reducing sugars (%)</th></tr>
<tr><th colspan="5">Potassium sorbate (B)</th><th rowspan="2">Mean (A×S), (S)</th><th rowspan="2">Mean (A)</th></tr>
<tr><th>B1-Control</th><th colspan="2">B2-75 ppm</th><th colspan="2">B3-150 ppm</th></tr>
<tr><td rowspan="4">S1-Initial</td><td>A1- 8%</td><td>8.07</td><td colspan="2">8.04</td><td colspan="2">8.11</td><td>8.07</td><td rowspan="7">A1: 7.65</td></tr>
<tr><td>A2- 10%</td><td>8.09</td><td colspan="2">8.07</td><td colspan="2">8.08</td><td>8.08</td></tr>
<tr><td>A3- 12%</td><td>8.09</td><td colspan="2">8.10</td><td colspan="2">8.08</td><td>8.09</td></tr>
<tr><td>Mean (B×S)</td><td>8.09</td><td colspan="2">8.07</td><td colspan="2">8.09</td><td>S1: 8.08</td></tr>
<tr><td rowspan="4">S2-15 Day</td><td>A1- 8%</td><td>7.89</td><td colspan="2">7.93</td><td colspan="2">7.98</td><td>7.93</td></tr>
<tr><td>A2- 10%</td><td>7.87</td><td colspan="2">7.98</td><td colspan="2">7.93</td><td>7.93</td></tr>
<tr><td>A3- 12%</td><td>7.84</td><td colspan="2">7.99</td><td colspan="2">7.95</td><td>7.93</td></tr>
<tr><td>Mean (B×S)</td><td>7.87</td><td colspan="2">7.97</td><td colspan="2">7.95</td><td>S2: 7.93</td><td rowspan="7">A2: 7.64</td></tr>
<tr><td rowspan="4">S3-30 Day</td><td>A1- 8%</td><td>7.63</td><td colspan="2">7.68</td><td colspan="2">7.84</td><td>7.72</td></tr>
<tr><td>A2- 10%</td><td>7.60</td><td colspan="2">7.69</td><td colspan="2">7.80</td><td>7.70</td></tr>
<tr><td>A3- 12%</td><td>7.53</td><td colspan="2">7.67</td><td colspan="2">7.81</td><td>7.67</td></tr>
<tr><td>Mean (B×S)</td><td>7.59</td><td colspan="2">7.68</td><td colspan="2">7.82</td><td>S3: 7.69</td></tr>
<tr><td rowspan="4">S4-45 Day</td><td>A1- 8%</td><td>7.15</td><td colspan="2">7.41</td><td colspan="2">7.66</td><td>7.41</td></tr>
<tr><td>A2- 10%</td><td>7.12</td><td colspan="2">7.39</td><td colspan="2">7.59</td><td>7.37</td></tr>
<tr><td>A3- 12%</td><td>7.06</td><td colspan="2">7.36</td><td colspan="2">7.57</td><td>7.33</td><td rowspan="7">A3: 7.62</td></tr>
<tr><td>Mean (B×S)</td><td>7.11</td><td colspan="2">7.39</td><td colspan="2">7.61</td><td>S4: 7.37</td></tr>
<tr><td rowspan="4">S5-60 Day</td><td>A1- 8%</td><td>6.86</td><td colspan="2">7.15</td><td colspan="2">7.40</td><td>7.13</td></tr>
<tr><td>A2- 10%</td><td>6.81</td><td colspan="2">7.17</td><td colspan="2">7.33</td><td>7.10</td></tr>
<tr><td>A3- 12%</td><td>6.77</td><td colspan="2">7.12</td><td colspan="2">7.31</td><td>7.06</td></tr>
<tr><td>Mean (B×S)</td><td>6.81</td><td colspan="2">7.14</td><td colspan="2">7.35</td><td>S5: 7.10</td></tr>
<tr><td></td><td>Mean (B)</td><td>7.49</td><td colspan="2">7.65</td><td colspan="2">7.76</td><td></td></tr>
<tr><td rowspan="3">A×B</td><td>A1- 8%</td><td>7.52</td><td colspan="2">7.64</td><td colspan="2">7.80</td><td></td><td></td></tr>
<tr><td>A2- 10%</td><td>7.50</td><td colspan="2">7.66</td><td colspan="2">7.75</td><td></td><td></td></tr>
<tr><td>A3- 12%</td><td>7.46</td><td colspan="2">7.65</td><td colspan="2">7.74</td><td></td><td></td></tr>
<tr><td></td><td></td><td>A</td><td>B</td><td>A×B</td><td>S</td><td>A×S</td><td>B×S</td><td>A×B×S</td></tr>
<tr><td></td><td>SEm±</td><td>0.0685</td><td>0.0685</td><td>0.1187</td><td>0.0235</td><td>0.0407</td><td>0.0407</td><td>0.0705</td></tr>
<tr><td></td><td>CD at 5%</td><td>NS</td><td>0.203</td><td>NS</td><td>0.066</td><td>NS</td><td>0.114</td><td>NS</td></tr>
<tr><td></td><td>CV%</td><td colspan="3">5.71</td><td colspan="4">1.52</td></tr>
</table>

### Potassium content (ppm)

Maximum decrease in potassium content from 492.88 to 364.30 ppm ($A_2B_3S_1$ to $A_2B_3S_5$) in milkshake prepared using 10 percent sapota pulp and preserved with 150 ppm potassium sorbate sorbate and minimum decrease in potassium content from 410.47 to 306.04 ppm ($A_3B_1S_1$ to $A_3B_1S_5$) in milkshake prepared using 12 percent sapota pulp and contain no preservative. (Fig. 1). Comparable results were reported by Karangiya *et al.* (2020) [4] and Zinzala *et al.* (2016) [11].

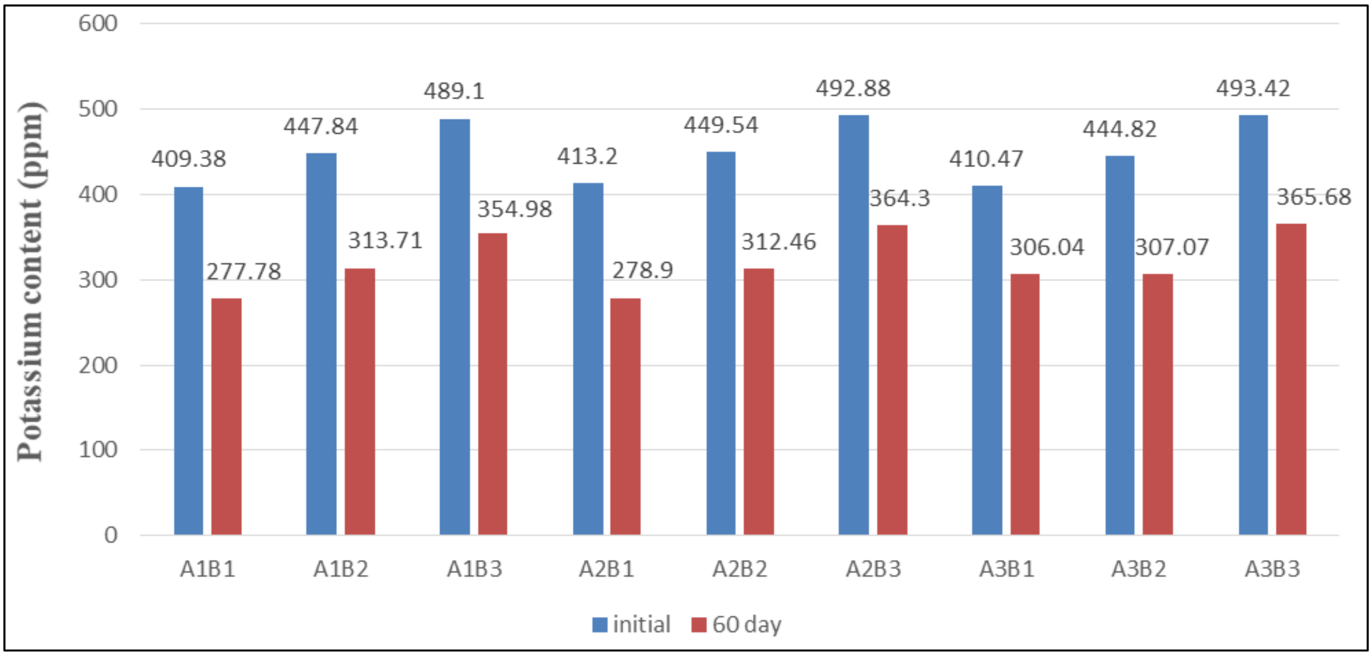


**Fig 1:** Effect of different treatments on potassium content (ppm) of sapota milkshake during storage

### Sodium content (ppm)

Data for sodium content of sapota milkshake has been presented in Fig. 2. Interaction of pulp, potassium sorbate and storage found to have non significant differences. Similar results were reported by Zinzala *et al.* (2016) [11].

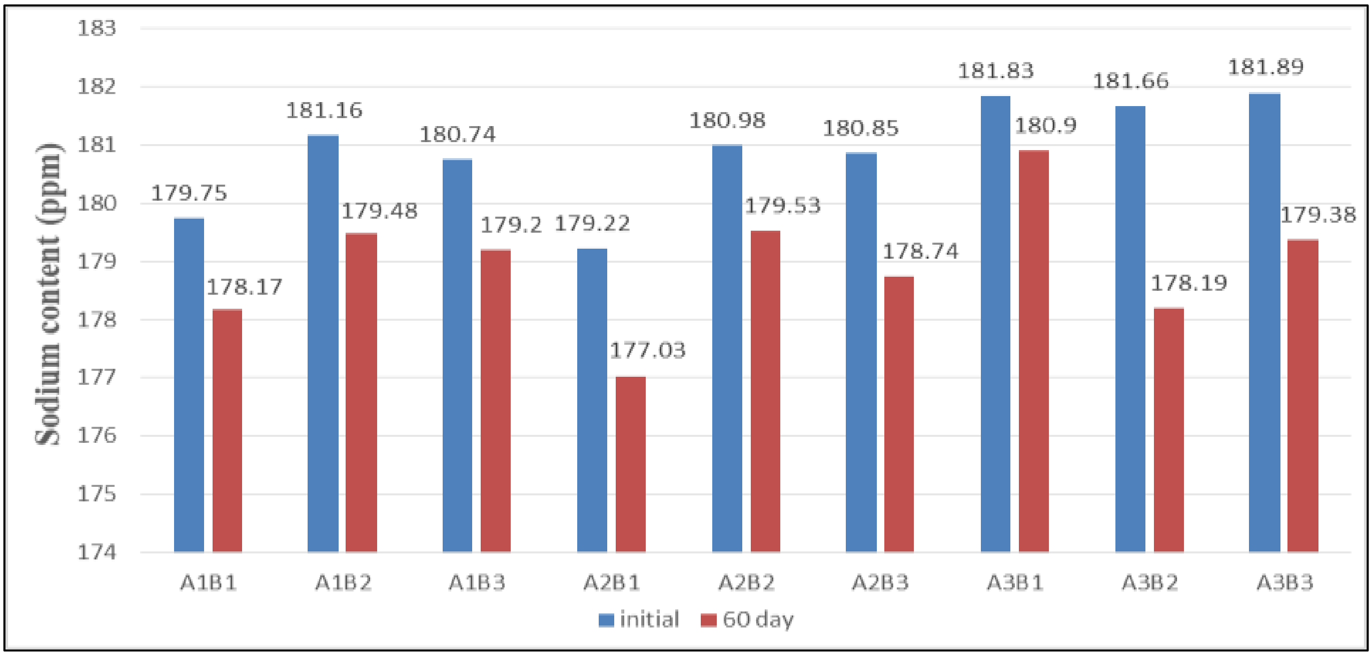


**Fig 2:** Effect of different treatments on sodium content (ppm) of sapota milkshake during storage

**Calcium content (ppm):** Data for sodium content of sapota milkshake has been presented in Fig. 3. Interaction of pulp, potassium sorbate and storage found to have non significant differences.

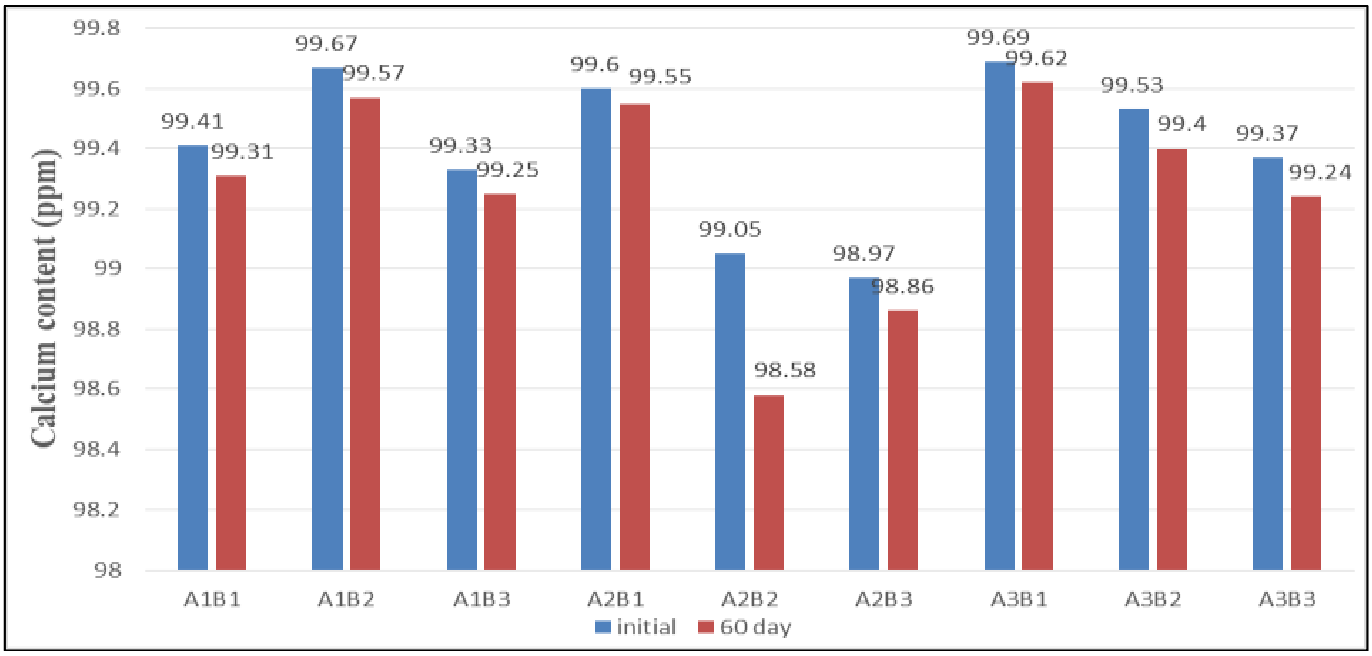


**Fig 3:** Effect of different treatments on calcium content (ppm) of sapota milkshake during storage

**Protein**

Minimum decrease in protein from 0.457 to 0.390 percent ($A_1B_3S_1$ to $A_1B_3S_5$) in milkshake prepared using 8 percent sapota pulp and preserved with 150 ppm potassium sorbate (Table 8). Decrease in protein content upon storage might be due to increase in population of micro-organisms that leads to consume protein for their growth. Similar result was observed by Vaghashiya *et al.* (2015) [10], Sangani *et al.* (2021) [7] and Zinzala *et al.* (2016) [11] in blended nectar.

**Table 8:** Effect of different treatments on protein (%) of sapota milkshake during storage

| Storage (S) | Sapota pulp (A) | Protein (%) | | | | |
|---|---|---|---|---|---|---|
| | | Potassium sorbate (B) | | | Mean (A×S), (S) | Mean (A) |
| | | B1-Control | B2-75 ppm | B3-150 ppm | | |
| S1- Initial | A1- 8% | 0.467 | 0.467 | 0.457 | 0.463 | |
| | A2- 10% | 0.470 | 0.470 | 0.463 | 0.468 | |
| | A3- 12% | 0.473 | 0.473 | 0.470 | 0.472 | |
| | Mean (B×S) | 0.470 | 0.470 | 0.463 | S1:0.468 | A1:0.412 |
| S2- 15 Day | A1- 8% | 0.463 | 0.460 | 0.450 | 0.458 | |
| | A2- 10% | 0.457 | 0.467 | 0.450 | 0.458 | |
| | A3- 12% | 0.463 | 0.457 | 0.463 | 0.461 | |
| | Mean (B×S) | 0.461 | 0.461 | 0.454 | S2:0.459 | |
| S3- 30 Day | A1- 8% | 0.427 | 0.433 | 0.440 | 0.433 | |
| | A2- 10% | 0.417 | 0.427 | 0.437 | 0.427 | |
| | A3- 12% | 0.393 | 0.420 | 0.450 | 0.421 | A2:0.407 |
| | Mean (B×S) | 0.412 | 0.427 | 0.442 | S3:0.427 | |
| S4- 45 Day | A1- 8% | 0.337 | 0.370 | 0.417 | 0.374 | |
| | A2- 10% | 0.333 | 0.360 | 0.413 | 0.369 | |
| | A3- 12% | 0.327 | 0.353 | 0.420 | 0.367 | |
| | Mean (B×S) | 0.332 | 0.361 | 0.417 | S4:0.370 | |
| S5- 60 Day | A1- 8% | 0.257 | 0.343 | 0.390 | 0.330 | |
| | A2- 10% | 0.237 | 0.317 | 0.383 | 0.312 | A3:0.403 |
| | A3- 12% | 0.213 | 0.297 | 0.377 | 0.296 | |
| | Mean (B×S) | 0.236 | 0.319 | 0.383 | S5:0.313 | |
| | Mean (B) | 0.382 | 0.408 | 0.432 | | |
| A×B | A1- 8% | 0.390 | 0.415 | 0.431 | | |
| | A2- 10% | 0.383 | 0.408 | 0.429 | | |
| | A3- 12% | 0.374 | 0.400 | 0.436 | | |

| | | A | B | A×B | S | A×S | B×S | A×B×S |
|---|---|---|---|---|---|---|---|---|
| | SEm± | 0.0021 | 0.0021 | 0.0037 | 0.0024 | 0.0042 | 0.0042 | 0.0073 |
| | CD at 5% | NS | 0.006 | NS | 0.006 | 0.011 | 0.011 | NS |
| | CV% | 3.64 | | | 3.12 | | | |

## Microbial Parameter of Sapota Milkshake

### Total Plate Count (CFU/ml)

The perusal of data pertaining to total plate count of sapota milkshake in Table 9. Data shows that sapota milkshake prepared using 150 ppm potassium sorbate were free from microbial contamination upto 30 days of storage. At 30 day, contamination was detected in milkshake preserved with 75 ppm potassium sorbate. The milkshake prepared without potassium sorbate contamination was detected at 15 days of storage. Since each milkshake sample had a microbiological count below the acceptable level, they were all safe to consume during their two-month storage period. Similar results were recorded by Hossin *et al.* (2021) [3], Sakhale *et al.* (2012) [5], Shukla *et al.* (2017) [8] Sangani *et al.* (2021) [7] and Sampedro *et al.* (2009) [6].

**Table 9:** Effect of different treatments on total plate count (CFU/ml) of sapota milkshake during storage

| Storage (S) | Sapota Pulp (A) | Total plate count (CFU/ml) | | |
|---|---|---|---|---|
| | | Potassium sorbate(B) | | |
| | | B1- Control | B2- 75 ppm | B3- 150 ppm |
| 0 Day (S1) | A1- 8% | 0.00 | 0.00 | 0.00 |
| | A2- 10% | 0.00 | 0.00 | 0.00 |
| | A3- 12% | 0.00 | 0.00 | 0.00 |
| 15 Day (S2) | A1- 8% | 5.81 | 0.00 | 0.00 |
| | A2- 10% | 6.15 | 0.00 | 0.00 |
| | A3- 12% | 5.90 | 0.00 | 0.00 |
| 30 Day (S3) | A1- 8% | 18.18 | 3.42 | 0.00 |
| | A2- 10% | 19.15 | 3.28 | 0.00 |
| | A3- 12% | 21.12 | 2.98 | 0.00 |
| 45 Day (S4) | A1- 8% | 31.00 | 8.41 | 2.58 |
| | A2- 10% | 32.74 | 9.61 | 2.87 |
| | A3- 12% | 33.78 | 11.53 | 2.87 |
| 60 Day (S5) | A1- 8% | 42.93 | 15.15 | 6.11 |
| | A2- 10% | 44.91 | 17.23 | 6.50 |
| | A3- 12% | 47.13 | 19.59 | 6.77 |

## Conclusion

From the foregoing discussion, it can be concluded that shelf life of sapota milkshake prepared with 8 percent sapota pulp (A1) can be extended upto two month when preserved with 150 ppm potassium sorbate (B3). Overall sapota milkshake can be prepared using 8 percent sapota pulp, 15 percent milk by maintaining 15 ºBrix TSS followed by heating (96±1 °C) for 5 min, addition of 150 ppm potassium sorbate and 0.1 percent sodium alginate, filling into glass bottles (1.0- 1.2 cm headspace) and heat processing at 121±1 °C for 30 min. The sapota milkshake prepared using this process can be successfully stored for a period of two months in glass bottle without much changes in physico-chemical and microbial quality. Thus, the developed technology can commercially be adopted by food processing industry for the production of sapota milkshake.

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