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Effect of Storage Time on Physico-chemical Properties and Bioactive Potential of Mix Fruit Juice Powder Fortified with Carambola Bagasse

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The proposed study was conducted with an aim to assess the effect of storage on physicochemical properties and bioactive potential of mix fruit juice powder fortified with carambola bagasse. Carambola-guava mix fruit juice powder fortified with carambola bagasse powder was prepared by

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adding 5% carambola bagasse, 50% carambola juice, 50% guava juice and 25% maltodextrin (MD) followed by spray drying at inlet air temperature 180°C and feed flow rate of 8ml/min. Samples were sealed in plastic pouches and stored under ambient conditions for 90 days. A significant increase was found in moisture, total soluble solids and water activity of mix juice powder during 90 days of storage. A gradual and significant decrease in vitamin C, free radical scavenging activity, crude fiber, total phenolics content was recorded at the end of storage. Total carotenoids and overall acceptability of the product also showed an insignificant decrease during the storage periods. The proposed study showed that mix fruit juice powder supplemented with carambola bagasse could be stored up to 90 days without compromising the sensory acceptability. However, the bioactive potential of the product was significantly affected during storage showing a significant reduction in the product quality under ambient storage conditions.

Keywords: Carambola Bagasse; inlet air temperature; mix juice; maltodextrin; parameters.

1. INTRODUCTION

Fruit powders have a wide range of applications in the food industry as flavouring and functional ingredients [1]. The global market size of fruit powders is expected to reach $21.5 billion by 2026 as compared to $14.3 billion in 2021 [2]. Compared with fresh fruits, fruit powders are storage stable, highly portable, cost-effective and need less care during storage and transportation [3]. However, most fruit powders are hygroscopic in nature and may absorb moisture from the environment over the time, resulting in changes in their physico-chemical properties [4,5]. Numerous chemical and physical reactions can occur with the bioactive compounds and sensory acceptability phenolic compounds present in these powders during food processing and subsequent storage. Besides, many changes occur in the biochemical composition of products. Several factors including the temperature and storage time can influence the chemical stability of the phenolic compounds and compromise the use of the powders as a dye and as a functional ingredient [6]. Studies on the changes in the qualitative and quantitative composition of phenolic compounds present in these powdered products during storage at different temperatures and times are of great importance in order to better understand the mechanisms of their degradation and to widen the range of future applications of these ingredients in food systems [6-8]. Storage stability of the phenolic compounds, color and antioxidant activity of jambolan juice powder obtained by foam mat drying was evaluated by de Carvalho Tavares [9]. Effect of storage time and temperature on quality changes in freeze-dried snacks bbtained with fruit Pomace and pectin Powders has bee studied by Karwacka et al. [10].

Therefore, considering the above aspects, the present study was carried out to optimise the development of a functional mixed fruit beverage powder fortified with fibre rich fraction of carambola pomace.

2. MATERIALS AND METHODS

All the chemicals used were of analytical grade from taken to biochemistry lab and post-harvest technology analytical lab college of horticulture.

2.1 Materials

Carambola fruit: Ripe fruit and firm fruits free from mouldy or discolouration were procured from the market of Azadpur mandi, Delhi, India. Ripe guava were purchase from local market of Banda.

2.2 Preparation of the Carambola Bagasse Powder

The selected fruits of carambola were washed and cut in small pieces by the knife followed by grinding in grinder. The juice was strained through double level muslin cloth and pomace was collected. The collected pomace was freeze dried at -55°C and stored in polyethylene pouches. Juice was collected and further used for preparation of mixed juice powder.

2.3 Preparation of the Guava Juice

Guava pulp was extracted as per standard method. The pulp was treated with pectinase enzyme @ 0.22 mg / kg. The mixed pulp was kept at 50°C in water bath for 1hr then dipped in heated for 5 minutes to deactivate pectinase reaction. The pulp was put in double layer of muslin cloth and squeezed to get the juice. The juice was collected for further experiment.

2.4 Preparation of Carambola Bagasse Fortified Mix Juice Powder

Carambola and guava and juice were blended in different proportions viz. 100:0, 90:10, 80:20, 70:30, 60:40 and 50:50. The best juice mix was obtained by blending the fruit juice in the ratio of 50:50 (Guava: carambola) on the basis of overall acceptability. To the mixed juice 25% maltodextrin was added and the whole mix was blended using a DBK-Mini Mag stirrer. The final TSS of the feed mixtures were maintained to 10°B to maintain a constant feed flow rate. The fruit juice mixture was spray dried at inlet temperatures 180 °C and outlet temperature of 85°C in a laboratory scale spray drier (Model No. LSD- Mini Spray Dryer, JISL). The feed rate was maintained at 8ml/min. To the dried mixed juice powder, 5% of carambola bagasse powder was added and obtained product was packed in airtight glass jar at room temperature. The effect of storage on biochemical properties of carambola bagasse fortified mix juice powder was assessed for a period of 90 days.

2.5 Analysis of Product

TSS was determined with digital refractometer (0-80°B make Hanna). The parameters such as TSS, ascorbic acid and overall acceptability were analyzed by the methods suggested by Ranganna et al. [11]. Total phenolic content was analyzed by Folin-Ciocalteu method as described by Chan et al. [12]. Total antioxidant activity was estimated according to Brand-Williams et al. [13] using 6 x 10-5 mol/L solution of DPPH in methanol as a source of free radicals. The absorbance was recorded at 515 nm by UV-VS spectrophotometer using methanol as blank. Water activity of samples was measured using water activity meter (Model: LabSwift make Novasina). The samples were measured using moisture analyser (Model HE53 Make Mettler Toledo). The crude fiber content of samples was determined as per the method of AOAC [14] using automatic fiber analyzer (FibroTRON Make Tulin Ltd.). Total carotenoids sample was estimated through procedure suggested by Akter [15].

3. RESULTS AND DISCUSSION

3.1 Effect of Storage on Biochemical Properties

The results presented in Table 1 shows the effect of storage on biochemical properties of carambola bagasse fortified mix juice powder. The TSS of mixed juice powder decreased from a mean maximum value of 86.40°B to 87.60°B at 90 days. A gradual but non-significant increase in the TSS content was recorded with the advancement of storage duration up to 90 days. which might be due to hydrolysis of polysaccharides (starch) into monosaccharides (sugars). Similar results was found by Poskar et al. [16] who observed the effect of maltodextrin levels on physico-chemical qualities of spray dried aonla (*Emblica officinalis* Gaertn.) juice powder. The results are in confirmation with the findings reported by Park et al. [17-22]. Water activity of mix juice powder decreased from 0.365 to 0.315 at the end of storage. The ratio of water vapor pressure in a food system to pure water vapor pressure at the same temperature is known as water activity. The amount of free water in a food system that is involved in any metabolic activities is measured by water activity. Reduced water activity suggests a longer shelf life since there is less free water available for metabolic activities. It was also confirmed by the moisture content of juice powder during storage which showed similar trend. The moisture content is a fundamental property for spray-dried powders for determining its stability and storage [23]. The similar results have been reported in spray dried Sohiong powder during the 12 days of storage period [24]. They also reported a non-linear increasing trend. This increase may be attributed to the sugars present in fruit and carrier agent, i.e. maltodextrin, which increased the water adsorption of powder [25]. The degree of increase or decrease in the moisture content of powder may also depend on the concentration of maltodextrin used in the feed. Similar results were also reported for spray dried yogurt and tamarind powders [26,27]. A gradual but non-significant decrease in crude fibre content was recorded during storage. The fibre content of juice powder decreased from 11.00 to 10.25% after 90 days.

3.2 Effect of Storage on Bioactive Potential

The data pertaining to Fig. 1 (a-d) showed that the vitamin C content of carambola pomace fortify mix juice powder significantly decreased during storage at room temperatures. The maximum vitamin C content was recorded at 0 days (120.47mg/100g) which significantly decreased after 90 days (84.58mg/100g).This decreases the content of vitamin C may be attributed to the high reactivity of the enediol structure which increase at higher temperature and promotes degradative reactions as well as weakens the vitamin [28].

Table 1. Effect of storage on biochemical properties of mix juice powder

Storage (Days)	TSS (°B)	Water Activity (a_w)	Moisture (%)	Crude fiber (%)
0	86.40	0.315	5.20	11.00
30	86.70	0.326	5.85	10.75
60	87.20	0.347	6.30	10.50
90	87.60	0.365	6.70	10.25
CD (0.05)	NS	0.015	0.064	NS
SE(m)	0.409	0.005	0.021	0.725
SE(d)	0.578	0.007	0.029	1.026
C.V.	0.940	2.836	0.682	13.652

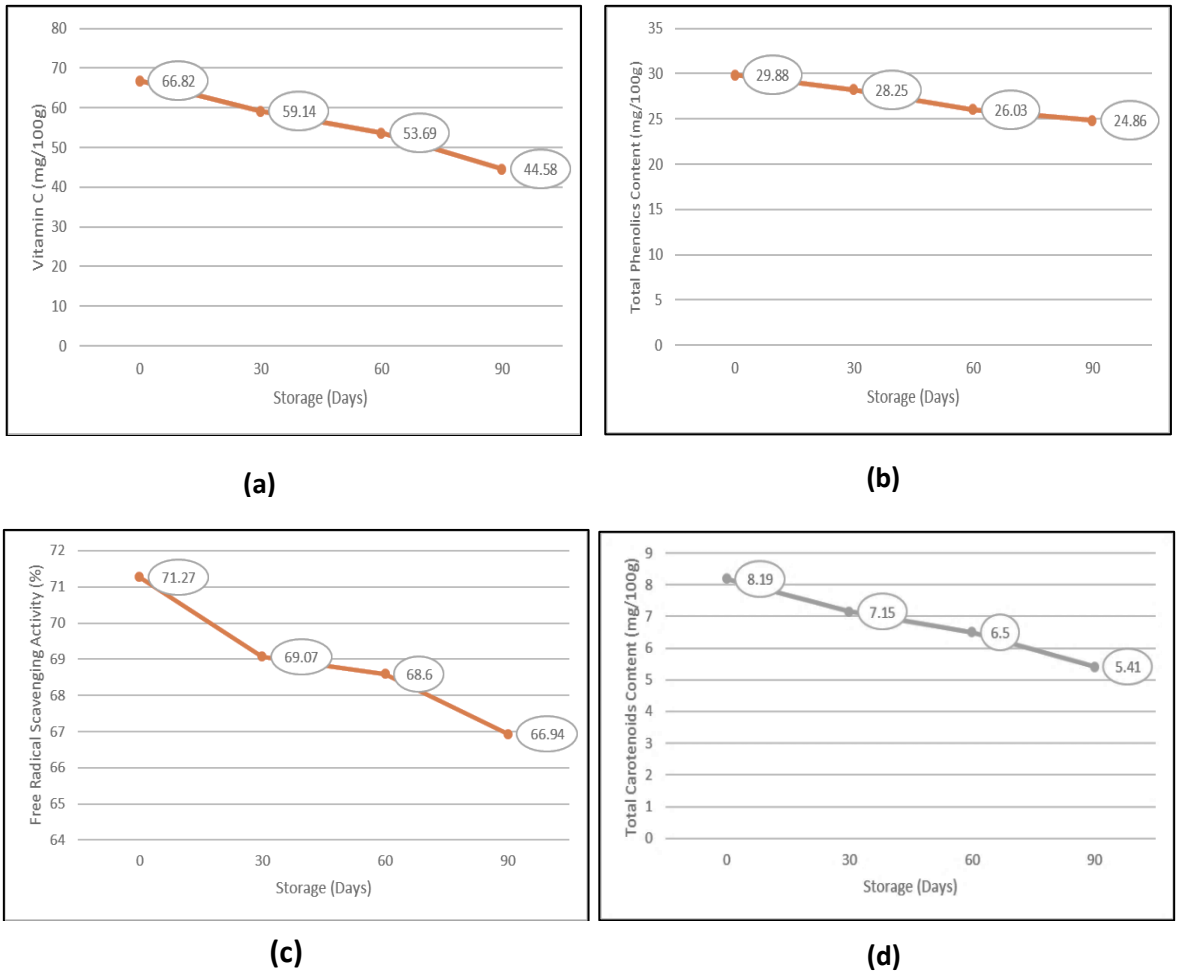

Fig. 1. Effect of storage on bioactive potential of mix fruit juice powder fortified with carambola bagasse a) vitamin c b) total phenolics content c) FRSA (free radical scavenging activity d) total carotenoids content

Free radical scavenging activity (FRSA) of carambola pomace fortify mix juice powder was not significantly influenced by the days of storage and showed a decrease during 0 to 90 days storage periods (Fig 1(c)). The highest value for FRSA was recorded as 71.27% at 0 days while the lowest as 66.94% at 90 days storage periods. Reduction in FRSA was probably due to high temperature storage which negatively affects the antioxidant compounds. The same has been confirmed by our results for TPC, vitamin C and total carotenoids content. Similar findings have been reported by Sornsomboonsuk et al. [29] in spray dried bael fruit powder during storage. The observations showed that TPC value decreased during the storage at 90 days. The initial value decreased from 29.88 and 24.86mg/100g during 90 days the storage periods. The decrease of the

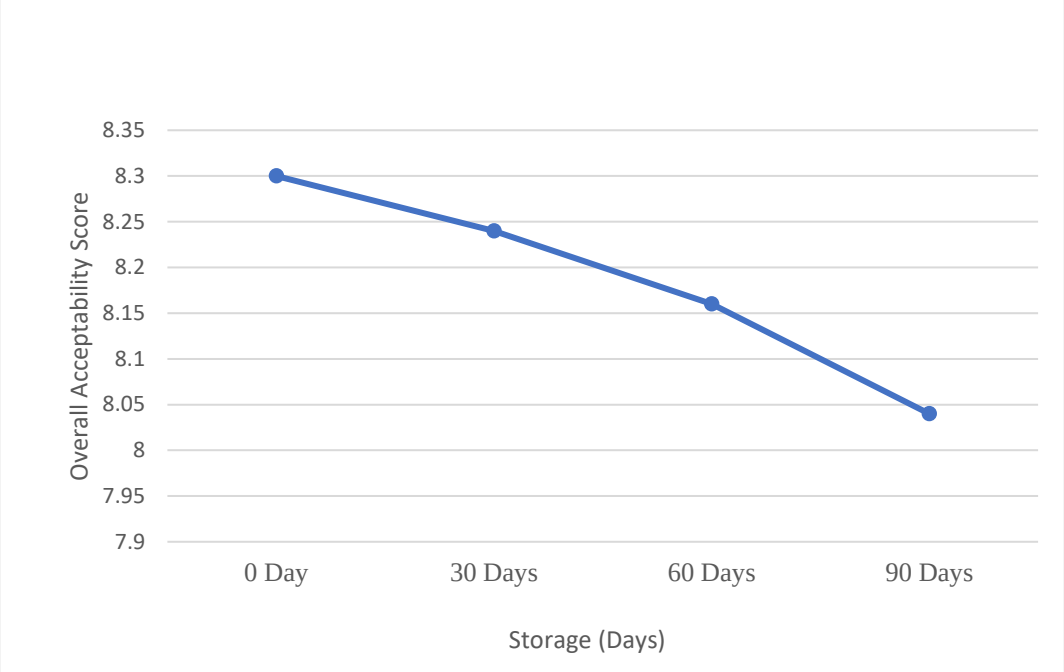

Fig. 2. Effect of storage on overall acceptability of Mix Fruit Juice Powder Fortified with Carambola Bagasse

polyphenolic content at high temperatures may be due to increased oxidation of these bioactive components. The rates of these oxidation reactions increase as temperature increases. Smiler result was found by Moldovan et al. [30]. Effects of storage temperature on the total phenolic content of Cornelian Cherry (*Cornus mas* L.) fruits extracts. Total carotenoids value of the product decreased during the storage at 90 days from an initial value of 8.19 to 5.41 during 90 days the storage periods. The sensitivity of carotenoids to heat, light, and oxygen is very high. The combination of them may have provoked the oxidative process leading to convert carotenoid into aromatic compounds. Due to the presence of conjugated double bonds in the polyene chain, the total carotenoid would have been degraded by isomerization and oxidation under high temperature exposure [31]. Similar result was found by Rivas et al. [32] during study on stability of bioactive compounds of microencapsulated mango and passion fruit mixed pulp.

3.3 Overall Acceptability

The score recorded on 9-point hedonic scale for Overall acceptability of carambola pomace fortify mix juice powder was found to decrease during the storage at 90 days (Fig 2). It decreased from a mean initial value of 8.30 to 8.04 after 90 days under ambient storage conditions. Our result were in accordance to Selvamuthukumaran et al. [33] who studied the effect of modified atmosphere packaging on sensory properties of spray-dried sea buckthorn fruit juice powder.

4. CONCLUSIONS

There was a significant effect of the storage duration on the quality of the Mix Fruit Juice Powder Fortified with Carambola Bagasse. The quality characteristics of juice powder namely, moisture content, a_w, and total soluble solids increased with the increase of the storage period whereas vitamin C, total phenolics, free radical scavenging activity and total carotenoids content of juice powder decreased with the increase of the storage period. Overall acceptability of the juice powder didn't show any significant change during the storage. Spray dried carambola mix juice powder thus can be made into a health promoting reconstituted drink and as well as found increase the shelf life of powder during the storage periods.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image

generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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