PHYSICOCHEMICAL ANALYSIS AND SHELF LIFE EVALUATION OF FORTIFIED BEETROOT JAM WITH APPLE POMACE AND CHIA SEED

Saumya Maurya[1], Dr. Priyanka Shankar[2]

[1]*M.Sc. Student, Department of Food and Nutrition, School of Home Science, Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh, India*

[2]*Assistant Professor, Department of Food and Nutrition, School of Home Science, Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh, India*

ABSTRACT

Beetroot, apple pomace and chia seed are loaded with many nutritive values like dietary fiber, protein, and vitamin C, calcium, antioxidant, and many more valuable nutrient which is helpful in growth, health and development. Here the beetroot jam was prepared by fortifying it with apple pomace and chia seed which increases its nutritional properties. The prepared beetroot jam fortified with apple pomace and chia seed was conducted for physicochemical analysis where its chemical analysis (like p^H, TSS, Titratable acidity and vitamin C content), proximate analysis, and shelf life estimation. In the test for its chemical analysis it was found that the prepared value added product that is beetroot jam with apple pomace and chia seed had TSS 65^0 Brix, p^H of 3.8, and titratable acidity 3.7% respectively. Whereas the proximate analysis show that protein content was 2.18g/100g, fat content was 2.1%, moisture content was 50.22%, ash content was 4.29%, and dietary fibre was 23.44% which indicates that the valued added prepared jam had good sources of nutrient and it is helpful in to meet up the daily requirement of the nutrients. The beetroot jam with apple pomace and chia seed was also studied for the shelf life with different days of beetroot jam samples and the results found was that the Day 1 shows 3.6×10^6 CFU, Day 72 shows 27×10^6 CFU, and Day 88 shows 32.3×10^6 CFU which represents that the prepared product was safe for consumption event after these days and its shelf life can be increased by proper storing conditions.

Keyword: *Chemical properties[1], proximate analysis[2], Shelf life[3], and CFU (Colony Forming Unit)[4]*

1. INTRODUCTION

Food preservation and canning of fruits and vegetables have emerged as more and more acceptable. People are becoming interested in doing it [1]. One of the most crucial ways of fruit and vegetable preservation is jam production. There are different types of jam and they differ from each other in the raw materials used, processing methods, and additives. Commercially, jams are made by thermal concentrating the mixture under normal or reduced pressure and this process produces a jam with a thick or gelled consistency [2]. The fruit enzymes and pectin are also guaranteed to be destroyed, and the result is concentrated to the point where its acidity and decreased water activity make it self-preserving [2].

The U.S. Code of Federal Regulations (CFR) has given definitions and standards for the jams. This regulation allows the use of some safe and suitable optional ingredients such as nutritive carbohydrate sweeteners, spices, acidifying agents, and pectin in an amount. The final TSS (Total Soluble Solids) of the jam shall be 65^0 Brix or 65% by weight. Therefore, jams are a mixture of fruit as a whole, in pieces, or pulped; fresh, concentrated, frozen, or canned sugar, and other minor ingredients that help develop texture because of the formation of a gel between sugars and pectin substances along with fruit and vegetable acidity. All fruits and vegetables do have not enough

acidity or pectin content for gel formation which is why it is necessary to add sugar and pectin during the preparation of jam [3].

Beta vulgaris Linn, also known as beetroot, is a colourful and adaptable vegetable in the Chenopodiaceae family. It is known by a variety of names, including Chukander, and is commonly consumed raw, as juice, baked, or boiled. Sucrose is the primary sugar found in red beets. It has a bright crimson colour and an earthy flavour and aroma. Despite having few calories, beets are high in essential vitamins and minerals. Red beets are low-fat vegetables high in carbohydrates, starch, soluble fibres, and proteins. They are also low in calories. Numerous phytochemicals with biological activity are also present. Betalains are among them, accounting for 70-100% of the phenolic content of beetroot [4]. Beetroot also contains soluble fibre, a variety of minerals (such as calcium, magnesium, iron, potassium, phosphorus, salt, and zinc), and vitamins (such as biotin, folic acid, niacin, and vitamin B6) that are all beneficial to health [5].

Apple pomace is a significant byproduct produced during the processing of apple juice. Pomace, a byproduct of the apple juice processing industries, contains a wide range of nutritionally important compounds, including carbohydrates, phenolic compounds, dietary fibre, and minerals. These important compounds can be recovered from apple pomace, and apple pomace can even be used directly or after minimal processing in food systems. As a result, apple pomace can be used to improve the health benefits and commercial value of food products. Apple pomace contained approximately 2.2-3.3% seeds, 0.5-0.9% stem, and 70.0-75% apple meat. The average dietary fibre content was 36.8% [6].

Chia seed, also known as Salvia hispanica L., has numerous therapeutic and nutritional benefits. This annual plant can be found from western Mexico to northern Guatemala. The mottled-coloured seeds are 2mm long and come in brown, grey, black, and white shades [9]. They are said to have anti-oxidative properties, regulate lipid metabolism, protect the cardiovascular system [10], be anti-inflammatory, and improve athletic performance. It is also effective in preventing strokes and heart attacks in patients with type II diabetes. It also has a significant reduction in blood pressure, blood sugar, and body weight [7].

The food industry must constantly look for new and improved ways to innovate. Vegetable jams could help the jam industry, which is struggling to develop new products, become more competitive [8].

The aim of this work was to introduce a new product and develop a value-added beetroot jam with apple pomace and chia seed to increase the nutritional composition and health benefits. Because, while preparing or processing the jam its losses some nutritional value. The developed product was conducted for physicochemical analysis and shelf life evaluation to know about its nutritive value and length of time for safe consumption.

2. MATERIAL AND METHODS

2.1 Source of experimental materials

The present investigation based on standardization of value-added beetroot jam by using apple pomace and chia seed was carried out in the Department of Food and Nutrition, School of Home Science, Babasaheb Bhimrao Ambedkar University, Lucknow-226025, Uttar Pradesh. Beetroot, apple, and chia seed for the present study were purchased from the local market of South City, Lucknow area.

2.2 Preparation of Jam

The preparation of jam was done by initially preparing apple pomace from the apple. Apple pomace was prepared by Apple. For this procedure, the apple was brought from the local market of South City, Lucknow. The apple was then preceded for sorting and grading followed by thoroughly washing. Then it was peeled, cut into small, and weighed. After weighing, the apple was crushed and poured into a vinegar and water mixture for 30 minutes. Then it was dehydrated or dried. After that, it was ground into fine powder.

Chia seed was brought from the local market of Lucknow. It was then roasted and ground into fine powder respectively.

Beetroot was obtained from the local market near BBAU and was subjected to sorting and grading followed by thorough washing in order to remove dirt, dust, and other foreign materials from its surface. It was then peeled, cut into small pieces, and boiled. The beetroot was pulped with the help of a grinder. The pulp obtained was

cooked for a few minutes and then sugar was added after that with continuous stirring. After a few minutes, apple pomace and chia seed powder were added. Then cinnamon powder and ginger juice were added. The pectin and citric acid were added and cooked until the TSS reached 65^0-68^0 Brix. The sugar was 40%, citric acid 0.5-0.6%, and pectin 0.8% was added to beetroot pulp.

2.3 p^H Measurement

The p^H of the prepared jam was determined by using a digital p^H meter.

2.4 TSS (Total Soluble Solid) Measurement

The TSS of the prepared jam was determined by using a digital refractometer.

2.5 Titratable Acidity

The titratable acidity of the prepared jam was determined by the IS-1989 method.

$$Titratable\ acidity\% = \frac{ml \times N \times 280.4}{V \times 1000} \times 100$$

2.6 Vitamin C Estimation

The Vitamin C in a solution is determined by the redox titration method by using iodine. For this 20ml of sample aliquot was taken into 250ml conical flask and 150 ml distilled water was added into it, then 1ml of starch solution. Then it was titrated against iodine solution. The end point of titration was dark blue-black colour.

2.7 Proximate Analysis

A. Moisture content:

The moisture content of the sample was determined by the AOAC method by using the oven drying method.

$$Moisture\ content(m.c.\%) = \frac{W_m}{W_m + W_d} \times 100$$

B. Total Solid (Ash):

The total ash content of jam sample was determined by the using the muffle furnace. For this the procedures are followed as:

$$Total\ ash\ \% = \frac{Weight\ of\ ash\ (g)}{Weight\ of\ sample\ (g)} \times 100$$

C. Fat content:

For crude fat content of food sample, the **Soxhlet extraction** method. Moisture free sample was weighed 3gm and kept into thimble. Then 250 ml Diethyl ether was poured into the thimble holder which contains sample. Then the soxhlet apparatus was on and temperature was set at 34 ± 2^0C and run for 6 hours. Then the sample extraction obtained into the bottom flask was weighed. The fat content was calculated by the following formula:

$$Crude\ fat\ (\%) = \frac{W_4 - W_3}{W_2 - W_1} \times 100$$

Where,
W_1 = Weight of empty thimble (g),
W_2 = Weight of thimble + sample (g),
W_3 = Weight of empty flask (g),
W_4 = Weight of flask + fat (g).

D. Analysis of Dietary Fiber:

The crude dietary fiber in the prepared jam was determined by sequential acid and alkali hydrolysis method by AOAC. 0.128M Sulphuric Acid was used as boil in acid and 0.313M Sodium Hydroxide was used as boil in base. Firstly the sample 2gm was weighed and boiled in acid 0.128M sulphuric acid for 30 minutes and then filtered. The filterate was again boiled, but in base solution 0.313M Sodium Hydroxide for 30 minutes and filtered. The filterate was dried in oven for 2 hours and then ashing of it done in muffle furnace for 5 hours and weight was obtained. Then the crude fibre was percentage was obtained by using the formula:

$$Crude\ Fibre\ (\%) = \frac{W_1 - W_2}{W} \times 100$$

Where, W_1 = Weight of the sample before ashing, g
W_2 = Weight of the sample after ashing, g
W = Weight of the sample, g

E. Protein estimation:

The total protein by the Kjeldahl method is defined as the amount of nitrogen experimentally found and multiplied by an appropriate conversion factor. The protein content of the jam sample was estimated by the IS: 7219-1973 RA method. The method of estimation of nitrogen by Kjeldhal method includes three steps;

(a) Digestion: 0.2gm sample, 2gm digestion mixture, and 20ml concentrated sulphuric acid. Boiled for at least 3 to 5 hours. Digested sample and distilled water make upto 100ml.

(b) Distillation: 30ml of 4% boric acid, 10ml digested sample, 50ml of 40% NaOH, and, 50 ml distilled water into distillation flask and heated at 200^0C.

(c) Titration: 0.l N HCl into burette and 10-20ml sample into conical flask with 2-3 drops of methyl red indicator. Titrated it for 3 to 4 times.

$$Protein\ g/100g = \frac{(c-b) \times 14d \times 6.25}{a \times 1000} \times 100$$

2.8 Shelf life evaluation:

For the shelf life analysis of the valued added prepared jam, nutrient agar was used at different intervals. For this test the sample of different days like 1 day, 72 days and 88 days was checked for the microbial growth on the nutrient agar. The plates of nutrient agar with sample was incubated for 24 hours to check the microbial growth and colonies. For this test the nutrient agar was prepared by 25gm of nutrient broth in 1 litre of distilled water and then it was autoclaved for 15 minutes at 15 psi and 121^0C. then it was cooled down and poured into the petri plates in laminar air flow and left for solidify in it. After that serial dilution (10^1 to 10^7) of diluted sample was done and 10^4 dilution factor was taken for pouring on petri plate containing media. Then it was incubated inverted for 24 hours at 37^0C. Then the cfu (Colony Forming Unit) was counted usung digital colony counter.

3. RESULT AND DISCUSSION

The prepared fortified beetroot jam with apple pomace and chia seed is conducted for various chemical, proximate and shelf life estimation and the result of the present study have been discussed as:

3.1 Chemical Properties

The chemical properties of the value added jam were analysed and the result for that were shows that the TSS was 65^0 Brix, p^H was 3.8, Titratable acidity was 3.7%, and vitamin C was found 146mg/100ml.

Table 1: Chemical analysis of prepared jam

S. No.	Parameter	Amount
1.	Total Soluble Solid	65^0 Brix
2.	P^H	3.8
3.	Titratable acidity	3.7%
4.	Vitamin C	146mg/100ml

3.2 Proximate Analysis

The proximate analysis of the prepared value-added jam shows that the protein content was 2.18g/100g, fat content was 2.1%, moisture content was 50.22%, ash content was 4.29%, and dietary fibre was 23.44%.

Table 2: Proximate analysis tests result.

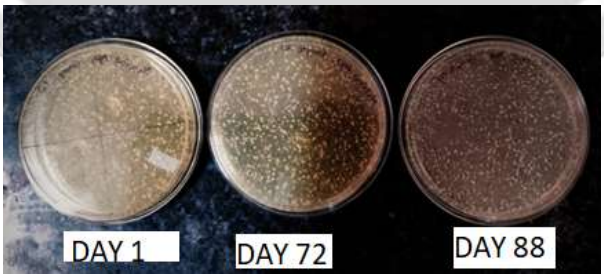
S. No.	Parameter	Amount
1.	Moisture	50.22%
2.	Ash	4.29%
3.	Fat	2.1%
4.	Protein	2.18g/100g
5.	Dietary Fibre	23.44%

3.3 Shelf Life evaluation

The shelf life of the product was carried out by microbial process. The CFU count on nutrient agar was done for this test. The different samples after different days inoculated on petri plates show different results and numbers of colonies. The CFU count was as followed shown in table:

Table 3: CFU count.

S.No.	Days	Dilution no.	No. of colonies	CFU (ml)
1.	1	10^4	36	3.6×10^6
2.	72	10^4	270	27×10^6
3.	88	10^4	325	32.3×10^6



Picture 1: Nutrient Agar Media petri plates of Samples.

4. CONCLUSION

It was concluded that the prepared value-added beetroot jam with apple pomace and chia seed has TSS of 65^0 brix, p^H of 3.8, titratable acidity was 3.7% and also has good sources of vitamin C, dietary fibre, protein, and many more nutrients which shows that the prepared value added is rich in nutrient that will help in daily requirement of nutrients. Beside these, the prepared jam was also conducted for shelf life where the sample which was prepare one day before (Day 1) microbial test shows 3.6×10^6 CFU, Day 72 shows 27×10^6 CFU, and Day 88 shows 32.3×10^6 CFU. The microbial test shows that this product is safe to use and can be stored for three month and more than three month with proper storage conditions.

5. REFERENCES:

[1] **Jimenez, et al., 2021.** Food preservation: Making tasty cooked Strawberry Jam. University of Florida. UF/IFAS Extension.

[2] **Fasogbon et al., 2013.** Studies on the chemical and sensory properties of jam from osmotically dehydrated pineapple slices. British Journal of applied Science and Technology. 3(4):1327-1335.

[3] **Zhao, Yanyun. 2007.** Berry fruit: Value-added Products for Health Promotion. Taylor & Francis Group LLC. Chapter 13: Berry jams and jellies. 368-386.

[4] **Mathangi S., and Balasaraswathi, M. 2019.** Formulation of horsegram cake enriched with beetroot powder. International Journal of Applied Home Science. 6(1):61-65.

[5] **Vanajakshi, V., Vijayendra, S.V.N., Varadaraj, M.C., Venkateshwaran, G., and Agrawal, R. 2015.** LWT. Food Sci. Tech. 63, 1268.

[6] **CARSON, K. J., COLLINS, J. L., & PENFIELD, M. P. 1994.** Unrefined, Dried Apple Pomace as a Potential Food Ingredient. Journal of Food Science. 59(6), 1213–1215. doi:10.1111/j.1365-2621.1994.tb14679.x

[7] **Ayerza, R., and Coates, W. 2005.** Chia: Rediscovering an ancient crop of the Aztecs. University of Arizona Tucson, Arizona, USA.

[8] **Pelsmaker, S. De., Gellynck, X., Delbaere, C., Declercq, N., & Dewettinck, K. 2015.** Food Qual. Pref. 41,20.

[9] **Cahill, J. 2003.** Ethnobotany of chia, Salvia hispanica L. (Lamiaceae). Economic Botany 57:604- 618.

[10] **Alonso-Calderón, A., Chávez-Bravo, E., Rivera, A., Montalvo-Paquini, C., ArroyoTapia, R., Monterrosas-Santamaria, M., Jiménez-Salgado, T., & Tapia-Hernández, A., 2013.** Characterization of black chia seed (Salvia hispanica L) and oil and quantification of β-sitosterol. International Research Journal of Biological Sciences. 2(1), 70-72.