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FORMULATION AND QUALITY ASSESSMENT OF CORN SILK BASED FRUIT BEVERAGE

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Abstract: The formulation and standardization of corn silk based fruit beverage was conducted in order to develop innovative beverage formulation and study the changes in beverage quality during storage period of 30 days. The preliminary trials of corn silk based fruit beverage were conducted to standardize optimum level of corn silk extract, pineapple juice, sugar, preservative, stabilizer and water. The sensory evaluation by a panel of trained and semi trained judges was conducted, and the S2 formulation was selected with corn silk extract to pineapple juice ratio as 50:20 for 200 ml beverage. The proximate analysis data of developed corn silk based fruit beverage revealed that the moisture and total ash content were 77.99 % and 0.52 %, respectively. The carbohydrates, crude fat content, crude protein, Vitamin C and crude fiber values were reported as 11.56 g/100 ml,0.12 g/100 ml, 4.3 g/100 ml, 8.95 mg/100 ml and 5.6 g/100 ml, respectively. The beverage was packed in glass bottles and stored at ambient (24°C) and refrigeration temperature (4°C). The storage studies of selected samples were conducted at 15 days interval to evaluate changes in chemical parameters such as acidity, pH, TSS, Vitamin C, reducing sugar, total sugar, density and specific gravity of the corn silk based fruit beverage.

Index Terms **– Corn Silk, Pineapple, Fruit base Beverage.**

I. INTRODUCTION

Ready to Serve fruit beverages are gaining popularity around the world because of different factors. Beverages are a good source of hydration as well as energy and other nutrients such as vitamins, minerals, protein, and lipids (Arthey 1995). Since the last decade, the production and formulation of foods with functional properties known to enhance health have been reported and explored. This advancement has also aided in the lowering of various lifestyle-related disorders. These foods include certain bioactive components, such as prebiotic, probiotic and symbiotic components, in moderate levels (Moussavi *et al.*, 2011).

Corn silk is commonly used in Chinese medicine for the treatment of oedema of various origins and hepato-biliary disorders (Bensky and Gamble 1986). Several authors have supported thetherapeutic properties of corn silk, including antioxidant activity (Maksimovic *et al.*, 2005), anti- diabetic activity, antibiotic activity against corn earworm (Rau *et al.*, 2006), endurance against insect attacks (Guevara *et al*., 2000) and anti-tumour activity (Habtemariam1998). According to phytochemical research, corn silk contains a variety of flavonoids, p-coumaricacid, chlorogenic acid, ferulic acid, volatile oil, phytosterols, fixed oil, allantoin, sugars, tannin and minerals (Elliger *et al.*, 1980).

At present, specifically corn silk based products developed like powder, cosmetics and tea are commercial in Korea, China, Japan, United States of America and United Kingdom. In spite of this, corn silk is still considered as an unused product obtained from corn processing industry. Therefore, abundant opportunities can be considered to convert corn unused into value-added foods. (Sarepoua *et al.*, 2013).

The current research entitled "Formulation and Quality Evaluation of Corn Silk Based Fruit Beverage" was undertaken to explore the potential utilization of beverage, throughinnovative food product development. Sincere efforts have been made to explore the physico-chemical and nutritional features of corn silk and pineapple in this study. The efforts were made to develop blended beverage. Further, developed blended beverage were qualitatively assessed for proximate composition, chemical composition, shelf life and techno-economic feasibility.

II.RESEARCH MATERIALSANDMETHODS

2.1 Materials

2.1.1 Raw materials

The corn silk and pineapple were procured from the local market, Pune. Whereas, citric acidand sugar was purchased from local supermarket, Loni-Kalbhor, Pune. The pineapples obtained were fully mature, healthy, bruise less and uniform sized. Equipment's and utensils were obtained from MIT School of Food Technology, MIT ADTUniversity, Pune.

2.1.2 Chemicals and Packaging material

Chemicals (analytical grade) required for the work were available from laboratory of MIT School of Food Technology, Pune. Glass bottles used as packaging material for blended juice, were obtained from local market, Loni Kalbhor .

2.2 Methodology

2.2.1 Crude Fat Content

The fat was estimated by the protocol given in Ranganna (1986) as given below:

Procedure:

A clean, dry Soxhlet flask was weighed (W1). Take 3 g of dried sample (W2) was transferred to a thimble and the top of the thimble was plugged with a cotton plug. The thimble was dropped into a Soxhlet apparatus. Approximately, 75 ml of Petroleum ether was poured through the sample into the flask. One end of the fat extraction tube was attached to the flask and other to condenser. The sample was extracted for 16 hr. After the extraction of fat from the sample into the solvent, the solvent was recovered. The solvent in the flask was evaporated in an oven at 100º C for 1 hr., further cooled and weighed (W3). The crude fat percent was calculated as follows:

$$Crude\ Fat(\%) = \frac{W3 - W1}{W2} \times 100$$

2.2.2 Moisture Content

The moisture content was determined using the hot air oven method. The sample was weighed (W1) approximately 10 g and kept in a petri plate and allow to dry at 110º C in the hot air oven with periodically weighing until constant. The dried sample was kept in desiccatorfor cooling. The weight (W2) of cooled sample was obtained. The moisture content was calculated as follows:

$$Moisture\ content(\%\ mc) = \frac{W1 - W2}{W1} \times 100$$

2.2.3 Crude Protein Content

The nitrogen was determined by Kjeldahl method and protein was then calculated by using the below given formula.

Procedure:

0.4 g of sample was weighed and transferred to Kjeldahl flask. Around 2.5 g of digestion mixture, and 10 ml of concentrated H_2SO_4 was added to it. The Kjeldahl flask was kept in the digestion assembly. The assembly was heated to 420º C and the sample was digested till all the fumes of SO_2 were exhumed. The flask was cooled and transferred to the digestion assembly. 50 ml of 40% NaOH was added to it and distillation was started. The ammonia gas was liberated during the distillation process and was absorbed in the 25 ml of 3 % Boric acid solution taken in a conical flask. 3-4 drops of mixed indicator were added to it and it was titrated against 0.116 N HCl till pink color end point was obtained. The titre value was noted and % nitrogen in sample was calculated using following formula:

$$Nitrogen(\%) = \frac{(Sampletitre - Blanktitre) \times NormalityofHCl \times 14}{Weightofsample \times 1000} \times 100$$

%Protein =6.25x%Nitrogen

2.2.4. Carbohydrates

The carbohydrates are estimated by anthrone method.

Procedure:

Take clean and dry test tubes and mark all the tubes as per the protocol. Pipette out 0.1-0.5 ml of glucose standard solution in duplicate test tubes. In one test tube take only 1 ml of distilled water and mark it as blank. Make up the volume to 1 ml in each test tube by adding distilled water. Then add 3 ml of anthrone reagent to each test tube and mix thoroughly. Heat the test tubes for 8 min in a boiling water bath. Cool rapidly and read the green to dark green color at 630 nm. Draw a standard graph by plotting concentration of the standard on the X-axis and absorbance on the Y-axis. From the graph calculate the amount of carbohydrate present in the sample tube.

$$Carbohydrate\ content\ in\ 100\ mg\ of\ sample = \frac{mg\ of glucose \times 100}{Volume\ of\ test\ sample}$$

2.2.5. Ash Content

Protocol was used to determine the total ash content of the sample (Ranganna, 1986)

Procedure:

The silica crucible (W1) was weighed. Then, 5 g of sample was weighed (W2) in it. The contents in the crucibles were charred on a Bunsen burner and then were kept in muffle furnace at 525- 550º C for 6 hr. The crucibles were cooled overnight and weighed (W3) again.Percent total ash was calculated as follows:

$$Ash\ content(\%) = \frac{W_3 - W_1}{W_2}$$

2.2.6. Crude Fiber Content

Crude Fiber was estimated using the protocol given by Ranganna (1986) using Fibroton apparatus.

Procedure:

2-3 g defatted sample was weighed (W) and transferred to the crucibles for fibre estimation. The crucible was placed in the hot extraction unit. For acid extraction, 150 ml 1.25 % H_2SO_4 was poured in the crucible. The acid wash was done at 400º C for 45 min and then, washed withdistilled water. The acid wash was followed by alkali wash with 1.25 % NaOH and after washing with distilled water, the crucibles were dried in hot air oven at 100º C till free from moisture. Then, the weights of crucible were taken (W1) and the crucible were placed in muffle furnace at 400º C for 5-6 h. After cooling the crucibles, weight of crucible with ash was taken (W2).

$$Crude\ Fibre\ content(\%) = \frac{W1 - W2}{W} \times 100$$

2.2.7. Determination of Energy Value

Procedure:

Energy value = (Carbohydrate + Protein) x 4 + Fat x 9. Ranganna, S. (1986).

2.2.8. Ascorbic acid content

The ascorbic acid content was determined by Assay method given by Ranganna (1986) as portrayed below:

Procedure:

Preparation of sample: 10 g/ml of sample was mixed with 100 ml of 3% HPO_3. It was then filtered. An aliquot (10ml) of the sample wasmeasured and titrated against standard dye till pink color was observed as end point, which persisted for 15 s. The Ascorbic Acid content ofthe sample was calculated by using the following formula:

$$Ascorbic\ acid(mg/100\ g) = \frac{\text{Titre value} \times \text{Dye factor} \times \text{Volume made up}}{\text{Aliquot of sample taken for estimation} \times \text{Weight of sample taken for estimation}} \times 100$$

2.2.9. Sensory evaluation of corn silk based fruit beverage

A semi-trained panel evaluated the sensory attributes of a corn silk-based fruit beverage using a 9-point hedonic rating scale, as defined by Amerine et al (1965). The mean value of the sensory score was calculated and given for each sensory attribute (Ranganna, 1986).

2.2.10. Statistical analysis of data

According to Panse and Sukhatme's methodology, the data collected was analyzed for statistical significance using Factorial Completely Randomized Design (1967).

2.3. Flow chart for preparation of corn silk based fruit beverage

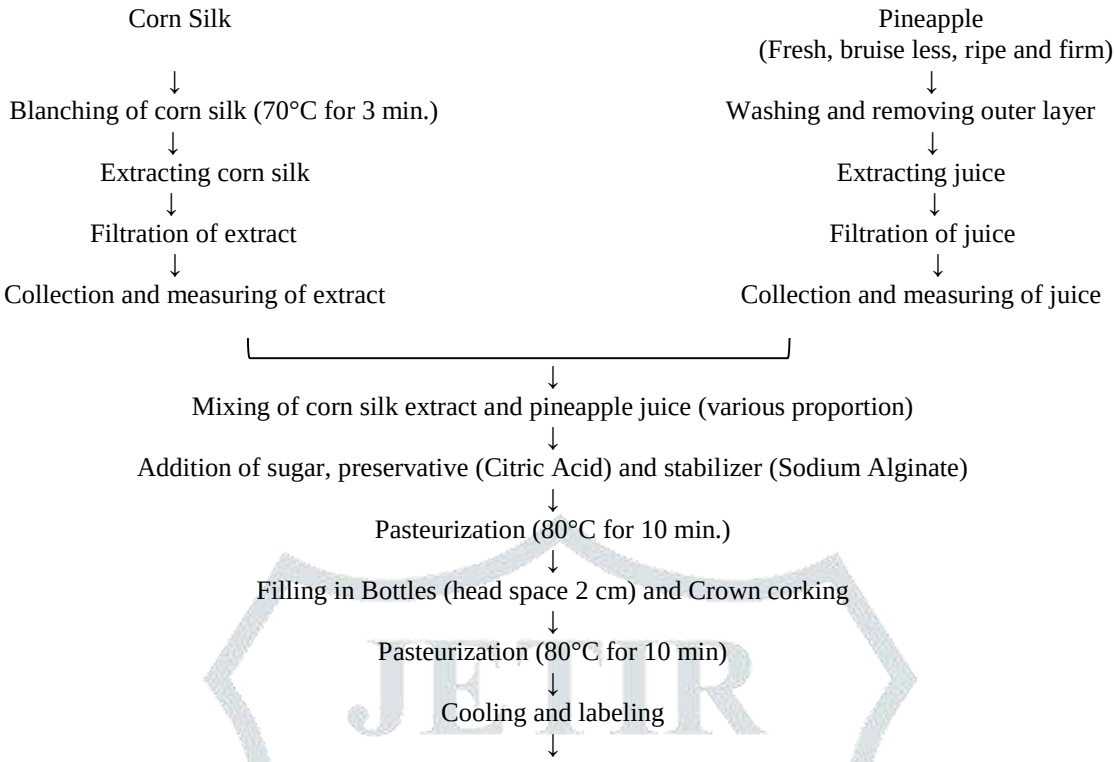

Fig. 2.3. Flowchart for preparation of corn silk based fruit beverage

2.3.1. Procedure of corn silk based fruit beverage preparation

2.3.2. Selection of fruit

The corn silk was separated from selected corns for preparation of extract. As previously stated, completely ripened, bruise-free, consistent pineapples were chosen for beverage preparation.

2.3.3. Blanching of corn silk

To remove the adherent dirt, the corn silk was rinsed under running tap water. The corn silk was then subjected to blanching treatment, i.e., putting corn silk in hot water (constant temperature 70 °C) for 3 minutes and then cooled in normal water.

2.3.4. Preparation of fruits for pulping

To remove the adherent dirt/dust, the pineapples were rinsed under running tap water. After washing the fruits, the fruit skin was peeled and the leaves were removed with a stainless-steel knife.

2.3.5. Extraction and filtration corn silk

Corn silk was extracted after blanching, and the extract was filtered through muslin cloth to eliminate contaminants and big particles.

2.3.6. Extraction and filtration of juice

The pineapples were cut into pieces and ground using mixer cum grinder. To remove the fibrous fraction and big particles from the juice, it was filtered through muslin cloth. The prepared juice was measured and collected in bottle.

2.3.7 Procedure for preparation of corn silk based fruit beverage

The corn silk extract was blended with pineapple juice in variations S0, S1, S2 and S3, with ratio of corn silk extract to pineapple juice as 70:0, 60:10, 50:20 and 40:30, respectively. The ground sugar was added to required quantity of blend and diluted with water. The similar method was used in all treatments. The preservative (Citric Acid) and stabilizer (Sodium Alginate) were mixed to the juice treatments. It was homogenized with a juicer and then filtered through muslin cloth to remove any remaining contaminants. The produced juice was preserved with 0.1 g/100ml of citric acid. It was pasteurized for 10 minutes at 80°C temperature.

2.3.8. Bottling

The pasteurized juice was poured into 200 mL clean, pre-sterilized dried glass bottles with a 2.0 cm headspace and sealed airtight with a crown corking machine. After sealing the juice bottles were again pasteurized at 80^0C for 10 min.

2.3.9. Storage

The juice bottles were cooled and stored in a dry environment at ambient temperature (25±2°C) and refrigeration temperature (4±2° C). All juices were analyzed chemically and aesthetically.

Plate no. 1 Corn silk

Plate no. 2 Pineapple

Plate no.3 Corn silk based fruit beverage

2.4.1. Treatment details

Different samples of beverage S_0, S_1, S_2 and S_3 were prepared by blending corn silk extract and pineapple juice in different proportions. The formulation is presented as below in table.

Table No. 3.1 Formulation for Corn silk based Fruit Beverage

Sample code	Corn silk extract (ml/100ml)	Pineapple fruit juice (ml/100ml)	Sugar (g/100ml)	Water (ml/100ml)	Stabilizer (g/100ml)	Preservative (g/100ml)
S_0	70	-	10.00	19.80	0.10	0.10
S_1	60	10	10.00	19.80	0.10	0.10
S_2	**50**	20	**10.00**	**19.80**	**0.10**	**0.10**
S_3	40	30	10.00	19.80	0.10	0.10

S_0- Control sample,
S_1- Blend of 60% corn silk extract and 10% pineapple juice,
S_2- Blend of 50% corn silk extract and 20% pineapple juice,
S_3- Blend of 40% corn silk extract and 30% pineapple juice.

III. RESULTS AND DISCUSSION

3.1. Formulation and standardization of corn silk based fruit beverage

The corn silk based fruit beverage formulation was standardized by using ingredients, corn silk extract, pineapple juice, sugar, water, preservative (Citric Acid) and stabilizer (Sodium Alginate) as displayed in table 3.1. The sugar, water, preservative and stabilizer quantity were kept constant based on prior determination. The corn silk beverage was thus formulated by modifying quantity of corn silk extract and pineapple juice in ratios as 70:0 considered as control (S_0), 60:10 (S_1), 50:20 (S_2) and 40:30 (S_3), as depicted in table 3.1.

Table No.3.1 Standardization of ingredients for Corn silk based fruit beverage

Sample	Corn silk extract (ml/100ml)	Pineapple juice (ml/100ml)	Sugar (g/100ml)	Water (ml/100ml)	Preservative (g/100ml)	Stabilizer (g/100ml)
S_0	70	0	10	19.8	0.10	0.10
S_1	60	10	10	19.8	0.10	0.10
S_2	**50**	**20**	**10**	**19.8**	**0.10**	**0.10**
S_3	40	30	10	19.8	0.10	0.10

S_0- Control sample,
S_1- Blend of 60% corn silk extract and 10% pineapple juice,
S_2- Blend of 50% corn silk extract and 20% pineapple juice,
S_3- Blend of 40% corn silk extract and 30% pineapple juice.

3.2. Sensory evaluation of corn silk based fruit beverage

Table No.3.2 Sensory evaluation of corn silk based fruit beverage

Treatment No.	Colour & appearance	Taste	Flavor	Mouthfeel	Overall acceptability
S_0	7	6.8	7	7	7.3
S_1	7.3	7	6.1	6.3	6.6
S_2	**8**	**7.6**	**7.8**	**8.1**	**8**
S_3	7.5	7.3	7.1	7	7.1

S_0- Control sample,
S_1- Blend of 60% corn silk extract and 10% pineapple juice,
S_2- Blend of 50% corn silk extract and 20% pineapple juice,
S_3- Blend of 40% corn silk extract and 30% pineapple juice.

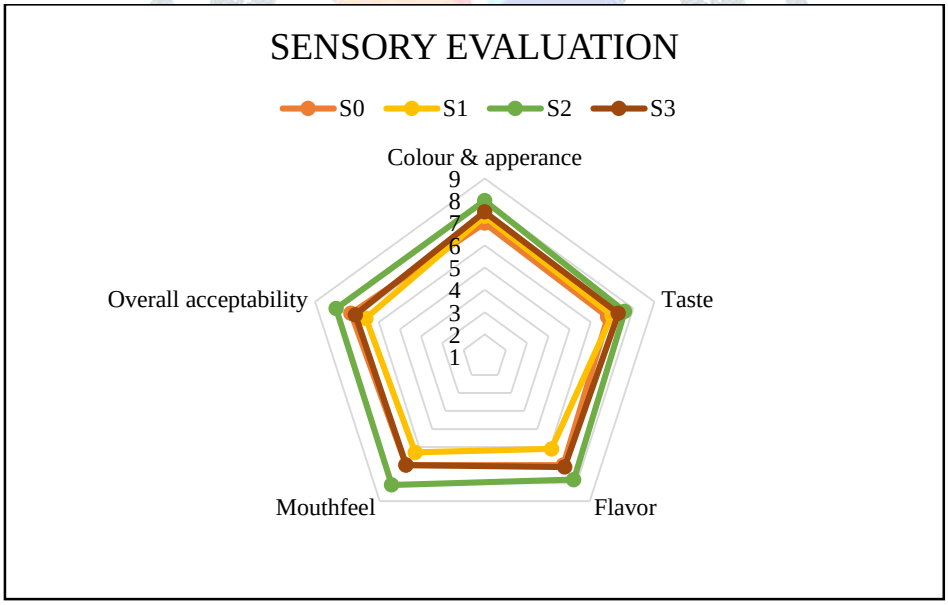

Figure. 3.2 Sensory evaluation of corn silk based fruit beverage

3.3. Proximate analysis of developed corn silk based fruit beverage

The proximate analysis data of developed corn silk based fruit beverage is displayed in Table 3.3. According to the conducted analysis, the values of moisture and total ash content were 77.99 % and 0.52 %, respectively. The Vitamin C content of the beverage was 8.95 mg/100 ml. The good amount of vitamin C content can be attributed to corn silk and pineapple incorporation, as supported by result of other studies (Nawaz *et al.*, 2018). The carbohydrates, crude fat content, crude protein and crude fiber values were reported as 11.56 g/100 ml, 0.12 g/100 ml, 4.3 g/100 ml and 5.6 g/100 ml, respectively. The carbohydrate content of developed product was compared to other pineapple based researches (Hossain *et al.*, 2015). The lower amount of fat can be attributed to corn silk extract fortification majorly, as supported by some studies (Rajalakshmi *et al.*, 2020).

Table No. 4.7 Proximate analysis of developed corn silk based fruit beverage

Sr. No.	Properties	Result (per 100 ml)
1	Moisture (%)	77.99
2	Carbohydrate (g/100 ml)	11.56
3	Crude Protein (g/100 ml)	4.3
4	Crude Fat content (g/100 ml)	0.12
5	Crude Fiber (g/100 ml)	5.6
6	Vitamin C (mg/100 ml)	8.95
7	Ash content (%)	0.52

IV. SUMMARY AND CONCLUSION

The current study titled 'Formulation and quality assessment of corn silk based fruit beverage' was undertaken in order to formulate and standardize corn silk based fruit beverage with ingredients, corn silk extract and pineapple juice, containing Vitamin C. The study also aimed to prepare product that could provide medicinal, health benefits and waste utilization. The outcomes of the research on this beverage are summarized as follows:

The corn silk based fruit beverage formulation was standardized with ingredients, corn silk extract, pineapple juice, sugar, water, preservative (Citric Acid) and stabilizer (Sodium Alginate). The sugar, water, preservative and stabilizer quantity were kept constant based on prior determination. The corn silk beverage was thus formulated by modifying quantity of corn silk extract and pineapple juice in ratios as 70:0 (as control, S_0), 60:10 (S_1), 50:20 (S_2) and 40:30 (S_3).

The sensory evaluation of corn silk based fruit beverage was conducted and results revealed that the overall acceptability of S_2 beverage formulation acquired superior score (8) than three other formulations. The data acquired from evaluation of S_0, S_1, S_2 and S_3 formulations, revealed that formulation S_2 obtained score for color, taste, flavor, mouthfeel as 8, 7.6, 7.8, 8.1 and 8 respectively. Thus, formulation S_2 was selected and thus standardized for further analysis and study. The results of proximate analysis of standardized corn silk based fruit beverage showed that moisture and total ash content were 77.99 % and 0.52 %, respectively. While, crude protein content in the developed beverage was estimated to be 4.3 g/100 ml. The carbohydrates, crude fat content and crude fiber content values were detected as 11.56 g/100 ml, 0.12 g/100 ml and 5.6 g/100 ml, respectively. The Vitamin C content was analyzed and was revealed to be 8.95 mg/100 ml. The microbial analysis of corn silk based fruit beverage revealed that the total plate count and yeast/mold were not detected. The antibacterial characteristics of corn silk, as stated in the results and discussion, could account for this outcome.

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