Sensory-Based Standardization of a Ready-to-Reconstitute Sugarcane Beverage mix

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ABSTRACT

The rising demand for convenient and natural instant beverages has prompted the development of a foam mat dried instant sugarcane beverage mix. This study aimed to standardize the formulation of such a mix using foam mat dried sugarcane juice powder, mint, ginger, and citric acid. Various combinations were evaluated for their sensory qualities, including color, taste, flavour, texture, and overall acceptability, using a 9-point hedonic scale by a trained panel. Among the tested formulations, sample S_2—comprising 14% sugarcane powder, 0.1% mint, 0.025% ginger, and 0.1% citric acid—received the highest sensory scores across all parameters. The foam mat drying technique effectively preserved the natural characteristics and improved the reconstitution quality of the powder. These findings suggest that S2 is an optimal formulation for producing a shelf-stable, nutritionally rich, and sensorially acceptable instant sugarcane beverage, thereby offering a promising value-added product for commercial development.

INTRODUCTION

The instant beverages trend aligns with India's booming non-alcoholic beverages market, projected to grow from $38.03 billion in 2022 to $88.25 billion by 2027 at a CAGR of 18.3%. The rising adoption of vending machines in offices, retail outlets, and transit hubs further supports this shift. Manufacturers are innovating with single-serve sachets and travel-friendly formats to cater to evolving consumer preferences, reinforcing the convenience-driven expansion of the instant beverage segment. In India, the government has promoted juice processing under various value addition and startup schemes to enhance farmer income and create employment opportunities (Ministry of Food Processing Industries [MoFPI], 2022).

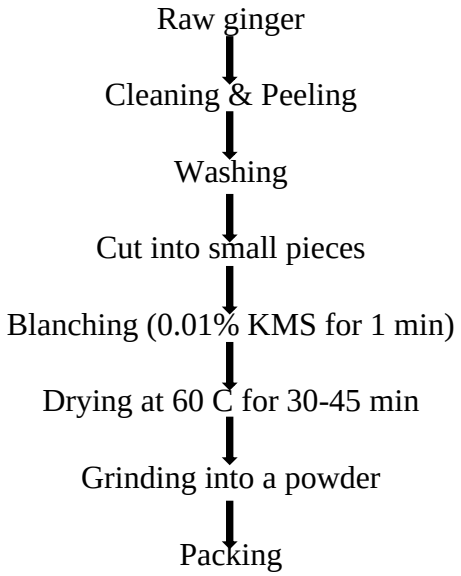
Developing stable, easy-to-use instant beverage mixes from sugarcane juice has gained attention. Among various drying methods, foam mat drying has emerged as a promising technique for producing fruit and vegetable powders with better retention of flavour, colour, and nutrients while offering rapid reconstitution properties (Thuwapanichayanan et al., 2008; Jaya & Das, 2004). In foam mat drying, the liquid juice is first converted into stable foam by incorporating foaming agents, followed by drying at relatively low temperatures, which helps minimize thermal degradation of sensitive bioactive compounds (Nindo & Tang, 2007).

The standardization of an instant beverage mix using foam mat dried sugarcane powder aims to transform fresh juice into a shelf-stable, easily reconstitute product that preserves the characteristic flavour and nutritional benefits of sugarcane. Such a product can cater to growing consumer demand for natural, convenient, and health-oriented beverage options, while also providing value addition and reducing post-harvest losses (Kalem et al., 2022). Standardization involves optimizing formulation to ensure consistent quality and sensory acceptability.

MATERIAL AND METHODS

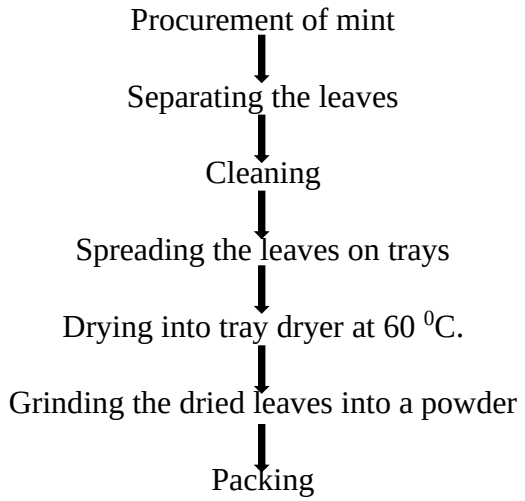
The sugarcane juice was extracted through extractor and immediately pasteurized at temperature of 80 ^{0}C for 2-3 min (Marques et al., 2016). The extracted sugarcane juice has the pH 5.1 and total soluble solids fixed to 18- 20 ^{0}Bx according to Raghavan et al., (2002). The process for foam mat drying of sugarcane juice was followed as Raghavan et al., (2002) and Marques et al. (2016) with some changes. In this research carboxymethyl cellulose and xanthan gum used as a foaming agent and stabilizer respectively. Maltodextrin (DE 5-20%) was used as bulking or dying agent to enhance the drying process.

1.1.1 Preparation of ginger powder



Flowchart 1: Preparation of ginger powder

1.1.2 Preparation of mint powder



Flowchart 2: Preparation of mint powder

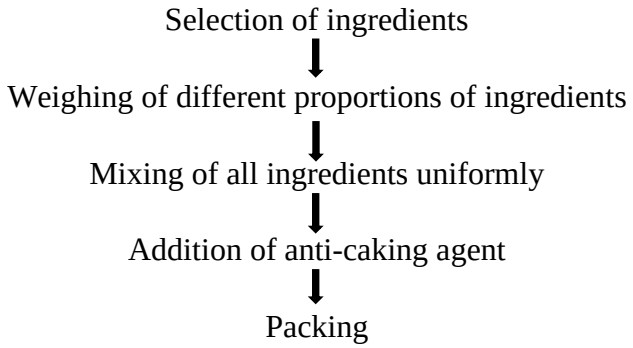
Standardization of instant sugarcane beverage

For the preparation of an instant sugarcane beverage, foam mat dried sugarcane juice powder is the main ingredient. Ginger, and mint powders serve as essential ingredients to enhance the taste and flavour. These additional ingredients ensure that the instant beverage

meets all sensorial and functional characteristics. The foam mat dried sugarcane juice powder was prepared according to Yepuri, S.R (2025).

To maintain the functional properties of instant standardized beverage powder anticaking agent which is silicon dioxide is used in 0.1%. To preparing quality sugarcane beverage powder foam mat drying technology is used by studying its quality and functional properties at different levels of foaming agents and temperatures.

Preparation of instant sugarcane beverage mix



Flowchart 3: Process flow for instant sugarcane beverage mix

Table 1: Formulation of Instant sugarcane beverage mix

Samples	Dried Sugarcane Powder (%)	Mint powder (%)	Ginger powder (%)	Citric acid (%)
Control	14	-	-	-
S_1	13	0.1	0.025	0.1
S_2	14	0.1	0.025	0.1
S_3	15	0.1	0.025	0.1

Sugarcane powder (SP); Mint powder (MP); Ginger powder (GP); Citric acid (CA)

Sensory evaluation

The sensory evaluation of the reconstituted, both control and experimental samples, was conducted by a panel of 12 trained and semi-trained members. The panel consisted of postgraduate students and academic staff from the College of Food Technology, Parbhani, all with prior experience in sensory assessment. Evaluations were based on a 9-point Hedonic Scale, where panellists rated various sensory attributes such as colour, flavour, taste, aroma, mouthfeel, and overall acceptability. The scale ranged from 9 (‘like extremely’) to 1 (‘dislike extremely’).

RESULTS AND DISCUSSION

Standardization of instant sugarcane beverage mix

The instant sugarcane beverage mix was prepared by using the ingredients mentioned in raw materials such as foam mat dried sugarcane juice powder, mint powder, ginger powder and citric acid.

On the trail and error method fixed the minimum required composition of each ingredient as mentioned. After fixation of minimum ingredients composition, formulated four different compositions of instant beverage mix as tabulated in table 1. These four formulations dissolved in 100 ml of drinking water for the evaluation of sensory attributes, such as color, taste, flavour, texture(mouthfeel) and overall acceptability. The trained and semi trained panelists were evaluated each sample and marked the scores based on 9-point hedonic scale (like extremely to unlike extremely) as table 2 and figure 1.

For beverages, color is a crucial quality factor that affects perceptions of freshness and initial impressions. S_2 had the highest ratings (7.5) of any sample, suggesting a more appealing look. This could be as a result of S_2's superior natural color due to addition of mint powder. S_1 and control, on the other hand, had the lowest score (6), indicating little color appeal because of control 1 was without adding mint powder. By minimizing heat exposure and oxidation, foam drying aids in color preservation (Vega-Gálvez et al., 2012).

Another main factor influencing customer preference is taste. S_2 had the highest taste score (8.5), followed by S_3 (7), while S_1 and control both received 6. This suggests that S_2 was more palatable and could have kept more of the original sugarcane flavorings. Optimal sugarcane powder and citric acid balance can improve taste retention in S_2 as similar to fresh sugarcane juice. Furthermore, it's possible that the foaming agents utilized helped shield delicate components from drying damage.

Flavour, which combines taste and aroma, trended similarly to taste. With the maximum score of (8), S_2 had a pleasing and well-balanced flavour because of addition of optimum ginger powder. When compared to traditional techniques, this demonstrates how well foam mat drying preserves volatile flavour components. According to studies by Mishra et al. (2014), foamed samples often retain more aroma-active chemicals because of their shorter drying durations and softer temperatures.

Table: 2 Sensory evaluation of reconstituted sugarcane beverage

Sample	Colour	Taste	Flavour	Texture (consistency)	Overall acceptability
Control A	6	6	6	6.5	6
Control B	7.5	6	6	6.5	6
S_1	6	6	6	6.5	6
S_2	7.5	8.5	8	8	8
S_3	6.5	7	7	7	7
SE ±	0.183	0.149	0.365	0.236	0.105
CD at 5%	0.407	0.332	0.815	0.525	0.235

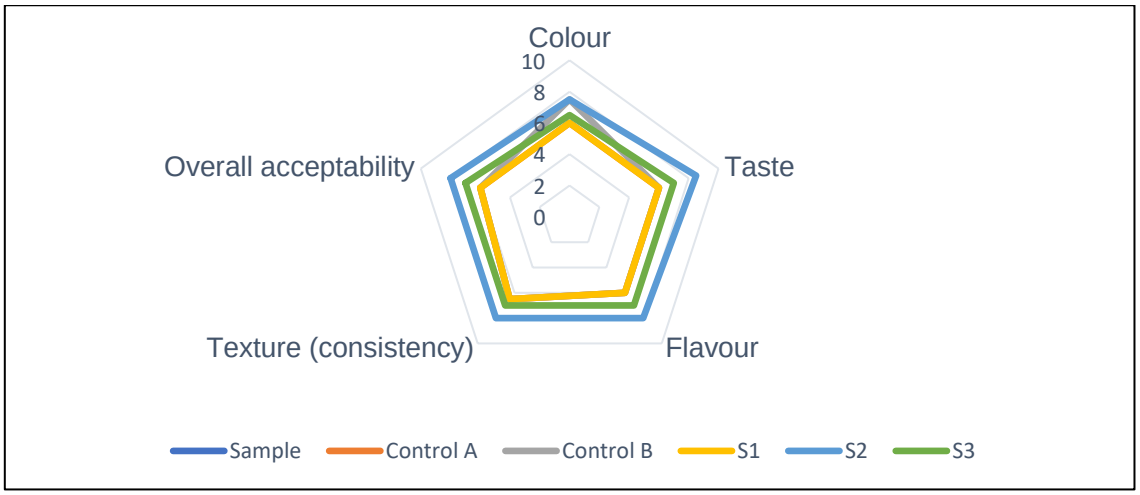


Fig. 1: Graphical representation of sensory evaluation of instant sugarcane beverage

The mouthfeel and consistency of the reconstituted beverage are reflected in its texture. S_2 demonstrated better solubility and homogeneity following reconstitution, earning the maximum score of (8) once more. Whereas S_3 and control scored very well (7 and 6.5, respectively). Better powder solubility and dispersion, which resulted in a smooth and steady sip, were probably facilitated by the foam structure formed during processing in S_2. This is in line with Kandasamy et al. (2018), who observed that foam mat dried powders have improved dispersion and wettability.

Acceptability as a whole incorporates all sensory factors. With the highest acceptance score of (8), S_2 had exceptional consumer potential. S_3 came in second with a score of 7, while every other sample, including S_1 and controls, had a score of 6. The effectiveness of optimizing

foam-mat drying conditions, which enhanced both technical attributes (yield, drying time, etc.) and sensory appeal, is shown in S_2's higher performance across all sensory criteria. Among the four different compositions the sample (S_2) had the optimum sensory attributes.

Conclusion

The standardization of an instant sugarcane beverage mix using foam mat drying technology successfully produced a convenient, shelf-stable product with excellent sensory attributes. Among the four formulations evaluated, S2 demonstrated superior color, taste, flavour, texture, and overall acceptability. The incorporation of mint and ginger powder, combined with optimized drying conditions, contributed to enhanced sensory performance and retention of natural flavors. Foam mat drying proved effective in preserving volatile compounds and improving powder solubility, making the reconstituted beverage comparable to fresh juice. This approach not only caters to the growing demand for ready-to-drink health-oriented beverages but also contributes to the value addition of sugarcane and reduction of post-harvest losses.

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