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Development and evaluation of nutritious and functional beverage from mature green mango fruit, mint leaves and chia seeds

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Abstract
The functional and nutritious beverage from Ramkela green mango variety, mint leaves and chia seeds was developed and evaluated for changes in its physico-chemical, microbiological and sensory parameters at monthly interval for three months storage period. Data show that average fruit weight and yield of pulp of mature green mango fruits were 208.00 g and 62.33 g/kg fruit. Yield of paste of mint leaves was 77%. Total soluble solids (TSS), ascorbic acid and acidity of the mature green mango-mint RTS were analyzed to be 12, 8.66, 0.22%, respectively, whereas total carotenoids and total chlorophyll were found to be 0.28 mg/100 g and 3.25 mg/100 g respectively. RTS contained protein (0.057%), fat (0.048%) and fibre (0.161%) due to the supplementation of chia seeds. Spiced mature green mango-mint RTS drink variant supplemented with 2% chia seeds had maximum overall acceptability score (8.50). The scores for colour and appearance, flavour, taste, mouthfeel and overall acceptability in the beverage decreased significantly during storage, however, the product was found acceptable even at three months storage. Total soluble solids and acidity increased significantly while ascorbic acid, total carotenoids and total chlorophyll decreased significantly during the storage period.

Keywords: Green mango, mint, chia seeds, physico-chemical, sensory parameter, storage

1. Introduction
Mango is called the king of fruits due to its succulent texture and exotic flavour, and it is widely eaten by consumers at all stages of maturity (Fowomola, 2010; Torres-Leon *et al.*, 2016) [9, 18]. Apart from direct consumption, more than half of the mangoes are used to make nectar, puree, squash, slices, jelly, pickles, etc. (Nadeem *et al.*, 2016) [14]. Processing of mango fruit into diverse shelf-stable products makes the seasonal fruit conveniently available to consumers all year round. Some of the common processed products from mango fruit are derived from the pulp. Apart from the primary products from mango pulp, derivatives of mango pulp can be used to enrich or flavor secondary products such as yoghurt, ice cream, beverages, and soft drinks (Owino & Ambuko, 2021) [15]. Natural juice products are made from a single fruit species, while mixed fruit products are made by combining two or three separate fruit juices with or without sugar (Lozano, 2006) [12]. Compared to single fruit juice, juice blends increase the nutritious quality and overall acceptability of beverages. Juice blending also encourages the processing of new products with a good taste, which has been well received by the food industry and consumers (De Carvalho *et al.*, 2007) [7]. Fresh mango pulp or juice, one of the most popular mango products, is still in high demand because it can maximally preserve the taste and function of fruit. Many studies have shown that fresh mango fruit or its juice is high in micronutrients like vitamins, dietary fibre and bio-compounds like ascorbic acid, phenols and carotenoids, all of which can lead to health promoting properties like antioxidant, hypoglycemic and anti-cancer (Sogi *et al.*, 2013) [17].
Mint (*Mentha viridis* L.) has the common name *Pudina* and is a member of Lamiaceae family. Representatives of the *Mentha* species are often used as flavor additives to confectionery, baked goods, chewing gum and tea (Salehi *et al.*, 2018) [16]. Mint leaves are high in vitamins and minerals, which are important for a healthy body. It is often said to alleviate the effects of indigestion, heartburn, irritable bowel syndrome by calming the muscles in and around the intestine. It is a potent antioxidant that protects the body from the development of cancerous cells; a healthy blood cleanser and it also aids in the clearing up of skin disorders including acne (Aflatuni *et al.*, 2005) [1].

People have been more worried about their lifestyle, hygiene and fitness in the modern era. Apart from refreshment, increased consumer understanding of juice drinks has increased the positive qualities needed by these items. Fruit mixtures have several benefits, including a variety of aromas and flavours, as well as the amount of its nutritious ingredients (Malik *et al.*, 2020) [13].

Salvia hispanica popularly known as chia is an ancient seed which was popular among the Aztecs in Mexico (Gazem *et al.*, 2017) [10]. Chia plant is an herbaceous vascular in appearance, semi oval in shape with smooth, glossy peel of black, brown, grey, black spotted or white shading. Chia seeds comprises of oil content 30.21 g/100 g, proteins 25.32/100 g proteins, dietary fiber 37.5 g/100 g and major insoluble fiber 35.06 g/100 g, which reveals the contribution of chia seeds to human nutrition as functional food (Da Silva *et al.*, 2017) [6]. It is commercially available and used by a wide range of customers due to its positive health benefits linked to chronic diseases such as obesity, cardiovascular disease, diabetes and cancer (Capitani *et al.*, 2012) [4]. The high quantity of essential fatty acids, dietary fibre, fat, enzymes, vitamins and minerals in chia seeds contribute to these health benefits. The content of omega-3 unsaturated fatty acids varies according to temperature and plant altitude; the colder and higher the area, the higher the content of omega-3 unsaturated fatty acids (Ayerza & Coates, 2011) [2]. Chia seed is eaten whole or ground into flour, or added to other foods such as yoghurts, salads, fruits, breads, biscuits, granola bars, drinks and other products (Vuksan *et al.*, 2007) [19]. Considering the nutritional and medicinal importance of mature green mango fruits, mint leaves and chia seeds, an experiment was conducted to standardize processing parameters for development and evaluation of value added sweet and spiced ready-to-serve (RTS) drink variants from mature green mango fruits, mint leaves and chia seeds.

2. Materials and methods

2.1 Procurement of raw materials

Mature green mango fruits cv. Ramkela, mint twigs, chia seeds, spices and other ingredients were procured from local market, Hisar (Haryana).

2.2 Collection and storage of mature green mango pulp

The mature green mango fruits were washed with clean running water thoroughly, peeled off, destoned and sliced. The stones and peels were discarded and fruit slices were pressure cooked with equal quantity of water (1:1) for 10 minutes and blended in a mixer to obtain homogeneous pulp. The mango pulp was filled in polypropylene jars and stored in deep freezer for preparation of value added ready-to-serve (RTS) drink variants.

2.2 Collection and storage of mint paste

Fresh mint twigs were washed under clean tap water thoroughly for removal of dirt particles. Mint leaves were separated from twigs and ground in mixer grinder by mixing 40 ml water to 1 kg leaves for making smooth paste. The mint paste was packed in polypropylene jars and stored in deep freezer for preparation of value added ready-to-serve (RTS) drink variants.

2.3 Standardization of blends and recipes for sweet and spiced ready-to-serve (RTS) drink

Preliminary trials were conducted to standardize optimum mango-mint blend and recipe for chia seeds, spices and other ingredients to develop most acceptable sweet and spiced mango-mint ready-to-serve (RTS) drink. Mature green mango pulp and mint paste were blended in the following proportions (100:0, 95:5, 90:10, 85:15 and 80:20) for preparation of sweet and spiced mango-mint RTS drink. The recipe for RTS drink was standardized using 10 to 25 per cent mango-mint blend, and adjusting 10 to 15 per cent total soluble solids (TSS) and 0.18 to 0.28 per cent acidity.

2.4 Optimization of chia seeds concentration

Chia seeds were soaked in lukewarm water (1:10 ratio) overnight, ground to fine paste and mixed @ 1, 2 and 3% with sweet and spiced ready-to-serve (RTS) drink variants to standardize an optimum quantity of chia seeds for developing a nutritious and functional beverage.

2.5 Preparations of sweet and spiced RTS drink variants

Mature green mango-mint blend (90:10) was optimized for preparation of sweet and spiced RTS drink variants. TSS and acidity were analyzed in mango-mint blend and sugar syrup was prepared with a gentle boiling using requisite recipe ingredients (sugar and water for sweet RTS drink; and sugar, water, spices and other ingredients for spiced RTS drink) for adjusting 12% TSS in RTS drink (w/w basis) as per standardized recipe. Citric acid was not required due to adjustable acids (0.22%) already present in the blend. Sugar syrup was cooled, strained through stainless steel sieve and mixed with mango-mint blend and chia seeds extract (1, 2 and 3%). The beverages were homogenized properly, strained through muslin cloth, filled in pre sterilized 200 ml capacity glass bottles leaving 2.5 cm head space and sealed with crown corks. The sealed glass bottles were pasteurized at 85±5 ºC for 15 minutes, cooled in air, labelled and stored at room temperature for evaluation of physico-chemical and sensory quality at monthly intervals for three months.

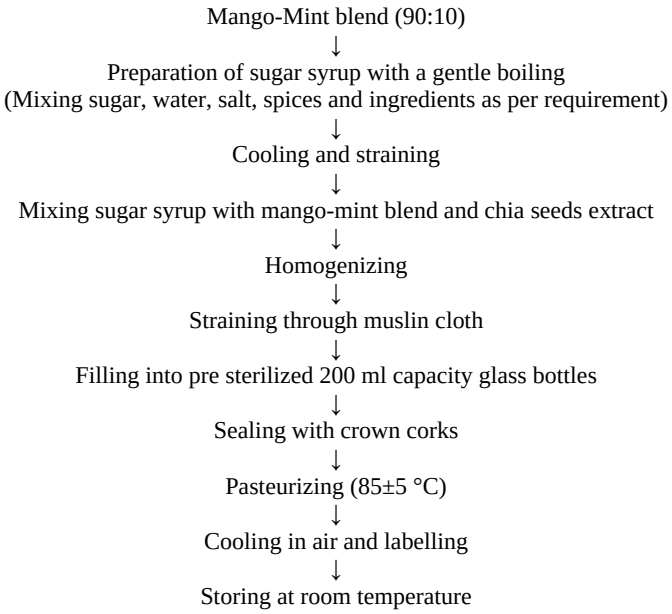

Fig 1: Flow diagram for preparation of sweet and spiced RTS drinks variants

3. Estimation of physico-chemical characteristics

3.1 Pulp weight (g per kg fruit)

Randomly selected mature green mango fruits were weighed on top pan electronic balance. The fruits were peeled off, destoned and the separated pulp was weighed. The pulp weight was expressed in grams per kg of fruit.

3.2 Paste weight (g per kg of mint twigs)
Paste was prepared by blending mint leaves using 40 ml water per kg mint leaves. It was weighed separately on top pan electronic balance and its average weight was expressed in grams per kg of mint twigs.

3.3 Yield of mature green mango pulp and mint paste (%)
The yield of mature green mango pulp was calculated by dividing weight of mango pulp with weight of fruit and multiplying by 100. Similarly, yield of mint paste was calculated by dividing weight of mint paste with weight of mint twigs and multiplying by 100. The values were expressed in per cent.

3.4 Total soluble solids (%)
Total soluble solids (TSS) were estimated by hand refractometer (0-32%) at ambient temperature for mature green mango-mint blend and RTS drink variants and the values were expressed as per cent TSS.

3.5 Acidity (%)
The acidity was determined as per the method given by Ranganna (2014). Five grams macerated sample was taken and mixed with 50 ml boiled distilled water. It was cooled; filtered and appropriate volume was made. Five ml aliquots from mature green mango-mint blend and RTS drink variants were titrated against 0.1N sodium hydroxide using 1% phenolphthalein solution as an indicator. Acidity was calculated from the volume of alkali used and the results were expressed as grams of anhydrous citric acid present per 100 g or ml of sample.

3.6 Ascorbic acid (mg/100 g or ml)
Ascorbic acid was determined as per the method given by Ranganna (2014). Ascorbic acid was extracted from mango pulp; mint paste; mango-mint blend and RTS drink variants by macerating 5 g or ml of sample with 25 ml of 3% meta-phosphoric acid. The extract was filtered through double layer of muslin cloth and appropriate volume was made. Five ml aliquot was titrated against 2, 6-dichlorophenol indophenol dye till the appearance of light pink colour. The results were expressed in terms of mg ascorbic acid per 100 g or ml by the following formula:

$$\frac{\text{Titre value x Dye factor x Volume made up x 100}}{\text{Wt. or volume of sample x Vol. of aliquot}} \quad \text{Ascorbic acid in mg/100 g or ml}$$

3.7 Total carotenoids (mg/100 g or ml)
Total carotenoids were determined spectrophotometrically with slight modifications as per the method described by Rodriguez-Amaya (2004). Acetone extracts were used for estimation of total carotenoids by recording optical density at 452 ηm using visible spectrophotometer (TVS 25, Toshniwal) with acetone as blank for mango-mint blend extract and petroleum ether for RTS drink extract. The total carotenoids content of each sample was calculated and expressed as mg/100 g or ml.

3.8 Total chlorophyll (mg/l)
Total chlorophyll was estimated as per the method of Arnon (1949). The supernatant was used for estimation and the absorbance was measured at 652 ηm by Spectrophotometer (Visible Spectrophotometer, TVS 25, Toshniwal) with acetone as blank. The contents (mg/l) were calculated by using formula and converted into mg/100 g or ml.

3.9 Protein (%)
Protein was estimated using micro-Kjeldhal method (AOAC, 2005) with KELPLUS nitrogen estimation system. The distillate was titrated by 0.1N hydrochloric acid and the quantity of ammonia absorbed in boric acid was determined. Conversion factor of 6.25 was used to calculate % protein.

3.10 Fat (%)
Fat was estimated by Soxhlet extraction apparatus using method of Ranganna (2014). Fat percentage was calculated by dividing weight of ether soluble material with weight of sample and multiplying by 100.

3.11 Fibre (%)
Fibre was also estimated by the method of Ranganna (2014). The loss in weight of sample represented crude fibre and it was calculated by dividing loss in weight of sample with sample weight and multiplying it by 100.

4. Sensory evaluation (9-point hedonic scale)
Sensory evaluation of RTS drink variants was done immediately after preparation and at monthly intervals for three months storage period by a panel of ten semi-trained judges using 9-point hedonic scale as described by Ranganna (2014). The products were evaluated for colour and appearance, taste, flavour, mouthfeel and overall acceptability. The overall acceptability of RTS drink variants was based on mean scores obtained from all the sensory parameters. The samples with mean scores of 6 and above out of 9 were considered acceptable.

5. Results
a) Physico-chemical characteristics of mature green mango fruit, mint leaves and chia seeds
Mature green mango fruit, mint leaves and chia seeds were analyzed for various physico-chemical characteristics. Data (Table 1) reveal that mango contained fruit weight (208 g), pulp weight (623.3 g/kg fruit), while mint twigs contained leaves weight (760 g/kg mint twigs), paste weight (778.4 g/kg mint twigs). Yield of pulp in mature green mango fruits and yield of paste in mint leaves were 62.33 and 77.84%. Mature green mango fruit and mint leaves had ascorbic acid content (85.29 and 4.60 mg/100 g), total carotenoids (0.179 and 15.85 mg/100 g) and total chlorophyll (1.48 and 172.90 mg/100 g), respectively. Chia seeds contained protein (16.96%), fat (31.13%) and fibre (23.53%).

b) Standardization of blends and recipes ingredients for sweet and spiced mature green mango-mint RTS drink variants
Among various mango-mint blends (100:0, 95:5, 90:10, 85:15

and 80:20), RTS drink developed by using 20 per cent mango-mint (90:10) blend, and adjusting 12 per cent TSS and 0.22 per cent acidity was found most acceptable. Common salt (0.20%), rock salt (0.20%), black salt (0.20%), black pepper powder (0.075%), chat masala (0.40%), roasted cumin powder (0.10%) and small cardamom powder (0.05%) were standardized to develop spiced mango-mint RTS drink. Among different concentrations of chia seeds (0, 1, 2, 3%), spiced mature green mango-mint RTS drink variants (with and without 2% chia seeds) were preferred (8.50 and 8.10) over sweet mature green mango-mint RTS drink variants (with and without 2% chia seeds) having overall acceptability score of 8.40 and 8.00 (Table 2). Spiced mature green mango-mint RTS drink variant supplemented with 2% chia seeds had maximum overall acceptability score (8.50) followed by sweet mature green mango-mint RTS drink variant supplemented with 2% chia seeds (8.40).

6. Storage studies

6.1 Total soluble solids (%)

There was significant increase in total soluble solids (TSS) of sweet and spiced mature green mango-mint RTS drink variants (without and with 2% chia seeds) at three months storage (Table 3). It might be due to hydrolysis of insoluble polysaccharides into simple and soluble sugars. The results are in agreement with the observations of Yadav *et al*. (2013) in Aloevera-ginger-mint RTS drink and Choudhary *et al*. (2013) in aonla squash. Lather *et al*. (2015) recorded higher TSS in aonla juice treated with sodium benzoate (0.1%) than KMS (0.1%) treated juice. Akinola *et al*. (2018) observed that TSS increased in orange juice treated with sodium benzoate, while it remained as such in juice treated with potassium sorbate. Although, Yousaf *et al*. (2016) recorded highest increase in TSS in watermelon pulpy juice treated with 0.1% potassium sorbate followed by 0.05% sodium benzoate during three months storage, while minimum increase in TSS in juice having 0.05% KMS followed by 0.1% sodium benzoate was observed at end of storage.

6.2 Acidity (%)

There was significant increase in acidity of sweet and spiced mature green mango-mint RTS drink variants prepared without and with 2% chia seeds during three months storage (Table 3). There were also significant differences in acidity percentage among different mature green mango-mint RTS drink variants. Interaction between treatments and storage period was also significant. Rathod *et al.* (2014) also observed increment in acidity in bael-aonla RTS drink during forty-five days storage. Similarly, acidity increased (0.50 to 0.55%) in kinnow-aonla (1:2) beverage over six month's storage period (Balaji & Prasad, 2014). In contrary to results of present study, Moazzem *et al.* (2019) observed decrease in titratable acidity in wood apple beverage during 50 days storage. Maximum decrease in acidity was recorded in beverage treated with KMS and citric acid (100 ppm each) at the end of storage, might be due to chemical reactions between organic constituents and conversion of acids into salt and sugars by enzymes.

6.3 Ascorbic acid (mg/100 g or ml)

The data in Table 3 show significant decrease in ascorbic acid content (8.66 to 4.31 and 7.75 to 4.23 mg/100 ml) and (9.18 to 4.45 and 8.89 to 4.35 mg/100 ml) of sweet and spiced mature green mango-mint RTS drink variants prepared without and with 2% chia seeds during three months storage. It might be due to the fact that stability of ascorbic acid content depends upon extent of thermal processing, air entrapped in headspace of bottles, storage temperature and atmospheric/dissolved oxygen levels. Buvaneshwari *et al*. (2020) also observed decline in ascorbic acid in banana pseudo stem RTS drink stored at ambient and refrigerated temperature for 45 days. The results are also in agreement with those of Sindhumati & Premlatha (2013) in papaya: pineapple RTS drink, Rathod (2014) in bael: aonla RTS drink and Sood *et al*. (2010) in mango squash using cheese whey and soy whey.

6.4 Total carotenoids (mg/100 g or ml)

It is clear from the data (Table 3) that total carotenoids declined from (0.280 to 0.238 and 0.283 to 0.243 mg/100 ml) and (0.422 to 0.358 and 0.428 to 0.372 mg/100 ml) of sweet and spiced mature green mango-mint RTS drink variants prepared without and with 2% chia seeds during three months storage. Similarly, Kaur & Sharma (2013) reported 23% loss in β-carotene in carrot juice after three months ambient storage and Majumdar *et al*. (2011) reported 57% loss in β-carotene in bottle gourd-basil blended juice after six months storage. Selvamuthukumaran & Kahnum (2013) reported higher loss (68%) of carotenoids in spiced seabuckthorn-pineapple squash stored at 37 °C than at 30 °C (61%). Silva *et al*. (2016) also observed decrease in carotenoids in chemically preserved red guava juice upon 180 days storage. Maximum carotenoids retention was recorded in juice treated with 0.004% sodium metabisulphite, followed by 0.05% sodium benzoate.

6.5 Total chlorophyll (mg/l)

Total chlorophyll declined from (3.250 to 2.940 and 1.680 to 1.420 mg/100 ml) and (2.200 to 1.840 and 1.200 to 0.890 mg/100 ml) of sweet and spiced mature green mango-mint RTS drink variants (without and with 2% chia seeds), respectively during three months storage (Table 3). Similar results were reported by Gaur *et al*. (2007) in chlorophyll degradation kinetics of mint leaves puree. They reported that chlorophyll degradation followed the first order reaction kinetics. Chlorophyll in mint leaves puree was found to be most heat stable at pH 7.5; whereas at pH 6.5 and 8.5; the rate of chlorophyll degradation was found to be comparatively higher. Bochnak-Niedzwiecka *et al*. (2020) developed vegetable based powdered beverages. The high temperature of rehydration of beverage powder (30% of carrot, 30% of pumpkin and 10% parsley leaves) adversely affected the colour of beverages. This might be due to thermal degradation of chlorophyll generating pheophytins (yellow pigments) and oxidation and isomerization (cis-trans) of carotenoids during heating (Lien, 2016).

6.6 Protein

Data (Table 3) reveal significant increase in protein (0.057 to 0.345 and 0.062 to 0.347%) of sweet and spiced mature green mango-mint RTS drink variants (without and with 2% chia seeds), respectively during three months storage. Bhardwaj and Saraswat (2019) [3] prepared the sports drink with pomegranate juice, cucumber juice, dextrose and different ratios of chia seeds and mint leaves juice and pink salt in the developed drink and contains inconsistent result of protein

with RTS drink. In the same way, De Souza *et al.* (2020) [8] conducted research on a fermented dairy beverage with caja-mango pulp and found protein content (4%) inconsistent with our result. The addition of chia seeds increased the levels of crude protein with 4.26% (Kowaleski *et al*., 2020) [11].

6.7 Fat

Fat in RTS drink variants shows increasing trend (0.048 to 0.614 and 0.055 to 0.624%) of sweet and spiced mature green mango-mint RTS drink variants by supplementing 2% chia seeds (Table 3). The addition of chia seeds increased the levels of lipids with 5.37% (Kowaleski *et al*., 2020) [11]. Similarly, De Souza *et al.* (2020) [8] prepared a fermented dairy beverage with caja-mango pulp and found fat content (2.4%), which is in consistent with the present finding.

6.8 Fibre

Fibre content was found to be increased (0.161 to 0.525 and 0.380 to 0.697%) in sweet and spiced mature green mango-mint RTS drink variants by supplementing 2% chia seeds (Table 3). The addition of chia seeds increased the levels of dietary fibre with 2.58% (Kowaleski *et al*., 2020) [11]. Crude fibre content of cashew apple RTS beverages increased with aloe supplementation. The formulation of cashew apple RTS + osmo dehydarted aloe gel 10% (S_2) recorded the highest crude fibre of 0.99 per cent and 0.79 per cent for cashew apple RTS + osmo dehydarated aloe gel 5% (S_1), whereas cashew apple RTS drink without aloe (S_4) recorded the lowest crude fibre of 0.003 per cent. The biochemical profiling of aloe supplemented cashew apple RTS beverages revealed that RTS formulation supplemented with 10 per cent osmo dehydrated aloe gel was superior in quality attributes (Cherian & Lekshmi., 2021) [5].

7. Sensory evaluation during storage

Sensory quality of fruit beverages is the main parameter for deciding its marketability. Significant decrease in sensory scores for colour and appearance, taste, mouthfeel, flavour and overall acceptability of mature green mango-mint RTS drink variants was noticed during three months storage. In the present investigation, initially, RTS drink variants were appealing in colour and appearance with high sensory score, but changes were evidenced with the advancement in three months storage. It might be due to appealing colour of mango pulp and mint paste, initially during storage, which declined due to degradation of carotenoids, total phenols and ascorbic acid upon storage. The darkening of colour in RTS drink variants could be possible due to interaction of sugars and amino acid in acidic condition led to Maillard reaction upon storage. Spiced RTS drink variants had better colour scores than sweet RTS drink variants. Taste, flavour and mouthfeel scores also decreased with the advancement in storage duration due to break down of complex metabolites into simpler one, leading to volatilization of flavouring components, which might have affected taste perception. Taste and flavour of spiced RTS drink variants with chia seeds were found superior over sweet variants, which might be due to liking of sweet and spicy taste with unique aroma from combination of different spices. Mouthfeel score decreased during storage, but remained in acceptable limits. Comparatively, spiced RTS drink variants had good mouthfeel, which might be due to overall liking of spices and sweet aftertaste.

There was decrease in all sensory attributes that adversely affected overall acceptability of RTS drink variants during three months storage (Table 4). Data also revealed that spiced RTS drink variants with 2% chia seeds maintained good sensory quality, having higher acceptability scores at the end of storage. Results are in accordance with the findings of Ramachandran & Nagarajan (2014) in spiced papaya and aloe-papaya RTS drink, Kumar *et al.* (2013) in *Aloe vera*-aonla-ginger RTS drink, Yadav *et al.* (2013) in *Aloe vera* RTS drink, Sirohi *et al*. (2010) in whey-based mango-herbal beverage and Sood *et al*. (2010) in mango squash prepared using cheese whey and soy whey. Buvaneshwari *et al*. (2020) recorded higher sensory score (7.8) for lemon flavoured banana pseudo stem beverage stored at refrigerated temperature for 45 days.

8. Cost of production (Rs./L)

Data (Table 5) show that sweet and spiced mature green mango-mint RTS drink variants prepared with 2% chia seeds were costlier (Rs. 32.79 and Rs. 38.60/L) than those prepared without 2% chia seeds (Rs. 12.79 and Rs. 18.60/L).

9. Conclusion

Nutritious and functional beverage can be prepared from mature green mango fruit, mint leaves and chia seeds using mature green mango pulp and mint paste (90:10 ratio) and 2% chia seeds by following the standardized recipe (using 20% pulp, and adjusting 12% TSS and 0.22% acidity). For spiced RTS drink variants, spices (0.2% common salt, 0.2% rock salt, 0.2% black salt, 0.075% black pepper powder, 0.4% chat masala, 0.1% roasted cumin powder and 0.05% small cardamom powder) were optimized. Spiced mature green mango-mint RTS drink variant supplemented with 2% chia seeds had maximum overall acceptability score (8.50).

Table 1: Physico-chemical characteristics of mature green mango fruit, mint leaves and chia seeds*

Sr. No.	Parameters	Mature green mango fruit	Mint leaves	Chia seeds
1.	Fruit wt. (g)/leaves wt. (g/kg twigs)	208 ±8	760±6	-
2.	Pulp/paste weight (g/kg)	623.3±4.2	778.4±4.4	
3.	Yield of pulp/paste (%)	62.33 ±1.26	77.84±1.12	
4.	TSS (%)	7.60±0.0	2.74±0.0	
5.	Acidity (%)	1.28±0.03	0.04±0.0	
6.	Ascorbic acid (mg/100 g)	85.29±0.36	4.60±0.14	-
7.	Total carotenoids (mg/100 g)	0.179±0.006	15.85±0.19	-
8.	Total chlorophyll (mg/100 g)	1.48±0.08	172.90±0.70	-
9.	Protein (%)	-	-	16.96±0.11
10.	Fat (%)	-	-	31.13±0.06
11.	Fibre (%)	-	-	23.53±0.15

*The values are mean ± SD of three replicates.

Table 2: Sensory evaluation (9-point Hedonic scale) of sweet and spiced mature green mango-mint RTS drink variants

Treatments* (90 Mango: 10 Mint)		Colour and Appearance	Taste	Aroma	Mouthfeel	Overall acceptability
Sweet RTS drink with chia seeds (%)	0	7.90	8.00	7.90	8.20	8.00
	1	7.90	8.20	8.20	8.10	8.10
	2	8.10	8.50	8.40	8.60	8.40
	3	7.70	7.50	7.70	7.50	7.60
	CD at 5%	0.17	0.19	0.18	0.21	0.19
Spiced RTS drink with chia seeds (%)	0	7.80	8.10	8.20	8.30	8.10
	1	8.10	8.30	8.10	8.30	8.20
	2	8.50	8.50	8.40	8.60	8.50
	3	7.80	7.70	7.80	7.90	7.80
	CD at 5%	0.30	0.25	0.25	0.23	0.17

*RTS drink variants prepared using 20% pulp, and adjusting 12% TSS and 0.22% acidity

Table 3: Effect of storage on physico-chemical characteristics of sweet and spiced mature green mango-mint RTS drink variants

RTS drink* (90 Mango:10 Mint)	Storage (months)	TSS	Acidity	Ascorbic acid	Total carotenoids	Total chlorophyll	Protein	Fat	Fibre
		(%)		(mg/100 ml)			(%)		
Sweet (without 2% chia seeds)	0	12.00	0.220	8.66	0.280	3.250	0.057	0.048	0.161
	1	12.17	0.224	7.19	0.271	3.130	0.052	0.045	0.146
	2	12.40	0.224	5.43	0.255	3.050	0.048	0.043	0.132
	3	12.57	0.231	4.31	0.238	2.940	0.044	0.038	0.115
Sweet (with 2% chia seeds)	0	12.00	0.220	7.75	0.283	1.680	0.345	0.614	0.525
	1	12.40	0.220	6.45	0.273	1.570	0.342	0.604	0.518
	2	12.70	0.224	5.21	0.261	1.480	0.338	0.590	0.511
	3	13.13	0.231	4.23	0.243	1.420	0.334	0.581	0.503
Spiced (without 2% chia seeds)	0	12.00	0.220	9.18	0.422	2.200	0.062	0.055	0.380
	1	12.33	0.224	7.25	0.405	2.080	0.058	0.050	0.363
	2	12.60	0.238	5.73	0.384	1.940	0.052	0.046	0.352
	3	12.87	0.245	4.45	0.358	1.840	0.046	0.042	0.337
Spiced (with 2% chia seeds)	0	12.00	0.220	8.89	0.428	1.200	0.347	0.624	0.697
	1	12.50	0.224	6.73	0.410	1.050	0.344	0.613	0.683
	2	12.73	0.231	5.50	0.390	0.980	0.340	0.604	0.676
	3	13.17	0.238	4.35	0.372	0.890	0.337	0.593	0.667
CD at 5%	Treatment	0.15	0.002	NS	0.005	0.041	0.002	0.011	0.004
	Storage	0.15	0.002	0.67	0.005	0.041	0.002	0.011	0.004
	TxS	NS	0.004	NS	NS	NS	NS	NS	0.009

*RTS drink variants prepared using 20% pulp, and adjusting 12% TSS and 0.22% acidity; NS-Non-significant

Table 4: Effect of storage on sensory characteristics of sweet and spiced mature green mango-mint RTS drink variants

RTS drink* (90 Mango:10 Mint)	Storage (months)	Colour and appearance	Taste	Flavour	Mouthfeel	Overall acceptability
		9-point hedonic scale				
Sweet (without 2% chia seeds)	0	7.90	8.00	7.90	8.20	8.00
	1	7.80	7.90	7.70	7.80	7.80
	2	7.70	7.60	7.50	7.60	7.60
	3	7.30	7.50	7.40	7.40	7.40
Sweet (with 2% chia seeds)	0	8.10	8.50	8.40	8.60	8.40
	1	8.10	8.30	8.10	8.30	8.20
	2	8.00	8.00	7.90	8.10	8.00
	3	7.80	7.70	7.80	7.90	7.80
Spiced (without 2% chia seeds)	0	7.80	8.10	8.20	8.30	8.10
	1	7.80	8.00	8.10	8.10	8.00
	2	7.70	7.70	7.90	7.90	7.80
	3	7.50	7.60	7.70	7.60	7.60
Spiced (with 2% chia seeds)	0	8.40	8.50	8.50	8.60	8.50
	1	8.10	8.40	8.30	8.40	8.30
	2	8.00	8.20	8.10	8.30	8.15
	3	7.90	8.10	7.90	8.10	8.00
CD at 5%	Treatment (T)	0.11	0.12	0.10	0.13	0.07
	Storage (S)	0.11	0.12	0.10	0.13	0.07
	TxS	NS	NS	NS	NS	NS

*RTS drink variants prepared using 20% pulp and adjusting 12% TSS and 0.22% acidity; NS-Non-significant

Table 5: Cost of production (Rs./L) of sweet and spiced mature green mango-mint RTS drink variants

RTS drink variants (90 Mango:10 Mint)	Cost of production* (Rs./L)
Sweet RTS drink (without 2% chia seeds)	12.79
Sweet RTS drink (with 2% chia seeds)	32.79
Spiced RTS drink (without 2% chia seeds)	18.60
Spiced RTS drink (with 2% chia seeds)	38.60

*Includes cost of ingredients only

References

1. Aflatuni Abbas J, Uusitalo S, Hohtola. Variation in the amount of yield and in the extract composition between conventionally produced and micropropagated peppermint and spearmint. J Essential Oil Research. 2005;17(1):66-70.
2. Ayerza R, Coates W. Protein content, oil content and fatty acid profiles as potential criteria to determine the origin of commercially grown chia (*Salvia hispanica* L.). Industrial Crops and Products. 2011;34(2):1366-1371.
3. Bhardwaj S, Saraswat S. Product development, nutrient and sensory analysis of sports drink based on chia seeds (*Salvia hispanica* L.); c2019.
4. Capitani MI, Spotorno V, Nolasco SM, Tomás MC. Physico-chemical and functional characterization of by-products from chia (*Salvia hispanica* L.) seeds of Argentina. LWT-Food Science and Technology. 2012;45(1):94-102.
5. Cherian S, Lekshmi PG. Ready to Serve Aloe vera Gel Blended Functional Cashew Apple Beverage for Improved Nutritional and Sensory Qualities. J Krishi Vigyan. 2021;9(2):194-199.
6. Da Silva BP, Anunciacao PC, Da Silva Matyelka JC, Della Lucia CM, Martino HSD, Pinheiro-Sant'Ana HM. Chemical composition of Brazilian chia seeds grown in different places. Food Chemistry. 2017;221:1709-1716.
7. De Carvalho JM, Maia GA, De Figueiredo RW, De Brito ES, Rodrigues S. Development of a blended non-alcoholic beverage composed of coconut water and cashew apple juice containing caffeine. Journal of Food Quality. 2007;30(5):664-681.
8. De Souza HF, Borges LA, Lopes JPA, De Carvalho BMA, Santos SHS, De Almeida AC, *et al*. Elaboration, evaluation of nutritional information and physical-chemical stability of dairy fermented drink with cajamango pulp. Ciência Rural, 2020, 50(1).
9. Fowomola MA. Some nutrients and antinutrients contents of mango (*Magnifera indica*) seed. African Journal of Food Science. 2010;4(8):472-476.
10. Gazem RAA, H, Puneeth R, Madhu CS, Sharada AC. *In vitro* anticancer and anti-lipoxygenase activities of chia seed oil and its blends with selected vegetable oils, Asian Journal of Pharmaceutical and Clinical Research. 2017;10(10):124-128.
11. Kowaleski J, Quast LB, Steffens J, Lovato F, Dos Santos LR, Da Silva SZ, *et al*. Functional yogurt with strawberries and chia seeds. Food Bioscience. 2020;37:100-726.
12. Lozano JE. Fruit Manufacturing. Springer Science + Business Media, LLC; c2006.
13. Malik T, Gehlot R, Rekha, Sindhu R. Physico-chemical characteristics of mature green mango fruit pulp variety Ramkela and mint leaves. International Journal of Current Microbiology and Applied Sciences, Special. 2020;11:684-687.
14. Nadeem M, Imran M, Khalique A. Promising features of mango (*Mangifera indica* L.) kernel oil: A review. Journal of Food Science and Technology. 2016;53(5):2185-2195.
15. Owino WO, Ambuko JL. Mango Fruit Processing: Options for Small-Scale Processors in Developing Countries. Agriculture. 2021;11(11);1105.
16. Salehi B, Stojanovic-Radic Z, Matejic J, Sharopov F, Antolak H, Kręgiel D, *et al*. Plants of genus Mentha: From farm to food factory. Plants. 2018;7(3):70.
17. Sogi DS, Siddiq M, Greiby I, Dolan KD. Total phenolics, antioxidant activity and functional properties of 'Tommy Atkins' mango peel and kernel as affected by drying methods. Food Chemistry. 2013;141(3):2649-2655.
18. Torres-Leon C, Rojas R, Contreras-Esquivel JC, Serna-Cock L, Belmares-Cerda RE, Aguilar CN. Mango seed: Functional and nutritional properties. Trends in Food Science & Technology. 2016;55:109-117.
19. Vuksan V, Whitham D, Sievenpiper JL, Jenkins AL, Rogovik AL, Bazinet RP, *et al*. Supplementation of conventional therapy with the novel grain Salba (*Salvia hispanica* L.) improves major and emerging cardiovascular risk factors in type 2 diabetes: results of a randomized controlled trial. Diabetes Care. 2007;30(11):2804-2810.