International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(3): 468-475
www.biochemjournal.com
Received: 08-12-2023
Accepted: 13-01-2024

Mulukuri Naveena
Student, Department of Food Process Engineering, Dr. NTR College of Food Science & Technology, Bapatla, Andhra Pradesh, India

Blessy Sagar Seelam
Assistant professor,
Dr. NTR College of food science and techno logy,
Bapatla Acharya N.G Ranga Agricultural University,
Andhra Pradesh, India

K Vanitha
Student, Department of Food Process Engineering, Dr. NTR College of Food Science & Technology, Bapatla, Andhra Pradesh, India

K Keerthana
Student, Department of Food Process Engineering, Dr. NTR College of Food Science & Technology, Bapatla, Andhra Pradesh, India

K Chaitanya
Student, Department of Food Process Engineering, Dr. NTR College of Food Science & Technology, Bapatla, Andhra Pradesh, India

M Srija
Student, Department of Food Process Engineering, Dr. NTR College of Food Science & Technology, Bapatla, Andhra Pradesh, India

Corresponding Author:
Blessy Sagar Seelam
Assistant professor,
Dr. NTR College of food science and techno logy,
Bapatla Acharya N.G Ranga Agricultural University,
Andhra Pradesh, India

Development and quality evaluation of nutri-mix with watermelon seeds-pearl millet malt

Mulukuri Naveena, Blessy Sagar Seelam, K Vanitha, K Keerthana, K Chaitanya and M Srija

DOI: https://doi.org/10.33545/26174693.2024.v8.i3f.751

Abstract
Nutri-Mix is not only innovative but also nutritional rich product, including essential vitamins, minerals, and antioxidants, incorporating watermelon seeds and pearl millet into instant food. It's wonderful to see efforts to minimize food waste while promoting health and wellness. Watermelon seeds, often considered waste from the fruit, are nutritionally rich, containing folate, protein, fiber, vitamin B complex, phenolic compounds, and various minerals such as magnesium, potassium, phosphorous, sodium, iron, zinc, manganese, and copper. These seeds possess antioxidant activity and contribute to boosting immunity, aiding digestion, and maintaining the health of the nervous system and heart. Pearl millet is comparable to wheat in terms of protein content and superior to wheat in fats and minerals, particularly iron and calcium. Cocoa powder is consumed due to its good taste, flavor and health benefits. It's rich source of poly phenols especially abundant in flavonols. Cocoa poly phenols have antioxidant properties.
Watermelon seeds powder, pearl millet malt, cocoa powder and sugar of different proportions are used and made into a mix. 60% of sugar, 40% of watermelon seed powder, 0% of pearl millet malt, 0% of cocoa powder is considered as control sample (S_0). Sample treatments are named as S_1, S_2, S_3, S_4, S_5 respectively formulated using compositions of powders in ratio of 60:20:0:20, 60:20:5:15, 60:20:10:10, 60:20:15:5, 60:20:20:0. Incorporation of bajra powder in milk and other liquids is difficult so bajra is malted then powdered. The results showed that the drink mix of S_4 showed better results when reconstituted in milk. The S_4 samples have the high minerals and nutrients. the results of this sample is better than other with bulk density (0.666±0.14), water absorption capacity (4±0.67), solubility (15±0.98), sedimentation (0.4±0.008), carbohydrates (61.23±0.19), fat content (5.93±0.70), ash content (6±0.13), moisture content (4±0.10), Fiber content (5.42±0.21), protein content (17.42±0.09) and sensory evaluation with 8.5 rating. The NUTRI- MIX with pearl millet and watermelon seeds has increased the nutritional quality of the product. The product being rich in all the macronutrients can be used to tackle malnutrition in the children. Addition of watermelon seeds has increased sensorial acceptability along with nutritional enrichment. From the analysis conducted we conclude that S_4 sample has more acceptability due to its desirable proportions of the ingredients.

Keywords: Instant NUTRI-MIX**,** watermelon seeds, pearl millet malt, cocoa powder, proximate composition, microbiological property, sensory attribute

Introduction
Instant powder mixes are widely embraced for their simplicity, convenience, and quick preparation of food products, featuring pre-mixed ingredients. Among these, instant powder drinks stand out as a popular choice in the market, appealing not only to children but also to adults. The widespread appeal of cocoa-based products and drink powders can be attributed to their excellent dispersibility, solubility, and distinctive sensory qualities, including a pleasant melt-in-the-mouth experience. This research endeavors to create an innovative drink mix using pearl millet (bajra) and watermelon seeds (*Citrullus lanatus*) to harness the health benefits associated with these ingredients. Watermelon seeds, typically considered waste, prove to be nutritionally rich yet underutilized. They serve as a nutritional powerhouse, containing folate, protein, fiber, vitamin B complex, phenolic compounds, and various minerals such as magnesium, potassium, phosphorous, sodium, iron, zinc, manganese, and copper. Additionally, watermelon seeds exhibit antioxidant activity, contributing to health benefits such as immunity enhancement, digestive support, cell growth promotion, and maintenance of a healthy nervous system and heart. (Ghodke S.V *et al.* 2020) [21].

The proteins in watermelon seeds, primarily composed of globulin and glutelin, are easily digestible and possess a high amino acid score, making them valuable for producing high-quality protein products. These seeds are also associated with improved blood sugar control. Reportedly containing approximately 35% protein by weight in decorticated seeds, watermelon seeds offer a nutritionally rich amino acid profile. Beyond their nutritional value, watermelon seeds have economic benefits, particularly in regions where cultivation is on the rise. They find application in preparing snacks, milling into flour, and incorporating into sauces. The oil extracted from these seeds is used in cooking and forms an ingredient in cosmetics production. The richness of oil and protein in melon fruit seeds has been acknowledged, with Nigeria, for instance, producing oil from these seeds. (Ghodke S.V *et al.* 2020) [21].

Millet stands out as a versatile and adaptable grain, offering numerous straightforward preparation methods that make it accessible for individuals with celiac disease seeking gluten-free options in their diets. It serves as an excellent food choice for babies starting from six months of age. Millet's potential health benefits encompass cardiovascular protection, diabetes prevention, support for achieving and maintaining a healthy weight, and management of gut inflammation. Recognized in recent years as crucial substitutes for major cereal crops, millets play a vital role in addressing global food shortages and meeting the nutritional demands of both developed and developing countries. Millets are rich sources of essential nutrients, including dietary fiber, minerals, phenolics, and vitamins, contributing to various health benefits. (Archana Sehgal S, Kawatra A. 1998) [7].

Among millets, pearl millet is noted as the most economical source of energy, protein, iron, and zinc among cereals and pulses. Its nutritional composition matches wheat in protein content and surpasses wheat in fats and minerals, especially iron and calcium. However, the utilization of pearl millet is constrained by the presence of anti-nutritional factors such as phytates and polyphenols, along with challenges like a fibrous seed coat and colored pigments. Malting, involving the germination of millet grains in controlled moist conditions followed by drying at 50 °C for a specific duration, serves as a valuable process. The primary goal of germination is to stimulate the development of hydrolytic enzymes absent in ungerminated grains, while drying aims to halt enzymatic activity and enhance flavor. Malting contributes to a significant reduction in anti-nutritional components, thereby improving nutrient availability in the malt. This process has been reported to enhance *in vitro* digestibility, improve sensory quality, and extend the shelf life of the product. (Archana Sehgal S, Kawatra A. 1998) [7].

For centuries, cocoa powder has been consumed for its delightful taste, flavor, and associated health benefits. Cocoa stands out as one of the richest sources of polyphenols, particularly abundant in flavonols. The polyphenols found in cocoa, such as epicatechins, possess antioxidant properties that confer various positive effects against several pathological disorders, including cardiovascular disease, inflammatory processes, and cancer. The favorable impacts of cocoa are likely attributed to an increased bioavailability of nitric oxide. This heightened bioavailability potentially explains improvements in endothelial function, reduced platelet function, and beneficial effects on blood pressure, insulin resistance, and blood lipids. (Corti R *et al.* 2009) [14].

Materials and Methods

Criteria for raw materials selection

The importance of the watermelon seeds and their nutritional benefits as well as addition of instant nutria- mix incorporated with watermelon seeds and pearl millet malt to their everyday diet that helps you maintain physical and mental wellbeing. Based on the data obtained through this survey, the ingredient composition of powder NUTRI-MIX was finalized.

Preparation of malt, powders and processing flow chart of nutri - mix

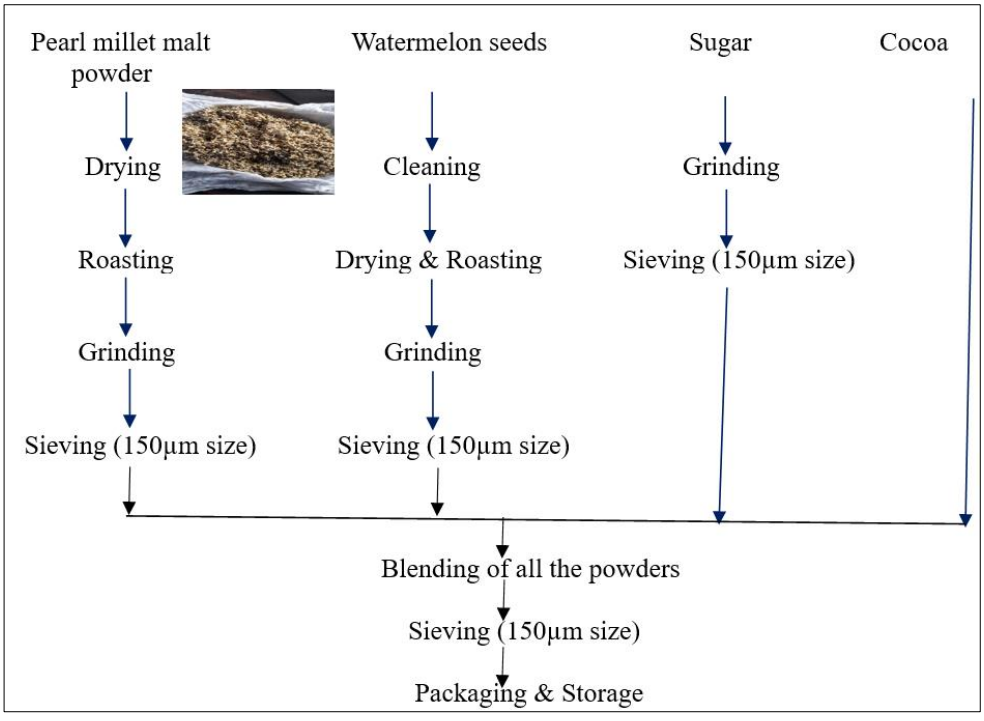

Fig 1: Flow chart for preparation of NUTRI-MIX

Table 1: Formulations of the Developed Product

Samples	Sugar	Watermelon seeds	Pearl millet malt	Cocoa powder
S_0 (Control)	60%	40%	0%	0%
S_1	60%	20%	0%	20%
S_2	60%	20%	5%	15%
S_3	60%	20%	10%	10%
S_4	60%	20%	15%	5%
S_5	60%	20%	20%	0%

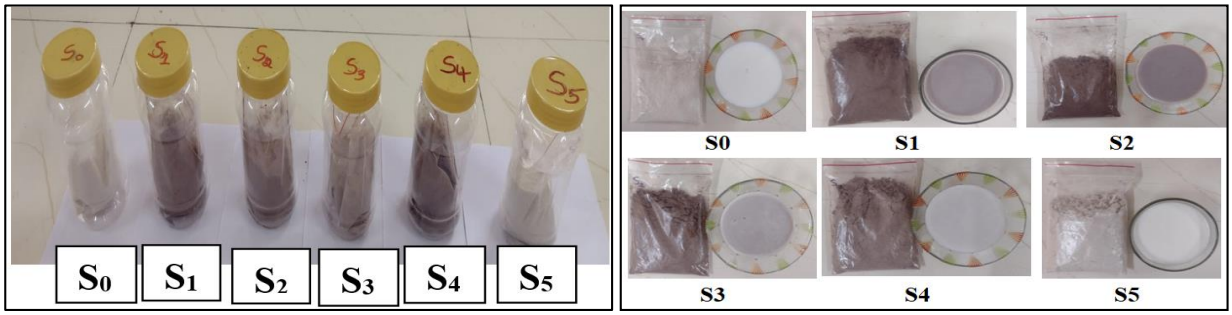

Fig 2: Instant NUTRI-MIX Samples

Physical analysis

Bulk density

Take 5 g of test sample in 100 mL graduated cylinder. The foot of cylinder is tapped on a research facility seat a few times until there's no assist dimensions of test left. The volume of the test is recorded (Kraithong *et al*. (2017) [22].

Bulk density (g/m^3) = Weight of flour (g)/ Volume of flour (mL)

Water absorption capacity (WAC)

The WAC is determined utilizing the strategy of Kraithong *et al*. (2017) [22]. One gram of flour was suspended in 10 mL of distilled water and blended with a vortex blender for 1 min. The suspensions were warmed in a water shower at 30 °C for 30 min with delicate stirring and centrifuged at 1,500. The supernatant was carefully poured into an aluminum dampness can some time recently being dried at 105 °C overnight. The sediments were collected and weighed. At that point WAC is calculated.

WAC (g/g) = Weight of wet sediment (g)/ Dry weight of flour (g)

Solubility

The Dissolvability were decided utilizing the strategy of Kraithong, *et al*. (2017) [22]. One gram of flour was suspended in 10 mL of refined water and blended with a vortex blender for 1 min. The suspensions were warmed in a water shower at 30 °C for 30 min with tender blending and centrifuged at 1,500. The supernatant was carefully poured into an aluminum dampness can some time recently being dried at 105 °C overnight. The silt were collected and weighed. At that point solubility is calculated.

Solubility (%) = Weight of dried supernatant (g)/ dry weight of flour (g) * 100

Sedimentation

Sedimentation is the method of permitting particles in suspension in water to settle out of the suspension beneath the impact of gravity. The particles that settle out from the suspension gotten to be silt, and in water treatment as slime. (Kraithong *et al.* (2017) [22].

Proximate analysis

Estimation of Fat Content (AOAC 2000) [4]

The fat substance of the test is decided by semi-continuous Soxhlet strategy utilizing Soxhlet device (Model SCS 4). Weigh 2-5 g of dampness free test and take it into a cellulose thimble. Cover the beat of the thimble with cotton and put it within the Soxhlet container of known weight. Pour 80mL of petroleum ether into the beaker. Place the container within the Soxhlet device. Organize the outlet and gulf channels. Switch on the Soxhlet device and set the temperature to 80 °C. Take off it for an hour. The petroleum ether extricates the fat from the test. After an hour increment the temperature to 160 °C for partition of petroleum ether by distillation process. Switch off the device and put the measuring utensil on a hot plate (or) hot discuss broiler at 100 °C for10 minutes for the expulsion of any buildups of petroleum ether. Take the weight of the container and once more put it on the hot plate (or) hot discuss stove. Rehash the method till the two sequential weights of the container are break even with. Note the ultimate weight of the measuring utensil and calculate the fat substance.

$$\text{Fat content (\%)} = \frac{\text{Final weight of the utensil) – (weight of the empty utensil}}{\text{Weight of sample}} \times 100$$

Estimation of Ash Content (AOAC 2000) [4]

To determine the ash content, utilize a muffle furnace by initially placing the crucible and its lid in the furnace at 550 °C for an overnight period. This ensures the elimination of impurities from the crucible surface. Subsequently, cool the crucible in a desiccator for 30 minutes. Accurately weigh the crucible and lid to three decimal places. Next, introduce approximately 5 grams of the sample into the crucible and return it to the furnace. Heat the crucible at 550 °C overnight, leaving the lid uncovered during the heating process. After complete heating, place the lid to prevent the loss of fluffy ash. Allow the crucible to cool in the desiccator and weigh the ash, along with the crucible and lid, when the sample transforms to a gray color.

If this transformation does not occur, return the crucible and lid to the furnace for further ashing.
Ash Content (%) = Weight of ash / Weight of the sample * 100

Estimation of moisture content (AOAC 2000) [4]
Initiate the drying process by drying the empty dish and its lid in an oven set at 105 °C for a duration of 3 hours, then transfer them to a desiccator for cooling. Subsequently, accurately weigh the empty dish and lid. Proceed by weighing approximately 3 grams of the sample into the dish, ensuring an even distribution. Place the dish with the sample in the oven and dry it for 3 hours at 105 °C. Upon completion of the drying process, transfer the dish with a partially covered lid to the desiccator for cooling. Finally, reweigh the dish along with its dried sample to complete the procedure.

$$\text{Moisture Content (\%)} = \frac{(W1-W2)}{W1} \times 100$$

Where:
W1 = weight (g) of sample before drying
W2 = weight (g) of sample after drying

Estimation of crude Fiber (AOAC 2000) [4]
Begin by extracting 2 grams of ground material with either ether or petroleum ether to eliminate fats, ensuring an initial boiling temperature between 35-38 °C and a final temperature of 52 °C. If the fat content is less than 1%, fat extraction can be skipped. After ether extraction, bubble 2 grams of dried fabric with 200 mL of sulfuric acid for 30 minutes, joining bumping chips. Filter the mixture through muslin and wash with boiling water until the washings are no longer acidic. Proceed to boil the filtered material with 200 mL of sodium hydroxide solution for 30 minutes. Channel through muslin cloth once more, washing with 25 mL of bubbling 1.25% H2SO4, three 50 mL parcels of water, and 25 mL of alcohol. Transfer the residue to a pre-weighed ashing dish. Dry the residue for 2 hours at 130±2 °C. Cool the it in a desiccator and weigh. Ignite for 30 minutes at 600±15 °C. After cooling in a desiccator, reweigh to complete the process.

$$\text{\% Crude Fiber in ground sample} = \frac{(W1-W2)}{WS} \times 100$$

Where:
WS = weight (g) of sample.
W1 = weight (g) of crucible with sample.
W2 =weight (g) of crucible with ash.

Estimation of Protein Content by Kjeldhal method (AOAC 2000) [4]: The micro Kjeldahl method is employed for determining the protein content in the sample. This method is designed to estimate nitrogen (N2) and involves three key processes.

Digestion: Where nitrogen in complex structures found in samples such as plants, soil, meat, fertilizers, etc., is broken down into simpler forms. This process results in the release of nitrogen in the form of ammonium radicals (NH4+). An illustrative equation during the digestion of an organic sample is presented below as a fundamental example.

$$\text{Organic } N_2 + H_2SO_4 \rightarrow (NH_4)_2\,SO_4 + H_2O + CO_2$$

Measure 0.5 grams of the sample and transfer it to the digestion tube. Introduce 10-15 mL of a concentrated sulfuric acid and 527 g catalyst mixture into the digestion tube, then apply heat using the digestion block. It is recommended to keep the temperature within the range of 360 °C and 410 °C to minimize the potential escape of nitrogen. Throughout the digestion process, the sample undergoes a color change, ultimately appearing colorless or light green at its conclusion.

Distillation process
In the distillation process, ammonium radicals are transformed into ammonia under conditions of excess alkali. After neutralization, the digested sample is combined with 40% NaOH and heated, causing the release of ammonia during steam passage through the digested samples. The liberated ammonia is then dissolved in a solution containing 4% boric acid. The boric acid, now containing NH3, is utilized for titration. The acid digestion mixture is subsequently diluted and rendered strongly alkaline with NaOH, resulting in the liberation of NH3.

$$(NH_4)_2\,SO_4 + 2NaOH \xrightarrow{\triangle} 2NH_3 + NaSO_4 + 2H_2O$$

Titration
Perform titration on the solution comprising boric acid and a mixed indicator, which includes the ammonia distilled off, using standardized 0.1 N HCl. Establish the titration value by determining the titration of a blank solution containing boric acid and the mixed indicator.

$$NH_3H_3BO_3 \rightarrow NH_4^+ : H_2BO_3 + H_3BO$$

$$2NH_4\,H_2BO_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4 + 2H_2BO_3$$

$$N_2 \text{ present in given sample (\%)} = \frac{(Vs - Vb)\ \text{Normality of HCL} \times 14}{\text{Sample weight}} \times 100$$

Where:
Vs = Sample titer value.
Vb = blank titer value.

Estimation of Carbohydrates (AOAC 2000) [4]
The Carbohydrates content of the sample is calculated by using difference method to obtain 100% of the total composition (FAO, 2003) [15].

Carbohydrates (%) = 100 – (moisture + crude fiber + ash + protein + fat)

2 Organoleptic evaluations
Developed product was evaluated by 20 semi-trained panel members. Samples were coded and served to the panel members. The product was subjected to evaluation for appearance, taste, consistency and overall acceptability on a 9-point hedonic scale. Score sheet was used for evaluation of the product and same is presented in Appendix. The maximum score is 9. (Handbook of Food Science and Technology (pp.362-386) Chapter: Sensory Evaluation and Consumer Acceptability. ub2017).

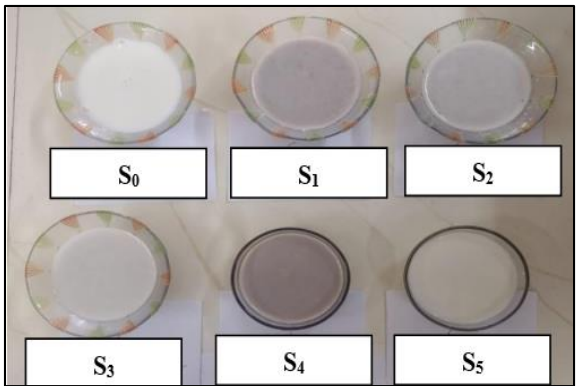

Fig 3: Final developed product for Sensory Evaluation

Storage studies

Total Plate Count (APHA 1992) [6]

To conduct a bacterial limit test, a total plate count agar medium was formulated. This involved dissolving 25 g of the medium in 1000 ml of diluted water, along with a 0.1% peptone water solution created by dissolving 100mg of peptone in 100 ml of water. Both the medium and peptone water underwent sterilization through autoclaving at 15lbs pressure and 121 °C for 5 minutes. The spread plate technique was employed for plating, followed by incubation at 37 °C for 48 hours. The sample's pH was adjusted to 7 using either 1 N NaOH or 1 N HCl. Sterilized media (15-20 ml) was transferred into petri plates and allowed to solidify. For sample preparation, 1 g of the sample was diluted in 100ml of peptone water. After solidification of the media in the petri plates, the plates were spread with the prepared sample using a glass rod. Petri plates were then closed and incubated in an inverted position in an incubator for 48 hours at 37 °C. Following this incubation period, the number of colonies was counted, and the results were recorded. (APHA 1992) [6].

Total Yeast & Mold Count (APHA 1992) [6]

In preparation for the fungal limit test, a potato dextrose agar media was formulated. This involved dissolving 39 g of media in 1000 ml of diluted water, and a 0.1% peptone water solution was created by dissolving 100 mg of peptone in 100 ml of water. Both the media and peptone water underwent sterilization through autoclaving at 15 lbs. pressure and 121 °C for 5 minutes. The spread plate technique was employed for planting, followed by incubation at a temperature range of 22-25 °C for 48 hours. The sample's pH was adjusted to 7 using either 1 N NaOH or 1 N HCl. Sterilized media (15-20 ml) was transferred into petri dish plates and allowed to solidify. For sample preparation, 1 g of the sample was diluted in 100 ml of peptone water. After solidification of the media in the petri plates, the plates were spread with the prepared sample using a glass rod. Petri plates were then closed, and incubation was carried out in an inverted position in an incubator for 48 hours at 23 °C. Following this incubation period, the number of colonies was counted, and the results were recorded. (APHA 1992) [6]

E. Coli Count (APHA 1992) [6]

EMB agar media was prepared for the fungal limit test by dissolving 10 g of media in 1000ml of diluted water. A 0.1% peptone water solution was concurrently prepared by dissolving 100mg of peptone in 100ml of water. Both the media and peptone water underwent sterilization through autoclaving at 15 lbs. pressure and 121 °C for 5 minutes. The spread plate technique was applied for planting, and incubation took place at a temperature of 37 °C for 24 hours. The sample's pH was adjusted to 7 using either 1 N NaOH or 1 N HCl. Sterilized media (15-20ml) was transferred into petri dish plates and allowed to solidify. For sample preparation, 1 g of the sample was diluted in 100 ml of peptone water. After solidification of the media in the petri plates, the plates were spread with the prepared sample using a glass rod. Petri plates were then closed, and incubation occurred in an inverted position in an incubator for 24 hours at 37 °C. Following this incubation period, the number of colonies was counted, and the results were recorded. (APHA 1992) [6]

2. Statistical analysis

Values are presented as means ± standard error (SE). For this study, the values were subjected to one way ANOVA with least significant difference test. The mean difference was considered significant if the P-value is ⩽.05 level.

Results and Discussions

Physical analysis

Table 2: Physical Analysis for Developed Products

Sample	Bulk Density	Water Absorption Capacity	Solubility	Sedimentation
S_0	0.714±0.010	2±0.032	20±0.012	0.2±0.001
S_1	0.562±0.010	2.5±0.067	25±0.095	0.24±0.082
S_2	0.588±0.015	2.64±0.042	20±0.095	0.28±0.008
S_3	0.625±0.013	3.5±0.056	19±0.096	0.3±0.002
S_4	0.666±0.014	4±0.067	15±0.098	0.4±0.0089
S_5	0.769±0.012	4.5±0.045	14±0.097	0.47±0.009

*All the values are presented as mean±standard deviation with three replications.

The bulk density was found to be highest in S_5 (0.769±0.12) since the absence of cocoa powder and S_1 (0.562±0.10) had the lowest since the presence of cocoa powder. The Water absorption capacity was found to be highest in S_5 (4.5±0.45) since the desirable compositions of the pearl millet malt and water melon seeds. S_0 (2±0.32) had the lowest since the presence of high proportions of sugar and watermelon seeds. The Solubility was found to be highest in S_1 (25±0.95) since the high content of cocoa powder leads to high solubility, S_5 (14±0.97) had no cocoa powder. The Sedimentation was found to be highest in S_5 (0.47±0.009) since the presence of high content of bajra malt and no cocoa powder. S_0 (0.2±0.001) had the lowest since the absence of bajra. Similar kind of findings were observed by Vanishree S *et al*. 2016 [20].

Proximate analysis

Table 3: Proximate Analysis for Developed Products

Sample	Fat Content	Ash Content	Moisture Content	Crude Fiber	Protein Content	Total Carbohydrates
S_0	7.21±0.13	4.48±0.30	4.12±0.12	5.01±0.23	16.02±0.12	59.01±0. 21
S_1	10.0±0.80	4.49±0.25	5.12±0.09	5.21±0.19	16.77±0.15	59.22±0.31
S_2	8.33±0.69	5.78±0.29	4.21±0.15	5.29±0.18	16.99±0.11	59.49±0.29
S_3	6.42±0.70	5.82±0.19	4.10±0.08	5.33±0.17	17.18±0.13	60.55±0.22
S_4	5.93±0.70	6±0.13	4±0.10	5.42±0.21	17.42±0.09	61.23±0.19
S_5	5.32±0.62	6.6±0.12	3.92±0.1	5.61±0.22	17.61±0.12	61.98±0.13

*All the values are presented as mean±standard deviation with three replications.

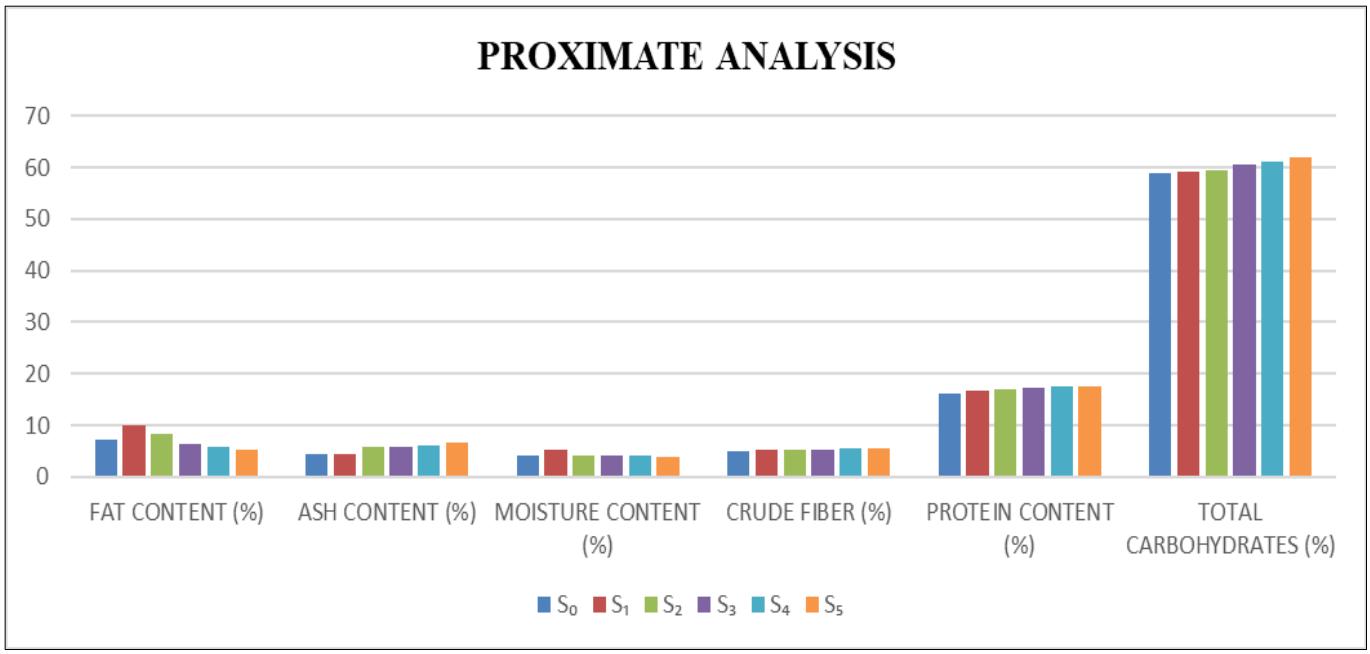

Fig 4: Proximate analysis of different NUTRI-MIX

Among all the samples, S_1 (10.0±0.80) had the highest fat content since presence of high amount of cocoa powder and S_5 (5.32±0.62) had the lowest fat content. This is because no addition of cocoa powder. Similar kind of findings were observed by Benkovic M *et al.* 2015 [10]. Among all the samples, S_5 (6.6±0.12) had the highest ash content as it contains low moisture content and dried malt. The lowest ash content was found to be in S_0 (4.48±0.30) being the control sample. Similar kind of findings were observed by Ghodke S.V *et al.* 2020 [21]. Among all the samples, the highest moisture content is observed in S_1 (5.12±0.09) and the lowest moisture is observed in S_5 (3.92±0.1). Moisture content as in agreement with and Similar kind of findings were observed by Ghodke S.V *et al.* 2020 [21]. Out of all the samples, S_5 (5.61±0.22) had the highest crude fiber content because pearl millet malt prove to be rich in fibers whereas, S_0 (5.01±0.23) had the lowest crude fiber content since no malt. Similar kind of findings were observed by Abdaka *et al.* 1998 [3]. The highest protein content is observed to be in S_5 (17.61±0.12) due to presence of high amount of bajra malt and watermelon seeds. The lowest protein content was observed to be in S_0 (16.02±0.12) due to the absence of bajra malt. Similar kind of findings were observed by Vanishree S *et al.* 2016 [20]. The Total Carbohydrates was found to be highest in S_5 (61.98±0.13) since pearl millet malt contain more carbohydrates. S_0 (59.01±0.21) had the lowest carbohydrate composition very similar to S_1 (59.22±0.31) since not having pearl millet malt. Similar kind of findings are observed in Abdaka *et al.* 1998 [3].

Organoleptic evaluation

The standardized procedure for optimisation of Nutri-Mix was employed and organoleptically evaluated on a 9-point hedonic scale for color, taste, consistency and overall acceptance. Best Nutri -Mix sample was selected on the above-mentioned parameters by a panel of 20 judges.

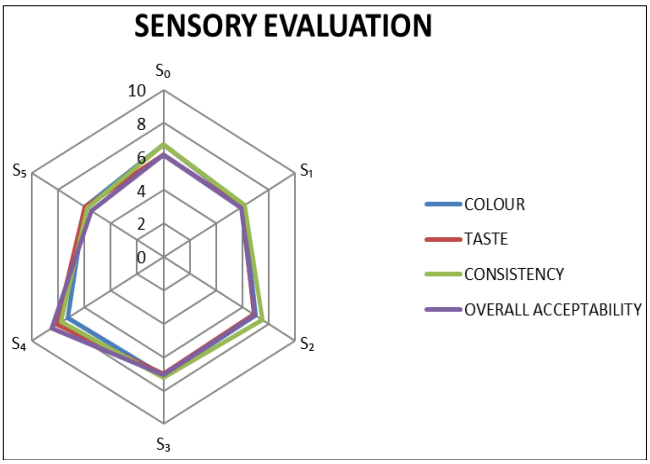

Fig 5: Radar chart of variation in organoleptic evaluation in different NUTRI-MIX samples

Storage studies (CFU/ml)

Table 4: TPC, Total Yeast & Mold count and *E. coli* count in different NUTRI-MIX Samples on 0th, 15th and 30th day

Samples	TPC 0th day	TPC 15th day	TPC 30th day	Yeast and Mold 0th day	Yeast and Mold 15th day	Yeast and Mold 30th day	E. coli 0th day	E. coli 15th day	E. coli 30th day
S_0	ND	ND	13±0.1	ND	ND	4±0.21	ND	ND	ND
S_1	ND	ND	12±0.02	ND	ND	3.9±0.03	ND	ND	ND
S_2	ND	ND	11±0.031	ND	ND	3.5±0.06	ND	ND	ND
S_3	ND	ND	9±0.03	ND	ND	3±0. 05	ND	ND	ND
S_4	ND	ND	8±0.03	ND	ND	2.7±0.09	ND	ND	ND
S_5	ND	ND	7.74±0.09	ND	ND	2±0.05	ND	ND	ND

*All the values are represented as mean±standard deviation with three replications,
Note: ND- Not Detected

Among all the samples, on the 0th and 15th day in the TPC, Total Yeast & Mold count and E-Coli count the microbial growth not detected, this is because there is no any growth of microbes in the samples and the samples are good. On the 30th day highest TPC was observed in S_0 (13±0.1) and lowest TPC was observed in S_5 (7.74±0.09) and also highest yeast and mold count was observed in S_0 sample (4±0.21) and lowest was observed in S_5 sample (2±0.05) due to its difference in moisture content. All the samples of the developed product were free of any E. coli growth over a period of 30 days, this is because of the products are free of any E-coli microorganisms. The results of these samples agree with the results in Vanishree S, *et al.* 2016 [20].

Conclusion

The drink mix with pearl millet and watermelon seeds has increased the nutritional quality of the product. The product being rich in all the macronutrients can be used to tackle malnutrition in the children. Six different samples of Nutri-Mix were developed from watermelon seeds, pearl millet malt and cocoa powder. The developed product was subjected to sensory evaluation by 20 semi- trained panelists to evaluate different sensory attributes. The sensory attributes like color, taste, consistency and overall acceptability was recorded highest for S_4 sample and lowest for S_5 sample. Hence S_5 sample was observed to have better nutritional properties compared to other samples. S_4 sample was observed to have better sensory acceptability compared to other samples by containing desirable proportions of the ingredients.

Reference

1. Protosoaie A, Luca S, Miron A. Flavor chemistry of cocoa and cocoa products-an overview. Comprehensive Reviews in Food Science and Food Safety. 2016;15:73-91.
2. AACC. Aproved Methods of the American Association of Cereal Chemists. 10th ed. St. Paul, Minnesota, USA: American Association of Cereal Chemists; c2000.
3. Abdaka AA, El Tinay AH, Mohamed BE, Abda3a AH. Proximate composition, starch, phytate and mineral contents of 10 pearl millet genotypes. Food Chemistry. 1998;63:243-246.
4. AOAC. Official Methods of Analysis. 17th ed. Arlington, VA: Association of Official Analytical Chemists; c2000.
5. AOAC. Official Methods of Analysis. 17th ed. Washington, USA: Association of Official Analytical Chemists, Inc.; c2000.
6. APHA. Compendium of methods for the microbiological examination of foods. Washington, DC: American Public Health Association; c1992.
7. Archana Sehgal S, Kawatra A. Reduction of polyphenol and phytic acid content of pearl millet grains by malting and blanching. Plant Foods Hum Nutr. 1998;53:93-98.
8. Arora P, Sehgal S, Kawatra A. Content and HCl-extractability of minerals as affected by acid treatment of pearl millet. Food Chem. 2003;80:141-144.
9. Badau MH, Nkama I, Jideani IA. Phytic acid content and hydrochloric acid extractability of minerals in pearl millet as affected by germination time and cultivar. Journal of Food Chemistry. 2005;92:425-435.
10. Benkovic M, Tusek A, Belscak-Cvitanovic A, Bauman I. Artificial neural network modeling of changes in physical and chemical properties of cocoa powder mixtures during agglomeration. LWT - Food Science and Technology. 2015;64:140-148.
11. Tabiri B, Agbenorhevi JK, Wireko-Manu FD, Ompouma EI. Watermelon Seeds as Food: Nutrient Composition, Phytochemicals and Antioxidant Activity. International Journal of Nutrition and Food Sciences. 2016;5(2):139-144.
12. Braide W, Odiong I, Oranusi S. Phytochemical and Antibacterial properties of the seed of Watermelon (*Citrullus lanatus*). Prime Journal of Microbiology Research. 2012;2(3):99-104.
13. Braide W, Odiong I, Oranusi S. Phytochemical and Antibacterial properties of the seed of watermelon (*Citrullus lanatus*). Prime Journal of Microbiology Research. 2012;2(3):99-104.
14. Corti R, Flammer A, Hollenberg N, Luscher T. Cocoa and cardiovascular Health Circulation. 2009;10(119):1433-1441.
15. FAO (Food and Agriculture Organization of the United Nations). Food Energy: Methods of Analysis and conversion factors. Rome, Italy: Report of a technical workshop; Food and Nutrition paper volume 77, FAO; c2003.
16. Handbook of Food Science and Technology. Chapter: Sensory Evaluation and Consumer Acceptability; c2017. p. 362-386.
17. Lakshmi J, Purnima K. Nutritional potential, bioaccessibility of minerals and functionality of watermelon (*Citrullus vulgaris*) seeds. LWT- Food science and technology. 2011;44:1821-1826.
18. Malleshi N, Chakravarthy M, Kumar S. A process for the preparation of milled malted flour. Indian Patent No: 18487; c1995.

19. Meilgaard M, Civile GV, Carr BT. Sensory Evaluation Techniques. 4th ed. Florida, USA: CRC Press; c2007.
20. Vanishree S, Kammar MR, Nidoni U. Development and Evaluation of Pearl Millet Based Novel Health Drink. The Indian Journal of Nutrition and Dietetics. 2016;53(4):5483-5486
21. Ghodke SV, Dhanke ON, Dere UP, Dhamdhere AJ. Development of Innovative Finger Millet -Watermelon Seed Powder Drink Mix. Aegaeum Journal, 2020, 8(10).
22. Kraithong S, Lee S, Rawdkuen S. Physicochemical and functional properties of Thai organic rice flour. Journal of cereal science. 2017;79:10.1016.
23. Wani A, Sogi D, Singh P, Wani I, Shivhare U. Characterization & functional properties of watermelon (*Citrullus lanatus*) seed proteins. J Sci. Food Agric. 2011;91:113-191.