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Biochemical characterization, organoleptic evaluation and functional properties of health beverage mix

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Abstract
Health or nutri-drink mix is the product with essential nutrients which generally helps boosts the energy levels; positioned by the enterprise as taste enhancers. A nutritious beverage mix was developed by incorporation of horsegram malt flour, to enhance the nutritional profile. The present investigation focused on malting of horsegram seeds to enhance nutritional, functional parameters and reduce the anti-nutritional factors. The malted flour was added to the compositional beverage mix developed with levels of 0%, 5%, 10%, 20%.

The performed investigation resulted that all samples (T_0, T_1, T_2, T_3, T_4) were organoleptically acceptable. Formulation (T_3) was found to gain higher score for sensory parameters (color and appearance-8.5, consistency -8.3, taste-8.0, flavor-8.0, overall acceptability-8.3). The selected sample (T_3) was found to have higher levels of protein and crude fibre (15.73 ± 0.66 g/100 g, 5.13 ± 0.53 g/100 g) as compared to control sample, due to orderly increase in levels of malt to mix. The mineral content i.e., magnesium, phosphorus and zinc levels were found to be enhanced in selected sample (T_3) as 62.03 ± 0.09 mg/100 g, 116.90 ± 2.09 mg/100 g, 5.57 ± 0.24 mg/100 g. The functional properties of the beverage mix were found to be magnified as for Bulk density, WAC, OAC, etc. The health beverage mix was found to be high energy levels i.e., 371.15 kcal.

Keywords: Nutritional profile, malt, anti-nutritional, organoleptic, functional

Introduction
India, a country with abundant food production, yet faces the issues of food hunger and food insecurity. The nutritional status of the country needs to be masked by initiating the food supply of healthy, nutritious foods. The utilization of the regional crops for the development of nutritious food in the form of supplementary foods will enhance the nutritional security to the population. Cereals, legumes, pulses generally are grown on larger extent. The grains need to be processed to enhance the nutritional profile by various methods such as soaking, germination, fermentation, etc. Malting, the technique used to enhance the nutritional level as well as reduce the anti-nutritional factors of the grains. Thus, the malted cereal or legume flour can be a great sustainable option for incorporation into diets or other food products.

In India, malt-based food drinks are prominently known as health drinks, widely consumed by the growing children, women, and adults for the enhanced nutrition power. These drinks too serve as taste enhancers, added to the diet for overall health and boosting of energy levels. Malted beverage or drinks as malt-based foods produced by blending of malt of grains with other cereal and legumes flour with or without whole milk or milk powder and / or cocoa powder and nuts like almonds, cashew, etc. Malted beverage mix act as nutritious, concentrating majorly on function and not on flavor. In India, the malt-based products are generally advertised as “health drinks.”

Horse gram *Macrotyloma uniflorum (Lam.) Verdc*., a leguminous major crop of ancient India, native to Southeast Asia and tropical Africa grown in arid and semi-arid regions. Horse gram, a food crop with good amount on nutrition, majorly rich source of proteins, amino-acids, minerals, still under-utilized for consumption (Gaikwad and Ghatge, 2022) [6]. Scientific research study shows the reduction of anti-nutritional factors in horse gram on various processing applications. Malting of horse gram efficiently enhances the nutritional profile and reduces the anti-nutritional factors i.e., phytates and tannins (Moktan and Ojha, 2016) [20].

Guar gum extracted from guar beans finds its applications in food products as thickening agents or aids in viscosity control for beverages, drinks, jams, liquid foods, etc. The present study focuses on incorporation of malted horse gram flour in the product developed i.e., health beverage mix by use of other ingredients as finger millet, watermelon seeds, jaggery, cocoa powder, skim milk powder, guar gum.

Materials and methodology

Material

Experimental food sample

The research study was conducted using raw materials as finger millet, horse gram, watermelon seeds, jaggery, cocoa powder, skim milk powder and guar gum. The raw material was procured from the local market at Parbhani. Food Grade Guar Gum of brand Foodfrillz was obtained from Pune market.

Methodology

a. **Malting:** Malting of horse gram seeds was performed by application of pre-treatments such as soaking, germination, steam cooking, drying, cleaning. The obtained malt was further grinded/ milled to obtain horse gram malt flour.
b. **Roasting:** Roasting of finger millet, water melon seeds and flax seeds was done to enhance the flavor profile. The roasted finger millet, watermelon seeds and flax seeds individually were grinded to fine size powder. The powder was sieved through 80 mesh size. The roasted material is stored in air-tight containers for further processing. The flours are roasted again prior to preparation of health drink mix for textural and flavor enhancement.
c. **Preparation of health drink mix:** The health drink mix was prepared by combining and blending of all the ingredients as per the formulations. The variations in fingermillet flour was done by incorporating the horsegram malt flour at the levels of 5%, 10%, 15% and 20%. The fine blended mix powder is sieved and stored in HDPE standing pouch packaging material.

Table 1: Formulation of health beverage mix

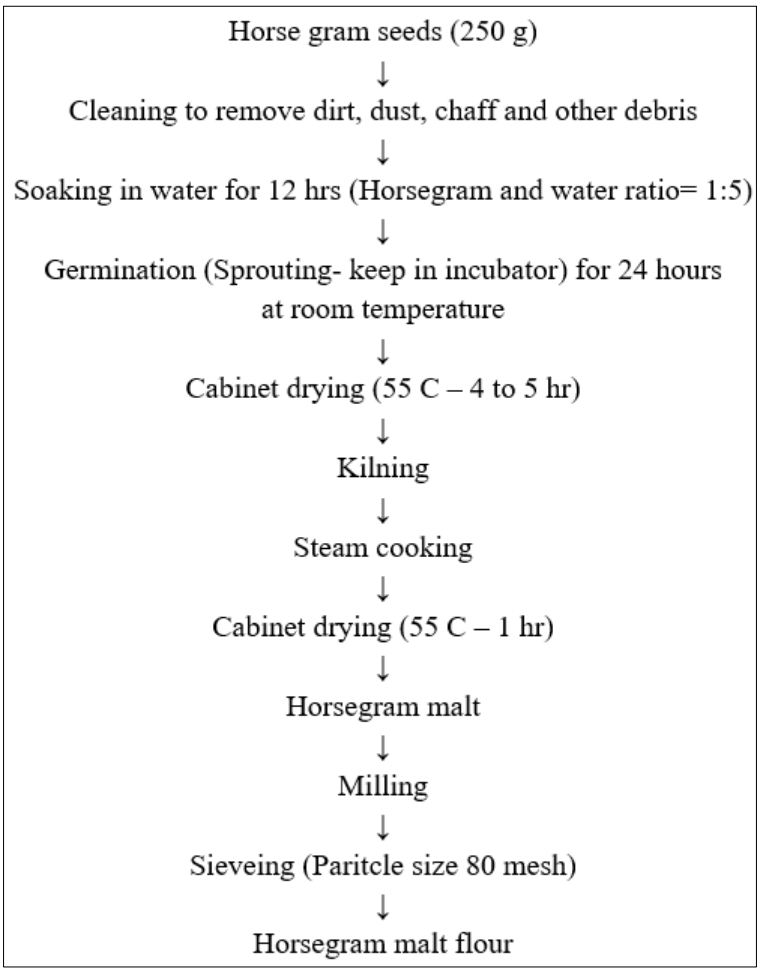
Ingredients	T_0 (Control)	T_1	T_2	T_3	T_4
Fingermillet flour (g)	30	25	20	15	20
Horsegram malt flour(g)	00	05	10	15	20
Jaggery powder (g)	48	48	48	48	48
Cocoa powder (g)	10	10	10	10	10
Skim milk powder (g)	08	08	08	08	08
Watermelon seed (g)	3.5	3.5	3.5	3.5	3.5
Guar gum powder (g)	0.5	0.5	0.5	0.5	0.5

Where,
T_0 is health drink mix without horsegram malt
T_1 is health drink mix with 5 percent horsegram malt
T_2 is health drink mix with 10 percent horsegram malt
T_3 is health drink mix with 15 percent horsegram malt
T_4 is health drink mix with 20 percent horsegram malt

Reconstitution of beverage

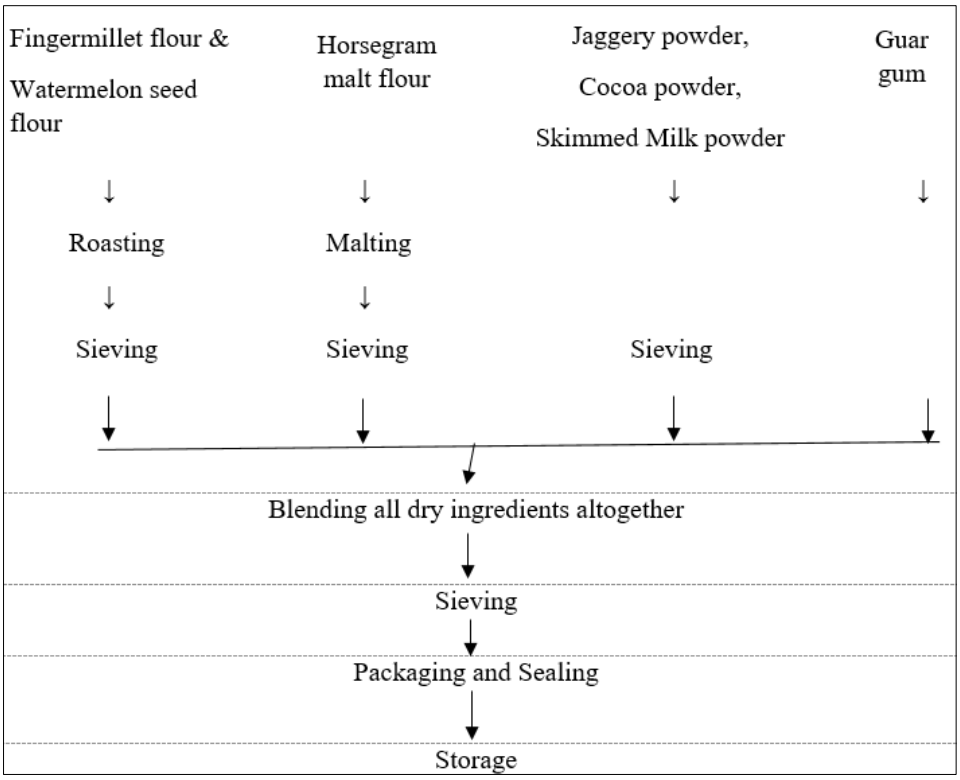
The beverage was prepared by mixing 20 g of mix powder into 250 ml of hot milk.

Preparation of horse gram malt flour



Flow chart 1: Malting of Horsegram

Preparation of health drink mix by incorporation of horse gram malt flour



Flow chart 2: Preparation of Health Drink mix

Sensory Evaluation of health beverage mix

Sensory evaluation of the trial combinations (T_0, T_1, T_2, T_3, T_4) was carried out by 10 semi-trained panelists on 9-point hedonic scale. The health beverage mix was evaluated for sensory evaluation based on colour, taste, flavor, texture and overall acceptability. Scores were given on hedonic scale ranging from 9 to 1 representing like extremely to dislike extremely respectively.

Evaluation of biochemical characteristics of health beverage mix: The moisture content, ash contents were determined by the standard method. The determination of protein content was estimated by the Kjeldahl (1976) method by initially calculating nitrogen content and further protein from the nitrogen content. The crude fat was extracted and measured by the Soxhlet apparatus using n-hexane, as per AACC, (2000) [1]. The crude fibers and total carbohydrates were performed according to the methodology described by Ranganna (1986) [13]. The energy value of the product can be determined by the Atwater and Wood (1986).

Physiological energy = (%protein x 4) + (% carbohydrate x 4) + (%fat x 9)

Determination of functional properties of health drink mix: The particle size was determined by sieving method and the maximum amount of weight retention of the sample. The Particle density was determined by a liquid displacement method method given by Beckett *et al* (1962) [5]. Morever, the bulk density of the sample was determined by gravimetric method described by Amandikwa *et al*., (2015) [2]. Swelling capacity of mix was calculated as given by Sowbhagya *et al.*, (2007) [16]. The water and oil absorption capacity of the sample was estimated by the method given by Sosulki et al., (1976) [15].

Statistical analysis

The results obtained were in triplicate (n = 3) and expressed as mean ± standard deviation.

Result and Discussion

Organoleptic evaluation of health beverage mix

The responses for organoleptic evaluation of health beverage mix are given in Table no.2. The comparative study for organoleptic parameters such as color, taste, flavor, texture, overall acceptability of the control and four trial combinations are presented in table 2.

Table 2: Organoleptic evaluation of health beverage mix

Sample	Sensory attributes				
	Color and appearance	Taste	Flavor	Texture (Consistency)	Overall acceptability
Control	8.0	8.0	8.1	8.1	8.1
T_1	7.8	7.8	7.8	8.1	7.9
T_2	8.0	7.9	7.6	8.0	8.0
T_3	8.1	8.0	8.0	8.3	8.3
T_4	7.4	7.2	6.9	7.2	7.5

*Each value is the average of 10 readings

The tabulated data revealed that combination T_3 obtained higher score for color and appearance i.e., 8.1 whereas lowest color value was observed in T_4 i.e., 7.4. Sample T_3 obtained highest score for flavor i.e. (8.0) while sample T_4 obtained less score for flavor i.e. (6.9). The sample T_3 obtained maximum score for taste (8.0) whereas sample T_4 obtained similar score for taste (7.1). When beverage mix is fortified with more than 15 per cent by malted drink mix then taste and textural attributes of mix get affected. The control sample and sample T_3 with highest acceptability were further evaluated for nutritional and functional characterization.

Biochemical characteristics of health beverage mix

The biochemical study of control and sample with higher acceptability was evaluated. The table 3 represents the biochemical analysis of the control and selected sample T_3, which comparatively depicts the decrease and increase of compositional factors on addition of horsegram malt in the mix.

Table 3: Proximate composition of health beverage mix

Parameters (%)	Control	Selected Sample T_3
Moisture	6.83 ± 0.04	4.57 ± 0.49
Protein	11.43 ± 1.12	15.73 ± 0.66
Fat	4.99 ± 0.59	5.03 ± 0.14
Ash	2.92 ± 0.32	3.34 ± 0.30
Carbohydrate	69.77 ± 1.33	65.74 ± 0.58
Crude fiber	2.81 ± 0.71	5.13 ± 0.53

*Each value is average of three determinations

The factual data revealed that the health beverage mix comes under the category of non-perishable food commodity as moisture content in control and T_3 sample was 6.83 ± 0.04 % and 4.57 ± 0.49 % respectively. With compare to control selected sample (T_3) contains more protein and it was observed that protein content of control and T_3 sample was 11.43 ± 1.12 % and 15.73 ± 0.66 % respectively. The increase in the protein content of the product was observed because of the malting process. Similar results were obtained by Kouakou *et al.,* 2013 [9] as the protein level in weaning mix increases with rise in addition of composite flours. Fat content of the control and T_3 sample was 4.99 ± 0.59 % and 5.03 ± 0.14 % respectively. T_3 sample contains less carbohydrate 65.74 ±0.58 % than the control sample 69.77 ± 1.33 % as the enhanced level of malt leads to increase in protein and ash, simultaneously decrease in carbohydrates.

Crude fibre content of the T_3 sample was found to be more than control sample as horsegram seeds tends to have the good quantity of fibre content and crude fibre was found 2.81 ± 0.71 % and 5.13 ± 0.53 % in control and T_3 sample. Ash content in the control and T_3 sample was 2.92 ± 0.32 %, 3.34 ± 0.30 % respectively. The ash content of selected sample was more than control due to the incorporation of horsegram malt. Selected sample found to be the good source of nutrient with compare to control. The obtained data narrated that the sample T_3 was the good source nutrition with good amount of protein, carbohydrate, and crude fibre.

Table 4: Mineral composition of health beverage mix

Parameters (mg/100 g)	Control	Selected Sample T_3
Calcium	136.45 ± 2.51	120.36 ± 1.74
Iron	6.08 ± 0.15	5.56 ± 0.12
Magnesium	51.19 ± 0.02	62.03 ± 0.09
Phosphorus	95.99 ± 2.06	116.90 ± 2.09
Zinc	2.28 ± 0.30	5.57 ± 0.24

*Each value is average of three determinations

The table 4 tabulated data depict the mineral composition of control and selected sample (T_3); which states the calcium content in the selected sample decreases as compared to control sample. The calcium contents of control and selected sample are as 136.45 ± 2.51 mg/100g, and 120.36 ± 1.74 mg/100 g respectively. The magnesium, phosphorus, and zinc contents of the selected sample T_3 have found to exhibit higher levels in comparison to control sample. The magnesium content of control and selected sample was found to be 51.19 ±0.02 mg/100 g, and 62.03 ± 0.0912 mg/100g.

Energy value of health drink mix based on chemical composition

The total energy value (Kcal) of control and selected sample was calculated theoretically by multiplying the carbohydrate, protein, and fat by 4,4 and 9 respectively, as depicted in table 4.

Table 4: Theoretical energy value of health beverage mix

Sample	Carbohydrate	Fat	Protein	Total Energy value (Kcal)
Control	69.77	4.99	11.43	369.71
Selected sample	65.74	5.03	15.73	371.15

The tabulation revealed the control sample of health beverage mix contains 369.71 Kcal total energy per 100 g and the total energy of the selected sample T_3 was found to be good source of energy with 371.15 Kcal per 100 g respectively.

Functional analysis of health beverage mix

Various functional properties of health beverage mix as particle size, particle density, bulk density swelling capacity, water absorption capacity and oil absorption capacity were determined and are presented in table 5.

Table 5: Functional parameters of health beverage mix

Parameters	Control	Selected sample T_3
Particle size (µm)	Less than 200	Less than 150
Particle density (g/ml)	1.26 ± 0.01	1.18 ± 0.03
Bulk Density (g/ml)	0.81 ± 0.03	0.79 ± 0.01
Swelling capacity (%)	8.02 ± 0.55	9.15 ± 0.40
Water absorption capacity (%)	137.92 ± 1.47	140.82 ± 0.64
Oil absorption capacity (%)	75.97 ± 0.33	78.95 ± 0.59

*Each value is average of three determinations

The tabulated data depicts the functional properties of control and selected sample T_3. The particle size of control sample was less than 200 µm and for selected sample, it was less than 150 µm, as the major retention of sample on the sieves was measured. The particle density of control and selected sample T_3 was noted to be 1.26 ± 0.01 g/ml and 1.18 ± 0.03 g/ml respectively. Similar findings for protein based instant beverage mix was noted to be particle size 169.3 µm and particle density 2.01 g/cm^3, by Swaminathan and Guha, 2018 [17]. The bulk density and swelling capacity of the control and selected sample T_3 was determined as 0.81 ± 0.03 g/ml, 8.02 ± 0.55 % and 0.79 ± 0.01 %, 9.15 ± 0.40 % respectively. The similar findings were reported by Victor *et al.,* 2016 as bulk density of sorghum ogi incorporated with 10 % cocoa powder was 0.557 ± 0.007 g/ml.

The water absorption capacity (WAC) of control and selected sample T_3 was determined as 137.92 ± 1.47 % and 140.82 ± 0.64% respectively, and similarly the findings of oil absorption capacity (OAC) 75.97 ± 0.33 % and 78.95 ± 0.59 %. The similar findings were recorded by Sadawarte *et al*., 2020 [14] as the WAC and the OAC of the weaning mix were 80.46% and 35% respectively.

Conclusion

The incorporation of 15% horsegram malt flour in the preparation of health beverage mix was found to score higher for organoleptic evaluation. The health beverage mix was found to have good nutritional profile as with higher levels of

protein i.e., 15.73 ± 0.66 g and minerals such as magnesium 62.03 ± 0.09 mg/100 g and phosphorus 116.90 ± 2.09 mg/100 g. The functional properties of the mix sample were found to be enhanced with increased levels of water and oil absorption capacity. Hence, the health beverage mix can be easily prepared by mixing the amount of mix in water/ milk. The incorporation of malt flour in the health beverage mix is successfully performed with good nutrient profile and enhanced functional properties. Thus, it can be concluded that malted beverage mix can contribute to the dietary status of consumers, leading to improvement in product acceptability.

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