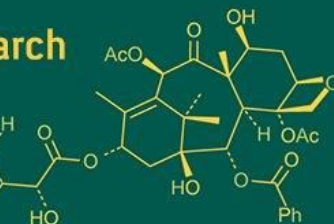


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Biochemical profiling, organoleptic assessment, and functional property analysis of the health supplement

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Abstract

Health supplement is a product with essential nutrients and fibers that generally helps boost energy levels; positioned by the enterprise as taste enhancers. The health supplement was developed by incorporating chicory flour to enhance the nutritional and fibrous profile. The present investigation focused on incorporating chicory flour to enhance nutritional, and functional parameters. The chicory flour was added to the compositional health supplement developed with 0%, 5%, 10%, 15% and 20%. The performed investigation showed that all samples (T₀, T₁, T₂, T₃, T₄) were organoleptically acceptable. Formulation (T₃) was found to gain higher score for sensory parameters (color and appearance-8, consistency -8.5, taste-8.5, flavor-8.5, overall acceptability-8.3). The selected sample (T₃) was found to have higher levels of crude fiber (5.13±0.5 g/100 g), as compared to control sample, due to an orderly increase in levels of chicory to mix. The mineral content i.e., calcium, magnesium, phosphorus, and zinc levels were found to be in a good amount of selected sample (T₃) as 95.82±1.54 mg/100 g, 167.08±2.12 mg/100 g, 318.85±3.54 mg/100 g, 5.57±0.24 mg/100 g respectively. The functional properties of the health supplement were found to be magnified for Bulk density, WAC, OAC, etc. The health supplement was found to have high energy levels i.e., 406.34 kcal.

Keywords: Chicory, health supplement, proximate, organoleptic, functional

1. Introduction

India is a nation blessed with substantial food production capabilities, yet it continues to grapple with hunger and food insecurity issues. To address these challenges, there is a pressing need to prioritize the supply of nutritious and healthy foods to improve the country's overall nutritional status. One effective strategy involves harnessing regional crops to develop supplementary foods that can enhance the population's nutritional and fiber intake. Among these crops, roots and medicinal plants are cultivated extensively, offering immense potential when processed using methods like roasting to elevate their nutritional and functional properties. Root flours, in particular, present a sustainable option for inclusion in various diets and food products.

In India, beverages made from root-based ingredients are commonly recognized as health drinks and are widely consumed by children, women, and adults for their rich nutritional benefits. These drinks not only contribute to overall health but also enhance the taste of the diet while boosting energy levels. Root-based beverages are often produced by blending root flours with other powders or flours, sometimes incorporating whole milk, milk powder, cocoa, or nuts like almonds and cashews. These health supplements focus primarily on delivering functional nutrition rather than flavor, and in India, such products are typically marketed as "health drinks," promoting overall well-being and nutrition (Kent *et al.* 2015) [7]. Chicory (*Cichorium intybus*) is a perennial plant known for its high inulin content (Gupta *et al.* 2003), a soluble dietary fiber that supports digestive health by acting as a prebiotic. Rich in bioactive compounds like phenolics, flavonoids, and sesquiterpene lactones, it offers antioxidant, anti-inflammatory, and liver-protective benefits. Traditionally used as a coffee substitute, chicory is now incorporated into functional foods and health supplements to enhance fiber intake and promote digestive well-being. Its roots are often processed into flour or roasted for use in health-promoting formulations (Pouille *et al.* 2022) [8].

This study aims to incorporate chicory flour into a health supplement, developed alongside other key ingredients such as moth bean malt, cashews, almonds, jaggery, cocoa powder, and skim milk powder. These ingredients have been carefully selected to enhance the nutritional profile and functionality of the product (Aguilera, 2019) ^[2], creating a balanced and health-promoting supplement. The incorporation of chicory flour, in particular, adds valuable dietary fiber and bioactive compounds, while the complementary ingredients contribute to the overall taste, texture, and nutritional value of the formulation (Wang & Cui, 2011) ^[17].

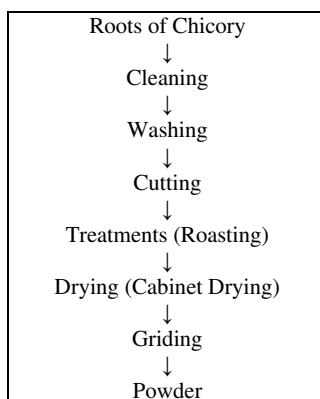
2. Materials and Methodology

2.1 Experimental food sample

The research study was conducted using raw materials such as chicory, moth bean malt, jaggery, cashew, almond, cocoa powder and skim milk powder. The raw material was procured from the local market at Parbhani.

2.2 Roasting: Chicory, almond, and cashew were used to enhance the flavor profile. The roasted chicory, almond and cashew individually were grinded to fine size powder. The powder was sieved through 120 mesh size. The roasted material is stored in air-tight containers for further processing.

2.3 Preparation of chicory flour



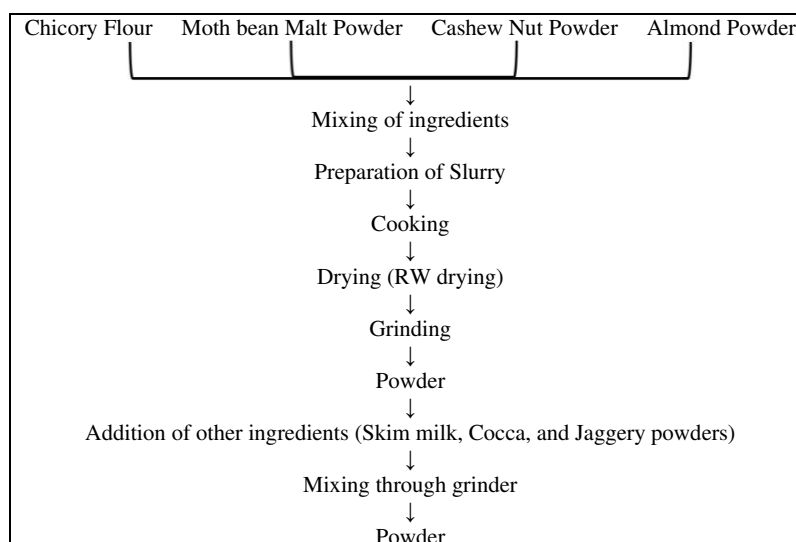
2.4 Preparation of health drink mix: A health supplement was prepared by combining and blending the ingredients (chicory, moth bean malt, cashew and almond powder) as per the formulations. The variations in chicory flour was done by incorporating the levels of 5%, 10%, 15% and 20%. Firstly take chicory, moth bean malt, cashew and almond in powder form for slurry, and blend all these ingredients with

water in a ratio of 1:4 to make a slurry for cooking at 80°C for 6 min. After cooking dry the slurry on a refractance window (RW) drying technology at 90°C (Raghavi *et al.*, 2018) ^[9]. after drying grind the dry material and add the remaining material i.e. cocoa powder, skim milk powder and jaggery powder. The fine blended mix powder is sieved and stored in a PET bottle as a packaging material.

Table 1: Formulation of health supplement

Sample/Ingredients(g)	Chicory	Moth bean malt	Jaggery	Cashew	Almond	Skim milk	Cocoa
TC	0	45	20	10	10	10	5
T ₁	5	40	20	10	10	10	5
T ₂	10	35	20	10	10	10	5
T ₃	15	30	20	10	10	10	5
T ₄	20	25	20	10	10	10	5

2.4.1 Preparation of health supplement by incorporation of chicory flour



2.5 Reconstitution of beverage

The beverage was made by thoroughly blending 20 grams of the powdered mix into 250 ml of hot milk.

2.6 Sensory Evaluation of health supplement

A sensory evaluation of the trial formulations (T₀, T₁, T₂, T₃, T₄) was conducted by a panel of 10 semi-trained individuals using a 9-point hedonic scale. The health supplement was assessed for sensory attributes like colour, taste, flavour, texture, and overall acceptability. Panelists rated each parameter on a scale of 9 to 1, with 9 indicating "like extremely" and 1 signifying "dislike extremely."

2.7 Evaluation of biochemical characteristics of health supplement

The moisture and ash contents were analyzed using standard procedures. Protein content was determined by the Kjeldahl method (1976), which involved calculating nitrogen content and subsequently converting it into protein. Crude fat was extracted and quantified using the soxhlet apparatus with n-hexane, following AACC guidelines (2000) [1]. Crude fiber and total carbohydrate content were assessed based on the method outlined by Ranganna (1986) [10]. The energy value of the product was calculated according to using the formula: Physiological energy = (% protein x 4) + (% carbohydrate x 4) + (% fat x 9).

2.8 Determination of functional properties of health supplement

The particle size of the sample was assessed using the sieving method, with the maximum weight retention recorded. Particle density was measured via the liquid displacement method as described by Beckett *et al.* (1962) [5]. Additionally, the bulk density was determined using the gravimetric method outlined by Amandikwa *et al.* (2015) [3]. The swelling capacity of the mix was calculated according to the procedure provided by Sowbhagya *et al.* (2007) [15]. The water and oil absorption capacities were evaluated using the method proposed by Sosulki *et al.* (1976) [14].

2.9 Statistical analysis

The results were collected in triplicate (n = 3) and are presented as the mean ± standard deviation.

3 Result and Discussion

3.1 Organoleptic evaluation of health supplement

The organoleptic evaluation results for the health supplement are detailed in Table 2. A comparative analysis of sensory attributes, including color, taste, flavor, texture, and overall acceptability, for the control and the four trial formulations, is also presented in Table 2.

Table 2: Organoleptic evaluation of health supplement

Sample	Colour and appearance	Taste	Flavour	Texture	Overall acceptability
Control	8	8	8	8.5	8.1
T ₁	7	7.5	8	7.5	7.5
T ₂	7.5	7.5	8	8	7.7
T ₃	8	8.5	8.5	8.5	8.3
T ₄	8.5	7.5	8	8	8
SE±	0.339	0.266	0.290	0.270	0.244
CD @ 5%	1.022	0.803	0.875	0.816	0.735

The table presents the sensory evaluation results for the control and four trial samples (T₁, T₂, T₃, T₄) of a health beverage mix. Various organoleptic parameters such as color, appearance, taste, flavor, texture, and overall acceptability were assessed using a 9-point hedonic scale. The control sample achieved consistently high scores across all attributes, with the highest value for texture (8.5) and an overall acceptability rating of 8.1. Among the trial combinations, T₃ demonstrated the most favorable sensory characteristics, receiving the highest scores in almost all categories, including flavor, texture, and overall acceptability, with a final overall score of 8.3. T₁ and T₂ showed moderate performance, with T₄ also performing well, especially in color and appearance.

The table also includes the standard error (SE±) and the critical difference (CD) at a 5% significance level for each attribute. The SE values indicate the level of variability in the scores, with texture having a slightly higher variation compared to taste. The CD values suggest the minimum difference required between samples to be considered statistically significant. Overall, the data suggest that T₃ is the most preferred trial combination in terms of sensory attributes, closely followed by T₄, while T₁ scored the lowest in most categories.

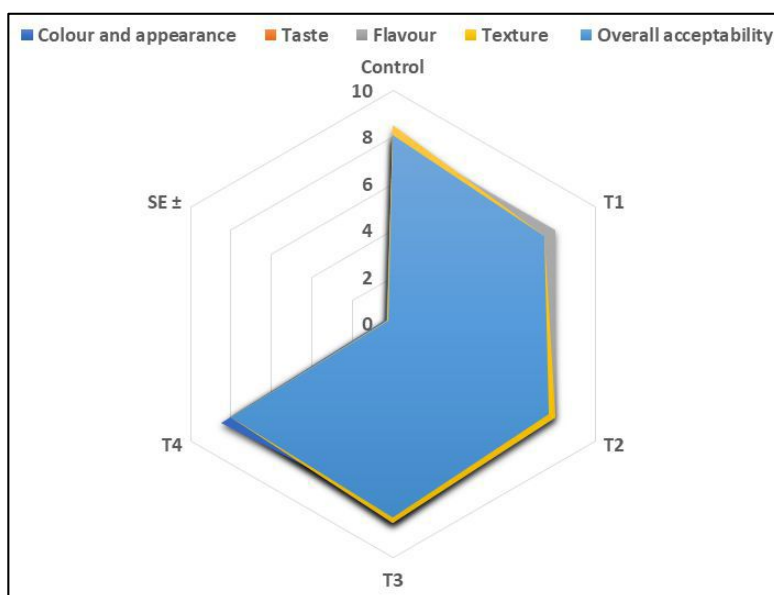


Fig 1: Organoleptic evaluation of health supplement

3.2 Biochemical characteristics of health supplement

The biochemical analysis focused on comparing the control sample with the one showing higher acceptability, T₃. Table 3 illustrates the biochemical evaluation of both the control and the selected T₃ sample, highlighting the variations in compositional factors resulting from the inclusion of chicory in the health supplement. This comparison reveals how the addition of chicory has influenced the compositional elements, showing both decreases and increases in various biochemical components.

Table 3: Proximate composition of health beverage mix

Parameters (%)	Control	Selected Sample (T ₃)
Moisture	5.82±0.03	4.2±0.07
Protein	16.32±1.02	15.76±1.04
Fat	11.7±0.92	11.02±0.97
Carbohydrates	59.88±1.63	61.03±1.23
Ash	1.99±0.02	2.18±0.05
Crude Fibre	4.97±0.06	5.13±0.5

The table provides a comparative biochemical analysis of the control and selected sample T₃, focusing on several key parameters. The moisture content decreased from 5.82% in the control to 4.2% in T₃, indicating a lower moisture level in the sample with chicory flour. Protein content slightly reduced from 16.32% to 15.76%, while fat content decreased from 11.7% to 11.02% similarly found with (Shree Jangra & Madan, 2018) ^[13]. On the other hand, carbohydrates increased from 59.88% in the control to 61.03% in T₃, suggesting a higher carbohydrate level with the addition of chicory flour.

Additionally, the ash content rose from 1.99% to 2.18%, and the crude fiber increased from 4.97% to 5.13%. These changes reflect how incorporating chicory flour affects the biochemical composition of the health supplement, leading to variations in moisture, protein, fat, carbohydrates, ash, and fiber content. The adjustments in these parameters highlight the influence of chicory flour on the nutritional profile of the supplement.

Table 4: Mineral composition of health beverage mix

Parameters (mg/100 g)	Control	Selected Sample (T ₃)
Ca	109.44±1.87	95.82±1.54
K	785.26±7.58	650.44±4.51
Mg	198.46±2.56	167.08±2.12
Fe	7.73±0.85	6.54±0.1
Na	21.52±0.5	24.56±1.24
Cu	0.98±0.002	0.87±0.001
P	381.17±4.54	318.85±3.54
Zn	2.18±0.04	1.88±0.1

The table displays the mineral content of the control sample compared to the selected sample T₃, measured in milligrams per 100 grams. For calcium (Ca), the control sample contains 109.44 mg, while T₃ has a lower concentration of 95.82 mg. Potassium (K) is reduced from 785.26 mg in the control to 650.44 mg in T₃. Magnesium (Mg) also decreases from 198.46 mg to 167.08 mg, and iron (Fe) falls from 7.73 mg to 6.54 mg in T₃. Conversely, sodium (Na) increases from 21.52 mg in the control to 24.56 mg in T₃.

Copper (Cu) content drops from 0.98 mg to 0.87 mg, phosphorus (P) decreases from 381.17 mg to 318.85 mg, and zinc (Zn) also reduces from 2.18 mg to 1.88 mg. These changes illustrate how the incorporation of chicory flour

affects the mineral composition of the health supplement, leading to reductions in several minerals while increasing sodium levels.

3.3 Energy value of health supplement based on chemical composition

The total energy value (Kcal) for both the control and selected sample was calculated using theoretical methods. This involved multiplying the amounts of carbohydrates and proteins by 4, and fats by 9, as shown in Table 4.

Table 4: Theoretical energy value of health supplement

Sample	Carbohydrate	Fat	Protein	Total energy value (Kcal)
Control	59.88	11.7	16.32	410.10
Selected T ₃	61.03	11.02	15.76	406.34

The table presents the calculated total energy values for both the control and selected sample T₃ based on their carbohydrate, fat, and protein content. For the control sample, which has 59.88% carbohydrates, 11.7% fat, and 16.32% protein, the total energy value is calculated to be 410.10 Kcal. In comparison, the selected T₃ sample contains 61.03% carbohydrates, 11.02% fat, and 15.76% protein, resulting in a total energy value of 406.34 Kcal.

The analysis shows that although the T₃ sample has a slightly higher carbohydrate content and a marginally lower fat and protein content compared to the control, its total energy value is slightly lower. This indicates that the energy contribution from each macronutrient in T₃ results in a marginally reduced total energy compared to the control sample.

3.4 Functional analysis of health supplement

The functional properties of the health supplement, including particle size, particle density, bulk density, swelling capacity, water absorption capacity, and oil absorption capacity, were assessed and are detailed in Table 5.

Table 5: Functional parameters of health supplement

Parameters	Control	Selected Sample (T ₃)
Particle size (µm)	160	150
Particle density (g/ml)	1.32±0.2	1.56±0.12
Bulk Density (g/ml)	0.85±0.04	0.78±0.02
Swelling capacity (%)	6.04±0.09	9.15±0.59
Water absorption capacity (%)	125.12±1.21	135.54±1.22
Oil absorption capacity (%)	71.98±0.55	76.65±0.48

The table displays the functional properties of the control sample and the selected sample T₃, including particle size, particle density, bulk density, swelling capacity, water absorption capacity, and oil absorption capacity. The particle size for the control is 160 µm, whereas T₃ has a slightly smaller particle size of 150 µm by (Swaminathan & Guha, 2018) ^[16]. The particle density of the control is 1.32 g/ml, while T₃ has a higher density of 1.56 g/ml. Bulk density decreases from 0.85 g/ml in the control to 0.78 g/ml in T₃, indicating a lighter sample.

In terms of swelling capacity, the control sample has a value of 6.04%, whereas T₃ shows a higher swelling capacity of 9.15%. The water absorption capacity also increases from 125.12% in the control to 135.54% in T₃ similar findings with (Sadawarte *et al.*, 2020) ^[12], and oil absorption capacity

risers from 71.98% to 76.65%. These results reflect how the selected sample T₃ exhibits different functional properties compared to the control, particularly in terms of particle characteristics and absorption capacities.

4. Conclusion

Adding 15% chicory flour to the health supplement significantly improved its organoleptic evaluation scores. The supplement demonstrated a strong nutritional profile, with a notable fiber content of 5.13±0.5 g. It also provided substantial amounts of essential minerals, including magnesium (167.08±2.12 mg/100 g), sodium (24.56 mg/100 g), potassium (650.44±4.51 mg/100 g), and phosphorus (318.85±3.54 mg/100 g). Furthermore, the functional properties of the supplement were enhanced, particularly in terms of water and oil absorption capacities.

The preparation of the health supplement is straightforward, requiring only mixing the powder with water or milk. The successful incorporation of chicory flour has led to a product with improved nutritional and fiber profiles and enhanced functional characteristics. Consequently, it can be concluded that the chicory-based health supplement offers significant benefits to consumers dietary intake and contributes positively to product acceptability.

5. References

1. AACC. Approved Methods of the American Association of Cereal Chemists. 10th ed. St. Paul, MN: American Association of Cereal Chemists; c2000.
2. Aguilera JM. The food matrix: implications in processing, nutrition and health. *Crit Rev Food Sci Nutr*. 2019;59(22):3612-3629. <https://doi.org/10.1080/10408398.2018.1502743>
3. Amandikwa C, Iwe MO, Uzomah A, Olawuni AI. Physico-chemical properties of wheat-yam flour composite bread. *Niger Food J*. 2015;33(1):12-17.
4. AOAC. Official Methods of Analysis. 17th ed. Washington DC: Association of Official Analytical Chemists; c2000.
5. Beckett DC, Emmons DB, Elliott JA. The determination of bulk density, particle density, and particle size distribution in skim milk powder. *Proc Int Dairy Congr*. 1962;16:913.
6. Gupta AK, Kaur N, Kaur N. Preparation of Inulin from Chicory Roots. *J Sci Ind Res*. 2003;62:592-596.
7. Kent M, Welladsen HM, Mangott A, Li Y. Nutritional evaluation of Australian microalgae as potential human health supplements. *PLoS One*. 2015;10(2) <https://doi.org/10.1371/journal.pone.0118985>
8. Pouille CL, Ouaza S, Roels E, Behra J, Tourret M, Molinié R, *et al*. Chicory: Understanding the Effects and Effectors of This Functional Food. *Nutrients*. 2022;14(5):957. <https://doi.org/10.3390/nu14050957>
9. Raghavi LM, Moses JA, Anandharamakrishnan C. Refractance window drying of foods: A review. *J Food Eng*. 2018;222:267-275. <https://doi.org/10.1016/j.jfoodeng.2017.11.032>
10. Ranganna S. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. 2nd ed. New Delhi: Tata McGraw Hill Publishing Co Ltd; c1986.
11. Sadawarte SK, Pawar VS, Sawate AR, Thorat PP, Surendar J. Effect of germination on proximate and phytochemical content of horse gram and green gram malt. *Int J Chem Stud*. 2018;6(3):1840-1844.
12. Sadawarte SK, Pawar VS, Thorat PP, Sawate AR. Development and evaluation of weaning food with incorporation of horse gram malt. *Int J Curr Microbiol Appl Sci*. 2020;9(7):3101-3108. <https://doi.org/10.20546/ijcmas.2020.907.361>
13. Shree Jangra S, Madan V. Proximate, mineral and chemical composition of different parts of chicory (*Cichorium intybus* L.). *J Pharmacogn Phytochem*. 2018;7(5):3311-3316.
14. Sosulski F, Humbert ES, Bui K, Jones JD. Functional properties of rapeseed flours, concentrates and isolate. *J Food Sci*. 1976;41(6):1349-1352.
15. Sowbhagya H, Suma F, Mahadevamma S. Spent residue from cumin: a potential source of dietary fiber. *Food Chem*. 2007;104(3):1220-1225.
16. Swaminathan I, Guha M. Protein-rich instant rice beverage mix and its quality attributes. *J Food Process Preserv*. 2018;42(6) <https://doi.org/10.1111/jfpp.13628>
17. Wang, Cui J. Perspectives and utilization technologies of chicory (*Cichorium intybus* L.): A review. *Afr J Biotechnol*. 2011;10(11):1988-2003. <https://doi.org/10.5897/AJB10.587>