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Development, Formulation, Nutritional Profile, And Sensory Evaluation of a Novel Drynaria Quercifolia-Incorporated Instant Health Mix for Bone Health

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ABSTRACT: **Background**: The Drynaria quercifolia is an important medicinal plant linked to bone and joint health. Developing the rhizome powder of this plant can be one possible way to utilize plant extracts in the development of functional foods by incorporating this rhizome powder into a nutritious food product.

Aim: The current study was carried out with the purpose of preparation of Drynaria quercifolia rhizome powder, its characterization and preparation of Drynaria instant health mix formulation using sensory acceptability, nutritional analysis, physio-chemical analysis, shelf stability of formulation.

Methods: Fresh rhizomes of D. quercifolia collected from Kolli hills were cleaned, peeled, washed, tray dried at 60°C for six hours and made into powder. Three formulations were prepared using varying amounts of Drynaria powder (30, 40, and 50 g) along with finger millet, Bengal gram, almond, pumpkin seed, flaxseed, and peanut. Sensory assessment was carried out by 100 panel members using five-point hedonic scale.

Results: Variation III, containing 50 g Drynaria powder and 20 g finger millet, demonstrated the highest overall acceptability score (4.84 ± 0.37). Significant differences were observed among formulations for sensory attributes ($p < 0.001$). Drynaria powder contained 333.7 kcal energy, 12.36 g protein, 68.64 g carbohydrate, 1.06 g fat, and 6.79 g fibre per 100 g. The selected health mix showed a reported shelf life of 30 days at room temperature, with bacterial counts increasing to 4×10^5 CFU/g by day 30.

Conclusion: The developed Drynaria-based instant health mix demonstrated good sensory acceptability and nutritional potential. Further safety, standardization, and clinical investigations are required before making health-related claims.

1.INTRODUCTION

Drynaria quercifolia (L.) J. Sm., belonging to the family Polypodiaceae, is a prominent epiphytic fern used extensively in ethnomedicine for bone healing, anti-inflammatory support, and joint disorder management [1]. The rhizome contains bioactive secondary metabolites, including flavonoids, triterpenoids, and phenolic acids, which exhibit antioxidant, antibacterial, and osteogenic activity [12]. Thermal processing during tray-drying at controlled temperatures (60°C) optimizes moisture removal without significantly compromising thermolabile bio actives, making it suitable for incorporation into dry powder matrices [5].

(Kanimozhi et al. 2022) reviewed the pharmacognostic characteristics, traditional applications, phytochemical constituents, and pharmacological activities of D. quercifolia[8]. Their review highlighted the reported antioxidant, antimicrobial, and anti-inflammatory potential of the plant. However, evidence from traditional use and laboratory studies should not be interpreted as proof that a food product can prevent or treat bone disease.

A 2023 review by (Mani et al) discussed the botanical characteristics, phytochemistry, and pharmacological properties of D. quercifolia, emphasizing the need for further investigation and standardization of medicinal plant materials[9]. This supports the importance of proper botanical identification, raw-material processing, and quality assessment in the present study

Composite health mixes exploit complementary nutrient profiles to provide broad-spectrum macro- and micronutrients. Finger millet (*Eleusine coracana*) serves as an exceptional dietary base, providing bioavailable calcium, dietary fiber, and slow-digesting carbohydrates vital for bone metabolism and glycemic control[4] Legumes such as Bengal gram (*Cicer arietinum*) contribute high-quality plant proteins rich in lysine, balancing the amino acid limitations of cereal grains[7] .The inclusion of nuts and oilseeds—such as almonds, peanuts, pumpkin seeds, and flaxseeds—supplies essential polyunsaturated fatty acids (ω-3 and ω-6), dietary fiber, iron, phosphorus, and magnesium [14].Dry roasting these components reduces moisture, inactivates antinutritional factors (e.g., phytates and tannins), enhances digestibility, and improves aroma through Maillard browning reactions[15].

Sensory evaluation utilizing hedonic rating scales provides standardized visual, olfactory, and gustatory acceptability data for novel food formulations[16]. Statistical validation via analysis of variance (ANOVA) and mean comparisons ensures that flavour masking of herbal ingredients like *Drynaria* is successfully achieved without compromising panel acceptability. The shelf life of dried composite mixes relies heavily on controlling moisture levels ($< 12\%$) and utilizing barrier packaging, such as polyethylene bags, to restrict humidity absorption, lipid oxidation, and microbial growth over storage intervals[3] .Monitoring bacterial and fungal counts via standard microbiological assays validates product safety across 30 to 45 days of ambient storage[2].

2. MATERIALS AND METHODS

The methodology is discussed under the following headings,

2.1Selection and Procurement of Drynaria quercifolia

Rhizomes of naturally growing Drynaria quercifolia (L.) J. Sm. (Class Polypodiopsida, Order Polypodiales, and Family Polypodiaceae) were collected from Kolli hills. The other ingredients, such as finger millet, pumpkin seed, black urad dal, flax seed, almond, peanut], were purchased from a supermarket in, Coimbatore district in Tamil Nadu.

2.2 Steps involved in the processing of Drynaria quercifolia into powder

Fresh Drynaria quercifolia rhizomes (1 kg) were selected, cleaned, weighed, peeled, washed, and graded. The rhizomes were tray-dried at 60°C for 6 hours and ground into fine powder, yielding 120 g of dry sample and 80 g of powdered rhizome. The steps involved in processing Drynaria quercifolia into powder are represented in Figure1.

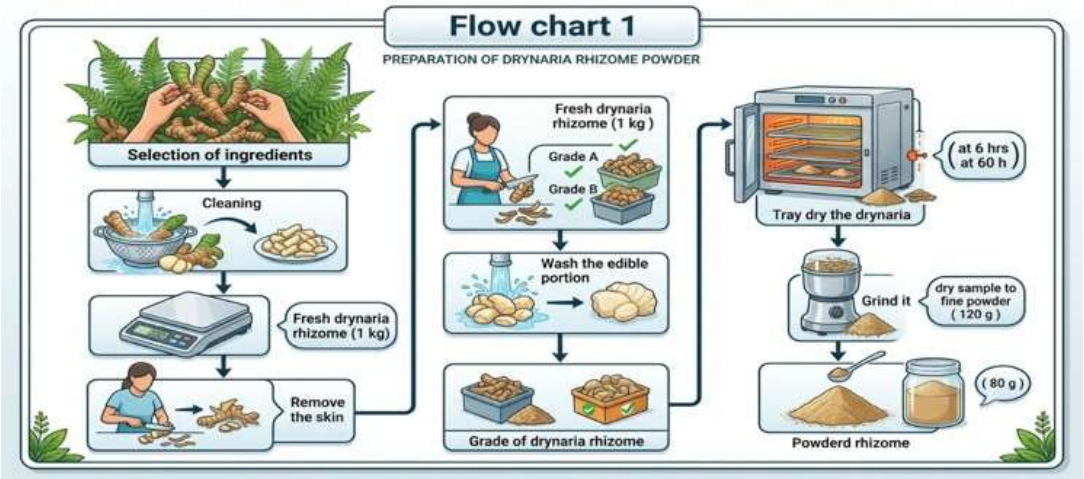


FIGURE 1 steps involved in processing Drynaria quercifolia into powder

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2.3 Preparation of Drynaria *quercifolia* into instant health mix powder

The preparation of the functional instant health mix was executed by integrating processed *Drynaria quercifolia* rhizome powder with a complementary matrix of cereals, legumes, nuts, and oilseeds across three standardized formulations (Variations I, II, and III). The primary variable assessed was the incorporation gradient of *Drynaria* rhizome powder balanced against finger millet (*Eleusine coracana*) flour. Variation I comprised 30% *Drynaria* powder and 40% finger millet; Variation II contained 40% *Drynaria* powder and 30% finger millet; and Variation III contained 50% *Drynaria* powder and 20% finger millet (w/w). The remaining ingredient proportions were held constant across all treatments to maintain baseline lipid, protein, and micronutrient stability: Bengal gram (*Cicer arietinum*, 5%), almond (*Prunus dulcis*, 5%), pumpkin seed (*Cucurbita pepo*, 5%), flaxseed (*Linum usitatissimum*, 5%), and peanut (*Arachis hypogaea*, 10%). The steps involved in preparation Drynaria instant health mix in Figure 2.

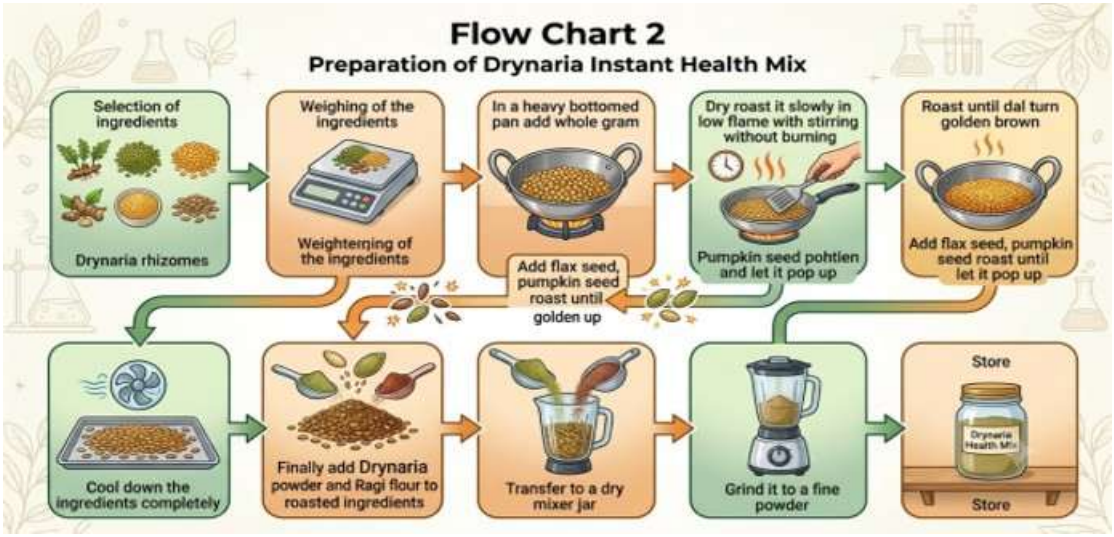


FIGURE 2 The steps involved in preparation Drynaria instant health mix

2.4 Standardisation of Drynaria *quercifolia* into instant health mix powder

The preparation protocol was standardized to optimize flavour profile, reduce antinutritional factors, and ensure a uniform particle size distribution. All constituent raw materials were gravimetrically measured using an analytical balance. Bengal gram was subjected to controlled dry thermal processing (roasting) in a heavy-bottomed vessel under low heat with continuous mechanical agitation to achieve uniform dextrinization and Maillard browning while preventing localized charring. Flaxseeds and pumpkin seeds were subsequently introduced to the thermal step until pericarp dehiscence (popping) occurred, facilitating moisture reduction and enhancing lipophilic compound release.

Following complete cooling to ambient temperature the roasted legumes and oilseeds were blended with pre-processed *Eleusine coracana* flour and *Drynaria quercifolia* rhizome powder. The composite mixture underwent mechanical comminution in a high-speed dry laboratory mill to obtain a homogenous, fine-grade powder matrix. The finalized instant formulations (Variations I–III) were immediately sealed in airtight containers to prevent hygroscopic moisture gain and volatile aromatic loss prior to organoleptic acceptability assessment and analytical characterization.

Table 1 Standardization of *Drynaria quercifolia* Instant Health Mix Powder in three variation

Ingredients	Variation I	Variation II	Variation III
***Drynaria quercifolia* powder**	30	40	50
Finger millet (*Eleusine coracana*) flour	40	30	20
Bengal gram (*Cicer arietinum*)	5	5	5

Almond (*Prunus dulcis*)	5	5	5
Pumpkin seed (*Cucurbita pepo*)	5	5	5
Flaxseed (*Linum usitatissimum*)	5	5	5
Peanut (*Arachis hypogaea*)	10	10	10
Total Weight (g)	**100**	**100**	**100**

2.5 Sensory evaluation of *Drynaria quercifolia* Instant Health Mix Powder

Sensory evaluation is a scientific discipline used to evoke, measure, analyse, and interpret responses to the characteristics of food and materials as perceived through the senses of sight, smell, taste, touch, and hearing (Stone and Sidel, 2004). The formulated instant Drynaria health mixes were evaluated by a panel of 100 students from the Department of Foods and Nutrition. The samples were coded and presented to the panel members for evaluation. Water was provided for mouth rinsing between samples. Scorecards were distributed, and the samples were assessed for colour and appearance, flavour, texture, taste, and overall acceptability using a five-point hedonic scale.

2.6 Physio chemical analysis of *Drynaria quercifolia* Instant Health Mix Powder

The physio-chemical properties of foods ultimately determine their perceived quality, sensory attributes and behaviour during production, storage and consumption(Brown A,2017).Hence physio-chemical properties of the foods are evaluated .The storage study was evaluated for the following physio-chemical properties initially and at fifteen days interval for a period of 45 days.

2.6.1Determination of Moisture Content

The moisture content of the sample was determined gravimetrically using a digital halogen moisture analyser. Approximately 2 to 5 g of the finely ground sample was evenly distributed onto a clean, dry sample pan and subjected to controlled thermal drying at 105°C. Heating was continued until complete evaporation of moisture was achieved and a constant mass was attained, with the total percentage of moisture recorded directly from the instrument's digital readout.

2.6.2Determination of Ash Content

The crude ash content was estimated gravimetrically following the standard AOAC (2000) muffle furnace incineration protocol. A 2 to 5 g sample was weighed into a pre-conditioned silica crucible and gently pre-charred over a flame to drive off volatile organic matter. The crucible was then transferred to a muffle furnace maintained at 550°C for 4 to 6 hours until complete carbonization and oxidation occurred, leaving a uniform light grey inorganic residue. After cooling to ambient temperature inside a desiccator, the residue was weighed to calculate the percentage of total ash content.

2.7Nutrient analysis of *Drynaria quercifolia* Instant Health Mix Powder

Nutrition analysis refers to the process of determining the nutritional content of foods and food products. The process can be performed through a variety of certified methods.

Carbohydrate: Calculated via the difference method by subtracting the combined percentages of moisture, crude protein, crude fat, ash, and fiber from 100%.

Protein: Quantified using the Kjeldahl digestion method by measuring total nitrogen and applying the standard conversion factor ($N \times 6.25$).

Fat: Measured gravimetrically following continuous hot solvent extraction of lipids using petroleum ether in a Soxhlet apparatus.

Fiber: Determined by sequential acid (H_2SO_4) and alkali ($NaOH$) digestion, measuring the weight loss of dried residue after high-temperature furnace ignition.

Iron: Quantified spectrophotometrically (or via Atomic Absorption Spectroscopy) by measuring the colour absorbance of iron complexes in acid-dissolved ash solutions.

Calcium: Estimated via EDTA complexometric titration (or $KMnO_4$ titration) of the acid-solubilized inorganic mineral ash.

Phosphorus: Measured calorimetrically by reacting liberated orthophosphates with ammonium molybdate reagent to form a blue complex read at a specific wavelength.

2.8 Microbiological and shelf-life analysis

To check the growth of microorganism such as bacteria, mould and yeast incorporated value-added products were subjected to microbial analysis at its initial and final (30 days) using standard procedure FSSAI manual method (2016) (Appendix 5) The shelf life of flour depends on various factors such as storage conditions and type of flour. Storing flour in air tight container in a cool, dark place helps prolong its freshness. The developed multipurpose flour is assessed by its microbial load on 1st ,15th, and 30th days EFLT / SOP / manual method

2.9 Statistical analysis of results After

The completion of sensory evaluation by 100 semi-trained panel members the collected data was consolidated and analysed statistically using mean and standard deviation using SPSS software.

3.Results

3.1 Organoleptic Evaluation and Acceptability of Formulated Drynaria Instant Health Mix

The instant health mix was prepared in three different variations, with Manna Health Mix serving as the control. The sensory acceptability of the three variations was evaluated and compared against the control. Table 1 presents the organoleptic scores for the control and the three instant health mix variations.

Table 2: Organoleptic Evaluation of Control and Health Mix Variations

Characteristics	Control	Variation I	Variation II	Variation III
Colour and Appearance	4.08±0.90	3.04±0.84	3.88±0.66	4.80±0.40
Flavour	4.24±0.83	2.64±0.63	3.44±0.65	4.64±0.48
Consistency	4.20±0.64	2.64±0.48	3.36±0.56	4.64±0.48
Taste	4.12±0.78	2.72±0.61	3.48±0.65	4.80±0.40
Total Score	16.60±2.54	11.00±1.79	14.10±1.79	18.80±1.09
Overall Acceptability	4.12±0.72	2.68±0.47	3.56±0.58	4.84±0.37

Values are expressed as Mean ± Standard Deviation (SD).

As shown in Table 1 and Figure 2, Variation III achieved the highest scores across all sensory parameters: appearance (4.80 ± 0.40), flavour (4.64 ± 0.48), consistency (4.64 ± 0.48), taste (4.80 ± 0.40), total score (18.80 ± 1.09), and overall acceptability (4.84 ± 0.37) compared to the other variations and the control sample.

These results are supported by Premagowri (2020), who reported high acceptability for a millet-based health mix formulated with *Saraca indica*. Based on obtaining the highest organoleptic scores, Variation III was selected for further analysis.

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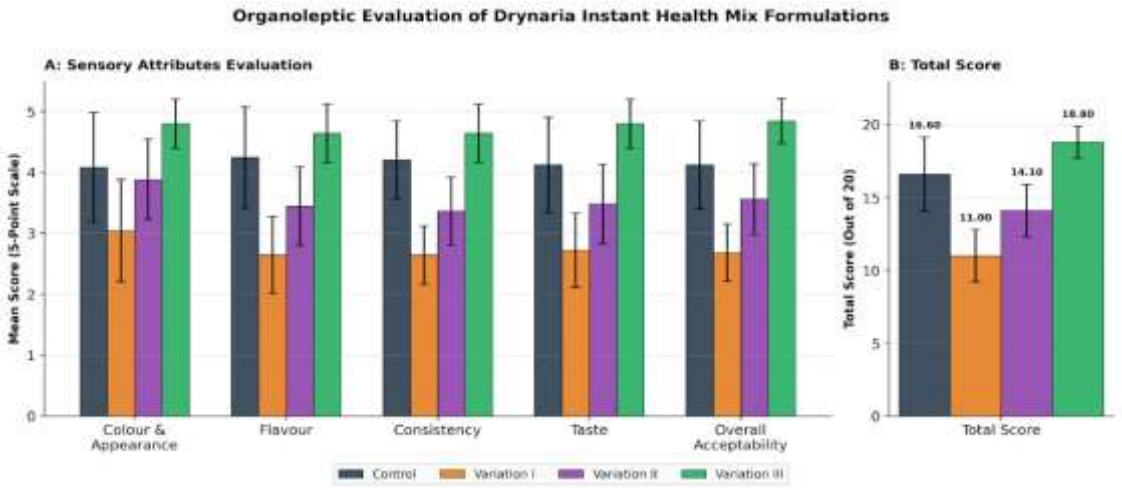


FIGURE 3 Organoleptic Evaluation and Acceptability of Formulated Drynaria Instant Health Mix

3.2 Analysis of Variance (ANOVA) for Sensory Scores of *Drynaria* Instant Health Mix

Table 3: Analysis of Variance (ANOVA) for Sensory Scores of *Drynaria* Instant Health Mix

Parameter	Source of Variation	Sum of Squares	Df	Mean Square	F-value
Colour and Appearance	Between Groups	39.310	3	13.103	25.443
	Within Groups	49.440	96	0.515	
	Total	88.750	99		
Flavour	Between Groups	59.000	3	19.667	44.697
	Within Groups	42.240	96	0.440	
	Total	101.240	99		
Consistency	Between Groups	59.310	3	19.770	64.820
	Within Groups	29.280	96	0.305	
	Total	88.590	99		
Taste	Between Groups	59.240	3	19.747	49.992
	Within Groups	37.920	96	0.395	
	Total	97.160	99		
Total Score	Between Groups	850.040	3	283.347	80.306
	Within Groups	338.720	96	3.528	
	Total	1188.760	99		
Overall Acceptability	Between Groups	62.400	3	20.800	67.459
	Within Groups	29.600	96	0.308	
	Total	92.000	99		

As shown in Table 3, a one-way ANOVA revealed statistically significant differences across all sensory attributes including colour and appearance, flavour, consistency, taste, total score, and overall acceptability among the different variations of Drynaria instant health mix ($p < 0.001$).

3.3 Physicochemical Properties of *Drynaria* Powder

The physicochemical properties of food play a vital role and are essential for addressing various processing challenges, including preservation, storage, distribution, and consumption (Aichatou Musavu Ndob et al., 2015). The edible portion of the *Drynaria* rhizome was oven-dried and ground into a powder. The sample was analysed in the laboratory for its physicochemical properties, and the results are tabulated below.

Table 4: Physio-Chemical Parameters of *Drynaria* Powder

S. No.	Parameter	Value (g / 100 g)
1	Total Ash	6.23
2	Moisture	11.67

3.3.1Moisture

All foods, regardless of the processing method, contain water or moisture, which typically accounts for 60% to 95% of natural food composition. Moisture content is critical to determining shelf life: lower moisture levels correlate with enhanced storage stability. The moisture content of the *Drynaria* powder was found to be 11.67 g / 100g.In comparison, Malavika Murugesan et al. (2023), in their study "Optimization of process parameters for the development of cake from novel flour blends of Drynaria quercifolia and Ipomoea batatas", reported a moisture content of 7.61 g / 100 g. The higher moisture level observed in the present sample may be attributed to differences in the powdering method or the dehydration technique applied.

3.3.2 Ash

Ash represents the inorganic residue remaining after complete incineration in a muffle furnace and directly reflects the mineral content present in the sample. The total ash content of the *Drynaria* powder was determined to be 6.23 g / 100g.Malavika Murugesan et al. (2023) recorded an ash content of 0.86 g / 100 g in their evaluation. The *Drynaria* powder analysed in this study shows a higher mineral/ash concentration, which could be attributed to variations in the plant species, soil conditions, or harvesting stage.

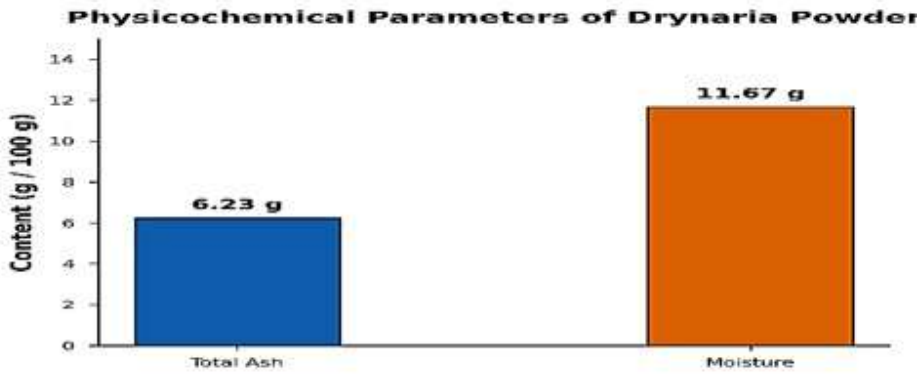


Figure 4 Physio-Chemical Parameters of *Drynaria* Powder

3.4 Nutritional and Mineral Profile of *Drynaria* Powder

Nutrient analysis is essential for evaluating the dietary value and overall functional quality of food materials. The nutritional parameters (proximate composition) and key mineral contents of the *Drynaria* powder were determined using standard analytical procedures. The combined results are presented in **Table 5**.

Table 5: Nutritional and Mineral Composition of *Drynaria* Powder (per 100 g)

S. No.	Parameter	Unit	Value (per 100 g)
1	Energy	kcal	333.70
2	Carbohydrate	g	68.64
3	Protein	g	12.36
4	Crude Fiber	g	6.79
5	Fat	g	1.06
6	Calcium	mg	36.90
7	Phosphorus	mg	26.40
8	Iron	mg	1.29

Nutritional Composition

The proximate analysis revealed that 100 g of *Drynaria* powder yields an energy value of 333.70 kcal, comprising 68.64 g of carbohydrates, 12.36 g of protein, 6.79 g of dietary fiber, and 1.06 g of fat. In comparison, Malavika Murugesan et al. (2023), in their investigation of flour blends containing *Drynaria quercifolia* and *Ipomoea batatas*, reported lower values for protein (2.44 g/100 g), fat (0.73 g/100 g), and fiber (3.84 g/100 g), but a higher carbohydrate content (75.92 g/100 g). The present study demonstrates higher levels of protein, fat, and fiber, indicating enhanced nutritional density in the evaluated *Drynaria* powder sample.The mineral evaluation indicated calcium, phosphorus, and iron concentrations of 36.90 mg, 26.40 mg, and 1.29 mg per 100 g, respectively. When compared with values reported by Zhang et al. (2004) for millet-based health mix formulations (calcium: 138 mg, phosphorus: 38.4 mg, and iron: 6.41 mg), the mineral contents of the current *Drynaria* powder were relatively lower. These variations in macronutrient and mineral profiles can be attributed to differences in geographical origin, soil fertility, botanical variety, maturity stage at harvest, and raw material processing methods.

3.5 Nutritional and Mineral Profile of instant health mix

TABLE 6 Nutritional and Mineral Profile of instant health mix

Ingredients	Quantity (g)	Energy (kcal)	Carbohydrate (g)	Protein (g)	Fat (g)	Fibre (g)	Iron (mg)	Calcium (mg)	Phosphorus (mg)
Finger millet	20	64.15	13.36	1.43	0.38	2.24	0.92	72.8	42
Pumpkin seed	5	28.7	0.74	1.49	2.45	6.5	0.4	2.6	58.7
Flax seed	5	22.19	0.55	0.93	1.78	1.31	0.27	12.85	22.25
Almond	5	30.46	0.53	1.04	2.95	0.65	0.23	11.5	22.3
Peanut	10	57	2.67	2.62	3.98	4.8	0.31	7.7	37
Black gram	5	14.57	2.2	1.1	0.08	20.41	0.3	4.31	17.25
Total (per 50 g mix)	50	217.07	20.05	8.61	11.62	35.91	2.43	111.76	199.5

From the above table, the nutritional composition of the instant health mix per 100 g was found to be energy - 217 .07 kcal, carbohydrate -20.05 g, protein -8.61 g, fat – 11.6 g, fibre – 35,91 g, - iron – 2,43 mg, calcium – 111.76 mg and phosphorus – 199.5 mg

3.6 Comparison of Nutritional Composition with Literature

A comparative evaluation was performed to benchmark the nutritional profile of the present *Drynaria* instant health mix against a published millet-based health mix (*Saraca indica* formulation) reported by Zhang et al. (2004). The comparative data per 100 g of sample are presented in table

Table 7 Comparative Nutritional Composition of *Drynaria* Instant Health Mix and Millet-Based Health Mix (per 100 g)

Sample / Formulation	Energy (kcal)	Carbohydrates (g)	Fat (g)	Protein (g)	Fiber (g)	Iron (mg)	Calcium (mg)
Drynaria Instant Health Mix (Present Study)	550.77	88.69	12.12	20.97	42.7	3.72	148.6
Millet-Based Health Mix (Zhang et al., 2004)	395.84	77.25	2.84	13.9	2.76	6.41	138

As in the Table7, the nutritional profile of the present *Drynaria* instant health mix was compared with the millet-based health mix studied by Zhang et al. (2004). The *Drynaria* health mix demonstrated substantially higher values across major macronutrients and energy density, yielding 550.77 kcal of energy, 88.69 g of carbohydrates, 20.97 g of protein, 12.12 g of fat, and 42.70 g of dietary fiber per 100 g sample, compared to 395.84 kcal, 77.25 g, 13.90 g, 2.84 g, and 2.76 g, respectively, for the millet-based mix. Furthermore, the calcium content of the present formulation (148.60 mg) was higher than that reported by Zhang et al. (138.00 mg). Conversely, the millet-based health mix exhibited a higher iron content (6.41 mg/100 g) than the *Drynaria* health mix (3.72 mg/100 g). The elevated fiber, protein, and energy metrics in the present formulation highlight its potential as an enriched functional health mix[17].

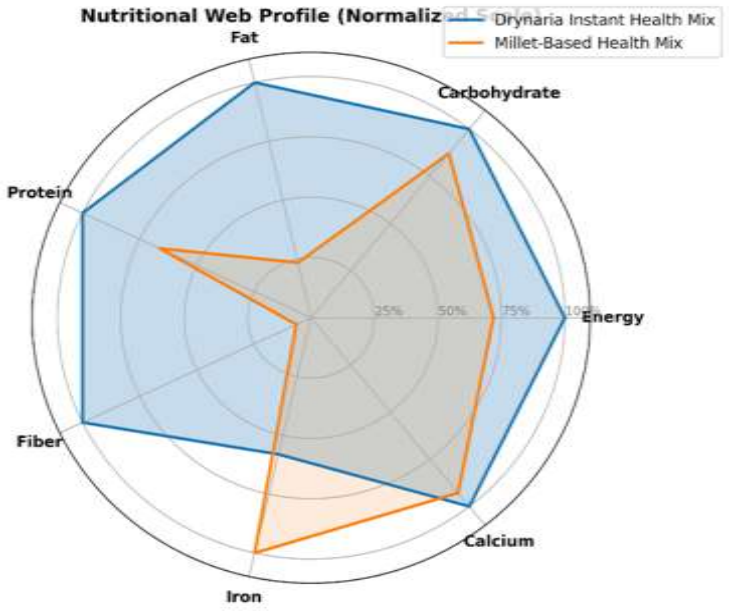


FIGURE5 Comparative nutritional web profile (Radar Plot) of *Drynaria* instant health mix vs. millet-based health mix (Zhang et al., 2004).

To comprehensively evaluate the multi-parameter nutritional profile of the *Drynaria* instant health mix without scale bias across differing unit dimensions (kcal/100 g, g/100 g, and mg/100 g), a normalized radar web analysis was conducted against the reference millet-based health mix reported by Zhang et al. (2004) (Figure 5). Each radial axis represents the relative percentage scale (0–100%) normalized to the highest absolute concentration recorded for each specific parameter across both sample groups.

As illustrated by the polygon geometry, the *Drynaria* instant health mix occupies a substantially larger total surface area relative to the reference millet-based formulation. This expanded web area reflects a superior overall nutritional density. Specifically, the formulation exhibits maximum relative peaks (100% boundary) across five key parameters: energy (550.77 kcal), carbohydrates (88.69 g), protein (20.97 g), fat (12.12 g), and dietary fibre (42.70 g). The pronounced expansion along the fiber and protein axes highlights the enhanced functional value of incorporating *Drynaria* rhizome powder in composite mix formulations.

In terms of mineral distribution, the *Drynaria* mix demonstrates an expanded outer perimeter for calcium (148.60 mg vs. 138.00 mg; 100% vs. 92.8%), whereas the reference millet formulation shows dominance along the iron axis (6.41 mg vs. 3.72 mg; 100% vs. 58.0%). Overall, the radar profile demonstrates that the novel *Drynaria* health mix offers a higher caloric, macronutrient, and dietary fiber density per 100 g serving compared to traditional millet-based blends."

3.7 Microbial analysis

The total bacterial count of the formulated drynaria instant health mix was found to be nil on 0th day and 2×105 CFU/gm on the 15th day and 4×105 CFU/gm at the end of 30th days. It was observed that the microbial count was similar to the Premagowri (2020) in their study "millet-based health mix saracaindica "with the similar microbial count of 4×105 CFU / gm in the study. The shelf life of the drynaria instant health mix was found to be 30 days when placed at room temperature. The shelf life can be improved by storing it in refrigerator temperature or by adding suitable food grade preservatives[13].

4. CONCLUSION

This study successfully developed and evaluated a novel functional instant health mix incorporating *Drynaria quercifolia* rhizome powder alongside finger millet, legumes, nuts, and oilseeds. Sensory evaluation revealed that Variation III (50 g Drynaria powder and 20 g finger millet) achieved the highest overall acceptability score (4.84 ± 0.37, $p < 0.001$), demonstrating that proper thermal processing effectively masked herbal flavours without compromising consumer organoleptic preferences. The finalized formulation exhibited superior macronutrient and energy density per 100 g—providing 550.77 kcal of energy, 20.97 g of protein, 12.12 g of fat, 42.70 g of dietary fibre, and 148.60 mg of calcium—significantly outperforming conventional millet-based health mixes. Microbiological analysis confirmed a safe room-temperature shelf life of 30 days (4 times 10^5 CFU/g). Overall, while the developed mix demonstrates strong potential as a nutrient-dense functional food matrix, further toxicological safety profiling, standardization, and clinical investigations are necessary before establishing formal therapeutic claims for bone health

Conflicts of interest:

Submitting a manuscript must be accompanied by a statement from the authors disclosing all financial and personnel relationships that might bias their work, if any. Moreover, they are requested to provide evidence of the presence or absence of upcoming conflicts. A separate page should cover this proclamation and if there are further details, they could be mentioned in the covering letter. If an organization encompasses any financial interest in the outcome of the study, the authors are appealed to provide a declaration that has full access to all data in the study and take complete responsibility for the integrity of data and the accuracy of data analysis.

Acknowledgments:

Acknowledgments should be mentioned for any technical assistance or general, financial, and material support or contributions that require acknowledgement.

Ethical consideration:

The need for formal ethical approval was waived by the Institutional Ethics Committee PSG College of Arts and Science, as the study consisted solely of a sensory evaluation of safe food products by 30 semi-trained panel members. The research was carried out in accordance with the standard guidelines and regulations of the committee for exempted human participation

studies.

Ethical Guidelines Statement

This study was approved by the Institutional Ethics Committee of PSG College of Arts and Science in accordance with the relevant guidelines and regulations set forth by the Declaration of PSG College of Arts and Science

Consent to participate

`Freely-given, written informed consent to participate in the study was obtained from all 30 semi-trained panel members prior to the sensory evaluation. All participants were adults over the age of 18 and were fully informed about the nature, purpose, and safety of the food products being evaluated.

Consent to publish

Not applicable.

Funding

This is study is purely non-stipendiary research work. So no funding agency so far.

Author contributions/authorship criteria:

In this section, each author's contribution must be exactly declared using initials to indicate each author's identity (for instance, "J.V. and V.S. designed the study; J.V. and V.S, conducted the experimental work; J.V analysed the data; J.V. and V.S. wrote the manuscript, etc."). Authors must fulfil all four criteria in order to qualify for authorship of a manuscript based on the guidelines of the International Committee of Medical Journal Editors/ICMJE (http://www.icmje.org). These criteria include making a substantial contribution to all aspects of the following:

- The conception and design of the study, or acquisition of data, or analysis and interpretation of data.
- Drafting the article or revising it critically for important intellectual content.
- Final approval of the version to be submitted.
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved." If an individual fail to meet all four of these criteria, they are not considered as an author and any contribution provided by them should be acknowledged in the Acknowledgements section of the manuscript. The corresponding author should specify the authors and also the other individuals that do not constitute authorship including the ones contribute funding, data collection, or general supervision of the research group. The corresponding author should write the order of authors in the cover letter and should be approved by all authors.

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