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Preparation and Quality Characterization of Herbal Nutritional Powder

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Abstract: ***Herbal nutrition is increasingly recognized for its role in promoting health through plant-derived bioactive compounds. This study aimed to develop and evaluate a herbal nutritional powder formulated from curry leaves (*****Murrayakoenigii*****), moringa leaves (*****Moringa oleifera*****), flaxseeds (*****Linum usitatissimum*****), and other traditional ingredients. Three formulations (T1, T2, T3) were prepared in varying proportions. Organoleptic evaluation was conducted using a 7-point hedonic scale by a panel of 20 judges. The best-accepted formulation (T2) underwent proximate, vitamin, mineral, fatty acid, antioxidant (DPPH, FRAP, ABTS), and microbial analyses using standard AOAC methods. Formulation T2 (50% curry leaves, 20% moringa leaves, 10% flaxseeds, 20% other ingredients) received the highest sensory scores. Nutritional analysis revealed that per 100 g, the powder contained 13.4 g protein, 32.5 g carbohydrates, 14 g fat, 11.2 g dietary fiber, 3% ash, and 309.6 kcal energy. It also provided key micronutrients: iron (7.1 mg), calcium (160 mg), zinc (1.68 mg), vitamin A (0.03 mg), vitamin E (4.75 mg), vitamin B1 (0.43 mg), along with essential fatty acids including alpha-linolenic acid (0.8 mg), linoleic acid (0.9 mg), and oleic acid (0.1 mg). Microbial analysis confirmed safety, with aerobic plate count and yeast/molds<10 CFU/g, and no detectable* **Enterobacteriaceae** ***or*** **Staphylococcus aureus.** ***The T2 herbal nutritional powder formulation demonstrated excellent sensory attributes, a rich nutritional profile, antioxidant activity, and microbial safety. It holds significant potential as a functional food supplement in promoting dietary health and wellness.***

Keywords: Herbal Nutritional Powder,functional food, curry leaves, moringa, flaxseed, Nutritional Analysis, Microbial Activity, Sensory Analysis

I. INTRODUCTION

Herbal nutrition is an expanding field focused on enhancing health by adding plant-based ingredients to our daily diet. These natural foods are rich in key nutrientssuch as vitamins, minerals, good fats and helpful plant compounds; that contribute to overall well-being. Recent studies highlight that herbs offer more than just nutrition. they also have healing and preventive benefits. As people become more health-conscious, herbal foods are gaining popularity for their potential to boost well-being, help prevent chronic illnessesand enhance quality of life.

Among the many herbs curry leaves (*Murrayakoenigii*), moringa leaves (*Moringa oleifera*), and flaxseeds (*Linum usitatissimum*) stand out as valuable contributors to both dietary and medicinal purposes. These herbs are particularly noted for their high concentrations of bioactive compounds that support metabolic health, immune function and oxidative balance.

Curry leaves, also referred to as "sweet neem leaves," are widely utilized in culinary practices particularly in Indian cuisine for their aromatic flavor. In addition to their culinary uses, curry leaves are known for their medicinal benefits are rich in alkaloids, flavonoids and phenolic compounds, they exhibit antioxidant, antimicrobial, anti-inflammatory and antidiabetic properties. These bioactive components make curry leaves a potent agent for improving health outcomes in individuals with chronic conditions (Meher et al., 2014).

Moringa oleifera, commonly known as the drumstick or horseradish tree. Moringa leaves contain essential amino acids, vitamin A (provitamin A, β-carotene), vitamin C (ascorbic acid), vitamin E (tocopherols) and polyphenolic compounds such as flavonoids and phenolic acids. Traditionally, Moringa leaves have been used for their antiseptic and healing properties in wound care and its antioxidant profile further boost their therapeutic potential (Gopalakrishnan et al., 2016).

Flaxseeds are increasingly recognized as a "superfood" due to their high concentration of omega-3 fatty acids, particularly alpha-linolenic acid (ALA), lignans, and dietary fiber. These bioactive compounds have numerous health benefits such as reducing the risk of cardiovascular disease, managing blood sugar levels and promoting digestive health. Flaxseeds are often utilized in the form of ground powder to enhance their bioavailability and maximize their nutritional impact (Nowak &Jeziorek, 2023).

Additionally, urad dal (*Vigna mungo*) is an important ingredient in this formulation, contributing a high protein content and essential amino acids like lysine, which is often lacking in cereal-based diets as well as it is also rich in micronutrients such as iron, calcium, and folate, urad dal helps to balance the amino acid profile of plant-based diets and provides a source of dietary fiber.

The current study aims to explore the potential of combining these herbal ingredients into a single functional product aherbal nutritional powder. This powder is formulated by carefully selecting specific proportions of curry leaves, moringa leaves, flaxseeds, and other ingredients like urad dal, garlic, and red chili. The aim is to develop a powder that provides various health benefits in addition to improving nutritional intake. The product is a nutrient-dense supplement with several therapeutic benefits which has been designed to be an easily accessible addition to the diet.

II. MATERIALS AND METHODS

Fresh curry leaves (Murrayakoenigii), moringa leaves (Moringa oleifera) and fenugreek seedpowder were procured from local market in Muppireddypally, Medak District, Telangana, India. All ingredients were manually sorted to remove foreign particles. Flaxseeds and urad dal (Vigna mungo) were obtained from certified organic stores to ensure quality and nutritionally rich.

Figure 1: Ingredients used for HerbalNutritional Powder

A. Formulation of Herbal Nutritional Powder

To develop the herbal nutritional powder, three types of formulations were prepared by varying the proportions of dried and powdered curry leaves (CL), moringa leaves (ML), flaxseeds (FS), and other ingredients (OI), which include urad dal, red chili, and garlic. The specific ratio's for each sample are outlined in Table 1. In Sample T1, the formulation consists of 30% curry leaves, 40% moringa leaves, 15% flaxseeds, and 15% other ingredients. Sample T2 had a different ratio, comprising 40% curry leaves, 30% moringa leaves, 15% flaxseeds and 15% other ingredients whereas Sample T3 was formulated with a distribution of 25% curry leaves, 25% moringa leaves, 25% flaxseeds and 15% other ingredients.

Table 1: Formulation for the Preparation of Herbal Nutritional Powder

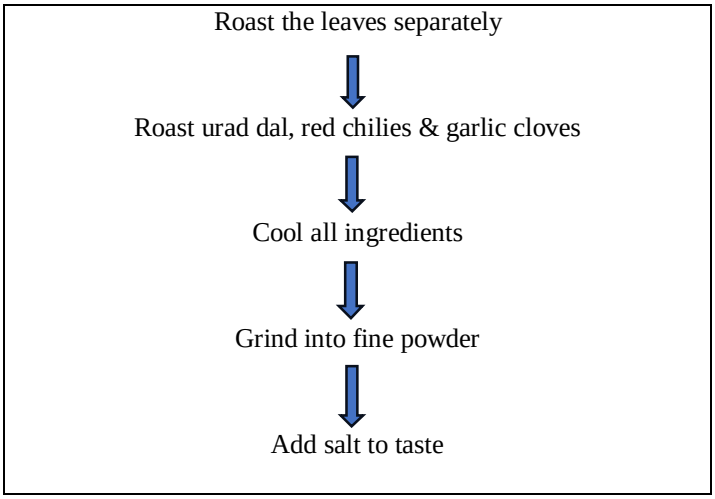
Samples	Combinations
T1	30% CL + 40%ML + 15%FS + 15%OI
T2	40%CL + 30%CL + 15%FS + 15%OI
T3	25%CL + 25%ML + 25%FS + 15%OI

Note: CL- Curry leaves, ML- Moringa leaves, FS- Flaxseeds, OI- Other Ingredients (Urad dal, red chilli and garlic).

B. Preparation of Herbal Nutritional Powder

The herbal nutritional powder was prepared by aiming to enhancing the flavor and preserving the nutritional value of the ingredients. Firstly, curry leaves, moringa leaves, and flaxseedswas separately roasted in a pan to improve flavor and reduce moisture content, ensuring a more concentrated and aromatic profile. Then, urad dal, red chilies, garlic and cloves were also dry roasted to release their essential oils and flavors. Once all the ingredients were cooled to room temperature then they were ground into a fine powder using a mixer grinder. To enhance the taste and balance the overall flavor salt was added as required. The prepared powder was thoroughly mixed and stored in airtight containers to preserve its quality (Fig 2) (Flowchart 1).

C. Method of Preparation



Flowchart 1 Preparation process of Herbal Nutritional Powder

Fig2:Herbal nutritional powder samples prepared for the sensory evaluation

1) Organoleptic Evaluation

The sensory evaluation was carried out three samples of nutritional powder prepared Sample T1, T2 and T3 by using a 7-point hedonic scale with panel of 20 judges considering 6 parameters such as colour, texture, aroma, taste, appearance, overall acceptability and identified best scores sample, the best score identified sample carried out for further analysis.

2) Nutritional Evaluation

Proximate analysis is a set of methods used to determine the nutritional composition of a food sample. It involves the measurement of various components such as energy, moisture, protein, fat, carbohydrates, ash and fibre.

3) *Protein Determination*

The AOAC 2001 by using Kjeldahl method, which is used for the determination of protein in the selected food sample. (AOAC International, 2001)

$$\text{Protein (\%)} = (N \times 6.25) / \text{Sample weight (g)}$$

4) Carbohydrates Determination

The carbohydrate content carried out by the differentiation method by (100 – moisture +Fat +Protein +ash +fibre) (AOAC International, 2022).

5) Moisture Determination

The AOAC 925.10 21st Edition is a method for determining the moisture content in the selected food sample by air oven dry method. (AOAC International, 2022)

Moisture content (%) = [Initial weight (W1) – Final weight (W2) / Initial weight (W2)] x 100

6) Ash Determination

The AOAC 945.05 is a method for determination of ash content in the selected food sample by gravimetric method. (AOAC International, 2022)

Ash content (%) = (Weight of ash / Weight of the sample) x 100

7) Fat Determination

The AOAC (Association of Official Agricultural Chemists) 20th Edition 2016 method (920.39) by gravimetric determination, which is used for the determination of fat in selected food sample. (AOAC International, 2019)

Fat (%) = (Weight of the extracted fat / Weight of the sample) x 100

8) Fiber Content

The AOAC 991.43 is a method for determination of total fibre content in the selected food sample by enzymatic-gravimetric method. (AOAC International, 2022)

Total Dietary Fiber % (TDF) = [Initial weight of the sample (W1) – Weight of the protein residue (W2) – Weight of the ash residue (W3) + Weight of the filtered fibre residue (W4)] / Initial weight of the sample (W1) x 100.

9) Mineral, Vitamin and Essential Fatty acid content

Formulated Herbal Nutritional Powder carried out mineral analysis (iron, calcium and zinc) (AOAC methods-AOAC 972.26, AOAC 985.35 and AOAC 999.11); whereas vitamin analysis (Vitamin A, Vitamin E and Vitamin B1) by AOAC method (AOAC 971.30, AOAC 2000.10 and AOAC 940.29)and Essential Fatty acid (Alpha-linolenic acid, Linolenic acid and Oleic acid) performed by (AOAC methods AOAC 996.06, AOAC 2012.13 and AOAC 2012.13).

10) Microbial analysis

Microbial analysis such as aerobic plate count, yeast & molds and *Enterobacteriaceae* was carried out for 30 days of study by procedure followed by Indian standard method. (FSSAI Manual, 2nd Edn.2022)

11) Statistical Analysis

Data obtained from sensory analysis is subjected to mean and standard deviation and it was statistically calculated by ANOVA using a significance of P value 0.05.

III. RESULTS AND DISCUSSION

1) Sensory Evaluation of Herbal Nutritional Powder

The sensory assessment was conducted in Muppireddipally, Manoharabad. The average scores and standard deviations for various sensory attributes recorded. For aroma, the T1 sample recorded a mean score of 6.35 with a standard deviation of 0.48, T2 had a mean of 6.7 and a standard deviation of 0.47, while T3 scored a mean of 6.5 with a standard deviation of 0.68. In terms of taste, T1 achieved a mean score of 6.75 (SD = 0.44), and T3 had a mean of 6.25 (SD = 0.78). For texture, T1 had a mean of 6.75 (SD = 0.55), T2 scored 6.95 (SD = 0.44), and T3 scored 6.55 (SD = 0.51). Regarding color, T1 received a mean score of 6.75 (SD = 0.44), T2 scored 6.25 (SD = 0.22), and T3 got 6.4 (SD = 0.59). For overall acceptability, T1 had a mean of 6.25 with a standard deviation of 0.63, T2 received 6.65 (SD = 0.48), and T3 scored 5.9 (SD = 0.64).T2 got the highest value which was selected for final analysis.

Table-2:Sensory parameters of Tested sample (T1, T2, T3) of Herbal Nutritional Powder

Sample	Colour	Texture	Aroma	Taste	Overall Acceptability
T1	6.75±0.44	6.75±0.55	6.35±0.48	6.7±0.47	6.25±0.63
T2	6.25±0.22	6.95±0.44	6.7±0.47	6.75±0.44	6.65±0.48
T3	6.4±0.59	6.55±0.51	6.5±0.68	6.25±0.78	5.9±0.64

2) Nutritional Analysis of Herbal Nutritional Powder

The nutritional composition of the optimized herbal nutritional powder is presented in Table 3**.** The formulation selected for analysis was the most acceptable sample based on sensory evaluation. The proximate analysis revealed the presence of balanced macronutrients and significant dietary fiber content.

Table 3: Nutritional analysis of Herbal Nutritional Powder

Test parameters	Result	Unit
Protein	13.4	g/100gm
Carbohydrates	32.5	g/100gm

Total Fat	14	g/100gm
Dietary fiber	11.2	g/100gm
Ash	3	%
Moisture content	7.15	%

3) Protein Content

The herbal nutritional powder contained 13.4 g of protein per 100 g, which is a considerable amount for a plant-based formulation. This high protein level can be attributed primarily to the inclusion of urad dal, moringa leaves, and flaxseeds, all of which are known sources of plant proteins and essential amino acids (Gopalakrishnan et al., 2016). The presence of lysine from urad dal complements cereal-based diets which often lack this essential amino acid, making the formulation particularly valuable in vegetarian and vegan dietary patterns.

4) Carbohydrates

The carbohydrate content was recorded at 32.5 g per 100 g, reflecting the natural carbohydrate levels from plant sources such as moringa leaves and urad dal. This moderate carbohydrate content makes the formulation suitable as a supplementary energy source without contributing excessive glycemic load.

5) Fat Content

The total fat content was found to be 14.0 g per 100 g, which is relatively high for a plant-based powder. This is largely due to the presence of flaxseeds, which are rich in beneficial omega-3 fatty acids, particularly alpha-linolenic acid (ALA). These fats are known for their cardioprotective and anti-inflammatory properties (Nowak &Jeziorek, 2023). The addition of such healthy fats acts as functional food with preventive health benefits.

6) Dietary Fiber

The dietary fiber content was measured at 11.2 g per 100 g, indicating that the powder is an excellent source of fiber. Fiber plays a crucial role in digestive health, glycemic control, and satiety. The high fiber content in the formulation likely comes from flaxseeds, moringa leaves, and curry leaves, all of which contribute both soluble and insoluble fiber fractions. This makes the powder suitable for use in diets targeting constipation, metabolic syndrome, and weight management.

7) Ash Content

The ash content, which reflects total mineral presence, it was 3.0%, which is suggesting that the powder is a good source of essential micronutrients such as calcium, iron, magnesium, and potassium. These minerals originate from moringa and curry leaves, which are particularly rich in iron and calcium (Gopalakrishnan et al., 2016; Meher et al., 2014).

8) Moisture Content

The powder exhibited a moisture content of 7.15%, which is within acceptable limits for dry food products. Low moisture content is crucial for the microbial stability and shelf-life of the product, indicating that the powder can be stored under ambient conditions without rapid spoilage. Proper roasting and drying of the ingredients likely contributed to the reduced moisture level.

9) Mineral Analysis of Herbal Nutritional Powder

The mineral composition of the optimized herbal nutritional powder is presented in Table 4**.**

10) Iron Content

The iron content of the herbal nutritional powder was recorded at 7.1 mg/100 g**,** indicating a significant contribution toward daily iron requirements, particularly for individuals at risk of iron deficiency anemia. This value can be attributed mainly to the Addition of moringa leaves, which are well-documented for their high iron concentration (Gopalakrishnan et al., 2016). Additionally, urad dalandcurry leaves further contribute to the iron content, making this powder beneficial for adolescent girls, pregnant women, and populations in regions where iron-deficiency anemia is prevalent.

According to the Indian Council of Medical Research (ICMR), the Recommended Dietary Allowance (RDA) of iron for adult women is 21 mg/day and for adult men is 17 mg/day (ICMR-NIN, 2020). Hence, a 100 g serving of this herbal powder provides approximately 34–42% of the daily requirement, depending on gender and physiological needs.

11) Calcium Content

Calcium was found to be 160 mg/100 g**,** confirming the formulation as a useful dietary source of this essential mineral. Moringa leaves are particularly recognized for their notably high calcium content, often surpassing that of milk on a per-weight basis (Gopalakrishnan et al., 2016). Adequate calcium intake is essential for bone development, muscular function, and enzymatic regulation.

With an adult RDA of 1000 mg/day for calcium (ICMR-NIN, 2020), the powder delivers approximately 16% of daily calcium needs in just a 100 g portion, making it a valuable addition to diets with low dairy intake or for individuals with lactose intolerance.

12) Zinc Content

The zinc content found to be 1.68 mg/100 g. Zinc plays a crucial role in immune function, wound healing, and DNA synthesis. The presence of zinc in the formulation is likely due to contributions from urad dal**,** moringa**,** andflaxseeds. all of which are moderate plant sources of zinc (Nowak &Jeziorek, 2023). While plant-based zinc is less bioavailable than that from animal sources due to the presence of phytates, regular consumption of such formulations may help mitigate mild zinc deficiency, especially in predominantly vegetarian populations.

The RDA for zinc is 12 mg/day for men and 10 mg/day for women (ICMR-NIN, 2020). Thus, the herbal powder provides approximately 14–17% of the daily zinc requirement, further validating its utility as a micronutrient-rich functional food.

Table 4: Mineral analysis of Herbal Nutritional Powder

Test parameters	Results	Unit
Iron	7.1	mg/100gm
Calcium	160	mg/100gm
Zinc	1.68	mg/100gm

13) Vitamin Analysis of Nutritional Powder

The vitamin content of the formulated herbal nutritional powder was analyzed to evaluate its potential as a micronutrient-rich functional food (Table 5). vitamin A (provitamin A, β-carotene)**,** vitamin E (α-tocopherol**)**, andvitamin B1 (thiamine)**.** These vitamins are critical for immune function, antioxidant protection, vision, energy metabolism, and neurological health.

14) Vitamin A (Provitamin A, β-Carotene)

The powder exhibited a vitamin A content of 0.03 mg/100 g**,** primarily in the form of β-carotene**,** a provitamin A carotenoid. This result reflects the contribution of moringa leaves**,** which are known for their high β-carotene content (Gopalakrishnan et al., 2016). β-carotene is converted into active vitamin A in the human body and is essential for vision**,** immune response**,** andepithelial tissue maintenance**.**

According to the ICMR-NIN (2020)**,** the RDA for vitamin A is 0.6–0.9 mg/day (as retinol equivalents). The content provided by the powder contributes approximately 3–5% of daily requirements per 100 g serving.

15) Vitamin E (α-Tocopherol)

The vitamin E content was found to be 4.75 mg/100 g**,** a significant level for a plant-based product. This antioxidant vitamin plays a key role in preventing lipid peroxidation, protecting cell membranes, and supporting cardiovascular health**.** The high level of vitamin E can be attributed to flaxseedsandmoringa leaves**,** both rich sources of α-tocopherol (Nowak &Jeziorek, 2023; Gopalakrishnan et al., 2016).

The RDA for vitamin E is 10 mg/day for adult males and 8 mg/day for adult females (ICMR-NIN, 2020). Thus, a 100 g portion of this herbal powder contributes approximately 48–59% of the daily requirement, emphasizing its relevance as a potent antioxidant-rich dietary supplement**.**

16) Vitamin B1 (Thiamine)

The formulation was found to contain 0.43 mg/100 g of vitamin B1 (thiamine), a water-soluble vitamin essential for carbohydrate metabolism and neurological function. This level is primarily influenced by the inclusion of urad dal and moringa leaves, both of which are natural sources of thiamine.With an RDA of 1.0–1.2 mg/day for adults (ICMR-NIN, 2020), this herbal powder provides approximately 35–43% of the daily thiamine requirement per 100 g serving.

Table 5: Vitamin analysis of Nutritional powder

Test Parameters	Results	Units
Vitamin A	0.03	mg/100gm
Vitamin E	4.75	mg/100gm
Vitamin B1	0.43	mg/100gm

17) Essential Fatty Acid analysis of Herbal Nutritional Powder

Essential fatty acids (EFAs) play a vital role in human health, contributing to cardiovascular protection, anti-inflammatory processes, neural development, and cellular function. The essential fatty acid composition of the formulated herbal nutritional powder is presented in Table 6**.**

18) Alpha-Linolenic Acid (ALA)

The formulation contains 0.8 mg/100 gof alpha-linolenic acid, an omega-3 fatty acid known for its cardioprotective, anti-inflammatory, and neuroprotective properties. ALA is a precursor to longer-chain omega-3 fatty acids like eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), which play critical roles in cardiovascular and cognitive health (Swanson et al., 2012). The primary source of ALA in the formulation is flaxseed, which is one of the richest plant sources of omega-3 fatty acids (Nowak &Jeziorek, 2023).

The regular consumption of ALA-rich foods is encouraged, particularly in vegetarian and vegan diets where marine-derived EPA/DHA is absent. According to international guidelines, the recommended daily intake of ALA ranges from 1.1 to 1.6 grams per day for adults (NIH Office of Dietary Supplements, 2021).

19) Linoleic Acid

Linoleic acid**,** an essential omega-6 fatty acid**,** was found at 0.9 mg/100 g in the sample. This fatty acid is a structural component of cell membranes and a precursor to arachidonic acid and prostaglandins, which are vital for immune function and inflammation regulation (Simopoulos, 2002). Like ALA, linoleic acid cannot be synthesized by the body and must be obtained from the diet.

The presence of both omega-3 and omega-6 fatty acids in the powder offers a balanced lipid profile, supporting systemic homeostasis. However, modern diets often exhibit an imbalanced omega-6 to omega-3 ratio. The Addition of flaxseeds in this formulation helps restore a healthier ratio, which is considered protective against chronic diseases like cardiovascular disease, diabetes, and certain cancers.

20) Oleic Acid

Oleic acid**,** a monounsaturated fatty acid (MUFA), was detected at 0.1 mg/100 g**.** Although present in small amounts, oleic acid contributes to lipid profile modulation and has been linked to improved HDL levels and reduced LDL cholesterol**.** Its inclusion complements the polyunsaturated fatty acid (PUFA) profile of the formulation. Oleic acid may be derived from both flaxseeds and urad dal**,** both of which naturally contain MUFAs (Bhatty, 1995).

Table 6: Essential Fatty Acids of Nutritional Powder

Test parameters	Unit	Result
Alpha-linolenic acid	0.8	mg/100gm
Linolenic acid	0.9	mg/100gm
Oleic acid	0.1	mg/100gm

21) Microbial Analysis of Herbal Nutritional Powder

Microbiological analysis is a critical aspect of evaluating food safety, particularly for plant-based nutritional products which may be prone to contamination during harvesting, drying, or storage. The results of the microbial analysis of the herbal nutritional powder are presented in **Table 7.**

22) Aerobic Plate Count (APC)

The aerobic plate count was found to be less than 10 CFU/g**,** indicating a very low level of general microbial load. This result confirms that the processing stepsdry roasting of ingredients**,** immediate grindingandproper hygienic handlingwere effective in minimizing microbial growth. According to the International Commission on Microbiological Specifications for Foods (ICMSF), acceptable limits for APC in dried food products generally range up to 10^3–10^4 CFU/g (ICMSF, 2005). The values in this study are well below these thresholds, indicating excellent microbiological quality.

23) Yeast and Mold Count

Yeast and mold counts were also <10 CFU/g**,** suggesting minimal fungal contamination. This is particularly important in dried products where residual moisture can support the growth of spoilage fungi or mycotoxin producers under improper storage conditions. The low counts may be attributed to the roasting process, which not only reduces microbial load but also decreases moisture content (observed at 7.15%), limiting the water activity required for fungal proliferation (Beuchat, 1981). The results comply with the microbial safety limits recommended by the Food Safety and Standards Authority of India (FSSAI, 2020), which suggest yeast and mold counts should not exceed 10^2 CFU/g in similar food categories.

24) Enterobacteriaceae

The absence of Enterobacteriaceae indicates that the product is free from fecal contamination and pathogenic coliform bacteria. This family includes many foodborne pathogens such as *Escherichia coli* and *Salmonella* spp., which can pose serious health risks. The absence of this group suggests good hygiene practices during raw material handling, processing, and packaging (Jay et al., 2005).

25) Staphylococcus aureus

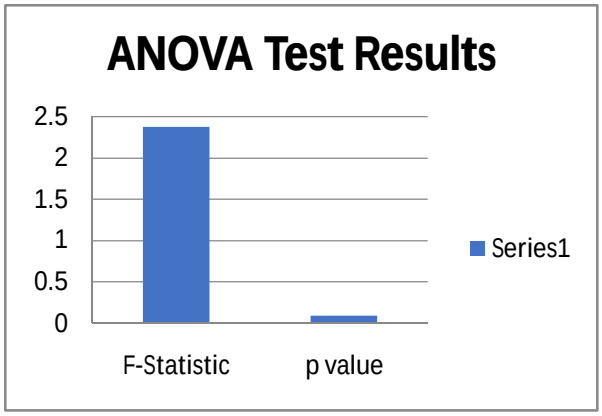
The test result confirmed that *Staphylococcus aureus* was absent in a 25 g sample of the powder. This pathogen, commonly associated with post-processing contamination through handling, can produce heat-stable enterotoxins that cause foodborne illness. Its absence suggests that post-processing handling and packaging were conducted under hygienic conditions**,** thereby preventing contamination through human contact or unclean surfaces (ICMSF, 2005).

Table 7: Microbial Analysis of Herbal Nutritional Powder

Test parameters	Unit	Results
Aerobic plate count	CFU/g	<10
Yeast &molds	CFU/g	<10
Enterobacteriaceae	CFU/g	Absent
S.aureus	CFU/25g	Absent

26) Statistical Analysis

To determine whether three were significant differences in sensory attributes among the three treatments (T1, T2, T3) of the herbal nutritional powder, a one-way Analysis of Variance (ANOVA) was conducted. The analysis yielded an F-statistic of 2.38 and a p-value of 0.09. Since the p-value (~0.09) is greater than 0.05, so we fail to reject the null hypothesis at the 5% significance level. This means there's no statistically significant difference between the means of T1, T2, and T3. The p-value = 0.09 means that there is a 9% probability that the observed differences in a group means (or more extreme differences) could have occurred by random chance if there were actually no differences (i.e., if the null hypothesis were true).



p-value: A p-value of 0.09 means there is a 9% chance that the observed differences in means due to random variation rather than a true difference.

F-statistics: An F-statistic of 2.38 indicates that the between-group variance is only slightly larger than the within-group variance.

IV. CONCLUSION

The present study successfully formulated and evaluated a herbal nutritional powder incorporating curry leaves, moringa leaves, flaxseeds, and other traditional ingredients. Among the three formulations, T2 (50% curry leaves, 20% moringa leaves, 10% flaxseeds, and 20% other ingredients) exhibited the highest organoleptic acceptability, making it the most favorable variant. Comprehensive nutritional analysis revealed that the powder is a valuable source of protein, essential fatty acids, dietary fiber, minerals (iron, calcium, zinc), and vitamins (A, E, B1), aligning with dietary requirements for functional health. Additionally, product exhibited excellent microbial safety, with negligible microbial load and absence of pathogens. These findings support the formulation's potential as a safe, shelf-stable, and nutritionally enriched functional food with promising applications in health-focused diets and food supplementation programs.

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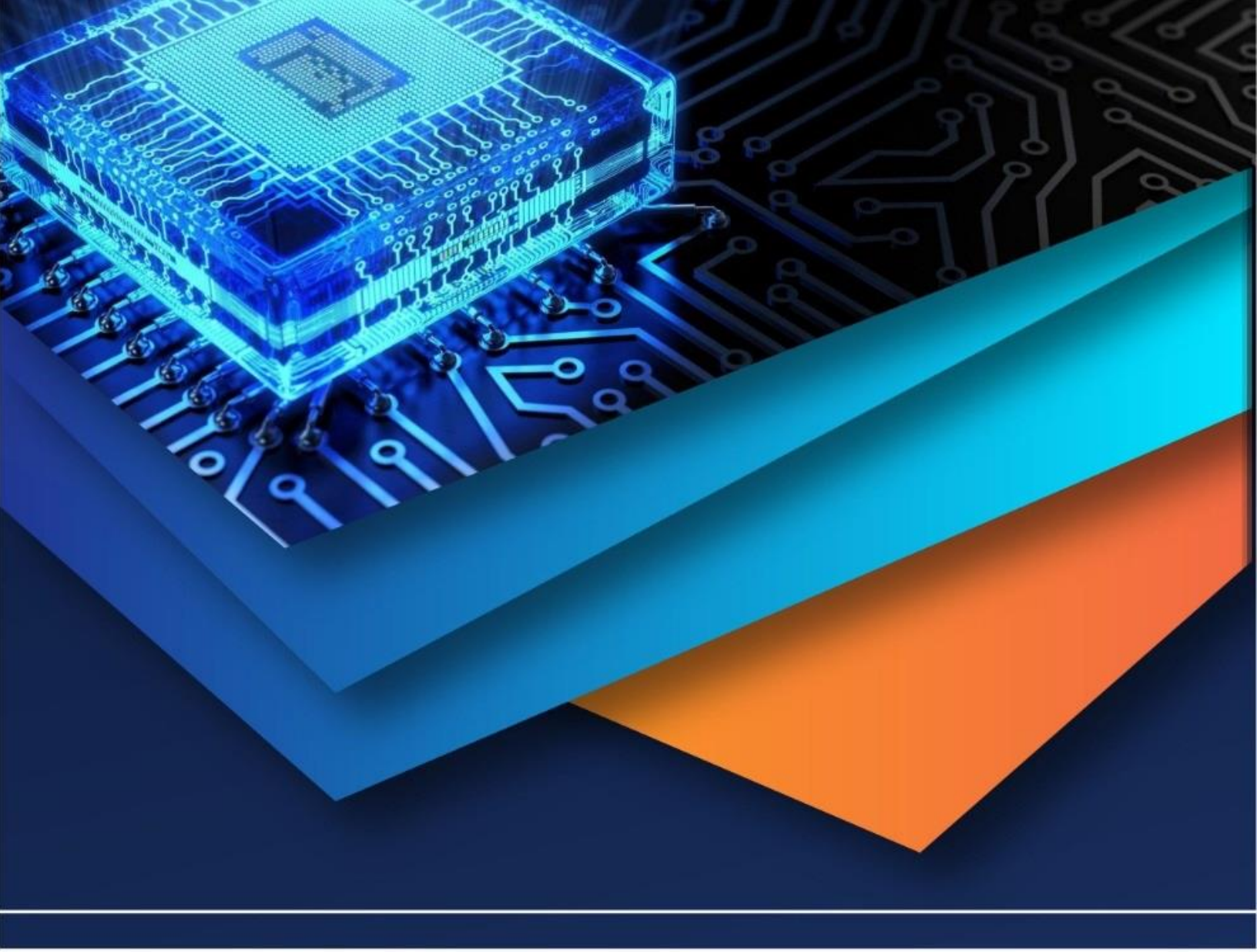

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