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Development, Characterization, and Nutritional Evaluation of a Functional Instant Soup Powder from UV-Treated Pleurotus Ostreatus, Moringa Oleifera, and Fermented Oryza Sativa

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ABSTRACT:

Aim: The objective of the current study was to formulate and pharmaceutically evaluate a convenient, nutrient oriented functional instant soup containing *Pleurotus ostreatus, Moringa oleifera* and fermented *Oryza Sativa* (Fermented rice) with emphasis on its physicochemical quality, phytochemical composition, antioxidant potential and nutritional properties.

Methods: The formulation-development approach was used in an experimental manner. The leaves of *M. oleifera*, *P. ostreatus*, and *Oryza Sativa* fermented rice were separately processed, dried, and powdered, and subsequently blended with selected edible spices and flavouring agents to develop the instant soup matrix. The formulation was analysed for moisture, ash, preliminary phytochemical constituents, total flavonoidal content, DPPH radical scavenging activity, proximate nutrition and total energy value. The antioxidant activity was evaluated by using the DPPH assay in 96-well plate and flavonoids were quantified by aluminium chloride colorimetric method with quercetin as reference standard.

Results: The developed dehydrated soup powder had satisfactory physicochemical properties, moisture content of 3.02% which implies good moisture removal and favorable storage properties. The ash content of ash of M. oleifera, P. ostreatus and fermented rice powders was found to be 5.79%, 4.43% and 1.29%, respectively. The preliminary phytochemical screening revealed the presence of alkaloids, flavonoids, tannins, steroids, triterpenoids, proteins and fixed oils. The linearity of the flavonoid assay was satisfactory with an R^2 value of 0.9883. The formulation exhibited concentration-dependent antioxidant activity, with a reported IC_{50} of 98.34 µg/mL, and a maximum DPPH radical-scavenging inhibition of 98.34% at 1000 µg/mL. Proximate analysis showed 62.4 g/100 g carbohydrate, 14.8 g/100 g protein, and 5.6 g/100 g fat, corresponding to a total energy value of 359.2 kcal/100 g.

Conclusion: Developed *P.ostreatus, M.oleifera*, *Oryza Sativa* instant soup is a potential multifunctional food matrix which combined the nutritional value, phytochemicals and antioxidant activity in a convenient, shelf-stable form. The overall results indicate its nutritional and health promoting potential as a functional food formulation, but further research on the vitamin D_2, vitamin B_{12}, sensory acceptability, storage stability and in vivo/clinical effects is recommended to confirm its nutritional and health promoting efficacy.

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1. INTRODUCTION

Rapid urbanization and increasingly demanding lifestyles have led to a growing reliance on convenient and ready-to-consume food products. Most of these Instant foods are junk food because they contain high amounts of sugar, fat, and salt while lacking sufficient protein, fiber, vitamins, and minerals. These nutrient-deficient meals eventually lead to malnutrition and related diseases. We can resolve this problem by providing easily prepared, nutrient-enriched foods (Ehrhart et al., 1975a). Malnutrition is a key contributor to the burden of disease. Undernutrition accounts for more than half of mortality in children under five globally, with the vast majority of these deaths taking place in low-income and middle-income countries like India (Fiddian-Green and Silen, 1975a). Functional foods, which offer health advantages beyond basic nourishment, have gained popularity in modern times. Changes in lifestyle, dietary imbalances, and the rising incidence of micronutrient deficiency necessitate novel food choices that are both convenient and nutritionally enriched. Functional foods, defined as dietary products with special constituents and beneficial physiological effects, are crucial for the prevention and treatment of chronic disorders (Kidder and Montgomery, 1975). Foods contain elements and bioactive molecules, including lipids, peptides and antioxidants, that are essential to human nutrition. The idea of producing foods with improved functionalities of intrinsic components has led to an increase in research activities and the development of "functional foods" in the food industry (Gardos and Cole, 1976a). As interest in functional foods grows, mushrooms are being employed more often in the production of innovative beverages (Veshohilova, 1975a).

Functional foods, when used as delivery vehicles for bioactive substances, provide two potential advantages: consumers are more likely to comply because eating is more enticing and satisfying than taking tablets, and a food matrix that enhances bioavailability can be developed (Stamm et al., 1976). For the promotion of functional foods, health claims are probably going to be particularly important, particularly when the maker has to explain the health effects of a novel food ingredient like plant stanol. However, because consumer food decisions are influenced by a number of factors other than rational understanding, they may not be sufficient on their own (Korelitz and Sommers, 1975). A lack of vitamin D is frequently linked to decreased immunity, poor bone condition, and heightened vulnerability to chronic medical conditions. In the same way, red blood cell production, brain function, and energy metabolism all depend on vitamin B complex. Despite their significance, deficits in these vitamins are nevertheless common because of insufficient dietary consumption. The vitamin D concentration of UV-exposed mushrooms depends on a number of factors, including the species of mushroom, the amount of UV exposure, the exposed surface area (whole or sliced), the intensity of the light, and the duration of exposure. A useful weapon in the strategic toolbox for tackling vitamin D deficiency globally is UV-exposed mushrooms (DeMeester and Johnson, 1975a). Mushrooms may be the only dietary source of vitamin D that has been fortified to provide a substantial amount of vitamin D2 in a single meal, and their consumption has increased significantly over the past 40 years on a global scale. When exposed to UV radiation, ergosterol in the mushroom cell wall transforms into pre-vitamin D2. A temperature-dependent thermal isomerization step to ergocalciferol, or vitamin D2, comes next (DeMeester and Johnson, 1975a) (Cardwell et al., 2018). Moringa oleifera (Moringaceae) is widely recognized as a nutritional source of easily digested, high-protein food (Berkmen and Lande, 1975a).

The leaves are rich in nutrients, such as vitamins, minerals, and amino acids, according to research from other countries. As a result, the leaves have been used to combat malnutrition, especially in small infants and nursing mothers. In order to be sustainable and easily accessible to the community, the strategy for preventing nutritional problems in expecting moms should make better use of local resources. (Moringa Oleifera) leaves have the potential to be a nutrient-rich, locally accessible food that is not yet completely utilized (Fiddian-Green and Silen, 1975b). The shrub's natural leaves Nutrients and nourishment are abundant in moringa oleifera. 28.66 g of protein, 929.29 mg of calcium, 715.22 mg of phosphorus, 9.99 g of iron, and 2.32 mg of zinc are all present in 100 g of moringa leaves (DeMeester and Johnson, 1975b). To enhance the nutritional value of instant soup, moringa leaf might be used as a beneficial food supplement to moringa-based soup mixes manufactured by drying (Durbin, 1975). Due to their ease of use of preparing foods, instant food products especially soups are taken in large quantities. But traditional quick soups frequently lack vital minerals and bioactive substances. The establishment of a small, soup formulation has benefits like regulated nutritional administration, increased shelf life, and accessibility. Flavonoids and phenolic compounds were examples of phytochemical with antioxidant qualities that assist prevent oxidative stress and lower the risk of chronic illnesses. The medicinal capacity of nutritious food is increased by adding these bioactive substances. Thus, the goal of the current study is to create a new instant soup mix that is enhanced with vitamin D and B complex and to assess its overall quality, phytochemical content, and antioxidant potential using a variety of analytical methods.

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2. MATERIALS AND METHODS

2.1 study design

An experimental formulation-development and laboratory characterization study was designed. The process involved procurement of raw materials, preprocessing and drying of raw materials, preparing fermented rice powder, formulation of the instant soup matrix, physicochemical characterization, preliminary phytochemical screening, estimation of flavonoids, antioxidant evaluation and nutritional assessment.

2.2 plant, fungal and cereal materials

Leaves of *Moringa oleifera* were collected from the local residential/community source. *Pleurotus ostreatus* was collected from a mushroom farm. The rice for preparing fermented rice powder was cooked and the cooked rice was fermented for about 24 h at the experimental conditions. The fermented rice was dried then ground into a powder. The remaining ingredients for soup used in the formulation were from a local market.

2.3 preparation and processing of functional ingredients:

The fresh leaves of *M. oleifera* were removed from stalks and washed to remove any foreign material attached to the leaves. The leaves were spread out thin on a mesh surface and dried under the processing parameters. The dried leaves were then ground and kept at ~30 ± 2℃ for further studies. The fresh oyster mushrooms were cleaned and cut into smaller pieces to provide larger surface area for drying. The mushroom slices were sun dried until they were brittle and then powdered. Considering the central proposed function of the UV treatment of mushrooms as vitamin D_2 formation, future experimental studies should include the irradiance, distance from the UV source, mushroom thickness, pre-treatment and post-treatment ergosterol and vitamin D_2 concentrations, and UV wavelength. Distilled water was used to ferment cooked rice for around 24 h. After fermentation, it was dried and crushed to a fine powder. The fermentation procedure should also include the rice-to-water ratio, the temperature of the fermentation process, the pH before and after fermentation, the fermentation vessel used, the use of a microbial starter culture or not, and the drying conditions for the production of the product.

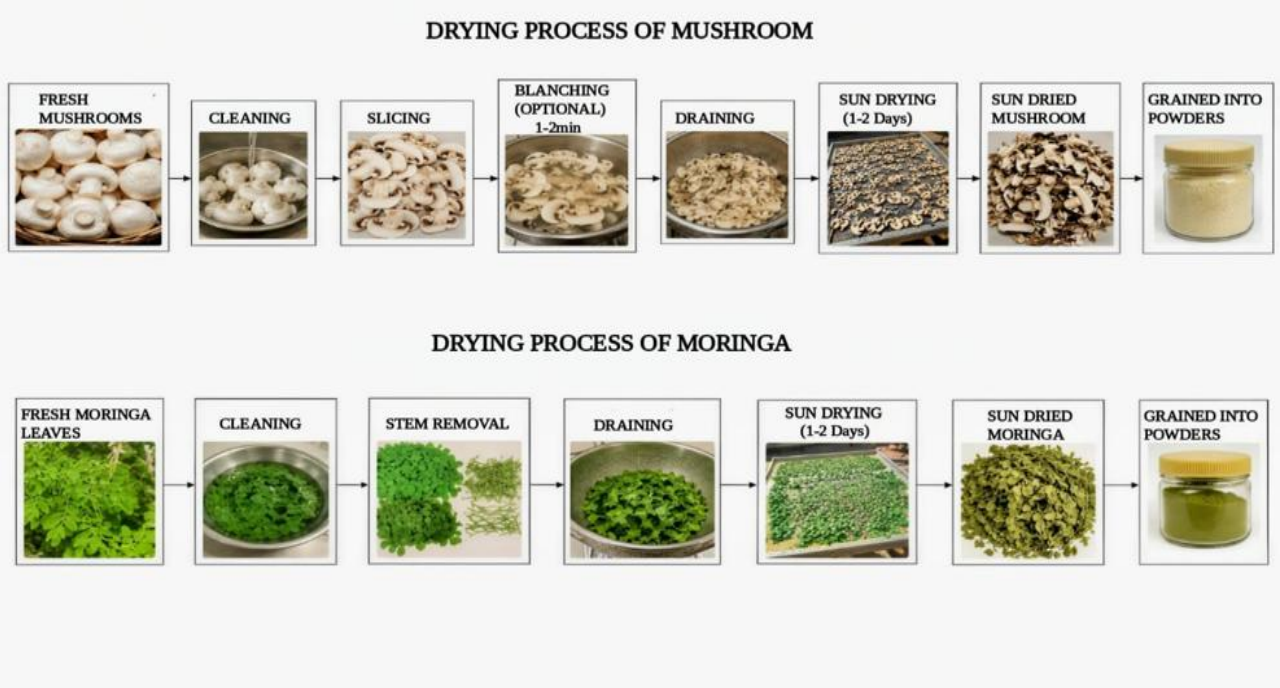

Figure 1: Drying process of the prepared samples carried out under controlled conditions prior to further analysis and formulation.

2.4 preparation and formulation of the functional instant soup

In order to create the quick soup, a number of components were blended of mentioned amounts. To enable to produce homogeneous mixture was dried. Leaf powder was combined using other substances to create fermented rice powder, oyster mushroom, and moringa soup powder. After being made, the soup powders were wrapped in bright or translucent polythene bags and utilized for taste and chemical testing.

Table 1: Composition of the formulated instant soup powder showing the ingredients and their respective quantities used in the formulation.

S.NO	MATERIALS	AMOUNT (g)
1.	UV treated *Pleurotus ostreatus* powder	150g
2.	Sun dried *Moringa oleifera* powder	75g
3.	*(Oryza Sativa)* Fermented rice powder	200g
4.	Ginger powder	10g
5.	Garlic powder	15g
6.	Pepper powder	15g
7.	Cumin powder	15g
8.	Onion powder	15g
9.	Red chilli	5g

3. PHARMACOGNOSTIC AND PHYSICOCHEMICAL EVALUATION

3.1 preliminary phytochemical screening

Qualitative Phytochemical screening of the formulated soup powder was conducted by standard procedures. The major classes of secondary and primary metabolites investigated were alkaloids, flavonoids, tannins, steroids, triterpenoids, proteins and fixed oils. The intensity of the characteristic reactions was used to record the results.

3.2 determination of total ash value

A silica crucible was used to burn 3g of the Moringa, Oyster Mushroom and fermented rice powder. The burned material was heated to 600–650 ^{0}C for five hours in a muffle furnace. The resulting ash was carbon-free white coloured ash. After cooling, it was weighed on the ash-free filter paper. To assess the raw materials' purity and quality, the ash value of rice powder, moringa, and mushrooms was calculated. In a muffle furnace, organic materials are burned at high temperatures (between 450°C and 600°C) to produce non-physiological matter (like sand or soil) and inorganic physiological minerals (like phosphates, carbonates, and silicates). A low ash percentage is a crucial requirement for quality raw materials because a high ash value will be noted if the fortified soup mix is adulterated or tainted with too many inorganic components (Bland et al., 1976).

3.3 Moisture content:

Moisture content is an important quality parameter that influences the stability, shelf life, and susceptibility of food products to microbial spoilage. The moisture content of the formulated instant soup powder was determined using a calibrated moisture analyzer. Approximately 3 g of the sample was accurately weighed and uniformly spread on the sample pan. The sample was subjected to controlled heating at 105°C until a constant weight was achieved. The moisture content was automatically calculated and displayed by the instrument based on the loss in weight during the drying process. The analysis was performed in triplicate, and the results were expressed as percentage moisture content.

Natural Resources for Human Health
eISSN: 2583-1194

4. PHYTOCHEMICAL QUANTIFICATION

4.1 total flavonoid content

The aluminium chloride method was used to determine the total quantity of flavonoids. In a 10 mL volumetric flask, 1 mg/mL of the extract was combined with distilled water. A 5% concentration of sodium nitrite (0.30 mL) was added to the flask. 0.30 mL of 10% AlCl3 has been added to the mixture after five minutes. 2ml of 1.0M NaOH were added to the solution and diluted to the mark with distilled water for an additional 5 mins. The extracts (100, 80, 60, 40, and 20 g/ml) were made in the same manner as quercetin. The absorbance of the extracts and reference solutions was measured using a UV/visible spectrophotometer set at 510 nm. The absorbance of the extracts and reference solutions was measured using a UV/visible spectrophotometer set at 510 nm. A UV/visible spectrophotometer was used to test the absorbance values of quercetin solutions at concentrations of 3.125, 6.25, 12.5, and 50 µg/mL at 510 nm in order to create a standard calibration curve. The total flavonoid concentration was computed from the calibration curve and expressed as milligrams of quercetin equivalent (QE) per gram of extracts (Veshohilova, 1975b).

4.2 antioxidant activity

The 1,1-diphenyl-2-picrylhydrazyl (DPPH) method was used to examine the diluted soup extract. The stock solution was made by dissolving 24mg of DPPH in 100ml of methanol. A workable mixture with an absorbance of about 0.973 at 517 nm and the DPPH stock solution by methanol. The assay was carried out by 96-well plate method.100 µL of extract was added to each well and 100 µL of DPPH working solutions were added to a each well. For a control, 100 µL of methanol and 100 µL of DPPH are added without extract. The 96-well plate were then left in total darkness for half an hour. In a result, the absorbance was taken at 517 nm (Glenn and Goldman, 1976).

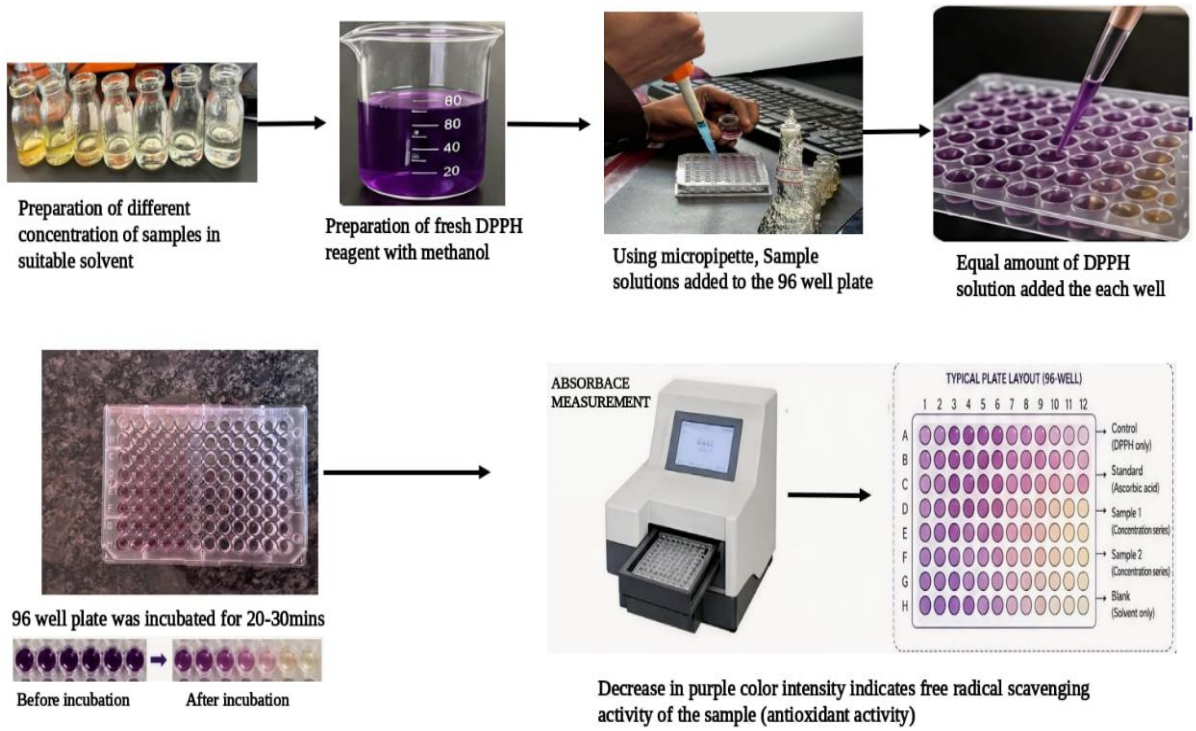

Figure 2: Schematic representation of the antioxidant activity analysis procedure, including sample preparation, extraction, reagent preparation, incubation, absorbance measurement, and calculation of antioxidant activity.

4.3 total energy content:

The total energy value of the formulated soup mixture contoured with mushroom, moringa and fermented rice powder was determined using the proximate composition values obtained for the carbohydrate, protein and fat. The energy value was estimated using the standard at water conversion factors. Transfer 0.2, 0.4, 0.6, 0.8 and 1 ml of working standard into each of the test tubes in the series of test tubes marked. Transfer 0.2, 0.4, 0.6, 0.8 and 1 ml of working standard into the marked test tubes. Take 1 mL of the sample in a new test tube (Pipette). Make up the volume to 1 mL in all the test tubes. A 1 mL of distilled water in a tube. Now add 5 mL of reagent C to all the test tubes including the test tubes labeled 'blank' and 'unknown'. Mix the contents of the tubes by vortexing / shaking the tubes and allow to stand for 10 min. Next, add 0.5 mL of reagent D, mixing well immediately, at room temperature and stir for 6. In the dark, keep for 30 min at a specific temperature. Now plot the absorbance at 660 nm vs blank. Then plot the standard curve by taking concentration of protein along X-axis and absorbance at 660 nm is plotted on the Y-axis. Then from this standard curve calculate the concentration of protein in the given sample.

5. RESULTS

5.1 phytochemical screening

Alkaloids, flavonoids, tannins, steroids, triterpenoids, proteins, and fixed oil were all found, according to the phytochemical examination. These chemicals have been shown to have medicinal and antioxidant qualities, indicating that the formulation could have bioactive potential.

Table 2: Preliminary Phytochemical Profile of the Developed Instant Nutritional Soup Formulation

Alkaloids	+
Flavonoids	+
Tannins	+
Steroids and triterpenoids	+++
Proteins	+
Fixed oil	+

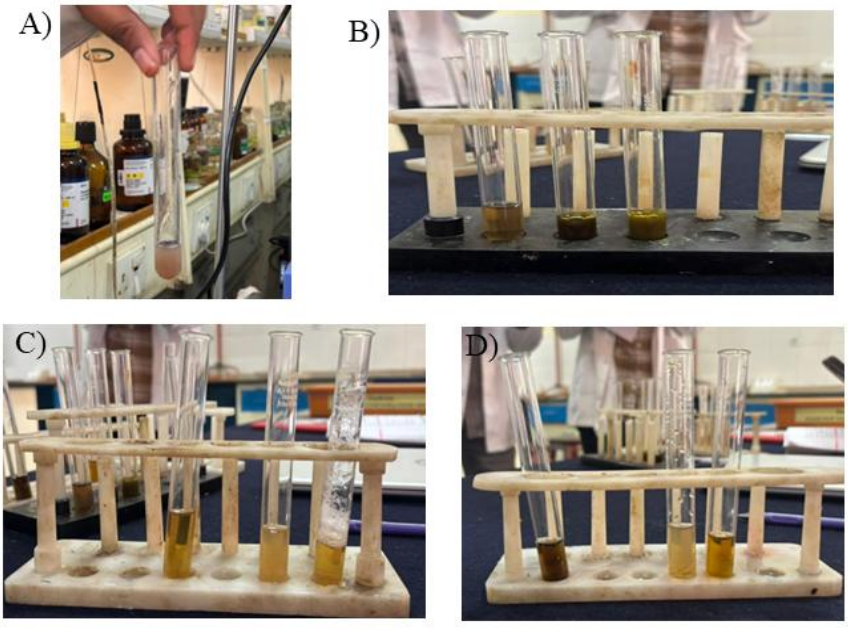

Figure 3: Phytochemical analysis of the fortified formulation showing the qualitative and quantitative presence of bioactive compounds contributing to its nutritional and functional properties.

5.2 ash value

The total ash value of Moringa was found to be 5.79%. The ash produced is light coloured and fine grained, which means that the organic material in the plant was effectively burned. The ash value of the Mushroom powder was 4.43%. This inorganic residue is naturally abundant in the presence of the essential minerals found in mushrooms. The uniformity of the ash suggests a good quality of processing as it is a sign that fungal biomass was well cleaned and dried before fortification. The total ash value was lowest in Rice powder 1.29%. This low percentage proves the purity of the rice powder, no inorganic bulking agent or adulterant was found.

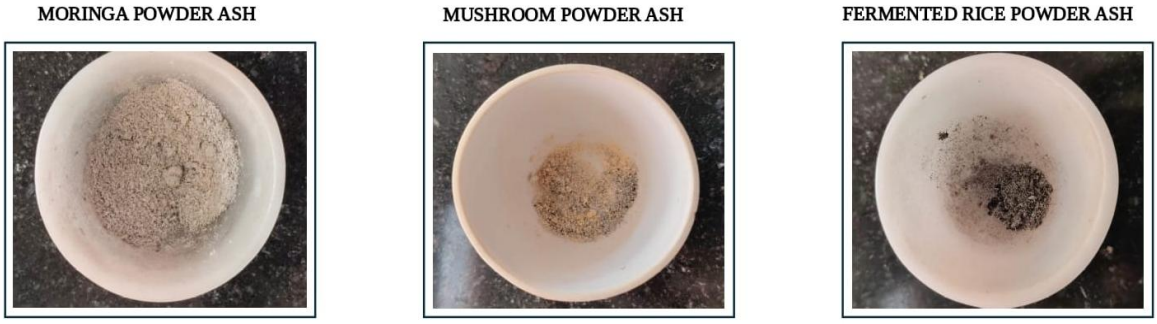

Figure 4: Ash value of the fortified soup instant mix formulation indicating the total mineral content present in the developed product.

5.3 moister content test:

By calculating the ratio of water mass to the total mass of the sample through a controlled drying process, we can determine the efficiency of the dehydration phase. Maintaining a low moisture percentage is essential to prevent caking, inhibit the growth of bacteria and fungi, and ensure the long-term stability of the bioactive plant constituents within the soup powder.

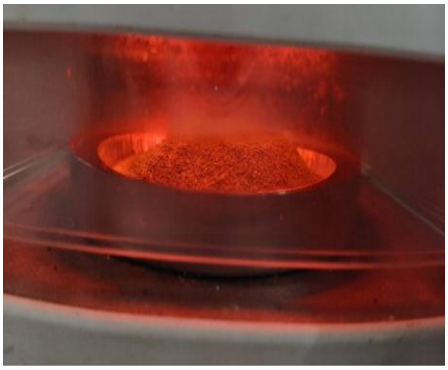

Figure 6. Determination of moisture content by drying the sample at 105°C.

The experimental analysis revealed that the moisture content of the soup powder was 3.02%. This value is well within the ideal range for dehydrated food products (typically < 10%), suggesting that the formulation has been sufficiently dried. The low water activity level indicated by this result implies that the fortified soup mix will have a stable shelf life and is highly resistant to degradation caused by moisture-induced chemical reactions or microbial contamination.

5.4 total flavonoid content

The nutritional soup mix exhibited a high total flavonoid content, with extract samples aligning closely along a linear calibration curve ($y = 0.0232x$, $R^2 = 0.9883$) within a concentration range of 25 to 80 µg/mL.

Natural Resources for Human Health
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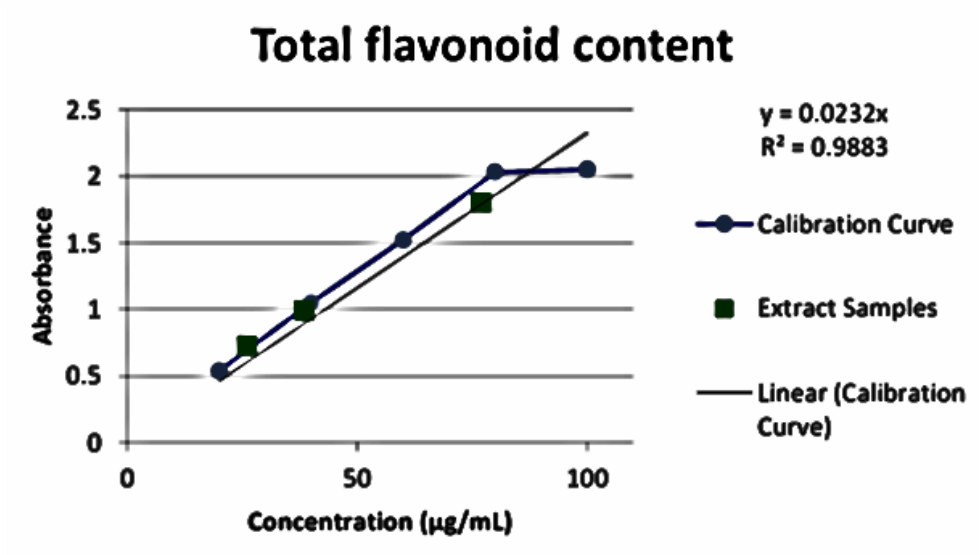

Figure 7: Total flavonoid content of the fortified soup instant mix formulation showing the concentration of flavonoids associated with antioxidant and health-promoting properties.

Figure 8: Total flavonoid content of the fortified soup instant mix formulation showing the concentration of flavonoids using UV analyzer.

5.5 antioxidant activity

High radical scavenging activity was indicated by the antioxidant assay's IC_{50} value of 98.342541 µg/mL Higher antioxidant effectiveness corresponds with lower IC_{50} values, indicating that the formulation is successful in lowering oxidative stress.

Table 2: The antioxidant scavenging activity of the fortified soup mix demonstrates a significant dose-dependent response, with the percentage of inhibition increasing proportionally with the sample concentration.

Concentration	C	S	C-S	C-S/C	C-S/C*100
1000	0.241333	0.004	0.237333	0.983425	98.342541
500	0.241333	0.013	0.228333	0.946133	94.61326
250	0.241333	0.052	0.189333	0.78453	78.453039
125	0.241333	0.13425	0.107083	0.443715	44.371547

62.5	0.241333	0.204	0.037333	0.154696	15.469613
31.25	0.241333	0.2268	0.014533	0.060221	6.0220994
15.625	0.241333	0.236	0.005333	0.022099	2.2099448

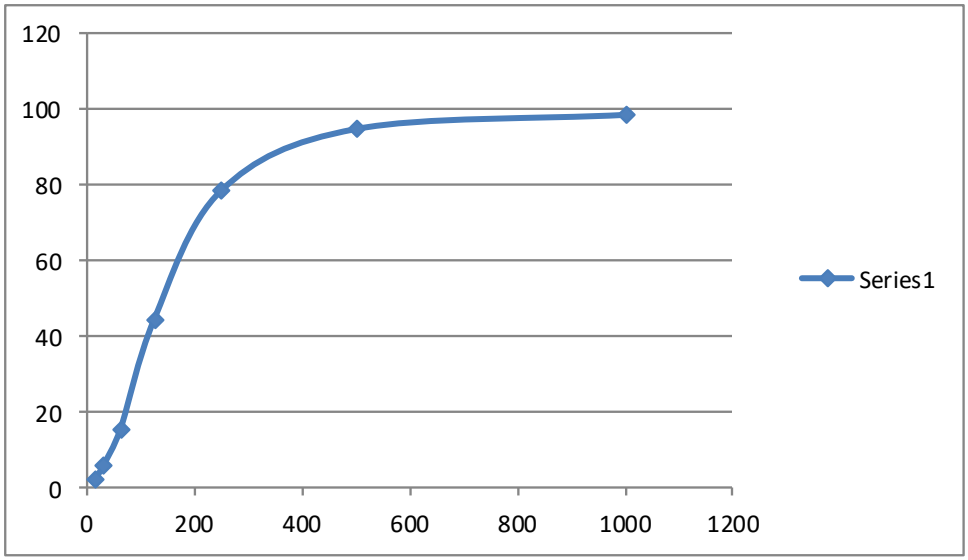

Figure 9: The graphical representation illustrates the scavenging kinetics of the fortified soup mix, showcasing a characteristic hyperbolic curve

5.7 total energy content:

The result obtained from the composition analysis indicated that the formulated soup mixture had moderate nutritional value and due to the addition of mushroom, moringa and fermented rice powder.

The proximate values which were obtained were:

Carbohydrate = 62.4 g/100 g

Protein = 14.8 g/100 g

Fat = 5.6 g/100 g

The total energy value of the formulated soup mixture was 359.2 kcal/100 g. The intermediate energy density of the formulation could be due to the presence of fermented rice powder, mushroom components and moringa leaves which contain high amounts of carbohydrates, proteins and moringa leaves which contain high amount of nutrients. The formulation can thus be considered as a balanced, functional food with a macronutrient composition, appropriate for health promoting applications in food.

6. DISCUSSION

The goal of the current study was to create and evaluate a nutrient-enriched instant soup with the primary functional ingredients being fermented rice powder, oyster mushroom (Pleurotus ostreatus) powder, and Moringa oleifera leaf powder. The prepared soup's appropriateness as a functional food product was assessed methodically using phytochemistry, antioxidant activity, and energy density. The results obtained have confirmed the scientific foundation for combining these three bioactive rich ingredients in a convenient and shelf-stable form. The commentary contextualizes the findings.

The total ash content of the Moringa oleifera leaf powder (5.79%), oyster mushroom powder (4.43%) and fermented rice powder (1.29%) is an important quality indicator of the mineral nature of the raw materials used. The ash content is a parameter that shows the purity and mineral content of food ingredients and it's the inorganic component of the food remaining after complete combustion of the organic one. The ash content in the present study is within the general range of the value reported in Moringa varieties cultivated in various geographical provenances as the ash content of dried Moringa leaf preparations ranges from 4% to 12% (DeMeester and Johnson, 1975c). The differences in ash content between the various studies may be due to the fact that various soil mineral compositions were used, and that the leaves were collected at different stages of maturity, and dried at different temperatures (DeMeester and Johnson, 1975d). This ash value of 4.43% for oyster mushroom powder is fairly similar to the range of ash (4-10%) reported earlier on dried Pleurotus ostreatus under different mushroom growing conditions (Berkmen and Lande, 1975b). The results obtained for Pleurotus ostreatus showed that the ash content in dried Pleurotus ostreatus was 8.22% which is attributed to the high mineral loading characteristic of the species such as Potassium, Iron and Magnesium (Schmoldt et al., 1975). The relatively low ash content noted in the present study could be due to the natural sun-drying process used and the substrate used in the mushroom growing process. The inorganic residue of rice powder is 1.29% which falls in the inorganic residue range of polished or semi-processed rice, which is known to contain less mineral matter than rice containing the husks intact (Poliak, 1975a).

Moisture Content. The moisture content of the formulated soup powder was found as 3.02% which is far below 10% which is the accepted limit for moisture content in dehydrated food products. on the formulation of soup powder using mushroom, moringa leaf and soy flour moisture content ranging from 2.83%, 3.63% and 5.46% respectively was reported, which is well within the moisture content of the present formulation (Ehrhart et al., 1975b). The phytochemical screening of the formulated soup showed the presence of alkaloids, flavonoids, tannins, steroids, triterpenoids, proteins and fixed oils. Such bioactive ingredients are consistent with the known phytochemical profile of the ingredients. Moringa oleifera has been reported to be rich in phenolic compounds with remarkable antioxidant, anti-inflammatory and immunomodulatory properties, including quercetin, kaempferol, and isothiocyanate [25]. The occurrence of steroids and triterpenoids (+++) is particularly significant as these compounds. While the phytochemical profile of Moringa is complimented by another spectrum of bioactive polysaccharides (mainly beta-glucans) and Ergosterol in Oyster mushrooms. The fermentation process is also known to increase the bioavailability of these constituents as fermentation improves the amount of phenolic constituents and antioxidant capacity by the hydrolysis of bound phenolic constituents by microbial enzymes during fermentation [26].

The total flavonoids content in the soup formulation was analysed using colorimetric method with aluminium chloride and quercetin as standard. The calibration curve showed a good linear correlation ($y = 0.0232x$; $R^2 = 0.9883$) indicating the reliability and precision of the assay throughout the range of sample concentrations studied (25–80 µg/mL). The value of this R^2 is similar to that of other researchers for analogous phytochemical studies that used quercetin as the standard; the values for the linear coefficient are consistently higher than 0.98, indicating that this method is suitable for flavonoids quantification in complex food matrices [27]. The flavonoids are a wide category of polyphenolics with various structures and recognized as possessing anti-oxidant, metal chelating and enzyme-inhibiting properties. The leaves of Moringa oleifera are one of the main sources of the flavonoids in this formulation, being a rich source of quercetin-3-glucoside and kaempferol glycosides, among the most powerful flavonoids in dietary sources, in humans (Veshohilova, 1975c). Antioxidant activity (DPPH Assay). One of the most widely used in vitro antioxidant activity assays for plant extracts and foods was the DPPH (1,1-diphenyl-2-picrylhydrazyl) free radical scavenging assay to which the fortified soup formulation was presented. The formulation had the highest percentage of 98.34 % at 1000 µg/mL and its calculated IC_{50} value was 98.34 µg/mL, making it a potent dose dependent radical scavenging activity.

The antioxidant activity found in this study agrees with the previous reports about the antioxidant activity of Moringa oleifera based formulations in different previous literatures that showed the antioxidant activity of Moringa leaf extracts, with IC_{50} values ranging from 69.47 to 280 µg/mL, which were obtained by different preparation methods and solvents (Veshohilova, 1975d). effect of all three ingredients above, with the superior scavenging effect, is attributed to Moringa flavonoids and phenolic acids, the oyster mushroom Ergothioneine and phenolics and beta-glucans, and fermented rice gamma-aminobutyric acid (GABA) and increased free phenolics generated by microbial biotransformation (Gardos and Cole, 1976b). The total energy content of the formulated soup powder was estimated to be 359.2 kcal/100 g, based on the proximate composition values of the formulated soup powder which were calculated to be 62.4 g/100 g for carbohydrate, 14.8 g/100 g for protein and 5.6 g/100 g for fat using the standard Atwater conversion factors. This energy density is similar to the values reported with other formulations of instant soup with plant enrichment (Ehrhart et al., 1975c) and it suggests that the energy profile of the

present formulation is within the suggested energy ranges for the functional dried soups. A recently published study on a vegan oyster mushroom soup powder that had moringa, mung bean and pumpkin added to it found the energy content to be 287 kcal/100 g, which is lower than the present finding and may be due to the different formulations of the mushroom soup powder used in the study (Poliak, 1975b).

7. CONCLUSION

Overall, the parameters used for the quality assessment of the instant soup developed such as ash value, moisture content, phytochemical profile, total flavonoid content, antioxidant activity and total energy content indicate that the developed formulation has a good potential as a functional food. A combination of three nutritionally and phytochemically complementary ingredients "combined" in a single convenient soup format is a promising strategy to address the nutritional deficiencies in clinical and community settings. The potential of the important phytonutrients of this formulation to be accepted as palatable, stable in shelf-life and bioactive in vivo should be explored, and the clinical efficacy of this formulation should be studied in target populations.

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Conflicts of interest:

The author declares no conflict of interest.

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