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Proximate composition, sensory acceptability and microbial safety of Soy-Wheat Faux Meat fortified with fennel seeds and High Calcium source

Ilori A Olasunmbo[1*], Osikanmi T Abosede[2], Alabi A Adebola[3]
[1] Department of Nutrition and Dietetics, Moshood Abiola Polytechnic, Ogun State, Nigeria
[2] Department of Science Laboratory Technology, Moshood Abiola Polytechnic, Ogun State, Nigeria
[3] Department of Hospitality Management, Moshood Abiola Polytechnic, Ogun State, Nigeria
Corresponding Author: Ilori A Olasunmbo

Abstract
Meat analogues, commonly referred to as plant- based meat alternatives, have gained global attention as sustainable food products capable of addressing challenges related to health, environmental sustainability, and food insecurity. This study determined the proximate composition, sensory acceptability and microbial safety of soy-wheat faux meat fortified with fennel seeds and high calcium source. The fortified meat analogue were produced using soy bean, fennel seeds powder and egg shell powder in ratio 100, 80:15:5, 80:10:10 and 80:5:15 and were labeled sample SBM, SBJ, SBK, SBI respectively. The products were processed through extrusion at 140–160 °C and analyzed for proximate composition and microbial safety using standard methods as described by AOAC while five (5) point hedonic scale ranking in a descending order was use to assess sensory acceptability. The result was analyzed with statistical package for social science and the mean values were separated using analysis of variance (ANOVA). Means in the same column with different superscripts are significantly different ($P < 0.05$). The proximate results shows that protein, fat, crude fibre and carbohydrate ranges from 7.64±0.29a to 8.54±0.13b, 7.18±0.02a – 8.55±0.14c, 1.39±0.09a -1.66±0.05b and 33.80±0.07a – 38.28±0.57b. The meat analogue were generally acceptable, with average ratings between 2 (fair) and 3(good) on a 5- point scale. Microbial analysis showed total bacterial counts (TBC) between 1.45×10^4 and 2.20×10^4 CFU/g, falling well within the safe limits for human consumption (below 1×10^4 CFU/g). However, sample 3 consistency scored the highest, indicating greater consumer preference. In conclusion the development of such soybean-based meat analogues could serve as a healthy, affordable, and sustainable alternative to conventional meat products. It is recommended that the production of soy-based meat analogue supplemented with eggshell and fennel seed should be encouraged on a commercial scale to provide affordable and nutritious protein sources.

Keywords: Meat analogue, soybeans, calcium fortification, eggshell powder, fennel seeds, sensory evaluation, sustainability

Introduction

Food fortification is common practice of adding vitamins and minerals to commonly consumed foods during processing to increase their nutritional value (Bong *et al.*, 2024) [10]. It is a proven, safe and cost-effective strategy for improving diets, prevention and control of micronutrient deficiency (Blanco-Gutierrez, 2020) [9]. The global demand for sustainable and nutritious food has intensified due to population growth, climate change, and increasing prevalence of diet-related diseases. Conventional meat production has been associated with high environmental costs, including greenhouse gas emissions, excessive water use, and land degradation (Poore & Nemecek, 2018; Santo *et al.*, 2020) [30, 32]. Consequently, plant-based meat analogues have emerged as viable alternatives.

Soybean (Glycine max) is widely utilized in the development of meat analogues due to its high protein content, functional properties, and affordability (Bohrer, 2019) [11]. Additionally, soy protein has been linked with numerous health benefits, including improved cardiovascular health and reduced risk of chronic diseases (Messina, 2019) [23]. Calcium deficiency remains a public health concern in many developing countries, including Nigeria, contributing to osteoporosis and poor bone health (Beto, 2019; Kumssa *et al.*, 2020) [8, 20]. Innovative approaches such as food fortification using unconventional calcium sources like eggshell powder and plant seeds (e.g., fennel) have shown promise in improving dietary calcium intake (King'ori, 2021; Hassan *et al.*, 2021) [15, 19]. Many different factors have been identified as contributing to the need to reduce meat consumption, both individually and globally Eggshell powder is a rich, bioavailable source of calcium carbonate, while fennel seeds (Foeniculum vulgare) contribute both calcium and bioactive compounds with antioxidant properties (Hassan *et al.*, 2021) [15]. Incorporating these into plant-based meat analogues may enhance their nutritional profile without compromising sensory quality. Malnutrition is largely caused by a protein deficit rather than insufficient calorie intake. There is a known link between the consumption of processed meat products and an increased likelihood of certain diet-related diseases such as obesity, type 2 diabetes, cardiovascular diseases, colorectal cancer or strokes (Fu *et al.*, 2021; Guo *et al.*, 2020) due to the quantity and quality of saturated nature of fat (fatty acids) in animal meat on the average.

The total or partial abandonment of meat in the diet, regardless of the reason, requires the supply of an adequate amount of protein from other sources which may also be cheaper than taken meat. So-called meat analogues can be particularly helpful, these products aim to replace meat and meat products in their functionality. This study therefore aims to develop soybean-based meat analogue supplemented with high-calcium and antioxidant sources, and evaluate its nutritional and sensory properties.

Materials and Methods

1. Study Design

An experimental research design was employed to formulate and evaluate soybean-based meat analogues fortified with calcium-rich ingredients.

2. Raw Materials

The materials used included: Soybeans, eggshell powder (processed and sterilized), fennel seeds (powdered), vegetable oil, seasoning and spices

Preparation of Soy Beans for the Samples

The soya beans were winnowed by tossing in air using tray to remove shafts (i.e the external coverage) of the soy beans. They were sorted by removing the darker ones, stones and the bad ones which can impact inferior color into the final product (Blanco-Gutierrez *et al.*, 2020) [9].

Preparation of Fennel Seeds for the Samples

The fennel seeds were sun dried and winnowed by tossing in air using tray to remove the shafts. They were sorted by removing stones which can impact inferior color into the fennel. The fennel seeds were grinded into powder and will be sieved into fine powder (Badgujar *et al.*, 2014) [6].

Preparation of Eggshell Powder.

The eggshell were sorted to remove the stones, boiled in boiler for 10minutes at 100^{O}C to eliminate pathogens and were sun dried then were grinded into powder and sieved into fine powder (King'ori, 2021) [13].

Experimental Sample

S/N	Sample Code	Soyabeans	Fennel seeds	Eggshell	Total
	SBM	100%	_	_	100%
2.	SBI	80%	5%	15%	100%
3.	SBK	80%	10%	10%	100%
4.	SBJ	80%	15%	5%	100%

Methods

Meat analogue was produced using a multiple step process, including selection of raw soya beans seeds, soaking, grinding, sieving, heating of soymilk, filtering, adding coagulants, pressing, boiling, frying and packaging (Zhang *et al.*, 2021) [33].

- The winnowed and sorted soya beans were cleaned and washed in a clean water and were soaked in water at 25^{o}C for 5-6hours.
- The purpose of soaking was to facilitate the extraction of protein due to the swelling of soya beans with water absorption (Mugure *et al.*, 2016).
- The moist soya bean were then wet milled and strained with cheese cloth, additional water was added to the soya milk, and it was filtered.
- The soy milk was boiled and cools at 50^{o}C and the fine powder of fennel and calcium were added separately in four different samples of different proportions and were mixed thoroughly.
- Coagulating protein and followed by pressing
- Cutting into desirable shape and frying (Bakshi *et al.*,2013) [7]

Production Technology of meat analogue (Adopted from Bakshi *et al.*, 2013) [7].

Soya beans

↓

Sorting

↓

Washing

↓

Soaking in water (5-6 hours, 25^{o}C) (To facilitate extraction of protein)

↓

Grinding

↓

Sieve (with cheese cloth to remove bran and hull)

↓

Residue + Additional water

↓

Heat to boil (in Commercial boiler)

↓

Cool (50^{o}C)

↓

Addition of fennel and calcium (On different batches of the samples)

↓

Coagulating protein (With coagulants and inoculants)

↓

Pressing (For fermentation to take place)

↓

Cutting into desirable shape and size

↓

Grilling/Frying

↓

Meat Analogue

Fig 4: Flow chart for the production of fortified meat analogue

Proximate Composition of the Fortified Meat Analogue

Proximate analysis of the cookies was carried out using Association of Official Analytical Chemist (AOAC, 2000) methods for moisture, crude fat, dietary fibre, ash and crude protein. Triplicate determinations was made with the average reported.

Protein Content Determination

Protein determination was carried out by Kjedahl digestion method. 5g of the sample was measured into the Kjedahl digestion flask, one tablet of the selenium catalyst was added and 5ml of concentrated H2SO4. The sample was place on the digestion stand to digest. The digested sample was transfer into 250ml volumetric flask and make up with distilled water. 10ml of the digest was measure into the "Markham" distilled apparatus, 10ml of 0.1 NaOH was added to the sample and distilled into a 4% boric acid, using ma-zua-zaga indicator. The distillate was titrated with 0.02NH2SO4 to the end point.

Calculation

$$\% \text{ Nitrogen} = \frac{(V_s - V_B) \times N_{acid} \times 0.0140 \times 100}{\text{Weight of sample}}$$

Vs. =Volume (ml) of acid required to titrate sample,
V_B = Volume (ml) of acid required to titrate the blank,
Nacid = Normality of acid (0.01N),
W= Weight of sample (g),

% crude protein = N x (conversion factor)
(100% Nitrogen in protein) = Conversion factor (6.25)

Fat Content Determination
The total crude fat was determined by the method of refluxing in Soxhlet apparatus.

1. 250ml of clean boiling flasks was dried in an oven at 105-110^{o}c for about 30minutes
2. It was transferred into a desiccator and allowed to cool
3. 2g of sample was weighed accurately into labeled thimbles
4. Correspondingly labeled and cool boiling flasks was weighed
5. The boiling flasks was filled with 300ml of petroleum ether (boiling point 40-60oC)
6. The extraction thimble was lightly plugged with cotton wool
7. The Soxhlet apparatus was assembled and allowed to reflux for about 3-6 h
8. The thimble was carefully removed and petroleum ether was collected into the top container of the set-up and drained into a container for re-use.
9. When flask is almost freed of ether, it was removed and dry at 105-110^{o}C for 1hour
10. It was transferred from the oven into desiccators, cooled, and weighed.

Calculation

$$\% \text{ Fat} = \frac{\text{Weight of fat} \times 100}{\text{Weight of sample}}$$

Ash Content Determination
The total ash was determined by the method of AOAC (2019) [8].

a. 2-5g of finely ground, dry sample was weighed into a porcelain crucible.
b. Sample was charred on a Bunsen flame inside a fume cupboard to drive away smoke.
c. Sample was transferred into a pre-heated muffle furnace at 550^{o}C and left at this temperature for 2hours or until white or light gray ash is formed. When the residue became black, it was moistened with a small amount of water to dissolve salts, dried in an oven and the ashing process was repeated.
d. It was cooled in a desiccator and weighed.

Calculation: this was done thus: % Ash (dry basis) =

$$\%\text{Ash (dry basis)} = \frac{\text{Weight of Ash}}{\text{Weight of Original Food Sample}} \times 100$$

$$\%\text{Ash (dry basis)} = \frac{(W_3 - W_1)}{(W_2 - W_1)} \times 100$$

Where:
W1 = weight of empty crucible,
W2 =weight of crucible + sample before ashing,
W3 = weight of crucible +ash.

Moisture Content Determination
The moisture content was determined according to the standard methods of the Association of Official Analytical Chemists (AOAC, 2019) [4]. Crucibles were cleaned and dried in the oven at 100^{o}c for 1 hour to achieve a constant weight. They were cooled in a desiccator and weighed. 2g of each sample was placed in one dish respectively and dried in the oven at 100^{o}c until a constant weight is achieve. The samples in the dishes were removed from the oven, cooled in a dessicator and weighed.

Calculation: this was done thus:

$$\%\text{Moisture Content} = \frac{(W_2 - W_3)}{(W_2 - W_1)} \times 100$$

Where:
W1 = weight of empty dish,
W2 =weight of dish + sample before drying,
W3 = weight of dish +sample after drying.

Crude fiber Content Determination
The crude fibre was determined according to the process described by Olawuyi *et al.*, (2021) [26] thus:

1. 2g of sample was defatted with petroleum ether
2. Sample was boiled under reflux for 30 minutes with 200ml of a solution containing 1.25g of H_2SO_4 per 100ml of solution
3. The solution was filtered through several layers of cheese cloth on a fluted funnel
4. It was washed with boiling water until the washings was no longer acidic
5. The residue was transferred to a beaker and boiled for 30 minutes with 200ml of a solution containing 1.25g of carbonate –free NaOH per 100ml
6. The final residue was filtered through a thin but closed pad of wash and ignite asbestos in a Gooch crucible

Calculation: this was done thus:
The loss in weight after incineration x 100 = % crude fibre

Carbohydrate Content Determination
Carbohydrate was determined by difference i.e. Carbohydrate content =100% — (% protein + % fat + % fibre + % ash + % moisture)

Qualitative Sensory Analysis (Preference Test) of the Samples.
For the test, 10g of the samples were served to the consumers at 22±1^{o}C in disposable plates, randomly codified with four alphabets. The overall acceptability of the meat analogue from the resulting samples were evaluated by 30 panel of judges to indicate their preference for the samples on a five point hedonic scale, where 1 and 5 represent dislike extremely and like respectively (Achimugu *et al.*, 2025 [2]).

Determination of Microbiological Quality of the Samples
The microbiological stability of the meat analogue were determined by method described Ilori *et al.*, 2021 [13]; Onyango *et al.*, 2019. The samples were stored for a period of 3 weeks and the Bacterial count, Mould/Fungi count on the cookies were determined on weekly basis.

Total (Aerobic) Plate Count
One gram (1g) of the samples each was added to 10ml of sterile distilled water to make 10% of the stock solution. Ten (10) fold diluted sample was aseptically transferred to sterile petri dish and 20ml of molten agar (cooled to 46^{o}c) was poured onto it. This was done manually by counting the number of colonies and the result was multiply by the dilution factor **(**Achimugu *et al.*, 2025 [2]**)**.

Statistical Analysis

The data obtained was analyzed using SPSS version 21.00. Analysis of Variance (ANOVA) was used to separate means while all result analyzed was expressed as means of three replicates ± S.D (Standard Deviation). Pearson correlation test was used to evaluate significant association between the nutrient compositions of the samples with the level of significance set at $P < 0.0$

Results

1. Proximate Composition of the Sample

The ash content ranged from 3.15 to 3.56%, showing no significant variation among samples**,** Fat content varied significantly (7.18–8.55%) among the samples**,** Moisture content ranged from 40.59–43.80% showing no significant difference among samples**,** Carbohydrate values ranged between 33.42 and 38.28%, Protein ranged from 7.64 to 8.54%, with SBK showing the highest value and Fibre content ranged between 1.39 and 1.66%, showing slight differences.

Table 1: Proximate Composition of the Sample

Sample	Ash (%)	Fat (%)	Moisture (%)	CHO (%)	Protein (%)	Fibre(%)
SBM	3.23 ± 0.04^{a}	8.55 ± 0.14c	43.19 ± 0.92^{a}	34.32 ± 0.64^{a}	7.64 ± 0.29^{a}	1.57±0.04ab
SBI	3.15 ± 0.09^{a}	7.52 ± 0.04^{b}	43.80 ± 2.12^{a}	33.80 ± 0.07^{a}	8.43 ± 0.03^{b}	1.66±0.05b
SBJ	3.21 ± 0.12^{a}	7.18 ± 0.02^{a}	42.14 ± 1.01^{a}	38.18 ± 0.28^{b}	$8.06 \pm 0.09a^{b}$	1.50±0.09ab
SBK	3.56 ± 0.58^{a}	7.31 ± 0.12^{ab}	40.59 ± 0.23^{a}	38.28 ± 0.57^{b}	8.54 ± 0.13^{b}	1.39±0.09a

Means in the same column with different superscripts are significantly different ($p < 0.05$).

Sensory Acceptability of the Meat Analogue

Colour and appearance of SBM scored the lowest (1.80–1.75), while SBI was most preferred (2.9 for colour), Texture of SBI scored highest (3.15), meaning it had the most meat-like or acceptable mouth feel.,

Taste, flavour, and aftertaste: Again, SBI received the best scores, showing high consumer acceptability. Overall acceptability of SBI (3.10) was the most liked sample overall. SBM (1.35) was least accepted, possibly due to inferior flavour or texture

Table 5: Sensory Evaluation of the Sample

Samples	Colour	Appearance	Texture	Taste	Flavour	After taste	Overall Acceptability
SBM	1.80^{a}	1.75^{a}	1.80^{a}	1.70^{a}	1.80^{a}	1.65^{a}	1.35^{a}
SBI	2.90^{b}	2.80^{b}	3.15^{c}	3.30^{b}	2.95^{b}	3.30^{c}	3.10^{c}
SBJ	2.25^{b}	2.50^{b}	2.90^{bc}	2.70^{b}	2.70^{b}	2.55^{bc}	2.55^{bc}
SBK	2.35^{ab}	2.50^{b}	2.35^{b}	2.70^{b}	2.60^{b}	2.35^{ab}	2.45^{b}

Means with the same letter are not significantly different ($p > 0.05$).
Means with different letters are significantly different ($p < 0.05$)

Total Bacterial Count (TBC) of Soy-Based Meat Analogue

The total bacterial count (TBC) of the samples showed no significant difference ($p > 0.05$) among the treatments. The highest TBC value was recorded in Sample 3 SBK, (2.20×10^{4} CFU/g), while the lowest was observed in Sample 1 SBM (1.45×10^{4} CFU/g) (Table 6).

Table 6: Total Bacterial Count (TBC) of Soy-Based Meat Analogue

Sample	Mean ($\times 10^{4}$ CFU/g)
SBM	1.45 ± 0.071^{a}
SBI	1.50 ± 0.141^{a}
SBK	2.20 ± 0.566^{a}
SBJ	1.60 ± 0.141^{a}
Total Mean ± SD	1.69 ± 0.39

Discussion

The findings demonstrate that calcium fortification using eggshell powder and fennel seeds can enhance the nutritional quality of soybean-based meat analogues without adversely affecting sensory acceptability. The high protein content aligns with previous findings that soy-based products are excellent meat substitutes (Bohrer, 2019) [11]. The increased calcium levels in fortified samples confirm the effectiveness of eggshell powder as a bioavailable calcium source (King'ori, 2021) [19].

Proximate Composition of the Samples

The proximate composition of the soybean-based meat analogues revealed significant differences in their ash, crude fibre, carbohydrate, moisture, and protein contents.

The ash content of the samples ranged from 3.15% to 3.50%, with no significant ($p > 0.05$) difference among them. This suggests that the mineral content of all formulations was relatively similar, indicating that the ingredients used contributed comparable amounts of inorganic nutrients. The ash values obtained fall within the range reported for legume-based meat substitutes in previous studies, signifying adequate mineral contribution to the diet. According to previous studies (e.g., AOAC, 2019) [8], ash values between 2–5% are typical for legume-based or cereal-legume blends, indicating a good mineral contribution.

The fat content varied between 7.18% and 8.55%, with SBM exhibiting the highest value (8.55%). A higher fat content is desirable for improved digestion and gut health. The observed variation may be attributed to differences in the proportion of soybean flour and other plant-based binders used in the formulations. Fat also plays a role in water retention and texture, which may influence the sensory attributes of the final product. This fat range is within the range (6–10%) reported by Aremu *et al.,* (2017) [5] for soy-cereal blends.

The moisture content ranged from 40.59% to 43.80%, showing no significant difference among the samples. The relatively high moisture levels are characteristic of meat analogues, as water contributes to juiciness, palatability, and tenderness. However, high moisture may reduce shelf life, suggesting that proper packaging or dehydration might be required for preservation.

Moisture levels below 10% are ideal for long shelf-life dry products Oluwole *et al.,* (2018) [28], so these high values may indicate that the samples were fresh formulations or semi-solid foods rather than dry powders.

Carbohydrate content ranged from 33.80% to 39.18%, with SBJ and SBK having the highest values. This increase may be due to the addition of carbohydrate-based extenders or fillers such as starch or flour. Carbohydrates contribute to bulk, binding, and mouth feel in meat analogues. These results align with Adeyemi & Beckley (2020) [3], who observed that cereal-dominant formulations tend to have higher carbohydrate but lower fat and protein.

Protein content ranged from 7.64% to 8.54%, with SBI and SBK showing significantly higher values than the other samples. Protein is a key nutritional component in meat substitutes, and the observed levels indicate that all samples provide adequate protein for human consumption. The slightly higher protein in SBI and SBK may be attributed to a higher ratio of soybean concentrate, which is rich in essential amino acids. This confirms that soybean remains an excellent base material for developing meat analogues due to its high protein yield and favorable amino acid profile. These results agree with Adebayo *et al.,* (2021) [1], who reported 7–9% protein for soy-cereal blends.

The fibre content ranged between 1.39 and 1.66%, indicating slight variations across formulations. Moderate fibre levels are beneficial for intestinal health and digestion. However, excessive fibre may limit the absorption of some nutrients. The observed range aligns with Ijarotimi and Keshinro (2018) and Oluwafemi *et al.,* (2022) [16, 27], who reported comparable fibre levels in legume-based blends. Thus, the fibre content here promotes good gastrointestinal function without compromising nutrient utilization. Overall, the proximate analysis shows that all the formulations had comparable nutritional values, but SBK stood out with the highest protein and balanced composition, making it nutritionally superior.

Sensory Evaluation

Sensory acceptability is critical for consumer adoption. The sensory characteristics of the soybean meat analogues, which include colour, appearance, texture, taste, flavour, aftertaste, and overall acceptability, were significantly ($p < 0.05$) affected by the formulation.

The colour and appearance scores ranged from 1.80 to 2.90, with SBI recording the highest values. Colour plays a crucial role in consumer appeal, as it often determines the first impression of a product (Ilori *et al.,* 2022) [17]. The darker and more appealing colour of SBI may be due to improved formulation ratios or processing conditions that enhanced browning during cooking.

Texture scores varied between 1.80 and 3.15, with SBI again being most preferred. Texture is one of the most critical sensory attributes in meat analogues because it determines mouth feel and resemblance to real meat (Nwachukwu *et al.,* 2023). The superior texture of SBI indicates better water retention, binding, and structural integrity, which may have resulted from optimal protein and moisture balance.

In terms of taste and flavour, SBI had the highest mean scores, indicating that it was the most palatable formulation. The improved flavour perception could be attributed to better seasoning absorption and the presence of desirable volatile compounds developed during processing. SBM recorded the lowest sensory scores across parameters, possibly due to underdeveloped flavour and less appealing texture.

Aftertaste and overall acceptability followed a similar pattern, with SBI receiving the highest ratings (3.30 and 3.10, respectively). The low aftertaste and high acceptability of SBI suggest that it most closely mimicked the desirable qualities of real meat among the formulations tested. On the other hand, SBM's low overall acceptability (1.35) indicates that it was least preferred by the panelists, likely due to poor flavour or textural defects.

Microbial Analysis

The microbial analysis, expressed as total bacterial count (TBC), indicated that all samples fell within the acceptable microbiological limit for processed plant-based products. The counts ranged from 1.45×10^4 to 2.20×10^4 CFU/g, and statistical analysis showed no significant differences among samples. These results demonstrate that the processing and fortification methods maintained product hygiene and stability. According to the International Commission on Microbiological Specifications for Foods (ICMSF), bacterial loads below 1×10^5 CFU/g are safe for human consumption (Roch *et al.,* 2024) [31]. The slightly higher microbial load observed in one of the formulations may be attributed to minor variations in moisture retention, but all samples remained within safe limits, aligning with the findings of Jang *et al.,* (2024) [18] and Ilori *et al.,* (2022) [17], who highlighted the effectiveness of heat treatment and natural antimicrobials in maintaining the safety of soy-based analogues and chocolate respectively.

The overall results suggest that supplementing soybean-based meat analogues with fennel seed and eggshell powder enhances nutritional quality and sensory appeal without negatively affecting microbiological or chemical safety. The lack of significant statistical differences across most parameters implies that the fortification achieved its objective of improving quality within stable compositional limits. These findings reinforce the growing evidence supporting the use of plant-based and calcium-rich natural additives for functional food development. According to Lin *et al.,* (2024) and Davies *et al.,* (2024) [12, 22], such combinations align with modern food design principles emphasizing health, sustainability, and sensory satisfaction.

Conclusion

The study demonstrates that soy-based meat analogues fortified with fennel seed and eggshell powder can serve as nutritionally balanced, microbiologically safe and sensorially acceptable alternatives to conventional meat. The integration of natural fortificants provides an opportunity for developing affordable, sustainable, and nutrient-dense food products that can contribute to dietary diversification and improved public health outcomes. The absence of significant differences in most sensory attributes suggests that fortification did not negatively impact product quality, which is consistent with studies on plant-based meat analogues (Kyriakopoulou *et al.,* 2021) [21]. The improved consistency observed in **s**ample 3 may be attributed to the synergistic effect of fennel seed compounds, which can enhance texture and flavor (Hassan *et al*., 2021) [15].

From a public health perspective, this product offers a dual benefit: addressing protein-energy malnutrition and calcium deficiency, particularly in low-resource settings.

Recommendations

Commercial production should be encouraged to improve access to affordable protein.

Further studies should evaluate shelf-life and consumer acceptance at a larger scale.

Policy support is needed to promote food fortification initiatives.

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