ASEAN Journal of
Agriculture and Food Engineering

Journal homepage: https://ejournal.bumipublikasinusantara.id/index.php/ajafe

Formulation, Proximate Composition, and Sensory Evaluation of Organic Condiment Cubes from Traditional Nigerian Ingredients (Soya Beans, Daddawa, Crayfish, and Stockfish) as an Alternative to Commercial Seasoning Cubes

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ABSTRACT

This study formulated and evaluated organic condiment cubes from traditional Nigerian food ingredients, including soya beans, daddawa, crayfish, stockfish, olive oil, and iodised salt. The cubes were produced through ingredient processing, blending, compression, drying, and packaging, then compared with a commercial seasoning cube. Proximate analysis showed that the organic condiment cube had higher crude protein, crude fiber, carbohydrate, and energy values, while the commercial seasoning cube had higher sodium and ash contents. Sensory evaluation indicated that the organic cube received higher scores for aroma, taste, aftertaste, and overall acceptability. The findings suggest that condiment cubes made from traditional ingredients can provide a nutritionally improved and acceptable alternative to commercial seasoning cubes.

ARTICLE INFO

Article History:
Submitted/Received 14 Dec 2025
First Revised 19 Jan 2026
Accepted 10 Feb 2026
First Available online 12 Feb 2026
Publication Date 01 Mar 2026

Keyword:
Daddawa;
Nigerian food;
Organic condiment cube;
Proximate composition;
Sensory evaluation;
Soya beans;
Traditional food ingredients.

1. INTRODUCTION

Condiments and seasoning agents are important components of food preparation. They enhance flavour, improve palatability, and contribute to the overall sensory quality of meals. In many Nigerian households, seasoning cubes are widely used because they are convenient, affordable, and able to produce a consistent savoury taste in different dishes. However, many commercial seasoning cubes are formulated with high levels of salt, monosodium glutamate, hydrogenated fats, flavour enhancers, colourants, and other additives, raising concerns about their long-term nutritional and public health implications [1, 2].

The increasing interest in natural and minimally processed food products has encouraged renewed attention to traditional food ingredients as alternatives to industrially processed foods. Recent applied studies have also shown that natural and locally available materials can be developed into functional products beyond their conventional uses, supporting broader interest in sustainable material-based innovation [3]. In Nigeria and other West African food cultures, ingredients such as daddawa, soya beans, crayfish, and stockfish have long been used to improve flavour while also contributing protein, minerals, fatty acids, and other nutrients to the diet [4-7]. These ingredients are culturally familiar, locally available, and nutritionally valuable, making them suitable for the development of improved condiment products.

Daddawa, a fermented condiment produced from *Parkia biglobosa* seeds, is especially important in traditional Nigerian cuisine because it provides a strong umami flavour and contributes to the sensory depth of soups and stews. Its fermentation process produces free amino acids, including glutamic acid, which contributes to savoury taste and makes it a natural flavour enhancer [7-9]. The use of daddawa in a structured condiment cube can therefore help preserve traditional flavour while reducing dependence on synthetic flavour enhancers.

Fermented legume-based condiments, such as those produced from African locust bean, rely on microbial activity to develop flavour, improve sensory characteristics, and generate savoury compounds, which support the functional role of daddawa in the formulation [9]. Soya beans also provide an important nutritional base for condiment formulation because they are rich in plant protein, essential amino acids, and bioactive compounds. Processed soya bean flour can improve the protein content, texture, and binding capacity of food formulations, making it suitable as a major ingredient in organic condiment cubes [10]. When combined with daddawa, crayfish, and stockfish, soya beans can help produce a condiment with both plant-based and animal-derived nutritional value.

Crayfish and stockfish are commonly used in Nigerian cooking because they contribute aroma, flavour, protein, and minerals. Dried crayfish is rich in protein and minerals such as calcium, phosphorus, magnesium, and zinc, while stockfish provides dense animal protein and marine-derived nutrients [5, 11]. Their inclusion in condiment cube formulation can improve nutritional quality while maintaining the familiar flavour profile expected in traditional Nigerian dishes.

Olive oil may also contribute functional value to condiment formulation by serving as a lipid binder and source of monounsaturated fatty acids. Unlike hydrogenated fats commonly used in some commercial products, olive oil is associated with a healthier lipid profile and contains antioxidant compounds such as polyphenols [12]. Its use in organic condiment cubes can help improve texture while supporting the development of a cleaner and more nutritionally balanced product.

Despite the nutritional potential of these traditional ingredients, there is still a need for systematic product development that converts them into a convenient and standardized condiment form. Many traditional condiments are used in loose, paste, or powdered forms, while commercial seasoning cubes remain popular because of their convenience, uniformity, and ease of storage. Developing organic condiment cubes from traditional Nigerian food ingredients may therefore provide a practical alternative that combines cultural familiarity, improved nutritional composition, and consumer acceptability.

This study formulated and evaluated organic condiment cubes from traditional Nigerian food ingredients, including soya beans, daddawa, crayfish, stockfish, olive oil, and iodized salt. The study determined the ingredient composition, proximate composition, sensory properties, and nutritional-health profile of the organic condiment cube in comparison with a commercial seasoning cube. The findings are expected to contribute to the development of healthier, locally sourced, and culturally relevant alternatives to industrial seasoning products.

2. METHODS

This study used an experimental food formulation and comparative evaluation approach to develop organic condiment cubes from traditional Nigerian food ingredients and compare them with a commercial seasoning cube. The work involved raw material preparation, formulation, cube compression, drying, packaging, proximate analysis, sensory evaluation, and statistical comparison. The organic condiment cube was formulated from soya beans, daddawa, crayfish, stockfish, olive oil, and iodized salt. A commonly available commercial seasoning cube was used as the control sample. The ingredients used in the organic condiment cube formulation and their functional roles are presented in **Table 1**.

Table 1. Ingredient composition of the organic condiment cube formulation.

INGREDIENT	QUANTITY (per 100g BATCH)	ROLE IN FORMULATION
Soya beans (*Glycine max*)	30 g	Protein base, texture binder, flavour carrier
Daddawa, fermented *Parkia biglobosa*	25 g	Umami flavour, natural glutamate source, flavour development
Crayfish, dried *Penaeus notialis*	20 g	Marine protein, aroma, mineral enrichment
Stockfish, dried *Gadus morhua*	12 g	Animal protein, omega-3 source, depth of flavour
Extra virgin olive oil (*Olea europaea*)	8 g	Lipid binder, antioxidant source, texture emulsifier
Iodised salt, NaCl	5 g	Palatability, preservation, and mineral supplementation

All raw materials were obtained from reliable local suppliers and checked before processing. The soya beans were sorted to remove stones, damaged seeds, and foreign materials. They were soaked in distilled water, dehulled, rinsed, roasted, and milled into flour. Roasting was used to reduce moisture, improve flavour, and lower anti-nutritional factors associated with raw legumes. The daddawa was inspected for colour, moisture condition, and absence of visible mould, then ground and sieved to obtain a uniform powder. The crayfish was sorted, further dried, and milled into powder. The stockfish was rehydrated, deboned,

dried, and milled before inclusion in the formulation. The olive oil was used as the lipid binder, while iodised salt was added for flavour and preservation.

The formulation followed a controlled blending procedure. The dry ingredients, consisting of soya bean flour, daddawa powder, crayfish powder, stockfish powder, and iodised salt, were weighed accurately and mixed until a uniform blend was obtained. Olive oil was then added gradually while mixing continued to ensure even distribution throughout the dry matrix. The mixture was checked manually for cohesiveness by pressing a small portion between the fingers. A suitable blend was expected to hold together without excessive crumbling or oil separation.

After blending, the mixture was placed into a stainless-steel cube mould measuring approximately 10 mm × 10 mm × 10 mm. The cubes were compressed using a manual press to obtain a compact structure similar to commercial seasoning cubes. The formed cubes were then dried under controlled temperature to reduce moisture and improve storage stability. Drying was continued until the cubes reached a low final moisture level suitable for dried condiment products. Low moisture content is important in dried food products because it reduces microbial growth and supports shelf stability [13].

The dried organic condiment cubes were individually wrapped in food-grade packaging material and stored under ambient conditions before analysis. The commercial seasoning cube used for comparison was purchased from a registered retail outlet and stored under the same conditions. Both the organic condiment cube and the commercial seasoning cube were subjected to proximate composition analysis and sensory evaluation.

Proximate analysis was conducted using standard analytical procedures. Moisture content was determined by oven drying to constant weight. Crude protein was analyzed using the Kjeldahl nitrogen method with a nitrogen-to-protein conversion factor. Crude fat was determined through solvent extraction, while crude fiber was measured by acid-alkali digestion. Ash content was determined through incineration in a muffle furnace. Carbohydrate content was calculated by difference, and energy value was calculated using Atwater conversion factors. Sodium content was determined using flame photometry. The analytical procedures followed standard AOAC methods for food composition analysis.

Sensory evaluation was conducted using 30 semi-trained panellists recruited from the university community. The panellists evaluated soup samples prepared under standardized conditions using either the organic condiment cube or the commercial seasoning cube as the only seasoning agent. The samples were coded and served in similar containers to reduce bias. A nine-point hedonic scale was used to evaluate colour or appearance, aroma or odour, taste or flavour, saltiness, aftertaste, and overall acceptability. Panellists gave their ratings based on preference and sensory perception of each sample.

The data from proximate analysis were expressed as mean and standard deviation. The organic condiment cube and commercial seasoning cube were compared to determine differences in nutritional composition. Sensory evaluation data were also summarized using mean and standard deviation. Statistical analysis was conducted to identify significant differences between the two products. The interpretation focused on whether the organic condiment cube showed improved nutritional value and acceptable sensory quality compared with the commercial seasoning cube.

Ethical consideration was observed during the sensory evaluation. Panellists were informed about the purpose of the evaluation, and participation was voluntary. The data were reported in a summarized form without identifying individual panellists.

3. RESULTS AND DISCUSSION

The results present the nutritional composition, sensory properties, and health-related comparison between the formulated organic condiment cube and the commercial seasoning cube. The analysis focused on whether the organic condiment cube developed from traditional Nigerian food ingredients could provide improved nutritional value while maintaining acceptable sensory quality. The original manuscript reported three main comparison tables in this section: proximate composition, sensory evaluation, and nutritional-health profile.

The proximate composition of the organic condiment cube and the commercial seasoning cube is presented in **Table 2**. The organic condiment cube had a markedly higher crude protein content than the commercial seasoning cube. The high protein value of the organic cube can be attributed to the combined contribution of soya beans, daddawa, crayfish, and stockfish. These ingredients are naturally rich in plant and animal proteins, making them suitable for improving the nutritional profile of seasoning products. Soya beans and fermented legume condiments contain high protein levels, while crayfish and dried fish products also provide concentrated marine-derived protein [5, 6].

Table 2. Proximate composition of organic condiment cube and commercial seasoning cube.

PARAMETER	ORGANIC CONDIMENT CUBE	COMMERCIAL SEASONING CUBE	SIGNIFICANCE
Moisture content	4.2 ± 0.3%	3.8 ± 0.2%	$p > 0.05$, NS
Crude protein	38.2 ± 1.3%	22.4 ± 0.9%	$p < 0.001$
Crude fat	9.8 ± 0.6%	14.6 ± 0.8%	$p < 0.001$
Crude fiber	4.7 ± 0.4%	0.3 ± 0.1%	$p < 0.001$
Ash	8.1 ± 0.5%	38.2 ± 1.1%	$p < 0.001$
Carbohydrate	35.0 ± 1.2%	20.7 ± 0.9%	$p < 0.001$
Energy	374.6 ± 5.3 kcal/100 g	297.4 ± 4.8 kcal/100 g	$p < 0.01$
Sodium	310 ± 12 mg/100 g	1,200 ± 45 mg/100 g	$p < 0.001$

The organic condiment cube also had higher crude fiber than the commercial seasoning cube. This is likely due to the presence of soya bean flour and daddawa, which retain plant-derived fiber components after processing. Dietary fiber is nutritionally important because it supports gastrointestinal function and is associated with reduced risk of diet-related chronic conditions [15]. Although seasoning cubes are consumed in small quantities, the higher fiber content of the organic formulation still indicates a more nutritionally complex product than the commercial seasoning cube.

The commercial seasoning cube had a higher crude fat content than the organic condiment cube. However, the nutritional implications of fat content depend not only on quantity but also on fat quality. The fat fraction of the organic cube was derived mainly from olive oil, crayfish, and stockfish, which are associated with unsaturated fatty acids. In contrast, commercial seasoning products may contain hydrogenated or saturated fats, which are less

desirable from a cardiovascular health perspective [12, 16]. Therefore, the lower fat content and healthier lipid sources in the organic cube may be considered nutritionally favourable.

The ash and sodium values showed one of the most important differences between the two products. The commercial seasoning cube recorded a much higher ash content and sodium level than the organic cube. This difference reflects the heavy use of salt and mineral-based additives in industrial seasoning formulations. Excessive dietary sodium intake has been associated with hypertension and cardiovascular risk, making sodium reduction an important public health goal [1]. The lower sodium content of the organic cube suggests that it may offer a healthier alternative for consumers who need to reduce sodium intake.

The organic condiment cube also had higher carbohydrate and energy values than the commercial seasoning cube. This may reflect the presence of whole food ingredients, especially soya beans and daddawa, rather than a formulation dominated by salt and additives. The higher energy value should not be interpreted negatively because condiment cubes are consumed in small quantities. Instead, it indicates that the organic cube contains more nutrient-bearing components, including protein, fiber, lipid, and carbohydrate.

The proximate composition results suggest that the organic condiment cube has a stronger nutritional profile than the commercial seasoning cube. It provides higher protein, fiber, carbohydrate, and energy values while containing substantially lower sodium. These findings support the potential of traditional Nigerian food ingredients as raw materials for developing healthier condiment products.

The sensory attributes of the organic condiment cube and the commercial seasoning cube are presented in **Table 3**. The organic condiment cube achieved higher sensory scores for aroma, taste, aftertaste, and overall acceptability. The high aroma score may be linked to the combined flavour contributions of daddawa, crayfish, roasted soya bean flour, and stockfish. Fermented condiments such as daddawa contain volatile compounds that contribute savoury, nutty, and fermented aroma notes, while crayfish and stockfish add marine and umami characteristics [8, 9].

Table 3. Sensory evaluation scores of the organic condiment cube and the commercial seasoning cube.

SENSORY ATTRIBUTE	ORGANIC CONDIMENT CUBE	COMMERCIAL SEASONING CUBE	SIGNIFICANCE
Colour / Appearance	7.4 ± 0.5	7.8 ± 0.4	$p > 0.05$, NS
Aroma / Odour	8.1 ± 0.3	7.4 ± 0.4	$p < 0.01$
Taste / Flavour	7.9 ± 0.4	7.3 ± 0.5	$p < 0.05$
Saltiness	6.8 ± 0.6	8.2 ± 0.3	$p < 0.001$
Aftertaste	7.5 ± 0.4	6.4 ± 0.6	$p < 0.01$
Overall Acceptability	8.0 ± 0.3	7.2 ± 0.5	$p < 0.01$

The organic condiment cube also received a higher taste score than the commercial seasoning cube. This suggests that the traditional ingredients were able to produce a desirable flavour profile without relying heavily on synthetic flavour enhancers. Daddawa naturally contributes glutamic acid, which produces umami taste, while stockfish may contribute nucleotide-based flavour compounds that enhance savouriness [2, 17]. The combination of plant-based, fermented, and marine ingredients, therefore, provided a complex flavour profile that was acceptable to panellists.

The commercial seasoning cube received a higher saltiness score. This result is expected because the commercial product had a much higher sodium content. Although high saltiness may increase immediate flavour intensity, it is not necessarily a nutritional advantage. Excessive salt consumption remains a major public health concern, and food reformulation strategies that reduce sodium while maintaining flavour are strongly encouraged [1]. In this study, the organic condiment cube achieved better overall acceptability despite having lower saltiness, suggesting that flavour quality can be improved through traditional ingredients rather than excessive sodium.

The organic condiment cube also had a better aftertaste score. This may be due to the absence of synthetic additives and the use of whole traditional ingredients. A pleasant aftertaste is important for condiment acceptability because seasoning products are expected to enhance meals without leaving an unpleasant or artificial flavour. The lower aftertaste score of the commercial seasoning cube may reflect the lingering effect of high salt content, flavour enhancers, or other industrial additives.

There was no significant difference in colour or appearance between the two products. This indicates that the organic condiment cube had an appearance that was comparable to the commercial product. The colour of the organic cube likely resulted from roasted soya beans, daddawa, crayfish, and stockfish. This finding is important because consumers often judge seasoning products not only by flavour but also by visual familiarity. A comparable appearance may support consumer acceptance of the organic alternative.

Acceptability was higher for the organic condiment cube than for the commercial seasoning cube. This result suggests that the organic cube was not only nutritionally improved but also sensorially competitive. Consumer acceptability is essential for product development because a healthier product is unlikely to succeed if it does not meet sensory expectations. The sensory findings, therefore, support the feasibility of developing condiment cubes from traditional Nigerian food ingredients.

The nutritional and health-related comparison between the organic condiment cube and the commercial seasoning cube is summarized in **Table 4**. The organic condiment cube provides several potential nutritional and health advantages over the commercial seasoning cube. Its protein sources are derived from both plant and marine ingredients, which may improve amino acid diversity. The inclusion of soya beans, daddawa, crayfish, and stockfish contributes to a broader nutrient profile than a seasoning cube based mainly on hydrolysed vegetable protein, salt, and additives.

The lipid profile of the organic condiment cube is also more favourable because olive oil and marine ingredients provide unsaturated fatty acids. In contrast, commercial seasoning cubes may use hydrogenated fats or saturated fats for texture and stability. Diets high in trans-fatty acids and undesirable saturated fats have been associated with cardiovascular risk, while unsaturated fats are generally considered more favourable for heart health [12, 16].

The sodium reduction in the organic cube is one of the most important findings. The organic condiment cube contained substantially less sodium than the commercial seasoning cube, which may make it more suitable for consumers concerned about hypertension and cardiovascular health. Although the organic cube still contains iodised salt for palatability and preservation, its sodium level was much lower than that of the commercial product. This supports its potential role as a lower-sodium seasoning alternative.

Table 4. Nutritional and health comparison of organic condiment cube and commercial seasoning cube.

PARAMETER	ORGANIC CONDIMENT CUBE	COMMERCIAL SEASONING CUBE	HEALTH IMPLICATION
Protein source	Plant and marine-derived protein	Hydrolyzed vegetable protein	Broader amino acid contribution in the organic product
Fat type	Unsaturated fat from olive oil and marine sources	Saturated or hydrogenated fat	Better lipid profile in the organic product
Sodium content	310 mg/100 g	1,200 mg/100 g	Lower sodium intake risk in the organic product
MSG content	No synthetic MSG; natural glutamates only	Synthetic MSG may be present	Cleaner formulation in the organic product
Fiber content	4.7%	0.3%	Higher fiber contribution in the organic product
Antioxidants	Olive polyphenols, soya isoflavones, daddawa phenolics	Synthetic antioxidants may be present	Natural antioxidant sources in the organic product
Additives/ preservatives	None, salt-preserved	Colourants, stabilisers, or emulsifiers may be present	Cleaner label in the organic product
Shelf life	6–9 months under controlled storage	18–24 months	Longer shelf life in the commercial product

The organic cube also had a cleaner label profile because it was formulated from recognizable traditional food ingredients without synthetic additives. This aligns with the increasing demand for natural and minimally processed foods. Consumers are becoming more interested in products made from local ingredients with fewer artificial additives, especially when such products can still deliver acceptable flavour and convenience. However, the commercial seasoning cube had the advantage of a longer shelf life. This is likely due to industrial processing, lower moisture, higher salt content, preservatives, and packaging systems designed for extended storage. The organic condiment cube may require further optimization to improve shelf stability. Future work should therefore include microbiological testing, packaging improvement, storage stability evaluation, and scale-up trials.

Taken together, the results indicate that the organic condiment cube developed from traditional Nigerian food ingredients performed well in nutritional and sensory evaluation. It contained higher protein and fiber, lower sodium, and better overall acceptability than the commercial seasoning cube. These findings suggest that traditional food ingredients can be transformed into convenient, standardized, and nutritionally improved condiment products. The formulation may provide a promising alternative for consumers seeking healthier seasoning options while maintaining familiar Nigerian food flavours. These findings also contribute to broader discussions on local food innovation, sustainable food processing, and the use of food-based materials in applied food technology [18-20].

4. CONCLUSION

This study successfully formulated organic condiment cubes from traditional Nigerian food ingredients, including soya beans, daddawa, crayfish, stockfish, olive oil, and iodised salt. The formulation process showed that these local ingredients can be processed into a compact

seasoning cube through controlled preparation, blending, compression, drying, and packaging. The organic condiment cube had better nutritional properties than the commercial seasoning cube. It contained higher crude protein, crude fiber, carbohydrate, and energy values, while the commercial seasoning cube had higher sodium and ash contents. The lower sodium level of the organic cube suggests that it may serve as a healthier seasoning alternative, especially for consumers who need to reduce sodium intake. The sensory evaluation also showed that the organic condiment cube was acceptable to panellists. It received higher scores for aroma, taste, aftertaste, and overall acceptability, while the commercial seasoning cube scored higher only in saltiness. Flavour quality can be achieved through traditional food ingredients without relying heavily on excessive salt or synthetic additives. Organic condiment cubes made from traditional Nigerian food ingredients offer a promising alternative to commercial seasoning cubes. Future studies should examine shelf-life stability, microbial safety, packaging improvement, consumer acceptance, and small-scale production feasibility.

5. ACKNOWLEDGMENTS

We thank the laboratory staff of the Biological Sciences Department, Yobe State University, Damaturu (YSU), and the staff of the S.L.T Department in Federal Polytechnic, Damaturu, for providing the facilities and technical support necessary to conduct this research.

6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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