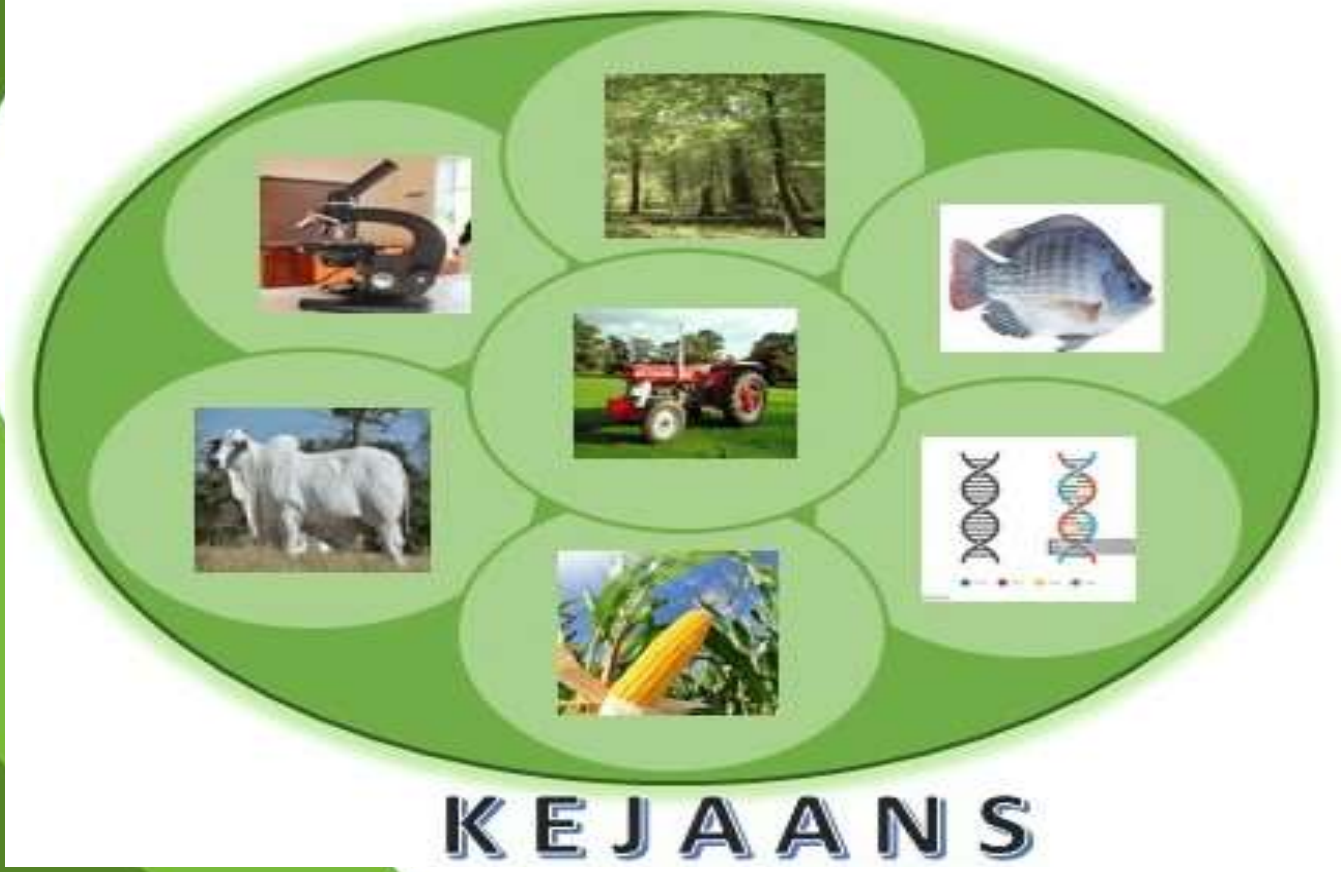
(KEJAANS)

KEBBI JOURNAL OF AGRICULTURE AND NATURAL SCIENCES

September, 2025, Vol. 1, issue 2



CONTACT:
The Editor-in-Chief,
Kebbi Journal of Agriculture and Natural Sciences,
Faculty of Agriculture,
Abdullahi Fodio University of Science and Technology
Aliero,
PMB 1144, Birnin kebbi, Nigeria.
Email: kejaanseditor@ksusta.edu.ng,

ISSN: 1595-5776

KEBBI JOURNAL OF AGRICULTURE AND NATURAL SCIENCES (KEJAANS)

September, 2025; Volume 1, Issue 2

OFFICIAL JOURNAL OF THE

FACULTY OF AGRICULTURE

ABDULLAHI FODIO UNIVERSITY OF SCIENCE AND TECHNOLOGY, ALIERO

ISSN: 1595-5776

About the Journal

This official scientific publication of the Faculty of Agriculture, Abdullahi Fodio University of Science and Technology Aliero, is a non-profit, open access, double-blind peer-reviewed Journal publishing four issues (January, April, July and October) per annum. The Journal is a platform open to collaborations with researchers, authors, institutions, research agencies and private companies related to Agriculture. The Mission of the Journal is to disseminate scientific knowledge through the publication of original research articles, research notes, book reviews, letters to the editor and reviews of Literature, representing a contribution to scientific and technological knowledge in respective areas covered by the Journal. The Kebbi Journal of Agriculture and Natural Sciences seeks to validate and disseminate new knowledge, making it public in order to strengthen the human capacity, constitute a link in the scientific community to the society and encouraging the expansion of University and academic researches.

Scope of Kebbi Journal of Agriculture and Natural Sciences (KEJAANS)

The Kebbi Journal of Agriculture and Natural Sciences has the sole aim of providing an intellectual platform and ideas for scholars, by promoting interdisciplinary studies related to agriculture and natural science through publishing the latest scientific research findings that are of direct policy implications and beneficial to the research community. Consequently, the journal covers all aspects of Crop Science, Animal Science, Agricultural Economics, Agricultural Extension and Rural Development, Food Science, Fisheries and Aquaculture, Biotechnology, Soil Science and Agricultural Engineering, Forestry and Environment, Wildlife, Agricultural Education, Agro-allied Industries as well as all Natural Science researches related to Agriculture.

KEBBI JOURNAL OF AGRICULTURE AND NATURAL SCIENCES (KEJAANS)
September, 2025: Volume 1, Issue 2 : 142-147
p-ISSN: 1595-5776

CHEMICAL COMPOSITION AND SENSORY VALUES OF MACKEREL FISH PATTIES AS AFFECTED BY DIFFERENT COOKING METHODS

Musa, V. A., Olorunsanya, A. O., Egbewande, O.O. and Yisa, M.

Department of Animal Production, Ibrahim Badamasi Babangida University, Lapai, Niger State

*Corresponding author: musavictor80@gmail.com; +2347032092132

ABSTRACT

As fish consumption continues to grow due to its high protein content and essential fatty acids, developing value-added products like fish patties can improve dietary intake and marketability. The study investigated the impact of different cooking methods on the quality of mackerel fish patties. It was conducted at the Animal Production Laboratory, Faculty of Agriculture, Ibrahim Badamasi Babangida University, Lapai, Niger State. A Completely Randomized Design (CRD) was employed with five cooking methods; broiling (10 minutes), frying(15 minutes), steaming(20 minutes), boiling(15 minutes), and baking(30 minutes). Each treatment were replicated five times and each replicate consisted of patties weighing 40g, prepared by incorporating sieved wheat flour into the minced fish, eggs, vegetable oil and seasonings. The patties were evaluated in terms of proximate composition, physicochemical properties, and sensory attributes. Significant differences ($p<0.05$) were observed among treatments. Steamed patties had the highest protein (37.00±0.001%) and cooking yield (95.00±1.77%), while fried patties recorded the highest fat (18.32±0.001%) and carbohydrate (14.35±0.001%) levels. Boiled patties retained the highest moisture (39.97±0.001%) but had lower protein. Sensory evaluation revealed steamed patties were most preferred in all the sensory parameters; juiciness, consistency, flavour and overall acceptability. The findings suggested steaming as the most suitable cooking method for producing nutritious and consumer-acceptable mackerel fish patties enhanced with wheat flour.

Keywords: Mackerel, wheat flour, patties, cooking methods, proximate composition, sensory evaluation

Introduction

Fish patties are convenient and nutritious products that have gained consumer acceptance as a means of diversifying fish consumption beyond fresh and preserved forms. They are especially important in developing countries where fish is a major source of protein but post-harvest losses remain high (Li et al. 2016).

Mackerel is a nutrient-rich fish with high-quality protein and essential omega-3 fatty acids (Kris-Etherton et al. 2003). However, despite its nutritional profile, it is underutilized in processed value-added products such as fish balls, fish cakes, fish sausage and fish burgers. The incorporation of binders like wheat flour helps improve patty structure, texture, and stability during cooking and storage of mackerel fish (Fan et al. 2016; Jin et al. 2020). In addition to formulation, cooking methods play a vital role in determining the nutritional and sensory quality of patties. Frying enhances flavour but often increases fat content, while steaming preserves protein and improves water

retention. Baking and boiling, on the other hand, may reduce juiciness due to moisture loss (Das & Pradhan, 2020; Kumar et al. 2021).

This study specifically examined the effect of five cooking methods (broiling, frying, steaming, boiling, and baking) on the quality of mackerel fish patties enriched with 25% wheat flour. .

Materials and Methods

Experimental Location

The study was conducted at the Animal Production Laboratory, Faculty of Agriculture, Ibrahim Badamasi Babangida University, Lapai, Niger State, Nigeria (Usman, 2013).

Experimental Design

A Completely Randomized Design (CRD) was employed with five cooking methods, replicated five times:
Treatment A: Broiling
Treatment B: Frying
Treatment C: Steaming
Treatment D: Boiling
Treatment E: Baking

Table 1: Recipe for the patties

Ingredients (%)	Composition (%)
Fish	66.00
Wheat flour	21.20
Egg	8.30
Seasoning cube	2.00
Pepper	1.50
Vegetable oil	0.70
Salt	0.30
Total	**100**

Recipe modified from Olayinka et al, (2009)

Materials

Fresh mackerel fish and commercially available wheat flour were purchased from Lapai market in Niger State and transported to the laboratory. The fish were cleaned, filleted, and minced to obtain a homogenous fish paste.

Methods

Preparation of mackerel fish

Fresh mackerel fish were thoroughly washed with clean water to remove any surface contaminants. The heads were cut off and filleted to remove the bones. The fillets were cut into smaller pieces suitable for mincing. The filleted fish were minced using a blender to create a uniform fish paste.

Formulation of fish patty mixture

Wheat flour (see Table 1) was weighed and set aside. All seasonings (salt, pepper and seasoning cube) were measured according to the desired flavour profile and mixed together in a small bowl. Eggs (2 eggs) were cracked into a separate bowl and lightly beaten. In a large mixing bowl, the minced mackerel was combined with the wheat flour. The mixture was mixed thoroughly by hand until the flour is evenly distributed throughout the fish paste. The seasonings were added to the mixture and mixed thoroughly to ensure even distribution of flavour. The beaten eggs were added gradually to the mixture, continuing to mix until the mixture became cohesive and could hold its shape.

Shaping the patties

The fish mixture was divided into five (5) equal portions, each weighing 40 grams. Each portion was shaped into round patties of uniform thickness. The shaped patties were placed on parchment paper and allowed to rest for 10-15 minutes before cooking. This helps the patties to set and retain their shape during cooking (Olayinka et al., 2009).

Cooking Methods

Frying method

KEBBI JOURNAL OF AGRICULTURE AND NATURAL SCIENCES (KEJAANS)
September, 2025: Volume 1, Issue 2 : 142-147
p-ISSN: 1595-5776

A non-sticky frying pan was used in frying the patties. The pan was placed on medium heat (150°C) with a little drop of vegetable oil in the pan. The oil was heated to 100°C as monitored by a thermometer. The patties were gently placed into the pan and fried for 15 minutes and flipped halfway through (Fernández-Martín et al., 2000).

Baking method

The oven was preheated to 200°C. The patties were gently placed on a baking tray which was lightly sprayed with oil. The patties were baked for 30 minutes and flipped halfway through (Teixeira et al., 2013).

Boiling method

A deep pot was filled with enough water and placed over medium-high heat (190°C) and the water was brought to a gentle boiling point. The patties were tied in nylon bags to prevent the patties from breaking apart. The tied patties were gently lowered and submerged into the boiling water (100º) and covered. The patties were allowed to cook for 15 minutes (Das and Pradhan 2020).

Steaming method

A steamer pot with a rack was used in steaming the patties. The bottom of the pot was filled with water ensuring the water doesn't touch the steaming rack. The steaming pot was placed over medium heat (150°C) and the water was made to boil at 100º before placing the patties. The patties were placed on parchment paper to prevent them from sticking and then placed on the rack in the steaming pot. The steamer pot was covered to trap the steam. The patties were steamed for 20 minutes (Das and Pradhan 2020).

Broiling method

Direct heat (200°C) was used in broiling the patties. A grilling rack was placed above the heat source and greased with oil to prevent the patties from sticking. The patties were placed on the rack and allowed to broil for 10 minutes and flipped halfway through to ensure even broiling on both sides (Kumar et al., 2021).

Data collection

Proximate composition analysis

Proximate analysis was conducted using AOAC (2019) methods to determine moisture, crude protein, crude fibre, fats, ash, and carbohydrate contents.

Cooking loss

This was determined using the equation thus:

$$\text{Cooking loss (\%)} = \frac{\text{weight of raw patties (g)} - \text{weight of cooked patties (g)}}{\text{weight of raw patties (g)}} \times 100$$

Cooking yield: This was determined as the difference between 100% and values of cooking loss of each treatment thus;

$$\text{Cooking yield (\%)} = \frac{\text{weight of cooked patties (g)}}{\text{weight of raw patties (g)}} \times 100$$

pH

The pH of the treatments was measured by a digital pH meter (Knick-Portamess 913 pH, Berlin, Germany). The treatment of 5g was mixed with 20ml of distilled water and the mixture was shaken for 3 minutes before measurements.

KEBBI JOURNAL OF AGRICULTURE AND NATURAL SCIENCES (KEJAANS)
September, 2025: Volume 1, Issue 2 : 142-147
p-ISSN: 1595-5776

Sensory evaluation

The consumer acceptance and preference were determined using 30 untrained taste panelists who were selected randomly among students and staff of Ibrahim Badamasi Babangida University Lapai, Faculty of Agriculture. The sensory evaluation parameters used include; tenderness, juiciness flavour, colour and overall acceptability based on a 5- point hedonic scale with 1 labeled dislike very much and 5 labeled like very much.

Statistical analysis

The data obtained were subjected to one-way analysis of variance (ANOVA) and data were reported as the means ±standard deviations. Comparison of means were done using Duncan's multiple-range test ($p<0.05$), Statistical Package for Social Sciences (SPSS 2009) software version 17.0 was used to analyze the results of the sensory evaluation.

Results

Proximate Composition

The proximate composition of patties varied significantly ($p<0.05$) among cooking methods (Table 2). Steamed patties retained the highest protein (37.00±0.001%), while boiled patties had the highest moisture (39.97±0.001%). Fried patties contained the most fat (18.32±0.001%) and carbohydrates (14.35±0.001%).

Table 2: Proximate analysis of mackerel fish patties incorporated with 25% wheat flour subjected to different cooking methods

Sample (%)	Moisture content	Ash	Crude protein	Crude fiber	Fat	Carbohydrate
A	32.51±0.001^{c}	2.10±0.007^{c}	33.80±0.007^{c}	1.05±0.001^{c}	18.01±0.001^{b}	12.53±0.001^{c}
B	31.10±0.014^{d}	2.00±0.071^{d}	33.07±0.001^{d}	1.16±0.001^{a}	18.32±0.001^{a}	14.35±0.001^{a}
C	33.90±0.007^{b}	3.30±0.007^{a}	37.00±0.001^{a}	1.11±0.001^{b}	12.37±0.001^{d}	12.32±0.001^{d}
D	39.97±0.001^{a}	2.00±0.007^{d}	32.76±0.001^{e}	1.17±0.001^{a}	11.98±0.001^{e}	12.12±0.001^{e}
E	29.65±0.001^{e}	3.10±0.007^{b}	36.00±0.007^{b}	1.10±0.007^{b}	16.30±0.007^{c}	13.85±0.001^{b}
SEM ±	1.23	0.19	0.56	0.01	0.91	0.30
P value	0.00	0.00	0.00	0.00	0.00	0.00

a, b, c, d: Means with different superscripts within the same column differ significantly ($P<0.05$). SEM = Standard Error of Means. Sample A: Broiled, Sample B: Fried, Sample C: Steamed, Sample D: Boiled, Sample E: Baked

Physicochemical Properties

Cooking methods influenced cooking yield, cooking loss, and pH (Table 3). Steamed patties recorded the highest cooking yield (95.00±1.77%), while baked patties had the lowest (67.50±5.30%). pH values ranged from 6.21 to 6.30, indicating acceptable quality across treatments.

Sensory Evaluation

Sensory scores differed significantly across treatments (Table 4). Steamed patties were rated the most favoured method across all sensory parameters, and particularly for tenderness (4.61), juiciness (4.35), colour (4.08), flavour (3.85), and consistency (3.96), making it the most acceptable overall (4.12).

KEBBI JOURNAL OF AGRICULTURE AND NATURAL SCIENCES (KEJAANS)
September, 2025: Volume 1, Issue 2 : 142-147
p-ISSN: 1595-5776

Table 3: Physicochemical properties of mackerel fish patties incorporated with 25% wheat flour subjected to different cooking methods

Sample	Cooking yield (%)	Cooking loss (%)	pH
A	72.00±3.26^{cd}	28.00±3.26^{ab}	6.23±0.001^{c}
B	74.50±3.26^{c}	25.50±3.26^{b}	6.21±0.001^{e}
C	95.00±1.77^{a}	5.00±1.77^{d}	6.28±0.001^{b}
D	82.00±3.26^{b}	18.00±3.26^{c}	6.30±0.007^{a}
E	67.50±5.30^{d}	32.50±5.30^{a}	6.22±0.001^{d}
SEM ±	2.07	2.07	0.01
P value	0.00	0.00	0.00

a, b, c, d: Means with different superscripts within the same column differ significantly (P<0.05). SEM = Standard Error of Means. Sample A: Broiled, Sample B: Fried, Sample C: Steamed, Sample D: Boiled, Sample E: Baked

Table 4: Sensory evaluation of mackerel fish patties incorporated with 25% wheat flour subjected to different cooking methods

Sample	Tenderness	Juiciness	Colour	Flavour	Consistency	Overall Acceptability
A	4.24±0.72^{a}	2.84±1.40^{d}	3.24±1.09^{b}	3.36±1.32	3.24±1.09^{bc}	3.76±0.93
B	3.33±1.01^{b}	3.50±1.14^{bc}	3.46±0.98^{ab}	3.58±0.78	3.63±0.58^{abc}	3.88±0.85
C	4.61±0.51^{a}	4.35±0.49^{a}	4.08±1.09^{a}	3.85±0.46	3.96±1.11^{a}	4.12±0.59
D	4.24±0.88^{a}	4.04±0.73^{ab}	4.00±0.96^{a}	3.76±0.78	3.84±1.18^{ab}	3.76±0.78
E	3.52±0.77^{b}	3.40±0.87^{c}	3.80±1.00^{ab}	3.68±0.75	3.12±1.05^{c}	3.88±0.60
SEM ±	0.08	0.09	0.09	0.08	0.10	0.07
P value	0.00	0.00	0.02	0.32	0.02	0.44

a, b, c, d: Means with different superscripts within the same column differ significantly (P<0.05). SEM = Standard Error of Means. Sample A: Broiled, Sample B: Fried, Sample C: Steamed, Sample D: Boiled, Sample E: Baked

Discussion

The study investigated the impact of different cooking methods on the quality of mackerel fish patties incorporated with 25% wheat flour, analyzing its effects on nutritional composition, sensory attributes, and physicochemical properties. The findings confirm that cooking methods have a significant influence on the nutritional and sensory qualities of fish patties. Steamed patties exhibited superior protein retention, cooking yield, and sensory scores, likely due to reduced nutrient leaching and minimal oil absorption. Similar results were reported by Kumar et al. (2021), who found steaming to be more effective than frying or baking in preserving protein in fish patties. Frying, while enhancing flavour, caused substantial fat absorption, which increased caloric content but reduced nutritional balance. This agrees with Jin et al. (2020), who observed that fried fish patties contained significantly more fat than steamed or baked alternatives. Boiled patties, though high in moisture, showed reduced protein levels, possibly due to nutrient leaching into the cooking water, consistent with Das and Pradhan (2020).

Baking resulted in the lowest cooking yield, which aligns with the findings of Teixeira et al. (2013), who observed greater moisture loss

during oven treatments. Sensory results highlighted steaming as the optimal method for balancing tenderness, juiciness, and acceptability, while fried patties, despite their strong flavour, were penalized for greasiness. These results underscore the importance of selecting appropriate cooking methods to maximize both nutritional and sensory qualities in value-added fish products.

Conclusion

This study demonstrated that cooking methods significantly affected the proximate composition, physicochemical properties, and sensory characteristics of mackerel fish patties enriched with 25% wheat flour. Steaming emerged as the best method, producing patties with higher protein content, cooking yield, and overall acceptability. Frying, although flavourful, increased fat content and reduced consumer preference, while baking and boiling were less favourable. Steaming is therefore recommended for producing nutritious and consumer-acceptable fish patties.

References

AOAC. (2019). Official methods of analysis (21st ed.). Association of Official Analytical Chemists.

Das, S., & Pradhan, R. (2020). Comparative analysis of cooking methods on quality of catfish patties. Food Science and Technology International, 26(3), 223–231.

Fan, W., Sun, J., & Qiu, Y. (2016). Effects of wheat flour incorporation on the quality of fish patties. International Journal of Food Science and Nutrition, 67(8), 1015–1023.

Fernández-Martín, F., Pérez-Mateos, M., Solas, M. T., & Montero, P. (2000). Influence of cooking methods on quality of fish patties. Food Chemistry, 71(1), 41–49.

Jin, S. K., Choi, J. S., & Kim, Y. J. (2020). Proximate composition and sensory evaluation of mackerel fish patties incorporated with wheat flour. Food Chemistry, 312, 126–130.

Kris-Etherton, P. M., Harris, W. S., & Appel, L. J. (2003). Fish consumption, fish oil, omega-3 fatty acids, and cardiovascular disease. Circulation, 106(21), 2747–2757.

Kumar, P., Singh, A., & Nath, A. (2021). Effect of cooking methods on sensory attributes of pangasius patties. Journal of Aquatic Food Product Technology, 30(1), 85–96.

Li, X., Li, J., & Chang, Q. (2016). Development of value-added fishery products: A review of fish patties. Journal of Food Processing and Preservation, 40(5), 1093–1102.

Olayinka, O. A., Tope, A. A., Patricia, O., & Akande, R. (2009). The nutritional composition, sensory evaluation and microbiological studies of fish cake made from shrimp by-catch. African Journal of Food Science, 3(7), 177–183.

Teixeira, B., Pires, C., and Mendes, R., (2013). Comparative study of deep-frying and air-frying of fish patties made from farmed gilthead seabream (Sparus aurata). Food Chemistry, 135(3), 2134-2139.

Usman, M. (2013). Geographic profile of Lapai, Niger State, Nigeria. Nigerian Journal of Geography and Environment, 4(2), 45–52.