

Market Dynamics and Consumer Preference for Smoked *Clarias gariepinus* and *Oreochromis niloticus* in Selected Markets of Asaba, Delta State, Nigeria

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Abstract

Fish smoking remains an important preservation method in Nigeria, extending shelf life, improving sensory quality, and facilitating fish distribution in the absence of reliable cold-chain facilities. This study assessed the availability, marketability, and consumer acceptance of smoked *Clarias gariepinus* (African catfish) and *Oreochromis niloticus* (Nile tilapia) in Ugbolu and Ogbegonogo markets, Asaba, Delta State, Nigeria. A cross-sectional survey design combining quantitative and qualitative approaches was employed. Data were collected from 120 respondents, comprising fish sellers and consumers, using structured questionnaires, interviews, and direct market observations. Descriptive statistics and analysis of variance (ANOVA) were used to evaluate differences in market performance and consumer acceptance. Results showed that smoked *Clarias gariepinus* was more consistently available and exhibited significantly higher marketability than *Oreochromis niloticus*, with a greater sales rate, demand, and profitability. Significant differences were observed in price ($F_{3,12} = 159.47$, $p < 0.001$), unit sales ($F_{3,12} = 58.17$, $p < 0.001$), and profit margin ($F_{3,12} = 686.39$, $p < 0.001$). Consumer acceptance also differed significantly among treatments for taste, aroma, texture, appearance, and overall acceptability ($p < 0.05$), with smoked catfish receiving higher sensory ratings than smoked tilapia. Consumer preference was influenced by sensory attributes, price, and product availability. The superior performance of catfish was attributed to its favourable processing characteristics, longer shelf stability, and stronger consumer appeal. The study highlights the need for improved processing technologies and efficient value-chain management to enhance product quality, market performance, and sustainability of the smoked fish sector.

Keywords: Availability, Catfish, Consumer acceptance, Marketability, Tilapia

Article History

Submitted

May 01, 2026

Revised

July 21, 2026

First Published Online

July 24, 2026

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doi.org/10.62050/ljsir2026.v4n2.850

Introduction

Fish production remains a critical component of global food systems, contributing substantially to food security, nutrition, and economic development, particularly in developing regions. In sub-Saharan Africa, fisheries and aquaculture play a vital role in providing affordable animal protein and essential micronutrients to rapidly growing populations. Recent global assessments indicate that fish accounts for a significant proportion of animal protein intake for millions of people, with demand projected to increase due to population growth, urbanization, and dietary transitions toward healthier protein sources [1-3]. Nigeria, endowed with extensive inland water bodies and a rapidly expanding aquaculture sector, represents one of Africa's largest fish-producing nations. Within this context, fish production contributes not only to national food security but also to employment generation and poverty alleviation [4, 5].

Despite the importance of fish as a dietary staple, its highly perishable nature poses significant challenges to post-harvest management and distribution. Fresh fish deteriorates rapidly due to microbial proliferation,

enzymatic degradation, and oxidative processes, particularly under tropical environmental conditions characterized by high temperatures and humidity [6, 7]. These processes result in significant quantitative and qualitative losses, which are especially pronounced in developing countries where cold chain infrastructure is limited or unreliable. Consequently, traditional preservation methods remain indispensable in ensuring the availability and accessibility of fish products.

Among these preservation techniques, smoking has been widely practiced across Nigeria and other parts of West Africa as an effective and culturally accepted method for extending the shelf life of fish. Fish smoking reduces moisture content, inhibits microbial growth, and imparts desirable sensory attributes such as flavour, aroma, and texture, thereby enhancing product acceptability [8, 6]. Beyond preservation, smoking also facilitates transportation and storage, making fish products more accessible to inland and urban populations. In recent years, the demand for smoked fish has increased significantly, driven by urbanization, changing lifestyles, and consumer preference for convenient and ready-to-use food products [9, 10].



Clarias gariepinus (African catfish) and *Oreochromis niloticus* (Nile tilapia) are among the most economically important fish species in Nigeria. Their dominance in both capture fisheries and aquaculture systems can be attributed to their adaptability, rapid growth rates, and high reproductive capacity. These species are also nutritionally valuable, providing high-quality protein, essential fatty acids, and micronutrients necessary for human health [11, 2]. In addition, their suitability for processing, particularly smoking, has enhanced their commercial relevance in local markets. Catfish, in particular, is widely preferred due to its firm flesh, higher fat content, and longer shelf life after processing, while tilapia remains an important alternative due to its affordability and widespread availability [11].

The growing demand for smoked fish in Nigeria reflects broader socio-economic transformations, including rapid urbanization and rising population density. Urban centres such as Asaba serve as important consumption hubs where demand for processed fish products continues to increase. Markets such as Ugbolu and Ogbeogonogo play a central role in the distribution of smoked fish, linking producers, processors, and consumers within the regional value chain. These markets are characterized by complex interactions among supply, pricing, consumer preferences, and competition, all of which influence the availability and marketability of fish products [12, 4].

Consumer behaviour is a critical determinant of market performance in the fisheries sector. Preferences for fish species and processed products are influenced by a combination of sensory attributes, economic factors, and socio-cultural considerations. Attributes such as taste, texture, aroma, and appearance are key drivers of consumer acceptance, while price and income levels determine purchasing power and consumption frequency [13]. Furthermore, increasing awareness of food quality and safety has led consumers to place greater emphasis on processing methods and hygienic conditions, thereby influencing market competitiveness. In this regard, smoked fish products must meet both sensory expectations and safety standards to remain competitive in evolving markets [14].

Marketability of smoked fish is also shaped by structural factors, including supply chain efficiency, infrastructure, and competition from alternative protein sources. In Nigeria, imported frozen fish products present a significant challenge to local fish processors due to their relatively lower prices and consistent availability. This competition affects pricing dynamics and may influence consumer choice, particularly among low-income households [4]. Additionally, inadequate storage facilities, poor transportation systems, and seasonal fluctuations in fish supply further constrain the efficiency of the smoked fish value chain [15].

The role of gender in fish consumption and marketing is another important dimension that has gained increasing attention in recent studies. Women often play a central role in fish processing, marketing, and household food

provisioning, thereby influencing purchasing decisions and consumption patterns. However, contemporary evidence suggests that while gender may influence purchasing roles, actual product preference is more strongly determined by economic and sensory factors [16]. Understanding these dynamics is essential for designing inclusive and effective market interventions.

Despite the recognized importance of smoked fish in Nigeria, empirical studies examining the combined aspects of availability, marketability, and consumer acceptance at specific local markets remain limited. Most existing studies focus on either production or processing, with less attention given to market-level dynamics and consumer behaviour. This gap limits the ability of stakeholders to develop targeted strategies that address both supply-side and demand-side challenges within the fisheries value chain.

This study therefore investigates the availability, marketability, and consumer acceptance of smoked *C. gariepinus* and *O. niloticus* in Ugbolu and Ogbeogonogo markets, Delta State, Nigeria. By integrating quantitative and qualitative approaches, the research provides a comprehensive assessment of market structure, consumer preferences, and supply dynamics. The findings are expected to contribute to improved fish marketing strategies, enhanced post-harvest management practices, and sustainable development of the fisheries sector in Nigeria. Moreover, the study offers context-specific insights that can inform policy formulation and support the resilience of local fish markets in the face of evolving economic and environmental challenges.

Materials and Methods

Study area

The study was conducted in Ugbolu and Ogbeogonogo markets located in Asaba, Delta State, Nigeria. Asaba lies within the humid tropical rainforest zone and serves as a major urban centre characterized by increasing population density and expanding commercial activities. Ugbolu market is situated along a semi-urban corridor with strong linkages to peri-urban fish production zones, while Ogbeogonogo market is a major urban market that functions as a central distribution hub for fish and other food commodities within the metropolis. These markets were selected on purpose because smoked fish is consistently available in both markets throughout the year, ensuring adequate sample availability for the study. Although the selection was non-random, the markets represent two common marketing environments in Asaba (semi-urban and urban) which differ in terms of trading volume, infrastructure, product handling practices, and consumer traffic thereby providing useful insights into smoked fish quality and microbial contamination across varying market conditions within the same geographical area.

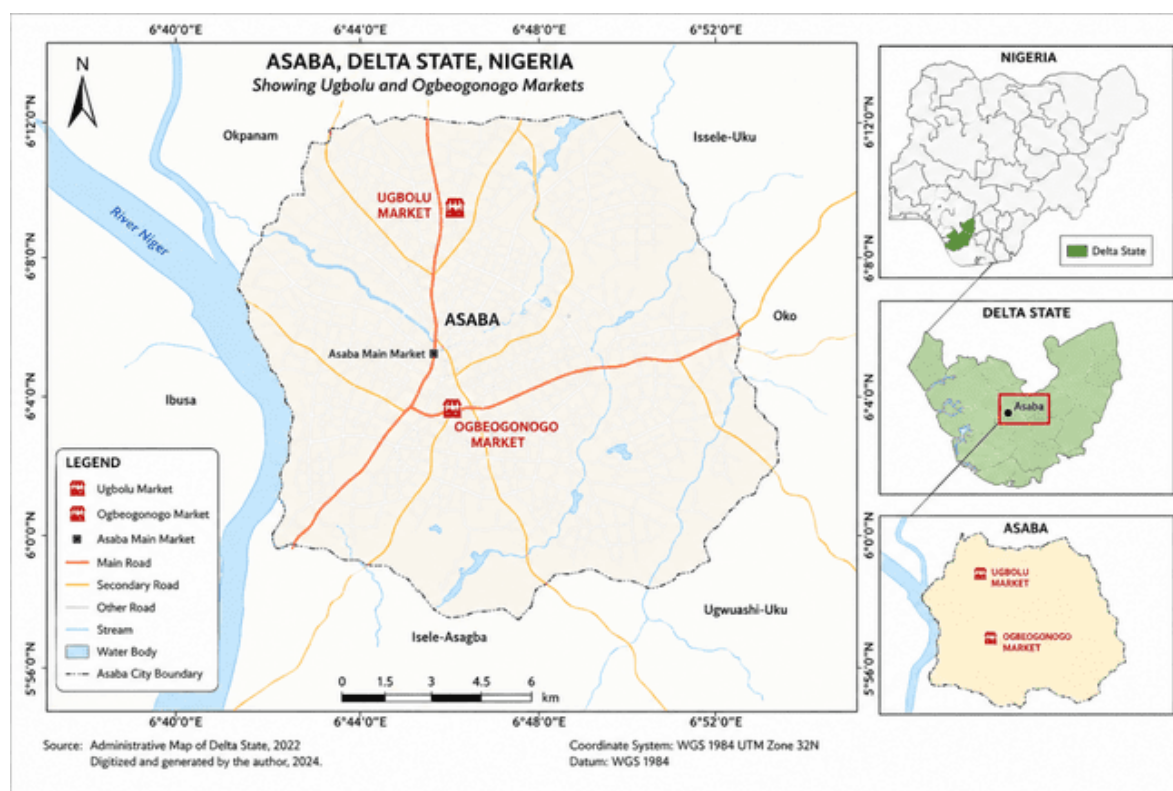


Figure 1: The Map of Asaba showing Ugbolu and Ogbeogonogo markets

Research design

A cross-sectional survey design was adopted to capture information on availability, marketability, and consumer acceptance of smoked *C. gariepinus* and *O. niloticus*. The study combined quantitative and qualitative approaches to ensure comprehensive data collection. Observational assessments of product availability were complemented with structured questionnaires administered to fish sellers and consumers.

Sampling procedure

A multistage sampling technique was employed. In the first stage, the two major markets were purposively selected due to their high level of fish trading activities. In the second stage, fish sellers dealing specifically in smoked fish were identified within each market. A simple random sampling technique was then used to select respondents from this group. In addition, consumers purchasing smoked fish during the study period were randomly approached and included in the survey.

A total of 120 respondents participated in the study, comprising 60 fish sellers and 60 consumers across the two markets. This sample size was considered adequate for capturing variability in responses and ensuring statistical reliability.

Data collection

Primary data were collected through structured questionnaires and direct observation. The questionnaire was divided into sections covering socio-

economic characteristics, species availability, pricing, consumer preferences, and factors influencing purchasing decisions. Sensory attributes influencing acceptance, including taste, aroma, texture, and appearance, were assessed using a Likert-type scale. Observational data were also collected to verify species availability, product presentation, and market conditions. These observations provided additional context for interpreting questionnaire responses and ensured triangulation of data.

Measurement of variables

Availability

Availability was assessed based on the frequency and quantity of smoked *Clarias gariepinus* and *Oreochromis niloticus* observed in the markets during the survey period. Sellers were also asked to indicate supply consistency and seasonal variations.

Marketability

Marketability was evaluated using indicators such as sales rate, demand level, pricing, and perceived profitability. Respondents were asked to rank species based on ease of sale and customer preference.

Consumer acceptance

Consumer acceptance was measured using sensory attributes including taste, aroma, texture, and overall acceptability. Responses were scored on a 9-point hedonic scale, where higher values indicated greater preference.



Data analysis

Data were analyzed using descriptive and inferential statistical tools. Descriptive statistics, including means, percentages, and frequency distributions, were used to summarize socio-economic characteristics, availability patterns, and consumer preferences.

Inferential statistics were employed to examine differences between species and across markets. Analysis of variance (ANOVA) was used to test for significant differences in consumer acceptance scores, while chi-square tests were applied to assess relationships between categorical variables such as species preference and socio-economic factors. Statistical significance was determined at $p < 0.05$. All analyses were conducted using IBM SPSS Statistics version 24 software, and results were presented in tables and figures for clarity.

Results and Discussion

Table 1 revealed that fish marketing activities in both Ugbolu and Ogbeogonogo markets are dominated by individuals within the economically active age group. A substantial proportion of respondents were between 25 and 50 years, indicating that fish trading constitutes an important livelihood activity within the study area. According to Nwabunike [17], in Abakaliki urban, individuals above the age of 30 years make up 41.43 % of people involved in fish marketing. Other respondents within the ages of 26-30, 21-25 and 15-20 years make up 30, 20 and 8.57 % respectively of the fish marketers in Abakaliki. Adeyolanu *et al.* [18] also reported that people within the ages of 31-40 years dominated the fish market space in selected markets in Lagos and Ogun states followed by those within 20-30 years (21.67 %) and above 40 years (18.05 %). This is a pointer that more of youths are engaged in fish marketing in Ugbolu and Ogbeogonogo and by extension the markets across the Nigerian state.

Table 1: Socio-economic characteristics of respondents in Ugbolu and Ogbeogonogo markets, Asaba, Delta State

Variable	Category	Frequency (n=120)	Percentage (%)
Age	18-24	18	15.0
	25-34	36	30.0
	35-44	34	28.3
	45-54	20	16.7
	≥55	12	10.0
Gender	Male	38	31.7
	Female	82	68.3
Education	No formal education	12	10.0
	Primary	28	23.3
	Secondary	54	45.0
	Tertiary	26	21.7
Occupation	Fish seller	60	50.0
	Consumer	60	50.0

Female participation was notably higher among fish sellers in both Ugbolu and Ogbeogonogo markets corroborating the report by Nwabunike [17] that the

female gender dominated the fish market (90 %) compared to the males that make up the remaining 10 % in Abakaliki urban. A similar view was reported by Agbebi and Adetuwo [19] that much more females sell fish than males in Igbokoda Fish Market, Ondo State, Nigeria. According to Adeyolanu *et al.* [18] 74.9 % females engage in fish marketing as compared to males (25.1 %) in selected fish markets in Lagos and Ogun states. This is a true reflection of the traditional gender roles in fish processing and marketing within Nigerian markets as females appear to be more skilled in marketing fish. Also, its societal perception that fish selling is a female job.

Most respondents in both Ugbolu and Ogbeogonogo markets had at least secondary education which was not far from the observation of Nwabunike [17] who reported well over 50 % of fish marketers to have attained secondary school education. Also, in Igbokoda Fish Market, Ondo State, 60 % of the fish marketers have one form of formal education [19]. This therefore suggests a moderate level of literacy that may influence business practices and consumer awareness.

Household sizes were generally large which is in sync with the view of Nwabunike [17] of the household sizes of between 4-6 and 7-9 members which makes up over 80 % of fish marketers household in Abakaliki urban. Agbebi and Adetuwo [19] reported that higher percentage of fish marketers have large households (6-10 members) which explains why fish marketers rarely engage hired labour. This may also contribute to increased consumer demand for affordable fish protein sources.

Observational data in Fig. 2 above confirmed that smoked *Clarias gariepinus* occupied a larger proportion of display space in both markets, indicating its dominance in market supply. The higher availability of *C. gariepinus* suggests a well-established production and distribution network that supports continuous market presence. Parvin *et al.* [20] in a comparative study on fish availability and marketing system of fish markets in Mohammadpur, Dhaka, Bangladesh reported that Siluriformes as being the second most dominant fish across the different markets in Mohammadpur, Dhaka as compared to Cichliformes. Onyia *et al.* [21] in a study on the Comparative Economics of Fresh and Smoked Fish Marketing in some Local Government Areas in Adamawa State, Nigeria came to a conclusion that *Clarias* and *Tilapia* constitute the choice fish in Nigerian markets and that they were more available than the others species in the study area. However, smoked *Clarias* and *Tilapia* are the choice fish in Nigerian markets. According to the report of [22], catfish was relatively more available (12.66 %) than tilapia (11 %) across Municipal, Datter hat and Sonapur markets in Noakhali district, Bangladesh. The availability patterns documented in Ugbolu and Ogbeogonogo markets further highlight the importance of supply chain efficiency and production systems.

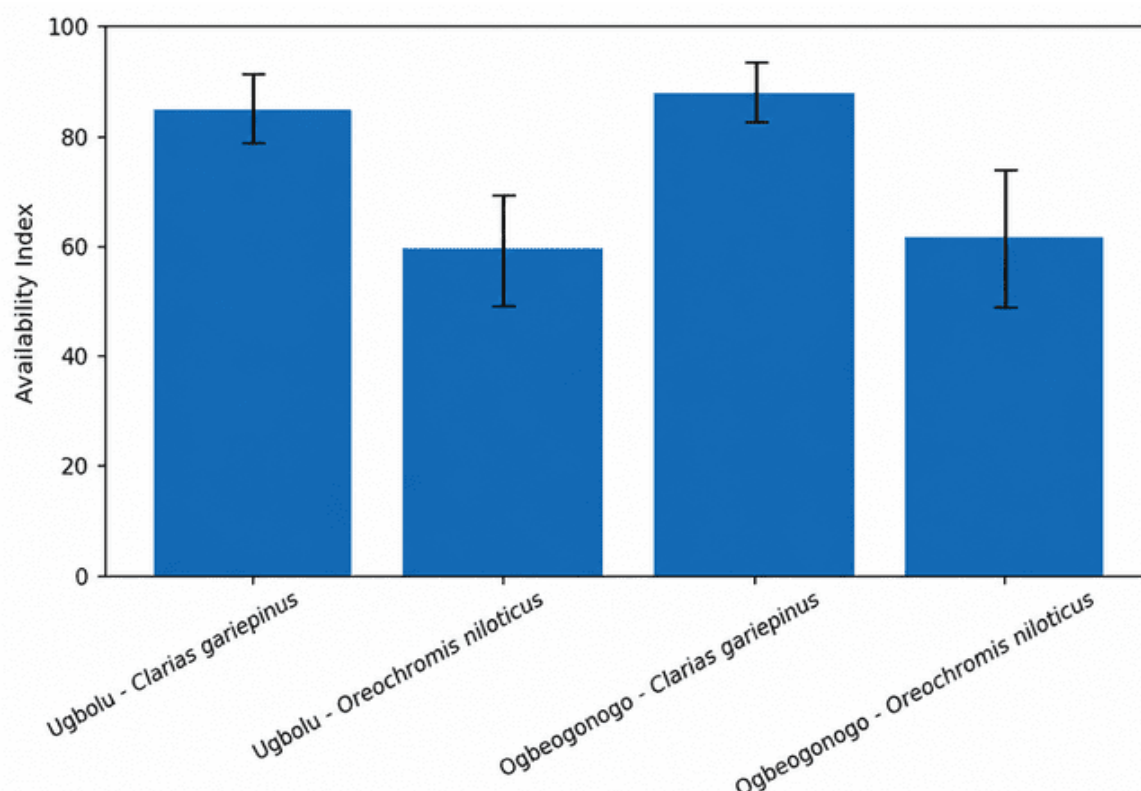


Figure 2: Availability of smoked *C. gariepinus* and *O. niloticus* across surveyed markets

Table 2: Marketability indicators of smoked *C. gariepinus* and *O. niloticus* in the study area

Parameter	<i>Clarias gariepinus</i>		<i>Oreochromis niloticus</i>		F-value	df	P-value
	Ugbolu	Ogbeogonogo	Ugbolu	Ogbeogonogo			
Mean							
Price (₦)	3,100 ± 120 ^a	3,200 ± 150 ^a	2,200 ± 110 ^b	2,400 ± 130 ^b	43.64	1	<0.001
Sales							
Rate (units/day)	17.4 ± 1.9 ^a	18.5 ± 2.1 ^a	10.7 ± 0.8 ^b	11.2 ± 1.8 ^b	6.55	1	<0.001
Profit							
Margin (%)	34.2 ± 2.4 ^a	35.2 ± 3.4 ^a	21.6 ± 2.1 ^b	24.6 ± 2.9 ^b	64.29	1	<0.001
Demand Ranking		1 st		2 nd			

Values with different superscripts across rows differ significantly ($p < 0.05$)

"a" = higher sales rate, Consumer demand and higher profit; "b" = lower sales rate, Consumer demand and lower profit

Marketability analysis (Table 2) revealed that smoked *C. gariepinus* had a higher sales rate and demand compared to *O. niloticus*. Sellers consistently ranked *C. gariepinus* as the easiest species to sell, citing strong consumer preference and better shelf stability as key advantages. The higher demand for smoked *C. gariepinus* aligns with consumer preference for products that combine sensory appeal with perceived durability, its value for money, and because it possesses more flesh, is easier to fillet and is less bony compared to *O. niloticus*. The view of [23] differed from the report of this current study since in Vihiga and Kirinyaga counties in Kenya, consumers preferred *O. niloticus* more to *C. gariepinus*. However, it is worthy of note that 45 % of consumers resident in Kirinyaga County preferred catfish compared to a dismal 3 % in Vihiga County. This is likely attributable to Nile Tilapia being farmed more compared to *C. gariepinus*

in Kenya. In Nigerian aquaculture production, particularly in Ugbolu and Ogbeogonogo environs, *C. gariepinus* is the dominant fish produced via aquaculture systems. The preferences of consumers for *C. gariepinus* in Kirinyaga was because it is relatively fleshier, easy to fillet and less bony compared to *O. niloticus* [23].

Price analysis in Ugbolu and Ogbeogonogo markets showed that smoked *C. gariepinus* commanded higher market prices than *O. niloticus*. However, its rapid turnover rate offset potential pricing constraints. Consumers expressed willingness to pay premium prices for *C. gariepinus* due to its perceived quality and durability. *O. niloticus*, although less expensive, exhibited slower sales rates, particularly during periods of reduced demand. In the same light, the Profitability assessment indicated that *C. gariepinus* provided higher returns to sellers due to lower post-harvest losses and



higher demand. These findings highlight the economic advantage associated with trading smoked *C. gariepinus* within the study area. According to Obiero *et al.* [23] *O. niloticus* is relatively more expensive than *C. gariepinus* in both counties with good profit margins from the sale of these fishes in both counties however, there was no significant difference between the amount of *O. niloticus* and *C. gariepinus* that the average household in the two counties purchased per shopping trip.

Consumer acceptance results in Table 3 demonstrated significant differences between the two species across all sensory attributes. Smoked *C. gariepinus* recorded higher mean scores for taste, aroma, texture, and overall

acceptability compared to *O. niloticus* implying the former has more acceptance and patronage than the later. Taste and aroma emerged as the most influential factors affecting consumer preference. Respondents described smoked *Clarias gariepinus* as having a richer flavour and more appealing aroma, which contributed to its higher acceptance. This concurs with Yin and Shi [7] that pointed to taste as being a good predictor of consumers' food choices as a sensory attribute. Texture was also an important determinant, with catfish perceived as firmer and more satisfying compared to the softer texture of tilapia.

Table 3: Consumer acceptance scores (Mean $\pm$ SD) of smoked *C. gariepinus* and *O. niloticus* in the study area

Attribute	<i>Clarias gariepinus</i>		<i>Oreochromis niloticus</i>		F-value	df	P-Value
	Ugbolu	Ogbeogonogo	Ugbolu	Ogbeogonogo			
Taste	8.45 $\pm$ 0.52 ^a	8.47 $\pm$ 0.50 ^a	7.12 $\pm$ 0.63 ^b	7.32 $\pm$ 0.23 ^b	5.53	(3, 12)	0.013
Aroma	8.30 $\pm$ 0.48 ^a	8.34 $\pm$ 0.41 ^a	6.95 $\pm$ 0.70 ^b	6.93 $\pm$ 0.71 ^b	10.00	(3, 12)	< 0.01
Texture	8.10 $\pm$ 0.55 ^a	8.12 $\pm$ 0.45 ^a	6.80 $\pm$ 0.68 ^b	6.80 $\pm$ 0.68 ^b	4.86	(3, 12)	0.020
Appearance	8.25 $\pm$ 0.50 ^a	8.27 $\pm$ 0.51 ^a	7.05 $\pm$ 0.60 ^b	7.12 $\pm$ 0.40 ^b	17.60	(3, 12)	< 0.001
Overall Acceptability	8.35 $\pm$ 0.50 ^a	8.37 $\pm$ 0.47 ^a	7.00 $\pm$ 0.65 ^b	7.16 $\pm$ 0.25 ^b	8.31	(3, 12)	0.003

Values with different superscripts across rows differ significantly ($p < 0.05$); ^a = better attributes; ^b = good attributes

ANOVA results confirmed that differences in sensory scores between the two species across Ugbolu and Ogbeogonogo markets were statistically significant ($p < 0.05$), indicating that species type plays a critical role in consumer acceptance. This aligns with the view of Okey [24] in his study on Consumer Preferences for Wild and Farmed Fish in Different Urban Communities of Central Cross River, who reported silver catfish and *C. gariepinus* as being more preferred to *O. niloticus* regardless of the relatively greater availability of the *O. niloticus* in the market space from the wild environment than *C. gariepinus*. Some scholars [25, 26] also agree that price, overall quality standards, nutritional value, healthiness, taste, availability, freshness and size were the influencers of fish consumer purchasing behaviour.

Conclusion

This study provides a comprehensive assessment of the availability, marketability, and consumer acceptance of smoked *Clarias gariepinus* and *Oreochromis niloticus* in Ugbolu and Ogbeogonogo markets, Asaba, Delta State, Nigeria. The findings revealed that smoked *C. gariepinus* is the most available, preferred, and patronized smoked fish species in the study area. This preference is largely attributable to its favourable sensory characteristics, including taste, texture, and overall acceptability, as well as its strong market presence compared to *O. niloticus*.

The study further established that consumer purchasing decisions are influenced by a combination of factors, including product quality and price. In addition, differences in market structure and location were found to affect product availability and purchasing patterns across the two markets. These findings underscore the importance of maintaining product quality and

affordability in enhancing the marketability and consumer acceptance of smoked fish products.

Despite the valuable insights provided by this study, certain limitations should be acknowledged. The research was restricted to fish marketers and consumers in Ugbolu and Ogbeogonogo markets within Asaba metropolis; therefore, the findings may not be fully representative of other markets within Delta State or Nigeria as a whole. Furthermore, the study employed a sample size of 120 respondents due to time and resource constraints. A larger sample size covering a wider geographical area could improve the generalizability of the findings. Finally, the study focused exclusively on smoked *C. gariepinus* and *O. niloticus*. Other fish species and processed fish products were not investigated, and consumer preferences for these products may differ.

Recommendations

Future studies should therefore include a broader range of fish species, product forms, and market locations to provide a more comprehensive understanding of fish marketability and consumer preferences. In addition, fish processors and marketers should prioritize the maintenance of high product quality, particularly in terms of appearance, taste, texture, and freshness, as these attributes significantly influence consumer preference and purchasing decisions. Fish marketers should regularly assess consumer preferences and purchasing patterns to align product supply with consumer demand and thereby improve sales and profitability.

Conflict of interest: I have no conflict of interest to declare.

Acknowledgement: I sincerely appreciate Mr Chinedu Ezeji for his invaluable assistance during the field data collection process. His efforts in interpreting the questionnaire from English into the respondents' local dialect and translating their responses back into English helped to eliminate language barriers and facilitated the smooth administration of the questionnaires. His support greatly contributed to the successful completion of this study.

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Citing this Article

Akpotu, J. O. (2026). Market dynamics and consumer preference for smoked *Clarias gariepinus* and *Oreochromis niloticus* in selected markets of Asaba, Delta State, Nigeria. *Lafia Journal of Scientific and Industrial Research*, 4(2), 90–97. <https://doi.org/10.62050/ljsir2026.v4n2.850>