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The Determinants of Recall Event Timing of Contaminated Frozen Poultry Products in Retail Outlets in North-Central Nigeria

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ABSTRACT

This study examined the determinants of the recall event timing of contaminated frozen poultry products in retail outlets in North-Central Nigeria. It specifically identified the potential sources of frozen poultry product hazards in retail outlets, assessed the effectiveness of existing management strategies employed by retailers in preventing frozen poultry product recall in the outlets, and examined the factors influencing the recall event timing of contaminated frozen poultry products in retail outlets in the study area. Multistage sampling was employed to sample 202 respondents, and the data collected using a well-structured questionnaire was analyzed using descriptive statistics and discrete-time survival analysis. The results showed that most of the frozen poultry product retailers in outlets in the study area were men within the age bracket of 21 and 40 years and had a monthly restocking frequency of approximately four times. The result revealed that power outage was the highest potential source of hazards associated with frozen poultry products in retail outlets in the study area. Packaging poultry products before freezing, product labelling, and fridge segmentation are effective management strategies. The result of the factors influencing the recall event timing of contaminated frozen poultry products in retail outlets showed that retailing experience ($P<0.01$) and cooperative membership ($P>0.01$) significantly influenced the recall event timing of contaminated frozen poultry products in the study area. The study recommends that the Government offer tax incentives to retailers investing in reliable backup power solutions and provide guidelines for effective communication during recall events.

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Introduction

The Nigerian agricultural sector accounted for about 21.66% of the country's Gross Domestic Product (GDP) in the first quarter of 2023 (National Bureau of Statistics [NBS], 2023). With an estimated population of around 223.8 million, a national population growth rate of 2.41% per annum, an average economic growth rate of 3.6% per annum (World Bank, 2023). The poultry sub-sector is an integral part of the Nigerian agricultural economy, contributing an estimated 40.6% of total food production, which is 337.3 million tons of poultry meat and eggs in 2020, with the majority of production coming from small-scale farmers who engage in semi-intensive or intensive farms (United Nations Food and Agriculture Organization [FAO], 2020); thus, the sub-sector helps to reduce poverty and improve rural households' living standards (FAO, 2018). The worldwide poultry sub-sector was valued at $322.55 billion in 2021, with a projected Compound Annual Growth Rate (CAGR) of 3.8%; it is forecast to reach $422.97 billion by 2025, with a CAGR of 7% (Feed Additive, 2021).

The Poultry Association of Nigeria (PAN) asserted that the sector, directly and indirectly, employs over 25 million people (The Guardian, 2021), and PAN later estimated that poultry accounts for around 13.99% of the country's overall meat consumption in 2021 (Olowa, 2021). Poultry products are high in protein (Bordoni & Danesi, 2017), and Nigeria is a large, expanding, and sustainable market for frozen poultry products. Moreover, no religious or cultural practices in Nigeria prohibit poultry products from being added to the human diet. Hence, nearly all Nigerians are prospective customers of frozen poultry products.

Abdulraheem et al. (2016) linked Nigeria's low animal protein intake, well below the FAO's minimal recommendation of 53.8g/day, to larger household sizes, illiteracy, and poverty. Since Clarence Birdseye brought quick-frozen meals to the public in 1912, frozen food has been an excellent means of preservation; with refrigerators and deep freezers in the twentieth century, the popularity of frozen products is increasing. The frozen poultry products industry in Nigeria is rapidly growing, offering accessible protein sources to Sub-Saharan Africa, making them highly desired and valued exports; in fact, the Nigerian Export Promotion Council (NEPC) noted that demand for Nigerian frozen poultry products is growing in neighbouring countries, creating export opportunities for the country (Ibirogba & Ikhaghu, 2022). Moreso, frozen poultry products are in high demand among fast food providers such as hotels, restaurants, and supermarkets, and according to Foraminifera Market Research Limited (2016), almost 50 million Nigerians use imported frozen chicken, turkey, and fish daily.

Frozen poultry products (FPPs) refer to numerous sorts of poultry products preserved by freezing, converting moisture to ice to stop food degradation within an optimal storage range of -18°C to -20°C (Mercier et al., 2017) and inhibit the development of most bacteria for preservation (Willenberg & Mills-Gray, 2019). FPPs may contain hazardous germs such as *Salmonella* and *Campylobacter*, which can cause severe sickness if not carefully kept below 40°F until ready to cook (Food and Drug Administration [FDA], 2021). FPPs such as frozen turkey meat, chicken meat, and chicken nuggets are popular protein sources in Nigeria and abroad (Agbebi, 2010; Bektas et al., 2011). FPPs provide convenience, a longer shelf life, and a variety of alternatives (Agbebi, 2010; Bektas et al., 2011). According to Hussein et al. (2020), FPPs can last up to 9 months depending on freezer conditions and packaging, whereas cooked goods only last four days and raw products just 1 to 2 days.

According to the Centers for Disease Control and Prevention, [CDC] (2021), poultry products are among the primary sources of foodborne diseases. The worldwide avian influenza epidemic in 2016, notably in China, drastically impacted the global poultry supply, affecting 13.6% of output (Chatziprodromidou et al., 2018). In Nigeria, two crucial events influenced the industry: the 2003 prohibition on imported frozen chicken products, which strengthened the domestic market, and the Avian Influenza outbreak in 2007.

Retail stores are critical in sustaining FPPs' safety requirements (Karshima, 2013; Oloso, 2020). They serve as the final link in the supply chain before items are delivered to customers, and the most significant pricing margin occurs at the retail level in the frozen chicken products supply chain (Bertrand et al., 2018). Donelan et al. (2016) noted that retailers ensure suitable storage conditions, handling methods, and quality control systems are in place to reduce the risk of contamination and maintain the freshness and safety of FPPs. Effectively managing FPPs at retail outlets is crucial to guaranteeing food safety and reducing the potential of product recalls. Hence, businesses like Chi Farms and Amo Farm invest in advanced training programmes to encourage Nigeria's best chicken storage practices (Onyesi, 2021).

Product recall is a response to a product-harm crisis, and it is described as an action taken by a manufacturer or distributor to withdraw a product from the market because it may cause health and safety issues, as well as perhaps death, to customers (Anwar, 2014; National Medical Products Administration, 2007). Product recalls can occur in a variety of settings, including online, offline, required, and voluntary recalls and various forms of recalls may have varied consequences when food recalls occur (Bortoli & Freundt, 2017; Hu et al., 2017; Liu & Ma, 2016). Amid e-commerce rapid expansion, Liu and Ma (2016) found news media disclosing food safety incidents, fostering public concerns, and spurring recall action by governments and businesses.

Complex supply networks can significantly amplify the impact of product recalls, leading to stock drops, brand damage, and heightened sensitivity from rivals (Steven et al., 2014; Singh, 2018; Cheah et al., 2011; Souza-Monteiro & Hooker, 2012). This amplification shows the importance of food recalls in protecting public health. With Africa experiencing approximately 91 million cases of foodborne diseases annually and 137,000 fatalities (World Health Organization [WHO], 2023), and Nigeria's hospital data indicating that 30% of health cases are foodborne (Akinwale et al., 2020), effective food recall systems are crucial. They serve as a vital measure to mitigate the risks posed by food safety issues within complex supply chains and safeguard public health.

Food safety is a critical global issue, and various regulatory bodies work to uphold standards to protect public health. For instance, international recalls such as El Abuelito Cheese in early 2021 due to contamination concerns (FDA, 2021) and International Golden Foods' recall of Al Kanater tahini (FDA, 2021) illustrate the global efforts to address food safety risks. Similarly, Three Squirrels recalled pine nuts for excessive hydrogen dioxide in China (State Administration for Market Regulation [SAMR], 2021). In Nigeria, agencies like the National Agency for Food and Drug Administration and Control (NAFDAC) and the Standards Organization of Nigeria (SON) are crucial in maintaining food safety standards and preventing the importation of expired frozen meat. For example, NAFDAC's recall of a chicken sausage sandwich in July 2019 due to potential Norovirus infection from China highlights the ongoing vigilance required to safeguard public health.

The FDA classifies food product recalls into three categories based on the likelihood of adverse health consequences and depending on the agencies that seek the recall: voluntary recall by enterprises and mandated recall by the Government (Kong et al., 2019). When food producers/distributors find an issue, they accept responsibility, halt production, and alert authorities and the public (Lu & Zhang, 2010; SAMR, 2021). Governments' authority may step in for non-compliance (FDA, 2021).

Several studies on the potential sources of hazards in poultry products have been conducted (Bohaychuk et al., 2006; Ishola & Taiwo, 2014; Mund et al., 2017; Ricke, 2020), but none of these studies focused on FPPs retail outlets. In food contamination, generally, there is a research gap regarding the identification of potential sources of contamination in retail outlets for FPPs. Da

Silva et al. (2021) studied the risk of transmission of *Salmonella spp* in chilled broilers in supermarkets in Brazil, and Green et al. (2013) evaluated the frequency of inadequate chicken cross-contamination prevention and cooking practices in restaurants in the United States. None of the studies mentioned has focused on identifying and assessing specific contamination sources in the context of FPP retail outlets, particularly in Nigeria.

Nigerian FPP retail shops may recall spoiled goods to prevent bad press, complaints, lawsuits, and image damage. The timing of a product recall issue might have significant ramifications for both merchants and customers. According to an FDA study, the timing of a recall event may determine the severity of the consequences for affected individuals and the financial impact on the company (FDA, 2021). Though product recalls often occur in retail outlets, more studies are needed to investigate the variables that lead to the incidence of product recall events in Nigerian FPPs retail stores. Studies like Lutz et al. (2020) sought to identify the specific characteristics that lead to product recalls in the context of *Salmonella* outbreaks in Vancouver, Canada. Walley et al. (2014) investigated UK consumers' purchase behaviours, attitudes, and decision-making variables for poultry products.

All these aforementioned studies were conducted mainly in Western nations, and literature on the topic remains scarce. Given the limitations of the existing literature, there is a need for a study that specifically provides insights into the management strategies' effectiveness and the potential sources of contamination that could lead to a recall event of FPP recalls in retail outlets. Thus, this study aimed toanalyse the determinants of recall event timing of contaminated FPPs in retail outlets in North-Central Nigeria. It specifically identified the socioeconomic characteristics of the FPPs retail outlets in the study area, identified the potential sources of FPPs hazards in retail outlets in the study area, assessed the effectiveness of existing management strategies employed by retailers in preventing FPP recalls in the outlets in the study area, and examined the factors influencing the recall event timing of contaminated FPPs in retail outlets in the study area. The null hypothesis that there is no significant relationship between the socioeconomic characteristics of retailers and the recall event timing of contaminated FPPs in outlets in the study area was tested.

The Nigerian agricultural sector significantly contributes to the GDP, with the poultry sub-sector playing a crucial role in food production and poverty reduction, particularly among small-scale farmers. Despite a growing market for frozen poultry products in Nigeria and neighbouring countries, challenges such as power outages and complex supply chains pose risks to food safety. Effective management and recall strategies are essential to mitigate these risks, but existing literature lacks a focused study on contamination sources and recall management in Nigerian FPP retail outlets. This study addressed these gaps by analysing the factors influencing recall event timing, management strategies, and contamination sources, highlighting the need for robust food safety measures in Nigeria.

Materials and Methods

Ethical Approval

Ethical approval was obtained after presenting the proposal seminar (UA/FA/AEC/POS/Vol. 5/0015) on the 13th of September, 2023 at the University of Abuja, Nigeria. The university granted approval as part of a dissertation. The research conduct was carefully reviewed to ensure it adhered to international standards for food-related research.

Study Area

The study was carried out in the North-Central region of Nigeria. The area has seven States, namely Federal Capital Territory, Benue, Kwara, Kogi, Nasarawa, Niger, and Plateau. It is between arid north and moist south with temperatures ranging from 18°C – 37°C yearly and rainfall ranging from 1000mm to 1500mm per annum. It is known as the nation's flourishing agricultural produce area. Two (2) selected areas in the region are Abuja and Nasarawa. The elevated urban activities within Abuja, the nation's capital, coupled with the strategic positioning of outlets in Nasarawa state proximate to its border with Abuja, effectively serving as a feeder to the Abuja metropolis, render Abuja and Nasarawa a compelling scenario for the conducted study.

Abuja, the Federal Capital Territory (FCT), is between Longitude: 7°23.9144' E and Latitude: 9°4.5887' N. It has an area of around 8000 km^2 and a mean elevation of 476 m above sea level (Nigerian Gross Open Data for Africa, 2020). Abuja is bounded on the east by Nasarawa, north by Kaduna, west by Niger, and south by Kogi. It is 476 meters above sea level (Owolabi et al., 2020), with a population of 3,840,000 (Microtrend, 2022). Nasarawa state is located at Latitude 8°32'20.22" N and Longitude 7°42'29.56" E. It covers an area of approximately 27,137.8 km2 and has a population of 2,886,097 (City Population, 2022). Nasarawa State is bordered by Kaduna State in the north, Plateau State in the east, Benue State in the east, and Kogi State in the west (Kalra et al., 2008). Abuja is split into six area councils: Abaji, Bwari, Kuje, Gwagwalada, Kwali, and AMAC. AMAC is an abbreviation for Abuja Municipal Area Council, one of Abuja's local government areas, while Nasarawa State is divided into 13 Local Government Areas, which are Akwanga, Awe, Obi, Karu, Nasarawa, Nasarawa Eggon, Keffi, Wamba, Doma, Lafia, Kokona, Toto and Keana.

According to Boumphrey (2010), Abuja grew by 139.7% between 2000 and 2010, making it one of the world's fastest-growing cities. The city's population rises yearly, forming satellite towns such as Suleja, Gwagwalada, Lugbe, Kuje, and other minor communities. Nasarawa State, on the other hand, is quickly becoming a top investment destination, owing to its constant business-friendly policies, strong government backing, and the state's high degree of security due to its closeness to the nation's capital. Nasarawa State is highly inhabited, particularly along the Karu axis, Mararaba, and new Nyanya (Onyedinefu, 2022). Onyedinefu (2022) noted that karu is not only commercially feasible, but it also guarantees investors reliable and long-term returns on investment.

Sampling Procedures and Sample Size

The study used the multistage sampling technique. In the first stage, three (3) markets known for their high relative intensity of FPPs retailing outlets were selected purposively from within Abuja and Nasarawa state. To ensure these markets captured the full range of FPP retailing activities, including direct selling, refrigerating/freezing, cold chain logistics, and retailing, data collection was conducted across different times and vendor types within each market. Wuse, Garki, and Kado markets were selected in Abuja, while Masaka, New Nyanya, and Mararaba international markets were selected in Nasarawa state. In the second stage, the list of active FPP retail outlets within the last 12 months was compiled from the various market associations. The compilation of the lists constitutes the sample frame for the study. Table 1 below summarises the FPPs retail outlets in the selected Abuja and Nasarawa state markets.

As shown in Table 1 below, the sample frame is 202 active frozen poultry products retail outlets. A census approach was adopted as the sampling technique to survey all 202 FPP retailers in the market for comprehensive representation and in-depth analysis of the entire sampled population. Thus, the study's sample size was 202 FPP retailers in Nasarawa state and Abuja. The data for this study was gathered from primary sources through personal interviews using a well-structured questionnaire.

Method of Data Analysis

Descriptive statistics such as tables, frequency, percentages, mean, and the Cox proportional hazards regression in the Discrete-Time Survival Analysis were used to achieve the various objectives of the study.

Discrete-Time Survival Analysis

Figure one gives a pictorial view of the survival analysis scheme on the retail outlets, arrival from larger cold rooms to the retail outlet freezers, that is, the end of the study period.

Predictor variables: age, sex, preventive measures and management strategies

Y_t = dependent variable; Y_t (age, sex, preventive measures and management strategies)

Event of interest = recall of frozen poultry products

$$\delta = 0\begin{cases}0, \\ 1,\end{cases}$$

0= Censored did not obtain the event of interest

1= Failure obtained the event of interest i.e recall of frozen poultry products

The Cox proportional hazards regression in the discrete-time survival analysis was used to identify the factors influencing the recall event timing of contaminated FPPs in the study area.

Table 1. Distribution of the frozen poultry products retail outlets in the selected markets

S/N	States	Markets	Retailers
1	Abuja	Wuse market	25
2	--	Garki market	28
3	--	Kado market	57
4	Nasarawa	Masaka market	33
5	--	Mararaba international market	24
6	--	New Nyanya market	35
		TOTAL	202

Source: Compiled by the Researchers

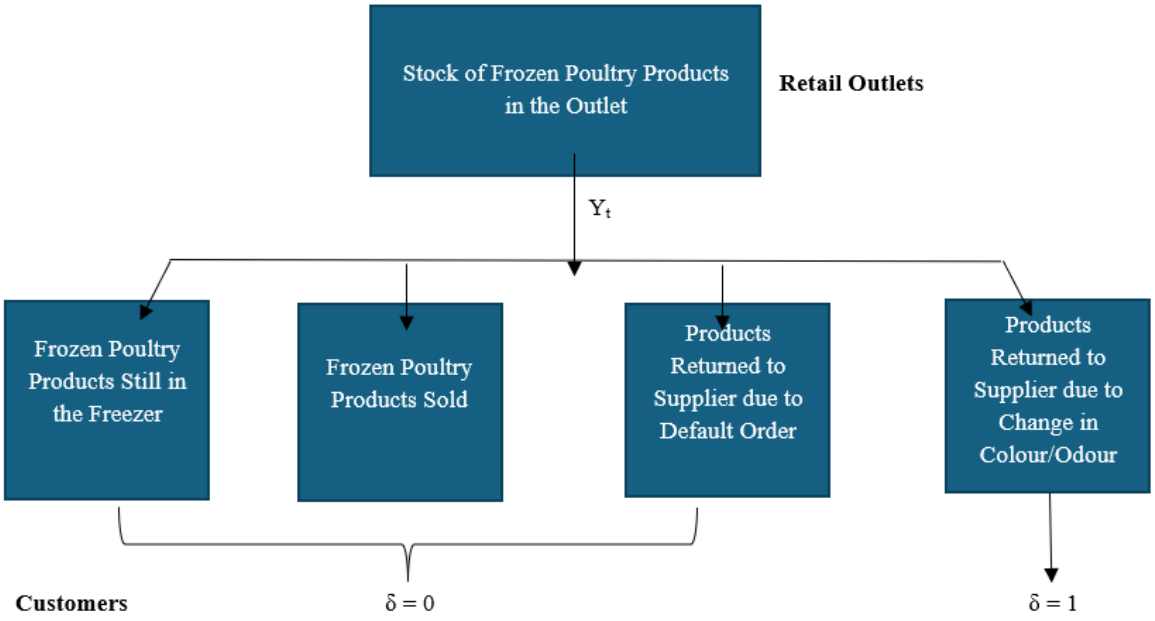

Figure 1. Survival model for biomedical data

The Cox proportional hazards regression, a semiparametric model, is the most often used regression model for studying survival data (Kleinbaum & Klein 2012). Mathematically, the Cox proportional hazards model can be represented as follows:

$$H(t) = Pr\ (t \leq T < t + T \geq t \quad (1)$$

Where: T is a discrete random variable indicating the event's occurrence time (which was measured in days for this study). The Cox model can be estimated using the following regression:

$$h(t|X) = h_o(t) \bullet exp\ (\beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n) \quad (2)$$

where h(t|X) represents the hazard rate or hazard function for an individual retailer with a specific set of covariate values (X_1, X_2, ..., X_n), $h_o(t)$ is the baseline hazard function that represents the hazard for an individual retailer with all covariates equal to zero, and β_1, β_2, ..., β_n are the estimated coefficients associated with each covariate X_1, X_2, ..., X_n. This study specified the baseline hazard function as the logarithm of time:

$$\ln(t) = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_{10} X_{10} + u_i \quad (3)$$

Where:

Ln (t) is the complementary log transformation of the baseline hazard (logarithm of discrete event occurrence time).

t = time before the recall event occurrence (days)

X_1 = FPPs retailing experience (years in the FPPs business).

X_2 = Total number of freezers owned in the outlet

X_3 = FPPs retail outlet freezer capacity (in kilogram)

X_4 = Sex of the FPPs outlet retailers (1 for male, 0 for otherwise)

X_5 = Age of the FPPs outlet retailers (years)

X_6 = Years of education (Number of years in school)

X_7 = Cooperative membership (1 for membership, 0 for otherwise)

X_8 = Retail outlet's source of FPPs (1 for larger cold rooms, 0 for otherwise)

X_9 = Source of product safety information (1 for official notification from government agencies, 0 for otherwise)

X_{10} = Total number of FPPs purchased per month (in kilogram)

β_0 = intercept,

$\beta_1 - \beta_{10}$ = coefficients/parameter estimates.

Results and Discussion

The Socioeconomic Characteristics of the FPPs Retail Outlets

In Table 2, the socioeconomic characteristics of the FPP retail outlets in the study area showed that the majority of the FPP retailers in outlets in the study area were men. This finding implies that FPP retail outlets in the study area are dominated by men, which is consistent with the results of Msetule et al. (2017), who made similar findings in their study of contamination of frozen broiler chicken meats with antimicrobial-resistant thermophilic campylobacter in Tanzania. The mean age of the FPP retailers is approximately 42 years, implying that the majority of them are economically active members of the population and thus constitute a reasonable labour force for the FPP outlets capable of coping with the challenges and management strategies associated with recall event and hazard prevention activities in the study area. These findings corroborated Olutegbe et al. (2021) argument that people in their forties and fifties are nimbler and more risk-taking than the old.

The respondents' educational attainment showed that the mean number of years spent in school by the FPP retailers is approximately 13 years, implying that an average retailer in the outlets had attained secondary education, which takes at least 12 years to complete. This suggests that the FPP retailers in the sampled outlets are literate. Education has been found to raise human capital levels and give the essential skills for profit or self-employment value chain exploration (Makame et al., 2018). The mean number of years of frozen poultry product retailing experience was approximately 11 years. This implies that the average frozen poultry retailer in the research area has been in business for at least ten years. Experience levels, according to Ali et al. (2021), can impact corporate management and decision-making. Retailers with more experience may have better insights into industry trends and knowledge that can be translated into enhanced management strategies that could prevent FPP contamination.

Table 2 also shows that the mean number of freezers in FPPs retailing outlets in the study area is approximately 5 freezers. The number of freezers affects storage capacity and, consequently, the scale of retail operations. According to Madushani and Howshigan (2020) and Yang and Tang (2023). retailers with more refrigerators may have the potential to offer a more comprehensive product range.

The mean freezer storage capacity and monthly restocking frequency are approximately 84kg and 4 times per month, respectively. Nwaiku and Ejechi (2022) and Cahyati and Mahendra (2020) asserted that restocking frequency influences inventory management and product availability.

Additionally, Table 2 also revealed that the retail outlets in the study area offer various types of FPPs, with chicken wings, turkey wings, and chicken laps being the most common. A significant percentage of respondents are cooperative members. Cooperative membership can influence supply chain dynamics and access to resources. Retailers who are cooperative members may have different sourcing advantages (Schulze & Spiller, 2021).

The Potential Sources of FPPs Hazards in Retail Outlets

The result of the potential sources of hazards associated with FPPs in retail outlets in the study area is presented in Table 3. The table revealed that Power Outage (26.32%) is the highest potential source of hazards associated with FPPs in retail outlets in the study area; this is closely followed by Electrical Fault (21.48%). Power outages and electrical faults, such as equipment malfunction or electrical fires, disrupt refrigeration systems, leading to temperature fluctuations that may compromise the safety of FPPs (FDA, 2021).

Table 2. Frequency Distribution of the Socioeconomic Characteristics of the FPPs Retailer in Outlets in the Study Area

Variable	Frequency	Percentage	Mean Value
Sex			
Female	76	37.62	
Male	126	62.38	
Total	202	100	
Age Range (years)			42.30
21-30	33	16.34	
31-40	65	32.18	
41-50	54	26.72	
51-60	45	22.28	
61-70	5	2.48	
Total	202	100	
Retailing Experience (years)			10.49
1-8	88	43.56	
9-16	80	39.60	
17-24	32	15.84	
25-32	2	0.99	
Total	202	100	
Number of Years in School (years)			12.99
1-5	12	5.94	
6-10	29	14.36	
11-15	85	42.08	
16-19	76	37.62	
Total	202	100	
Number of Freezers			4.92
1-3	39	19.31	
4-6	125	61.88	
7-9	38	18.81	
Total	202	100	
Freezer Capacity (kg)			83.85
40-60	20	9.95	
61-81	77	38.31	
82-102	104	51.74	
Total	201	100	
Monthly Restocking Frequency (time per month)			3.96
1-3	65	40.88	
4-6	86	54.09	
7-9	8	5.03	
Total	159	100	
Type of FPPs Retailed			
Chicken Wings	113	19.12	
Turkey Wings	187	31.64	
Chicken Laps	178	30.12	
Whole Chicken	113	19.12	
Total	591	100	
Cooperative Membership			
No	73	35.64	
Yes	130	64.36	
Total	202	100	

Source: Computed from Field Data, 2024.

Other potential sources of hazards associated with FPPs in retail outlets in the study area include temperature abuse (9.96%), cross-contamination (6.97%), improper handling (5.97%), packaging defects (5.83%), lack of proper cleaning and sanitation (5.55%), employee hygiene (4.27%), competition (4.13%), and inadequate storage conditions (3.70%). Temperature abuse involves improper storage and handling of FPPs, leading to temperature fluctuations that can promote bacterial growth and spoilage (FDA, 2021). Inadequate cleaning and sanitation practices and improper handling of FPPs can result in physical damage, cross-contamination of pathogens from one development surface to another, thawing, and packaging defects, increasing the risk of product hazards (Gouda et al., 2020). This result also resonates with Harmse et al. (2016) assertion that competition among outlets in the same market can lead to price pressure and potentially impact food safety if retailers compromise product quality or safety measures to reduce costs.

Diseases (3.56%) and Inadequate pest control (2.28%) were the least of the potential sources of hazards associated with FPPs in retail outlets in the study area. This implies

that retailers in the study area haveoptimised their storage conditions and implemented effective pest control to ensure properorganisation and access while maintaining product safety. The result on the awareness of contaminated FPP-borne illnesses in Table 3 revealed that a significant majority (79.70%) of respondents are aware of diseases associated with contaminated FPPs. This high awareness suggests that the retail outlets are conscious of the risks associated with these products. Thus, an effective management strategy must be employed toprioritise food safety measures to prevent product recalls.

The most common sources of product safety information are official notifications from government agencies (79.70%), followed by market associations (7.43%) and social media (5.45%). The result points to the crucial role of government agencies in disseminating safety information. Most respondents (79.70%) have recalled FPPs in the last 12 months. This underscores the importance of maintaining strict food safety practices throughout the FPP supply chain (Bukachi et al., 2021). Table 3 also showed that the majority (79.70%) of respondents expressed a willingness to recall contaminated FPPs. According to Bukachi et al. (2021), retailers' desire to recall products demonstrates their concern for food safety and the trust of their customer base.

The Effectiveness of the Existing Management Strategies Employed by Retailers in Preventing FPP Recall in the Outlets

The results in Table 4 above provided insights into the perceived effectiveness of existing management strategies employed by retailers in preventing FPP recalls in the outlets in the study area. The mean value of packaging poultry products before freezing (3.81) indicated that the majority of the retailers in outlets in the study area strongly agree that packaging poultry products before freezing strategy is an effective measure. This suggests proper packaging can be a robust preventive measure for product recall. Most respondents agree that product labelling and fridge segmentation are effective management strategies (3.13). According to Karalliyadda and Kazunari (2020), labelling andorganisation can improve product safety.

The respondents agreed that encouragement of customer feedback (2.97), fostering a culture of safety and accountability (2.92), regular communication with suppliers (2.91), and staying up to date on industry regulations and standards (2.90) are all effective management strategies employed in preventing FPP recalls in their outlets. These allow for early detection of potential issues (Fistarol et al., 2015).

Table 3. Distribution of the Sources of FPP Hazards in Retail Outlets in the Study Area

Potential Hazard Sources	Frequency	Percentage (%)
Diseases	25	3.56
Cross-contamination	49	6.97
Temperature abuse	70	9.96
Improper handling	42	5.97
Competition	29	4.13
Electrical fault	151	21.48
Inadequate storage conditions	26	3.70
Power outage	185	26.32
Packaging defects	41	5.83
Lack of proper cleaning and sanitation	39	5.55
Employee hygiene	30	4.27
Inadequate pest control	16	2.28
Total	703*	100
Awareness of Contaminated FPPs-Borne Illnesses		
Yes	161	79.70
No	41	20.30
Total	202	100
Sources of Product Safety Information		
News	2	0.99
Social media	11	5.45
Official notifications from government agencies	161	79.70
Market associations	15	7.43
follow retailers	11	5.45
Customers	2	0.99
Total	202	100
FPP Recall Within the Last 12 Months		
Yes	161	79.70
No	41	20.30
Total	202	100
Willingness to Recall Contaminated FPPs		
Yes	161	79.70
No	41	20.30
Total	202	100

*Multiple Response; Source: Computed from Field Data, 2024.

Employee training on handling and storage and establishing a product recall system strategy, with a mean of 2.87, agreed they are both effective. Well-trained staff canminimise mishandling and contamination risks. Also, strict quality control measures (2.86), regular inspections and auditing (2.84), and regularly reviewing and revising Procedures (2.84) were effective management strategies employed by retailers in preventing FPP recalls in the outlets in the study area. Stringent quality checks can help identify and prevent contaminated products from reaching consumers (Niyonzima et al., 2015).

Most respondents agree that special safety conditions during product preparation (2.81) and clear labelling and signs (2.80) are effective management strategies. This highlights the importance of hygiene, proper labelling, and safety protocols during food preservation to convey important safety information to consumers (Teffo & Tabit, 2020).

Factors Influencing the Recall Event Timing of Contaminated FPPs in Retail Outlets

To examine the factors influencing the recall event timing of contaminated FPPs in retail outlets in the study area, some variables: Sex of the FPP outlet retailers, age of the FPP outlet retailers, number of years in school, Cooperative membership, Retail outlet's source of FPPs, Total number of freezers own in the outlet, FPPs retail outlet freezer capacity, source of product safety information, Total number of FPPs purchased per month and FPPs retailing experience were regressed against the time in days leading to the FPPs recall event in retail outlets in the study area, in a Cox regression survival analysis and the result presented in Table 5.

The log-likelihood, which measures how well the Cox proportional hazards model fits the survival test, has a value of 1569.477 in Table 5, suggesting that the model provides a relatively good explanation of the observed survival times and recall indicators. The chi-square value of 27.984 shows that the overall Cox proportional hazards model is statistically significant at the 1% significance level, indicating that the model provides an excellent fit to the explanatory variables and explains recall event timing.

Five (5) out of the ten (10) variables in the model statistically significantly influenced the recall event timing of contaminated FPPs in the study area. Retailing experience (-1.252) is significant at 1%, cooperative membership (0.297) and total number of FPPs purchased per month (0.424) were significant at 5%, Freezer capacity (-0.946) and source of FPPs (0.335) were significant at 10% in relation to the recall event timing of contaminated FPPs in the study area. This led to the rejection of the null hypothesis that there is no significant relationship between the socioeconomic characteristics of retailers and the recall event timing of contaminated FPPs in outlets in the study area.

Table 4. Distribution of the Effectiveness of Existing Management Strategies Employed by Retailers in Preventing FPP Recall in the Outlets in the Study Area

Management Strategies	SA	A	D	SD	MV	R
Packaging poultry products before freezing effectively prevents poultry product contamination/recall in retail outlets.	167(82.67)	32(15.84)	3(1.49)	0(0.00)	3.81	SA
Product labelling and fridge segmentation effectively prevent poultry product contamination/recall in retail outlets.	36(18.27)	151(76.65)	10(5.08)	0(0.00)	3.13	A
Poultry product preparation under special safety conditions effectively prevents contamination/recall in retail outlets.	29(17.26)	82(48.81)	53(31.55)	4(2.38)	2.81	A
Implementing strict quality control measures prevents FPP contamination/recall in retail outlets.	35(18.52)	95(50.26)	56(29.63)	3(1.59)	2.86	A
Employee training on proper handling and storage of frozen products is an effective measure for preventing product contamination/recall in retail outlets.	33(18.23)	96(53.04)	48(26.52)	4(2.21)	2.87	A
Regular inspections and auditing of outlets is an effective measure for curtailing your frozen product contamination/recall in retail outlets	30(16.67)	95(52.78)	51(28.33)	4(2.22)	2.84	A
The clear labelling and signs on FPPs have been effective in preventing product contamination/recall in retail outlets	23(12.43)	107(57.84)	50(27.03)	5(2.70)	2.80	A
The establishment of a product recall system in FPP retail outlets is effective in preventing product contamination/recall	31(17.42)	96(53.93)	48(26.97)	3(1.69)	2.87	A
Regularly communicating with suppliers is an effective measure for preventing product contamination/recall in retail outlets	31(16.67)	111(59.68)	40(21.51)	4(2.15)	2.91	A
The encouragement of customer feedback is an effective measure for preventing product contamination/recall in retail outlets	38(20.88)	102(56.04)	40(21.98)	2(1.10)	2.97	A
Staying up to date on industry regulations and standards is an effective measure for preventing product contamination/recall in retail outlets	33(18.23)	101(55.80)	43(23.76)	4(2.21)	2.90	A
Fostering a culture of safety and accountability is an effective measure for preventing product contamination/recall in retail outlets	31(16.76)	113(61.08)	37(20.00)	4(2.16)	2.92	A
Regularly reviewing and revising procedures is an effective measure for preventing product contamination/recall in retail outlets	24(12.63)	116(61.05)	46(24.21)	4(2.11)	2.84	A

MV: Mean value; R: Remark; SA=Strongly Agreed, A=Agreed, D=Disagreed, SD=Strongly Disagreed; %ages (%) in bracket; Source: Computed from Field Data, 2024.

Table 5. Result of the Factors Influencing the Recall Event Timing of Contaminated FPPs in Retail Outlets in the Study Area

Explanatory variables		Coefficients	S.E	Wald	Df	Exp(β)
Retailing experience (X_1)	β_1	-1.252***	0.488	6.581	1	0.286
Total number of freezers in the outlet (X_2)	β_2	1.541	1.233	1.563	1	4.67
Freezer capacity (X_3)	β_3	-0.946*	1.067	2.786	1	0.388
Sex (X_4)	β_4	0.063	0.175	0.128	1	1.065
Age (X_5)	β_5	0.295	1.032	0.081	1	1.343
Number of years in school (X_6)	β_7	0.249	0.398	0.392	1	1.282
Cooperative membership (X_7)	β_8	0.297**	0.212	3.963	1	1.346
Source of product safety information (X_8)	β_9	0.227	0.226	1.007	1	1.255
Source of FPPs (X_9)	β_{10}	0.335*	0.192	3.044	1	1.398
Total number of FPPs purchased per month (X_{10})	β_{11}	0.424**	0.429	4.974	1	1.528
Chi-square			27.984***			
Log Likelihood			1569.477			
Number of Observation	202					

*** = P<0.01, ** = P<0.05, * = P<0.1, S.E = Stands for Standard Error, df = degree of freedom; Source: Computed from Field Data, 2024.

The coefficient of retailing experience (-1.252) is significant at 1% and negatively influences the recall event timing of contaminated FPPs in the study area. This suggests that retailing experience is a strong predictor of recall event timing. A negative coefficient indicates that as the retailing experience increases, the recall's hazard (risk) decreases significantly. This implies that experienced retailers are less likely to experience recall events. This result aligns with the idea that experienced retailers may have better quality control measures and processes in place, reducing the likelihood of contaminated products reaching consumers. This aligns with prior research indicating that experienced retailers often have more robust quality control measures (Lima et al., 2016).

The coefficient of cooperative membership (0.297) is significant at 5% and positively influences the recall event timing of contaminated FPPs in the study area. The positive coefficient implies cooperative members have a higher recall hazard than non-members. This result is somewhat counterintuitive, as one might expect cooperatives to have stricter quality control; as Yu et al. (2020) noted, cooperatives are generally likely to enforce strict quality control standards. However, it could be due to other unmeasured factors related to cooperatives that increase the recall risk. Also, regulatory enforcement in the study area may not be stringent enough, and cooperatives might not necessarily comply better with food safety regulations than non-members. It may also be possible that members of cooperatives engage in riskier behaviour.

The coefficient of freezer capacity (-0.946) is significant at 10%. It negatively influences the recall event timing of contaminated FPPs in the study area, implying that as freezer capacity increases, the recall hazard decreases. Retailers with larger freezer capacity are less likely to experience recall events. This aligns with the idea that larger facilities may have better storage and handling capabilities. This result also indicates that retailers with larger freezer capacity are less likely to face recall events. This result supports Madushani and Howshigan's (2020) idea that increased storage capabilities contribute to better product handling.

The coefficient of source of FPPs (0.335) is significant at 10% and positively influences the recall event timing of contaminated FPPs in the study area; this positive coefficient suggests that FPPs sourced from larger cold rooms have a higher hazard of recall than those sourced from other sourced in the study area. Keaton et al. (2022) noted that retail products sourced from different suppliers come with risks associated with that source. The coefficient of the total number of FPPs purchased per month (0.424) is significant at 5%. It positively influences the recall event timing of contaminated FPPs in the study area, indicating that retailers purchasing more FPPs per month have a higher recall hazard. This might be due to increased volume, which leads to higher chances of encountering contaminated products. According to Zhu et al. (2018), higher purchase volumes are associated with an increased recall risk.

Conclusion

This study examined the determinants of recall event timing of contaminated FPPs in retail outlets in North-Central Nigeria. It specifically identified the potential sources of FPP hazards in retail outlets in the study area, assessed the effectiveness of existing management strategies employed by retailers in preventing FPP recall in the outlets in the study area, and examined the factors influencing the recall event timing of contaminated FPPs in retail outlets in the study area. The study showed that most of the FPP retailers in outlets in the study area were men, with a mean age of approximately 42 years. A significant percentage of respondents are cooperative members.

The result revealed that power outage was the highest potential source of hazards associated with FPPs in retail outlets in the study area, closely followed by electrical faults. Also, packaging poultry products before freezing product labelling and fridge segmentation were effective management strategic measures. The result of the factors influencing the recall event timing of contaminated FPPs in retail outlets in the study area showed that retailing experience (P<0.01), cooperative membership (P>0.01), and total number of FPPs purchased per month (P>0.01), significantly influenced the recall event timing of contaminated FPPs in the study area. Thus, the study concludes that there is a significant relationship between the socioeconomic characteristics of retailers and the recall event timing of contaminated FPPs in outlets in North-Central Nigeria.

Based on these findings, the study recommends that retail outlets in the study area should invest in backup power sources such as generators or uninterruptible power supplies (UPS). To encourage their efforts, the Government should offer tax incentives to retailers investing in reliable backup power solutions. Government agencies and cooperatives should provide educational resources to encourage retailers to adopt andprioritise effective management strategies and provide guidelines for effective communication during recall events. Also, retail outlets should be encouraged to optimise their freezer capacity to improve overall storage conditions and potentially reducing the risk of contamination in their outlets.

This study contributes valuable knowledge to the fields of food safety, supply chain management, and retail practices in the frozen poultry product industry. The insights gained can inform policy development, industry best practices, and academic research in related domains. Future studies could expand the geographic scope beyond Abuja and Nasarawa, employing longitudinal and mixed-methods approaches to conduct comparative analyses between urban and rural retail outlets, explore the integration of technology in recall management, behavioral aspects of retailers and consumers, and the economic impacts of recalls, and improve management strategies for frozen poultry product recalls in Nigeria.

Declarations

The authors declare no conflict of interest

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