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AWARENESS AND MITIGATION MEASURES OF AFLATOXIN AMONG POULTRY FARMERS AND FEED MILLERS IN IJEBU-ODE AND IGBESA AREA OF OGUN STATE, NIGERIA

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ABSTRACT

Poultry feed ingredients which comprise of maize, peanut meal, soya bean meal and mixtures of maize, groundnut cake and other crops have been associated with mycotoxin contamination during crop production and storage, with limited attention given to this by local poultry farmers and regulatory bodies. A quarter of the world's growing crops are affected by mycotoxins each year. In this study, level of awareness and mitigation measures of aflatoxin among poultry farmers and feed millers in Ijebu-Ode and Igbesa area of Ogun State, Nigeria was assessed. 120 respondents were purposively selected comprising poultry farmers and feed processors. A survey research design (well-structured questionnaire) was used to elicit information from the respondents. The questionnaire measured among other things the demographic information of the sampled population, their level of awareness of aflatoxin and mitigation practices. Data obtained were analysed using descriptive statistics such as frequency count, percentages, mean and standard deviation. The results revealed that majority (88.34%) of respondents were aged 18-50 years. The industry appeared male-dominated, with 70.9%. Out of the sampled population, 59.17% were married and 58.82% had tertiary education. Regarding mycotoxin awareness, 52.72% of respondents were unaware, and farmers and processors exhibited similar knowledge about influencing factors and dangers. The findings showed that both poultry farmers and feed millers in the study area were not adequately informed about the problem of aflatoxins. Therefore, there is dare need for interventions and educational programs to enhance awareness and practices among poultry stakeholders in the study area.

Key words: awareness, aflatoxin, poultry feed, feed ingredients, processor

INTRODUCTION

In recent years, the Nigerian poultry industry has been rapidly expanding and has become one of the most commercialized sub-sectors of Nigerian agriculture (USDA, 2021). However, poultry feed ingredients which comprises of maize, peanut meal, soya bean meal and mixtures of maize, groundnut cake and other crops have been associated with aflatoxin contamination during crop production and storage (Kimanya *et al.,* 2008), with limited attention given to this by local poultry farmers and regulatory bodies. Food and Agriculture Organization (2010) reports that about a quarter of the world's growing crops are affected by aflatoxins each year. In a recent study by Oyegunwa *et al.* (2021) on aflatoxin contamination in maize and other poultry feed ingredients obtained from feed mills in Ijebu Ode, all ingredients tested for aflatoxin contamination were above the European regulatory limit of 20 parts per billion aflatoxins. This has raised the question of whether the farmers who patronize these feed millers are aware of the presence of aflatoxin in the feed ingredients or not. Such knowledge gap needs to be filled. Therefore, the purpose of this study is to assess the level of awareness and mitigation measures of aflatoxin among poultry farmers and feed millers in Ijebu-Ode and Igbesa area of Ogun State, Nigeria. The objectives of this study include:

i. to describe the socio-economic characteristics of the respondents in the study area;
ii. to determine the level of awareness of aflatoxin among the respondents in the study area;
iii. to verify the feed storage practices adopted by the respondents in the study area;
iv. to determine the feed purchasing practices used by the respondents in the study area; and
v. to identify the mitigation measures adopted by the respondents in the study area.

MATERIALS AND METHODS

Study Area

The study was carried out in Ogun State. The State is located in southwestern part of Nigeria and covers 16,762 km^2. Ondo State to the East, Oyo and Osun States to the North, Lagos State to the South, and the

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Republic of Benin to the West are its neighbours. Ogun State is blessed with natural resources, including mineral deposits and a large area of rich soil excellent for farming. A broad variety of arable crops, including as rice, maize, cassava, yams, and bananas, as well as cash crops, such as cocoa, kola nuts, rubber, palm oil, and palm kernels, can be grown in the state thanks to its climate and soil. Ogun State ranks among the top producers of poultry food and feed on a significant scale. Agriculture, including poultry farming and feed milling, plays a significant role in the livelihoods of residents of Ijebu Ode and Igbesa. Igbesa situated in the Ado-Odo/Ota Local Government Area (LGA) of Ogun State, has witnessed industrial growth in recent years. It hosts many manufacturing companies and industries, contributing to its economic development. Amidst industrial activities, agricultural practices remain integral to the local economy, with poultry farming and related activities being prevalent. There are 20 LGAs in the State and Ogun State Agricultural Development Project (OGADEP) is sub-divided into four agricultural zones namely Abeokuta, Ijebu, Ikenne and Ilaro. However, Ijebu Ode (under Ijebu zone) and Igbesa (under Ilaro zones) were purposively selected because they were well known for their poultry and feed production (Ogun State Diary, 2023). Ijebu Ode and Igbesa were purposively selected for this study because they had more poultry farms and feed mills than other parts of Ogun State. Poultry farming encompasses broilers, layers, and other poultry species, supplying eggs and meat to local markets and beyond. Feed mills are crucial components of the poultry value chain, providing formulated feed to ensure proper nutrition for the birds.

Sampling Procedure

The study population comprised of poultry farmers and feed millers in the study area. At the time of the study, there were 200 registered poultry farmers and 200 registered feed millers in the study area (Ogun State Agricultural Development Project, 2023). 30% of the poultry farmers (60 respondents) and 30% of the feed millers (60 respondents) were purposively selected using random sample method. Thus, 120 respondents in all were selected for the study.

Method of Data Collection

Based on the study's objectives, primary data were collected from the respondents in the study area using a well-structured questionnaire. Level of awareness of aflatoxin among the respondents was measured on a Yes (1) and No (0) scale and they were also asked to add other options not listed. The individual mean score was found for each item of awareness and used for decision making**.** Storage practices among selected poultry farmers and feed processors was measured on a modification of Likert-like three-point scale of highly hygienic (2), mild hygienic (1) and not hygienic (0) and the individual mean score for each item with the cut-off (1.5). Feed Purchasing Practices was measured on a Yes (1) and No (0) scale and they were also asked to add other options not listed. The individual mean score was found for each item of awareness and used for decision making**.** Mitigation measures adopted by the respondents was measured on a modification of Likert-like three-point scale of highly effective (2), effective (1) and not effective (0) and they were also asked to add other options not listed. The individual mean score was found for each effective item and used to rank the mitigation measures in order of their effectiveness.

Method of Data Analysis

Descriptive statistics such as frequency counts, percentages, mean and standard deviation were used for data analysis.

RESULTS

Objective 1: Socio-economic Characteristics of the Respondents in the Study Area

Results in Table 1 show that majority (50.0%) of the respondents were within the age group of 35-50 years for poultry farmers while 48.3% for feed millers. This indicates that youths are more involved in the poultry and feed processing business in the study area, and in their active age, with the strength and vigour to carry out all the laborious activities involved in agricultural production. The male (71.7%) was more than female (28.3%) for poultry famers while 70.0% were male and 30.0% were female for feed millers. This implies that poultry farming and feed processing is male dominated in the Ijebu-Ode and Igbesa. The marital status of respondents revealed that 56.7% of poultry famers were married and 61.7% of feed millers were also married. On educational attainment, a good number of the poultry farmers had post-primary education (33.3%) and 26.7% had tertiary education compared to 30.0% of feed millers who had post-primary education and 23.3% had tertiary education. On farm size, 33.3% of poultry farmers had between 2-4.99 acres while 58.3% of the feed millers had less than one acre. This implies that majority of the feed millers did not have enough space for storage and this may be a contributing factor to aflatoxin due to poor storage system. On years of experience, 50.0% of the poultry farmers had 1-5 years of experience while 53.3% of the feed millers also had 1-5 years of experience. This shows that both poultry farmers and feed millers in the study area were experienced. On household size, 45.0% of both poultry farmers and feed millers had less than five persons in their household. It could be deduced that both respondents had some of their family members are being catered for by them. This result is in agreement with the findings of Allameh *et al.*

Table 1: Socioeconomic characteristics of the respondents (number of observations, n = 60, for each of poultry farmers and feed millers)

	Poultry farmers		Feed millers		Mean
	F	%	*F*	%	
Age (years)					
18-34	20	33.3	27	45.0	34
35-50	30	50.0	29	48.3	
51-65	6	10.0	1	1.7	
> 65	4	6.7	3	5.0	
Sex					
Male	43	71.7	42	70.0	
Female	17	28.3	18	30.0	
Marital Status					
Single	20	33.3	17	28.3	
Divorced	5	8.3	5	8.3	
Widow	1	1.7	1	1.7	
Married	34	56.7	37	61.7	
Education					
No formal Edu.	10	16.7	12	20	
Primary	14	23.3	16	26.7	
Post-Primary	20	33.3	18	30.0	
Tertiary	16	26.7	14	23.3	
Farm size					
< 1 Acre	16	26.7	35	58.3	3
1–1.99 Acres	15	25.0	25	41.7	
2–4.99 Acres	20	33.3	-	-	
> 5 Acres	9	15.0	-	-	
Years of experience					
1-5 yrs	30	50.0	32	53.3	9
6-10 yrs	14	23.3	20	33.3	
11-15 yrs	6	10.0	4	6.7	
16-20 yrs	6	10.0	1	1.7	
21 yrs and above	4	6.7	3	5.0	
Household size					
< 5	27	45.0	27	45.0	6
5-9	19	31.7	20	33.3	
10 and above	14	23.3	13	21.7	

Source: Field Survey, 2023. *F* - frequency

(2011) that the socio-economic status of poultry farmers and feed millers are dependent on the size of their farms or mills and monthly income earned. Afolabi *et al.* (2019) reported that poultry farmers and feed millers with higher education status, larger farm size, higher income and small household size are likely to make more profit and keep growing in the business compared to other counterpart in the poultry businesses.

Objective 2: Level of Awareness of Aflatoxin Among the Respondents in the Study Area

Table 2 above reveals the findings about the poultry farmers and feed millers' awareness on mycotoxins in poultry feeds. The parameters include awareness, occurrence, factors influencing mycotoxin contamination, dangers of mycotoxin contamination, effects to animals and humans, and preventive measures with a mean value and standard deviation of 2.55 ± 1.82 respectively. This implies that majority of the respondents were not aware of mycotoxins and their occurrence compared to those aware. This is an indication that poultry farmers and feed millers in this study area did not have any knowledge on factors influencing mycotoxin contamination and its dangers on health of both human and poultry birds.

The result in Table 3 show that majority of the respondents (52.5%) had low level of awareness of aflatoxins while 47.5% of the respondents had high level of awareness of aflatoxins in the study area. The low level of awareness of aflatoxins could be linked to lack of public awareness of aflatoxin despite the fact that many of the respondents in the study area were educated. It could be ascertained that public awareness of aflatoxins is low. This result supports the findings of Afolabi *et al.* (2019) that to be educated does not mean being current and knowledgeable about toxins until there is proper public awareness and control measures. Oyegunwa *et al.* (2021) also found out that poultry farmers should be close to current information about their birds in cases of disease outbreaks.

Objective 3: Feed Storage Practices Adopted by the Respondents in the Study Area

Table 4 shows the results of the survey on the general feed storage. All the 120 respondents practiced stock piling of the feeds and feed ingredients especially maize bran (81.8%) in preparation for seasons of scarcity. About 59% of them reported storing feed because of the period of scarcity. Also, majority of them (75%) store between 100-1000 kg, which was reported to be around one month of storage duration. About 89% of the respondents have encountered storage problem, of which fumigation is 70.5%. Majority (88.6%) of the respondents reported having encountered molds in their feeds and ingredients during storage, while 72.7% did not practice the first-in first-out good store management practice. This result supports the

Table 2: Aflatoxin awareness among respondents (n = 120)

Awareness Parameter	Response	Frequency (Percentage)
Awareness of aflatoxins	Yes	57 (47.5)
	No	63 (52.5)
Occurrence	Yes	52 (43.2)
	No	68 (56.8)
Factors influencing aflatoxin contamination	Rodents/Insects/Molds	14 (11.4)
	Poor harvesting/ Handling	8 (6.8)
	Moisture	12 (27.3)
	Do not know	24 (54.5)
Dangers of aflatoxin contamination	Few eggs	33 (11.36)
	Ill-health	11 (9.09)
	Poor growth	27 (22.73)
	Do not know	25 (56.82)
Solution to aflatoxin contamination	Drying	68 (43.18)
	Mixing own feed	8 (6.82)
	Sorting	3 (2.27)
	Pesticide	22 (18.18)
Awareness of aflatoxin effects to humans/animals	Yes	19 (15.91)
	No	101 (84.09)
Total awareness value	Mean ± SD	2.55 ± 1.82

Source: Field Survey, 2023

Table 3: Categorization of level of awareness of aflatoxin among respondents

Category	Frequency	Percentage
Low	63	52.5
High	57	47.5
Mean ± SD	2.55±1.82	
Minimum	5.00	
Maximum	24.00	

Source: Field Survey, 2023

Table 4: Feed storage practices adopted by the respondents

Category	Response	Frequency (%)	Mean
Reasons for stock piling feed/ingredients	Preparation for period of scarcity	71 (59.1)	1.73
	Favourable/lower prices	44 (36.4)	
	Others (own harvest)	5(4.5)	
Average duration of storage	< 1 month	71 (59.1)	1.41
	> 1 month	49 (40.9)	
Form stored	Individual ingredients, especially maize bran	98 (81.8	1.60
	Mixed	22(18.2)	
Quantity stored (kg)	< 100	49 (40.9)	1.92
	100-1000	90 (75.0)	
	> 1000	8(6.8)	
Structure of storage area	Raised platform	33 (27.3)	1.35
	On floor	87 (72.7)	
Ever encountered storage problems	Yes	106 (88.6)	1.46
	No	14(11.4)	
Storage problem management	Fumigation	85(70.5)	2.01
	Proper drying	25(20.5)	
	Binder	11(9.1)	
Practice First in-First out	Yes	33 (27.3)	1.50
	No	87 (72.7)	

Source: Field Survey, 2023. Mean = 1.5 (Highly hygienic, Mild hygienic, Not hygienic)

findings of Allameh *et al.* (2011) that feed storage problem management and structure of storage are the major determinants of safety and hygiene of feed stored and durability of feed storage can help check aflatoxins and its mitigating measures. Williams *et al.* (2010) discovered that poor processing and storage facilities are causing major setback for both poultry farmers and feed processors in Nigeria.

Objective 4: Feed Purchasing Practices Used by the Respondents in the Study Area

The results in Table 5 on feed purchasing practices of poultry farmers in Ijebu-Ode and Igbesa show that the majority (59.1%) of the respondents got their feed from commercial feed millers. The feed ingredients were gotten from different sources, like small-scale feed traders, local miller/supplier, and local processors, with close percentages reported. Many (56.8%) of the respondents did purchase feeds from the same supplier while 31% obtained their feeds from other sources as determined by the prevailing market prices.

Table 5: Feed purchasing practices among selected poultry farmers and feed processors

Items	Response	Frequency (%)	Mean
Feed Source	Local supplier	19 (15.9)	0.71
	Commercial processor	71 (59.1)	
	Combined local and commercial processor	30 (25.0)	
Ingredient source	Small scale feed traders	38 (31.8)	0.94
	Local miller/supplier	35 (29.5)	
	Local Processor/agent	22 (18.2)	
	Mechanical Processor/agent	25 (20.5)	
Quality determi-nation method	Source from reliable source	5 (4.5)	0.60
	Inspect for foreign objects	44 (36.4)	
	Appearance, not moldy	22 (18.2)	
	Moisture check (subjective)	46 (38.6)	
	Texture check	3 (2.3)	
Source from same supplier	Yes	3(2.3)	0.56
	No	68 (56.8)	
	Price influence	38 (31.8)	

Source: Field Survey, 2023. Mean = 0.5 (Yes, No)

Objective 5: Mitigation Measures Adopted by the Respondents in the Study Area

The results in Table 6 show the various mitigation measures adopted by the respondents in the study area and were rated and ranked according to their mean values. They include avoidance of contaminated feed (1st), safe disposal of contaminated feed (2nd), improved public awareness on aflatoxin (3rd), lowering mold growth in harvested crops (4th), planting pest-resistant varieties of crops (5th), improving feed storage hygiene (6th), modulating the metabolism of ingested aflatoxin (7th), reducing internal dose and subsequent risk (8th), prophylactic control measures (9th), strengthening extension services for awareness (10th) and clay-based enterosorbents (11th) while proper implementation of feed safety policies (12th). This is indication that few respondents who were aware of aflatoxin in the study area adopted avoidance of contaminated feed, safe disposal of contaminated feed, improved public awareness on aflatoxin and many more for

Table 6: Mean and ranking of mitigation measures adopted by the respondents

Items	Mean	Rank
Avoidance of contaminated feed	2.113	1st
Safe disposal of contaminated feed	1.654	2nd
Improved public awareness on aflatoxin	1.638	3rd
Lowering mold growth in harvested crops	1.560	4th
Planting pest-resistant varieties of crops	1.549	5th
Improving feed storage hygiene	1.500	6th
Modulating the metabolism of ingested aflatoxin	1.459	7th
Reducing internal dose and subsequent risk	1.300	8th
Prophylactic control measures	1.294	9th
Strengthening extension services for awareness	1.254	10th
Clay-based enterosorbents	1.201	11th
Proper implementation of feed safety policies	1.190	12th

Source: Field Survey, 2023

mitigating aflatoxin among the poultry farmers and feed millers in the study area. This result supports the findings of Afolabi *et al.* (2019) that avoidance of contaminated feed, safe disposal of contaminated feed, improved public awareness on aflatoxin have been adopted for large scale poultry farmers and feed millers in industrialized areas in order to avert higher mortality rate and low productivity among poultry birds. Makau *et al.* (2016) found out that mitigation measures adopted by various poultry farmers should be in agreement with their environmental climate.

DISCUSSION

The outcome of this research findings unveiled an obvious lack of knowledge on aflatoxins among both poultry farmers and feed millers in Igbesa and Ijebu Ode area of Ogun State, with poultry farmers displaying a slightly higher level of awareness than feed millers. This contrasts with the results of Kang'ethe and Lang'a (2009), who reported that 67% of urban farmers were unaware of the existence of aflatoxins in grains. Moreover, feed millers exhibited a higher level of knowledge of aflatoxin. However, despite this knowledge, little or no measures were implemented to mitigate exposure to animals. A parallel study by Makau *et al.* (2016) indicated that approximately 38.5% of farmers were aware of aflatoxicosis in dairy cows, while Marechera and Ndwiga (2014) reported a higher percentage (92.5%) of farmers having knowledge about aflatoxins, influenced by previous aflatoxin outbreaks in the region.

In contrast, processors demonstrated a comparatively higher awareness of certain aspects of aflatoxin prevention strategies than farmers, with some reporting the use of binders. The survey also brought to light inadequate storage practices, including stockpiling and storing feeds on the floor, which predispose feedstuffs to contamination by aflatoxin-producing fungi (Cheat *et al.,* 2016; Makau *et al.,* 2016). Moreover, this poor storage methodology contributes to increased feed dampness and moisture content, facilitating mold growth due to the pressure exerted by feeds upon each other (Munthali *et al.,* 2016).

CONCLUSION

The study showed that both poultry farmers and feed millers in the study area were not adequately informed about aflatoxin, with over 50.0% of participants exhibiting a lack of awareness concerning these toxins, their occurrence, predisposing factors, and associated risks to animals and humans. Few respondents who were aware of aflatoxin adopted avoidance of contaminated feed, safe disposal of contaminated feed, improved public awareness on aflatoxin, lowering mold growth in harvested crops, planting pest-resistant varieties of crops, improving feed storage hygiene and many more as mitigating measures of aflatoxin in the study area.

RECOMMENDATIONS

Based on the findings of this study highlighted above, it is recommended that:

i. The Government should develop strategies targeted at minimizing aflatoxins contamination while the maize is still in the field (pre-harvest).
ii. Strengthening of existing public extension services to enable it to deliver useful updates or information on aflatoxins and its mitigating measures. Government and private sectors should play a crucial role in strengthening policies that impact on feed safety, as well as support risk assessment initiatives to ensure that well thought out standards for aflatoxins are in place.

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