A pilot survey on the identification of different deformities and prevalence of cracked eggs in commercial layers' farms in Ogbomoso metropolis, Oyo State, Nigeria

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Abstract

This research was conducted within Ogbomoso town, Oyo State, to identify the different types of cracks and deformed eggs common in the study area. It highlighted the socio-economic characteristics of the commercial layer farmers, flock characteristics, feed and feeding, veterinary service, cracks and deformed eggs incidence, causes of deformed eggs, and measures to minimize them. Data were collected through a structured questionnaire administered on 40 identified commercial layer farms that were randomly selected. Data analyses were carried out using frequency counts, pie charts, and percentages. The result of the study indicated that the majority (90%) of the respondents were male with a few (10%) females, and the majority (90%) were Christian with 10% Muslims. The entire respondents attained tertiary education. Seventy-five percent (75%) of the studied farm used veterinary services on their farm and 25% did not. All (100%) of the farms studied experience one type of cracks/deformed eggs or the other. The most common cracks and deformed eggs observed in this research were gross cracks (15.52%), blood spots (13.79), and thin shells (12.93%) while mottled crack (0.86%) was the least experienced crack. The causes of cracks and deformed eggs as indicated by the farmers showed that cracks and deformed eggs were majorly caused by birds' cages (23.2%), birds (20.3%), and vermin (15.9%), and few were caused by diseases, hormonal changes and during the process of eggs transportation. The major means of controlling cracks and deformed eggs observed in this research were proper handling of the eggs (22.7%), disease prevention (19.7%), and control of rats (19.7%) while the least control measure suggested was the use of antibiotics. Gross crack which resulted in a large hold and broken membrane is the most common egg crack in the farms. The results of this research show that all the farms studied experience cracks and deformed eggs on their farms and different approaches are being used to minimize the effect therefore, farmers need to minimize the occurrence in other to reduce the loss of money through it.

Keywords: deformed eggs, debeaking, gross crack, mottled crack, star cracked egg, sandpaper egg, blood stained egg.

Uma pesquisa piloto sobre a identificação de diferentes deformidades e prevalência de ovos quebrados em granjas de poedeiras comerciais na metrópole de Ogbomoso, Estado de Oyo, Nigéria

Resumo

Esta pesquisa foi realizada na cidade de Ogbomoso, Estado de Oyo, para identificar os diferentes tipos de rachaduras e ovos deformados comuns na área de estudo. Destacou as características socioeconómicas dos

criadores de poedeiras comerciais, características do rebanho, alimentação e alimentação, serviço veterinário, incidência de fissuras e ovos deformados, causas de ovos deformados e medidas para minimizá-los. Os dados foram coletados por meio de um questionário estruturado aplicado em 40 granjas comerciais de poedeiras identificadas e selecionadas aleatoriamente. As análises de dados foram realizadas usando contagens de frequência, gráficos de pizza e porcentagens. O resultado do estudo indicou que a maioria (90%) dos entrevistados eram homens e algumas (10%) mulheres, e a maioria (90%) eram cristãos com 10% de muçulmanos. Todos os entrevistados concluíram o ensino superior. Setenta e cinco por cento (75%) da fazenda estudada utilizavam serviços veterinários em sua fazenda e 25% não. Todas (100%) das granjas estudadas apresentam um ou outro tipo de rachadura/ovos deformados. As trincas e ovos deformados mais comuns observados nesta pesquisa foram trincas grosseiras (15,52%), manchas de sangue (13,79) e cascas finas (12,93%), enquanto a trinca mosqueada (0,86%) foi a trinca menos experimentada. As causas de rachaduras e ovos deformados indicadas pelos agricultores mostraram que rachaduras e ovos deformados foram causados principalmente por gaiolas de pássaros (23,2%), pássaros (20,3%) e vermes (15,9%), e poucos foram causados por doenças, alterações hormonais e durante o processo de transporte dos óvulos. As principais formas de controle de fissuras e ovos deformados observadas nesta pesquisa foram o manejo adequado dos ovos (22,7%), prevenção de doenças (19,7%) e controle de ratos (19,7%), enquanto a menor medida de controle sugerida foi o uso de antibióticos. A rachadura grosseira que resultou em uma grande retenção e membrana quebrada é a rachadura de ovo mais comum nas granjas. Os resultados desta pesquisa mostram que todas as fazendas estudadas apresentam rachaduras e ovos deformados em suas fazendas e diferentes abordagens estão sendo utilizadas para minimizar o efeito, portanto, os agricultores precisam minimizar a ocorrência em outras para reduzir a perda de dinheiro através disso.

Palavras-chave: ovos deformados, debicagem, rachadura grosseira, rachadura manchada, ovo rachado em forma de estrela, ovo de lixa, ovo manchado de sangue.

1. Introduction

Eggs have been recognized as an important food article from primitive times with men snatching them from the nest of wild birds. They provide a unique, well-balanced source of nutrients for persons of all ages. The availability, modesty, cost, ease of preparation, peculiar taste appeal, and low caloric value give eggs a premium place, especially in children's diets (Layman; Rodriquez, 2009). The egg of chicken is a complete diet for the developing embryo (Ojo, 2000). However, in developing countries eggs are more affordable by the common man than other sources of animal protein thus giving poultry more advantage over other livestock (Okeke, 2000).

Eggs are used in many producing companies, according to Tereshchuk & Starovoitova, (2013) egg products are traditionally used to produce mayonnaises as emulsifiers; the main emulsifier in mayonnaise is egg yolk, more precisely, lecithin and other phospholipids contained in it. In commercial egg-laying farm enterprises, commercial layer strains produce eggs for food and egg processing industries, and the success depends on the total number and size of eggs produced (Olawumi; Adeoti, 2009).

The quality of table eggs is dependent on diverse influences before and after oviposition, the hen's health and age, diet quality and safety, and housing environment are intrinsic aspects that define the quality of eggs laid. According to Hincke et al. (2000), the incidence of eggshell breakage and downgraded eggs (cracks) remains elevated, despite improvements in shell quality by manipulation of nutritional, environmental, and genetic factors. Such eggs are considered to be hazardous because their contents are exposed to bacterial pathogens, and they may be used in products not thoroughly cooked. According to Wolc et al. (2012), the frequency of defects has been reduced substantially in commercial crosses of layer hens in the last decades as a result of intensive selection in pure lines, well-established crossing schemes, lighting control programs, and improved nutrition. However, the incidence of downgraded eggs still represents an important source of economic loss for the egg industry due to product loss and the need for further processing.

Shell formation over one laying year is biologically a stressful event and the age-related changes in shell thickness and shell ultra-structure are reflected in deteriorating physical parameters such as breaking strength (Solomon, 2010; Damte et al., 2024). A decline in eggshell quality is usually noticed as hens approach the end of a laying period (Mazzuco; Hester, 2005). In this way, the condition of the eggshell at the oviposition time can influence the incidence of shell breakage. Hincke et al. (2000) reported that, despite great deal of basic research into calcium metabolism and eggshell formation, the problem of weak or poor-quality eggshells remains a significant factor for the industry. The irregularities in shell shape, texture, and surface are commonly observed during a regular egg-laying cycle and the causes are varied from factors that cause disturbance to the birds (any

kind of stress) to inadequate nutrition and lighting regimens (photoperiod) and/or diseases. Deformed and cracked eggs have great economic implications on the farm as well as the sustainability of the poultry industry, especially breeder farms.

Therefore, this study was designed to assist commercial egg layer farms, in identifying different types of cracks and deformed eggs occurring on their farm, investigating their causes, and providing possible measures to reduce and or control the identified types of cracks and deformed eggs.

2. Materials and Methods

2.1 Study location

The study was carried out in the Ogbomoso community, Oyo state, Nigeria. Ogbomoso is located in the derived savannah that lies on longitude 40101 East of Greenwich Meridian and latitude 80 101 North of the equator. The altitude ranges from 300m to 600m above sea level and the mean temperature and annual rainfall are 27 ºC and 1247mm, respectively (Google Earth, 2020).

2.2 Data collection

A random sampling technique was used in the selection of the respondents for the questionnaire administration. A total sample size of 40 randomly selected commercial layers' farms, was used for this study. Data were collected from primary sources through the use of a structured questionnaire. The questionnaire was designed such that the questions there were ranked, specific and directed to the commercial layer farmers alone. Distribution of the questionnaire was done through personal contact with the commercial layer farmers at their respective farms. The printed colour chart (plates 1-13) of the various type of crack/deformed eggs was also presented to the farmer to enable them to identify the common crack/deformed egg on their farm.

2.3 Statistical analysis

All data collected on the field survey were subjected to descriptive statistical analysis using IBM SPSS (statistical package for social science students) version 21 software package. This gives room for comparison of variables with the aid of statistical entities like pie chart.

3. Results and Discussion

3.1 Socio-economic characteristics and educational level

Table 1 shows the socio-economic characteristics and educational level of the farmers in the Ogbomoso community who engaged in commercial layers production, almost (90%) of all the farm owners were males while only 10% of them were females, The majority of poultry egg producers being male can be attributable to lack of easy access to loans by female farmers as compared to their male counterparts. Bamiro et al. (2001) also assert that the female gender as compared to the male folks is less efficient as poultry egg farmers. It was also discovered that the majority (55%) of the respondents were farmers while 25% were retirees, 15% were civil servants and very few (5%) of them were students. The majority of the commercial layers farmers in the Ogbomoso community were predominantly of the Christian religion (90%) while the remaining 10% were Muslims, it could be deduced that commercial layers farming in the Ogbomoso community is a Christian work. As indicated in the result, 55% of the commercial layers farmers had been in the business for more than 5 years while 42.5% had spent 3-4 years and 2.5% had spent 1-2 years.

It could be deduced that commercial layers production is a literate business, as all the respondents acquired tertiary education. This implies that there were more educated people in commercial layers farms. However, this does not suggest that in commercial layers production education was a barrier but rather an added advantage for efficient management. With this level of education, there is a tendency for the farmers to avail themselves of technological innovations and also acquire modern techniques of management for overall improved productivity. This study agrees with the findings of Ologbon, et al. (2012) that a greater percentage of small-scale poultry farmers in Ogun State had formal Education but findings disagree with the findings of Gbigbi (2012) who reported that a greater percentage of Artisanal fishing households in Niger Delta had no formal education.

Table 1. Socio-economic characteristics and educational level of respondents.

Variables	Frequency	Percentage
Gender		
Male	36	90
Female	4	10
Occupation		
Farming	22	55
Artisan	-	-
Trading	-	-
Civil Servant	6	15
Retiree	10	25
Student	2	5
Others	-	-
Religion		
Christianity	36	90
Islam	4	10
Traditional	-	-
Others	-	-
Year in Business		
1-2 Years	1	2.5
3-4yrs	17	42.5
> 5yrs	22	55
Educational Level		
Primary	-	-
Secondary		
Tertiary	40	100
Quranic	-	-
Non Formal	-	-
Other	-	-

Note: (-) not determined. Source: Field Survey, (2016).

3.2 Flock characteristics

Table 2 shows the flock characteristics of commercial layer farms in the Ogbomoso community, about 60% of the farms had flock sizes of between 1001-5000, while flock sizes of 5001-10,000, 501-1000, and 10,001-100,0000 are 10, 10, 10% respectively. The rest had a flock of < 500 and > 100000. The brown strain of layers was the mostly kept by the respondents with the percentage 58.62% followed by Naira black (17.24%) and Hacco black (13.79%) while the least kept strains were Hi-line, Dominant Brown and Dominant Black. About 36.4% of the respondents got their flocks from Amo farms, 18.2% from CHI, 18.2% from Zartech, 6.1% from Farm support, 6.1% got theirs from Nabest while 3.0% got theirs from RTO, DAYTEE, USA, Germany and Israel.

Depending on the number of birds owned by the proprietors of each farm, the poultry farms are divided into various scales of operation. According to Omotosho & Oladele, (1988), Subhash et al. (1999), and Ojo (2003), poultry egg farmers having less than 1,000 birds were considered small-scale farmers, 1,001-3,000 as medium-scale farmers while those having 3,000 and above birds were large scale farmers. According to these authors, Ogbomoso can be referred to as the medium layers farmers because 60% of the farmers had between

1,001 and 5,000.

However, the classification by Adene & Oguntade, (2006), and Obi et al. (2008) shows that farms having between 500 and 2,000 birds were considered small-scale farms those farms having more than 2,000 birds but less than 10,000 birds were regarded as a medium commercial farm while those having 10,000 birds and above are classified as large poultry farms. Consequently, only 25% of Ogbomoso layers farmers are large-scale farmers by the classification of the researcher. The commonly reared strains within the study area show that Isa Brown had the largest percentage (58.62%) and Amo Farms, CHI, and Zartech hatcheries were the common sources of pullet. Amo Farms gained the highest patronage (36.40%) may be as a result of been the closest, largest existing hatchery in the area.

Table 2. Flock characteristics of the respondents.

Variables	Frequency	Percentage
Flock Size		
< 500	2	5
501-1,000	4	10
1,001-5,000	24	60
5,001-10,000	4	10
10,001-100,000	4	10
> 100,000	2	5
Strain of Layers		
Naira Black	10	17.24
Isa Brown	34	58.62
Hacco Black	8	13.79
Hi-Line	2	3.45
Dominant Black	2	3.45
Dominant Brown	2	3.45
Source of Flock		
Obasanjo	-	-
Amo Farms	24	36.4
Chi	12	18.2
Zartech	12	18.2
RTO	2	3.0
FarmSupport	4	6.1
Daytee	2	3.0
USA	2	3.0
Germany	2	3.0
Israel	2	3.0
Nabest	4	6.1

Note: (-) not determined. Source: Field Survey, (2016).

3.3 Record keeping, husbandry methods, and finance

Table 3 shows the types of the record kept husbandry methods and finance of the commercial layers' farms in the Ogbomoso community. All the farms always keep records on their farms, this was made easy because 100% of the respondents were educated. The majority of the farms (70%) used battery cages for rearing their birds while 30% of the farms used both deep litter and battery cage systems. The choice of using battery cages mostly may

be linked to the ease of management and health of the birds since the birds will not have contact with their droppings.

It was concluded by Samiullah et al. (2014) that cage eggs were better in overall quality when directly compared with free-range eggs while Dukic-Stojcic et al. (2009) described eggs obtained from conventional cage system as being cleaner and having better overall egg quality compared with free range. Shell thickness was not significantly different between free-range and cage systems in several previous studies (Wang et al., 2009; Van Den Brand et al., 2004; Varguez-Montero et al., 2012). Record keeping according to Mertens et al. (2006) has indicated the critical points between egg production and the production system. The author indicated aviary and free-range system to have a similar total breakage of 1.94% and 1.99%, respectively after collecting the eggs.

Grading and packing seem to be the second critical point in the logistic chain after laying and collection. The higher breakage percentages in the collection and packing operation indicate a possible higher risk at those points in the logistic chain. In the first case, the collecting belts may generate an extremely high percentage (36.85%) of broken eggs due to technical problems. Breakage due to transportation ranged from 0.16 to 2.65%. According to Singh et al. (2009) who reported that eggs from hens on litter were heavier and this could have correlated with live weight and egg production.

Sourcing for finance is critical to the sustainability of a commercial egg-laying farm, the survey shows that 34.6% of the farms sourced their finance from banks, 26.9% from cooperatives, 19.2% from family, 11.5% from their salary, 3.8% from government and 3.8% got theirs from friends. A larger percentage (61.5%) of farmer obtained their money from banks and cooperatives. This may have a serious setback on the growth of the poultry business because of the difficulties involved in the methods of securing loans from the bank and the interest rate. Youths may not be able to obtain a bank loan because of the requirements for collateral. Providing loan by the government may be a way out to enable youth to see Layers Farm as a business of choice.

Table 3. Record keeping, husbandry methods, and source of finance.

Variables	Frequency	Percentage
Record Keeping		
Yes	40	100
No	-	-
Record Type		
Finance	40	100
Health	40	100
Production	40	100
Marketing	24	60
Management System		
Deep Litter	-	-
Battery Cage	28	70
Both	12	30
Source of Finance		
Government	2	3.8
Bank	18	34.6
Money Lender	-	-
Cooperative	14	26.9
Family	10	19.2
Friends	2	3.8
Salary	6	11.5

Note: (-) not determined. Source: Field Survey, (2016).

3.4 Debeaking methods and reason for debeaking

Table 4 shows the information about debeaking, methods, and reason for debeaking. Ninety (90%) of the farms debeaked their layers while the remaining 10% did not debeak their layers. Sixty-five percent (65%) of the farms that debeaked their layers, used debeaking machine, 15% used manual method and 20% used both manual and automated methods. Also, 57.5% of the respondents who debeaked theirs layers did it at the age of 10-12 weeks, 35% did it at age 1-9 weeks and 7.5% did it at age 13-15 weeks. Sixty-three percent (63%) of the farms debeaked their layers to prevent cannibalism, while 37% did it to avoid egg pecking.

Aerni et al. (2000) stated that high rates of feather pecking and pronounced feather damage were only found in hens housed without access to straw and fed on pellets. To avoid problems with feather pecking, it is recommended that laying hens are provided with foraging material and fed on mash. El-Lethey et al. (2000) similarly conclude that the provision of foraging material and food forms have significant effects on both feather pecking and indicators of stress. Hartini et al. (2002) found that the form of feed presented and the time of consumption to be more important than dietary deficiencies in triggering cannibalism in layers farms. Feeding high-fibre, low-energy diets or roughage reduces feather pecking (Van Krimpen et al., 2005).

Insoluble fibre (non-starch polysaccharides and lignin) affects gut functions and modulates nutrient digestion and there are indications that diets high in insoluble fibre are preventive of cannibalism outbreaks in laying hens (Hetland et al., 2004). Steenfeldt et al. (2007) observed that access to maize silage, barley-pea silage, or carrots decreased damaging pecking, reduced severe feather-pecking behavior, and improved plumage quality.

Table 4. Debeaking, method, and reason for debeaking.

Variables	Frequency	Percentage
Debeaking		
Yes	36	90
No	4	10
Methods of Debeaking		
Manual	6	15.00
Automated	26	65.00
Both (Manual and Automated)	8	20.00
Age of Debeaking		
1-9	14	35
10-12	23	57.5
13-15	3	7.5
Reason for Debeaking		
Avoid Egg Pecking	20	37
Prevent Cannibalism	34	63

Source: Field Survey, (2016).

3.5 Feeds and feeding

The feeding characteristics of the commercial layers farms in the Ogbomoso community as indicated in (Table 5) show that 40.7% used Amobyn feed, 25.9% used their own formulated feeds, 18.5% used livestock feeds while the remaining 3.7% used hybrid feeds. Furthermore, 80% of the farms fed their layers twice per day, 10% fed once a day and 10% fed three or more times a day. Faulty feed and feeding methods are sometimes responsible for reduced egg production, small egg size, reduced shell quality, reduced growth, excess fat storage, overfeeding, and high mortality (Oyedeji et al., 2007). Among other problems, Halima (2007) identified poor nutrition as one of the major constraints in chicken production. Ad libitum feeding also results in high mortality in laying hens (Oyedeji et al., 2007).

Crounch et al. (2002a) revealed that quantitative feed restriction reduces body weight and feed consumption

without reducing egg production. Spradley et al. (2008) and Taherkhani et al. (2010) reported that increasing feeding frequency to 2 times per day affects the productive performance of broiler breeder hens. Cave (1981) revealed that feeding 3 times per day increased the percentage of hen-day egg production for the first 10 weeks of the production cycle. Spradley et al. (2008) and Taherkhani et al. (2010) reported that birds fed twice a day produced more eggs compared with birds fed once a day through 42 and 39 weeks of age, respectively. The authors reported that hens who received feed 2 or 3 times per day laid 4.8 eggs more than those fed once per day through 38 weeks of age. 95% of the farms used manual methods to feed their layers while the rest used both manual and automatic methods to feed their layers. 73.9% of the farms used boreholes as source of water for their farms, 21.7% used well water while the remaining 4.3% used water fetched from the river.

The effect of drinking water sources according to Koelkebeck et al. (1999) was that water quality differed based on the sources of water. Some water parameters such as sodium and chlorine varied with water sources. Water intake was affected based on the water sources and also hen day production and egg yield were reportedly lower for hens consuming well water. The type of minerals find in drinking water has been shown to affect layer's performance, Jensen et al. (1976) showed that elevated concentrations of calcium, magnesium, and sodium were associated with the incidence of fatty liver syndrome in commercial layers. Zhang et al. (1991) reported that layers consuming water supplemented with 2000 mg $NaCl/L^{-1}$ had significantly lower egg production, more defective eggshells, lower hatchability, and a higher rate of embryonic mortality than hens consuming 41 and 35 mg/L^{-1} of Na and C1, respectively. It is therefore very important not to overlook the importance of good water quality for optimum poultry performance.

Table 5. Feeds and feeding.

Variables	Frequency	Percentage
Feed Source		
AmoByn	22	40.7
Top Feed	-	-
Animal Care	6	11.1
On Farm	-	-
TollMilling	-	-
Personal Formulae	14	25.9
Hybrid	2	3.7
Livestock	10	18.5
Feeding Times/Day		
Once	4	10
Twice	32	80
Three or More	4	10
Feeding Methods		
Manual	38	95.0
Automated	-	-
Both	2	5.0
Water Source		
Bore Hole	34	73.9
Well	10	21.7
River	2	4.3
Rain	-	-
Tap	-	-

Note: (-) not determined. Source: Field Survey, (2016).

3.5 Health and disease management

Table 6 shows the health and disease management of commercial layer farms in the Ogbomoso community. Most (70%) of the farms reported that they did not experience disease outbreaks while the remaining (30%) had experienced disease outbreaks on their farm. Furthermore, 95% of the farms vaccinated their layers while only a few (5%) did not. 75% of the farms used veterinary service, the remaining 25% did not use veterinary service, The farms that vaccinated their layers vaccinated them against new castle diseases (38.6%), EDS (20%), fowl pox (17.1), IBD (12.9), Marek (8.6), and IB (2.9).

Newcastle disease (ND) is a deadly viral disease of poultry all over the world since the time of its first isolation in England in 1926 till today (Banu et al., 2009). It is considered as one of the major economic threats to poultry population because of the high morbidity, which may vary from 90 to 100% in unprotected birds depending on the virulence of the Newcastle disease virus (NDV) exposed (Alexander, 2003). ND is a major problem in laying birds due to huge losses encountered as a result of poor quality eggs, reduction in egg production, and mortalities (Alexander, 2003).

Table 6. Health and disease management.

Variables	Frequency	Percentage
Disease Outbreak		
Yes	12	30
No	28	70
Outbreak Type		
Marek	-	-
Newcastle	8	20.0
Cocci	-	-
CRD	2	5.0
Others	-	-
Vaccination		
Yes	38	95
No	2	5
Veterinary Service		
Yes	30	75.0
No	10	25
Diseases Vaccinated Against		
Newcastle	27	38.6
EDS	14	20.0
Fowlpox	12	17.1
Marek	6	8.6
IB	2	2.9
Ibd	9	12.9

Note: (-) not determined; Cocci. – Coccidiosis, CRD - Chronic Respiratory Disease, EDS - Egg Drop Syndrome, IB - Infectious Bronchitis, IBD - Infectious Bursa Diseases; Egg Collection, Storage and Marketing Problems. Source: Field Survey, (2016).

Table 7 shows the result of egg collection, storage, and marketing problems of commercial layers farms in the

Ogbomoso community. It was observed that 95% of the farms collected theirs eggs making use of hand while 5% used both hand-picking and automated methods for their egg collection. Seventy percent (70%) of the farms collected their eggs twice daily while few farms collected their eggs three or more times a day and once a day with percentages of 20% and 10% respectively. As observed from the study, 95% of the farms use trays for egg collection while a few (5%) use buckets.

For place of egg storage, it was observed that 90% of the farms stored their eggs in the store while 10% stored theirs in the pen. Egg marketing is faced with various challenges as identified by the respondents during the study, it was observed that 43.6% selected unstable egg price as a marketing problem, 30.8% selected poor sales, 15.4% selected lack of market place, 5.1% economic situation, 2.6% poor infrastructure, and 2.6% feed cost. The market is the total of all business activities performed in the movement of commodities from the point of initial production until the commodities are in the hands of the ultimate consumer (Adekanye, 1988).

According to Badejo (1983); Wong (1991); Ogundipe (1996), and Aduku (2002) poultry marketing is a very challenging task for any sizeable poultry production outfit in Nigeria, no farmer should invest in it unless he has a fair knowledge of the market outlet and the size of their demand. Commercial poultry is faced with many problems, such as the high cost of feeding and veterinary drugs, poor quality of commercial feed due to formulating errors, inadequate capital and lack of knowledge of nutrient and energy requirements of the various classes of poultry, diseases/parasite, mortality and high cost of input (Aromolaran, 1999).

Table. Egg collection, storage, marketing, and marketing problems.

Variables	Frequency	Percentage
Mode of Egg Collection		
Hand Picking	38	95
Automated	-	-
Handpicking and Automated	2	5
Frequency of Collection		
Once	4	10
Twice	28	70
Three or More	8	20
Material Used for Collection		
Tray	38	95
Bucket	2	5
Other	-	-
Place of Storage		
Store	36	90.0
Pen	4	10.0
Others	-	-
Marketing Problem		
Unstable Price	34	43.6
Poor Sales	24	30.8
Lack of Market Place	12	15.4
Poor Infrastructure	2	2.6
Feed Cost	2	2.6
Economic Situation	4	5.1

Note: (-) not determined. Source: Field Survey, (2016).

3.6 Price per crate of cracked and normal egg

Table 8 shows the price/crate of cracked and deformed eggs, it was observed that the farm sold their deformed eggs at lower prices when compared with the normal whole eggs, about 42.9% of the studied farm sold their cracked egg at the rate of 500 per crate, while 21.4, 14.3, 7.1, 7.1 and 7.1% sold at ₦400, ₦350, ₦200, ₦300 and ₦450 respectively. Also, the price per crate of normal whole eggs in the studied area shows that 45% sold at the rate of ₦700 per crate, 25% and 20% sold at the rate of ₦650 and ₦600 respectively, while few farms sold their eggs at a higher price ₦750 and ₦800 with percentages of 5% and 5% respectively. The comparison between the price of normal eggs and that of cracked and deformed eggs shows that the more the number of cracks the farmer records on their farms, the more the reduction of profit coming from the sale of eggs.

Table 8. Price per crate of cracked and normal eggs.

Variables	Frequency	Percentage
Price/Cracked Eggs		
200	2	7.1
300	2	7.1
350	4	14.3
400	6	21.4
450	2	7.1
500	12	42.9
Price/Normal Eggs		
600	8	20
650	10	25
700	18	45
750	2	5
800	2	5

Source: Field Survey, (2016).

3.7 Cracks/deformed eggs incidence, causes, and method of controlling cracked eggs incidence on commercial layer farms

Table 9 indicates the cracked and deformed egg incidence, causes, and methods of control. It is crystal clear that all the farms experienced one type of crack or deformed eggs. More so, 23.2% of the farms said the causes of cracks and deformed eggs were the layers cage, poorly designed battery cages can lead to egg loss to cracking, and 20.3% said the birds either by pecking or playing with the eggs with their legs, vermins (15.9%), while the least selected were due to storage, hormonal changes, and transportation process. The following are the causes of cracked and deformed eggs: stress, genetics, environmental temperature, diseases, management, saline drinking water, age of birds, nutrition, mechanical damage, and infrequent egg collection.

Age of bird affect egg shell soundness as reported by Coutts & Wilson (1990) and young birds with immature shell glands may produce misshapen eggs (Coutts; Wilson, 1990). Overcrowding of birds, changes in the lighting program, poor shed ventilation, and inadequate water supply can contribute to an increased incidence of shell defects associated with egg texture (Coutts; Wilson, 1990). Infectious bronchitis (IB), a viral disease caused by a coronavirus that attacks the mucus membranes of the respiratory and reproductive tracts (Jones, 2006) may result in egg defects. Similarly, birds affected by egg drop syndrome (EDS), caused by an adenovirus, initially produce pale eggs, quickly followed by thin-, soft-shelled, or shell-less eggs (McFerran; Adair, 2003). The respondents however suggested the control measures that can be used to control the various identified cracks and deformed eggs which include, proper handling of the eggs, prevention of diseases, control of rats, addition of limestone or oyster shell or both in layers diet, addition of bone meal, use of good water, use of antibiotics.

Table 9. Cracked egg incidence, causes, and methods of control.

Variables	Frequency	Percentage
Crack Incidence		
Yes	40	100
No	-	-
Causes of Cracked /Deformed Eggs		
Handling	20	14.5
Storage	10	7.2
Birds	28	20.3
Cage	32	23.2
Nutrition	20	14.5
Vermins	22	15.9
Diseases	2	1.4
Hormonal Changes	2	1.4
During Transportation	2	1.4
Method of Controlling Cracked/Deformed Eggs		
Adding BoneMeal to Feed	6	4.5
Adding Limestone or Oyster Shell	6	4.5
Both (Limestone and Oyster Shell)	16	12.1
Adjust Feed	12	9.1
Good Water Source	8	6.1
Proper Handling	30	22.7
Prevent Diseases	26	19.7
Control Rats	26	19.7
Use of Antibiotics	2	1.5

Source: Field Survey, (2016).

3.8 Different types of cracked and deformed eggs

Figure 1 illustrates the different types of cracked and deformed eggs common on commercial layers farms in the Ogbomoso community, It was observed (Figure 2) that gross crack (15.52%) is the type of crack that was majorly experienced by the respondents, this is followed by blood stain, thin shell, flat-sided and cage mark with 13.79, 12.7, 11.21 and 11.21% respectively while the least experienced crack was a mottled crack (0.86%), Rough or “sandpaper” shells, pimples, pinholes and mottled or glassy-shells are all eggshell defects associated with eggshell texture, These defects are frequently a result of bird age, but may also be caused by other factors (Coutts; Wilson, 1990).

Stress and diseases have the potential to influence the deposition of eggshell pigmentation during egg formation (Mertens et al., 2010). Infectious bronchitis is an example and has been implicated in the production of "watery white", a condition observed when chemical changes like secretions from the magnum affect the shell structure of eggs (Solomon, 1997), causing the shell membranes to be arranged in a distorted manner due to the absence of an adequate template for the regular shell mineralization as occur in body-checked or corrugated shells. The incidence of this type of eggshell defect could reach 1% and in older birds' flocks, 9% (Coutts; Wilson, 2007, cited in Helenice; Antonio, 2014).

Another common surface defect observed in the eggshell is the coated shell when additional calcium deposits or extracuticular coverings are observed and possibly reflects the timing and magnitude of the stress or disturbance experienced by the flock (Solomon, 1997). It is a commonly observed incidence of about 1% and could be caused by the age of the birds (often younger flocks) coming into production (Coutts; Wilson, 2007, cited in

Helenice; Antonio, 2014).

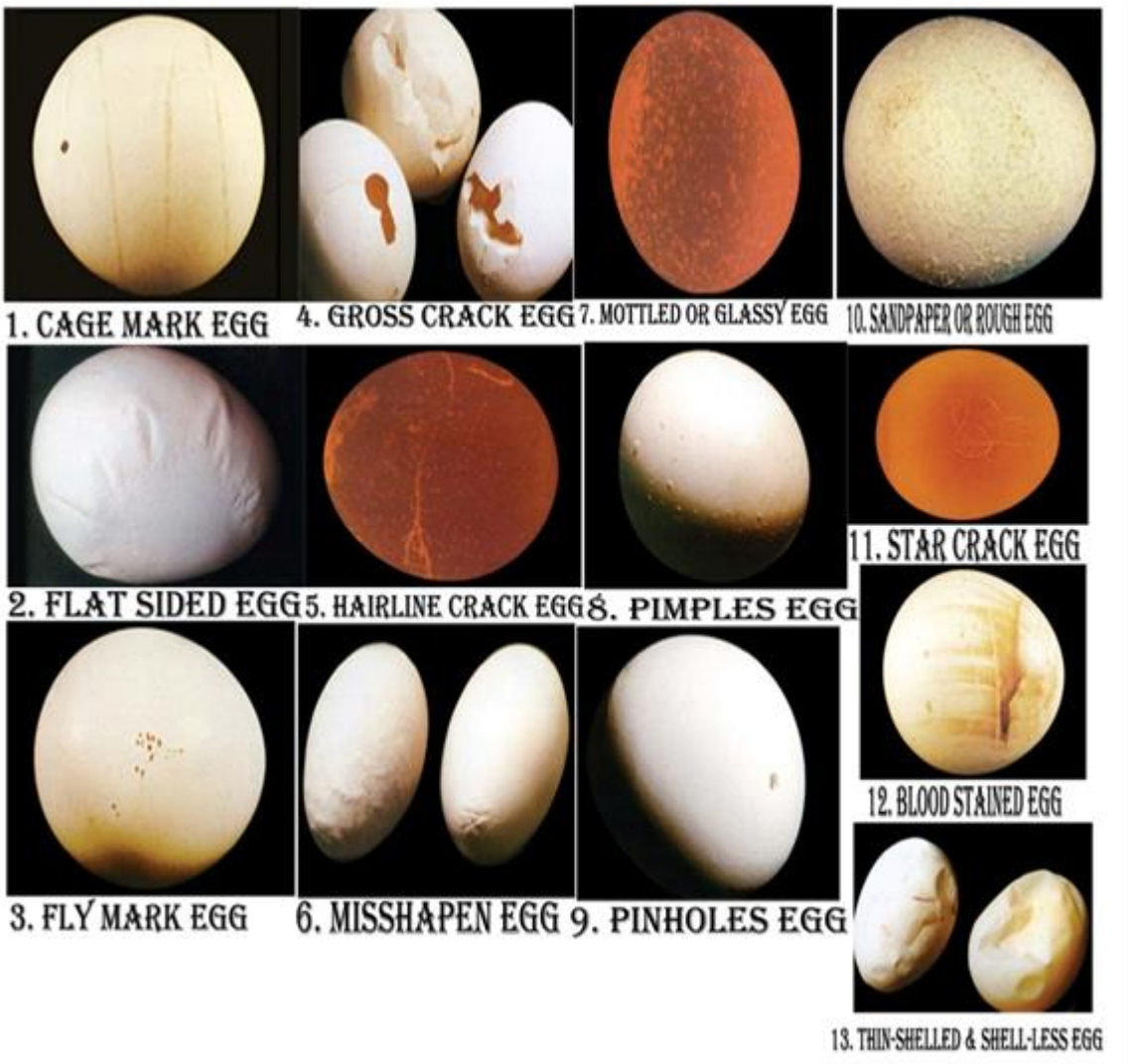

Figure 1. Coloured chart of different types of cracks and deformed eggs. Source: Authors, 2024.

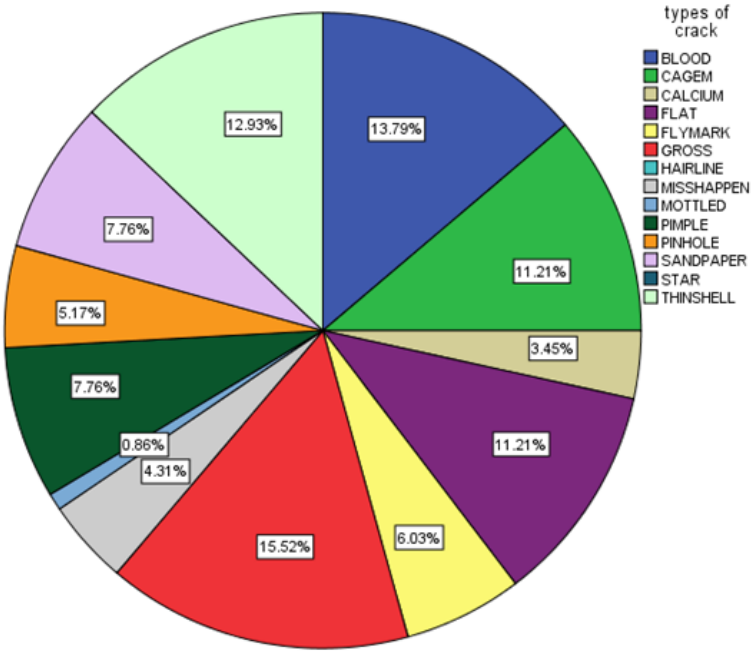

Figure 2. Pie chart showing different types of cracked/deformed eggs on the commercial layer farms in the Ogbomoso community. Source: Authors, 2024.

4. Conclusions

The result of this study showed that the majority of the respondents were males, Christian and they all had tertiary education. The result also indicated that all the farms studied experienced cracked and deformed eggs, among the cracks experienced, gross crack is the most common type, and the least is mottled crack. The causes of cracked and deformed eggs identified by the respondents include the birds, poor handling, vermins, nutrition, storage, transportation process, bird cages, and diseases. The respondent also identified various measures for controlling the incidence of cracks and deformed eggs, which includes, the use of good water, controlling of rats, provision of sufficient calcium in the feed of birds, prevention of diseases, and use of non-prohibited antibiotics.

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6. Authors' Contributions

Muritala Daniel Shittu: designed the research work and produced the questionnaire. *Muritala Daniel Shittu* and *Quadri Olatunji Agboola*: wrote the manuscript. *Oyefunmike Oluwatoyin Adeyi* and *Robiat Olutoyosi Kareem*: helped to administer the questionnaire to various commercial poultry farmers. *Olusegun Ojeniyi Ojebiyi* and *Sodiq Gbolagade Ademola*: help to correct the manuscript. *Blessing Opeyemi Akinwande*: helps to retype the corrected manuscript.

7. Conflicts of Interest

No conflicts of interest.

8. Ethics Approval

Not applicable.

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