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Feed Type and Period Influence on Egg Quality Traits

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ABSTRACT
The study was conducted between November and December 2018, to determine the influence of feed type and period on egg quality traits. A total of 246 commercial laying hens were used for the study. The experimental birds were managed in battery cages system and fed *ad-libitum*. The parameters recorded were egg weight (EW), egg length (EL), egg width (EWd), shell thickness (ST), shell weight (SW), yolk weight (YW), yolk length (YL) and albumen weight (AW). Data generated were analyzed using analysis of variance. The overall mean EW, EL, EWd, ST, SW, YW, YL and AW were 56.73 kg, 53.18 mm, 44.47 mm, 0.49 mm, 7.71 kg, 14.15 kg, 36.08 mm and 34.78 kg. Feed type had no effect on all traits observed. However, significantly higher EW, EL, EWd, YW and AW were observed in the morning period than afternoon hours (57.74±0.42 vs 55.71±0.49 kg; P<0.01, 58.64±0.49 vs 53.73±0.61 mm; P<0.001, 46.51±0.52 vs 42.44±0.65; P<0.05 and 35.69±0.34 vs 33.86±0.41 kg; P<0.001). For shell thickness, the latter period had higher value than the former (0.56±0.02 vs 0.42±0.02 kg; P<0.001). The study revealed that feed type had no influence on egg quality traits and the results obtained for morning period was high compared to the afternoon hours.
KEYWORDS :Feed Type, Period, Egg Quality Trait, Laying Hens

1.0 Introduction

Kramer (1951) defined quality as the characteristics of a specific meal that affect or cause a customer to reject this item. Egg weight, egg length, egg width, egg index, shell weight, shell thickness, albumin height, albumin width, yolk height, yolk index, and haugh unit are all common terms that define both internal and exterior quality. Among the healthiest foods, eggs and meat rank with milk as one of the top sources of protein, iron (Fe), and vitamins (Oluyemi and Roberts, 2000). Stadelmam (1977) described it as the features of eggs that influence customer acceptance and are the more significant price-contributing factors. Due to the importance of eggs as a source of protein for human nutrition, consumers began to expect certain levels of quality in these components (Uluocak et al., 1999). Due to the production economy and customer desires for higher quality eggs, it is crucial to monitor and assess the internal and exterior quality of chicken eggs. Islam et al. (2001) discovered that breeds' exterior and internal egg quality features had an impact on subsequent generations' productivity. Genotype had a substantial impact on egg shape index, yolk and albumin quality, and yolk index, according to Tumova et al. (2007).Similar to this, Yakubu et al. (2008) found substantial variations in most egg characteristics, with the exception of shell weight and yolk index, between typical feathered and bare neck eggs. In a study of exotic Isa brown layer breeders, Olawumi and Ogunlade (2008) found extremely significant connections between the majority of internal and exterior quality parameters. Yousria et al. (2010) also found that the bulk of egg quality features in Egyptian Gimmizah and Bandra, as well as their crosses, showed a substantial positive link. The overall quantity of high-quality eggs produced determines the flock's economic performance. When moving eggs from manufacturing to consumption, about 7-8% of the total amount are cracked. Consequently, the quantity of cracked and broken eggs causes major economic issues for both. Egg weight and egg index are stated to be factors of egg resistance to breaking and are seen to be extremely essential qualities when eggs are packaged in containers by Peters et al. (2007) and Kul and Seker (2004). According to Smith (1990), the Haugh unit should be at least 40% and the appropriate value for the egg index should be 0.75. (Ayorinde et al., 1999). The features of diverse genotypes of our village chickens in the state that affect egg quality have received very little study attention to date, and there is a severe lack of knowledge in this area. The goal of the current study was to analyse, evaluate, and link the numerous egg quality traits in the normal smooth feathered, frizzled, and bare neck phenotypes of village chickens in Adamawa state.

1.2 Problem Statement

The amount and quality of feed consumed, water intake, light intensity and duration, parasite infestation, illness, management, and environmental conditions can all have an impact on egg production (Jacob et al., 1998). While Majaro (2001) and Yakubu et al. (2007) claimed the opposite, different authors examined the influence of breed on egg production and found no discernible effect (Duduyemi, 2005). Additionally, Gwaza and Egahi (2009) revealed that breed had a sizable impact on age at peak egg production. In the same vein, Abdel-Rahman (2000) found that the bare neck genotype outperformed full feathered mates in terms of egg production, sexual maturity, mortality rate, and feed efficiency.It is clear that characteristics that improve egg quality are extremely important to the chicken breeding business (Bain, 2005). The yolk and white, or albumen, also make up the inside of a hen's egg. The egg product market places a lot of emphasis on interior qualities such yolk index, Haugh Unit, and chemical composition as demand for liquid eggs, frozen eggs, egg powder, and yolk oil rises (Scott and Silversides, 2001).

1.3 Research Objective

Determine the impact of diet and period on egg quality traits in Lohman Brown Layers is the goal of the current study. While the precise goals are to ascertain how diet affects egg qualities and how laying time affects egg parameters.

2.0 Literature Review

This section focuses on the theoretical aspects of the research and compares it to the literature already in existence using the applicable studies.

2.1 Classification of Chicken

There are around 60 breeds and 175 different kinds of chicken divided into 12 classifications (Obioha, 1992). A class of breeds are those that share a common geographic background. The origin of the breeds is indicated by the names—Asian, American, and Mediterranean. A breed is a group of animals that share a certain set of physical characteristics, such as body type, skin tone, carriage or station, and toe count. Variety is a breed category that is based on the colour of the feathers, the shape of the comb, or if a beard or muff is present. The Plymouth Rock can therefore be barred, white, buff, or any other hue.The Rhode Island Red comes in single or rose comb varieties. The physical characteristics and body type should be the same in each instance. Breed and variety don't tell us anything about the traits of productive cattle. does, though. A strain is a collection of breeding populations that are part of a variety or cross that have been bred and cultivated to have certain desirable traits. There are several commercial strains that have been developed for certain reasons, mostly for egg production, including Babcock, Dekalb, Hyline, and Shaver.

2.1.1 Exotic breeds of laying birds

Although the first exotic chickens were probably brought into Nigeria in the early 1950s, it wasn't until the late 1950s, following their successful adaption and performance, that their full economic potential became apparent. At that time, the Rhode Island Red, Barred Plymouth Rock, New Hampshire, and White Leghorn were among the first breeds introduced. Although they arrived as straight breeds, their progenitors were blends of many blood lines that had been created via multiple generations of crossings in the original or adapted nations. Several hybrids created from inbred lines and cross-breeding procedures to create strains for growth or egg production were later imported. According to Obioha (1992), the hybrids that are currently more prevalent in tropical Africa include:

Table 1: Hybrids Distribution

United State	United Kingdom	France	Canada	E Isreal
1 Hyline / B11	1. Rangers/Sykes	5 Warren Sex-Linked	1. Shaver Star Cross	1 Yarkon
2 Hyline 935	2. Thornbers 808		2. Shaver Star Cross 444T	2 Yaafa
3 Harco (Obioha, 1992)	3. Thornbers 909		3. Brown Eggs Shaver 579 (intensive and alternative)	
4 Babcock 300				
5 Babcock 380				

These layers can operate in a variety of ways, and as a result of breeders' quick genetic turnover, new strains are nearly constantly introduced to the market (Obioha, 1992). Commercial white-type hybrids, which lay white-shelled eggs and cost the least to feed to egg converters, are among the best chicken breeds. Large, brown-shelled eggs are laid by commercial red-plumed birds (such Rhode Island Reds and New Hampshire) or sex-linked hybrids. These birds lay plenty of eggs and have juicy corpses. In comparison to hybrids that deposit white eggs, those that lay more eggs have a tendency to be more docile. All varieties of fowl lay eggs, however not all of them are equally productive (Clauer, 2005).

2.2 Physical (External) and Internal Measure of Eggs

2.2.1 Egg quality

Quality is "the aggregate of features of a certain food item which impact the acceptance or preference for that food by the customer," according to Kramer (1951), referenced by Koelkebeck (2006). This definition makes it obvious that egg quality will mean various things to different individuals, and that a consumer's impression of quality will probably change depending on how they plan to utilise the egg and their own tastes. A cursory study of the legal requirements for eggs sold worldwide provides a good illustration of this. Eggs are classified as either class "A" or class "B" eggs under the European Union Egg Marketing Regulations, which are in effect in all member states of the EU (Council of the European Union, 2006; European Commission, 2003), and only eggs rated "A" are allowed to be sold.Both class "A" and class "B" eggs may be sold in Nigeria for retail or direct human consumption, with the main distinction being that class "A" eggs command or draw a higher price than class "B" eggs. Contrarily, Coutts and Wilson (1990) noted that internal egg quality parameters such albumen or yolk quality have received less attention. However, when shelling eggs that will be traded, they must be: visibly clean; candling should not have any apparent fractures unless it has undergone a procedure to eradicate harmful organisms; It has not yet hatched; There is no sign of embryo growth or putrefaction; Nor are there any substantial blood clots. The handling and storage of the eggs should be done in a way that minimises condensation on the surface of the eggs.Only eggs that have been pasteurised (or have undergone a similar procedure) and satisfy the microbiological standards may be sold for human consumption. Eggshell quality and interior quality are crucial components in assessing egg quality, hence eggshell grading systems may differ from nation to country or area to region (Jacob et al., 2000).

2.2.2 Eggshell quality

The great majority of eggs are sold whole, and a consumer's initial assessment of each egg they buy is based on how well-made they believe the shell to be. The eggshell integrity, texture, form, colour, and cleanliness are the five primary categories of faults listed in the Egg Producers Federation of New Zealand (Inc) (EPF) Code of Practice (EPF and NZFSA, 2002).

2.2.3 Egg shell integrity

Eggs with thin or no shells as well as cracks of any size, including star cracks, hairline cracks, and severe cracks, are all regarded to have poor egg shell integrity. A large percentage of broken eggs will have a detrimental effect on the profitability of any egg producer since, for example, cracked eggs cannot be made available for retail sale in New Zealand (Food Standards Australia New Zealand, 2006). One of the most apparent causes of egg shell fractures is mechanical damage, which can be brought on by the birds themselves or by bad management practises such infrequent egg collection, harsh handling, poor feed quality, and poor cage design and/or upkeep.Eggshell strength ultimately determines how sound the shell is; eggs with weaker shells are more likely to crack and break, which can lead to microbial contamination. There are several elements that might influence shell strength, including Different strains of laying hens differ greatly in egg size, egg quality, and egg production as a result of genetic selection (Curtis et al., 1995), and there are obvious variations between contemporary commercial birds and conventional breeds of laying hens (Hocking et al., 2003). Selection for one trait, like as productivity or egg weight, may have an impact on the hen's other traits, such as egg shell quality (Poggenpoel et al., 1996).

Egg size

Smaller eggs have stronger shells than bigger ones because the calcium that chickens may deposit in the shell must be distributed across a broader surface area (Butcher and Miles, 2003a).

Age of the birds

According to Butcher and Miles, older birds tend to lay larger eggs and produce more eggs, which has an effect on shell strength (2003a). Eggs without a shell or with a thin shell can be laid by young birds with immature shell glands. This can be avoided by delaying the start of sexual maturity by one to two weeks (Coutts and Wilson, 1990).

Strain

As a result of genetic selection, different strains of laying hen vary significantly in egg shell quality, egg size, and production (Curtis *et al.,* 1995) and there are clear differences between modern commercial birds and traditional breeds of laying fowl (Hocking *etal*., 2003). Selection for one characteristics such as production or egg weight can affect other characteristics of the hen such as egg shell quality (Poggenpoel*et al*., 1996).

Stress

Soft or thin-shelled eggs are a common phenomenon after stress in laying hens. Factors which cause oviposition prior to shell deposition will result in soft or thin eggs. High (above 25^{o}C) environmental temperature may affect the bird's feed and calcium intake, resulting in less calcium available for shell deposition (Natalie, 2008; Coutts and Wilson, 1990; Natalie, 2008; Solomon 1991; Jones 2006; (Koelkebeck, 2006;Arima*et al.*1976as cited by Jones, 2006).

Nutrition and water quality

It is really important to recognise the contribution drinking water makes to the supply of minerals and trace elements. Both calcium and phosphorus are important macrominerals, with calcium playing a key role in the development of the shell throughout the night. The correct use of calcium and phosphorus depends on getting enough vitamin D. (Boorman et al., 1989; Coetzee 2002).

Mycotoxicosis

Jewers (1990) noted that during ochratoxicosis field outbreaks, thin rubbery shells that shatter more easily than usual have been seen. Similar to this, during a T-2 toxicosis epidemic, egg breakages increased from 3 to 15 percent, with an additional 18 percent of eggs breaking while being transported to clients (Jewers, 1990). In comparison to birds fed the control diet or diets enriched with mannan oligosaccharides, birds fed diets containing 2.5ppm (part per million) of aflatoxin B1 had lower egg shell weights, according to Zaghini et al. (2005).

Genetics

According to Clunies et al. (1992, referenced by Jones, 2006), chickens who lay thick-shelled eggs retain more calcium from their diet than those that lay thin-shelled eggs. Both egg types produced the same amount of eggs, regardless of whether the shells were thick or thin.

Disease

Infectious bronchitis (IB), a coronavirus-based viral illness that affects the mucous membranes of the respiratory and reproductive systems, can lead to egg abnormalities (Butcher and Miles, 2003a; Cavanagh and Naqi, 2003; Jones, 2006). These include eggs with pale shells and eggs with weak shell integrity (Butcher and Miles, 2003a; Cavanagh and Naqi, 2003; Beyer, 2005; Jones, 2006). Comparably, birds with the adenovirus-based egg drop syndrome (EDS) produce pale eggs at first, followed by thin, fragile, or eggs without a shell (McFerran and Adair, 2003).

2.2.4 Eggshell texture

Disease

Egg shell flaws related to egg shell texture include rough or "sandpaper" shells, bumps, pinholes, and mottled or glassy shell s.

These flaws are typically brought on by the age of the bird, but they can also be brought on by other circumstances (Coutts and Wilson, 1990; Natalie, 2008).

Mycotoxicosis

Rough or "sandpaper" eggshells have been linked to a number of illnesses, including IB, infectious laryngotracheitis (ILT) (Beyer, 2005; Coutts and Wilson, 1990), and avian encephalomyelitis (AE) (Coutts and Wilson, 1990).As was previously mentioned, ochra-toxicosis may cause rubbery-shelled eggs (Jewers, 1990). .

Genetics

It is believed that the ability to produce eggs with calcium deposits on the shell (or pimple) is inherited (Butcher and Miles, 2003a; Coutts and Wilson, 1990).

Management

A higher prevalence of shell abnormalities linked to egg texture can be brought on by overcrowding of birds, a change in lighting programme, inadequate shed ventilation, and a lack of water availability (Coutts and Wilson, 1990).

2.2.5 Eggshell shape

Eggs that are misshapen have a different shape from the smooth usual form (for example, flat-sided eggs and body-checked eggs). There are several potential causes of this:

Age of bird: Young birds with immature shell glands may lay eggs that aren't round, much like with shell soundness (Coutts and Wilson, 1990).

Body-checked eggs are those whose shells break in the shell gland during the development process and are identified by grooves and ridges (i.e. 10-14 hours before the egg is laid). Although the injury is somewhat repairable, the egg develops a protrusion (Solomon, 1991; Natalie, 2008). When two eggs are in the shell gland at once, the eggs become flat-sided (Natalie, 2008). Both flaws might be brought on by congestion, fear, or other factors.

Disease: If the albumen quality is particularly low, there is no solid foundation on which to create the shell because the albumen of the egg and its surrounding membrane provide the framework on which the egg shell is placed (Natalie, 2008). As a result, illnesses that lead to poor albumen quality frequently result in an increase in the number of eggs with abnormal shapes. Egg Drop Syndrome (EDS) (McFerran and Adair, 2003; Coutts and Wilson, 1990), Infectious Bronchitis (IB) (Jones, 2006; Butcher and Miles, 2003a; Cavanagh and Naqi, 2003), and specific Newcastle Disease (NCD) or Avian Influenza (AI) are examples of these (Butcher and Miles, 2003a; Coutts and Wilson, 1990).

2.2.6 Eggshell colour

The colour of the egg shell is determined primarily by the genetics of the hen, with white-feathered hens laying white eggs and brown birds laying brown eggs. The quantity of pigment in the cuticle, which forms on the surface of the shell, also determines the colour of an egg.These factors include:

Stress: Epinephrine, a stress hormone, will delay oviposition and stop shell gland cuticle synthesis, which can result in the production of pale-shelled eggs. Stressors can include, for example, handling, a lot of noise, and crowded cages (Butcher and Miles, 2003b).

Age of bird: Pigment intensity diminishes with age in birds. This may be as a result of less pigment being produced or more pigment being spread across a larger surface area (Butcher and Miles, 2003b).

Chemotherapeutic drugs: It has been demonstrated that some medications alter the colour of egg shells.

An anticoccidial medicine called nicarbazin, for instance, provided at a quantity of 5 mg per day, can cause the generation of pale eggs within 24 hours, while greater doses can cause full depigmentation (Butcher and Miles, 2003b). Yellow egg shells may also develop from chlortetracycline (600-800 ppm) (Beyer, 2005; Natalie, 2008).

Diseases: Viruses which affect the mucus membranes of the respiratory and reproductive tract, such as NCD and IB, not only cause a decrease in egg production but also cause the shell to become abnormally thin and pale (Beyer, 2005; Butcher and Miles, 2003b).

2.2.7 Eggshell hygiene

Most eggs are clean when laid and subsequently contaminated with faecal material or other contaminants. Defects listed in the EPF code of practise include cage marks, stained eggs and fly marks. Good management practises will help reduce the number of dirty eggs (EPF and NZFSA, 2002; Coutts and Wilson, 1990).

Management: Good management practises will help reduce the number of dirty eggs. These practises include frequent collection of eggs, as well as regular replacement of litter material in the nest boxes or cage floors and roll-out trays. It is found that fly stains, water stains, and grease or oil stains may occur, and can be prevented by good shed and equipment maintenance or management (Coutts and Wilson, 1990).

Nutrition and/or bird health: Any factor which causes diarrhoea in the birds (for example, high dietary salt levels) will also result in an increase in the number of dirty eggs collected. Blood smears on eggs can be minimised by good pullet management, including weight for age, lighting, and beak trimming if necessary (Coutts and Wilson, 1990).

2.2.8 Internal egg quality

Internal (shell) egg quality begins to decline as soon as the egg is laid. Internal egg quality is extremely important because of its many functional and aesthetic properties. The EPF Code of Practice lists a total of nine internal defects, and these can be broadly categorised into three groups.

2.2.9 Yolk quality

Yolk quality is determined by the colour, texture, firmness, and smell of the yolk. The primary determination of yolk colour is the xanthophyll (plant pigment) content of the diet consumed. Yolk colour can be easily manipulated to meet market demands (Jacob *et al*. 2000; Beyer, 2005).

These factors could include:

- Worms (Coutts and Wilson, 1990).
- Any factor which inhibits liver function, subsequent lipid metabolism, and the deposition of pigment in the yolk For example, mycotoxicosis is caused by aflatoxin BI (Zaghini*et al*., 2005) and coccidiosis, although this is rare in adult hens.
- Mottled yolks (with many pale spots and blotches which vary in colour, size and shape) occur when the contents of the albumen and yolk mix as a result of degeneration and increased permeability of the vitelline membrane (Jacob *et al*., 2000). Factors affecting mottling were reviewed in detail by Cunningham and Sanford (1974). Dietary factors which may cause mottled yolks include
- The presence of nicarbazin (an anticoccidalagent) in the feed has been shown by numerous authors to cause mottling (Jones *et al*., 1990).
- Worming drugs such as phenothiazine (Coutts and Wilson, 1990), dibutyltindialaurate (*Jacob et al*., 2000). It was observed that yolk defects were not recorded when peperazine was fed at the manufacturer's recommendations. Similarly, they only observed defects when dibutyltindialaurate was fed at the recommended level but over a much longer period.
- Gossypol from cotton and meal (*Jacob et al*., 2000).
- Certain antioxidants such as gallic acid (from grapes, tea, and oak bark) and tannic acid (Coutts and Wilson, 1990), or tannins from grains such as sorghum (Jacob *et al.,* 2000).
- Eggs should be collected regularly and stored at temperatures of 7–130°C and humidity of 50–60% (Jacob et al., 2000).

Yolk firmness: The yolk of a freshly laid egg is round and firm (Jacob *et al*., 2000). However, as the egg ages and the vitelline membrane degenerates, water from the albumen moves into the yolk and gives the yolk a flattened shape.

Yolk texture: Rubbery yolks may be caused by severe chilling and freezing of intact eggs, the consumption of crude cottonseed oil, or the seeds of some weeds (Jacob *et al*., 2000).

2.2.10 Albumin quality

Albumin quality is determined by the consistency, appearance, and functional characteristics; albumen quality is expressed in Haugh Units (HU), which are derived from the albumen's height and the egg's weight (Coutts and Wilson, 1990). For eggs to reach the customer, a minimum HU measurement is 60. However, the majority of farm-produced eggs have to be between 75 and 85 HU (Coutts and Wilson, 1990).

2.3. Factors Affecting Internal Egg Quality Indices

2.3.1 Age of the hen

HU will decrease with increasing bird age value, with HU decreasing by around 1.5 to 2 units (Coutts and Wilson, 1990) for each month in lay. Doyon *et al.* (1986, cited by Jones, 2006) stated that HU decreases at a fairly constant rate of 0.0458 units per day of lay as the hen ages. It was found that in an ideal situation, HU should be on average 102 at 20 weeks of age, falling to an average of 74 HU by 12 weeks of age.

2.3.2 Genetics

The strain of bird has also been shown to play a role in albumin consistency, with some strains consistently producing eggs with thin albumin. Curtis *et al.* (1985, cited by Jones, 2006) reported that brown egg layers produced eggs with higher HU, while other authors (Williams, (1992) cited by Jones (2006); Hill (1981) cited by Jones (2006)) reported that HU values were more variable within the brown egg layers compared with those that lay white eggs. High-producing birds tend to lay eggs with relatively lower amounts of thick albumin, and, although this can be influenced by selective breeding, egg numbers are usually considered more important.

2.3.3 Age and storage of the egg

As the egg ages and CO2 (carbon dioxide) is lost through the shell, the contents of the egg become more alkaline, causing the albumin to become transparent and increasingly watery (Natalie, 2008). At higher temperatures, the loss of CO_2 is faster and the albumin quality deteriorates faster. Decreasing shed temperatures in the hotter months combined with regular collection of eggs will help to reduce deterioration of the albumin before collection (Jones, 2006; Coutts and Wilson, 1990).

Eggs stored at ambient temperatures and humidity levels lower than 70% will lose 10–15 HU in a few days from the point of lay. By 35 days, these eggs will lose up to 30 HU. Storage of eggs at temperatures of 7–130C and humidity of 50–60% will reduce the rate of degeneration of thick albumen proteins. Therefore, egg albumin quality will be maintained for longer (Jones, 2006). Oiling of eggs can also help to reduce CO2 losses and thus help maintain internal egg quality (Beyer, 2005; Koelkebeck, 1999; Coutts and Wilson, 1990), but it is not a substitute for cold storage (Jacob *et al*., 2000).

2.3.4 Diseases

Diseases such as certain strains of EDS, IB (Jacob *et al*., 2000; Coutts and Wilson, 1990), NCD, and ILT (Jacob *et al*., 2000) can cause a decrease in albumin consistency.

2.3.5 Blood Stains

Blood spots may vary from indistinguishable spots on the surface of the yolk to heavy contamination throughout the yolk (Coutts and Wilson, 1990). Although blood spots are normally closely associated with the yolk (Natalie, 2008), occasionally blood may be diffused through the albumin (Coutts and Wilson, 1990). Blood spots occur when small blood vessels in the ovary rupture when the yolk is released (Natalie, 2008).

Vitamin deficiency: Vitamin K plays an important role in blood clotting. Blood spots can result in an increased occurrence of blood spots (Bains, 1999).

Genetics: Some strains of birds appear to be predisposed to blood spots (Coutts and Wilson, 1990), although the incidence is low (Bayer, 2005).

Avian encephalomyelitis has been reported as a cause of blood spots (Coutts and Wilson, 1990).

Mycotoxicosis: Jewers (1990) reported an increase in blood spots from "essentially 0 to 3%" in birds affected by T-2 toxicosis. Bains (1990) suggested that mycotoxicosis may reduce vitamin K absorption, and this may explain the elevated incidence of blood spots in hens affected by T-2 toxicosis.

2.3.6 Meat locations

These are usually associated with the albumin (Natalie, 2008) rather than the yolk and often consist of small pieces of body tissue (Coutts and Wilson, 1990). However, some may consist of partially broken down blood spots (Coutts and

Wilson, 1990) or pigments. The occurrence of blood spots varies with the strain of bird, increases with the age of the bird and is reported to be higher in brown egg layers (Coutts and Wilson, 1990).

Contamination by bacteria or fungi

Solomon (1991) suggested that while pores on the surface of the egg do represent possible ports of entry for bacteria, particularly as the cuticle hardens just after oviposition, these are of secondary importance to the structural defects that are likely routes for bacteria to enter the egg. Bacteria and fungal contamination of eggs usually results in black, red, or green rot. The egg looks and smells putrid when broken out of the shell (Bayer, 2005; Coutts and Wilson, 1990). Bacterial and fungal contamination of eggs, resulting from faecal contamination of the egg, can be prevented by good management practises including regular replacement of nesting materials or good cage maintenance as appropriate (Beyer, 2005; Coutts and Wilson, 1990). Bacterial contamination of the egg contents may also occur as a result of an infection in the oviduct of the hen, and any affected hens should be culled (Coutts and Wilson, 1990). Proper handling and storage of eggs following collection will minimise the opportunity for bacterial or fungal contamination. However, improper washing procedures, high storage temperatures, and humidity will increase the incidence of bacterial or fungal contamination (Coutts and Wilson, 1990). Careful attention should be paid to the feed source, as salmonella spp. can be transmitted through the feed.

2.3.8 Roundworms in eggs

Coutts and Wilson (1990) reported that where roundworm infestation of the intestinal tract occurs, worms may migrate from the cloaca into the oviduct and become enclosed in the egg. This can be prevented by good flock management.

2.3.9 Off-odors and flavors

Although off-odours and flavours are rare if eggs are stored correctly (Coutts and Wilson, 1990), eggs readily absorb strong odours or flavours. Storage of eggs in close proximity to fish oils and meals, sour milk, strongly scented or decaying fruits and vegetables, mould, disinfectants, and kerosene is likely to result in the development of off-odours or flavours (Coutts and Wilson, 1990). However, eggs that have been oiled are less likely to absorb foreign odours (Coutts and Wilson, 1990). Old eggs and eggs stored at high temperatures are more likely to exhibit off-odours or flavours. Other sources of off-odours or flavours include strongly flavoured feed ingredients such as fish meal or fish oil, some vegetables (including onions, turnips, and excessive amounts of cabbage), and rapeseed or canola (Coutts and Wilson, 1990).

3.0 Methodology

The study was carried out in the Bauchi, Bauchi State, campus of the Abubakar Tafawa Balewa University Teaching and Research Farm. 5.3 percent of Nigeria's geographical mass, or 49,119 km2 total, is occupied by the state of Bauchi, which is situated between latitudes 90 and 120 and longitudes 80 and 110. (Abubakar, 1974). Kano and Jigawa to the north; Taraba and Plateau to the south; Gombe and Yobe to the east; and Kaduna to the west are the seven states that border Bauchi.

3.1 Feeds

The nutrition facts of the experimental diets arepresented in table 2 below.

Table 2: Feed composition

Content	Feed 1	Feed 2
Metabolizable energy	2680kcal/kg	2650 kcal/kg
Crude Protein	16.8%	16.5%
Fat	3.6%	4.4.%
Fibre	4.2%	5.0%
Calcium	4.2%	3.75%
Phosphorus	0.5%	0.45%
Methionine	0.45%	0.4%
Lysine	0.85%	0.8%

3.2 Health Management of Laying Hens

The laying hens were fed *ad libitum* and had access to clean, fresh water. On a routine basis, antibiotics (oxytetracycline), anticoccidial drugs (Amprolium), and anti-helminthic (piperazine) were used against any ailment.

3.3 Data Collection and Analysis

Egg quality traits

About twenty-three (23) egg quality traits were measured in the Animal Production Laboratory of Abubakar Tafawa Balewa University, Bauchi. These include: egg weight, egg length, egg width, shell weight, shell thickness, yolk weight, yolk and albumen weights. Weights of egg, shell, yolk, and albumen were determined using an electronic scale (accuracy of 0.01 g); egg length and width were measured using a digital Verniercalliper (0.01mm accuracy); and shell thickness was measured using a digital micrometre screw gauge (0.01mm accuracy).

Data generated for egg parameters was subjected to analysis of variance (ANOVA) using the general linear model (GLM) procedure of SPSS, version 25 (2017). Significantly different means were compared using the least significant differences (LSD). The model utilized was as follow:

$Y_{ij} = U + F_i + P_j + e_{ij}$

Y_{ij} = Observation on dependent variable

U= Overall mean

F_i = Effect of i^{th} feed (1,2)

P_j= Effect of j^{th} period (1, 2)

e_{ij}=Residual error

4.0 Results and Discussions

4.1 Feed Influence on Egg Quality Traits

Average egg quality traits according to feed type are presented in Table 3. Feed type had no significant influence on all the egg parameters observed.

4.2 Effect of Period on Egg Quality Traits

Least square means of egg quality parameters according to the period of laying are shown in Table 4. There was significant influence of period on egg length, egg width, shell thickness and albumen weight (P<0.001), egg weight (P<0.01) and yolk weight (P<0.05). Morning eggs had higher albumen and yolk weights, length, and width than afternoon eggs (57.740.40 g, 35.690.34 g, 14.32 0.12 g, 58.640.49 mm, and 46.510.52 mm vs 55.710.48 g, 33.860.41 g, 13.970.13 g, 53.730.61 mm, and 42.440.68 mm). For shell thickness, the latter had a higher value than the former (0.56±0.02 vs 0.42±0.02 mm). However, a non-significant effect of period was observed on shell weight and yolk length.

Table 3: Effect of feed type on egg quality traits

Variable	Overall mean ± S.E	Feed 1	Feed 2	LOS
Egg weight	56.73±0.32	56.65±0.45	56.81±0.45	NS
Egg length	56.18±0.39	56.09±0.56	56.27±0.55	NS
Egg width	44.47±0.41	44.32±0.58	44.62±0.57	NS
Shell thickness	0.49±0.01	0.46±0.02	0.53±0.02	NS
Shell weight	7.71±0.06	7.82±0.09	7.61±0.08	NS
Yolk weight	14.15±0.08	14.00±0.12	14.29±0.12	NS
York length	36.08±0.11	35.99±0.16	36.17±0.16	NS
Albumen weight	34.78±0.26	34.83±0.38	34.72±0.37	NS

LOS = Level of significance and NS = Non-significant

Table 4: Effect of period on egg quality traits

Variable	Overall mean ± S.E	Period 1	Period 2	LOS
Egg weight	56.73±0.32	57.74±0.42	55.71±0.49	**
Egg length	56.18±0.39	58.64±0.49	53.73±0.61	***
Egg width	44.47±0.41	46.51±0.52	42.44±0.63	***
Shell thickness	0.49±0.01	0.42±0.02	0.56±0.02	***
Shell weight	7.71±0.06	7.73±0.08	7.70±0.09	NS
Yolk weight	14.15±0.08	14.32±0.12	13.97±0.13	*
York length	36.08±0.11	36.22±0.14	35.94±0.17	NS
Albumen weight	34.78±0.26	35.69±0.34	33.86±0.41	***

LOS = Level of significance, * = P<0.05, ** = P<0.01, *** = P<0.001 and NS = Non-significant

The findings of Bobbo et al. (2013), who showed a non-significant affect of various diets on egg quality measures in local hens, are consistent with the conclusion that feed had no effect on egg quality features as shown in the current study. When studying Japanese quail, Hrncar et al. (2014) observed that there was no discernible difference in the thickness of the shell between the Panda White and Cinnamon Brown strains. Additionally, Abdullahi et al. (2018) found a non-significant effect of diet type on egg quality attributes in two strains of Shika brown layers (A and B). In a similar vein, several researchers' publications revealed variations in various chicken genotypes' traits related to egg quality (Khalil et al., 2013; Wambui et al., 2018). In their research, they noted.Obike et al. (2011), on the other hand, observed that there was no appreciable difference between the shell weights of Black and Pearl guinea fowl. This observation is supported by similar reports Ahmad et al. (2018) made among Shika brown layer strains A and B. Although the authors claimed that the shell weight in A was numerically greater than that in B, the difference was not statistically significant. Rajkumar et al. (2009) and Nwachukwu et al. (2015), who studied local chicken and Japanese quail, respectively, observed that strain had no appreciable influence on the weight of the two species' shells. In comparison to other strains, they observed a greater mean in the bare neck (normal and dwarf). These authors went on to explain that this variance was caused by genes that regulate development and feather dispersion.

Additionally, compared to Rhode Island Red hens, Oravka layers had considerably greater albumen weight, according to Hanusova et al. (2015). However, Obike et al. (2011) found no statistically significant difference between the Pearl and Black Guinea fowl strains' albumen weights. Nwachukwu et al. (2015) achieved comparable findings while studying the Panda white and Cinnamon Brown strains of Japanese quails.

5.0 Conclusion and Recommendations

The purpose of the study was to ascertain how feed type and time affected the characteristics of egg quality. For the investigation, 240 commercial layer eggs were utilised. According to the type of meal, the birds were divided into two treatments and kept in a battery cage system (Feed 1 and Feed 2). The following characteristics of the eggs were recorded: egg weight, egg length, egg breadth, shell weight, thickness, yolk weight, yolk length, and albumen weight. Eggs were collected twice a day (morning and afternoon). According to the findings, period had a significant impact on egg length, egg breadth, shell thickness, albumen weight, egg weight, and yolk weight (P 0.001, P 0.01, and P 0.02, respectively) (P 0.05).However, there was only a negligible impact of meal type on the qualities of the eggs. The research found a relationship between the time period and egg quality features. A non-significant influence of feed type was noticed, nevertheless. Commercial layer birds should be fed feed 1 since it performs better than feed 2 for increased egg quality features.

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