Effect of Chicken Strain on the Nutrient Composition of Eggs

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Abstract— *The study examined the effect of chicken strain (Isa brown, Lohmann brown, Isa white and Noiler) on the proximate composition of eggs laid by 22-weeks old hens. Completely Randomized Design (CRD) was used to carry out the study. The Gravimetric method, Furnace Incineration Gravimetric method, Bligh Dryer method, Kjeldahl method, AOAC 2019 method and Arithmetic Difference method were used to determine the Moisture content, Ash content, Fat content, Protein content, Crude fiber and Carbohydrate content of the egg samples, respectively. The mean values of the proximate composition of the four strains (Isa brown, Lohmann brown, Isa white and Noiler) of chicken studied are: Crude fiber- 0.47%, 0.41%, 0.41%, 0.44%; Moisture content- 75.08%, 75.14%, 76.06%, 76.40%; Ash content- 0.16%, 0.40%, 0.49%, 0.42%; Protein content- 12.56%, 12.51%, 11.74%, 11.03%; Carbohydrate content- 1.72%, 0.94%, 0.57%, 1.51% and Fat content- 10.01%, 10.61%, 10.74%, 10.20% respectively. The study invariably revealed that the eggs of Isa brown hens have more protein, carbohydrate and crude fiber contents. Eggs of Isa white hens contain significantly more fat and ash contents compared to those of Isa brown, Lohmann brown and Noiler hens. Noiler eggs have the highest moisture content. In conclusion, from a nutritional point of view, eggs of Isa brown strain are healthier because they contain less amount of fat and higher percentage of protein.*

Keywords— breeds, nutrient composition.

I. INTRODUCTION

A Strain is a certain family of birds that are usually bred with a certain emphasis on specific traits (Daniels, 2015). A strain, also called a bloodline or simply a line, is a family of related chickens. They are distinctive in having been selectively bred by a single person or organization long enough for all the chickens to be uniquely uniform in some way. Commercial strains of birds (that can be hybrid birds, not just pure bred birds) are usually given specific names after the producer, or after the cross, example, the Black Rock hybrid (Daniels, 2015). However, poultry farming is fast becoming an attractive business in Nigeria due to its short gestation and generation interval, prolificacy and lack of taboos to its production coupled with an increasing demand for its products by large segment of the populace especially during religious, local and national festivals. In order to meet this increasing demand, there is an urgent task of developing or procuring the fastest growing strains for new entrants and long-time poultry farmers who have resources to invest in this sub-sector which generates employment opportunities for both skilled and unskilled labour. The improvement in this sub-sector will no doubt lead to increase in protein consumption and enhance the well-being of the people in addition to promoting national growth and development. There is strong evidence that there are genetic differences in growth rate between strains or breeds of chickens (Deeb and Lamont, 2002; Olawumi, 2011)

Nutrient composition according to Wikipedia is a detailed set of information on the nutritionally important components of foods and provides values for energy and nutrients including protein, carbohydrates, fat, vitamins and minerals and for other important food components such as fiber. The nutritional value of an egg is divided between the egg white and the egg yolk. The egg white contains more than half the egg's total protein, while the egg yolk contains all the fat in the egg and a little less than half of the protein (The Gourmet Egg recipe book, 2021). The nutrient composition of various foods depends on several factors which include species, breeds, cultivars, ecological factors, post-harvest handling, preservation and storage techniques (FAO, 2013; Onyenweaku *et al*., 2018). Some foods are considered healthy depending on their nutrient content, while others

are considered to be unhealthy (FAO, 2007; Onyenweaku *et al*., 2018). Therefore, this study is aimed at determining the effect of chicken strain on the nutrient composition of eggs and comparing them for the benefit of farmers and consumers.

II. MATERIALS AND METHODS

2.1 Location of Study

The study was carried out at Maeve Research Laboratory, Awka. It is located at temporary site of Nnamdi Azikiwe University, Awka. Awka town is located in South-Eastern part of Nigeria and in the eastern part of Anambra State. It is bound by Latitudes 6°11'N and 6°17'N and Longitude 7°02'E and 7°08'E.

2.2 Experimental Design

The experiment was conducted using Completely Randomized Design (CRD) to test the effect of chicken strain on the nutrient composition of eggs. There were four treatment groups comprising Isa Brown, Isa White, Lohmann Brown and Noiler and five replicates.

The model of the design is as follows:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where,

Y_{ij}= Single Observation

μ = Overall Mean

T_i = Effect of Treatment (chicken strain)

e_{ij}= Random Error

2.3 Sample Collection

The eggs used for this experiment were procured from Maeve Farm, Okpuno, Awka South Local Government Area, Anambra State. The eggs were collected from 22 weeks and transported to Maeve Laboratory for nutrient composition analysis.

2.4 Equipment

The equipment used include, 250ml beaker, 250ml conical flask, sterile magnetic stirrer, burette, moisture meter, digital weighing balance, centrifuge and kjeldahl apparatus.

2.5 Reagent

The reagents used include, methanol, chloroform, selenium catalyst, NaOH, sulphuric acid, indicator-bromocressol green and methyl red.

2.6 Sample Preparation

The egg samples were thoroughly washed with distilled water in Maeve Laboratory, Awka, Anambra State, Nigeria. The egg samples were cracked, opened and emptied into 250ml beaker. The sample was then mixed properly till it became homogenous and ready for use.

2.7 Proximate Determination

2.7.1 Moisture Content Determination

The moisture content of the samples was determined by gravimetric method as described by Pearson (1976), James (1995) and Bradley (2003). A measured weight of the fresh sample (5g) was put in a previously weighed moisture can and dried in the oven at 95-100°C under pressure not exceeding 100mgHg for 30 minutes in the first instance. It was cooled on the desiccator and reweighed. The weight was recorded and the sample returned to the oven for further drying. The drying, cooling and weighing was done at intervals and repeatedly until a constant weight was obtained. By weight difference, the weight of moisture lost was determined and expressed as a percentage of the sampled weight analyzed.

It was calculated using the formula:

$$\text{Moisture (\%)} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

Where

W_1= initial weight of empty crucible

W_2= weight of empty crucible+ sample

W_3= final weight of empty crucible + sample after drying to constant weight

2.7.2 Ash Content Determination

The furnace incineration gravimetric method (AOAC, 2000) was used. A measured weight **(**5g) of each sample was put in a previously weighed porcelain crucible. The sample in the crucible was put in a muffle furnace at 550^{o}C for 2 hours, the sample was allowed to burn until it became white ash. The crucible was carefully removed from the furnace (taking care not to allow air blow the ash away), cooled in the desiccator and reweighed. The difference in weight of ash was obtained and expressed as percentage of the sample weight analyzed. The ash content of the sample was then calculated using the formula:

$$\text{Ash (\%)} = \frac{W_2 - W_1}{W} \times 100$$

Where:

W = weight of sample

W1 = weight of empty crucible

W2 = weight of crucible + ash

2.7.3 Fat Content Determination

Bligh dryer method of (2010) was used. 5ml of the solvent was measured into centrifuged tube. 3ml of methanol and chloroform was poured into the sample. The mixture was centrifuged for 30mins and the fat content separated. The fat content was weighted and the percentage content calculated as follow:

$$\text{Fat (\%)} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

Where;

W1 = weight of empty filter paper

W2 = weight of paper + sample before defatting

W3 = weight of paper + sample after defatting and drying.

2.7.4 Crude Protein Determination

The protein content of the samples was determined by the kjeldahl method as described by James (1995). The total nitrogen was determined and multiplied by the factor 6.25 to obtain the protein content; 0.5g of each sample was mixed with 10ml of concentrated sulphuric acid (H_2SO_4) in a kjeldahl digestion flask. A tablet of a selenium catalyst was added to it and the mixture was digested by heating in a fume cupboard until a clear solution was obtained. Each of the digest was carefully transferred into a 100ml volumetric flask and made up to the mark by distilled water. A 10ml portion of each digest was mixed with an equal volume of 45% NaOH solution in a kjeldahl distilling unit. The mixture was distilled and the distillate collected into 10ml of 4% boric acid solution containing three (3) drops of mixed indicator-bromocressol green and methyl red. A total of 50ml distillate was collected and titrated against 0.02N H_2SO_4 solution from green to a deep red point. A reagent blank was also digested, distilled and then titrated, just as the sample. The nitrogen and protein content was calculated thus:

$$\text{Nitrogen (\%)} = \frac{\text{T} \times 0.02\text{N} \times 14}{W \times 1000} \times 100$$

Where;

W = weight of sample analyzed

N = Normality of titrant (0.02N)

T= Titre value

14= Molar mass of Nitrogen

The percentage of protein was calculated as % protein = %nitrogen × 6.25**.**

2.8 Crude Fiber (AOAC 2019 Method)

2ml of petroleum ether and 10ml of H_2SO_4 were added to 5ml of the sample. The mixture was refluxed for 15minsand washed with warm water to remove excess acid. 5ml of $CaCO_3$ was added and boiled for another 15mins. The mixture was filtered and the residue collected. The residue was oven fried, weighed and cooled. The sample residual was then incinerated and weighed. Percentage crude fiber was then calculated as

%Crude fiber = loss in weight after incineration x 100

2.9 Carbohydrate Content Determination:

The carbohydrate content of the test samples was determined by estimation using the arithmetic difference method described by Bemiller (2003). The carbohydrate was calculated and expressed as the Nitrogen Free Extract (NFE) as shown below:

%CHO (Nitrogen Free Extract) = 100 - % [MC + P + Fat+ Ash + CF].

2.10 Statistical Analysis

The data collected were all subjected to One Way Analysis of Variance (ANOVA) using SPSS version 21. The differences between treatment means were separated using $P<0.05$.

III. RESULTS

The effect of chicken strain on the proximate composition of chicken eggs are shown in Table 1. Significant differences ($P<0.05$) exist between the crude fiber contents of the eggs studied. Isa brown and Noiler breeds had the highest crude fiber contents, though Noiler, Isa white and Lohmann brown are statistically similar ($p>0.05$). The moisture contents of the eggs are uniform ($p>0.05$), irrespective of the strain. On the other hand, ash contents of the chicken eggs are significant ($P<0.05$). Isa white outscored ($p>0.05$) Lohmann brown and Isa brown in ash content. The ash contents of Isa white and Noiler are similar ($p>0.05$) and those of Lohmann brown and Noiler are the same statistically ($p>0.05$).

TABLE 1
THE EFFECT OF CHICKEN STRAIN ON THE NUTRIENT COMPOSITION OF EGGS

PARAMETERS %	ISA BROWN (T1)	LOHMANN BROWN (T2)	ISA WHITE (T3)	NOILER (T4)	P VALUE
Crude fiber	0.47b	0.41a	0.41a	0.44ab	0.01
Moisture content	75.08	75.14	76.06	76.4	0.95
Ash content	0.16a	0.40b	0.49c	0.42bc	0
Protein	12.56	12.51	11.74	11.03	0.12
Carbohydrate	1.72d	0.94b	0.57a	1.51c	0
Fat	10.01a	10.61c	10.74d	10.20b	0

Again, the protein contents are similar ($p>0.05$) across the strain. The discrepancies in strain were highest in carbohydrate and fat contents of the eggs. The carbohydrate contents of the Isa brown was highest ($P<0.05$) followed by the Noiler strain and the least being the Isa white ($P<0.05$). Contrariwise, Isa white had the highest fat content followed by Lohmann brown and the least being the Isa brown ($P<0.05$).

IV. DISCUSSION

The mean values for protein content of eggs from the four strains are slightly different from USDA (2018) recommended value of 12.6%, but those of Isa brown and Lohmann brown are similar to that reported by Mann (2007; 2008) who gave a mean value of 12.5% for whole raw fresh egg. The difference observed may be as a result of genotype, feeding or environment. Therefore, Isa brown and Lohmann brown eggs should be a preference to commercial egg producers and consumers whose interest is on improving the quantity of protein consumed or supplied to the body.

There is significant difference between the treatment means of carbohydrate with the mean values different from that reported by USDA (2018) who gave a value of 0.7%. This may be due to feeding and as such consumers should go for Isa brown and Noiler eggs with the highest carbohydrate content.

The values for fat obtained in this study across the treatments (10.01-10.73%) are similar to the reports by Seuss-Baum *et al.* (2011) and Jones *et al*. (2010) who gave the values of 8.7-11.2% and 9.93-11.71%, respectively. This implies that the consumption of eggs from the four strains is healthy for consumers especially in building up of energy in the body.

The moisture contents of the egg samples are similar to 76.1% which was reported by USDA (2018) and there is no significant difference between the treatment means ($P>0.05$). Comparing the mean values gotten from the experiment, it can be inferred that consumers whose major interest is on the moisture content of eggs should go for Noiler eggs.

Ash content which is a measure of the total amount of minerals present in a food was analyzed and it was found that the ash contents of the four strains are less than 0.86-0.89% for eggs of different shell colour (brown and white) according to Jones *et al*. (2010). The difference may be as a result of humidity, environment or feeding.

There is significant difference between the treatment means of crude fiber with Isa brown having the highest value. However, since crude fiber is of little food value it is advised that consumers should go for Lohmann brown eggs which have the lowest crude fiber content as this will help facilitate the utilization of valuable food nutrients embedded in these eggs.

V. CONCLUSION

The results obtained from the experiment show that the eggs of Isa brown strain have more protein, carbohydrate, and crude fiber contents while they are less in those of Isa white, Lohmann brown and Noiler breeds. Eggs of Isa white strain contain more fat and ash contents compared to those of Isa brown, Lohmann brown and Noiler breeds. Noiler eggs have the highest moisture content.

In conclusion, from a nutritional point of view, eggs of Isa brown strain are healthier because they contain less amount of fat and higher percentage of protein. This makes Isa brown eggs more acceptable by consumers as its consumption will help reduce the risk of high accumulation of fat in the body which when not properly burnt down can lead to obesity, heart burn and other health hazards. Again, due to its high protein content, when consumed will help in the repair of worn-out tissues in the body which will help promote good health as the immune system is strengthened in its fight against diseases.

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