

RESEARCH ARTICLE

RELATIONSHIP BETWEEN LIVE WEIGHT, INTERNAL ORGANS, AND BODY PART WEIGHTS OF BROILER CHICKENS

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ARTICLE DETAILS

Article History:

Received 04 August 2022
Accepted 06 September 2022
Available online 07 September 2022

ABSTRACT

The study was conducted to ascertain the relationship in terms of percentage weights of internal organs and body parts of Ross 308 broiler birds to their live weights. A total of eighteen (18) broiler birds were used for the experiment which lasted for a total of eight (8) weeks. The birds were fed commercial diets at both starter and finisher phase and reared on deep litter following standard procedures. The live weights of the birds were measured using an electronic scale and following slaughter procedures. Carcass weight, internal organ weights and body parts weights were measured and recorded for computing the percentage weights of the internal organs and parts to the live weights of the birds. Internal organs evaluated were heart, lungs, gizzard, liver, spleen and intestine while the body parts were carcass, head, neck, wings, breast muscle, thighs and shanks. Data collected were analyzed using descriptive statistics. The weights of the internal organs and body parts of the birds were presented as percentages of the live weights. Percentage average weight of internal organs to live weight shows that the gizzard, liver and intestine constituted more than the heart, lungs and spleen but the percentage weight range shows that they are less regulated than the heart, lungs and spleen. Percentage average weight of body parts of the broiler birds to live weight were more in carcass, breast muscle and thighs than in the head, neck, wings and shanks.

KEYWORDS

Broiler Chickens, Carcass Weight, Internal Organs, Live Weight, Percentage Weights

1. INTRODUCTION

Body growth is represented by the sum of protein, fat, water, and ash depositions. In broilers, the deposition rates and the ratio of these components characterize the physiological age of the birds and their maturity stage, which are influenced by genotype and environment (Vincek et al., 2011). During the last few decades, genetic improvement has developed broilers with high daily weight gain and high feed intake capacity (Sakomura et al., 2005; Sakomura et al., 2011). The selection for traits such as growth rate, body composition, and feed efficiency has allowed annual genetic gains of 2-3% in the efficiency of meat production. Improvements in other traits, such as robustness, specific and general disease resistance, and absence of metabolic defects, also contribute for this progress (McKay, 2008). When comparing a modern strain (Ross 708) with a strain that had not been selected since 1950 found at 35 days of age, that the modern broilers presented higher growth capacity (1.8 vs. 1.0 kg live weight) and better feed efficiency (Schmidt et al., 2009). The modern birds also presented higher breast yield (18 vs. 9%), earlier liver development and function, and longer jejunum and ileum, suggesting better nutrient absorption and utilization.

The biological growth of broilers follows a sigmoidal pattern with an initial slow growth rate which increases as bird ages (acceleration) up to a maximum rate (inflection point), after which it gradually decreases (deceleration). Commercial broilers supply a wide range of markets, which vary according to community, custom, and economic sector. Live birds are still sold in some places. A large proportion of broilers are sold dressed, with or without some of the appendages and the most sophisticated markets demand select portions that are devoid of skin, fat,

and bone. To cater to this wide range of tastes, the poultry industry has developed highly sophisticated evisceration equipment to produce the desired products (Sakomura et al., 2011). However, little information is available with which to predict the weights of the important parts of the broiler, which vary according to age, weight, strain, sex, rearing environment, and the feeds and feeding program used during the growing period. The most comprehensive information available thus far is now outdated because of the rapid progress that has been made by geneticists in improving the performance in modern so-called high-yield genotypes (Hancock et al., 1995; Sakomura et al., 2011). Based on the above premise, this study seeks to determine the weights of internal organs and body parts of Ross 308 broiler birds in relation to their live weights.

2. LITERATURE REVIEW

2.1 Broiler Chickens

A broiler is any chicken (*Gallus gallus domesticus*) that is bred and raised specifically for meat production (Kruchten, 2002). Most commercial broilers reach slaughter weight between four and seven weeks of age, although slower growing breeds reach slaughter weight at approximately 14 weeks of age. Typical broilers have white feathers and yellowish skin (Bessei, 2006).

2.2 Broiler Growth, Internal Organs, and Body Parts

According to the models to predict economic performance of broilers, it is necessary to include components of the body that generate revenue (Fisher and Gous, 2008). These vary widely in different enterprises from the whole eviscerated carcass to dissected meat, and may include waste

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DOI:
10.26480/mahj.02.2022.64.66

components in some markets, such as offal and feet. The ideal situation is to predict the growth of many such components, taking into account the bird's genotype, feeding and environmental effects, and age at slaughter. Particular problems arise from small, but commercially important differences between breeds, and from treatments at one stage of growth, such as high protein levels in starter diets, which may express modified yield components later in life. Different approaches to this problem are outlined by these authors, with the preferred method of using allometric relationships with feather-free body protein as the principle predictor, and with adjustments for body fatness and perhaps degree of maturity.

The growth potential of several broiler chicken strains has been studied (Marcato et al., 2008). However, there are few studies about growth curves of the body parts of broiler chickens. A group researchers evaluated growth of the body, breast, thigh, drumstick, wing, and breast meat of males from 2 commercial strains (Goliomytis et al., 2003; Cobb 500 and Shaver Starbro). Recently, researchers also evaluated the allometric growth of physical parts of several strains of chickens (Danisman and Gous, 2008; 2011). However, information about the relationship between internal organs, body weight part and live weight of broilers during growth has not been reported previously.

Some consumers of poultry meat have preference for some parts of the body, and it has been reported that different breeds of animals, including broilers, may have increased growth in a particular organ or body part than other breeds (Koops and Grossman, 1991). Knowing breeds that have comparative advantage on a particular organ/body part than the other will be of great value to the poultry farmer in choosing breeds that will satisfy the desires of his/her customers. According to the study of the relationship between live weight, internal organs and body part weights of broiler chickens will further help animal scientists in serving as a guide during carcass analysis and also in predicting the various internal organs and body parts weights from their live and carcass weights which means that the weight of the gizzard, which is a choice organ for many consumers, may be known without slaughtering the bird (Butzen et al., 2013).

3. MATERIALS AND METHODS

3.1 Experimental Site

The experiment was carried out at the Poultry Unit of the Teaching and Research Farms, Federal University of Technology, Owerri. The site is located on Latitude 5° 27' 50¹¹. 230 N and Longitude 7° 02' 49¹¹. 330 E on elevation of 55m above sea level (Handheld Global Positioning System-GPS receiver). The study area is predominated by rainforest vegetation with 27-29°C mean annual temperature.

3.2 Experimental Animals and Their Management

A total of eighteen (18) Ross 308-day-old chicks sourced from a reputable hatchery in Owerri were used for the experiment. Prior to arrival of the birds, the pens were thoroughly cleaned, washed and disinfected. The chicks were brooded for two (2) weeks using kerosene stove as a source of heat. The birds were raised on deep litter system. Feed and water were supplied *ad-libitum*. All necessary vaccinations and routine husbandry management practices were duly observed (Leeson and Summers, 2005). The experiment lasted for a period of fifty six (56) days.

3.3 Experimental Diet

The basal diet was formulated to contain 3000kcal/kg ME and 23% Crude Protein (CP) for starter phase and 2900kcal/kg ME and 21% Crude Protein (CP) for finisher phase. Table 1 below shows the gross composition of experimental diets fed to the broiler chickens at both starter and finisher phase of the experiment.

3.4 Data Collection

The live weights of the birds were measured using an electronic scale; and following slaughter procedures outlined by carcass weight, internal organ weights and body parts weights were measured and recorded for computing the percentage weights of the internal organs and parts to the live weights of the birds (Thaxton et al., 2009).

3.5 Data Analysis

Data collected were analyzed using descriptive statistics. The weights of the internal organs and body parts of the birds were presented as percentages of the live weights using the formula below:

$$Organ\ or\ Body\ part\ weight\ percent = \frac{100}{live\ weight} \times Organ\ or\ Body\ part\ weight.$$

Table 1: Gross Composition of Experimental Basal Diet.		
Ingredients (g/kg)	Starter (1-21 days)	Finisher (22-56days)
Maize	52.00	55.00
Soybean Meal	35.00	28.00
Fish meal (72% CP)	3.00	-----
Vegetable oil (PK oil)	4.80	2.10
GNC	-----	10.00
Limestone	1.00	1.00
Bone Meal	3.00	3.00
L-Lysine HCL	0.30	0.25
DL-Methionine	0.30	0.20
Salt	0.30	0.25
Vitamins & Minerals Premix	0.30	0.30
TOTAL	100.00	100.00
Calculated Analysis		
ME (Kcal/kg)	2992.86	2906.38
CP (%)	22.64	21.11
CF (%)	4.42	2.87
Ca (%)	2.82	5.59
Lys (%)	1.54	1.23
Met (%)	0.65	0.51
Fat (%)	5.32	5.71
Ash (%)	2.36	2.51

*Premix will contain vitamin A: 12,000,000IU, Vit D3: 2, 5000, 000IU, Vit K: 2,000mg, Vit B1: 2,250mg, Vit B2: 6,000mg, Vit B6:4,500mg, Vit B12:15mg, Niacin 40,000mg, Panthothenic acid: 15,000mg, Folic acid: 1,500mg, Biotin: 50mg, Choline chloride: 300,000mg, Manganese: 80,000mg, Zinc: 50,000mg, Iron: 20,000mg, Copper: 5,000mg, Iodine: 1,000mg, Selenium: 200mg, Cobalt: 50mg, Antioxidant: 125,000mg.

4. RESULTS

The total weights, average weights and weight ranges of the live weight and internal organ weights of the experimental birds and the percentages of their average weight and weight range are presented in Table 2. Percentage average organ weights recorded 0.40 for heart, 0.69 for lungs, 2.51 for liver, 2.12 for gizzard, 0.09 for spleen and 3.89 for the intestine. The percentage range of the live weight of the birds was 12.79 while those of the internal organs were 0.06 for heart, 0.15 for lungs, 0.52 for liver, 0.47 for gizzard, 0.01 for spleen and 0.21 for intestine.

Table 2: Percentage weights of the internal organs of the experimental chickens					
Parameter	Total	Average		Range	
	(g)	(g)	(%)	(g)	(%)
Live Wt.	42186.29	2343.68	100	299.56	12.79
Heart	168.78	9.38	0.40	1.52	0.06
Lungs	290.21	16.12	0.69	3.61	0.15
Liver	1059.59	58.87	2.51	12.19	0.52
Gizzard	894.89	49.72	2.12	11.05	0.47
Spleen	36.79	2.04	0.09	0.20	0.01
Intestine	1639.11	91.06	3.89	5.01	0.21

Table 3 presents the total weights, average weights and weight ranges of the live weight and body parts weights of the experimental birds. The broiler birds recorded percentage average weight of 81.94 for carcass, 2.80 for head, 3.00 for neck, 7.59 for wings, 23.98 for breast muscle, 23.42 for thighs and 2.14 for shanks. Percentage weight range recorded 13.23 for carcass, 0.74 for head, 0.39 for neck, 0.88 for wings, 2.92 for breast muscle, 4.07 for thighs and 1.05 for shanks.

Table 3: Percentage Weights of Internal Organs of The Experimental Chickens

Parameter	Total	Average		Range	
	(g)	(g)	(%)	(g)	(%)
Live Wt.	42186.29	2343.68	100	299.56	12.79
Carcass	34543.10	1919.06	81.94	309.78	13.23
Head	1178.27	65.46	2.80	17.43	0.74
Neck	1265.24	70.29	3.00	9.09	0.39
Wings	3198.27	177.68	7.59	20.54	0.88
Breast Muscle	10107.05	561.50	23.98	68.33	2.92
Thighs	9870.87	548.38	23.42	95.25	4.07
Shanks	903.47	50.19	2.14	24.68	1.05

5. DISCUSSION

The results of this study clearly demonstrate that the allometric and isometric growth patterns of the experimental birds is in agreement with the report (Lawrence and Fowler, 2002). The percentage average weights show the amount or percentage of the organ or body part weight that constitutes the live weight of the birds (Alkan et al., 2011). The percentage weight ranges probably is a depiction of how wide or narrow the organ or body part growth can vary, which in turn indicate the degree of regulation of the organ or body part by the regulatory mechanisms of the animal's body (Frandsen et al., 2009). The liver, gizzard and intestine of the broiler birds were the internal organs found to have higher percentage weight than other internal organs. However, considering the percentage weight range, the spleen, heart and lungs seem to be more tightly regulated than the liver, gizzard and intestine.

Carcass percentage of the birds is no doubt the biggest component of the live weight. This is followed by the breast muscle and the thighs. The head, neck and wings, although constituting lesser percentages, are more tightly regulated than the breast muscle and thighs. It could be observed from the results of this study that the more the percentage of an organ or body part to the live weight, the less tightly regulated is the weight or growth of the organ or body part. Interestingly, it was observed that the shank, although not among the major components of the live weight like the carcass, breast muscle and thighs, was not tightly regulated, but had a wider range of values resulting in the higher percentage range than the head, neck and wings.

6. CONCLUSION

Internal organ and body parts growths in Ross 308 broiler birds are at various rates and regulation by the regulatory mechanisms of the bird. Some are tightly regulated while others are loosely regulated. It was observed that the more an organ or a body part constitutes a greater percentage of the live weight, the less tightly regulated is that organ or the body part. However, an exception was observed in the shanks, in which it was less tightly regulated despite constituting a relatively smaller percentage of the live weight.

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