MUSCLE FIBRE CHARACTERISTICS OF COMMERCIAL BROILER AND INDIGENOUS CHICKEN

***Olagoke, O. C., Akinwumi, A. O., Olusanya, S. A., Oladoke, O. M., Adebayo, Y. O., Olawuyi, B. S., Adesunloro, O.O. and Emiola I. A.**
Department of Animal Nutrition and Biotechnology, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.
*Corresponding author: ocolagoke@lautech.edu.ng; 08034635519

ABSTRACT
Meat quality is mainly determined by the muscle's fibre number, cross-sectional area (CSA) and fibre types. An experiment was conducted to assess the muscle fibre traits of commercial broiler and indigenous chicken breeds. Matured commercial and indigenous chickens were randomly assigned five treatment groups comprising Arbor Acre (T1), Noiler (T2), Ross 308 (T3), indigenous (T4) and ISA Brown spent layer (T5). The selected chickens were slaughtered and allowed to bleed through while fresh meat samples were collected from the thigh muscle of each treatment and replicated thrice. Samples were evaluated for muscle fibre diameter, total number of fibre (TNF), fibre length, muscle density and cross-sectional area of fibre (CSAF). Data were subjected to One-Way Analysis of Variance using IBM SPSS (2000) version 25. The results revealed significant ($p < 0.05$) differences in all the parameters examined. Noiler and ISA Brown spent layer chickens exhibited significantly larger fibre diameters compared to the other breeds. Elevated ($p < 0.05$) values of TNF were observed for Ross 308 and indigenous chicken which was similar to ($p > 0.05$) to that of spent layer compared to other breeds. A higher value of fibre length was recorded for spent layer compared to others with the same trends observed for muscle density and CSAF. Hence, meat from ISA Brown spent layer and indigenous chicken has superior meat quality suitable for product development while Ross 308 had superior quantity as reflected by the fibre density, fibre length, TNF and CSAF.
Keywords: Arbor Acre, Ross 308, Indigenous, Spent layer, Muscle fibre traits

INTRODUCTION

The indigenous (slow-growing) chickens are recognized for higher sensory quality and superior nutrient composition leading to speculation that they may produce meat with superior quality compared to commercial broilers (Mikulski *et al*., 2011). The fast-growing commercial broiler chickens (e.g Arbor Acres and Ross 308) on the other hand were bred for rapid growth, high meat yield and faster turnaround. Noiler chickens are slow growth, dual purpose improved crossbred of White Plymouth Rock chicken and Nigerian Indigenous chicken developed by Amo Farms Limited, Oyo State, Nigeria- purposely for meat and egg production for small scale farmers. Fast growing birds had low feed conversion ratio, and attain a market weight of 2.5kg (Ismail and Joo, 2017) at 5-6weeks, the more reason it was considered suitable for large scale production. Contrarily, noiler attains market size of about 3kg at 10-12weeks, higher feed conversion ratio compared to broiler, however offers a more meat yield compared to layers. In terms of meat quality, broiler meat is considered softer, and flavourful, while noiler is firmer, more flavourful owing to slow growth rate and increased muscle mass (Chodova *et al*., 2021). Selection for rapid growth and high breast yield may have negative impact on sensory and functional qualities of the meat (Le Bihan-Duval, 2003).

Direct relationships exist between growth rate, muscle fibre and meat quality (Joo *et al*., 2013). According to Mehmood and Zhang (2020) the proportions of these fiber types are highly dependent on the breed differences based on location and function of specific muscle in the body. Post mortem muscle metabolism which is a crucial factor to determine fresh meat quality is affected by TNF and CSAF (Kim *et al*., 2013). These quality traits are evaluated by the consumer before buying the meat products, and these traits contribute to the consumer's expectation towards good quality meat. Hence, the present study investigated the muscle fibre characteristics of commercial broiler and indigenous chicken.

MATERIALS AND METHODS

Location of the experiment

The rearing of poultry birds was carried out at the Poultry Unit, Teaching and Research Farms, Ladoke Akintola University of Technology, LAUTECH Ogbomoso. Meat processing was carried out at the Meat Science Laboratory of the Department of Animal Nutrition and Biotechnology, LAUTECH, Ogbomoso.

Sample preparation

Matured chicken of about 2.5kg from commercial broiler chicken (6weeks), about 3.5kg of noiler (13weeks) and 1.8kg of indigenous chicken (table size) were procured from within the Teaching and Research Farms, LAUTECH

and within Ogbomoso metropolis. Each breed was randomly assigned a treatment comprising Arbor acre representing T1, Noiler as T2, Ross 308 as T3, Indigenous Yoruba Ecotype and ISA Brown spent layer represented T4 and T5 respectively. The birds were restrained and slaughtered by severing the jugular vein of the neck region. The muscle was allowed to bleed through and carcasses scalded at 70 ºC, plucked and eviscerated according to the industrial standard practice. Carcasses were chilled in a chiller, where they remained immersed in iced water at approximately 0.6 ºC for 75 min. After chilling, chicken carcasses were placed in coolers and aged at 4 ± 1 ºC up to 6 h *postmortem* before further processing. The thigh muscle was dissected from the carcasses and separated for each of the chicken. Carcasses were replicated in triplicate and analysed for meat quality traits for fresh samples.

Collection of Data

Evaluation of muscle fibre characteristics: Muscle fibre morphological traits were determined using hematoxylin and eosin (H&E) staining. Each muscle sample was fixed in 4% paraformaldehyde for 24h and paraffin-embedded, and a microtome was used to prepare 5-mm thick sections. After drying overnight at 40°C, the sections were counterstained with H&E using a Leica Autostainer XL (Leica Biosystems). The samples were scanned the fibre diameter and cross-sectional area were calculated using an image analysis system. For each sample, 3 different points on 3 images containing approximately 300 muscle fibers were estimated. Measurements was taken on samples from 6 chickens from the same group.

Statistical Analysis

Data generated were subjected to One-Way Analysis of Variance using SPSS (2000) version 25 and the means were separated using Duncan's multiple range test at probability level of 5%.

RESULTS AND DISCUSSION

The muscle fibre morphological traits of indigenous chicken and commercial broiler chicken are presented in Figures 1 to 5. The fibre diameter is shown in Figure 1. There are significant differences in the fibre diameter across the chicken type. Significantly (p=0.000) higher fibre diameter was observed in noiler and spent layer with lower values (p=0.000) recorded for other chicken types. The total number of fibre (TNF) was shown in Figure 2 which revealed increased (p=0.000) TNF for Ross 308, Indigenous chicken and spent layer. However, the TNF significantly (p=0.000) reduced in Noiler chickens. The fibre length (Figure 3) was significantly elevated in the spent layer (p=0.000) compared to other chicken types. The cross-sectional area (Figure 5) of muscle follows the same trend with fibre length. The muscle density (Figure 4) of the spent layers significantly increased compared to other chicken types while the least muscle density was recorded in Ross 308 chicken.

Muscle fibre characteristics influence muscle yield and meat quality (Liu *et al*., 2023). A total number of fibre and CSAF are contributing factors to muscle mass and the resultant meat quality of poultry meat. Higher TNF were observed in the indigenous and ISA Brown spent layer and the commercial broiler, Ross 308. Traits like total number of fibres, muscle density, and fibre length are beneficial in meat quality and animal welfare because they indicate improved muscle development and improved meat quality. The present results agreed with that of Huo *et al*. (2021) who observed higher fibre density in 1-day-old Xueshan (an indigenous chicken breed in China) and Ross 308 broiler. Increased muscle fibre length and diameter indicate a tougher meat which was evident in spent layer and noiler compared to other chicken types. Animals with larger muscle fibres of moderate size produced a higher quality and quantity of meat (Koomhrong *et al.,* 2015) which is evident in TNF of Ross 308, indigenous and ISA Brown spent layer chicken. According to Tumoiva and Teimouri (2009), muscle fibre from fast-growing lines has twice as large fibre diameters as slow-growing lines which contradicted the results of the present study in that noiler and spent layers have a larger diameter than other types. Koomhrong *et al.* (2015) also reiterate that the muscle fibre area and fibre diameter of Arbor Acre broiler at 55 days of age was significantly higher than the Thai native chicken of China.

It could be suggested from this study that the spent layer with higher fibre diameter, TNF, fibre length, muscle density and CSAF could be a result of their different muscle characteristics, management practices, feeding rations, sex, age, as well as their feed conversion ratio (Mehmood and Zhang, 2020). Liu *et al*. (2023) also observed no difference between the muscle fibre characteristics of the breast muscle of indigenous broilers and commercial laying hens. The authors also observed a larger muscle fibre diameter and CSAF in the thigh muscles of commercial laying hens compared to the indigenous laying hens

CONCLUSION AND APPLICATION

It could be deduced from this study that spent layers possess enlarged fibre diameter which lead to increased muscle volume. Meat samples from ISA Brown spent layer and Indigenous chicken were observed to possess increased quality of meat which is suitable for further product development compared to other breeds while the commercial broiler, Ross 308 is preferred for better quantity as revealed by the total number of muscle fibre, fibre length, fibre diameter, muscle density and cross sectional area.

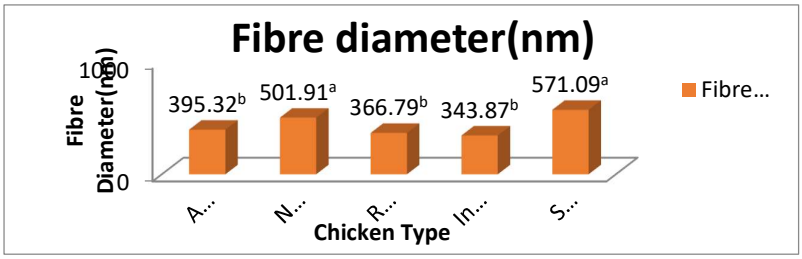

Figure 1: Fibre Diameter of Indigenous and Commercial Broiler Chicken

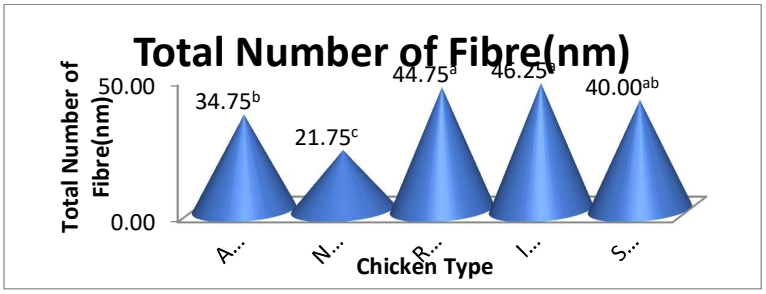

Figure 2: Total Number of Fibre of Indigenous and Commercial Broiler Chicken

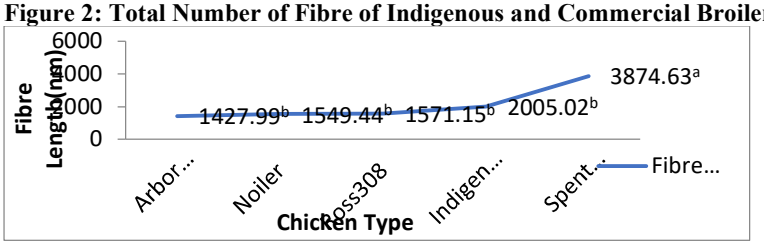

Figure 3: Fibre Length of Indigenous and Commercial Broiler Chicken

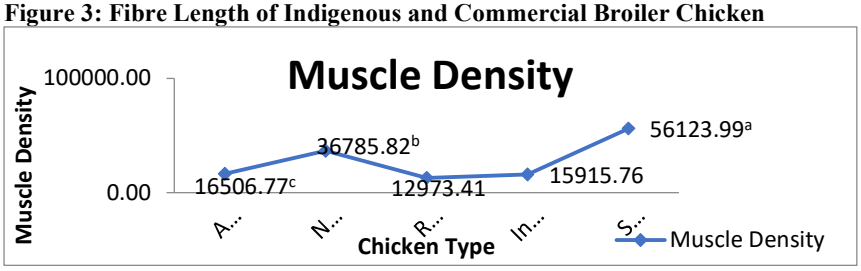

Figure 4: Muscle Density of Indigenous and Commercial Broiler Chicken

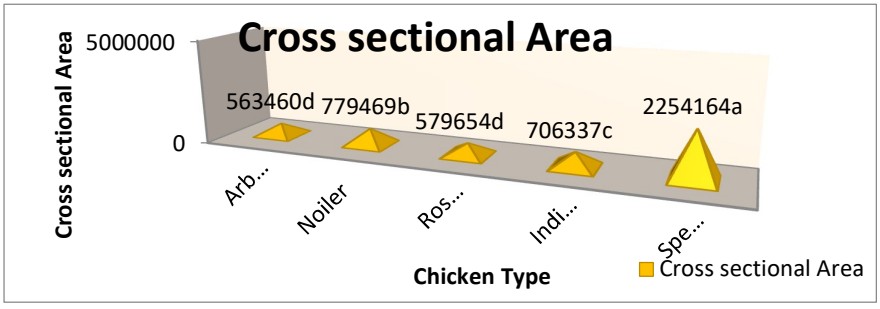

Figure 5: Muscle Cross sectional Area of Indigenous and Commercial Broiler Chicken

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