Global Veterinaria 11 (1): 55-58, 2013
ISSN 1992-6197

DOI: 10.5829/idosi.gv.2013.11.1.73205

Comparison of Chicken Strains: Muscle Fibre Diameter and Numbers in *Pectoralis superficialis* Muscle

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Abstract: This study was performed to evaluate muscle fibre diameter and numbers in *Pectoralis superficialis* muscle in two different chicken genotypes. A total of 40 adult clinically healthy native chicken and Ross commercial broilers (20 females and 20 males), aged 8-10 weeks, were used. Tissue samples were taken from the middle parts of left and right *Pectoralis superficialis* muscle. After fixation in 10% buffered formalin solution, sections were prepared, using routine histological techniques. Tissue samples were stained by Hematoxylin and eosin. By using the lattice line graticule (5*5), the total numbers of muscle fibres were determined. Also, the mean diameters of the muscle fibre were measured by using ocular micrometer. Results showed that the mean muscle fibre diameters in native chickens ranged from 29-52.5 µm, whereas in Ross commercial broilers ranged from 31-39 µm. No evident difference between the left and right sides of *Pectoralis superficialis* muscle was observed in the both diameter and numbers of muscle fibres in both chicken strains. Sex related difference was observed only in the mean muscle fibre diameters of the left sides of *Pectoralis superficialis* muscle of native chickens. The mean total fibre numbers in native chickens ranged from 74.67-89.33 µm, whereas in Ross commercial broilers ranged from 64-70.67 µm. There were no significant sex differences for the total number of muscle fibres of *Pectoralis superficialis* muscle of both chicken strains. It is concluded that the both diameter and total fibre number per mm^2 of *Pectoralis superficialis* muscle in native chickens were higher than those of the Ross commercial broilers, as well as, in females than males.

Key words: Commercial Broiler · Muscle Fibre · Native Chicken · *Pectoralis superficialis*

INTRODUCTION

The size and number of muscle fibre are factors that influence muscle mass and meat quality. The major components of muscles are muscle fibres. It is well known that biophysical, histological and biochemical characteristics of muscle fibres play a key role of meat quality [1]. So understanding and investigation this characteristic is one of the most practical importance to poultry and meat scientists [2-4].

Many studies have attempted to understand the muscle fibre characteristics. Dransfiel and Sosnicki reported that fast growing male chickens had *pectoralis* muscle fibres three to five times wider than slower growing chickens and an increase in the number of giant fibre [5]. Muscle fibres from fast growing lines of chickens have larger fibre diameters than slow growing lines and larger fibre diameters are often associated with an increased number of giant fibres [6]. Mobini and Asadi Khoshoii showed that the domestic fowls had more muscle fibre percentage in *Quadiceps femoris* muscle than the Ross broilersn[7]. Scheuermann *et al*. reported that male broiler chicken had higher muscle fibre density in *pectoralis* muscle than female broiler chicken [8]. Chiang *et al*. found that sex of chickens had no influence on either the proportion of muscle fibre types or areas [9].

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Mobini reported that the histomorphometrical features of intramuscular connective tissues were similar in the left and right sides of *Pectoralis profundus* and *Quadiceps femoris* muscles in both Ross broiler and native chickens [10, 11].

In Shahrekord, most of the farmers rear Ross commercial broiler and native chickens. These two chickens' strains reared in different conditions [7, 10, 11]. However, no comparative information has ever been gained on the numbers and diameters of the muscle fibres of *Pectoralis superficialis* in the native chicken and Ross commercial broilers. Therefore, the present study was aimed to evaluate muscle fibre diameter and numbers in *Pectoralis superficialis* muscle in two different chicken genotypes in both sexes.

MATERIALS AND METHODS

A total of 40 adult clinically healthy chickens (aged 8-10 weeks), 20 from native chickens and 20 from Ross commercial broilers of both sexes (20 each sex) were obtained from the Research farm of household bird's maintenance of College of Veterinary Medicine, Islamic Azad University of Shahrekord. The native chickens were fed by grains, seeds, green grasses and garden leftover; in contrast, the commercial Ross broilers were reared in well hygienic condition and received feed and water ad libitum. The birds were deeply anesthetized by excess ether inhalation. The samples were taken from the middle parts of left and right *Pectoralis superficialis* muscle. Tissue samples were immediately fixed in 10% buffered neutral formalin solution for 24-48 hours, dehydrated and embedded in paraffin wax. Tissue sections (5 µm) were stained by Hematoxylin and eosin [12]. The total numbers of muscle fibres per mm^2 were determined by using the lattice line graticule (5*5) and the mean diameters of the muscle fibre were measured by using ocular micrometer. Data were analysed by one-way ANOVA and Duncan's multiple range test to detect significant differences ($P<0.05$), using the SPSS v. 18 statistic software.

RESULTS AND DISCUSSION

No evident difference between the left and right sides of *Pectoralis superficialis* muscle was observed in the both diameter and numbers of muscle fibres in both chicken strains (Tables 1, 2). This finding is in agreement with the previous findings [7, 10, 11, 13].

Table 1: Average diameters (µm) of muscle fibres in different regions of *Pectoralis superficialis* muscle in adult Ross commercial broiler and native chickens (Mean ± SE)

Strains	Gender	Right	Left
Native chickens	Male	34.50±6.47^{ab}	30.00±5.00^{a}
	Female	29.00±3.35^{a}	52.50±14.79^{b}
Ross broiler	Male	39.00±9.94^{b}	31.00±10.84^{a}
	Female	35.00±3.53^{ab}	32.00±11.51^{a}

Non-similar small letters within a column differ significantly ($P<0.05$).

Table 2: Average numbers of muscle fibres per mm^2 (%) in different regions of *Pectoralis superficialis* muscle in Ross commercial broiler and native chickens (Mean ± SE)

Strains	Gender	Right	Left
Native chickens	Male	74.67±12.86	89.33±8.33^{b}
	Female	85.33±11.55	88.00±4.00^{b}
Ross broiler	Male	65.33±8.33	70.67±6.11^{a}
	Female	64.00±26.23	70.67±12.22^{a}

Non-similar small letters within a column differ significantly ($P<0.05$).

Sex related difference was observed only in the mean muscle fibre diameters of the left sides of *Pectoralis superficialis* muscle of native chickens (Table 1). Mobini and Asadi Khoshoii and Mobini reported no significant differences between male and females [7 and 10].

Although, Essen-Gustavasson reported that the muscle fibres from fast growing lines of chickens had larger fibre diameters than slow growing lines [6], but in this study, the mean muscle fibre diameters in native chickens ranged from 29-52.5 µm, whereas in Ross commercial broilers ranged from 31-39 µm (Table 1). These values in Beijing-You chickens [14] and in Jata-line chickens were 31.42 and 38.95 µm respectively [15].

Female native chickens had an average diameter of 29-52.5 µm, whereas Ross commercial broilers had an average diameter of 32-35 µm. This value in COBB-500 commercial hybrid chickens was 31.6 µm [16].

The mean muscle fibre diameters in male Ross commercial broilers (31-39 µm) were higher than those of native chickens (30-34.5 µm). This value in COBB-500 commercial hybrid chickens was 34.08 µm [16].

There were no significant sex differences for the total number of muscle fibres of *Pectoralis superficialis* muscle of both chicken strains (Table 2). This finding is in agreement with the previous findings [17-19]. Sex-related differences in the number of muscle fibres have been reported for cattle [20], chickens [8, 21], rats [22, 23] and humans [24, 25]. In these cases males exhibited higher muscle fibre numbers compared to females.

In this study, the total fibre number per mm^2 of *Pectoralis superficialis* muscle were more in the both sexes of the native chickens than those of the Ross commercial broilers. The mean total fibre numbers in native chickens ranged from 74.67-89.33 µm (Table2), whereas in Ross commercial broilers ranged from 64-70.67 µm. An *et al*. reported that the total fibre number of Beijing-You chicken was 7.00×10^5 [14].

The mean total fibre numbers in male native chickens (74.67-89.33 µm) were higher than those of Ross commercial broilers (65.33-70.67 µm). These differences might be due to the differences between the breeds [26]. This value in COBB-500 commercial hybrid chickens was 904.02 [16].

Teuşan *et al*. reported the mean total fibre numbers of 786.54 in female COBB-500 commercial hybrid chickens [16], but in the present study, these values in native chickens ranged from 85.33-88 µm and in Ross commercial broilers ranged from 64-70.67 µm.

CONCLUSION

In conclusion, the both diameter and total fibre number per mm^2 of *Pectoralis superficialis* muscle in native chickens were higher than those of the Ross commercial broilers, as well as, in females than males. These differences might be due to the genetic factors, method of breeding and feeding of animals [15]

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