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Growth and carcass characteristics of lambs in relation to plasma IGF-I and some histological traits of *Longissimus lumbarum* and *Biceps femoris* as affected by breed and age at slaughter

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ABSTRACT

Ten male lambs of each of Rahmani (R) and Ossimi (O) were used to study the growth and carcass characteristics within their first year of age (360 days). After suckling period (4 months), lambs were fed on the regular ration. During the course of the experiment, body weight (BW) was recorded monthly accompanied by blood sampling to determine IGF-I. Four lambs from each breed were slaughtered at 270 and 360 days of age, and *Longissimus lumbarum* (*L. lumbarum*) at the 9th, 10th and 11th ribs and *Biceps femoris* (*B. femoris*) muscles were separated to be used for chemical analysis and histological study.

Breed had no effect on the growth curve of the two studied breeds. Chemical analysis indicated that (O) had higher fat (0.9%, $P<0.0001$) and lower (0.3%, $P<0.01$) moisture compared to (R), with no difference in protein and ash contents. The concentration of IGF-I was almost similar in both breeds up to day 270 of age, and then it was higher in (R). Number of fibers per bundle was higher ($P<0.05$) in (O) than in (R) by 6.1%, while, the other histological traits were similar in the two studied breeds.

Chemical analysis indicated that lambs slaughtered at 360 days of age had lower (0.7%, $P<0.0006$) moisture and higher fat (17.3%, $P<0.0001$) compared to day 270. Up to day 270 of age, IGF-I concentration was <500 ng/ml before increasing to >500 ng/ml up to the end of the experiment. No effect of age was observed on the studied histological traits.

L. lumbarum muscle contained higher protein (4.2%, $P<0.0001$), fat (104%, $P<0.0001$) and ash (10%, $P<0.001$), while moisture was less (5.6%, $P<0.0001$) compared to *B. femoris* muscle. *B. femoris* muscle was higher ($P<0.0001$) in number and diameter of fibers, bundle and stroma sectional areas relative to *L. lumbarum* by 38.2, 78.8, 53.2 and 23.8%, respectively.

1. Introduction

Growth is a complicated process influenced mainly by age (Hassan and El-Feel, 1991), sex (Aboul-Naga et al., 1980), genotype (Aboul-Naga et al., 1980; Hassan, 1993), level of feeding (Awadalla et al., 1997), and castration process of males (Darwish et al., 1973), these are in addition to the levels of metabolic hormones.

Muscle development is an output of the rate of protein synthesis and degradation as controlled by IGF-I action (Gatford et al., 1996; Oksbjerg et al., 2004). IGF-I is involved in postnatal growth (McGuire et al., 1992), through mediating the anabolic actions of growth hormone (Jones and Clemmons, 1995; Liu and LeRoith, 1999). Also, it increases muscle mass via its action on muscle hypertrophy (Beermann et al., 1987; Mathison et al., 1998) and stimulating muscle cells uptake of amino acids, and protein synthesis (Shimizu et al., 1986). Hence, determination of plasma IGF-I concentration in growing lambs may provide a physiological interpretation of growth feature (Medrano and Bradford, 1991; Gatford et al., 1996, 1997; Whisnant et al., 1997). Studying growth feature in relation to some physiological measures may have a particular importance for understanding factors controlling muscle growth,

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thus modifying carcass composition through increasing the rate of lean tissue deposition (Wolf et al., 2001).

Egyptian sheep were slaughtered usually around 12 months of age (pubertal age, Karam, 1957; Hamdon et al., 2006) when a considerable change in carcass (Lawrence and Fowler, 1998) and chemical composition of meat (Hassan and El-Feel, 1991; Hassan, 1993; Awadalla et al., 1997) occurs.

Rahmani and Ossimi are native fat tailed breeds reared mainly in the north of Egypt. These breeds represent the majority of sheep population and consequently the main source of mutton. Many trials were conducted to describe growth performance and chemical composition of meat of these two breeds either from birth to weaning (Swidan et al., 1979; Aboul-Naga et al., 1980) or from 6 to 12 months of age (Hassan and El-Feel, 1991; Awadalla et al., 1997). However, no data are available describing their growth curve over their first year of age.

In the light of the previous facts, the objectives of the present study were to; a) describe the growth features of Rahmani and Ossimi lambs in relation to plasma IGF-I concentration and the histological characteristics some skeletal muscles, and b) determine the effect of age at slaughter on the physical and chemical characteristics of the meat.

2. Materials and methods

This study was carried out on two equal groups of Rahmani and Ossimi male lambs ($n=10$ each), which were born between October and November 2004. Lambs were kept with their dams for four months post-lambing (suckling period) and afterward they were kept free in semi-shaded open yards. Lambs were fed according to their live body weight (NRC, 1985) on concentrate feed mixture in addition to the Egyptian clover (*Trifolium alexandrinum*) from October to April or its hay from May to September. Drinking water and mineral blocks were made available all the daytime.

Body weight (BW) was recorded every 30 days (± 3 d) starting from birth. Lambs were prevented to suckle their dams or prevented from feeding 12 h before weighing. After weighing 5 ml blood samples were collected in heparinized tubes from the jugular vein to determine IGF-I. Blood samples were centrifuged at 3000 rpm for 20 min and the harvested plasma was kept at -20 °C till the time of hormonal assay.

The concentration of IGF-I was assessed by RIA technique using ready-coated tube kit (Bio-Source Europe, Nivelles, Belgium), with intra- and inter-assay coefficients were 9.2 and 5.6%, respectively. The standard curve ranged from 0.0 to 5000 ng IGF-1/ml. Cross-reaction of the IGF-I antibody was reported by the manufacturer to be 100% for IGF-I, 0.7% for IGF-II, and <0.1% for insulin and growth hormones.

At 270 and 360 days of age, four lambs per age per breed were chosen randomly to be slaughtered at the experimental abattoir of Faculty of Agriculture, Cairo University, Giza, Egypt, after 18 h of fasting. Lambs were weighed (kg) then slaughtered using a sharp knife by cutting the jugular veins with no stunning. After complete bleeding, carcass was skinned and eviscerated before weighing and afterward it was sectioned down through the vertebral column to right and left sides. The *Longissimus lumbarum* (*L. lumbarum*) at the 9th, 10th and 11th ribs (rib cut) as representing carcass composition and *Biceps femoris* (*B. femoris*) as representing high price cut in sheep (Wolf et al., 2001) muscles were separated from the right side of the carcass to be used for chemical analysis (AOAC, 2000) and histological study.

Area (cm^2) of the fresh sections of *L. lumbarum* muscle (between the 8th and 9th ribs) was recorded by a planimeter before separating rib cut into lean, fat and bone. The monthly BW was used to draw the growth curve from birth to 360 days old. The growth curve was divided into three phases: P I, from birth to weaning (120 days), P II, from weaning to the expected age of puberty (240 days, Karam, 1957) and P III, from expected age at puberty to 360 days. Dressing percentage was calculated as the hot carcass weight divided by the BW at slaughter multiplied by 100.

The histological sections were prepared according to Bancroft et al. (1996) and stained by Haematoxylin and Eosin solutions (5%). Slides were examined microscopically (×100) and digitally photographed. Two digital photocopies were taken, the first of the tissue section in three replicates, and the second of the Haemocytometer. By Auto Cad® (2004) software all histological measures ($n=470\pm20$) were calculated using two layers of digital photos; the digital image of the

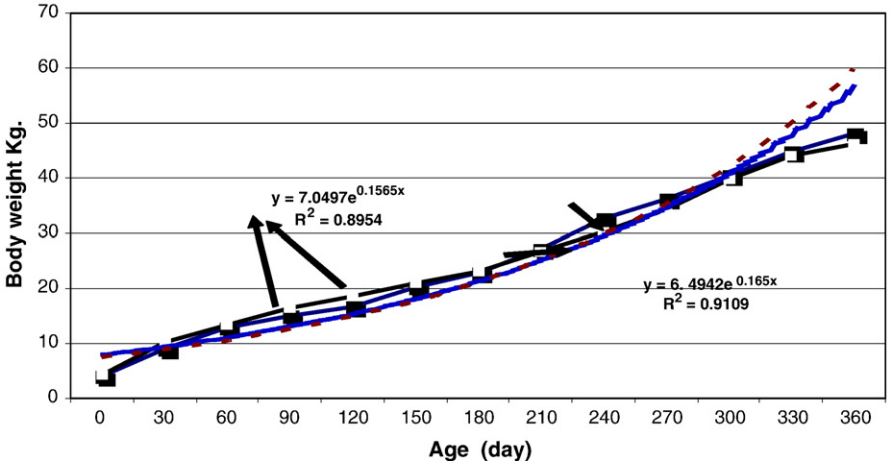

Fig. 1. The growth curve of Rahmani and Ossimi lambs during the first year of age.