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Gross and Morphometric Evaluation of Deltoideus Muscle of Cattle and One-Humped Camel

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Abstract:

The study was conducted using 25 forelimbs each obtained from male camels (Camelus dromedarius) and cattle (Zebu type) purchased from Sokoto Municipal Modern abattoir. The animals were within the ages of 6 months, 1year, 3years, 5 years and 7 years. The forelimbs were dissected and deltoideus identified and measured. Morphologically, the scapular part of the deltoideus in cattle appeared paler in contrast to it acromial counterpart, as well as when compared to the camel's deltoideus. The morphometric parameters showed increased values along age especially in camels. Considering the variables obtained in deltoideus architecture, it therefore concluded that the deltoideus of cattle seems to have greater potential production force than the camel.

Keywords: ***Gross, morphometric, deltoideus, cattle; one-humped camel.***

Introduction

The deltoideus muscle lies partly on the triceps brachii in the angle between the scapula and the humerus, partly on the infraspinatus and teres minor. It is named after the Greek letter *delta*, which is shaped like an equilateral triangle, and it is divided into a scapular part and an acromial part (Smuts and Bezuidenhout, 1987). The *Pars scapularis* (scapular part) arises aponeurotically from the scapular spine, the vertebral border of the infraspinous fossa and the surface of the infraspinatus muscle, becoming fleshy over the caudal border of the infraspinatus. It partly covers the origin of the long and lateral heads of the triceps brachii. Some of its fibres attach to the fascia covering the lateral head, while a strong fascial band on its deep face inserts on the deltoid tuberosity and on an area proximal to it (Pasquini *et al.*, 1985; Smuts and Bezuidenhout, 1987). The *Pars acromialis* (acromial part) arises from the acromion and inserts in common with the scapular part of the deltoideus (Smuts and Bezuidenhout, 1987; Dyce *et al.*, 2010). The main action of the muscle is to flex the shoulder joint and abduct the arm (Sisson and Grossman, 1975).

The origin of deltoideus muscle is partly aponeurotic and partly fleshy; the aponeurosis fuses with that which covers the infraspinatus; and the caudal part is attached to the scapula immediately cranial to the origin of the long head of triceps brachii. The belly of the muscle lies for the most part in a groove formed in the triceps brachii, and it is widest about its middle (Sisson and Grossman, 1975). Superficially, it is related to the skin, fascia and cutaneus omobrachialicus, while deeply, it is related to the infraspinatus, teres minor, triceps brachii and brachialis muscles, and branches of the caudal circumflex humeral artery and axillary nerve. It received blood supply chiefly through the caudal circumflex humeral artery and the subscapular artery and it is innervated by axillary nerve (Sisson and Grossman, 1975; Ashdown and Done, 2011).

Literature search revealed works done on different aspects related to the deltoideus muscles in different animal models and humans but none showed the comparative nature of the muscle in the cattle and one-humped camel. Although little is understood about the relationship between the gross appearance of the muscular features and the structure and function of the associated parts of the deltoideus muscle; this research attempts to incorporate aspects of both gross and morphometric structural features of the muscle in relation to anatomical region of the muscle and species of the animal studied.

Materials and Method

An ante mortem examination was carried out on male cattle (Zebu type) and camels (*Camelus dromedarius*, the one-humped camel) brought to Sokoto Municipal Modern abattoir. Their ages were determined prior to slaughter using the methods of Wilson (1984) and Dyce *et al.* (2010) and aged 6 months, 1 year, 3 years, 5 years and 7 years, while

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their live body weights were estimated using linear body measurement based on the formula of Yagil, (1994).

Twenty five (25) forelimbs from both male and cattle and camel devoid of any musculoskeletal deformity or diseases were purchased for this study. The purchased forelimbs were wrapped in clean polythene bags and then transported in a clean cool box containing ice cubes to the Laboratory of the Department of Veterinary Anatomy, Usmanu Danfodiyo University, Sokoto, Nigeria. The forelimbs were carefully dissected and the muscles of interest identified using the methods described by Chibuzo (2006) and Sonfada (2008). The identified muscles were studied and photographed using a digital camera (Samsung, MegaPixel 8.0, Made in China).

Morphometric parameters such as length, diameter and weight were determined using measuring tape (Butterfly type®) and weighing balances (P1210, Metler Instruments, AG Switzerland, with a sensitivity of 0.1kg and citizen scales 1 pvt. Ltd, Model MP-600, with a sensitivity of 0.1g) respectively. Numerical data obtained were reported as mean±SD (Standard deviation) and presented in form of tables. Data generated from the study were analysed using a two way ANOVA. Statistical significance of experimental observations were set at $P<0.05$ where appropriate. All statistical analyses were done using SPSS (Version 16.0, 2007).

Results

The deltoideus muscle was observed to be a round, triangular muscle (Plate 3) located on the scapulohumeral angle, partly lying on the infraspinatus and teres minor muscle proximally; and triceps brachii muscle distally (Plates 1 and 2). The deltoideus was attached by tendons to the scapula, and humerus. The deltoideus was observed to be widest at the top of the shoulder and narrowed to its apex as it insert on the deltoid tuberosity of the humerus. It was discovered that in the cattle the scapular part of the deltoideus appeared lighter in colour than the acromial part (Plates 2), while in the camel there was no such difference in the colour pattern of this muscle (Plate 1).

The morphometric parameters in the camel showed increased values along chronological age advancement of the animal. Similar observation was also made from the cattle, but with some fluctuating values across some certain age groups (Table 1). Highest morphometric values were obtained from the deltoideus muscle of camel aged 7 years (Table 1).

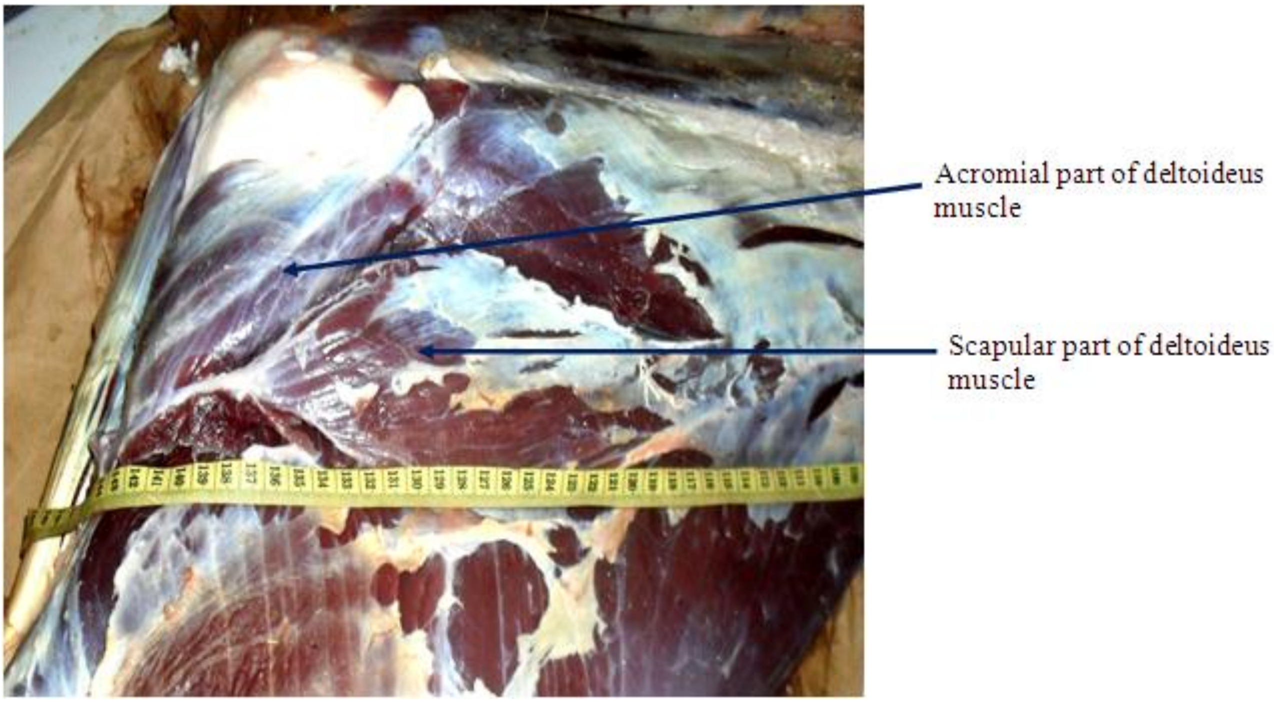

Plate 1: Gross appearance of the *Deltoideus* muscle showing: the acromial part and the Scapular part, in the one-humped camel (Magnification x125)

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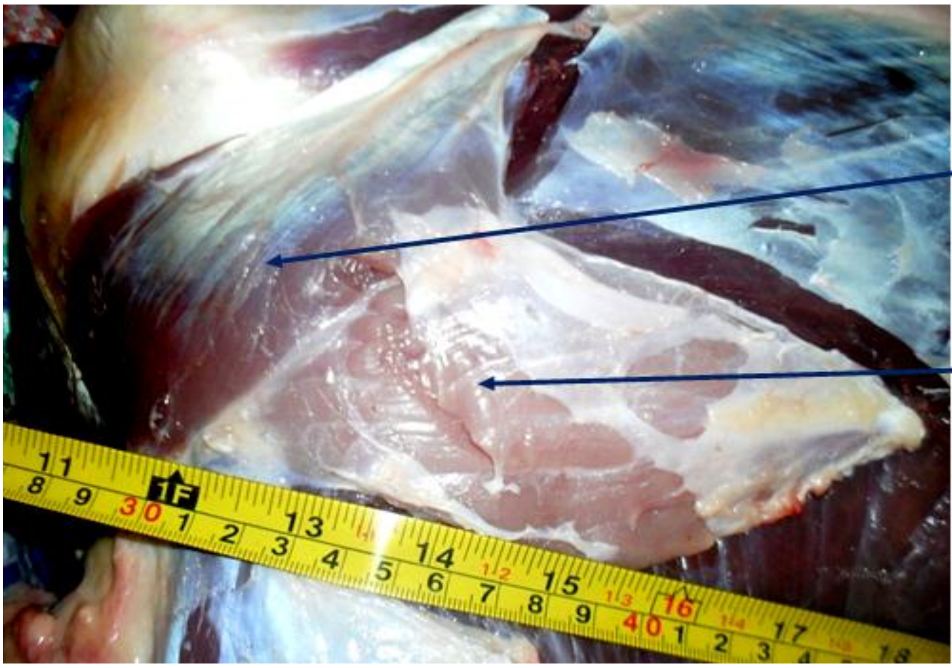

Plate 2: The Deltoideus muscle (*In situ*) in cattle, showing the Acromial part, and the Scapular part (Magnification x125).

Plate 3: Scapular and Acromial parts of Deltoideus muscle in cattle, separated (Magnification x125).

Table 1: Morphometric parameters of deltoideus muscle in camel and cattle (Mean±SD)

Muscle/Parameter	Camel	Cattle
6 Months Old		
Deltoideus		
L (cm)	14.88±0.51^{b}	18.94±1.33^{a}
C (cm)	13.16±0.37^{a}	11.90±0.43^{b}
W (g)	451.60±23.34^{a}	238.00±8.38^{b}
1 Year Old		
Deltoideus		
L (cm)	21.36±0.40^{a}	20.08±0.49^{a}
C (cm)	13.62±0.23^{b}	16.40±0.19^{a}
W (g)	589.20±29.05^{a}	242.78±8.74^{b}

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3 Years Old			
Deltoideus			
	L (cm)	26.26±0.25 [a]	19.28±0.67 [b]
	C (cm)	19.56±0.43 [a]	16.80±0.62 [b]
	W (g)	591.80±65.15 [a]	484.20±13.88 [b]
5 Years Old			
Deltoideus			
	L (cm)	31.52±0.79 [a]	21.40±0.29 [b]
	C (cm)	24.72±1.53 [a]	22.12±0.68 [a]
	W (g)	760.00±49.09 [a]	216.00±4.20 [b]
7 Years Old			
Deltoideus			
	L (cm)	32.36±1.32 [a]	23.28±0.70 [b]
	C (cm)	30.50±0.97 [a]	19.52±0.50 [b]
	W (g)	838.00±17.72 [a]	222.00±5.34 [b]

[ab] Means bearing different superscript in the same row within a subclass differ significantly ($p<0.05$)

Key: *L = Length; C = circumference; W = weight*

Discussion

Skeletal muscle is a highly organized, complex, and dynamic tissue that responds to mechanical forces placed upon it (Caiozzo, 2002; Lieber, 2002; Botticelli and Reggiani, 2006). It aids in maintenance of body posture against mechanical force by distributing loads and absorbing shocks (Lorenz and Campello, 2001). Skeletal muscles are composed mainly of contractile materials which enable the bones to move at the joints. These contractile properties can strongly influence normal muscle function, and therefore muscle force transmission, maintenance, and repair (Gillies and Lieber, 2011).

The observed morphology of deltoideus muscle was consistent with the findings of Watson and Wilson, (2007) and Williams *et al*. (1995) while it's isometric growth along chronological age agreed with what was reported by Sonfada (2008) and Sonfada *et al.* (2011) in camel. Morphometric values in camels increased with advanced age than in cattle; meaning greater potentials of higher meat yield in the camel than the cattle. Equally, increased development of the deltoideus could possibly be due to it structural and locomotive demands on the forelimb.

For these animals to be properly utilized for traction and draught, it is important for the deltoideus to develop along age advancement so as to compensate the demand placed on them. This observation was also further supported by the assertion by Sonfada (2008) and that of Moore and Persaud (1998), that muscles have to increase in length and width in order to keep pace with the growth of the skeleton during the postnatal period and that the ultimate size depends on the amount of exercise.

One of the most fundamental properties of skeletal muscle is that the amount of force it generates depended on its length and functional length of a muscle, as defined by Swatland, (1984). This observation may be responsible for the differences seen in this presentstudy between the two species (cattle and camel), since the camel possesses longer bones, there was corresponding muscular growth than the cattle.

The observed difference in the colour pattern of the scapular part of the deltoideus muscle in the cattle could probably be due to the differences in their myoglobin content. This could also be related to the role of the deltoideus muscle in abduction of the shoulder, with much of the work probably being performed by the scapular part of this muscle thereby leading to continued depletion of their myoglobin content, this finding is in agreement with Williams *et al.* (1997) that myoglobin are depleted with increased muscular activities.

Considering all of the muscle fibre architectural variables of the deltoid, the scapular part is predicted to probably have a slightly greater potential production force than the acromial part in the cattle. The researchers in the present study may therefore wish to recommend further work on quantification of the myoglobin content of the two different parts of deltoideus muscle in the cattle species, and probably relate them to their muscle biomechanics.

Conclusion

The deltoideus muscle of cattle seems to have greater potential production force than the camel.

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