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ARTICLE

Growth Changes in Selected Muscles of One-Humped Camel *(camelus Dromedarius*

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SUMMARY

Sixty seven camel fetuses, eight live camels, age range of 3 months to 2 years were used to study the muscle growth changes. The supraspinatus, biceps brachii and triceps brachii were studied in the forelimb while the Gluteobiceps, Semitendinosus and Semimembranosus were examined in the hind limb. At the prenatal level, the growth rate was significantly increased ($P<0.05$) between the trimesters and triceps brachii was observed with greater dimensions (length, weight and belly circumference). Similar observation was noticed at the postnatal level with isometric growth ($P<0.05$). Gluteobiceps was found to be the longest and semitendinosus was the shortest. Triceps brachii had greater weight and belly circumference. Growth of muscles was attributed to the growth in bone length. In addition effect of the supportive role and exercise were said to be contributory factors.

KEYWORDS: Growth, Changes, Selected, Muscles, One-humped camel

INTRODUCTION

The growth of carcass and its components is appropriately studied by a comparison of multiplicative growth, or by the use of allometry (Sivachelvan and Davies, 1986a). Allometry is a method of comparing measurements of two components when another component is fixed. Birth and maturity are critical stages in musculoskeletal development for the determination of proportionate growth. Growth studies on skeletal muscles have been carried out in different animals by several workers like Hanrahan *et al.* (1973) in mice; Wiskus *et al.* (1979) as in turkeys; Fowler *et al.* (1980) as in quail and Sivachelvan and Davies,(1986a) as in sheep. There is however a dearth of information on the camelids. In the camel much work appears to have been done on the physiology and agricultural values of camels, with very little work done on the morphology. Ghaji *et al.* (1982) have worked on the brain; Adogwa *et al.* (1987), on the brain; Ghaji *et al.* (1989), on the heart; Arnautovic,(1997), on the head; Duhan *et al.*(1996), on salivery glands; Marzook, (1996); on female reproductive organ Chollet *et al* (1997), on the parasites; Murray, (1997), on evolution; Gopal and Gahlot,(1997) on foot disorder; Endo *et al.* (2000), on hump attachment; Skidmore (2000a & b) on embryo transfer and anatomy of reproductive tract. However, the time related isometric proportionate changes of muscle of the camel are yet to be explored fully given its utility in traction in Northern Nigeria. Such study will further help in the understanding of growth dynamics, carcass improvement and breeding of camel in the sahelian pastoral setting. The recognition of the growing utility of the camel in traction and meat production particularly in the sahelian region of Nigeria forms the basis for a scientific assessment of the muscular growth changes in the carcass of dromedary. This will add to the available literature on the anatomical and specifically embryologic development in camel.

MATERIALS AND METHODS

The study involved an evaluation of the dromedary, using 67 fetuses collected from slaughtered camels from Sokoto metropolitan abattoir and 8 live camels with age range of 3months to 2 years to study the proportionate allometry. The collected fetuses were taken to Vet Anatomy Laboratory of Usmanu Danfodiyo University, Sokoto (UDUS). The fetal age was determined using a method adopted by Laing (1979) and Sivachelvan (1981). This was done by taking the weight of each of the fetuses using a beam balance. With the aid of tape rule (butterfly^{R}), the crown-rump length (CRL) was measured from the caudal fontanel to the base of the tail.

The modified method of Chibuzo (2006) was used for the dissection of the fetuses. Individual or group of muscles of the limbs (fore and hind) was dissected out, and the morphometric determined. Age of each live camel was determined according to the description of Wilson (1984) and Mallie and Bezuidenhout (1987). The camels were humanely slaughtered according to muslim (halal) method (Gracey 1986). However the point of severing the vessels in camel is at the thoracic inlet, not the throat as described by Gracey(1986). The slaughtered camels were flayed, eviscerated and carcass splited into four quarters. From each animal, a fore and hind quarter was taken to Veterinary Anatomy Laboratory of Usmanu Danfodiyo University, Sokoto (UDUS) for dissection. Supraspinatus, biceps brachii and triceps brachii muscles were dissected out from the fore quarter (Plate 1) while semimembranosus, semitendinosus and gluteobiceps muscles were similarly dissected from the hind quarter (Plate 2). The dissected muscles were thereafter weighed using a beam balance. With the aid of tape rule the length and belly circumference were taken. The data generated was subjected to ANOVA using Graphpad Instat Statistical Computer Package (Graphpad Software 2000).

RESULTS

Sixty seven (67) fetuses were used for this study. Out of this number, forty six (46) were females while the males were twenty one (21). More than half (38) constituting 56.7% were within the second trimester. First trimester had 29.9% (20) and the third trimester had 13.4% (9) respectively.

Table I: Shows the mean muscle length of camel at various stages of development ± SEM.

Muscle	Muscle development (months)					
	1 TM	2TM	3TM	3months	1year	2years
SM	2.73±0.09	8.86±0.51	16.35±0.56	28.84±0.94	34.18±0.47	72.48±1.19
ST	2.43±0.07	8.10±0.41	15.13±1.11	22.73±0.42	23.48±0.73	49.01±0.95
GL	3.10±0.33	9.51±0.61	18.98±3.81	30.35±1.21	42.68±0.78	88.28±1.05
BB	2.06±0.07	7.68±0.17	13.2±0.5	21.12±0.52	24.44±0.78	50.72±0.29
SSP	2.25±0.13	8.60±1.00	14.08±0.95	21.34±0.71	25.80±0.88	53.74±0.85
TR	3.73±0.13	10.54±0.56	20.48±2.02	30.55±0.81	35.03±0.80	75.76±1.16

Table II. Shows the mean weight of muscle in grams (g) of camel at various stages of development ± SEM.

Muscle	Muscle development					
	1 TM	2TM	3TM	3months	1year	2years
SM	0.61±0.06	10.78±1.44	51.64±8.08	486.0±4.72	80.4±2.67	1319.4±21.99
ST	0.43±0.07	8.38±1.09	43.68±2.08	240.0±2.10	259.5±1.49	549.9±6.65
GL	0.86±0.09	12.80±4.67	87.98±9.56	640.89±1.85	921.67±3.17	1927.0±21.84
SSP	0.43±0.07	10.81±1.44	39.14±7.70	298.97±2.61	329.59±1.43	691.48±3.66
BB	0.49±0.06	7.35± 0.82	37.96±9.69	208.28±2.52	265.84±4.16	553.83±4.74
TR	1.63±0.15	34.46±12.67	193.00±20.83	938.43±3.94	1279.4±26.77	2649.8±50.96

Table III. Shows the mean B/Circumference of camel muscles at various stages of development ± SEM.

Muscle	Muscle development (months)					
	1 TM	2TM	3TM	3months	1year	2years
SM	1.19±0.10	4.63±0.42	8.25±1.21	18.43±0.75	21.45±0.75	43.06±0.84
ST	0.71±0.08	4.33±0.53	7.35±1.33	15.26±0.48	15.70±0.55	34.01±0.67
GL	1.63±0.10	5.55±1.05	11.51±1.59	26.33±0.71	25.54±0.72	52.65±1.14
BS	1.39±0.08	6.66±0.36	8.09±0.49	15.99±0.68	16.79±0.43	34.08±1.57
BB	1.06±0.11	4.79±0.61	7.23±0.92	11.50±0.44	16.11±0.60	32.39±1.03
TR	2.26±0.44	9.61±0.68	15.11±1.08	26.25±1.05	35.09±0.79	72.46±0.89

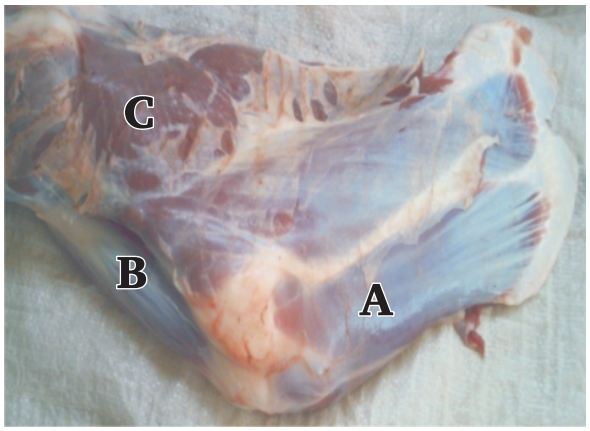


Plate 1

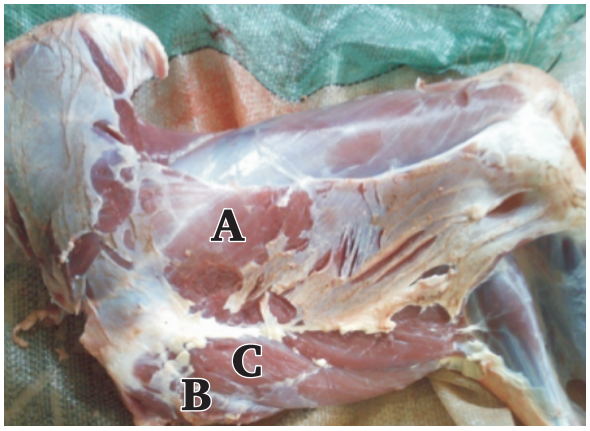
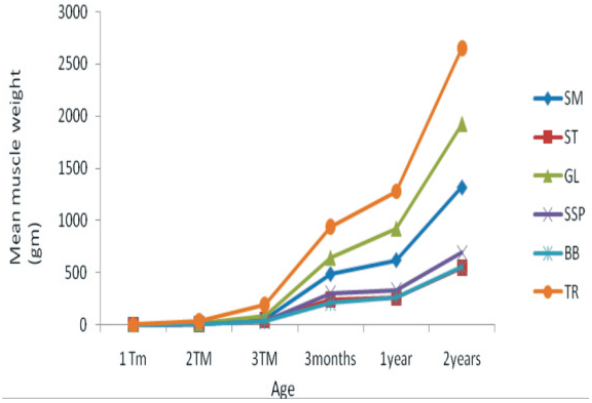
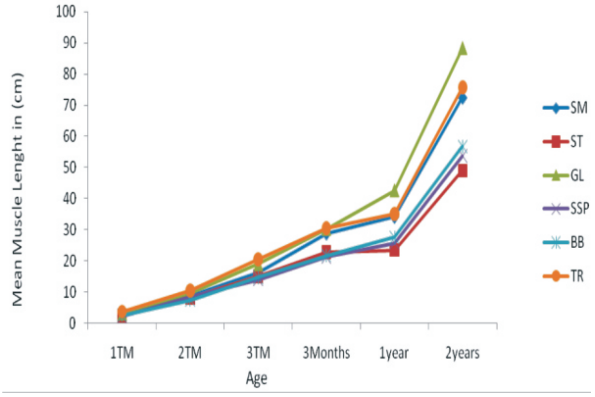


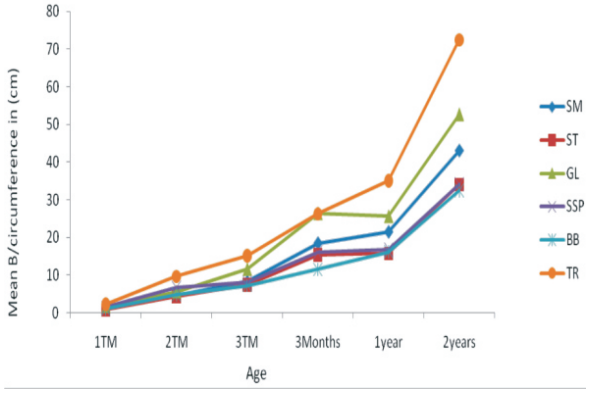
Plate 2



Fig, 1



Fig, 2



Fig, 3

Plate. 1: Lateral view of fore limb showing supraspinatus (A), biceps brachii (B) and triceps brachii ©. X 125

Plate 2: Lateral view of hind limb of camel showing gluteobiceps (A) semitendinosus (B)semimembranosus (C) muscles. X 125

Fig. 1: Mean muscle weights(g) of different muscle types at various stages of growth.

Fig. 2: Mean muscle lengths (cm) of different muscle types at various stages of development

Fig. 3: Mean belly circumferences (cm) of different muscle types at various stages of development.

Keys to Fig 1 -3:

SM- semimembranosus; SSP – supraspinatus; ST – semitendinosus; BB - biceps brachii; GL - gluteobiceps ; TR - triceps brachii

The studied muscles were in general observed to increase in weight, length and circumference from the stages of gestation to postnatal periods. Table I shows the initial mean weight of semimembranosus, semitendinosus and gluteobiceps to be 0.61±0.06g, 0.43±0.07g and 0.86±0.09 respectively at first trimester to a peak of 1319.4±21.99g, 549±6.65g and 1927 ± 21.84g respectively at 2 years of age. Similarly the supraspinatus, biceps brachii and triceps brachii muscles of the fetus had a mean weight of 0.43±0.07g, 0.49±0.06g and 1.63±0.15g respectively at first trimester to attain a mean weight of 691.48±3.66g for supraspinatus, 553.83±4.74g–biceps brachii and 2649.8±50.96g in the case of triceps brachii. The steady increase in weight is illustrated in Fig 1.

DISCUSSIONS

The muscle sizes as seen in this study showed isometric growth. At the prenatal stage, the growth rate was least observed at first trimester and thereafter increased significantly ($P<0.05$) to third trimester with almost all the muscle growth being doubled between second and third trimesters. Similar increase in growth was observed in the post natal animals from 3 months to 2 years of age; the dimensions (length, weight and belly circumference) of all the muscles under study were greater at 2 years($P<0.05$). This may likely agree with Moore and Persaud (1998) who observed that muscles have to increase in length and width in order to grow with the skeleton and, that ultimate size depends on the amount of exercise performed. Triceps brachii was observed with greater length, weight and belly circumference prenatally ($P<0.05$). Except at 2 years of age, where gluteobiceps was found to be longer ($P>0.05$), triceps muscle growth in the postnatal animals was similar to those of the prenatal animals. This possibly may be because triceps muscle has 3 heads (long, lateral and medial heads) and appeared more bulky (Dyce *et al*., 2010). Additionally, in complex muscle, it is possible that tendinously inserted myofibres can continue to grow in length after cessation of skeletal growth (Hammud *et al.,* 1971).

Muscle enlargement during the post natal growth period is caused by hypertrophy and elongation of existing fibres (Iwamato *et al.*, 1984; Timson and Dudenhoeffer 1985; Hebert *et al*., 1988; Kandarian and White, 1989; Roy *et al.,* 1991). This may likely be responsible for the growth observed in the individual muscle, especially the gluteobiceps in the hind limb and triceps in the fore limb. The weights of these two muscles (triceps and gluteobiceps) as observed in this study showed higher growth response with age, possibly due to their supportive and propulsive role in both limbs, because of their subjection to constant exercise; more so the forelimb is said to carry 60% of the trunk weight (Bezuidenhout and Hornsveld, 2000) and may also be additional reason for the tremendous changes seen in the growth of triceps brachi in this study. It is therefore recommended that further work in the areas of muscle fiber size and types be carried out in this species.

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