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Morphometric comparative study of the hind limb muscles in wild rabbit (*Oryctolagus cuniculus*) and domesticated rabbit (*Oryctolagus cuniculus domesticus*).

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Abstract

Aims: The functional morphology of the hind limb muscles has received less study than the functional morphology of their appendicular skeletons. This study explores the differences identified in these two groups accurately and simply by providing a complete description and comparative morphometric analysis of the hind leg muscles in wild and domesticated rabbits.

Methods: In this investigation, five adult male wild rabbits and five adult male domesticated rabbits, were employed.

Results: The study finds significant morphometric diversity among these rabbits other than size, although the sample size is too small and inadequate to determine if this reflects significant interspecific changes in hind leg muscles. Most conspicuously, anatomical and metric data show that the overall weight, length, and width of gluteal muscles in wild rabbits were larger than those in domesticated rabbits. The study also showed that the weight, length, and width of wild rabbits' biceps femoris and semitendinosus muscles were bigger than those of domesticated rabbits. Furthermore, the length and width of semimembranous muscle in domesticated rabbits were shown to be greater than in wild rabbits. The length of the quadratus femoris in wild rabbits, however, was less than in domesticated rabbits. The sartorius muscle parameters, on the other hand, appear to be the same as those of the other muscles in this study. **Conclusions:** These findings have substantial implications for individual positioning behavior theories and show that bigger samples and more comprehensive muscle series are required to increase our comprehension of these variations.

Keywords: morphometric, hind limb, semitendinosus, wild rabbit.

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Introduction

Since rabbits have strong muscles in their rear limbs, they can move quite quickly due to their ability to accelerate quickly. In addition, youngsters may have performance advantages that are superior to those of adults, which might boost their odds of surviving to reproductive maturity (1; 2 and 3). However, adult rabbits may be over-developed, which may hamper their performance (4). Although the development of the musculoskeletal system appears to give rabbits some benefits in escaping predators through quick acceleration, adult rabbits may be over-developed. In addition to skeletal muscle categorization, myological features could be employed. How an animal moves through its habitat is the primary factor in determining whether or not it will endure in that environment. This, in turn, is significantly dependent on the development of the animal's hind leg muscles (5). Their hind limb musculature demonstrates a variety of adaptations for burrowing, sprinting, leaping, swimming, climbing, and gliding due to the many habitats that rodents inhabit, which range from subterranean to terrestrial to semi-aquatic to arboreal environments. (6). This study was done to make an anatomical comparison between the hind limbs muscles of wild and domesticated rabbits**.**

Materials and methods

In this study, a total of 10 adult rabbits—five from the wild rabbits (Hares and jackrabbits are mammals belonging to the genus Lepus) and five from domesticed or farmed rabbits (more commonly known as a pet rabbit, bunny, bun, or bunny rabbit—is the domesticated form of the European rabbit, a member of the lagomorph family -were used. The anatomical description is according to (7; 8 and 9). With the assistance of metric instruments. The wild and domesticated rabbits that were used had an average body mass of 2000gm.

Results

The hind limb in rabbit

The gluteus muscle in wild and domestic rabbits was groups make up the initial layer of the muscle. These muscle groups include the superficial gluteal, middle gluteal, and deep gluteal. It is placed in

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the trochanter tertius of the femur, and it is generated from the gluteal fascia, the tuber sacrale, the caudal fascia, the lateral border of the sacrum, the first caudal vertebra, and half of the proximal section of the sacrotuberous ligament. It has a flexing effect on the hip joint. The gluteus caudalis nerve supplies this muscle with its motor impulses. (Fig. 1).

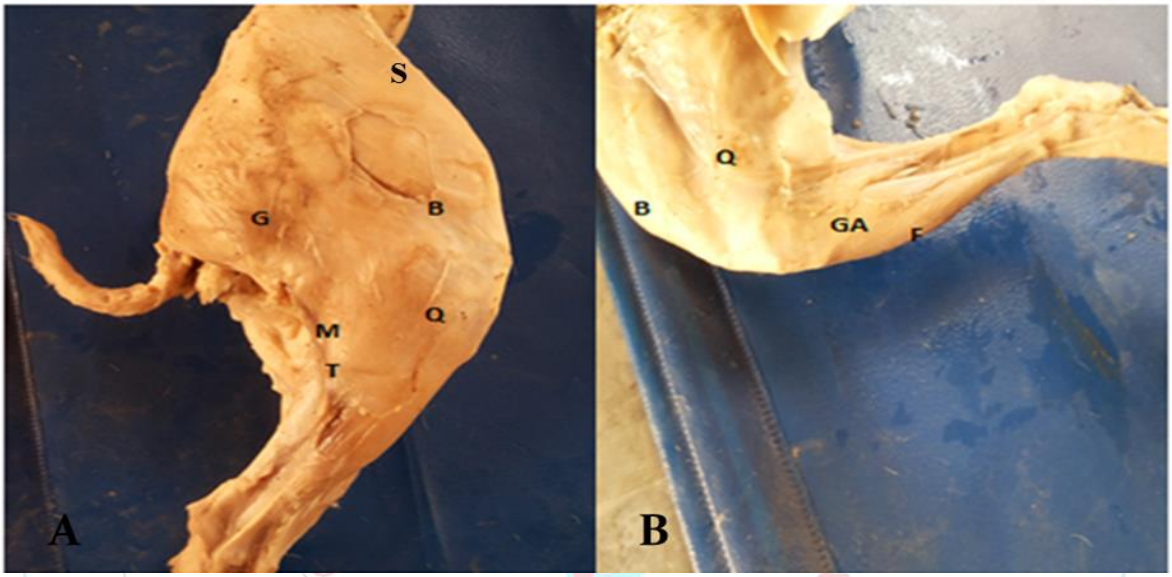

Fig.1:(wild rabbit A and domestic rabbit B) Lateral view of the muscles of hind limb: G (gluteus muscle), B (biceps femoris muscle), Q (quadriceps femoris muscle), T (semitendinosus muscle), M (Semimemberanous muscle) and GA (gastrocnemius muscle), F (flexor muscles of the leg).

According to the findings of this research, the semimembranous, semitendinosus, and quadratus femoris muscles in wild and domesticated rabbits make up the second layer of muscular tissue in the hind limb. The semitendinosus muscle had its genesis in the lateral angle of the ischial tuberosity, which is located between the biceps femoris and the semimembranosus. Its insertion point was on the medial side of the tibia, which is located in front of the flexor muscles and the tuber calcanei, together with the biceps femoris. The free, non-weight-bearing limb performs an extension of the hip and tarsal joints as well as a flexion of the stifle joint during this movement. It was supplied with nerve fibers from the tibialis anterior (Fig. 1, 2).

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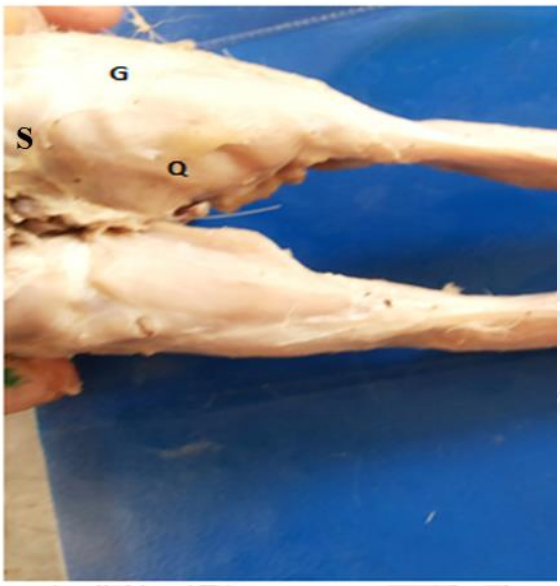

Fig.2 Frontal view of the muscles of the domestic rabbit hind limb: G (gleuteus muscle), Q (quadriceps femoris muscle)

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The current findings indicate that the semimembranous muscle in wild and domestic rabbits was originates from the lateral angle of the ischial tuberosity between the biceps femoris and the semimembranosus. Its insertion point was located on the medial surface of the tibia, in front of the flexor muscles and the tuber calcanei, together with the biceps femoris (Fig. 1).

The quadriceps femoris makes up the third layer of the thigh muscle on the inside of the thigh. This muscle was made up of four different divisions that wrapped themselves around the anterior, lateral, and medial sides of the femur. All four of these muscles originate from the femur, except for the rectus femoris, which originates from the ilium. These muscles all end at the patella. All of these divisions—the rectus femoris, the vastus lateralis, the vastus medialis, and the vastus intermedius—receive their blood supply from the anterior femoral artery, and the femoral nerve is responsible for innervating them. (Fig. 2).

It was also shown that the sartorius muscle in both animals had its insertion on the fascia iliaca, on the medial side of the tibia, and the medial border of the tibial crest. In herbivores, the cranial portion of the sartorius muscle also terminates at the cranial side and medial border of the patella. This occurs in carnivores. When the limb is projected forward, the movement flexes the hip and stifle, and when the body is in a standing position, it helps to extend the stifle. It receives its supply of nerve fibers from the saphenous nerve (Fig. 1, 2).

The study shows substantial morphometric variety among these rabbits other than in terms of size, but the

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sample size is too small and inadequate to evaluate whether or not this represents significant interspecific differences in the muscles of the hind legs (Fig. 1, 2). However, the following differences were observed in a morphometric study: The total weight of wild and domesticated rabbit gluteus muscles was (9 ± 1.19gm, and 3.5 ± 0.29gm), respectively. The total length of wild and domesticated rabbit gluteus muscles was (4 ± 0.14cm, and 2.5± 0.29cm), respectively. The total width of wild and domesticated rabbit gluteus muscles was (3.5± 0.88cm, and 2.5± 0.35cm), respectively (Table 1)

Table (1): Ranges of measured parameters (cm, gm) of gluteal muscles in wild and domesticated rabbits (Mean ± SE).

Parameters gluteal muscles	Wild rabbit	domestic rabbit
Weight (gm)	9 ± 1.19*	3.5 ± 0.29
Total length (cm)	4 ± 0.14*	2.5± 0.29
Width (cm)	3.5± 0.88*	2.5± 0.35

*Represent significant differences at (P<0.01) between horizontal rows.

Our study revealed that the total weight of wild and domesticated rabbit semitendinosus muscles was (11± 1.94gm, and 6± 1.29gm), respectively), and the total length of wild and domesticated rabbit semitendinosus muscles was (9.7± 0.94cm and 7.3± 0.76cm), respectively. While the total width of wild and domesticated rabbit semitendinosus muscles were (1.9± 0.54cm, and 1.5± 0.65cm), respectively (Tab 2).

The total weight of wild and domesticated rabbit semimembranosus muscles was (16± 1.28gm, and 12±1.24gm), respectively, and the total length of wild and domesticated rabbit semimembranous muscles was (7.0± 1.66cm and 10.0± 1.71cm), respectively. While in the same muscle, the total width of wild and domesticated rabbits were (20±2.18cm, and 21±1.32 cm), respectively (Tab 2).

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The total weight of wild and domesticated rabbit biceps femoris muscles was (18± 1.56 gm, and 17± 1.22 gm), respectively, and the total length of wild and domesticated rabbit biceps femoris muscles was (10.0± 1.12cm, and 9.0± 1.08cm), respectively. While the total width of wild and domestic rabbits biceps femoris muscles were (2.6± 0.19 cm, and 2.4±0.16cm), respectively (Tab. 2).

Table (2): Ranges of measured parameters (cm, gm) of semitendinosus muscles, semimembranous muscles, and biceps femoris muscles in wild and domesticated rabbits (Mean ± SE).

Parameters of semitendinosus muscles	**Wild rabbit**	**domestic rabbit**
Weight(gm)	11± 1.94*	6± 1.29
Total length(cm)	9.7± 0.94*	7.3± 0.76
Width(cm)	1.9± 0.54*	1.5± 0.65
Parameters of semimembranous muscles		
Weight(gm)	16± 1.28*	12± 1.24
Total length(cm)	7.0± 1.66*	10.0± 1.71
Width(cm)	20± 2.18*	21± 1.32
Parameters of biceps femoris muscles		
Weight(gm)	18± 1.56*	17± 1.22
Total length(cm)	10.0± 1.12*	9.0± 1.08
Width(cm)	2.6± 0.19*	2.4± 0.16

* Represent significant differences at (P<0.01) between horizontal rows.

The weight, length, and width of the quadriceps femoris muscles were (14± 1.64gm) , (6.1± 0.14cm) and (2.4± 0.83cm) in the wild rabbit, respectively, while the same parameters in domestic rabbit were (8± 1.43gm), (7.0± 0.98cm) and (2.0± 0.68cm) respectively (Table 3).

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Table (3): Ranges of measured parameters (cm, gm) of quadriceps femoris muscles in wild and domesticated rabbits (Mean ± SE).

Parameters of quadriceps femoris muscles	Wild rabbit	domestic rabbit
Weight(gm)	14± 1.64*	8± 1.43
Total length(cm)	6.1± 0.14*	7.0± 0.98
Width(cm)	2.4± 0.83*	2.0± 0.68

* Represent significant differences at (P<0.01) between horizontal rows.

The weight, length, and width of the Sartorius muscle were (6±0.85gm), (6.3± 0.66cm) and (1.3± 0.19cm) in the wild rabbit, respectively, while the same parameters in domestic rabbit were (4± 0.78gm), (4.0± 0.52cm) and (1.0± 0.13cm) respectively (Table 4).

Table (4): Ranges of measured parameters (cm, gm) of sartorius's muscle in wild and domesticated rabbits (Mean ± SE).

Sartorius muscles	Wild rabbit	domestic rabbit
Weight(gm)	6± 0.85*	4± 0.78
Total length(cm)	6.3± 0.66*	4.0± 0.52
Width(cm)	1.3± 0.19*	1.0± 0.13

*Represent significant differences at (P<0.01) between horizontal rows.

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Discussion

The pelvic girdle, the thigh, the leg, and the pes are the four components that make up the hind limb of the rabbit. The current results are confirmed by the finding of (10 and 11). The muscles of the hind limbs of wild rabbits and farmed rabbits do not differ morphologically; nonetheless, morphometric research found that the following differences do exist between the two groups of rabbits. The total weight of wild and domesticated rabbit gluteus muscles was also (9 ± 1.19gm, and 3.5 ± 0.29gm), respectively. The overall length of wild and domesticated rabbit gluteus muscles was (4±0.14cm and 2.5± 0.29cm), respectively. While the overall width of the gluteus muscles in wild rabbits were (3.5± 0.88cm) and in domesticated rabbits they were (2.5± 0.35cm). This results were approximately close to those recorded by (4 and 12). According to the findings of our study, the total weight of wild rabbit semitendinosus muscles was (11± 1.94 gm), while the total weight of domesticated rabbit semitendinosus muscles was (6± 1.29gm). Additionally, the total length of wild rabbit semitendinosus muscles was (9.7± 0.94cm), while domesticated rabbit semitendinosus muscles were (7.3± 0.76cm). Although the overall widths of the semitendinosus muscles in wild rabbits were (1.9± 0.54cm) and in domesticated rabbits they were only (1.5± 0.65) cm. This is related to the declaration of (13 and 14). The total weight of wild rabbit semimembranosus muscles was (16±1.28gm), while the total weight of cultivated rabbit semimembranous muscles was (12±1.24gm). The entire length of wild rabbit semimembranous muscles was (7.0± 1.66cm) and the total length of farmed rabbit semimembranous muscles was (10.0± 1.71cm). While they were in the same muscle, the overall width of wild rabbits and farmed rabbits were (20±2.18cm, and 21±1.32 cm), respectively, According to (15; 16; 17 and 4)). The total weight of the biceps femoris muscles in wild rabbits was (18± 1.56gm) and the total weight of the biceps femoris muscles in cultivated rabbits was (17± 1.22gm). The overall length of the biceps femoris muscles in wild rabbits

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was (10.0± 1.12cm) and in domesticated rabbits, it was (9.0± 1.08cm). While the entire width of wild rabbits was only 2.6± 0.19cm, had a total width of cultivated rabbits 2.4± 0.16cm. These parameters in wild and domesticated were close to those of Eastern cottontail rabbits (4). and larger in comparison in mouse (6) this give rise to thought that the variable values of mean weight, length and width were due to the species variations or may be related to the size and length of animals. The quadriceps femoris muscles of wild rabbits characterized by noticeable increased in the weight, and width more than the domesticated rabbits, and Sartorius muscles characterized by increased in the weight, length and width more than the domesticated rabbits, this differences may be due to the species differences and may be the development of the musculoskeletal system in wild rabbit appears to give rabbits some benefits in escaping predators through quick acceleration (5).

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