HISTOLOGICAL EXAMINATION OF FIBER NUMBER AMONG MUSCLES IN THE HIND LIMBS OF MICE

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Abstract

The purpose of this study was to determine whether or not the fiber number in one muscle or an animal (relative to Fiber number in the muscle or other animals) could be used to indicate relative fiber in other muscles within the animal. Twenty male mice selected for the largest variation for fiber number in the soleus muscle were used as subject for the study. Fiber number was then determined for the following 6 muscles in each of the animals : P,G,RF,VL,TA and BF correlation coefficients were used to make comparisons to relative fiber number among muscles and between individual muscle and the total fiber number for 7 muscles used from each animal. The results indicated that relative fiber number from one muscle could predict relative fiber number from another muscle. The comparisons of relative fiber number for each individual muscle to total fiber number indicated that each of the 7 muscles studied could be used to predict relative total fiber number. The results of this study indicate that relative fiber number from a small muscle in the body can be used to predict relative total fiber number in the body.

Introduction

Regulation of skeletal muscle growth has been of interest to the meat production industry for a number of year. Early studies in to the enhancement of muscle growth centered on breeding for increased body weight under the assumption that greater body weight was indicative of an increased muscle mass as well as an increased for content. (Fowler, 1958, Bailey, Kitts & wood, 1960,Biondini, Sutherland, 1968 ; Hrbis on ct L, 1976). Subsequently, investigators have focused on muscle characteristics (fibre number and fiber size) as they relate to muscle growth and development (Smith,1963 ; Robinson & Bradford, 1969 ; Hanrahan, Hooper & Mccarty, 1973 ; Fzekwe & Martin, 1975 ; Martin, White, Herbein & Fzekwe, 1979 ; Fowler, Campion, Marks & Martin, 1980).Forthe most part these studies have supported the concept that muscle fiber number is highly correlated with muscle size (Aberle & Doolitte, 1976 ; Luff & Gold spink, 1970) ; where as muscle fiber size is not as highly correlated to muscle size (Hooper, 1978 ; Mccarty & Shiel,1975). In almost all cases where the relationship between fiber number and muscle size has been studied, the muscle (s) used in the experiment has been a small muscle that is relatively insignificant in terms of the total muscle mass of the body. The assumption is that fiber number of one muscle is indicative of the fiber number in other muscle has been suggested by Stickland & Goldspink (1973) ; however, it has been largely ignored by most investigators.

An understanding of the relationship of fiber number among muscles within an individual animal is important to the interpretation of the current literature on the relationship between fiber number and muscle size. The interpretation of this relationship is important in the selection of animals for meat breading potential.

The purpose of this study was to investigate the fiber number relationship among muscle within an animal. Specifically it has been interested in determining whether

or not a high fiber number in one muscle of an animal, relative to the same muscle in the other animal. The term relative fiber number is utilized throughout this manuscript to indicate fiber number in a given muscle of an animal compared to the fiber number of the same muscle in a different animal. The mice was chosen for this study because of the relatively small number of fibers in the muscles of this species.

Materials and Methods

Twenty male white Blab/c mice (MWB/c). The animals were raised and kept under controlled conditions (standard laboratory food and lap water), they have the same size and weight, mice pass of undergo under wanted surgical removal of the solcus muscle from one leg. Surgery was performed under sterile conditions while the animal were anaesthetized with sodium pentobarbital. A longitudinal incision was made along the lateral aspect of the lower hind limb. The solcus muscle was isolated from beneath the gastronomies and plantar is muscles and removed. The muscles were stored at – 20 c until analyzed for fiber number. The incisions were closed with silk suture. Following recovery from anesthesia the animals were returned to their cages. Fiber number was determined by the nitric acid digestion method (Gollnick, Timoson, Moor & Riedly, 1981). The muscle was placed in a 15% nitric acid solution for 3 to 4 hours to remove the connective tissue. Following this oroccss the muscle was washed thoroughly and placed in distilled water.

Dissecting microscope and counted Following fiber number determination the 20 animals with the largest variation in soleus muscle fiber number were selected for the study.

These 20 animals were killed by carbon dioxide asphyxiation and the following muscles were removed from each animal ; plantar is, gastronomies, anterior, rectus femoris, vastuslateralis, biceps brachia, (femoris). Fiber number was determined for each muscle by the nitric acid digestion method. Comparisons were made among individual muscles and between each individual muscle and total fiber number of all muscles

Results and Discussion

The descriptive characteristics (mean fiber number standard deviation and maximum and minimum fiber numbers) of each muscle are presented in Table 1.

Correlation coefficient matrix for comparison of fiber number of individual muscles with each other is presented in table 2.

The data indicate a significant correlation (High relative fiber number in the other muscle within an animal indicates.(Clark, 1931 ; Golinick et al.1983 ;Swatland,1984). Even in muscles where the fibers appear to lie parallel to the long axis of the muscle, it id difficult to be certain that all the fiber will appear in a given cross – section (Timson, Bowlin, Duncnhocffer & George, 1985), since the percentage of the actual fiber number that will appear in a cross – section of a muscle varies from muscle to muscle(Nicks et al.1985). Thus interpretation of fiber number comparisons between two muscles using this method is difficult at best. The nitric acid digestion method for fiber number determination developed by Gollnick et al. (1981) has provided a technique where by the problems associated with fiber enumeration from histological cross – sections are alleviated.

The results of this study indicate that relative fiber number from one muscle in an animal is not always a good indicator of relative fiber number of another muscle (i.e. relative fiber number of soleus not a good predictor of relative fiber muscle of Biccps brachii). The data suggest that the tibialis antcrior is the best "indicator muscle " for themice, whereas the soleus would not be a good indicator muscle. However, relative

fiber number of each muscle studied was a good predictor of relative total fiber number .

Total fiber number is probably a more important characteristic than fiber number of any given muscle because number of any given muscle because it should relate better to the total muscle mass of the body assuming that fiber number decrmins relative muscle mass.

The results of this study support the earlier conclusion of Stickland & Goldspink (1973). The advantage of using the mice as an experimental model and the nitric acid digestion method for fiber enumeration is that all the fibers in the muscles utilized in the experiment can be counted. The degree to which data from the mice can be applied to other species is of course, open the question. However, the data from this study, using the mice, combined with data of Stickland & Goldspink (1973) using histological sections in the pig indicate that the concept of an indicator muscle for fiber number is probably valid for most species.

The concept of an indicator muscle, first suggest by Stickland & Goldspink (1973), is an extremely important one to research in the area of muscle fiber number. Many studies have been predicated on the assumption that fiber number in a single small muscle is indicative of fiber number throughout the body. Besides the applied aspect of selection of breeding stock on the basis of high fiber number studies of the correlation between fiber number and muscle size, as studies of muscle fiber number heritability can be conducted utilizing a small muscle with confidence that the results can be extended to larger muscles of the body.

Table 1 : Mean, standard deviation, maimum and minimum fibre numbers for the muscle utilized in the study.

No	Muscle	Mean	S.D.	Min.	Max
1	Soleus	2771	230	2292	3250
2	Plantaries (sartor is)	11888	623	11232	12545
3	Gastronomies	46755	2211	42059	51452
4	Rectus femoris	29893	1611	31951	27835
5					
6	Tibialis anterior	15769	1101	14218	17320
7	Biceps femoris (brachii)	9257	295	8952	9562

Table 2 : Correlation matrix for individual muscle comparisons Critical Value of r at P 0.05 is 0.645.

	S	P	G	RF	VL	TA	B
S	-	0.76	0.56	0.55	0.65	0.72	0.42
P	0.76	-	0.55	0.67	0.56	0.79	0.36
G	0.56	0.55	-	0.83	0.67	0.87	0.83
RF	0.55	0.67	0.83	-	0.41	0.73	0.66
VI	0.65	0.56	0.67	0.41	-	068	0.58
Ta	0.72	0.79	0.87	0.73	0.68	-	0.56
Bf	0.42	0.36	0.83	0.66	0.58	0.56	-

S: Soleus ; P : Plantaris ; G:Gasatrocnemius ;
RF : Rectus femoris ; VI: Vastus Iateralis ;
Ta : Tibialis anterior ; Bf: Biceps femoris.

Table 3 : Correlation coefficients for individual Muscles compared to total fibre number.

	Muscle	Correlation
1	Soleus	0.78
2	Plantaris	0.78
3	Gastronomies	0.97
4	Rectus femoris	0.90
5	Vastus laterals	0.86
6	Tibialis anterior	0.90
7	Biceps Femoris	0.81

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فحص نسيجي لعدد الألياف في عضلات الأرجل الخلفية للفئران

الخلاصة

الهدف من الدراسة معرفة العلاقة بين عدد الألياف في العضلة الواحدة مع عدد الألياف في عضلات أخرى من الحيوان ، كذلك معرفة العلاقة بين عدد ألياف العضلات في حيوانات أخرى قامت الدراسة على عشرين حيوان واستخدمت سبع عضلات (الاخمصية:Soleus، الخياطة : Plantaris (sarto)، التوامية الساقية: Gastronomies ، المستقيمة الفخمية: Rectus femoris، المتسعة الوحشية : Vastus laterals، الظنبوبية الامامية : Tibialis anterior ، وذات الرأسين الفخذية : Biceps brachii (femoris).

استخدمت الفروقات المعنوية للمقارنة في العلاقة بين عدد ألياف العضلات في الحيوان الواحد وبين عدد ألياف العضلات في الحيوانات الأخرى ، النتائج لهذه الدراسة تؤشر أن العلاقة بين عدد الألياف في عضلة صغيرة مفردة في الجسم يمكن ان تستخدم في العلاقة بين عدد ألياف العضلات الأخرى من جسم الحيوان.كذلك النتائج تبين أن العزلة الاخمصية تعتبر مؤشر ضعيف للعلاقة بين عدد أليافها مع عدد ألياف العضلات الأخرى ، بينما العضلة الظنبوبية الامامية تعتبر أفضل مؤشر للعلاقة أنفة الذكر.

نستنتج من الدراسة أن الأوجه التطبيقية لاختيار التزاوج في بعض الحيوانات الاقتصادية على أساس العدد الكبير لألياف العضلات والعلاقة بين عدد الألياف وحجم العضلات ، كذلك دراسة عدد ألياف العضلات وراثياً ، يمكن الربط بقناعة أن العضلات الصغيرة تؤدي إلى زيادة كتلة العضلات الكلية في جسم الحيوان.