WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 7.523
Volume 6, Issue 2, 1182-1189. Research Article ISSN 2277– 7105

INFLUENCE OF AGE AND TREAD MILL EXERCISE ON TISSUE PROTEIN PROFILES

Dr. M. Sharmila and *Dr. G. Swathi

Zoology Department, Government Degree College for Women, Srikalahasti, Chittoor(Dt), A.P.

Article Received on
20 Dec. 2016,
Revised on 10 Jan. 2017,
Accepted on 30 Jan. 2017
DOI: 10.20959/wjpr20172-7500

***Corresponding Author**
Dr. G. Swathi
Zoology Department,
Government Degree College
for Women, Srikalahasti,
Chittoor(Dt), A.P.

ABSTRACT

Ageing may be defined as sum total of all changes that occurs in man with the passages of time and lead to functional impairment and death. The whole body weight of the animal is based on the water or hydration level as 80% of its availability is in tissue composition and the remaining is made up of proteins, minerals and other intracellular components. The relative relationship between organ weights versus total body weight has a functional relevance in terms of biometric and physiological events. Proteins are biochemical compounds consisting of one or more polypeptides typically folded into a globular or fibrous form, facilitating a biological function. The animals of each age group were divided into two batches of six each i.e., Control (C) and Exercised (E) rats. Three months exercise period was selected for the present study. The body weights were recorded at an interval of one week for a period of three months in young and old, control and treadmill exercised rats. The body weights of individual rat were normalized to 100gm and 200gm for young and old rats respectively. In the present study the influence of protein was examined in selected tissues of male Wister strain albino rats with particular reference to ageing.

KEYWORDS: Body weight, Protein, Myosin, Actin.

INTRODUCTION

Proteins are the essential bio-chemical compounds of the living organisms, which plays an important role in cellular metabolism. The word "Protein" comes from the Greek word "Protos" which means "Of prime importance". Protein is the main building block of the human body. The smallest protein units are called Amino acids; they are the "bricks" that make up the protein blocks. They constitute about one fifth of an animal body on wet weight basis (Swaminathan, 1983). Proteins are biochemical compounds consisting of one or more polypeptides typically folded into a globular or fibrous form, facilitating a biological function. Proteins are the molecular instruments through which genetic information is expressed (Nelson and Cox, 2005). These are hydrolyzed to amino acids in the body which are further metabolized by incorporation into proteins or deamination or oxidation of amino acids (Murray *et al.*, 2007). The physiological state of the cell depends upon its free amino acid pool (Abidi, 1986).

Although body proteins represent a significant proportion of potential energy reserves, under normal circumstances they are not used for energy production. In an extended fast, however, muscle protein is degraded to amino acids for the synthesis of essential proteins and for gluconeogenesis to maintain blood glucose concentration. This accounts for the loss of muscle mass during fasting (Baynes and Dominiczak, 2005).

During ageing profound changes occur in the metabolic activities of protein profiles and related enzymes in skeletal muscles of rat. Normal senescence is associated with a number of changes in the composition and functioning of the animal body. A well documented change that occurs with ageing in old rats is with reference to the protein synthesis. Reduced myofibrillar protein synthesis may be an important mechanism of the muscle atrophy associated with ageing. In humans and animals, ageing is associated with pronounced morphological and functional changes in skeletal musculature including loss of muscle mass, decline in muscle strength and decreased speed of contraction. It was proposed that the age related changes of some enzymatic proteins are a result of oxygen free radical mediated damage and that the accumulation of damaged protein is a results of age related increase in the rate of oxygen free radical mediated damage or a loss in ability to degrade oxidized proteins suggested that the protein oxidation with age can be reduced by dietary restriction of proteins.

Hence, an attempt was made in the present investigation to study the effect of endurance exercise training on protein profiles in different muscle fibre types of ageing male albino rats to gain comprehensive picture of metabolic utilization of proteins and their derivatives.

MATERIAL AND METHODS

The animals were divided into four groups regarding their age group of each age group were divided into two batches of six each i.e., Control (C) and Exercised (E) rats. First group with tree months, 12 months and for them control groups (1 and 2) were maintained. The body weights were recorded at an interval of one week for a period of three months in young and old, control and treadmill exercised rats. The body weights of individual rat were normalized to 100gm and 200gm for young and old rats respectively. The protein level in this fraction was determined using the method of Lowry *et al.*, 1951.

RESULTS AND DISCUSSION

This paper is an attempt to analyze whether exercise may change the muscular protein content in different age groups compared to their control groups of the same age. An age dependent decrease was noticed in the levels of sarcoplasmic, myosin and acting of all muscle types in our study. The drop in the levels caused by ageing was countered by exercise training. A decrease in sarcoplasmic proteins and altered excitation contraction coupling with age may be responsible for the diminished contractile properties of the muscle fibres. Altered protein turnover may be responsible for the diminished skeletal muscle contractile properties observed with the age that are directly attributable to sarcoplasmic proteins involved in excitation contraction coupling, since basic metabolic rate (BMR) is directly related to the whole body protein turnover, a reduced turnover of proteins is expected in elderly, in view of age related recline in BMR.

Myosin and actin has a specific role in the excitation – contraction coupling of muscle fibres, which are key components in contraction and relaxation of muscle. In the present study, ageing resulted in a significantly lower percentage of myosin and actin. This may be due to loss of muscle mass and due to muscle atrophy observed during senescence. Morley et al. (2001) observed an age-related decrease in the synthesis rate of myosin, the major anabolic protein. Ferrington et al. (1997) suggested that the decreased turnover of these key proteins may in part account for the increased accumulation of protein modifications and the diminished skeletal muscle performance observed in aged organisms. Decrease in the ATPases may be the result of age related decrease in number of contractile elements as revealed by low content of electrophoretically analyzed myofibrillar proteins. The muscle protein in our result clearly suggests that there is significant increase in the protein content (Table 1), Sucrose Soluble Protein (Table 2), Sarcoplasmic Protein content (Table 4), Myosin content (Table 5) and Actin content (Table 6) in exercised rats when compared to control rats of their respective of age.

Collagen the major component of most connective tissues constitutes approximately 25% of the proteins of mammals. It provides an extracellular framework for all metazoan animals and exists in virtually every animal tissue (Murray *et al.*, 2000). It is projected that biological aging mainly depends on deleterious accumulation of insoluble inert protein that has escaped physiological proteolytic degradation. In this way vital intracellular transport mechanisms may be blocked, providing a motivation to several observations linked to aging (Anund Hallén, 2002). In our present study we had observed that insoluble protein content had been decreased in the exercised rats in the both age groups (Table 3). Collagen content and Non Collagen content (Table 7, 8) were both decreased in both groups in our experiment which clearly supports the above statement. This suggests that exercise may also help in decreasing aging.

Table 1: Changes in the Total Protein content in skeletal muscles of control and treadmill exercised (30 min/day. 5 days/week for 12 weeks) rats of two age groups. Values are expressed in mg of protein/gm wet wt of tissue.

S.No.	Muscle	Young Rats (3+3) Months		Old Rats (12+3) Months	
		Control	Exercised	Control	Exercised
1	Gastrocnemius	127.97± 4.50	164.19± 4.33 (28.30)	108.30± 5.88	133.85± 3.02 (23.59)
2	White Vastus	113.24± 3.36	136.60± 4.29 (20.63)	101.71 ± 2.32	126.13± 2.62 (24.00)
3	Red Vastus	135.50± 2.13	179.51± 1,52 (32.48)	126.81 ± 1.56	164.59± 1.34 (30.82)
4	Soleus	116.75± 6.00	151.27± 4.25 (29.57)	107.35 ± 2.74	128.21± 4.65 (19.43)

Values are expressed in Mean ± SD.

Table - 2: Changes in the Sucrose Soluble Protein content in skeletal muscles of control and treadmill exercised (30 min/day. 5 days/week for 12 weeks) rats of two age groups. Values are expressed in mg of protein/gm wet wt of tissue.

S.No.	Muscle	Young Rats (3+3) Months		Old Rats (12+3) Months	
		Control	Exercised	Control	Exercised
1	Gastrocnemius	64.79± 2.07	91.27± 1.75 (40.87)	62.09± 1.64	86.26± 2.10 (38.93)
2	White Vastus	56.50± 1.88	104.46± 2.92	49.16± 2.70	71.11± 3.16

			(84.88)		(44.65)
3	Red Vastus	69.27± 3.76	105.14± 1.15 (51.78)	65.53± 2.12	93.71± 2.07 (43.00)
4	Soleus	62.23± 3.30	90.97± 2.45 (46.18)	52.82± 1.61	81.43± 2.38 (54.17)

Values are expressed in Mean ± SD.

Table - 3: Changes in the Sucrose insoluble Protein content in skeletal muscles of control and treadmill exercised (30 min/day. 5 days/week for 12 weeks) rats of two age groups. Values are expressed in mg of protein/gm wet wt of tissue.

S.No.	Muscle	Young Rats (3+3) Months		Old Rats (12+3) Months	
		Control	Exercised	Control	Exercised
1	Gastrocnemius	58.28± 1.62	31.26± 2.94 (-46.36)	67.10± 4.09	40.64± 3.90 (-39.43)
2	White Vastus	54.92± 1.69	32.77± 2.10 (-40.33)	64.71± 1022	37.74± 2.37 (-41.68)
3	Red Vastus	65.36± 2.83	35.28± 2.66 (-46.02)	69.63± 1.76	38.38± 1.79 (-44.88)
4	Soleus	69.48± 1.27	33.84± 3.28 (-51.30)	73.62± 4.57	40.04± 2.77 (-45.61)

Values are expressed in Mean ± SD.

Table - 4: Alterations in the Sarcoplasmic Protein content in skeletal muscles of control and treadmill exercised (30 min/day. 5 days/week for 12 weeks) rats of two age groups. Values are expressed in mg of protein/gm wet wt of tissue.

S.No.	Muscle	Young Rats (3+3) Months		Old Rats (12+3) Months	
		Control	Exercised	Control	Exercised
1	Gastrocnemius	73.52± 2.42	97.94± 2.45 (33.22)	69.65± 1.87	78.32± 3.98 (12.45)
2	White Vastus	66.11± 1.90	90.86± 2.92 (37.44)	62.93± 1.75	83.41± 4.30 (32.54)
3	Red Vastus	76.00± 3.03	105.48± 3.79 (38.79)	71.67± 1.67	91.34± 4.62 (27.45)
4	Soleus	61.34± 1.80	78.95± 4.75 (28.71)	57.71± 1.86	75.80± 5.09 (31.35)

Values are expressed in Mean ± SD.

Table - 5: Changes in the Myosin content in skeletal muscles of control and treadmill exercised (30 min/day. 5 days/week for 12 weeks) rats of two age groups. Values are expressed in mg of protein/gm wet wt of tissue.

S.No.	Muscle	Young Rats (3+3) Months		Old Rats (12+3) Months	
		Control	Exercised	Control	Exercised
1	Gastrocnemius	80.06± 5.50	110.95± 2.87 (38.58)	65.40± 2.22	88.14± 2.26 (34.77)
2	White Vastus	69.21± 1.47	87.23± 2.16 (26.04)	61.09± 3.48	81.57± 3.14 (33.52)
3	Red Vastus	75.82± 1.97	107.20± 3.89 (41.39)	66.81± 3.76	84.99± 2.65 (27.21)
4	Soleus	70.51± 1.20	99.18± 2.27 (40.66)	62.53± 3.12	79.21± 2.37 (26.68)

Values are expressed in Mean ± SD.

Table - 6: Changes in the Actin content in skeletal muscles of control and treadmill exercised (30 min/day. 5 days/week for 12 weeks) rats of two age groups. Values are expressed in mg of protein/gm wet wt of tissue.

S.No.	Muscle	Young Rats (3+3) Months		Old Rats (12+3) Months	
		Control	Exercised	Control	Exercised
1	Gastrocnemius	85.11±3.39	114.49±3.69 (34.52)	78.36±1.19	95.60±2.55 (22.00)
2	White Vastus	76.82±2.27	101.23±2.86 (31.78)	60.78±2.28	72.86±1.71 (19.87)
3	Red Vastus	92.86±2.81	133.90±4.26 (44.20)	64.16±3.00	82.86±1.37 (29.15)
4	Soleus	95.60±3.96	133.90±3.89 (40.06)	82.31±2.23	106.40±2.03 (29.27)

Values are expressed in Mean ± SD.

Table - 7: Changes in the Collagen content in skeletal muscles of control and treadmill exercised (30 min/day. 5 days/week for 12 weeks) rats of two age groups. Values are expressed in mg of protein/gm wet wt of tissue.

S.No.	Muscle	Young Rats (3+3) Months		Old Rats (12+3) Months	
		Control	Exercised	Control	Exercised
1	Gastrocnemius	87.86±3.21	62.74±2.84 (-28.59)	115.34±4.33	87.50±1.78 (-24.14)
2	White Vastus	95.34±2.21	71.85±2.72 (-24.64)	102.92±3.84	76.02±2.39 (-26.14)
3	Red Vastus	60.05±2.84	38.77±2.22 (-35.44)	88.54±2.41	63.10±3.06 (-28.73)
4	Soleus	84.57±2.26	41.01±3.63 (-51.51)	112.06±2.44	72.54±2.29 (-35.27)

Values are expressed in Mean ± SD.

Table - 8: Changes in the Non Collagen content in skeletal muscles of control and treadmill exercised (30 min/day. 5 days/week for 12 weeks) rats of two age groups. Values are expressed in mg of protein/gm wet wt of tissue.

S.No.	Muscle	Young Rats (3+3) Months		Old Rats (12+3) Months	
		Control	Exercised	Control	Exercised
1	Gastrocnemius	86.71±3.95	60.07±1.71 (-30.72)	126.61±3.05	94.20±1.53 (-25.60)
2	White Vastus	99.29±4.80	63.86±1.64 (-35.68)	139.63±1.80	101.49±2.76 (-27.32)
3	Red Vastus	121.55±3.61	83.21±2.18 (-31.54)	141.75±1.96	119.09±2.14 (-16.00)
4	Soleus	88.63±5.79	51.54±2.63 (-41.85)	118.79±2.81	77.96±2.10 (-34.37)

Values are expressed in Mean ± SD.

All values are Mean, ± SD of six individual observations.

Values in parentheses are per cent change over respective control.

(3+3) indicates 3 months old rats, 3 months control/exercised.

(12+3) indicates 12 months old rats, 3 months control/exercised.

CONCLUSION

In conclusion, our data showed that the exercised rats were maintaining more protein content in muscle when compared to control group irrespective of age group and also observed that insoluble protein content had been decreased suggesting it may achieve positive effect on ageing. By maintaining life style management with daily exercise may increase quality of life and also it may decrease rapid ageing.

REFERENCE

1. Swaminathan, M. (1983). Handbook of food and nutrition, 3rd Edition, 22.
2. Nelson, D.L. and Cox, M.M. (2005). In: Lehinger principles of biochemistry, fourth edition, W.H. Freeman and company, New York. Abidi, 1986.
3. Morley, J.E., Baurngartner, R.N., Roubenoff, R., Mayer, J. and Nair, K.S. (2001). Sarcopenia. J. Lab. Clin. Med; 137(4): 231-43.
4. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2000). Harper's Biochemistry. Lange Medical Publications, 25th edition Appletion and Lange, Califiornia.
5. Anund Hallén, (2002). Accumulation of insoluble protein and aging. Biogerontology, 3(5): 307–316.

6. Deborah A. Ferrington, Terry E. Jones, Zhihai Qin, Melissa Miller-Schlyer, Thomas C. Squier, Diana J. Bigelow. (1997). Decreased conformational stability of the sarcoplasmic reticulum Ca-ATPase in aged skeletal muscle. 1330(2): 233–247.
7. Adibi, S.A. (1976) Metabolism of branched-chain amino acids in altered nutrition. Metab. 25: 1287-1302.
8. Baynes W, John, H Marek Dominiczak. In: Medical Biochemistry, Second Edition, 2005.