

## EFFECT OF PROLONGED ELECTRICAL STIMULATIONS ON THE LIPID METABOLISM OF THE EXERCISED AMPHIBIA MUSCLE

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### ABSTRACT

Pattern of changes in the lipid profiles of unstimulated (USM) and prolonged stimulated (PSM) muscles of *Rana hexadactyla* was studied during exercise. PSM exhibited lipid oriented metabolic pattern during exercise which was comparable with trained muscles. Prolonged exercising capacity of PSM was correlated towards its lipid utilizing nature during the course of exercise.

### INTRODUCTION

**E**LECTRICAL stimulations have been widely employed to induce exercise and training in a variety of animals<sup>1-6</sup>. Our previous studies revealed that the normal muscle can be converted into a trained condition through prolonged electrical stimulation<sup>6-9</sup>. Such muscles with prolonged electrical stimulation utilized only half of the glycogen content in comparison to the unstimulated muscles during exercise<sup>5-9</sup>.

The present study has been undertaken to analyse the lipid metabolic pattern in stimulated muscle in order to understand the reasons for lower utilization of carbohydrates during exercise.

### MATERIALS AND METHODS

Male frogs of species *R. hexadactyla* (Lesson)  $30 \pm 2$ g were employed in the present investigation. The frogs were divided into two groups. The first group of animals was maintained as controls. The right gastrocnemii of the second group of animals were subjected to *in vivo* electrical stimulation through two platinum electrodes placed on the skin (biphasic pulses of 5V at a frequency of 2 C/sec, for 30 min. per day) for 10 successive days and termed as prolonged stimulated muscle (PSM). The muscles from normal frogs were taken as unstimulated muscles (USM). Control and prolonged stimulated animals were double pithed and frozen immediately. The gastrocnemii from the frozen animals were isolated and chilled in freezing mixtures and were taken for biochemical assays. The triglycerides<sup>10</sup>, lipase activity<sup>11</sup>, phospholipids<sup>12</sup> free fatty acids<sup>10</sup> and glycerol<sup>13</sup> were estimated.

### RESULTS AND DISCUSSION

Prolonged stimulated muscle (PSM) recorded significant depletion in the triglyceride content after the completion of the exercise, while unstimulated muscle (USM) showed no change from the control suggesting the possible existence of lipid oriented

metabolism in the PSM. Lipase activity in PSM was elevated to higher level than USM during the course of exercise suggesting active lipolysis in PSM. The free fatty acid content of PSM was depleted while the same had little change from control in USM which was indicative of higher fatty acid oxidations than in PSM. Glycerol was mobilized into the metabolic activities of PSM leading to its depletion, while in USM the same was elevated. The phospholipid content of PSM had little change from control after exercise, while in USM they were highly depleted which was indicative of maintenance of active transport mechanisms in the PSM during the course of exercise. These observations suggest that the prolonged stimulated muscle metabolism was oriented towards higher mobilization of lipids and their derivatives during the course of exercise, which might have been responsible for higher contractile potential and sparing of glycogen, reported earlier<sup>5,9</sup>. Lipid oriented metabolism will be generally witnessed from trained muscles<sup>14</sup>.

Hence applicability of electrical stimulation in changing the muscle type has been envisaged and further work is in progress.

### ACKNOWLEDGEMENTS

CVNM is thankful to the CSIR, New Delhi, for the award of fellowship during the tenure of this work.

14 June 1983

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TABLE 1

Levels of triglycerides, lipase activity, phospholipids, free fatty acids and glycerol in the unstimulated muscle (USM) and prolonged stimulated muscle (PSM) of frogs.

S. No.	Component	Type of Muscle	Period of exercise in min					
			0	2	5	10	15	20
1.	Triglycerides (mg/g dry wt.)	USM	15.98 ± 1.67	15.74 ± 1.58	15.42 ± 1.71	15.09 ± 2.03	15.03 ± 1.45	15.67 ± 0.56
		PSM	10.62 ± 1.11	10.62 ± 0.87	10.28 ± 0.66	9.49 ± 1.53	9.2 ± 0.86	8.08 ± 1.02
2	Lipase activity (μ mol of PNFA cleaved/mg protein/h)	USM	0.73 ± 0.077	0.732 ± 0.077	0.737 ± 0.071	0.744 ± 0.076	0.766 ± 0.04	0.769 ± 0.053
		PSM	0.719 ± 0.031	0.745 ± 0.044	0.732 ± 0.035	0.828 ± 0.03	0.867 ± 0.063	0.875 ± 0.036
3	Phospholipids (mg/g dry wt.)	USM	59.38 ± 6.32	58.49 ± 4.14	58.55 ± 6.15	53.91 ± 5.37	49.61 ± 5.15	47.0 ± 3.03
		PSM	70.26 ± 4.24	70.08 ± 6.55	69.73 ± 5.08	69.78 ± 7.23	67.85 ± 8.56	64.59 ± 3.6
4.	Free fatty acids (mg/g dry wt.)	USM	19.15 ± 0.61	19.08 ± 0.17	18.59 ± 0.31	18.65 ± 0.37	17.67 ± 0.54	17.62 ± 0.16
		PSM	24.22 ± 0.35	23.62 ± 0.19	26.42 ± 0.35	23.68 ± 0.49	19.69 ± 0.77	15.63 ± 0.26
5.	Glycerol (mg/g dry wt.)	USM	1.04 ± 0.14	1.04 ± 0.14	1.07 ± 0.06	1.07 ± 0.09	1.09 ± 0.08	1.18 ± 0.007
		PSM	1.73 ± 0.15	1.73 ± 0.13	1.72 ± 0.1	1.3 ± 0.11	1.04 ± 0.1	0.911 ± 0.13

Values are mean of 8 individual observations. Mean ± S D ; + and - indicate percent increase and decrease over control respectively. 'P' denotes level of significance and 'NS' nonsignificance.

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## ANNOUNCEMENT

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### SECOND ALL INDIA CONFERENCE ON THIN FILM STATE PHENOMENA

The second All India Conference on Thin Film State Phenomena will be held at the Department of Physics, Indian Institute of Technology, Madras, during 31 January to 3 February 1984, on the occasion of the Silver Jubilee Celebrations of the Indian Institute of Technology, Madras.

The objectives and scope of the conference include several invited talks and contributed papers by active research workers from different parts of India working on the properties of Materials in the thin film state.

The objectives and scope of the conference are as follows: (1) Invited talks by senior persons actively investigating the various aspects of material behaviour in the thin film state will be arranged which will guide, educate and direct the younger research workers in their research activity, (2) Research works

carried out by different research workers in India will be presented as papers both orally and as posters, and discussed, (3) Panel discussions will be conducted to select areas of research activity in thin film state phenomena which need increased research activity and thrust, (4) Proceedings of the conference inclusive of both invited talks and research papers will be brought out to be distributed free to the participants and to some of the libraries in universities and research institutes in India. This will hopefully nucleate new centres of research activity in the Thin Film State Science and Technology.

For details please contact: Dr V. Damodara Das, Convener, Second All India Conference on Thin Film State Phenomena, Department of Physics, Indian Institute of Technology, Madras 600 036.

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