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GLYCOLYTIC OXIDATION OF GLUCOSE IN GASTROCNEMIUS MUSCLE OF TOAD, *BUFO MELANOSTICTUS* DURING PROGRESSIVE DENERVATION

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THE muscle metabolism is intriguingly regulated by the trophic influence of the innervating nerve to a large extent[1]. Elimination experiments of denervation[2] have shown a high metabolic interdependence between muscle and nerve cells. They have also supplied convincing evidence for nervous regulation of the physiological, metabolic and structural properties of the muscle. Several reports have been made on metabolic changes in hypertrophy of gastrocnemius muscle[6–9], but very few reports are available on changes during progressive denervation of muscle. It is a well-established fact that the muscle utilizes energy for its specific function and also for the maintenance and renewal of structure and chemical composition and for adaptation to new stimuli, in other words for trophic processes[1]. Carbohydrates are considered to be the main source of energy during muscle activity. The present study deals with the changes taking place in some of the substrates and glycolytic enzymes during progressive denervation atrophy.

The toads, *Bufo melanostictus* of medium size (30±5 g) were collected in and around Tirupati and maintained in glass aquarium tanks with sand as bed. The toads were fed with earthworms *ad libitum*. The toads were acclimatized to the laboratory conditions for a week before they were subjected to denervation process. The sciatic nerve section on one leg was performed as suggested by Swami and Satyanarayana[10]. The toads were double-pithed on 7th, 14th, 21st and 28th day postoperatively and both the denervated and contralateral gastrocnemius muscles were quickly excised in cold conditions. Five per cent tissue homogenates were prepared in a suitable medium and centrifuged at 1000 g for 10 min to remove the cell debris. The supernatants were assayed for phosphorylase[11], aldolase[12], lactate dehydrogenase (LDH)[13] and metabolites such as glycogen[14], lactate[15] and pyruvate[16]. The protein content was determined by the method of Lowry *et al*[17]. The data was analyzed by student *t* test to assess the difference between control and experiment.

The data showed that glycogen levels decreased significantly one week after denervation suggesting its reduced synthesis. The specific activity of phosphorylase, a glycogen-cleaving enzyme, was decreased during the first and the second week and an increase in the third and fourth week after denervation. Though phosphorylase activity was decreased during the first and second week after denervation, the glycogen was depleted indicating its reduced synthesis in the early stages of denervation. Similar results were reported by several investigators in various animals during denervation[7,18,19]. The enhanced phosphorylase activity and the decreased glycogen levels in the later weeks of denervation could be due to both the increased glycogenolysis and the decreased glycogenesis. In support of this, Ramachandra Rao[20] reported diminished uptake of ^{14}C glucose into glycogen in the denervated muscle.

In order to assess the extent of mobilization of glycogen into glycolytic pathway, aldolase activity was determined. Aldolase showed maximum decrease in activity in the first week and the extent of decrease declined with progressive denervation. This suggests reduced mobilization of glucose (glycogen) in the later period of denervation through glycolysis and increased oxidation through HMP shunt during prolonged periods of denervation. This is in consonance with earlier reports[21,22].

Except in the second week of denervation, the pyruvate content was significantly reduced whereas lactate level was elevated in the first week and thereafter no appreciable change was observed in comparison with contralateral muscle. The decreased pyruvate formation in the atrophied muscle could be attributed to the reduced glycolytic oxidation of glucose as evidenced by the decreased

Table 1 *Glycolytic changes in the gastrocnemius muscle of toad during progressive denervation atrophy*

Parameter	Weeks after denervation I		II		III		IV	
	CLC	D	CLC	D	CLC	D	CLC	D
Glycogen (mg glucose/g wet wt of tissue)	2.43±0.23	2.30±0.09 (−5.35)	2.59±0.10	1.16*±0.03 (−55.21)	2.55±0.17	1.52*±0.04 (−40.39)	2.59±0.02	1.10*±0.03 (−57.53)
Pyruvate (mg/g wet wt of tissue)	6.89± 0.06	5.92*±0.08 (−14.08)	6.95±0.06	8.16*±0.12 (+17.41)	7.02±0.05	5.86*±0.13 (−16.52)	6.99±0.17	4.84*±0.10 (−30.76)
Lactate (mg/g wet wt of tissue)	9.22±0.03	12.44*±0.02 (+34.92)	9.56±0.04	8.67±0.005 (−9.31)	10.00±0.06	9.11±0.01 (−8.90)	9.78±0.02	10.44±0.08 (+6.75)
Phosphorylase (μmol of pi/mg protein/hr)	5.79±0.10	4.45*±0.20 (−23.14)	5.36±0.14	4.52*±0.25 (−15.67)	5.42±0.09	6.28±0.18 (+15.87)	5.13±0.05	7.43*±0.23 (+44.83)
Aldolase (μmol of fructose cleaved/mg protein/hr)	14.37±0.60	10.65*±0.31 (−25.89)	13.95±0.67	11.76±0.98 (−15.70)	14.14±0.52	12.70±0.74 (−10.18)	14.04±0.44	12.92±1.43 (−7.98)
LDH (μmol of formazan/mg protein/hr)	0.31±0.03	0.27±0.22 (−11.40)	0.39±0.02	0.46±0.026 (+16.58)	0.39±0.029	0.50*±0.021 (+30.23)	0.35±0.016	0.45±0.028 (+25.64)

Each value is mean ±SD of six individual observations. Values in parentheses are per cent changes over controls. * Significantly different from control ($P<0.05$); CLC: Contralateral control; D: Denervated.

aldolase activity in the present study. The accumulation of lactate in the early phase of denervation suggests its decreased conversion to pyruvate. In support of this diminished specific activity of NAD-LDH after one week of denervation was observed. However, from the second week onwards the lactate content was reduced and the LDH activity was increased significantly. Increased LDH activity indicates mobilization of lactate to pyruvate either into TCA cycle or transamination pathway. The above data clearly indicate that glucose oxidation is impaired through glycolysis during progressive denervation.

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THRUST OF THE OVIPOSITOR OF FRUIT FLY, *DACUS DORSALIS* HANDEL

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ALTHOUGH there are no significant differences in the absolute power of muscles in insects and vertebrates, the force with which insects are able to exert pressure has not been worked out in detail[1]. The jumping efficiency of various insects species have been analysed[2,3] but no efforts have been directed towards determining the pressure exerted by the ovipositors of insects specially of those which lay their eggs in fruits or barks of trees. The present communication reports the amount of pressure exerted by the ovipositor of fruit fly, *Dacus dorsalis* Handel for ovipositing its eggs in the fruit of guava (*Psidium guajava* L). It was shown that the maximum pressure which the fruit fly ovipositor exerts is around 180 kg/cm^2.

Fruit fly, *D. dorsalis* is a serious pest of guava[4]. For determining the pressure exerted by the ovipositor of the fruit fly the guava variety, *Allahabad Safeda*, was used. A total of 739 fruits were examined and their hardness measured by using Magness-Tylor pressure testor. The percentage infestation of fruit was determined by keeping the fruit separately in wire mesh containers till such time that the maggots could easily be detected. The hardness of the fruit varied and it could withstand pressure between 7 and more than 180 kg/cm^2. On this basis the fruit could be divided into six distinct categories (table 1). Each category had nearly equal percentage of fruit. The infestation by the fruit flies