COMPARTMENTATION OF GLUCONEOGENIC ENZYMES IN ADULT RAT BRAIN

It is known that various parts of the brain differ in their biochemical make-up and that they belong to distinct phylogenetic ages[1]. Aerobic metabolism replaces and predominates anaerobic in evolutionary development of the brain[2]. Glucose metabolism proceeds through sugar phosphates and seems to depend largely upon several enzymes for key substrates. Glucose-6-phosphate is a key substrate which is at the junction of the several metabolic pathways like glycolysis, gluconeogenesis, glycogenesis, glycogenolysis and hexosemonophosphate cycle. Glucose-6-phosphate can enter any one of the cycles depending upon the relative activities of the key enzymes for the same substrate. Glucose-6-phosphatase (D-Glucose-6-Phosphate Phosphohydrolase, Ec. 3.1.3.7) and fructose 1, 6-diphosphatase (D-Fructose-1, 6-Diphosphate I. Phosphohydrolase, 3.1.3.11) play an important role in the regulation of carbohydrate metabolism by functioning in the various metabolic pathways. The presence of these two key enzymes in any tissue reflects its capacity to synthesize glucose from non-carbohydrate precursors[3–4]. So far, nothing is known about the significance of glucose-6-phosphatase and fructose 1, 6-diphosphatase activities in the reversal of glycolysis in the brain metabolism. The main aim of the present investigation is to find out the actual functions of these two enzymes in different compartments of the adult rat brain.

The investigations were carried out on adult albino rats (Holtzman strain, 6 month old, 300-500 gm) providing food and water *ad libitum*. The animals were killed by decapitation and the brain was carefully removed as quickly as possible. The brain was separated into optic lobes, cerebrum, hippocampus, cerebellum, the region containing pituitary and hypothalamus and medulla oblangata by the method described earlier[5]. The preparation of tissue samples and enzyme estimations were same as described elsewhere[3–4]. The experiment was repeated 6 times. Student " t" test was performed to know the level of significance.

It would be evident from Table I, that marked differences exist in the G–6-pase and F–D–pase activities among the six regions of the adult rat brain. The highest G–6–pase and F–D–pase activities were found in hippocampus followed by the region containing pituitary and hypothalamus, etc., optic lobes and cerebrum. The lowest values were recorded in medulla oblongata and cerebellum for these two enzymes.

Hippocampus, the seat of memory, has the highest glucose–6–phosphatase and fructose 1, 6-diphosphatase activities. This indicates that hippocampus is not only important for the memory functions but also has a high capacity to synthesize glucose from non-carbohydrate precursors in order to meet its various metabolic demands. The region containing pituitary, hypothalamus, etc., the co-ordination centre for different hormonal secretions has marked glucose–6–phosphatase and fructose 1, 6-diphosphatase activities. Cerebrum, the region of sensation, has low gluconeogenic enzyme activities. Though the process of glycolysis is high in medulla oblongata[1], the levels of glucose-6-phosphatase and fructose 1, 6-diphosphatase are very low. Regions of the brain belonging to lesser heirarchy displayed lesser activities of gluconeogenic enzymes. For example the activities of G–6–pase and F–D–pase are very low in cerebellum.

From these observations it is clear that different compartments of the brain do play an important role in carbohydrate metabolism next to liver and muscle. However the capacity of different regions of the brain

TABLE I

Differential distribution of glucose-6-phosphatase and fructose 1, 6-diphosphatase in different regions of the adult rat brain

Regions of the brain	Glucose-6-phosphatase*	Fructose 1, 6-diphosphatase*
(*a*) Optic lobes	0·360 ±0·0533	0·195 ±0·0029
(*b*) Cerebrum	0·301 ±0·0122[c]	0·164 ±0·0018
(*c*) Hippocampus	0·449 ±0·0406	0·240 ±0·0224[a–b]
(*d*) Cerebellum	0·212 ±0·0141[a–c,e,f]	0·130 ±0·0665[a–c]
(*e*) Pituitary and Hypothalamus etc.	0·379 ±0·0453	0·206 ±0·0060[a,c,d]
(*f*) Medulla oblongata	0·263 ±0·0032[b,c,e]	0·158 ±0·0147[a,c,e]

Values (* μ moles of pi liberated/mg protein at 37° C) are mean ± SE of 6 experiments. Student " t" test was performed between specific activities of glucose-6-phosphatase and fructose 1, 6-diphosphatase in different regions of the brain. Superscripts a–f indicate that $P > 0{\cdot}05$.

to synthesize glucose from non-carbohydrate precursors is markedly different from one region of the brain to another region. The possibility of their varied associations in the regulation of carbohydrate metabolism by functioning in various metabolic pathways has been already pointed out[3]

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October 7, 1977.

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MOBILIZATION OF ACID AND ALKALINE PHOSPHATASES IN THE DEGENERATING TAIL OF *BUFO MELANOSTICUS*

THE process of metamorphosis in the amphibian tadpole, morphologically characterized strangely, by the absorption of tail, undergoes a series of classic changes both physiologically and also biochemically. The degeneration of the tissue components is induced by a number of factors; interesting is the histolysis in phagocytosis which may be governed by the activity of certain bio-catalytic enzymes. The changes in the disintegration of the complex organelle including the absorption of tail in the metamorphosis of amphibian tadpole seem to be regulated by the lysosomal activity which in turn is governed by phosphatases activity as suggested by Novikoff[1]. However, the role of acid and alkaline phosphatases has been reported to be associated with the metabolism of carbohydrates[2], proteins[3], nucleic acids[4], lipids[3], secretory function of the tissue cells and in the electron transport[5,6,7]. As the degeneration of tissue cells is regulated by the lysosomal and phosphatases activity[1], the investigations become essential to assess the activity of acid and alkaline phosphatases in the degenerating tail of *Bufo melanosticus* which have been undertaken in the present communication.

Eggs of toad *B. melanosticus*, collected from the University campus, incubated in the aquarium with sufficient aquatic plants and space were allowed to grow to the maximum size. Progressive developmental stages in the larvae with regressive tail were grouped as shswn in Table I. Their total tail and body length were measured separately to find out any static relationship. The tails were sliced off from the bases, blotted on filter-paper and weighed to nearest 0·1 mg. The weighed tissue from the respective groups was kept separately in freezer for 48 hours, homogenized and processed for acid and alkaline phosphatases estimation using a method adopted by

TABLE I

Showing acid and alkaline phosphatase activity in the tail of B. melanosticus *during metamorphosis*
(Values are mean ± S.E. Four animals were used in each group)

Gr. No.	Total body length (cm) TBL	Tail length (cm) TL	Tail weight (mg) TW	Ratio of TBL/TL	Acid phosphatase activity µg/100 mg/hr.	Alkaline phosphatase activity µg/100 mg/hr.
1.	7 ±0·20	4·95±0·15	781±21	1·40±0	12·50±2·50	75·20±7·90
2.	4·85±0·15	2·80±0·10	195±15	1·71±0·02	143·70±3·80	167·50±8·40
3.	3·75±0·25	2 ±0·10	63·50±6·50	1·87±0·03	500 ±5·70	267·50±10·20
4.	3·70±0·20	1·70±0·10	64·6	2·14±0·03	562 ±2·70	310·40±6·80
5.	2·80±0·10	1·15±0·05	18±3	2·36±0·07	593·70 ±3·70	431·20±6·50
6.	2·85±0·50	1·10±0	18·50±1·50	2·58±0·04	793·30±4·10	492·50±8·20
7.	2·75±1·50	1 ±0	18·50±1·50	2·75±0·15	882·60±1·90	526 ±10·50
8.	2·90±0·10	1 ±0	19·50±2·50	2·93±0·10	1012·50±4·80	668·70±11·20
9.	2·65±1·50	0·75±0·05	16 ±1	3·46±0·09	1169·30±3·80	710·20±6·50
10.	2·60±1	0·70±0	16 ±1	3·70±0·14	1284·10±5·10	827·20±5·20