EFFECT OF AGE, SEX AND GONADAL HORMONE ON ALKALINE PHOSPHATASE ACTIVITY OF RAT BRAIN TISSUE*

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Introduction

Phosphatase has been known for sometime to be widely distributed in the body, both in tissues which normally ossify and in those which do not. Although it is the characteristic of this phosphatase that it can split glycerophosphate and other monoesters of phosphoric acid at high pH (about 9) it is not known whether all these phosphatases are the same. Bodansky (1937) showed that the activity of bone and kidney phosphatase was retarded by bile acids and that of the intestinal phosphatase, as might be expected, was not.

Much work, using histochemical and standard biochemical techniques, has been carried out on the phosphatase of various tissues of the animal body. The study of alkaline phosphatase in brain tissue was undertaken with a view to observe the effect of age, sex and gonadal hormone in terms of change in enzyme level, if any.

Material and Methods

Bodansky's method (1932) was used for the biochemical measurement of alkaline phosphatase activity of brain tissue. The 'alkaline phosphatase substrate' used was made up of Na-glycerophosphate, $CaCl_2$, $MgCl_2$, and Na-barbital in distilled water. Gomori's method (1939) was used for the histochemical study of the enzyme.

Albino rats of local variety were used and were divided into various groups as given in Tables I and II. Animals were sacrificed by decapitation except in the groups III and IV which were sacrificed by giving a blow on the neck. The brain tissue was quickly excised and kept in refrigerator for 2–3 minutes. It was then rapidly weighed and a 10% homogenate in distilled

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water was prepared by grinding in a mortar and then straining through muslin.

RESULTS

The values obtained for alkaline phosphatase in rat brain tissue are represented in a tabular form below (Tables I and II).

TABLE I

Alkaline phosphatase activity of brain tissue in different groups of male and female rats

Group No.	No. of animals	Sex	Body weight g. ±6 m.* (range)	Mg. of PO_4/100 mg. dry wt./hr., *i.e.*, A/W × 100 ±6 m.*
I M	6	Male	77 ±2·66 (55–95)	2·16 ±0·038
II M	6	,,	131·0 ±2·54 (120–150)	2·0
III M	6	,,	228 ±2·03 (Over 200)	1·58 ±0·03
I F	6	Female	76 ±2·136 (55–95)	1·66 ±0·021
II F	6	,,	133·0 ±2·35 (120–150)	1·76 ±0·033
III F	6	,,	214 ±4·238 (Over 200)	1·71 ±0·016

* 6m. = Standard Deviation of mean.

TABLE II

Alkaline phosphatase activity of brain tissue in three groups of female rats

Group No.	No. of animals	Body weight g. ±6 m.*	Mg. of PO_4/100 mg. dry wt./hr., *i.e.*, A/W ±100 ±6 m.*
IV F (Control) ..	6	96·08 ±1·08	1·65 ±0·011
V F (Ovariectomised) ..	6	108 ±4·49	2·16 ±0·01
VI F (Ovariectomised + Treated)	6	100 ±2·236	2·15 ±0·05

* 6m. = Standard deviation of mean.

There is no alteration in alkaline phosphatase value with increase in weights in either sex of animals except in the groups of male rats weighing over 200 gm., which show slightly less activity as compared to other groups of male rats. When alkaline phosphatase activity was studied in relation to sex of the animal, male rats exhibited slightly more activity than the females. The activity slightly increases after ovariectomy. There is no significant fall or rise in these values in case of spayed rats treated with female sex hormone.

Discussion

When referred to the literature it is seen that extensive work has not been carried out on alkaline phosphatase activity in brain tissue with reference to the factors of the age of the animal.

Richter and Hullin (1951) worked on the isolated nuclei from the cerebral cortex of human brain. It was demonstrated that the nuclei of the nerve cells contained active alkaline and acid phosphatases. Ross and Ely (1949) showed that alkaline phosphatase acts slowly on polymerised desoxyribonucleic acid as well as on depolymerised form of the acid. These authors also state in their paper that higher activity found in the nuclei in the brains of infants would agree with the suggested function of alkaline phosphatase in relation to desoxyribonucleic acid metabolism, which is particularly fast in actively developing tissue.

During the present investigation, however, the effect of age was not so marked.

Data are scarcely available regarding the effect of sex of the animal and gonadal hormone on alkaline phosphatase activity in brain tissue. The slight increase in ovariectomised animals may be suggestive of an inhibitory action of gonadal hormone but contrary to the expectation the results obtained with hormonally treated female castrates did not show tendency towards the normal value.

Histochemical studies of brain tissue for the distribution of the enzyme showed that the intensity of staining in the nuclei and the cytoplasm was somewhat equal. Other components of the tissue gave negative reaction. As compared to other organs the activity shown by the brain tissue is weak. There is no marked differentiation in phosphatase activity with change in age or sex of the animals. It is also observed that the activity indicated by cerebellum is more well marked than that of cerebrum.

SUMMARY

Influence of age, sex and female sex hormone on alkaline phosphatase activity of rat brain tissue was studied both biochemically and histochemically. No alteration in alkaline phosphatase value due to increase in weights (and age) in either sex of the rats was observed.

The values obtained in male rats were slightly higher than those for females.

The alkaline phosphatase values were slightly higher after ovariectomy. There was no significant rise or fall in these values in rats ovariectomised and treated with the hormone.

Histochemical studies showed weak activity in brain tissue which was not affected by age, sex or the female sex hormone.

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