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

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Introduction

In recent years, the study of the relationship of gonadal hormones to aging in the field of endocrinology has opened up a new approach towards hormone-enzyme relationship. It was decided therefore to elucidate the effect of gonadal hormones by studying the tissue metabolism at different age levels of animals of the two sexes.

Many chemicals influence the biochemical activity of animal tissues, and in general, the effects occur at the enzyme level. The hormones that regulate animal metabolism are among the substances known to influence the enzyme activity. However, the mechanism of hormonal action and especially the mode of hormonal regulation of cell metabolism are still obscure. Recently considerable attention has been paid to various enzymes in the brain during its development and attempts have been made to correlate the findings with the functional activity (Sperry, 1955). The role of acetylcholine in the nervous system is one of the most debated problems of physiology and hence the enzyme concerned with its breakdown was selected for the study. An attempt has been made to study the activity of this enzyme as related to age, sex and the female sex hormone.

Material and Methods

Method of Michael (1949) was used for the measurement of cholinesterase activity of brain tissue. Male and female albino rats of local variety were used throughout the study. The animals were divided into various groups as given in Tables I and II. The animals were sacrificed by the method of decapitation. The tissue was excised immediately after the animal was killed and kept at refrigerator temperature for 2–3 minutes. Tissue was

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then rapidly weighed on a balance. A 10% brain homogenate in distilled water was prepared by grinding it in a mortar and pestle and straining through muslin cloth.

Rats in the groups IVM and IVF were sacrificed by giving a blow on the neck instead of decapitation.

RESULTS

The results are summarised in Tables I and II.

TABLE I

Cholinesterase activity of brain tissue in different groups of male and female rats

Group No.	No. of animals	Sex	Body weight g. ± 6 m.* (range)	Esterase activity mean pH/hr. ± 6 m.*
I M	6	..	16·05±1·13 (10–15 days old)	1·19±0·06 (1·06–1·45)
II M	6	Male	74·9±4·57 (55–95)	1·20±0·218 (0·65–2·13)
III M	6	,,	137·0±2·73 (120–150)	1·16±0·03 (0·97–1·29)
IV M	6	,,	217·7±4·67 (Over 200)	1·22±0·063 (0·97–1·38)
II F	6	Female	72·4±3·01 (55–95)	1·91±0·079 (0·51–2·17)
III F.	6	,,	130·0±3·62 (120–150)	1·13±0·056 (0·99–1·25)
IV F	6	Female	225·0±8·11 (Over 200)	0·84±0·024 (0·80–0·90)

* 6 m. = Standard deviation of mean.

It will be seen that the cholinesterase values obtained for new-born animals are but slightly lower than those for the other groups and the difference is not significant. There is not much variation in the enzyme values due to increase in weight of animal. When the activity was studied in relation to sex, and sex hormone results obtained did not show any difference in the activity.

TABLE II

Cholinesterase activity of brain tissue in three groups of female rats

Group No.	No. of animals	Body weight g. ± 6 m.*	Esterase activity mean pH/hr. ±6 m.*
VF (Control) ..	6	98·0±0·7	1·13±0·056 (0·99–1·25)
VIF (Ovariectomised) ..	6	125·2±6·71	1·10±0·05 (0·90–1·28)
VIIF (Ovariectomised + Estradiol)	6	105·7±6·62	0·85±0·072 (0·69–0·97)

* 6 m. = Standard deviation of mean.

The mean values of the cholinesterase activity appear to show slight decrease with increase in weight of the animal but this is not significant.

DISCUSSION

Cholinesterase has been studied by various workers, in order to correlate the enzyme concentration and the function during growth. Nachmansohn (1950) demonstrated in a variety of cases that during growth high concentration in nerve tissue and at motor end plates is reached when the function develops. Earlier experiments were performed on the muscle of chick embryo (Nachmansohn, 1938, 1938 *a*, 1939). Extending the work further, in relation to central nervous system, Nachmansohn showed that in the central nervous system the time when the centres begin to function, high concentration of the enzyme appears. He also observed that in the brains of new-born rats and rabbits which are markedly underdeveloped, the enzyme concentration is low. During the first three weeks after the birth the concentration increases rapidly to high values and that is the time during which brain functions develop. In the brains of new-born guinea-pigs, on the other hand, which are well developed at the birth, the enzyme concentration is as high as in adults. Barcroft and Barron (1939) studied the enzyme in connection with the movements and reflexes of the sheep foetus.

Aprison and Himwich (1954) studied cholinesterase activity of different parts of rabbit brain in order to see the effect of age of the animal on enzyme activity. Cholinesterase activities were found to be low during gestation and rose to maximal values at different period after birth.

Skramstad (1956) studied cholinesterase activity in brain tissue of mice. He observed a remarkably low activity in infantile mice. Values only 15–20 per cent. of those in mature mice were obtained with three days old mice. Apparently there was a steady increase for about 4 weeks, until the level of maturity was reached.

Bayliss and Todrick (1953) in their study on the development of cholinesterase in the brain and spinal cord of young rats, observed that from the third to the twentieth day the acetylcholinesterase activity of the whole brain increased at the rate of slightly more than 300 units (μl./hr.) per day. There was fall in the rate after this age.

However, in the present investigation the effect of age of the animal on cholinesterase activity is not marked.

Skramstad (1956) while extending his work on cholinesterase activity of mice in relation to sex could not detect any difference in values of enzyme. In the present study also no difference in activity in male and female rats was observed. It is, therefore, suggested that the sex hormone has little effect on the enzyme activity of brain tissue. When the enzyme was studied in castrated females and female castrates treated with estradiol, no significant difference was observed, which supports the above supposition.

SUMMARY

The cholinesterase activity of rat brain tissue in relation to age, sex and gonadal hormone has been studied. No significant difference due to the age and sex was observed.

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