SEASONAL VARIATION IN THE ACTIVITY OF THYROID GLAND IN RATS

By

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(Received February 2, 1963).

The average serum protein bound iodine levels were 3·8 ± 0·16 µg and 3·2 ± 0·17 µg per 100 ml. in the month of January and May respectively. The rise in the serum PBI level in winter is the result of increased activity of the thyroid gland which is the result of increased secretion of TSH. This effect of the atmospheric temperature on the thyroid accounts, at least partly, for the low average serum PBI values seen in normal healthy Indians. Againthis possibility has to be remembered in interpreting results of any long term experiment.

It is more or less an accepted fact that thyroid gland shows a seasonal rhythm, the activity being more in winter than in summer months. This had been recorded in various animals, namely : chicks (Reinke *et al*, 1945), mice (Hurst, and Turner, 1949), sparrows (Wilson and Farner 1960), beavers and dogs (Kelsey *et al*, 1960).

For experimental work related to the activity of the thyroid gland, rat is to be preferred to other laboratory animals because its thyroid gland is very active and sensitive (Pitts River, 1960). The seasonal variation in the thyroid hormone secretion rate is convincingly demonstrated by Dempsey and Astwood (1943) and Mullick (1958). But the method used by them was rather an indirect one. Moreover, in the last decade or so, the reliablity of the serum protein bound iodine (PBI) as an index of the thyroid activity is well established (Kulkarni, 1963). Therefore, it was decided to record changes in serum PBI of rats under natural fluctuations in environmental conditions prevailing at Poona. The seasonal variation in other common thyroid indices like B M.R., thyroid weight and average acinar cell height were also noted simultaneously.

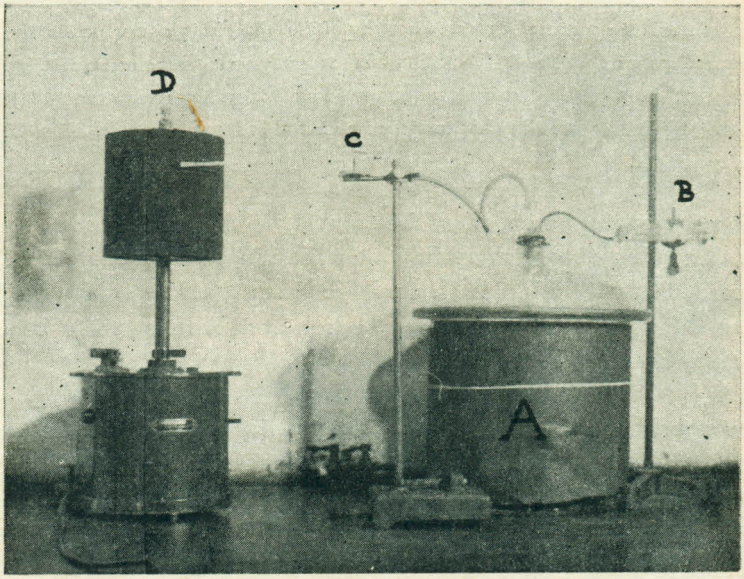
METHODS

The male albino rats of Haffkine strain bred in our animal colony formed the material for this work. They were housed in a well ventilated room

where the temperature changed with the changes in the atmospheric temperature. All the animals were kept under "surveillance" for 15 days to see that they were keeping good health.

The average atmospheric temperature was calculated from the mean of maximum and minimum temperatures of each of the fifteen days during surveillance.

After 15 days, the animals were fasted for 24 hrs, weighed and their B.M R. was determined by the method of D'Amour and Blood (1956). The apparatus was arranged as shown in Fig. 1 and the lower portion of the desiccator was filled in with 5 per cent NaOH solution. The zero line, and the



Arrangement of the apparatus for recording the B.M.R. of rats.

A. Desiccator covered with a dark paper to avoid excitation of the animal.
B. Syringe.
C. Marey's tambour.
D. Recording drum.

lines after injecting in and drawing out 20 ml. of air were just run around the drum. The rat was then placed on the desiccator platform, 25-30 ml. of air were forced in and the drum was started. From the time required for the consumption of 10 ml. of 0_2 under experimental conditions, the B.M.R. was calculated by assuming R.Q. to be 0·8.

Then the animals were etherized and the blood was collected from the jugular vein in heparinized tubes. The plasma was separated from the blood by centrifugation and the PBI was estimated by using the chloric acid digestion method of Zak *et al* (1952) which was suitably modified by Kulkarni and Desai (1963a) in our laboratory.

Ultimately, the animals were sacrificed. The thyroids were quantitatively taken out, cleaned and weighed accurately on a microbalance. The glands were fixed in Bouin's fluid and paraffin sections, stained with haematoxylin and eosin, were prepared as usual. The average height of the acinar cells was determined with ocular micrometer.

RESULTS

The values of B.M R., thyroid weight, average acinar cell height and plasma PBI, recorded in 26 rats during the month of January and in 16 rats during the month of May, are summarized in Table 1. The unpaired "t" test was applied to all parameters of the thyroid activity and in each case the probability, P value, was found to be statistically highly significant.

DISCUSSION

The most obvious reason for the rise in plasma PBI value in winter season appears to be the high rate of production of thyroid hormones. The average weight of the gland as well as the average acinal cell height were both increased significantly (Table 1). Dempsey and Astwood (1943) had found that the secretion rate of thyroid hormones in rats was considerably more at 1°C. temperature than the one at 35°C. These observations were further confirmed by Mullick (1958), again in rat as an experimental animals. Recently, Osiba (1959) had also recorded seasonal changes in the activity by using a more elaborate method viz., the uptake of I^{131} by thyroid gland.

The exact mechanism by which this rise of the secretion rate in winter season is brought about is not known. Probably increased demand for thyroid hormones in the cold environment might be due to an increased peripheral metabolism of them (Kassenaar *et al*, 1959) in order to provide more heat needed to combat cold. As a result of removal of the inhibiting effect of circulating thyroid hormones on the pituitary, there is increased secretion of the thyrotropic hormone (TSH). This, in turn, causes the enlargement of the thyroid gland as well as the increase in the height of acinar cells.

TABLE I

Seasonal variation of B.M.R., Thyroid weight, Average acinar cell height and Plasma P.B.I. in Rats.

Month of Experiment	January		May		t	P
Average Atmospheric Temp. in°C.	22·5		34·4			
	Mean	S.E.	Mean	S.E.		
B.M.R. in Cal/m²/hr.	31·8	2·8	24·3	2·3	2·9	< 0·01
Thyroid Weight in mg/100 G. body wt.	22·0	1·4	13·8	1·8	8·5	< 0·001
Average Aciner Cell Height in microns.	4·0	0·36	3·2	0·2	5·5	0·001
Plasma PBI in μg %	3·8	0·16	3·2	0·17	4·0	0·001

It was found by Kulkarni and Desai that the range of serum PBI values in normal healthy Indians is 2·4—5·1 μg per cent (1963b) which is definitely lower than the one in western subjects. In the light of the observation in these experiments, it is possible to account for the low values as a result of difference in climatic conditions. This does not, of course, rule out the possibility of any other factor which may also be responsible.

The seasonal variation should be remembered while interpreting results of the experiments related to the activity of the thyroid gland and the ones in which the thyroid may have direct or indirect influence.

Thanks are due to Dr. F. J. Mendonca, Dean, B. J. Medical College, Poona, for the facilities given to carry out the work.

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