

GLANDS AND GLAND PRODUCTS

IV. Seasonal Variations in the Total Iodine and Thyroxine Contents of the Thyroid Glands of South Indian Animals

BY

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THE thyroid stands unique amongst all the endocrine glands as regards susceptibility to geographic and seasonal variations. Glands from animals belonging to certain regions (especially the so-called 'goitrous regions') have been shown to contain very low iodine in marked contrast to the high iodine content reported for South Indian animals (Dey *et al.*).¹ That there is a marked seasonal variation in the iodine content of the thyroid was established by Seidell and Fenger² and by Fenger³ who analysed thyroid glands of hog, beef and sheep collected from the Mississippi valley and showed that during the summer months the glands might contain as much as three times the amount of iodine in the winter months. This observation has been confirmed by Veil and Sturm⁴ and also by Kendall and Simonsen⁵ who showed marked seasonal variations not only in the total iodine but also in the amount of thyroxine which could be isolated. The extensive investigations carried out by Riddle⁶ on the thyroids of doves have shown marked changes in the weight and iodine content of the gland with changes of season. Remarkably enough, Scottish and English animals show a fairly constant iodine content for desiccated thyroid throughout the seasons of the year.⁷

Two theories have been put forward to explain this seasonal variation in the iodine contents. Cameron⁸ and his school are of opinion that the predominant factor is the diet; during summer months the animals have free access to pastures whereas during the winter months they are confined indoors and fed on artificial diet. This theory is supported by numerous observations that the iodine content of thyroid can be artificially increased by feeding on diet rich in iodides (cf. Hunter and Simpson).⁹ Fenger,³ however, has suggested that the temperature factor is the most important of all in producing seasonal variation in the iodine content of the thyroid. There is an increased metabolism at lower temperatures and more of the hormonal secretion is poured out from the gland thereby depleting the latter of its iodine reserves; these effects are reversed during the summer months. This theory finds support in the experimental observations of Mills¹⁰ who found that high temperatures cause diminished activity of the thyroid and of Cramer¹¹ who showed that response to cold increases thyroid activity.

This seasonal variation in the iodine content of the thyroid glands has more than theoretical significance. Kendall¹² has pointed out that for the isolation of thyroxine the thyroid material available in the United States from the months of October to June is not practicable from a commercial point of view; in June, July and August the amount of thyroxine may

be almost five times as much as the amount which can be isolated from the same weight of hog glands in January and February.

The thyroid glands of cattle, sheep and pigs available from the Madras Corporation Slaughter House were collected during the twelve months, August 1943 to July 1944, desiccated and analysed for total and thyroxine iodine by standard methods. The results, which are represented in the following table,

TABLE I
Analysis of Thyroid Glands (desiccated)
collected during the twelve months
of the year

Month	Animal	Total Iodine (per cent.)	Thyroxine Iodine (per cent.)	% Ratio Thy- roxine Iodine Total Iodine
August 1943	Cattle	0.9113	0.3530	38.75
	Sheep	0.6650	0.2593	38.99
	Pig	0.9150	0.3904	42.67
Sept.	Cattle	0.9492	0.3861	40.67
	Sheep	0.7060	0.2959	41.91
	Pig	0.8314	0.3869	46.54
Oct.	Cattle	0.9642	0.3533	36.64
	Sheep	0.6479	0.2609	41.21
	Pig	0.8949	0.3949	44.14
Nov.	Cattle	0.9429	0.3620	38.39
	Sheep	0.6321	0.2607	41.24
	Pig	0.8590	0.3639	42.36
Dec	Cattle	0.9772	0.4045	41.39
	Sheep	0.6648	0.2770	41.67
	Pig	0.8325	0.3622	43.50
Jan. 1944	Cattle	0.9917	0.3964	39.96
	Sheep	0.7237	0.2904	40.14
	Pig	0.8181	0.3487	42.62
Feb.	Cattle	1.030	0.4041	39.23
	Sheep	0.7602	0.2924	38.47
	Pig	0.7833	0.3155	40.27
March	Cattle	0.9647	0.3691	38.25
	Sheep	0.7496	0.2678	35.72
	Pig	0.7715	0.3736	48.42

TABLE I—(Contd.)

Month	Animal	Total Iodine	Thyroxine Iodine	% Ratio Thyroxine Iodine
		(per cent.)	(per cent.)	Total Iodine
April	Cattle	0.9552	0.3590	37.58
	Sheep	0.7127	0.2636	36.99
	Pig	0.5664	0.3032	53.53
May	Cattle	0.9839	0.3420	34.75
	Sheep	0.7476	0.2716	36.33
	Pig	0.8038	0.3271	40.69
June	Cattle	0.9954	0.3623	36.40
	Sheep	0.7962	0.2913	36.59
	Pig	0.8109	0.3411	42.07
July	Cattle	1.052	0.3638	34.58
	Sheep	0.7678	0.2903	37.80
	Pig	0.8260	0.3432	41.56

indicate that there is practically no seasonal variation in the total or thyroxine iodine content of the glands.

Glands collected all round the year in South India can, therefore, be utilized for the preparation of thyroxine and thyroid extracts.

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3. Fenger, *Endocrinology*, 1918, **2**, 98.
4. Veil and Sturm, *Deutsch. Arch. Kl. Med.*, 1925, **147**, 166.
5. Kendall and Simonsea, *J. Biol. Chem.*, 1923., **80**, 357.
6. Riddle, *Amer. J. Physiol.*, 1925, **73**, 5; *Endocrinology* 1927, **11**, 161.
7. Martia *Pharm. J.*, 1912, **89**, 169, 444.
8. Cameron, *J. Biol. Chem.*, 1915, *J. Biol. Chem.*, **23**, 1.
9. Hunter and Simpson, *J. Biol. Chem.*, 1915, **20**, 119.
10. Mills, *Endocrinology*, 1932, **16**, 52.
11. Cramer, 'Fever, heat regulation, climate and the thyroid-adrenal apparatus,' 1923.
12. Kendall, 'Thyroxine', 1929.

THE SUGAR RESEARCH FOUNDATION

A LONG-RANGE programme of research on sugar will be undertaken at the Massachusetts Institute of Technology in co-operation with the newly established Sugar Research Foundation of New York, which has made a grant of \$125,000 for a five-year programme of research. Plans for the project were made public in a joint announcement by President Karl T. Compton, of the Massachusetts Institute of Technology, and Joseph F. Abbott, President of the Sugar Research Foundation.

The Foundation was established for the development of fundamental knowledge in the field of carbohydrate chemistry, biochemistry and nutrition. Membership is open to all producers and processors of sugar in the United States, Puerto Rico, Hawaii and Cuba.

Dr. Compton, in announcing the co-operative arrangement, said:—

"The new programme is another step in the Institute's long-established policy of co-operation with industry in fundamental research to improve industrial processes and develop new products. The project we are about to undertake is a pioneering plan of national significance in that it promises substantial benefits, not for one organization, but for an entire industry.

"The rewards of scientific research in co-operation with industry are by no means restricted to the development of new products, for the discovery of new knowledge in any branch of science invariably proves to be a contribution to advanced technical education in associated fields. Thus this sponsored research on sugar makes it possible for the Institute to continue and expand the programme of fundamental investigations in the field of carbohydrate

chemistry which has been in progress for several years.

"We are particularly glad that Dr. Robert C. Hockett, who has been given leave of absence from our Faculty to become the scientific director of the Sugar Research Foundation, will be in charge of this broad programme.

"The sugar industry is to be commended for its public service and vision for making possible this objective research. I feel sure it will be rewarded by results of great scientific value to the public."

Commenting on the new laboratory, Joseph F. Abbott, President of the Sugar Research Foundation, said in part:—

"It is anticipated that the chemical studies conducted under the arrangement with the Massachusetts Institute of Technology will not only extend knowledge of the rôle of sugar and other carbohydrates in the human body, but also will unfold wholly new industrial uses for sugar and its derivatives. It is our hope that the collaboration between the industry and this outstanding technical institution will prove to be of great benefit to science and the general public as well as to the industry.

"An important objective of this broad research programme will be the training of scientists in the field of carbohydrate chemistry to prepare them for service in the industry for further technical studies. Provision has also been made for fellowships for young graduate students who are candidates for advanced degrees to permit them to continue their work in this field."—*Science*, December 10, 1943, p. 509.