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# Influence of Climate on Thyroidal Iodine Metabolism in Buffalo-cows

## I. Thyroidal Iodine Concentration

By

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*With one figure and 4 tables*

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## Introduction

In Egypt, the buffalo-cow is considered an important dairy animal but ovarian inactivity is widespread among this species.

Many attempts have been made to overcome this serious problem. Mineral deficiencies, especially phosphorus deficiency, have been claimed to play an important role in the causation of this ovarian syndrome (FOUAD and SHOKEIR, 1959, and ZAKI and GOHER, 1961).

Iodine deficiency has been assumed by SCHMIDT et al. (1963) from the results of clinical studies of this syndrome.

SCHMIDT et al. (1964) concluded that calcium, phosphorus, manganese and vitamin $D_3$, and especially iodine deficiency, are the important causes of the impaired fertility of the Egyptian buffalo.

As the thyroid gland is the main organ in the animal body where iodine is stored, this work was undertaken to throw more light on the thyroidal iodine metabolism in buffalo-cows.

## Material and Methods

The thyroid glands of 320 non-pregnant buffalo-cows were collected from Giza slaughterhouse, U. A. R., over a period of one year. The glands were taken directly after slaughter. Connective tissue and fat were removed by trimming each gland and its fresh weight was estimated to the nearest 0.1 gram.

Estimation of total iodine (inorganic iodide and organically bound iodine) was carried out according to EL SADR and BARAKAT (1954).

The results were statistically analysed according to SNEDECOR (1956).

## Results

*Climatic Factors:* The average monthly data of climatic factors including length of sunshine, ambient temperature, relative humidity and atmospheric pressure prevailing at Giza during the period of this study are shown in Table 1.

*Table 1*
Average monthly results of climatic factors

| | Jan. | Febr. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S. S. | 7.3 | 7.7 | 8.9 | 9.8 | 11.1 | 11.8 | 12.0 | 11.0 | 10.0 | 9.3 | 8.4 | 7.3 |
| A. T. | 13.6 | 13.5 | 16.5 | 20.8 | 24.4 | 27.2 | 27.8 | 27.9 | 25.6 | 23.5 | 19.5 | 15.4 |
| R. H. | 67.8 | 64.8 | 54.6 | 49.0 | 46.2 | 48.2 | 56.4 | 61.0 | 62.0 | 62.6 | 69.6 | 67.2 |
| A. P. | 18.3 | 18.7 | 15.8 | 12.5 | 11.5 | 11.1 | 8.1 | 8.2 | 11.7 | 15.1 | 17.1 | 17.6 |

S. S. = Sunshine length in hours.
A. T. = Ambient temperature in °C.
R. H. = Relative humidity %.
A. P. = Atmospheric pressure in millibars (1,000 mb. +).

*Fresh Thyroid Weight:* The average monthly thyroid weights are presented in Table 2.

*Table 2*
Average monthly fresh thyroid weights

| Jan. | Febr. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.6 | 26.2 | 23.5 | 23.9 | 24.6 | 22.8 | 24.8 | 24.8 | 25.3 | 24.5 | 24.8 | 22.3 |

Over this period the average thyroid weight was 24.4 gm. with a standard deviation of 7.21 and a range from 12 to 58 gm.

Although the heaviest mean weights (26.25 gm.) were in February and the lightest (22.26 gm.) in December, analysis of variance showed that this difference is not significant.

*Thyroidal Iodine Concentration:* The average monthly results of iodine concentration expressed as mg. iodine per 100 gm. dry thyroid powder are given in Table 3.

*Table 3*
Average monthly thyroidal iodine concentration mg.%

| | Jan. | Febr. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Emp. | 202 | 180 | 176 | 235 | 232 | 236 | 271 | 260 | 288 | 211 | 254 | 232 |
| Theo. | 205 | 200 | 202 | 211 | 223 | 237 | 250 | 260 | 265 | 264 | 252 | 229 |

Emp. = Empirical values.
Theo. = Theoretical values.

A mean of 231.6 mg. % iodine was the general average of thyroidal iodine throughout this period, with a standard deviation of 68.9 and a range from 86.4 to 426.7 mg. %.

Analysis of variance in Table 4 showed that the variation between months is highly significant ($P < 0.001$). The highest iodine concentrations were seen during the hot summer months (July, August and September) and the lowest during the cold winter months of January, February and March.

*Table 4*
Analysis of variance of thyroidal iodine concentration

| Source of variation | Degrees of freedom | Variance | Component % |
|---|---|---|---|
| Between months | 11 | 31.761 *** | 21.9 |
| Regression (cubic) | 1 | 136.971 *** | - |
| Error | 308 | 3.749 | 70.1 |

*** = $P < 0.001$.

Moreover, the variance of the cubic regression was highly significant ($P < 0.001$). Thus, the sinoid curve was computed and the theoretical trend of thyroidal iodine concentration in buffalo-cows during the different months of the year is presented in Table 3 and Figure 1.

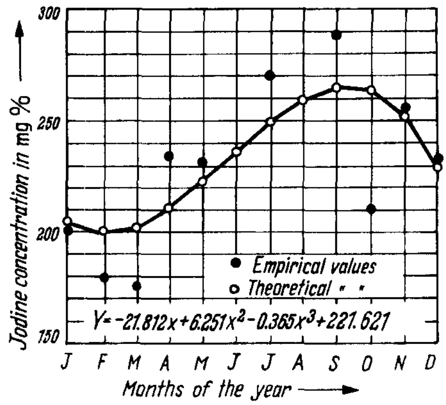


Fig. 1. Iodine concentration in the thyroid gland of buffaloes

### Coefficient of correlation between climatic factors and thyroidal iodine concentration

*a) Sunshine length*

The coefficient of correlation between sunshine length and thyroidal iodine concentration was ($r = + 0.60$) which is on a significant level ($P < 0.05$).

The regression between these two factors was:

$Y = + 16.2\,x + 85.4$

whereby x is the length of sunshine in hours per day and Y is the expected thyroidal iodine concentration in mg. %. This means that an increase of one hour in the sunshine length is accompanied by a corresponding increase of 16.2 mg. % of thyroidal iodine concentration.

*b) Ambient temperature*

The coefficient of correlation between these two factors was ($r = + 0.67$) which is significant ($P < 0.05$), and the regression obtained was:

$Y = + 5.35\,x + 126.49$

whereby x is the ambient temperature in °C.

An increase of 1 °C. in the ambient temperature is thus accompanied by a corresponding increase of 5.35 mg. % in thyroidal iodine concentration.

*c) Relative humidity*

A significant ($P < 0.01$) negative coeff. of corr. ($r = - 0.77$) was obtained between these two characters, and the regression was:

$Y = - 4.27\,x + 492.40$

whereby x is the relative humidity.

This means that with an increase of 1 % in the relative humidity, a corresponding decrease of 4.27 mg. % is expected in thyroidal iodine concentration.

*d) Atmospheric pressure*

The coeff. of corr. between these two traits was ($r = - 0.64$) which is significant ($P < 0.05$), and the estimated regression was:

$$Y = -7.47\,x + 342.46$$

whereby x is the atmospheric pressure in millibars (1000 mb. +).

Thus when the atmos. pres. is increased by 1 mb. (over 1000 mb.), there will be a decrease of 7.47 mg. % in thyroidal iodine concentration.

## Discussion

In this study a mean of 24.4 gm. was obtained for the fresh thyroid gland weight over a period of one year, with a standard deviation of 7.21 and a range from 12 to 58 gm. These results compare favourably with those obtained by Anderson (1956) who reported an average thyroid weight of 26.9 gm. for zebu cattle weighing from 901 to 1000 lb., and Swett et al. (1937, 1949 and 1955) for Guernseys, Jerseys and Holsteins. This similarity in findings may be due to a similarity of climatic conditions under which these animals are maintained. It has also been shown that tropical animals have smaller thyroids than northern animals (Brody and Kibler, 1941 and Swett et al., 1937, 1949 and 1955).

No seasonal variation in fresh thyroid weight was shown in this investigation. Although the heaviest thyroid weight (21.1 gm.) was obtained in winter and the lightest (23.7 gm.) in spring the difference was not significant ($P > 0.05$), which does not agree with the report of Seidell and Feneger (1913). This difference may be partly attributed to the fact that these authors based their conclusions upon figures obtained from time to time by counting out and weighing a certain number of glands. Alternatively this contradiction may be due to breed differences, local variations in climatic factors, nutritional and management systems adopted in each country.

The general average of thyroidal iodine concentration was 231.6 mg. % with a standard deviation of 68.9 and a range from 86.4 to 426.7 mg. %. Analysis of variance in Table 4 showed that there exists a highly significant ($P < 0.001$) seasonal variation in thyroidal iodine concentration, since the highest iodine values were seen during the hot summer months of July, August and September (271, 260 and 288 mg. % respectively) and the lowest during the cold months of January, February and March (202, 180 and 176 mg. %, respectively). These findings agree with those reported by Seidell and Feneger (1913) for sheep, pigs and beef cattle. Lodge et al. (1958) also found the highest average percentage of radio-active thyroidal iodine uptake during the hot summer months, and the lowest during the relatively cold spring. Similar findings were reported by Hoersch et al. (1961) and Flamboe and Reineke (1959) in sheep and goats, respectively.

The coefficients of correlation obtained in this study suggest that the increase in the length of sunshine results in an increase in thyroidal iodine concentration. This is not unexpected since Afiefy (1966) proved a highly significant ($P < 0.001$) positive correlation between the length of sunshine and ambient temperature and since an increased ambient temperature favours the accumulation of thyroidal iodine in heifers (Lodge et al., 1958), goats (Flamboe and Reineke, 1959) and sheep (Hoersch et al., 1961).

On the other hand, increased relative humidity or atmospheric pressure (within the limits prevailing in Egypt) caused a significant decrease in thyroidal iodine concentration. Afiefy (1966) reported a highly significant but negative correlation between ambient temperature and both relative humidity ($r = -0.83$) and atmospheric pressure ($r = -0.93$).

### Summary

The fresh weight and iodine concentration in the thyroid glands of 320 Egyptian buffalo-cows were studied during the different months of the year.

The mean fresh thyroid weight was 24.4 gm., with a standard deviation of 7.21 and a range from 12 to 58 gm. No significant seasonal variations could be demonstrated although the heaviest thyroids (26.25 gm.) were obtained in February and the lightest (22.26 mg.) in December.

The average thyroidal iodine concentration was 231.6 mg. %, with a standard deviation of 68.9 and a range from 86.4 to 426.7 mg. %. Significant seasonal variations were shown, with the highest concentrations during the hot months and the lowest during the cold months of the year.

Increased sunshine length and the resulting high ambient temperature significantly increased the concentration of thyroidal iodine.



### Résumé

**Influence du climat sur le métabolisme iodé de la thyroïde chez les buffles femelles**
**I. Concentration de l'iode thyroïdien**

On étudie le poids frais et la concentration de l'iode de thyroïdes de 320 buffles égyptiens femelles au cours des différents mois de l'année.

Le poids moyen de la thyroïde est de 24,4 gr., avec une déviation standard de 7,21, dans des limites de 12 à 58 gr. On n'observe pas de variations saisonnières significatives, bien que les thyroïdes les plus lourdes (26,25 gr) aient été trouvées en février et les plus légères (22,26 gr) en décembre.

La concentration moyenne de l'iode thyroïdien est de 231,6 mg %, avec une déviation standard de 68,9, dans des limites de 86,4 à 426,7 mg %. On observe des variations saisonnières significatives, avec des concentrations maximums pendant les mois chauds et minimums pendant les mois froids de l'année.

L'accroissement de la durée de l'insolation et la température ambiante élevée qui en résulte augmentent de façon significative la concentration de l'iode thyroïdien.



### Resumen

**Influjo del clima sobre el metabolismo del yodo tiroideo en búfalas**
**I. Concentración del yodo tiroideo**

Estudiáronse los pesos frescos y la concentración de yodo en los tiroides de 320 búfalas egipcias durante los diferentes meses del año.

El peso medio de los tiroides frescos era 24.4 g, con una desviación normal de 7.21, siendo los extremos absolutos 12 y 58 g. No se pudieron demostrar variaciones estacionales significantes, aunque los tiroides más pesados (26.25 g) se obtuvieron en Febrero y los más livianos (22.26 g) en Diciembre.

La concentratión promedio de yodo tiroideo era 231.6 mg %, con una desviación normal de 68.9 y extremos absolutos de 86.4 y 426.7 mg %. Se apreciaron variaciones estacionales significantes, con concentraciones máximas durante los meses calurosos y las mínimas durante los meses fríos del año.

La duración prolongada de los rayos solares y la temperatura ambiente alta resultante aumentaba significativamente la concentración del yodo tiroideo.


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