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Thyroid Function in Relation to Age at Puberty in Egyptian Water Buffalo Heifers

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SERUM total thyroxine, triiodothyronine, triiodothyronine uptake ratio and free thyroxine index were determined in sera of 57 water buffalo heifers during September, October and November. Correlation coefficients were made between each thyroid parameter and age at puberty. Negative correlations were obtained between age at puberty and T_4 ($P < .01$), during November, T_3 ($P < .01$, $P < .01$) during October and November and free thyroxine index ($P < .01$) during November. The results obtained suggested the importance of an opptimum level of thyroid hormones for the earlier attainment of puberty.

Cumulative reports during the last three decades supported the observation of low fertility and sterility in Egyptian water buffaloes, (Hafez, 1954; Oloufa, 1955, 1960; Ragab *et al.*, 1956; El-Sheikh and Mohamed, 1965) a problem which deserves the utmost consideration of animal physiologists. The exact mechanism (s) for the etiology of such observation is not well established.

The role of thyroid hormones in protein, carbohydrate, minerals and energy metabolism is well established and their relationship to the productivity of cattle and domestic animals was the subject of various reports (Schultze and Turner, 1945; Mixner *et al.*, 1966; Anderson and Harness, 1975). However, exhaustive review of literature showed a paucity of reports about the relationship between thyroid gland activity, as determined by specific and accurate techniques, and reproduction particularly in Egyptian water buffaloes. Physiological symptoms of heat in cows do not appear unless there is an optimal level of the thyroid hormone

(Spielman *et al.*, 1945). The association between changes in circulating hormonal level and ovarian activity is demonstrated in Freisian cows (Soliman *et al.*, 1964). The relationship between thyroid function and age at puberty must be known to serve as a knowledge base for recommendations to improve efficiency in animal reproduction.

The purpose of the present study was to determine thyroid gland activity in growing water buffaloes and to find out any possible relationship (s) between the various thyroid tests reflecting thyroid gland activity and the age of the animal at puberty. A primary objective of the study was to use various methods for evaluating thyroid function in order to clarify any possible relationship between thyroid activity and age at puberty since various reports indicated changes in one parameter of thyroid function without a corresponding change in another parameter (Ibrahim and Premachandra, 1972; among others), which the mechanisms underlying it are discussed elsewhere.

Material and Methods

The present study was carried out on a total of 57 water buffalo heifers (11-17 months old) maintained at the Animal Production Experimental Station, Faculty of Agriculture, Cairo University. The animals were kept outdoors under open sheds, day and night. They were fed on a balanced ration according to their body weight (Tommi, 1963). Water was provided *ad libitum* twice daily. Blood samples were collected from the jugular vein between 9.00 a.m. and 10.00 a.m. in plain vacutainer sterilized test tubes each month during September, October and November. The sera were analysed for thyroid hormones utilizing radioimmunoassay procedures. Total thyroxine was determined according to the method of Chopra *et al.* (1971). Triiodothyronine uptake ratio was performed according to the method of Irvin and Standeven (1968). In order to find out if the possible changes in the serum levels of circulating hormones are due to changes in the hormone carrier serum proteins, serum total protein and albumen were determined in the same sera using the sequential Auto-analyzed SMA-12/60. All the above mentioned determinations were carried out in the sera callected at the three intervals (September, October and Nov-

ember) before the ainmals reached-puberty. Seven animals out of the 57 heifers were followed up after attaining their puberty and the thyroid hormones was determined using the same radioimmunoassay procedures. The free throxine index was calculated according to Maclagan (1969).

Puberty was detected by rectal examination carried out on each heifer twice weekly for observing any possible changes in the ovaries. A hiefer was considered sexually mature if one or both ovaries contained a mature follicle, which ovulated and was followed by corpus luteum, or when an ovary contained a well formed corpus luteum (Zaki *et al.*, 1963), whether this hiefer showed external heat symptoms or not.

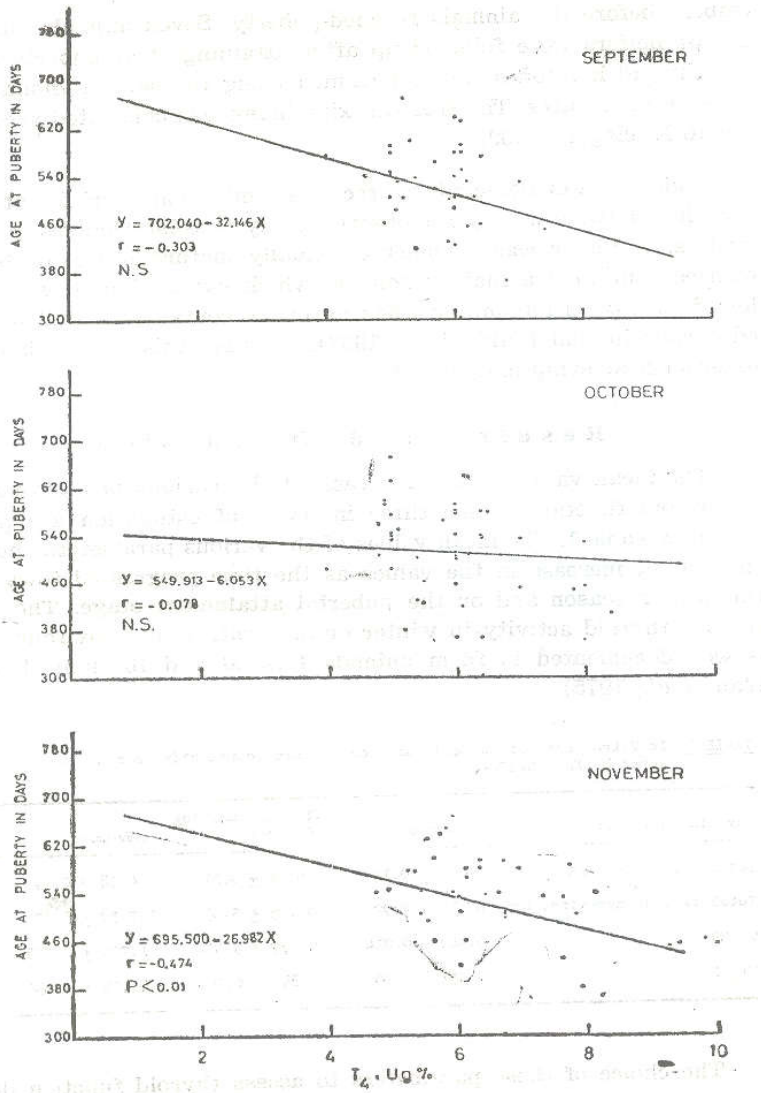
Results and Discussion

The mean value ± S.E. for each of the various *in vitro* tests of thyroid function at the three intervals of estimation are presented in Table 1. The mean values of the various parameters showed a slight increase in the values as the time progressed towards the winter season and/or the pubertal attainment stage. The increased thyroid activity in winter or moderately cold environment is well documented in farm animals (Kamal and Ibrahim, 1969; Wan *et al.*, 1975).

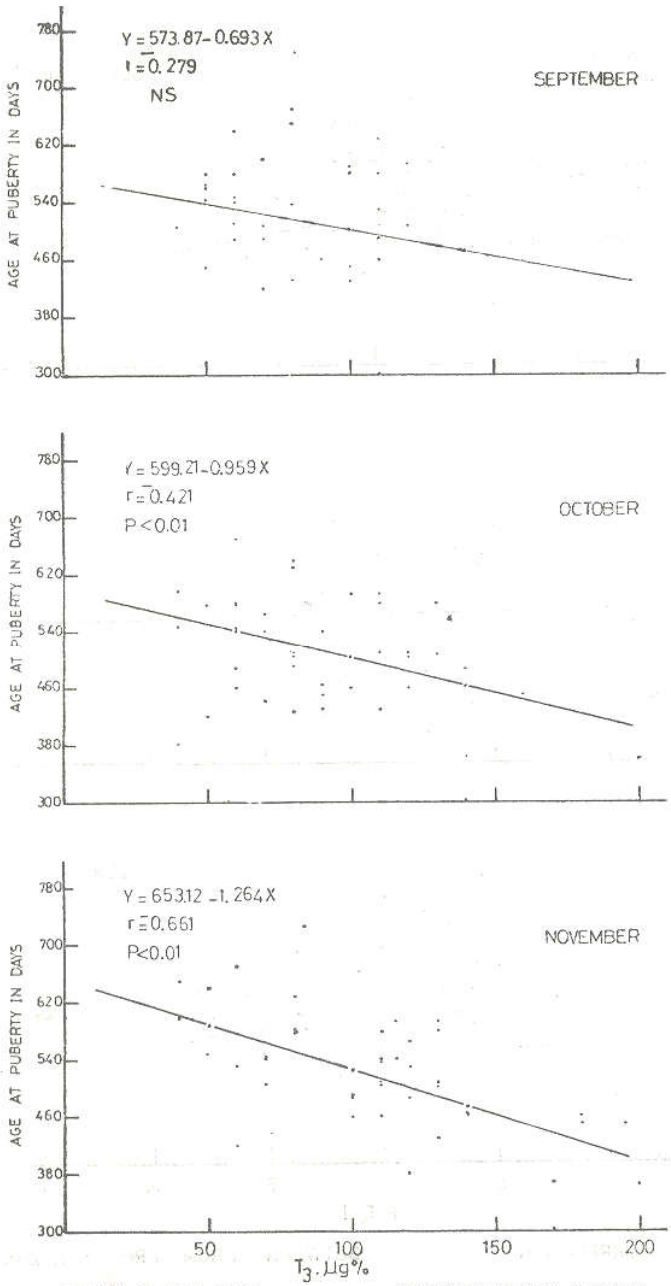
TABLE 1 In Vitro tests of thyroid function at three consecutive months in water buffalo heifers.

Thyroid Parameter	Time of sampling		
	September	October	November
Total thyroxine, ug%	5.67 ± 0.12	5.88 ± 0.14	6.58 ± 0.19
Total triiodothyronine, ng%	82.50 ± 4.92	89.25 ± 5.03	107.50 ± 5.82
T_3 UR	0.969 ± 0.014	0.979 ± 0.014	1.224 ± 0.189
FT_4 I	5.557 ± 0.186	5.841 ± 0.220	6.926 ± 0.298

The choice of these parameters to assess thyroid function deserves some comments. While total thyroxine and triiodothyronine reflect the circulating levels of thyroid hormones, free thyroxine index reflects the physiologically active part of the hormone which



FIG(1) CORRELATION BETWEEN SERUM TOTAL THYROXINE AND AGE AT PUBERTY



FIG(2) CORRELATION BETWEEN SERUM TRIIODO-THYRONINE AND AGE AT PUBERTY.

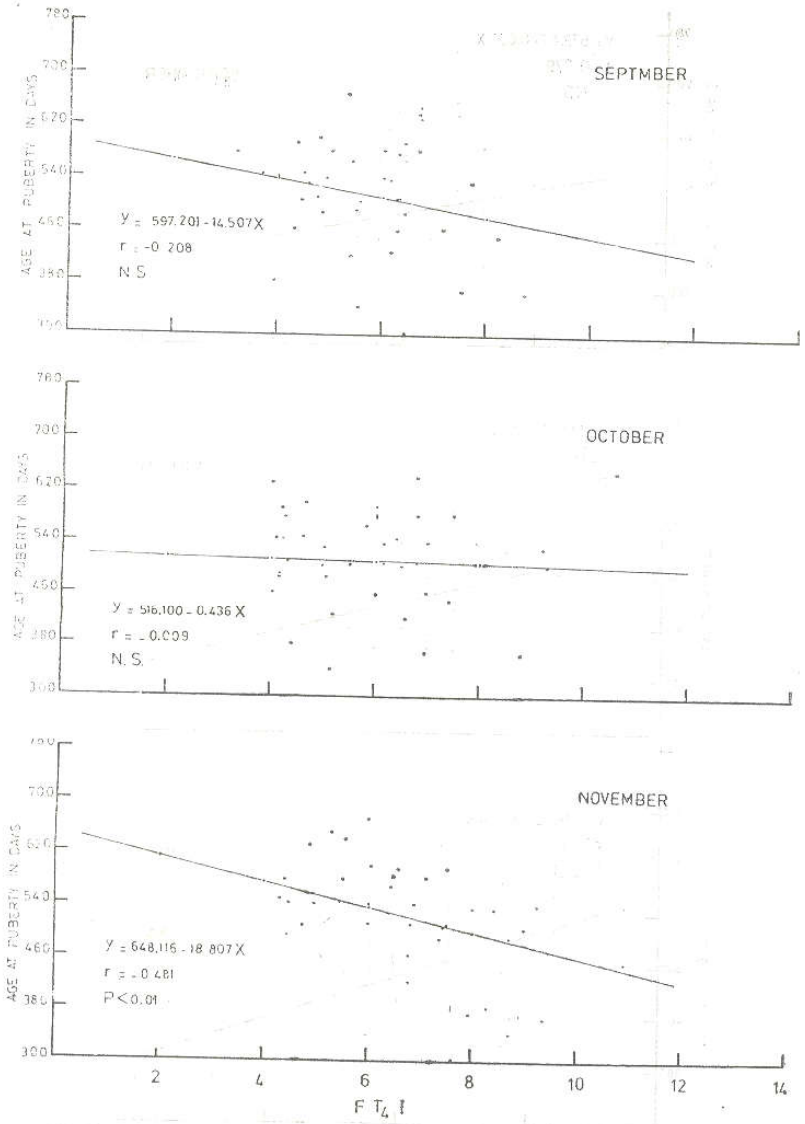


FIG (3). CORRELATION BETWEEN SERUM FREE THYROXIN INDEX AND AGE AT PUBERTY

act at the tissue level (Sterling and Hegedus, 1962). The inclusion of T_3UR in the present study was helpful in estimating the free thyroxine index. Correlation coefficients were estimated between each of these parameters and age at puberty at the three intervals of estimation to find out the relationship between age and T_4 (Fig. 1), T_3 (Fig. 2) and free thyroxine index (Fig. 3). No significant relationships were obtained for the first interval (September) and second interval (October) with the exception of T_3. However, significant negative correlations were obtained between each of the three parameters and the age at puberty indicating that with the increase in each of thyroxine, triiodothyronine or free thyroxine there is a corresponding decrease in age at puberty, an observation which might indicate the importance of thyroid hormones in the early attainment of puberty in water buffaloes.

The significant relationship between thyroid hormones and age at puberty can not be attributed to changes in hormone-carrier proteins. The mean values ± S.E. for serum proteins are presented in Table 2 and the relationship between the various serum pro-

TABLE 2 Mean value ± S.E. of serum total protein and albumin at three consecutive months in water buffalo heifers.

Time of sampling	Total protein, g%	Albumin, g%
September	7.81 ± 0.11	1.85 ± 0.03
October	7.86 ± 0.11	1.70 ± 0.05
November	8.92 ± 0.14	1.91 ± 0.05

TABLE 3 Correlation coefficients between total protein, albumin and each of T_4 and T_3.

	Time of sampling					
	September		October		November	
	d.F.	r	d.F.	r	d.F.	r
Total protein x T_4	50	0.091	50	-0.0219	52	-0.109
Total protein x T_3	50	0.050	49	-0.253	51	-0.286
Albumin x T_4	50	0.060	50	-0.262	52	-0.092
Albumin x T_3	50	0.101	49	-0.029	51	-0.185

All values were non significant

tein fractions and each of serum thyroxine, triiodothyronine are presented in Table 3. The non-significant correlations obtained in this study demonstrated the no effect of the protein levels on the circulating thyroid hormones levels within the range obtained in the study.

A comparison was made between the serum levels of thyroid hormones at two intervals; before puberty and after puberty. The results of such a comparison is illustrated in Fig. 4, as presented by the mean values and the corresponding standard errors. Unpaired "t" test revealed significant difference between the two groups in total triiodothyronine ($P < 0.01$) but not in total thyroxine. In both hormones, however, the post pubertal mean value was considerably higher than the corresponding pre-pubertal mean values.

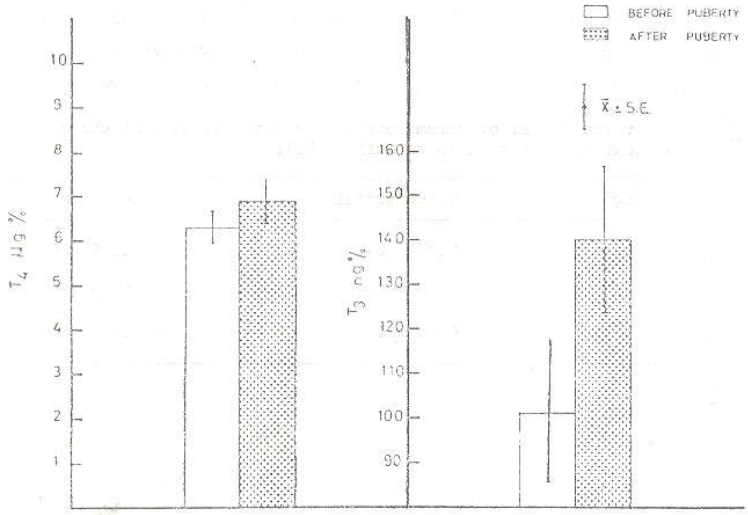


FIG (4) SERUM LEVELS OF THYROXINE AND TRIIODOTHYRONINE BEFORE AND AFTER PUBERTY

The present results suggest the importance of an optimum levels of thyroid hormones for the earlier attainment of puberty. However, further investigations are recommended to be carried out on the relationship between thyroid function and age

at puberty during the various seasons of the year. This also calls for further studies for the possible use of thyroid promoting agents in cases of delayed puberty.

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تقدير نشاط الغدة الدرقية فى عجلات الجاموس المصرى وعلاقته بعمر البلوغ

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لتفسير اسباب التباين فى عمر البلوغ فى عجلات الجاموس المصرى قدر نشاط الغدة الدرقية عن طريق قياس FT_4, T_3UR, T_3, T_4 فى السيرم .

أخذت عينات دم من ٥٧ عجلة جاموس تابعة لمشروع دراسة الخصب فى الجاموس فى شهور سبتمبر واكتوبر ونوفمبر وكانت متوسطات التقديرات كالاتى :

T_4 من ٦٧ر٥ – ٥٨ر٦ ميكروجرام/١٠٠ مل

T_3 من ٥ ر٨٢–١٠٧ نانو جرام/١٠٠ مل

T_3UR من ٩٦ر – ٢ر١

FT_4I من ٥ ر٥ – ٦ر٧

وقد حللت البيانات احصائيا ثم حسبت معاملات الارتباط بين سن البلوغ وقياسات نشاط الغدة الدرقية وكذلك معاملات الانحدار على العمر – من مناقشة نتائج هذه البيانات يلاحظ ان هناك اتجاها عاما لنقص مستويات نشاط الغدة الدرقية فى الافراد التى يتاخر فيها سن البلوغ وقد زاد وضوح هذه العلاقة فى تقديرات السيرم المأخوذة فى شهر نوفمبر يمكن الاستنتاج بان تاخر عمر البلوغ الجنسى فى عجلات الجاموس احد اسبابه نقص مستوى نشاط الغدة الدرقية ويوصى باستمرار الابحاث فى هذا الاتجاه لعلاج الحيوانات التى يتاخر فيها البلـــــوغ الجنسى باستخدام هرمونات الغدة الدرقية او المركبات التى تزيد من نشاطها .