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HYPERTHYROIDISM EFFECTS ON GONADS AND ENDOCRINES OF COCKS

I. MORPHOLOGICAL STUDIES

II. HISTOLOGICAL INTEGRATION

BY

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SUMMARY

Hyperthyroidism was induced in two years old White Baladi cocks by feeding different percentages of thyroprotein (protamone) from the ration, i.e. 0.006, 0.011, 0.017 and 0.022 %, during the summer months of June, July and August. Cocks representing each treated group, and one control group, were slaughtered to study the effect on the different gonads and endocrines. Also, the histological structure of the thyroids and the testes were studied. The following results and conclusions were observed :

I.—*Morphological Studies :*

1. Only mild hyperthyroidism (0.011 % and 0.017 %) exerted a stimulating effect of testes, epididymis and thymus weight; the other treatments caused atrophy in these organs.

2. The accessory sex organs and the secondary sex characters were decreased in size in all the treatments used here.

3. Thyroid size is reduced due to the different levels of hyperthyroidism induced in this work.

4. Thyroprotein feeding caused the reduction of adrenal's absolute weight, while mild doses of thyroprotein (0.011 and 0.017 %) increased adrenals' relative weight.

5. Feeding thyroprotein enlarged the size of the pituitary gland and the degree of response increased with increase in the rate of feeding thyroprotein.

II.—*Histological Integration :*

1. Group II (0.011 % thyroprotein) resulted in the highest spermatogenic activities. The seminiferous tubules contained the largest number of spermatids. Group II (0.017 %) also showed high spermatogenic activities. Mild hyperthyroidism induced in these groups favoured spermatogenesis. Group I (0.005 %) and the control showed the same inactive spermatogenesis, whilst the high doses (0.022 %) caused the deterioration of testicular tissue.

2. The control group and group I had the smallest thyroid follicles, the largest quantity of interfollicular cells and the most abundant colloid. Group II was medium in every structure, while group III and IV had the largest follicles, the smallest cell number and the least quantities of colloid.

3. Mild hyperthyroidism which was clear in group II and III, increased testis size and induced spermatogenesis. The low dose (0.005 %) had no effect when compared with the control, while high dose decreased spermatogenesis.

4. Feeding 0.011 % thyroprotein compensated for the normal seasonal decrease in thyroid activity during summer, and it also activated the thyroid itself. When thyroprotein was fed in higher quantities, the thyroid activity was depressed.

5. Reduction in thyroid activity due to summer effect was overcome by feeding certain moderate quantities of thyroid active substances, thus causing the enhancement of spermatogenic activity as measured by either histological examinations or by sperm production.

INTRODUCTION

I.—MORPHOLOGICAL STUDIES

Hyperthyroidism, induced by feeding desiccated thyroid, thyroxine or thyroprotein, caused the increase in testes size and spermatogenic activity (Jaap, 1933 ; Wheeler *et al.,* 1948 ; Kummaran and Turner, 1949). On the other hand, various workers showed that hyperthyroidism caused the decreased testes size and spermatogenesis (Turner *et al.,* 1944 ; Glazner and Jull, 1946 ; Wheeler *et al.,* 1948). Meanwhile, other workers found no effect of hyperthyroidism on testes size (Kheir

El-Din, 1955). The contradicting effects of hyperthyroidism on testes size and spermatogenic activity is due to differences in the rate of administrating thyroid active substances, age, breed, intact thyroid activity, reproductive activity and season of the year.

In adult male birds, thyroidectomy lead to the regression in testes size with which spermatogenesis cessation is associated (Benoit, 1936, 1937 ; Greenwood and Chu, 1939 ; Blivaiss and Domm, 1942 ; Payne, 1944).

Thyroid hyperplasia, produced by feeding rations low in iodine, gave indications of stimulating sexual development using comb and testes weight as a criterion (Nickolson and Breneman, 1945). On the other hand, thyroidectomy is found to cause the regression in the size of testis and comb in the mature cocks. Replacement therapy, induces growth of the testis and comb (Greenwood and Chu, 1939). When thyroid active substances are fed to males during mild weather, no effect is exerted on comb size, but when fed during hot weather comb size increases (Kheir El-Din, 1955).

Induced hypothyroidism in male birds by thiouracil as a thyroid depressant substance, caused the decrease in testes weight and spermatogenic activity (Scultze and Turner, 1945 ; Andrews and Schnetzler, 1946 ; Glazner and Jull, 1946 ; Jap, 1948 ; Shaffner and Andrews, 1948 ; Kumaran and Turner, 1949).

Feeding thyroid active substances at different rates or forms, caused the depression in thyrotrophic hormone secretion, and therefore depressed thyroxine secretion causing the atrophy of thyroid gland, either in the growing chicks (Turner, Irwin and Reineke, 1944) or in the mature animals or birds (Brody, 1945 ; Leonard, 1947 ; Turner, 1948 ; Kheir El-Din, 1955 ; Garren and Shaffner, 1956). When the environmental temperature is high, the effect of feeding thyroid active substances was enhanced and thyroid gland goes on regression rapidly and clearly (Oloufa *et al.*, 1951).

As far as the other organs, glands and gonads are concerned, in their response to feeding thyroid active substances, some workers showed no effects (Turner, 1948), others found some response in the prolonged treatment in some of the glands (Garren and Shaffner, 1956). In general,

adrenals weight are increased by hyperthyroidism (Miller and Riddle, 1942; Durey, 1949; Maqsood, 1950; Garren, 1953; Garren and Shaffner, 1956). Small doses of thyroid active substances have no effect on adrenals weight (Turner, 1948; Kheir El-Din, 1955). Thyroxine did not affect adrenal weight when injected in doses below or about equal to the normal secretion rate (Maqsood, 1954). Only large doses of thyroid active substances cause the enlargement of adrenals (Turner, 1948 *c*). Adrenal atrophy induced by eleviated environmental temperature can be partly prevented by small doses of iodinated protein, but if the doses are large, further atrophy develops (Money, 1954).

In general, it has been found that feeding thyroid active substances caused the decrease in pituitary size (Garren, 1953; Kheir El-Din, 1955). Meanwhile, prolonged treatment caused the increased in pituitary size (Garren, 1953). There is an inhibition in gonadotrophic hormone secretion, accompanied by the decreased thyroxine level in the blood (Gallone and Galuzzie, 1951).

As it is known that thyroids are more active during winter than summer (Winchester, 1940; Reineke and Turner, 1945), this investigation of the effects of different rates of hyperthyroidism on the gonads and endocrines of adult cocks, was done during the summer months in Egypt (Giza 30° N.), where summer is characterized by hot weather.

II.—HISTOLOGICAL INTEGRATION

Various investigators have studied the effect of hyperthyroidism on testis activity and spermatogenic activity. Their results, however, are contradicting due to differences in rates of administrating the thyroid active substances, age, breed, intact thyroid activity, reproductive activity and season of the year. Some workers found that inducing hyperthyroidism by feeding desiccated thyroid, thyroxine or thyroprotein, cause the increase in testis size and the activation of spermatogenic activity (Jaap, 1933; Wheeler *et al.*, 1948; Kumaran and Turner, 1949), while other workers have shown that hyperthyroidism cause the decrease in testis size and the inhibition of spermatogenic activity (Turner *et al.*, 1944; Glazner and Jull, 1946; Wheeler *et al.*, 1948).

The induction of hypothyroidism in male birds by thiouracil as a thyroid depressant substance, causes the decrease in testis weight and the depress of spermatogenic activity (Schultze and Turner, 1945; Andrews and Schnetzler, 1946; Glazner and Jull, 1946; Jaap, 1948; Shaffner and Andrews, 1948; Kumaran and Turner, 1949). Also, thyroidectomy in adult birds leads to the regression in testes size with which the cessation of spermatogenesis is associated (Benoit, 1936, 1937; Greenwood and Chu, 1939; Blivaiss and Domm, 1942; Payne, 1944). Only spermatogonial cells can be seen in their testes, while mature sperms are never found (Greenwood and Chu, 1939).

When thyroprotein, a thyroid active substance, is fed at relatively moderate levels (0.04 %), spermatogenesis is improved in old and young roosters, while high levels (0.08 and 0.168) depress spermatogenesis as measured by sperm production (Wilwerth, 1952). Also, when thyroprotein is fed in a mild level (0.01 %) for rabbits under intermittent heat, spermatogenic activity is activated (Oloufa *et al.*, 1951).

Thyroid feeding depresses the production of thyrotrophic hormone and therefore depresses thyroxin secretion causing the atrophy of thyroid gland (Brody, 1945; Leonard, 1947).

There are different methods for the estimation of thyroid activity, some of which are not very accurate such as the estimation of metabolic rate (Brody, 1945) or the protein bound iodine (Taurog and Chaikof, 1946). Other depend on administrating thyroid active substances, such as radioactive iodine (Pipes *et al.*, 1958) or the thiouracil-thyroxin method (Mixner *et al.*, 1944). The substances administered to birds in these two latter methods may affect greatly the other organs, glands and gonads, and may prevent their study in combination with different thyroid activities. To insure accurate study for body systems in combination with normal or artificially induced thyroid activities, histological examinations may be of some use.

It is a well known fact that thyrotrophic hormone induces an increase in the thyroid activity. After administration of antithyroid drugs, there is also an increase of size. This is due to the fact that the formation of active thyroid hormone is prevented by these drugs, which result in a decrease of thyroid hormone level in blood. This stimulates the output

of thyrotrophic hormone which in turn induces its effect by increasing thyroid gland activity. For that reason, in the histological examinations, hypo-(by anti-thyroid drugs) and hyperfunctioning gland (by pro-thyroid drugs) show the same changes in respect to the increase of cell size and number, and the decrease in colloid substances (Larson *et al.*, 1945). In the light of these changes, Lever (1948) and Lever and Viljin (1955) had recommended the method of dividing the inner diameter of thyroid follicles by the number of cells per follicle, as the most accurate method for determining the activity of thyroid gland rather than other histological or thyroid weight estimates. This previous method was also advised in case of high thyroid activity. The results of these histological studies, however, depend greatly on the kind of substances given, e.g. whether this activity is anti- or pro-thyroid.

MATERIALS AND METHODS

Hyperthyroidism was induced by feeding thyroprotein (protamone) at the rate of 2.5, 5.0, 7.5 and 10.0 grams per 100 pounds of mash, that equals 0.006, 0.011, 0.017 and 0.022 percent, to four groups (I, II, III and IV respectively) of White Baladi cocks of two years old. Each group was represented by four individuals. Another group of the same age and number of cocks served as control. Thyroprotein feeding lasted for the three months of summer (June, July and August). Normal rations composed of 15 % maize, 10 % wheat, 10 % barley, 20 % wheat bran, 20 % rice bran, 23 % cotton seed cake, 1.5 % calcium carbonate and 0.5 % salt, were used. Green feed was supplied in the form of shopped green maize leaves. Antibiotics and B_{12} (Pfiyzer 3 + 3) were added to the rations during August at the rate of 15 grams crystalline terramycin hydrochloride and 15 mgms. vitamin B_{12} per 100 kilogram mash. Vitamin A and B were added at the rate of 20 grams per 100 kilograms mash. At morning, half of the ration was given dry, while at noon the other half was given wet as it was mixed with fresh liquid blood from the slaughter house at the rate of a gallon per 100 lbs. mash.

At the end of the three months of the treatment, the cocks were sacrificed. The birds were weighed alive before being killed by bleeding.

Afterwards, the comb, the two spurs and the two wattles of each cock were separated, cleaned and weighed. The birds were then carefully desiccated and their gonads and endocrine glands were completely separated, freed from the adjoining tissues and weighed.

Histological Techniques

1. *Testis :*

The testes weights were represented by the average whole weight of both the right and left testes of the four males for each group. The samples were taken from the medium part of both the two testes of the four cocks for each group and then fixed in Bouin's solution. Testes samples were then washed, dehydrated, cleared and embedded in paraffin wax. The formed blocks were sectioned at 10 microns. The sections were stained by haematoxylin and eosin solution method, then mounted in canada balsam. Microscopic examinations were done for testes slides of each group. The different stages of spermatogenic activities were fully described. Microscopic examinations were carried out by a projector microscope. Number of seminiferous tubules was calculated in each projector field, and then multiplied by 88.5 to have the number of seminiferous tubules in one surface centimeter. The diameters of the seminiferous tubules were measured by the projector scale where each one millimeter equals 6 microns with objective $\times$ 10. Therefore, the diameter as obtained by the projector scale was multiplied by 6 to have the diameter in microns. Spherical seminiferous tubules were mostly chosen, while when other forms were measured, the diameter of the shorter and longer axis were averaged as the diameter of such tubules. Number of seminiferous tubules was counted in 160 microscopic fields representing 12 slides for each right and left testis of each of the 4 cocks for each group. Number of cells per tubule was counted and tubule diameter was measured in one of the seminiferous tubules in each microscopic fields. To standardize the counts, the spherical tubules were chosen and not the convoluted ones. The slides and microscopic fields, where the shrinkage was clearly due to the fixative, were avoided as far as possible. Photographs were taken by the projector objective $\times$ 10

and × 30 for one of testis slides of each group. The magnifications of the photographs were 165 and 500 respectively.

2. *Thyroid :*

The whole thyroid gland samples were fixed in Bouin's solution, washed, dehydrated, cleared and embedded in paraffin. Blocks of both right and left thyroids were sectioned at 5 microns, sections stained by haematoxylin and eosin method, and then mounted in canada balsam. Fully descriptive microscopic examinations for the follicles, epithelial cells, colloid substance, connective tissue stroma and interfollicular cells were carried out by a projector microscope. Four sections from each right and left thyroid for each of the 4 individuals of each group were examined. In each slide the number of epithelial cells was counted and the inner diameters were measured in the medical portion for 5 central follicles comprising 160 counts and 160 measurements for each group. To standardize the counts and measurements, spherical and convoluted follicles were chosen. In case of a follicle being more elliptical than spherical, the average of the largest and smallest diameters is sufficient to note the diameter item. The diameter, as obtained by the projector scale, was multiplied by 2 to express the measurement in microns. The examinations were made with a 30 × objective, and photographs were taken at a magnification of 165 ×.

RESULTS AND DISCUSSION

1. *Morphological Studies :*

As far as testes absolute and relative weights are concerned, the normal variations that occur in any living organ are found in this experiment. Stimulating, inhibiting and the non effects of feeding thyroid active substance are found. The effect differs according to the rate of administration. The mild dose (II) is the only one that caused an enlargement of testes size. The highest and the lowest levels did not exert a significant effect. The high level (III) had an inhibitory effect (Tables 1 and 2).

Epididymis weight was not affected by the lowest dose of thyroprotein,

while the minimum increase in epididymis weight was observed in the mild dose of group II. When the quantity of thyroprotein fed increases over the level of group II, epididymis weight decreases. All the treated groups have vasa deferentia of lower weight than the control group. With the increase of thyroprotein level in the ration, more decrease is observed in vasa deferentia weights. The same trend was observed in respect to comb weight and wattles weight. Spur weight decreased in all the treated groups. No regular trend could be observed within the four treated groups (Table 1). It seems that feeding a mild dose (II) of thyroid active substance during a hot weather similar to that of Giza Province, could stimulate sexual activity as far as testes and epididymis size are concerned. The accessory organs and the secondary sex characters are inhibited by the different hyperthyroidism levels induced in this experiment.

TABLE 1

Effect of thyroprotein feeding on reproductive organs, endocrines and secondary sex organs weights. (Weights in Grams).

Items	Control	Doses of thyroprotein			
		I	II	III	IV
Testes (Total)	21.400	16.950	28.525	9.400	18.100
Epididymis (Total)....	0.450	0.450	0.690	0.228	0.190
Vas deferens (Total)...	1.675	1.100	1.380	0.955	0.865
Thyroid (Total)	0.280	0.143	0.155	0.200	0.198
Adrenal (Total)	0.325	0.300	0.295	0.313	0.263
Pituitary.....	0.018	0.020	0.021	0.020	0.022
Thymus (Total)	1.900	1.125	2.550	1.200	0.540
Comb.....	22.400	15.550	14.500	14.700	9.700
Spur (Total).....	4.150	2.325	3.575	3.400	3.850
Wattles (Total).....	5.000	3.375	3.170	3.600	2.800

Hyperthyroidism in the different rates induced here cause the atrophy of thyroid gland. The highest reduction is observed in the group given

the lowest dose of thyroprotein (I), and as the rate of feeding thyroprotein increases the reduction in thyroid size is lowered (Tables 1 and 2).

When the absolute weight of adrenals are concerned, all the treated groups are lower in weights than the control (Table 1). However, there seems to be some stimulating effect of mild doses of thyroprotein (II and III) on adrenal relative weights, while the lowest and the highest doses do not affect adrenal relative weights (Table 2).

TABLE 2

Effect of thyroprotein feeding on relative weights of testes and endocrines to body weight.

Items	Control	Doses of thyroprotein			
		I	II	III	IV
Testes.....	1.223	1.009	1.940	0.632	1.261
Thyroid	0.016	0.009	0.011	0.013	0.014
Adrenal	0.018	0.018	0.020	0.021	0.018
Pituitary.....	0.0010	0.0012	0.0014	0.0013	0.0015
Thymus	0.108	0.067	0.173	0.081	0.038

Hyperthyroidism induced here at different levels causes the hypertrophy of pituitary gland (Tables 1 and 2). With the increase of the rate of hyperthyroidism, the rate of pituitary hypertrophy increased.

The mild dose of thyroprotein (II) that causes the highest increase in testes and epididymis size, causes also the highest increase in thymus absolute and relative weights. Thymus size in the other three groups is less than the control. The increase in the level of thyroprotein administered causes a coordinate decrease in thymus size. Almost the same trend of variation could be observed for both thymus and testes size, that may suggest a form of interrelationship between the two organs, which is not defined yet (Tables 1 and 2).

The conclusions drawn here are similar to those observed by other investigators in respect to all organs studied, when the levels of hyperthyroidism are similar to levels used here. These results contradict

with the others when the levels of hyperthyroidism, the form of the thyroid active substance, the environmental conditions, or the age, are different.

II.—HISTOLOGICAL INTEGRATION

A.—Testis :

1. *Control group :* The seminiferous tubules were normal and lined for most of their parts with approximately 5 to 7 layers of cells, of which 1 to 2 are spermatogonial cells, while the others are scattered layers of primary and secondary spermatocytes. Adjacent to this toward the lumen, are the spermatids and spermatozoa scattered and filling the lumen. Normal mitotic and miotic division activities are observed, resulting in a relatively moderate number of spermatids and spermatozoa. Most of seminiferous tubules have small well developed lumen and only few have medium lumen. The lumen were full of numerous spermatids and small number of spermatozoa. Reasonable number of Sertoli cells are found attached to the majority of the spermatozoa. Relatively large spaces are found between seminiferous tubules and are not full of stroma or interstitial cells, which are rarely observed. The seminiferous tubules are medium in size, mostly coiled, while few number are spherical. In general, cells representing different stages of spermatogenesis were found and no vacuoles were observed between them (Pl. I, A-B).

2. *Group I :* Normal seminiferous tubules were observed being medium in size. Several layers of cells arranged in raws are found with approximately 6 to 8 layers, of which 1 to 2 are spermatogonial cells, while the others are primary and secondary spermatocytes and spermatids. Adjacent to that is the spermatozoa in clusters attached to a moderate number of Sertli cells. Moderate mitotic and miotic are found resulting in a relatively large number of spermatozoa in the lumen, which is medium in size and moderately full of spermatozoa and few spermatids. Some have large lumen with few spermatozoa in it. The cells of the seminiferous tubules are mostly gathered in the center of the tubule

leaving wide space around without any cells in it. There may be degeneration in some tubules. However, the cells are distributed in most of tubule parts in most of the seminiferous tubules with large spaces between them. There are no spaces between the tubules, and rare interstitial cells and stroma are found. Most of the tubules show clear tortuosity, while some show spherical shape. No essential differences could be observed between the testicular tissue structure of this group and the control group (Pl. II, A-B).

3. *Group II :* Seminiferous tubules are lined with more clear several layers of cells than other groups. There are approximately 8-12 layers of which 2-3 are spermatogonial cells, the others being primary and secondary spermatocytes. Adjacent to this are numerous numbers of spermatids and spermatozoa that fill all the large sized lumen. The tubules are large filled with cells including large numbers of spermatozoa. Highly active mitotic and miotic activities are observed in this group resulting in large number of cells. The cells are gathered and compacted together. These numerous cells are due to enhancement of spermatogenesis divisions, activated by mild hyperthyroidism induced in this group. It seems that when thyroprotein is fed in a proper quantity, spermatogenesis is encouraged.

Also, a relatively large number of Sertoli cells are found, but spermatozoa are not quite attached to them as they are scattered in the lumen and not found in clausters as ordinarily found. Seminiferous tubules are found in large numbers although they are large in size, which results in relatively small or medium sized spaces between tubules which are occupied by moderate stroma and interstitial cells. The tubules are quite coiled with a small number of spherical ones. No degeneration occurs in the seminiferous tubules (Pl. III, A-B).

4. *Group III :* Slight differences are observed between this group and the previous one (II). Cell layers are less in number as they are not more than 10. Cells are still gathered and compacted together, but this is slightly less than the previous group. One to two cell layers are spermatogonial cells, the others are the primary and secondary spermatocytes. Spermatids and spermatozoa are scattered and occasionally

secondary spermatocytes are scattered in lumen. Active mitotic and miotic divisions occur in this group producing numerous cells. The lumen is large, but not as large as in the previous group, full of numerous spermatids and a moderate number of spermatozoa. A moderate number of Sertoli cells are found and the spermatozoa are mostly not attached to them as they are scattered in the lumen. Some of the cells are in the center leaving vacuoles, thus giving the appearance of some deterioration. Tubules are very large, numerous and full of cells but not like the previous group. Accordingly, no spaces could be seen between tubules, and though medium stroma and interstitial cells are found. There are large and medium spaces between cells in some of the tubules while others have no spaces. Seminiferous tubules show good tortuosity in most parts, while few show the spherical shape (Pl. IV, A-B).

5. *Group IV :* A quite clear deterioration occurs in the general structure. In this group, fewer layers of cells are observed than in any other group and they do not exceed 5 layers. A small number of cells are observed scattered in the tubules with large spaces between them. Only one layer is spermatogonial cells, the others are primary and secondary spermatocytes and spermatids. Few spermatozoa are observed in clusters inside the large lumen. Low mitotic and miotic activities are observed causing few number of cells. Also the fewer number of Sertoli cells are observed in this group. Occasionally few spermatids are observed inside lumen with the spermatozoa. Seminiferous tubules are large, leaving narrow spaces and rare stroma and interstitial cells between them. The tubules are quite coiled, accompanied with relatively small number with spherical shape (Pl. V, A-B).

When all the groups are considered, it could be clearly observed that group II shows the most active spermatogenesis. Group III also showed high spermatogenic activity but slightly less than group II. Mild hyperthyroidism (0.011% and 0.017%) seems to encourage spermatogenesis. The testicular tissue of the control group and the group fed the lowest dose of thyroprotein shows the same structure where inactive spermatogenesis are observed. Deterioration and inactive spermatogenesis are observed in group IV, where the highest level of thyroprotein was fed.

B.—Thyroid :

1. *Control group :* The thyroid tissue of this group is compacted and full of the relatively smallest follicles. No vacuoles could be distinguished between these follicles, and when there are spaces they are full of intensive connective tissue stroma and interfollicular cells, along with a rich supply of a network of blood vessels and nerve fibers. The follicles differ greatly in size ranging from 60 to 600 microns, but the majority are medium in size. The follicles are almost spherical or ovaid but some are tubular or sacculated. Lot of colloidal substance fill all the lumen of follicles. Also the colloid is more concentrated than in the other groups (Pl. VI, A).

2. *Group I :* Thyroid tissue of this group is less compacted. Follicles are slightly larger in size but the majority of them are small. No vacuoles could be distinguished between follicles and when there are spaces they are full of intensive connective tissue stroma and interfollicular cells, along with a medium supply of a network of blood vessels. Follicles do not differ in size greatly ranging from 60 to 480 microns, while the majority are medium in size. Most follicles are almost spherical or ovaid but some are tubular or sacculated. They contain some very rich concentrated colloid substances, but slightly less than the control group (Pl. VI, B).

3. *Group II :* Thyroid tissue of this group is less compacted than the previous groups. Follicles are medium in size and follicular cells are somewhat large, and the cells are arranged in layers in most of the follicles. Medium spaces are found between follicles, full of intensive connective tissue stroma and large interfollicular cells along with a rich supply of blood vessels. The follicles differ in size greatly, ranging from 48 to 540 microns, but the majority are medium in size. Most of the follicles are spherical. Moderate concentration and quantity of colloid substance are observed (Pl. VII, A).

4. *Group III :* Thyroid tissue of this group is less compacted than previous groups because most follicles are medium and large in size. However, some very small follicles are found causing the general average follicle diameter to be the smallest among the groups. The follicular cells are spherical in most follicles, arranged in two layers in some parts of the follicles, but their number is relatively small. Some of the cells, however, are elongated in shape. Many large spaces are found between follicles with medium quantities of interfollicular cells and stroma. The follicles are somewhat saculated or tubular, and their lumen contains medium quantities of colloid substance. Medium supply of blood vessels is observed. In general, some deterioration seems to occur in the thyroid tissue (Pl. VII, B).

5. *Group IV :* The least compactness is observed in the thyroid tissue of this group. Most follicles are large, some are larger than the microscopic field, and their diameters range from 60 to 960 microns. Most of the follicular cells are elongared, not clear, small in size and number. They are arranged in one layer only. Very large spaces are observed between follicles, containing rare interfollicular cells and stroma, and poor blood supply. The follicles are almost tubular or sacculated. The lowest colloid substance quantity is observed in this group and some follicles contain no colloid, while in the others the colloid does not fill the lumen. Most of the capsules show some deterioration (Pl. VIII).

As far as the thyroid tissue of all groups is concerned, it could be stated that the control group and group I have the smallest follicles, largest quantity of interfollicular cells, most concentrated colloid substance and the tissue is greatly compacted. Thyroid tissue of group II contains medium sized follicles, medium number of cells and medium quantities and concentration of colloid. Tissues of group III and IV have the largest follicles, smallest cell number, and least quantities and concentration of colloid. It seems that as the level of thyroprotein increases the number of both interfollicular and follicular cells decreases and the diameter increases, showing a gradual decrease in function with the increase of hyperthyroidism rate.

Activity Estimates Studies

A.—*Testis* :

The highest testes weight is observed for cocks of group II. Slight differences are observed between the control group and groups I and IV, whilst the least weight is observed for group III. This trend is also observed when the corresponding grams of testes per 100 gram of body weight is taken into consideration (Table 3).

Table 3

Effect of feeding different doses of thyroprotein on histological estimates in testes.

Treatment		Total testes weight (Gms.) (1)	Grams testes /100 g. body weight	No. of semin. tubules in 1 cm_2 (2)	Average diameter of seminiferous tubules μ (3)	Average cell number in each semin. tubule (4)
Control.....		21.400	1.223	1252.28	222.24	370.1
Thyroprotein doses	I	16.950	1.009	1473.53×	191.28×	360.3×
	II	28.525	1.940	2048.78	196.38	620.6
	III	9.400	0.632	1823.10	221.82	450.0
	IV	18.100	1.261	1292.10	229.98	316.0
Average.....		18.875	1.213	1577.96	212.34	423.4

1. Average testes wt. for 4 individuals of both right and left testes.
2. Average number in 160 microscopic fields.
3. Average of 160 seminiferous tubules.
4. Average of 160 seminiferous tubules.

× Round to whole numbers.

The least number of seminiferous tubules per unit area is observed for both the control and IV groups. Also, a relatively low number is observed for group I. The highest numbers are observed in groups II and III. Diameter of tubules does not give a strictly negative trend as it generally decreases as the number increases. The seminiferous

tubules are small in group I with wide spaces between them, resulting in a relatively small number per unit area. Meanwhile, others have large tubules and no wide spaces between them resulting in a large number of tubules per unit area. In this latter case, spermatogenic activity is supposed to be at its highest level. This could be observed in both groups II and III. However, both the control group and group IV, showing the lowest number of tubules, have the highest diameter. Clearly groups I and IV and the control show a low number of cells while the largest number is observed for group II. Mild hyperthyroidism which is clear in group II, and indicated in group III, induced both large testis size and spermatogenesis. Meanwhile, the low dose had no effect when compared with the control, and the high dose of group IV cause the deterioration of spermatogenesis. This conclusion is also drawn as far as semen and sperm production are concerned (Kamar, 1960).

B.—*Thyroid :*

All the treated groups have smaller thyroids than the control. As the dose of thyroprotein increases the corresponding weight of thyroid per 100 grams of body weight increases. It seems that this hypertrophy does not mean that the activity of thyroid increases. The other critical estimates show another trend of variation (Table 4).

TABLE 4 — Effect of feeding different doses of thyroprotein on histological estimates in thyroid gland.

Treatment		Total thyroid wt. per bird mg.	Mg. thyroid per 100 gm. body weight	Av. cell number in each follicle	Av. inner diameter of follicle (μ)	Av. cell number on diameter of follicle (n/d)
Control.....		280	16	37.65	79.04	0.48
Thyroprotein doses	I	143	9	32.66	61.02	0.54
	II	155	11	44.65	69.06	0.65
	III	200	13	30.97	54.50	0.57
	IV	198	14	37.86	88.36	0.43
Average		195	12.6	36.76	70.40	0.52

N.B. — The measurements and counts were made in a sum up of 160 follicles for each group.

A low number of follicular cells was observed for all groups except group II. The highest diameter is observed in both group IV and the control group, while the least is observed in group III. These two estimates do not give a clear picture about thyroid activity separately. By dividing cell number on inner diameter of follicles (n/d), a clear indication of thyroid activity is secured. In this work, it was found preferable to divide *n* by *d* to have the direct and positive relation with thyroid activity rather than dividing *d* by *n* as advised by Lever (1948). The latter method gives a negative relationship to thyroid activity. The value of n/d is low for group I and IV and the control, and high for both II and III groups, indicating the lowest activity for IV group and the highest for II group. It seems that feeding thyroid active substances in a certain amount (0.011 %) substitute for the decrease in thyroid activity, found by Reineke and Turner (1945) to occur during summer and activate the thyroid itself. When these substances increase over a certain limit (from 0.017 to 0.022 %), they depress thyroid activity. Also, small doses of thyroprotein cause the activation of thyroid when compared with control. It seems also that the activity of control's thyroid is low, and that mild feeding of thyroprotein (II and III) rise the activity to the normal levels. In the study of normal activity of thyroid gland, estimated by this method, this value was found to range from 58 to 67 (Kamar, 1961).

It is clear from this study and other studies (Reineke and Turner, 1945; Kamar, 1960, 1961), that when the hot summer environmental conditions cause the reduction in thyroid activity, certain moderate quantities of thyroid active substances can substitute the decreased activity, causing the enhancement of spermatogenic activities, either estimated by histological examination or by sperm production (Kamar, 1960).

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الملخص

تأثير الثيروبروتين على غدد وخصية الديوك

استعمل فى هذه التجربة الديوك البلدى من عمر سنتين حيث غذيت على عليقة تحتوى على نسبة ٠,٠٠٦ ٪ ، ٠,٠١١ ٪ ، ٠,٠١٧ ٪ ، ٠,٠٢٢ ٪ من مادة الثيروبروتين لإحداث أعراض زيادة عمل الغدة الدرقيـــة . وكانت مدة التجربة ثلاثة شهور فى أشهر يونيو ويوليو وأغسطس من الصيف . وقد استعملت مجموعة مماثلة لتعمل كمجموعة مقارنة بدون أن تعطى فى العليقة أى نسبة من الثيروبروتين . وفى نهاية الثلاثة شهور ذبحت الديوك وفحصت غددها الصماء وغدد الجنس والتركيب الهستولوجى للغدة الدرقية والخصية ووجدت النتائج الآتية :

(ا) التغيرات المورفولوجية :

١ – أحدث المستوى المتوسط من مادة الثيروبروتين (٠,٠١١ ، ٠,٠١٧ ٪) تأثيراً منشطاً للخصية والبربج والغدة التيموسية ، بينما خفضت المستويات الأخرى من الثيروبروتين حجم هذه الغدد .

٢ – خفضت المعاملات المختلفة حجم ووزن باقى أجزاء الجهاز التناسلى وصفات الجنس الثانوية مثل العرف والداليتان والمهماز .

٣ – انخفاض حجم الغدة الدرقية نتيجة لإعطاء مادة الثيروبروتين فى كل المستويات .

٤ – انخفاض وزن الغدة فوق الكلية نتيجة لإعطاء مادة الثيروبروتين فى كل المستويات ، ولكن الوزن النسبى لهذه الغدة ارتفع فى المجاميع التى أعطيت مستويات متوسطة (٠,٠١١ ، ٠,٠١٧ ٪) من الثيروبروتين .

٥ – بعد الفترة الطويلة من المعاملة زاد حجم الغدة النخامية فى كل المستويات المستعملة فى هذه التجربة . ووجد أنه كلما زاد مقدار الثيروبروتين المعطى كلما زاد حجم الغدة النخامية .

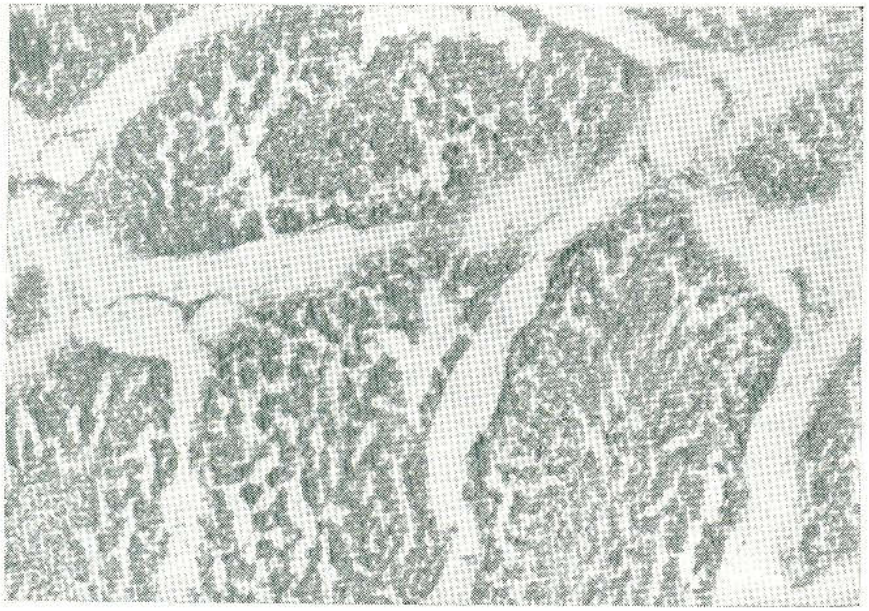
(ب) التغيرات الهستولوجيـــة :

١ – كان أكبر نشاط لتكوين المراحل المختلفة لتكوين الحيوان المنوى فى خصى المجموعة المعطاة ٠,٠١١ ٪ ثيروبروتين . وكذلك لوحظ فى المجموعة المغذاة على ٠,٠١٧ ٪ ثيروبروتين ولكن بصورة أقل نشاطاً . وقد أظهرت المجموعة المقارنة والمجموعة المعطاة ٠,٠٠٦ ٪ نفس المظهر

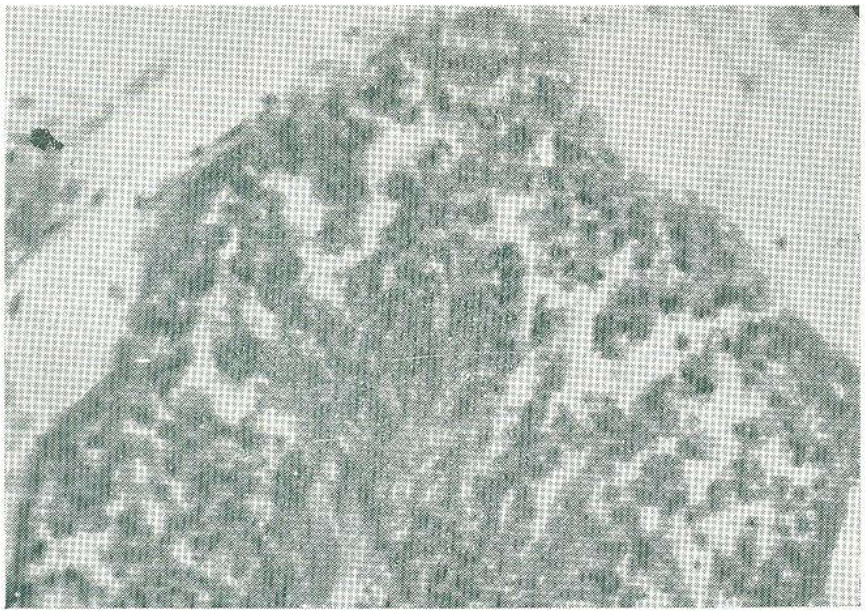
وكان نشاطهما منخفضاً . أما المجموعة المعطاة ٠,٠٢٢ ٪ فقد تدهورت فيها صفات الخصية الهستولوجية .

٢ – المجموعة المعطاة ٠,٠٠٦ ٪ ثيروبروتين والمجموعة المقارنة كانت حوصلات الغدة الدرقية صغيرة والنسيج الخلوى غزير والمادة الغروية كثيرة . أما المجموعة المعطاة ٠,٠١١ ٪ فقد كانت ذات مظهر متوسط فى كل الصفات . وكانت الحوصلات كبيرة والنسيج الخلوى قليل والمادة الغروية قليلة فى المجموعتين الأخريتين . ووجد أن إعطاء ٠,٠١١ ٪ ثيروبروتين يعوض النقص الحاصل فى إفراز الثيروكسين فى خلال الصيف وبذلك يعمل على تنشيط الغدة الدرقية . أما إذا أعطى الثيروبروتين بكميات أكبر من ذلك ، فإن ذلك يعمل على تدهور نشاط الغدة الدرقية . وكانت الكميات القليلة غير ذات تأثير محسوس على الغدة الدرقية .

٣ – ينخفض معدل إفراز هرمون الثيروكسين فى الصيف ، ولذلك فإن إعطاء كمية متوسطة من الثيروبروتين تكفى لتعويض هذا النقص وتعمل على رفع نشاط الغدة الدرقية نفسها ، وهذه بالتالى تعمل على رفع كفاءة إنتاج الحيوانات المنوية .

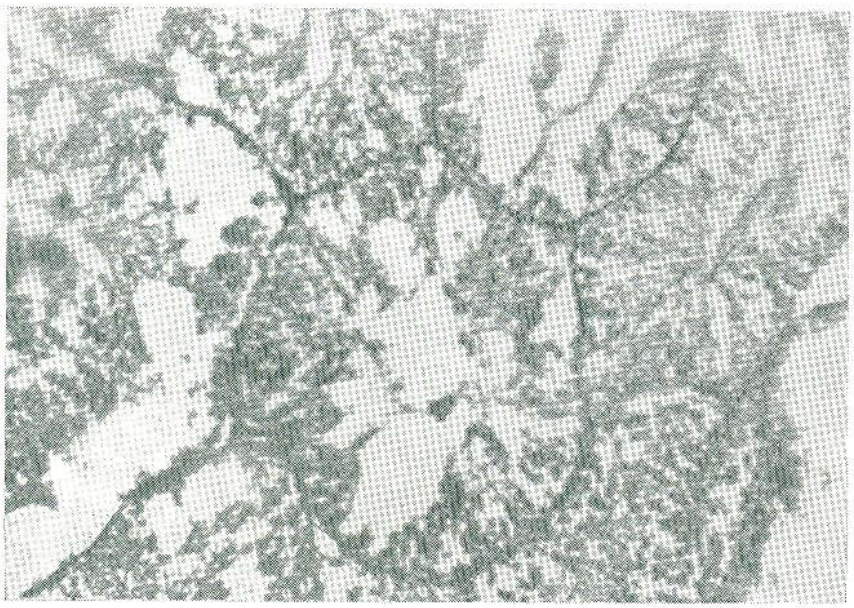


A



B

Testicular tissue section of White Baladi cocks from the control group. (A × 165, B × 500).



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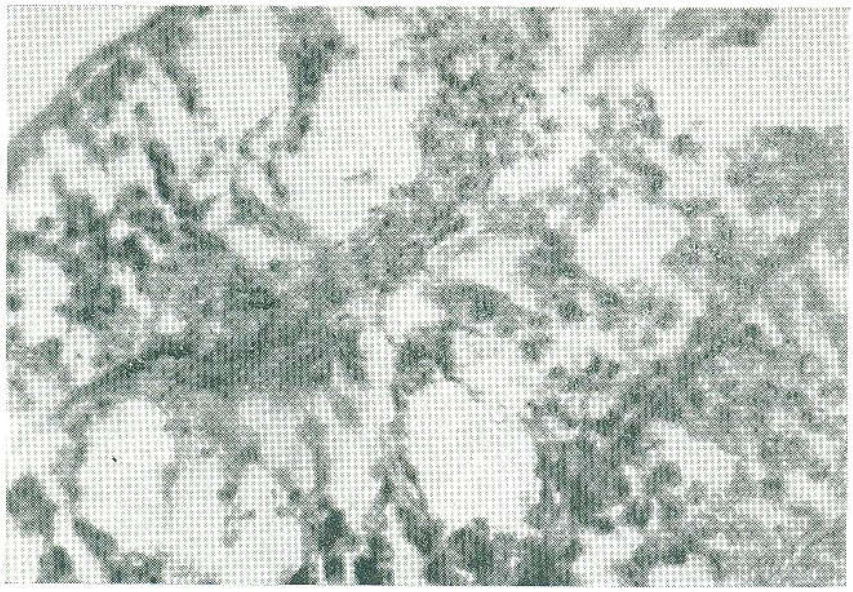
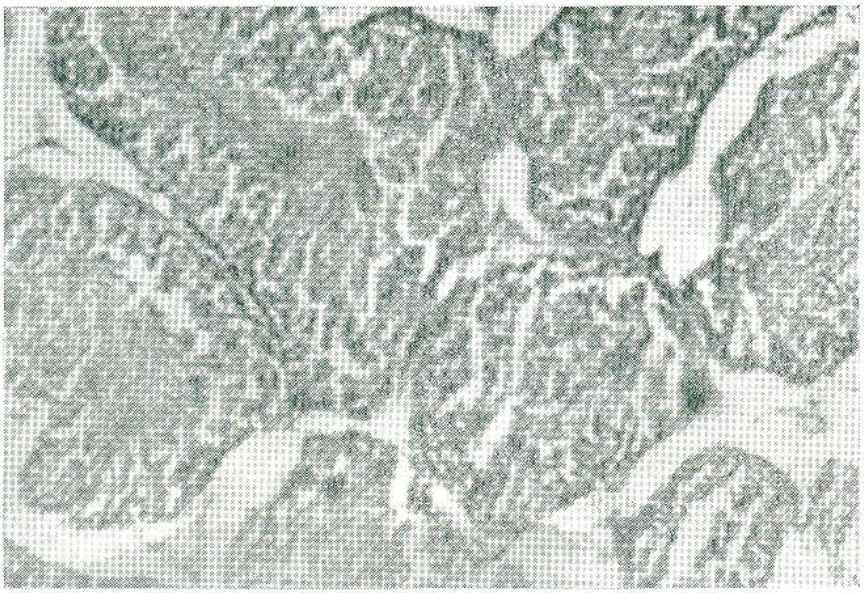


B

Testicular tissue section of White Baladi cocks fed 0.006 % thyroprotein.
(A × 165, B × 500).



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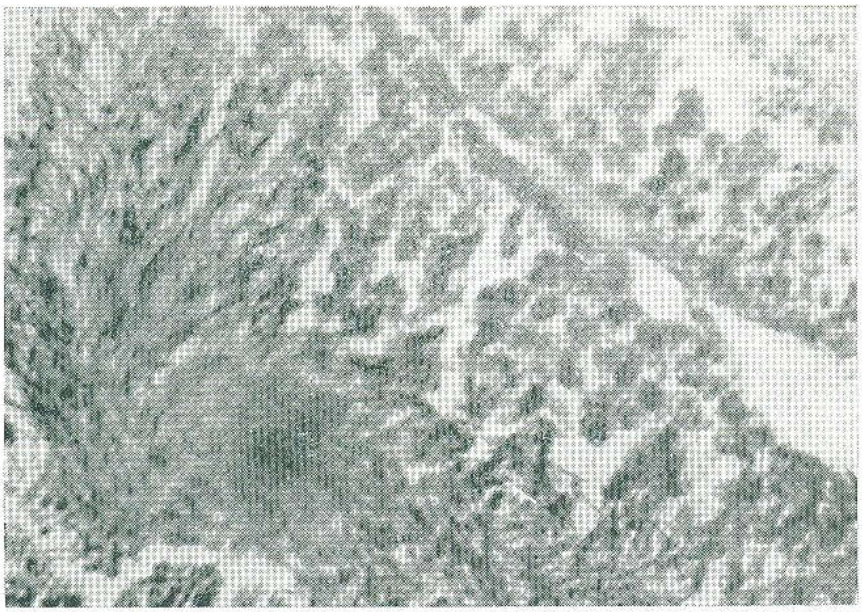
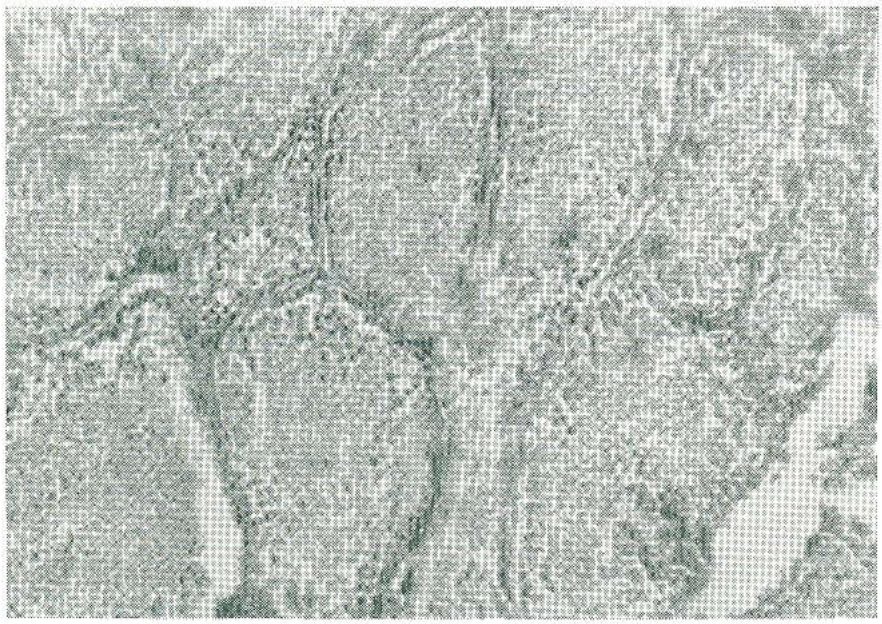


B

Testicular tissue section of White Baladi cocks fed 0.011 % thyroprotein.
(A × 165, B × 500).



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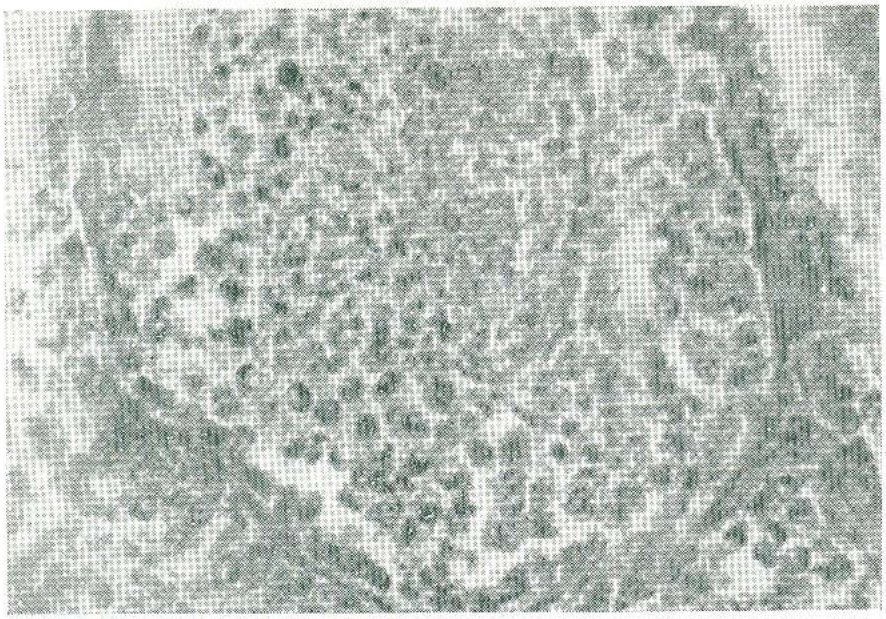
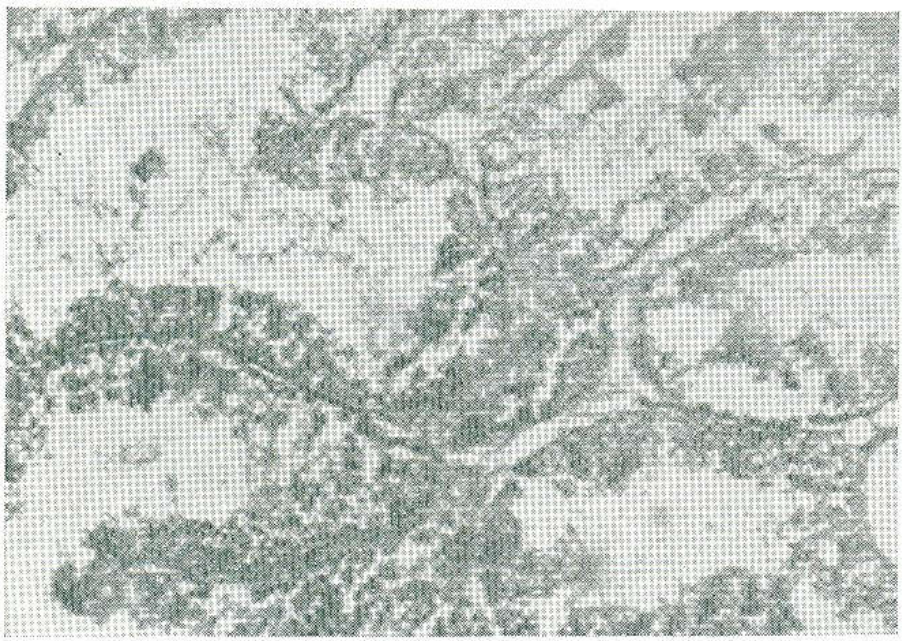


B

Testicular tissue section of White Baladi cocks fed 0.017 % thyroprotein.
(A × 165, B × 500).



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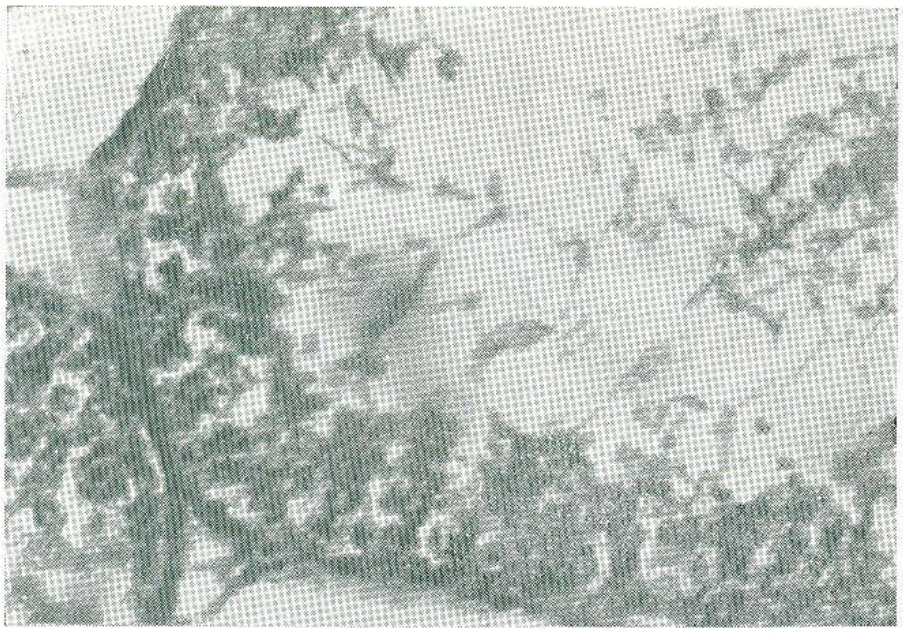
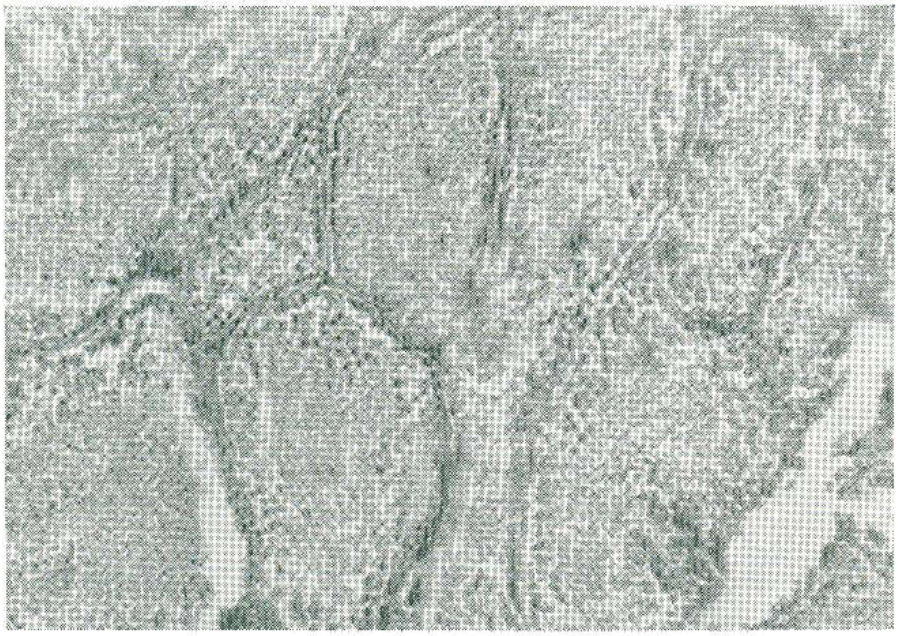


B

Testicular tissue section of White Baladi cocks fed 0.022 % thyroprotein.
(A × 165, B × 500).



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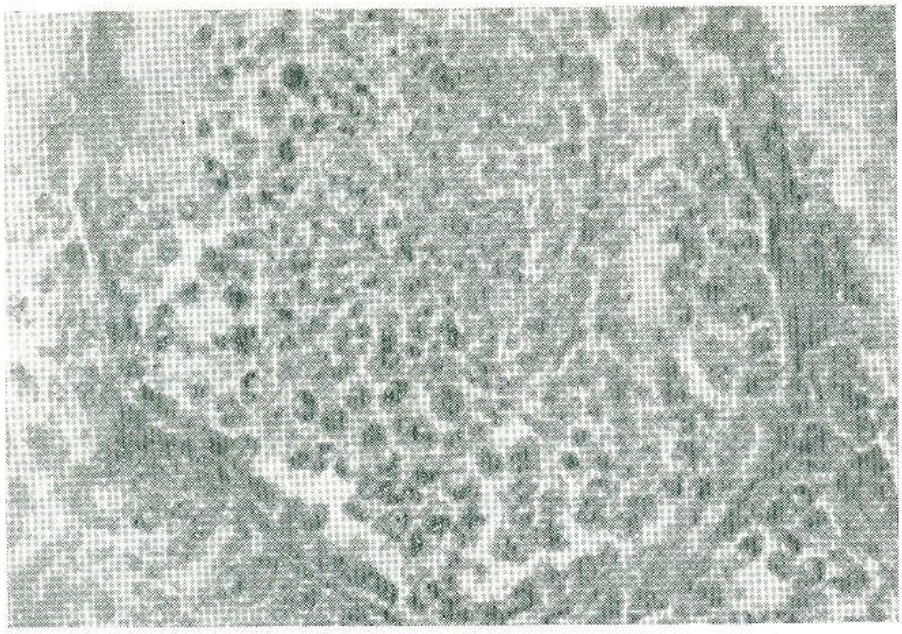
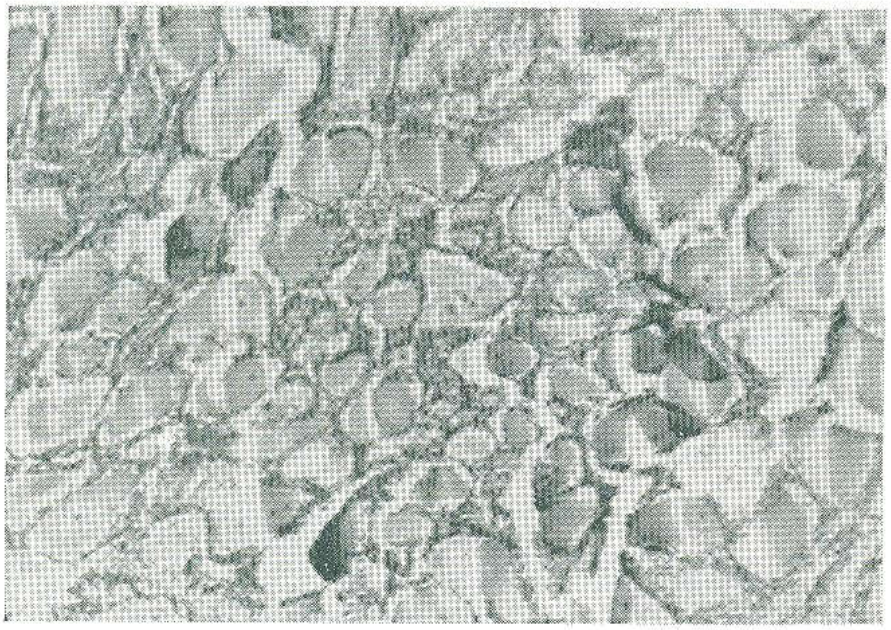
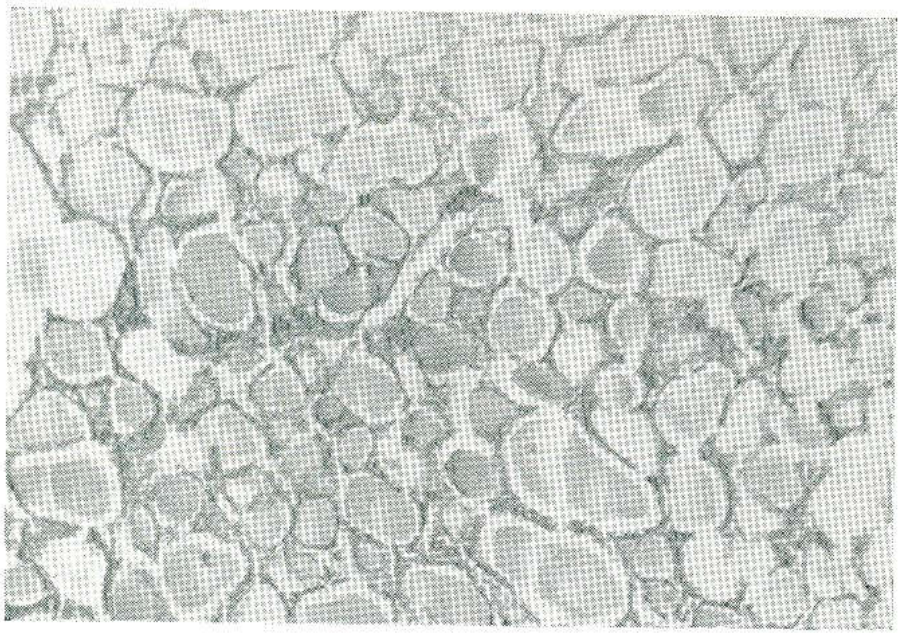


B

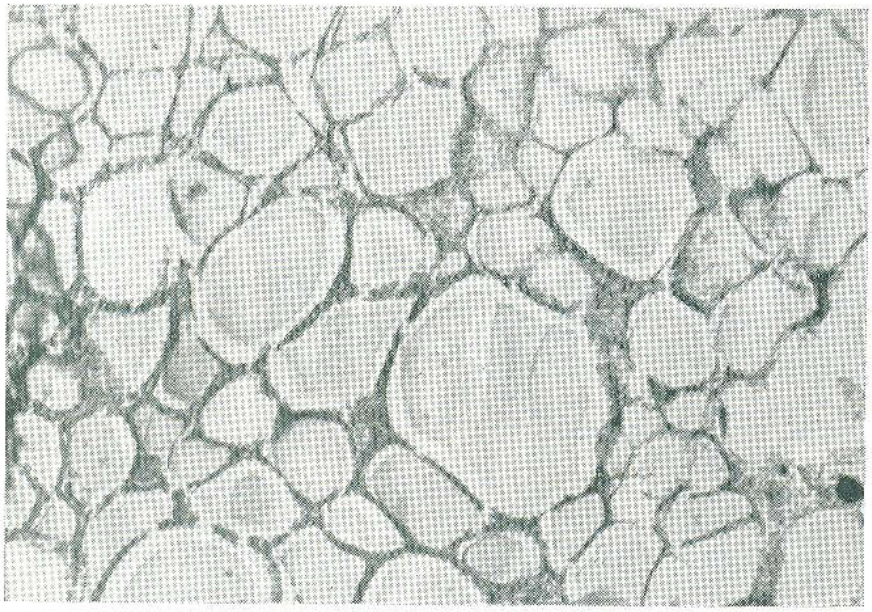
Testicular tissue section of White Baladi cocks fed 0.017 % thyroprotein.
(A × 165, B × 500).



A
Thyroid gland tissue section of White Baladi cocks from the control group.
(× 165).

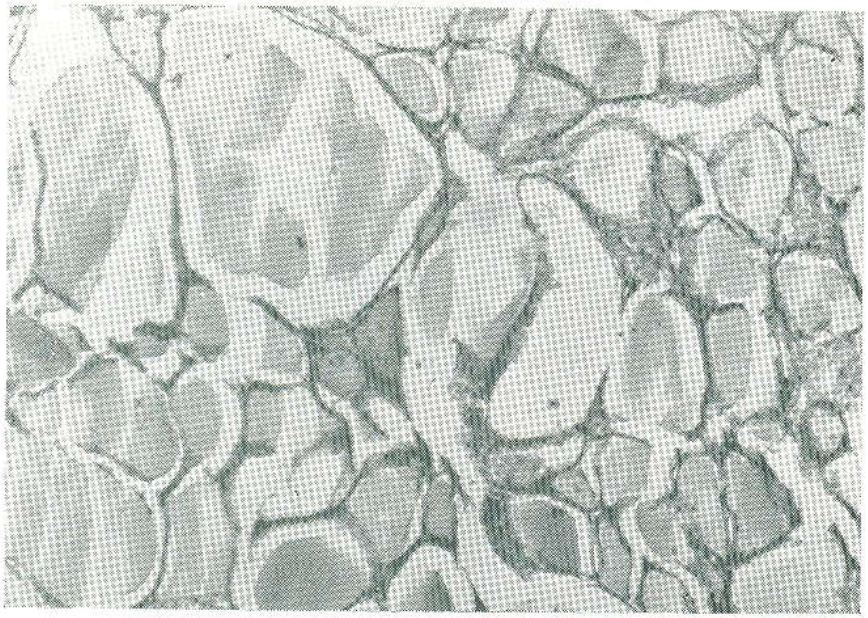


B
Thyroid gland tissue section of White Baladi cocks fed 0.006 % thyroprotein.
(× 165).



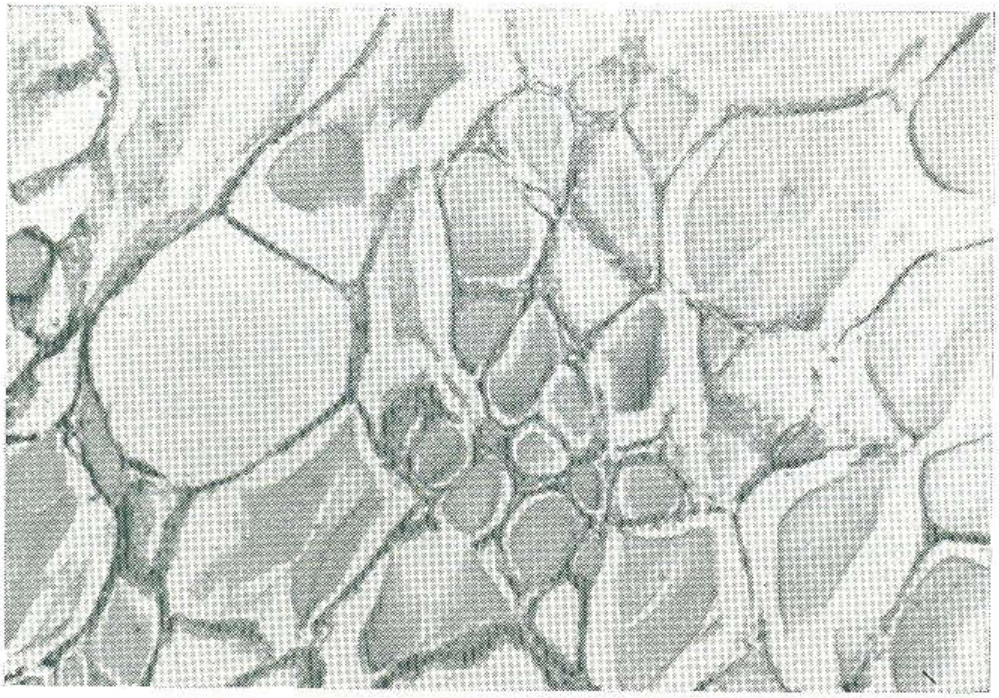
A

Thyroid gland tissue section of White Baladi cocks fed 0.011 % thyroprotein. (× 165).



B

Thyroid gland tissue section of White Baladi cocks fed 0.017 % thyroprotein. (× 165).



Thyroid gland tissue section of White Baladi cocks fed 0.022 % thyroprotein. (× 165).