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EFFECT OF THYROIDISM ON PRODUCTIVE PERFORMANCE OF GROWING NEW ZEALAND WHITE RABBITS UNDER HOT SUMMER CONDITION IN EGYPT

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ABSTRACT

Total of thirty growing New Zealand White rabbits (NZW) aged 35 days and 624±21.5(g) live body weight were used in this study. Rabbits were divided into similar three groups and treated once weekly as follows: The 1st group (control) was injected with saline solution, the 2nd and the 3rd groups were treated by eltroxin (hyperthyroidism) and carbimazole (hypothyroidism), respectively for two moths.

At 12 weeks of age, feed intake, body weight and body gain in carbimazole treatment were higher than eltroxin and control. Also, it improved growth rate and feed conversion than control by 8% and 3%, respectively. At 12 weeks of age, the minimum rectal temperature was found in eltroxin group.

Carbimazole had the higher final body weight than eltroxin and control by 11.1% and 13.5%, respectively. Dressing percentage was significantly ($P<0.05$) higher in eltroxin and carbimazole than that of the control group. However, weights of liver, kidneys, lungs and heart were almost higher in the control than both tested groups.

Level of T_4 and T_3 in control group increased compared to hyperthyroidism or hypothyroidism. There is no hematological change in both hyper and hypothyroid groups.

Keyword: Rabbit, thyroidism, body weight, T_3, T_4, carcass, rectal temperature.

INTRODUCTION

Rabbits exhibit seasonal patterns in production. In sheep, removal of the thyroid gland increased the production as reported by (Karsch *et al.*, 1995). It is not known whether the thyroid gland plays a key role in the transition to production and reproduction in animals (DeMoraes *et al.*, 1998). The thyroid gland has been known to regulate the metabolic activity in all animals (Iossa *et al.*, 2001). Thyroid hormones regulate basal metabolism and can alter nutrient requirements by increasing basal expenditure of energy. Induction of hypothyroidism in animals has been successfully accomplished using potent antithyroid compounds (Burroughs *et al.*, 1960).

The hypothyroidism increases live body weight by improving body condition and feed efficiency when fed for short duration to steers (Oyedipe *et al.*, 1982). Hypothyroidism decreased serum levels of thyroid hormones, which is due to decreased activity of the thyroid gland and the hypothalamus-pituitary

axis, (Thrift *et al.*, 1999). Hyperthyroidism (thyrotoxicosis) is a multisystemic disorder resulting from excessive circulating concentrations of T_3 and/or T_4 (Thoday, 1993).

The objectives of this experiment were to evaluate the effects of hypo and hyper-thyroidism on productive performance of growing New Zealand White rabbits under summer season.

MATERIALS AND METHODS

This study was carried out during the period from August 2004 till September 2004 in a private rabbit's farm (Haraz farm) at Abou-El-Atta village, Nubaria, El-Behera Governorate. The analytic work was carried out in Animal Production and Animal health Research Institutes, Agricultural Research Center, Ministry of Agriculture, Dokki, Giza, Egypt.

Thirty growing New Zealand White rabbits (NZW) aging 35 days and weighing 624±21.5(g) live body weight was used in this study. Rabbits were randomly divided into three experimental groups (10 rabbits in each). Rabbits were reared in open rabbitry house system, and kept in individually wire cages for (35X45X30 cm). Rabbits were fed *ad libitum* on ration containing 17% crud protein and 2721 digestible energy (Kcal/kg) and clean fresh water was available by nipple drinker at all the time. All experimental animals were reared under the same summer conditions (26-31°C). Environmental temperature outdoors and indoors were recorded daily at (08.00, 14.00 and 22.00 h) to obtain the weeks average of ambient temperature as shown in Table (1).

Table (1): Means±SE of environmental air temperature outdoors and indoors.

Temperature week	Outdoors			Indoors		
	08.00h	14.00h	22.00h	08.00h	14.00h	22.00h
1	30.86±0.40	35.00±0.62	25.14±0.51	26.14±0.67	30.57±0.43	29.14±0.51
3	31.00±0.31	36.12±0.53	23.71±0.42	26.57±0.57	31.17±0.37	29.43±0.43
5	30.14±0.80	34.00±0.53	27.00±0.44	27.43±0.57	28.71±0.29	28.71±0.57
7	26.43±1.19	30.29±0.71	23.14±0.80	25.43±0.20	29.43±0.72	27.43±0.65

All experimental animals were injected subcutaneous 0.5 ml once weekly as the follows: the first group, was injected with saline solution (control), the second and third groups were injected 0.5 ml eltroxin (hyperthyroidism) and/or carbimazole (hypothyroidism) solution to provide 15 µg/rabbit of them. The rabbits were weighed at the beginning of the experiment and bi-weekly thereafter. Body weight and feed intake were recorded bi-weekly; then body gain and feed conversion were calculated and growth rate (%) was calculated by the following equation.

$$\text{Growth rate (\%)} = \frac{\text{Final weight (W2)- Initial weight (W1)}}{0.5\,(W2+W1)} \times 100 \text{ ------ (Bordy, 1945)}$$

Blood samples were taken at 12 weeks old. Plasma samples were prepared by centrifugation (3000-rpm for 15 minutes) and stored at –20°C until analysis. Quantitative measurement of T_4 was carried by DSL-3200-USA ACTIVETM Thyroxin coated tube radioimmunoassay kits. The sensitivity, calculated by interpolation of mean minus two standard deviations of 12 replicates of the 0 µg/dl T_4 standard, is 0.4 µg/dl (Amer and Chicago, 1995). Quantitative measurement of T_3 was carried by DSL-3100-USA ACTIVETM Triiodothyronine coated tube radioimmunoassay kits. The sensitivity, calculated by interpolation of mean minus two standard deviations of 20 replicates of the 0 ng/dl T_3 standard, is 4.3 ng/dl (Tietiz, 1995). Carcass traits have been done for five rabbits from each group at 12 weeks old. Data were statistically analyzed using SAS (1995). Means were compared ($P<0.05$) using Duncan's multiple range test (Duncan, 1955) according the following model:

$Y_{ij} = \mu + T_i + e_{ij}$

Where: Y_{ij} = observation of the ij^{th} rabbits, μ = overall mean, commn element to all observations, T_i= effect i^{th} group, e_{ij} = random error component assumed to be normally distribute.

RESULTS AND DISCUSSION

Growth performance:

Effects of treatments on daily feed intake (FI) and live body weight (LBW) in growing NZW rabbits are shown in Table (2). At 6 weeks old, rabbits treated with eltroxin or carbimazole, showed slight decrease in both feed intake and body weight as compared to the control, this observation is in agreement with the finding of Harada and Kato (1982). Concerning the group treated with eltroxin, the catabolic action of thyroxin could prevail without an increase in feed intake, leading to a decrease of the body weight (Dojana *et al.*, 2000). This may be due to the reduction of thyroid hormone (hypothyroidism) caused to decrease of feed intake (Freake *at al.*, 2001).

Although, rabbits treated with carbimazole and eltroxin slightly increased their feed intakes than the control group at 8 weeks old by 15.52% and 1.54%, respectively, they showed lighter body weight than the control group at the same old by 7.73% and 5.12%, respectively. However, hyperthyroidism showed decreasing in FI and increasing BW than hypothyroidism at 8 weeks old. This observation is in agreement with the finding of Marai *et al.* (1994). Thyroidectomized (hypothyroidism) may increased rate of body protein breakdown and decreased both plasma T_3 and protein synthesis or it is occur in proportion to changes in total body mass (Buttery and Lindsay, 1980).

Hypothyroidism caused increasing in feed intake and body weight than hyperthyroidism and control at 10 weeks old. This observation was agreement with the finding of LeGrow *et al.*, (1999). They suggesting that growth was minimal in the hyperthyroidism state. This result also, may be due to the increasing of catabolism of feedstuffs in hyperthyroidism (Thrift *et al.*, 1999). The differences in the results at all ages may due to that T_4 level diminished, reaching its nadir and it then increased to approximate its basal level (Shirpour *et al.*, 2003).

At 12 weeks of age, rabbits treated with carbimazole showed higher feed intake than eltroxin and control by 2.27% and 14.22% and higher in body weight by 9.9% and 4.9%, respectively. The increase in body weight with may be due to the fact that T_4 stimulates protein synthesis and increases each of nitrogen retention, sensitivity of tissues to GH (Ingbar and Woeber, 1981).

Table 2: Means±SE of daily feed intake (FI) and live body weight (LBW) of growing NZW rabbits in different experimental groups.

Items	Control	Eltroxin	Carbimazole
Feed intake (g):			
6 weeks	67.2±2.0	66.4±1.1	66.5±1.2
8 weeks	75.1±2.2^{b}	76.3±1.2^{b}	86.8±3.5^{a}
10 weeks	106.5±4.0^{b}	114.5±2.7^{ab}	120.1±6.6^{a}
12 weeks	143.2±7.7^{b}	159.9±4.3^{ab}	163.5±17.2^{a}
Live body weight (g):			
5 weeks (Initial)	641.5±9.1	583.3±27.7	622.2±27.8
6 weeks	817.5±18.3	777.8±25.2	788.9±35.1
8 weeks	1215±27.44^{a}	1152.8±29.6^{b}	1121.1±44.9^{b}
10 weeks	1585±39.5^{ab}	1500±41.7^{b}	1652.8±52.1^{a}
12 weeks	1885±56.8^{b}	1800±61.2^{b}	1977.8±67.2^{a}

^{a,b} **Values having different superscripts in the same row are significantly different (P<0.05).**

On the other hand, the hyperthyroidism decreased body weight at 8 and 12 weeks old by (-5.1% and - 4.5%) than control, respectively (Table 2). This case known by thyrotoxicosis which are a reflection of the stimulation of metabolism induced by an excess of thyroid hormones in circulation then weight loss (Baulieu and Kelly, 1990). This may be due to the concentration of receptors is affected by the level of hormone and this has been suggested as an especially important homeostatic regulatory mechanism in cell communication and function (Buttery and Lindsay, 1980).

Changes in rectal and skin temperatures (Table 3) differed among groups at different ages studied. The maximum rectal and skin temperatures were observed in eltroxin group at 8 weeks of age. This may be due to hyperthyroidism caused heat intolerance (Thoday, 1993). Also, the minimum rectal and skin temperatures were observed in carbimazole group at 8 weeks of

age. This observation is in agreement with the finding of Thrift *et al.* (1999). They reported that the decline in rectal temperature of hypothyroidism is indicative of a change in metabolism. This contributes to the increased basal metabolic rate (O2 consumption by the whole animal at rest) and increased sensitivity to heat in hyperthyroidism, and the converse in hypothyroidism (Greenspan and Bsxter, 1994). Rectal and skin temperatures of growing rabbits were differed significantly from normal values during the period of this experimental (Table 3). At 12 weeks of age, the maximum rectal temperature was found in carbimazole group. The increase in rectal temperature of hypothyroidism in the first days post-treatment may be correspond to the increase in thyroid hormone and the decline of it is indicative of a change in metabolism, DeMoraes *et al.* (1998). Hypothyroidism is characterized by a decreased rate of oxygen consumption per unit of body surface area and a decrease in heat production (Loeb, 1996a).

Table 3: Means±SE of rectal temperature (RT) and skin temperature (ST) in growing NZW rabbits in different experimental groups.

Treatment Age at	Control		Eltroxin		Carbimazole	
	RT	ST	RT	ST	RT	ST
5 weeks	39.97±0.09^{a}	39.2±0.08^{a}	39.69±0.11^{ab}	39.09±0.12^{b}	39.59±0.13^{b}	39.32±0.09^{ab}
6 weeks	40.00±0.17	39.00±0.15	40.78±0.08	39.18±0.08	39.86±0.08	38.81±0.08
8 weeks	39.95±0.13^{a}	39.95±0.13	40.04±0.13^{a}	40.01±0.12	39.79±0.13^{b}	39.85±0.11
10 weeks	39.99±0.12^{a}	39.98±0.13	39.94±0.10^{a}	39.86±0.08	39.82±0.05^{b}	39.87±0.06
12 weeks	39.51±0.14^{a}	39.46±0.13	39.26±0.09^{b}	39.44±0.09	39.54±0.09^{a}	39.40±0.08

^{a,b} **Values having different superscripts in the same row are significantly different (P<0.05).**

Body gain improved with eltroxin than control and carbimazole by 22.73 % and 16.63% at 6, 4.78% and 12.87% at 6-8 weeks of age, respectively (Table 4). This observation is in agreement with the finding of Kline *et al.* (1949). This may be due to the utilization of synthetic goitergens has produced variable increase in body weight and daily gain (Thrift *et al.*, 1999). Weight loss with eltroxin than control and carbimazole by -22% and -24%, respectively at 8-10 weks of age. This weight loss is common in hyperthyroidism and caused by accelerated catabolism of feedstuffs and is accompanied by increased oxygen consumption. The loss in weight reflects a depletion of adipose tissue as well as muscle mass and often occurs despite an increase in caloric intake (Loeb, 1996b). Hypothyroidism effected indirect action by increasing in the receptors to increase protein synthesis and steroid hormones which are similar of GH and insulin response even though combined pre-parations an improvement in feed conversion efficiency and produced the best growth response (growth rate %), Buttery and Lindsay (1980). However, carbimazole enhanced body gain at 8-10 and 10-12 weeks than control and eltroxin by 61.86% and 55.24% at 8-10 weeks age, and 20.37% and 8.34% at 10-12 weeks of age, respectively. Also, it had improved growth rate and feed conversion than control by 8% and 3%, respectively during the whole experimental period.

Table 4: Means±SE of daily body gain (BG), growth rate (GR) and feed conversion (FC) of growing NZW rabbits in different experimental groups.

Items	Control	Eltroxin	Carbimazole
Average gain (g):			
5-6 weeks	17.6±1.8^{b}	21.60±2.0^{a}	18.5±1.8^{b}
6-8 weeks	39.7±1.5^{a}	41.66±1.7^{a}	36.9±1.8^{a}
8-10 weeks	37.0±2.1^{a}	38.58±2.2^{b}	59.9±1.5^{a}
10-12 weeks	30.0±2.4^{b}	33.33±2.8^{ab}	36.1±2.5^{a}
GR (%) (5-12 wk)	1.98±0.1	1.01±0.03	1.06±0.02
FC (5-12 wk)	4.1±0.1^{b}	4.6±0.2^{a}	3.95±0.2^{b}

^{a,b} **Values having different superscripts in the same row are significantly different (P<0.05).**

Carcass traits:

Carbimazole group had the higher final body weight than eltroxin and control groups by 11.1% and 13.5%, respectively (Table 5). This observation was agreement with the finding of Marai *et al.*, (1994). The increase in body weight during the hypothyroidism is presumably a consequence of increased energy availability associated with a reduction in the basal metabolic rate (Thrift *et al.*, 1999). Dressing percentage was significantly (P<0.05) higher in eltroxin and carbimazole groups than that of the control group. However, weights of the ovals including liver, kidneys, lungs and heart were almost higher in the control than both tested groups (Table 5). This observation for liver was agreement with the finding of Freake *et al.*, (2001).

Blood hormones:

As affected by hypothyroidism, T_4 and T_3 concentrations significantly (P<0.05) lower as compared hyperthyroidism by –34.6% and –43.3%, respectively (Figs. 1 and 2). The hypothyroidism probably affects the secretion of T_4 directly and it could be the excessive conversion of T_4 to T_3 (Cooper *et al.*, 1983). Hypothyroidism is known to decrease T_4 production from the thyroid gland and also to inhibit the extra thyroidal conversion of T_3 and T_4 (Achmadi and Terashima, 1995).

Table 5: Means ± SE of carcass traits in growing NZW rabbits in different experimental groups.

Items	Control	Eltroxin	Carbimazole
Final body weight (g)	1850±61.24^{b}	1890±81.24^{ab}	2100±68.92^{a}
Dressing weight(%)	62.40±0.48^{b}	64.25±0.32^{a}	64.21±0.74^{a}
Liver weight (%)	7.62±0.57	6.40±0.36	7.08±0.48
Kidneys weight (%)	1.49±0.08^{a}	1.18±0.05^{b}	1.23±0.05^{b}
Lungs weight (%)	1.28±0.08	1.07±0.05	1.10±0.10
Heart weight (%)	0.60±0.03^{a}	0.45±0.41^{b}	0.51±0.03^{ab}

^{a,b} **Values having different superscripts in the same row are significantly different (P<0.05).**

The basal level of T_4 in control group increased (3.7±0.6 µg/dl) compared to hyperthyroidism (3.5±0.5 µg/dl) or hypothyroidism (2.6±0.3 µg/dl) (Fig. 1). Serum T_4 declined in hyperthyroidism implying that administration of exogenous T_3 caused group negative feedback at the level of the hypothalamus or pituitary to stop synthesis or secretion of thyroid stimulating hormone (TSH) (Thrift *et al.*, 1999). Similar trend was observed for T_3 in control being (58.8±8.8 ng/dl) compared with (52.3±3.1) in hyperthyroidism and 36.5±6.3 in hypothyroidism (Fig. 2). The decline in T_3 concentration during the treatment period was reported by DeMoraes *et al.* (1998) for hypothyroidism. The decreasing in thyroid hormone in hypothyroidism being mor-nonounced in T_4 may be due to the process may reduce serum T_4 further, because T_3 production is still normal in spite of low absorption of follicular fluid, which results in low T_4 production. The organism probably compensates for the low metabolism following hypothyroidism by preventing the reduction of more metabolically potent hormone, T_3 (Shirpour *et al.*, 2003).

Hematological parameters:

Results of hematological parameters in Table (6) show insignificant differences in red blood cell count (RBCs), white blood cell count (WBCs), platlet count, hemoglobin concentration (Hb) and packed cell volume (PCV), lymphocytes, monocytes, neutrophils distribution, mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC) and mean corpuscular hemoglobin (MCH) values. Similar findings were recorded by Rivlin and Wagner (1969), who found that anemia is uncommon in hyperthyroidism; however, in one study among 50 patients with hyperthyroidism 4 women were found with moderate anemia. Wintrobe *et al.* (1981) stated that administration of carbimazole is thought to be one of the least toxic of antithyroid drugs particularly in regard to its effects on lymph. Also, Peterson and Turrel, (1986) recorded that carbimazole is the drug of choice for long-term medical management of feline hyperthyroidism. In contrast to our results, Bond *et al.* (1983) observed some hematological changes including raised packed cell volume (PCV), erythrocytosis, occasionally mild anemia may be found in hyperthyroid cats. Differences between our results and those reported by pervious authors could be related to variety of aspects in the experimental design, such as dose of drugs, frequency, species, time that was determined to evaluate hematological changes.

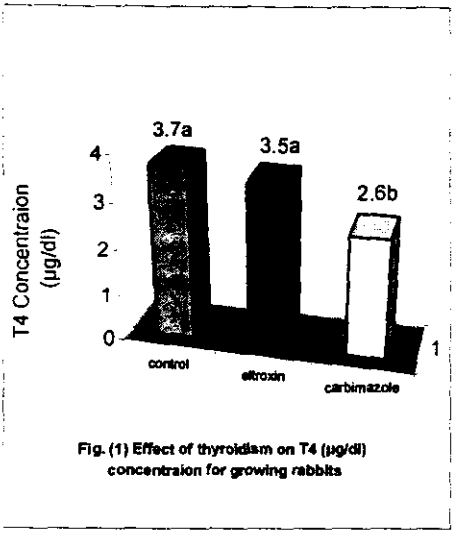

Fig. (1) Effect of thyroidism on T4 (µg/dl) concentraion for growing rabbits

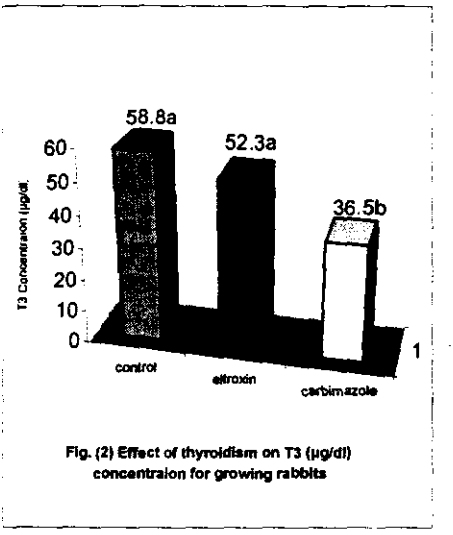

Fig. (2) Effect of thyroidism on T3 (µg/dl) concentraion for growing rabbits

Table 6: Means ± SE of hematological parameters of growing NZW rabbits in different groups

Items	Control	Eltroxin	Carbimazole
Red blood cells ($x10^6$/ml)	5.55±0.25	5.68±0.19	5.80±0.14
White blood cells ($x10^3$/ml)	7.02±1.24	5.53±1.03	5.24±0.25
Platlet counts ($x10^3$/ml)	324.20±82.05	236.00±50.51	223.40±30.43
Hemoglobin (g/100ml)	13.58±0.53	13.98±0.25	13.74±0.31
Hematocrit (PCV) (%)	38.34±1.72	38.28±0.91	38.46±0.89
Lymphocytes (%)	12.08±1.72	11.98±2.72	10.58±1.46
Monocytes (%)	14.88±1.63	15.87±2.53	14.84±0.73
Neutrophiles (%)	73.04±2.77	72.15±3.63	74.58±1.64
MCV*	68.40±0.68	67.00±1.06	66.80±0.58
MCHC*	35.74±0.34	37.15±0.95	36.14±0.38
MCH*	24.44±0.25	24.72±0.89	23.64±0.19

- **MCV mean corpuscular volume=PCV/RBCs**
- **MCHC mean corpuscular hemoglobin concentration= Hb/ PCV**
- **MCH mean corpuscular hemoglobin= Hb/RBCs**

On the basis of the foregoing results, it could be concluded that the hypothyroidism improved growth performance for growing rabbits under summer condition in Egypt, reaching appropriate live body weight for marketing at shorter ages.

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تأثير مستوى نشاط الغدة الدرقية علي الأداء الإنتاجي في أرانب النيوزيلندي الأبيض النامية تحت ظروف الصيف الحار في مصر

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أستخدم في هذه الدراسة عدد ٣٠ أرنب نيوزيلندي أبيض عمر ٣٥ يوم بمتوسط وزن ٦٢٤±٢١,٥جم وقد تم تقسيمهم إلي ثلاثة مجاميع متشابهة عوملت بالحقن تحت الجلد مرة واحدة أسبوعيا لمدة ٧ أسابيع كالتالي:

مجموعة أولي : (مجموعة المقارنة) تم حقنها ٠,٥مل محلول ملح فسيولوجي.

مجموعة ثانية : تم حقنها بالالتروكسين (لرفع نشاط الغدة الدرقية) ١٥ ميكروجرام/أرنب .

مجموعة ثالثة : تم حقنها بالكاربيمازول (لخفض نشاط الغدة الدرقية) ١٥ ميكروجرام/أرنب .

أوضحت النتائج زيادة كمية الغذاء المأكول ووزن الجسم والتحسين في معدل النمو والاستفادة الغذائية لمعاملة الكاربيمازول عن الألتروكسين والكنترول ولكن لوحظ انخفاض درجة حرارة المستقيم للمعاملة بالألتروكسين في عمر ١٢ أسبوع. أدت المعاملة بالكاربيمازول زيادة الوزن النهائي عن مجموعتي الألتروكسين والكنترول بمعدل ١١,١% و ١٣,٥% علي التوالي.

وكذلك وجد زيادة معنوية على مستوى ٥% في نسبة التصافي لمجموعتي الالتروكسين والكاربيمازول مقارنة بمجموعة الكنترول علي الرغم من زيادة أوزان كلا من الكبد والكليتين والرئتين والقلب فيها عن المجموعتين الأجرتين المعاملتين. وقد لوحظ أن ارتفاع مستوي هرموني الثيروكسين والتراي أيودوثيرونين في مجموعة الكنترول عن المجموعتين المعاملتين. ولم يكن هناك أي تأثيرات معنوية للمعاملات علي الخصائص الهيماتولوجية للدم .