RELATIONSHIP BETWEEN TRIIODO THYRONINE (T_3) AND INSULIN-LIKE GROWTH FACTOR (IGF_1) HORMONES IN EGYPTIAN LOCAL CHICKENS DURING GROWTH PERIOD

By

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Abstract *This study was conducted to detect the relationship between plasma levels of triiodothyronine (T_3) and insulin-like growth factor I (IGF-I) hormones and to evaluate the difference in some physiological parameters related to body weight among six lines of Golden Montazah (GM) chicken differing in body weight (BW). A total of 252 GM chickens "4-wk" old" were divided into six lines, heavy (HL), light (LL) and control (CL) according to their body weights (three lines within each sex) each line was represented by 3 replicates (14 chicks each). Live body weight (LBW), body weight gain (BWG), values of hematocrit (Ht) and the levels of blood plasma parameters, i.e. total protein (TP), calcium (Ca), Phosphorus (P), triiodothyronine (T_3) and insulin-like growth factor, (IGF1) hormones were determined at 4 and 12-wk of age. The results obtained showed significant ($P<0.01$) lines and sex difference in LBW and BWG. Average LBW and BWG for heavy lines and males were significantly ($P<0.01$) higher than that of light lines and females. The heavy line chicks exhibited the heaviest LBW and BWG while light line chicks were the lightest during the period from 4 to 12 wk-of age. The increase in HL body weight was associated with increase in plasma TP, Ca, P, T_3 and IGF_1. T_3 hormone was high and positive correlated with IGF_1 during the growth period at 4 till 12 wk-of age. It was concluded that we can used these results as indices of the highest productive performance birds in attaining the goal of improved meat production and decrease the total cost of production, through the different selection strategies.*

INTRODUCTION

Local chicken represents safety valve to poultry industry in Egypt and every advantage of novel and unconventional strategies aimed to improve the Egyptian poultry production, must taken in consideration. Blood biochemical and hematological traits could be important as indicator traits in breeding for high productivity (Obeidah *et al* 1978 and Peterson *et al* 1982).

It was well known that, growth and metabolism in avian species are regulated by a several of hormones and growth factors. Thyroid hormones (thyroxine "T_4" and triiodothyronine "T_3") and somatorophic axis hormones (growth hormone "GH" and insulin-like growth factor-1 (IGF-$_1$) are major regulators of normal growth and development (Scanes *et al* 1984; Vasilatos and Scanes, 1991 and McNabb and King. 1993). Buyse *et al* (1999) reported that one way of getting more insight in the hormonal regulation of growth is measuring the functional activity of involved hormonal axes in animals widely different in growth rate and body composition.

Goddard *et al* (1988) reported that there is a positive correlation (r=0.62) between circulating concentrations of IGF-1 and LBW when data from all lines (HL, LL and CL) in his study were combined. Scanes *et al* (1989) detected that, when plasma concentrations of IGF-1 were compared between genetic lines of chickens selected for low and high growth rate, IGF_1 was considerably higher in the high growth line. Dunnington *et al* (1993); Hammouda *et al* (2001) and Hassaan (2004) reported that the heavy line chicks of LBW exhibited higher T_3 level than those exhibited the light LBW. It was suggested that thyroid hormones are involved in IGF-1 production by regulating growth hormone receptor in the chicken (Tsuxada *et al* 1995).

It was reported that values of some hemato-biochemical parameters were related to growth performance in chicks.

Meluzzi *et al* (1992) and Saleh (1997) reported that the values of plasma protein were higher in heavy chicks than light chicks. Also, Fathi *et al* (2000) and Hassaan (2004) reported that the "Ht" values in males were higher than females Vo *et al* (1970); Krasnodebska *et al* (1999) and Hassaan (2004) reported that in chickens significant sex differences in plasma calcium and phosphorus which were higher in females than males and slight increase in HL than CL or LL. The objectives of this study were to detect the relationship between T_3 and IGF-1 hormones during growth period in local chicken and to evaluate the difference in some physiological

parameters related to body weight among six lines of GM chickens differing in LBW.

MATERIALS AND METHODS

Experimental Birds and management

This experiment was conducted at Poultry Breeding Farm, Faculty of Agriculture, Ain Shams University, Egypt. A total numbers 400 of one day old and unsexed Golden Montazah (GM) chicks were collectively brooded on littered floor pens till the 4-wk of age. Chicks were given feed and water *adlibitum*. Chicks were fed a diet containing 19.5% crude protein and 2878 Kcal ME/kg during the growth period up to eight weeks of age. After that during the finisher period, chicks were fed a diet containing 16.2% crude protein and 2928 Kcal –ME/kg. The minerals and vitamins were adequately supplied to cover the requirements according to NRC (1994). At four weeks of age a total of 252 GM chicks were assigned and sexed. Chicks were wing banded and divided into six lines (three lines within each sex) heavy (HL), light (LL) and control (Cl) according to their body weights, each line was represented by 3 replicates (14 chicks each). The male lines were designated to control "CM", heavy "HM" and light "LM" with average LBW of 232.30±1.56, 280.30±3.65 and 195.90±3.27 grams respectively. The female lines were control "CF", heavy "HF" and light "LF" with average LBW of 181.60±2.56, 218.40±3.15 and 155.20±2.66 grams respectively.

Measurements and observations:

Individual body weight for each line within each sex was recorded biweekly from four weeks of age through 12 weeks to the nearest gram. Body weight gain was calculated biweekly from 4 to 12 weeks of age, by subtracting the previous weeks body weight from the week being recorded. Hematocrit (Ht) values were determined using the conventional method.

At four and twelve weeks of age a total of 72 blood samples (36 samples for each age and 6 samples for each line within each sex) were withdrawn from wing vein into heparinized plastic tubes.

Plasma were harvested after centrifugation at 3500 r.p.m. for 10 minutes, decanted into waserman tubes, and stored at -20°C until biochemical analysis done. Plasma total protein, calcium, Phosphorus were determined by enzymatic methods using commercial kits (SCLAVO, INC., 5 Mansard Count, Wayne. N JO7470, USA). Plasma T_3 and IGF_1 were

determined by using available commercial kits, biomerieux, 69280-Marcy l'Etoile, France.

Statistical analysis: Analysis of variance for data was accomplished using the "SAS" General Linear Models (SAS Institute, 1994). Differences between means were tested for statistical significance using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Growth performance

Live body weight (LBW):

Average of LBW at four, six, eight, ten and twelve week of age were significantly ($P<0.01$) different among lines and between sexes of GM chicks (Table 1). The HL recorded the heaviest LBW at all ages studied from four to twelve week of age, whereas males were found to be significantly ($P<0.01$) heavier than females at all ages studied. These results were in accordance with the previous reports of (Sabri *et al.* (1995); El-Soudany (2003) and Hassaan (2004). They reported that sex and line showed highly significant differences in LBW of chickens at different ages, HL and males are heavier than LL and females at the same ages. However, Singh *et al.* (1990) concluded that sexual differences in LBW for chickens has polygenic basis of inheritance and selection could be effective in changing LBW relationship between male and female progenies.

Body weight gain (BWG):

Average of BWG at different periods from four to twelve week of age was affected by line (L) and Sex (S) for GM chicks Table 2). Average of BWG at different periods from four to twelve week of age were significantly ($P<0.01$) different among lines and between sexes. The HL was significantly ($P<0.01$) different from CL and LL at all ages studied and recorded the heaviest BWG while the lightest was that of the LL, whereas males had significantly ($P<0.01$) more BWG than females at all ages studied. These results are in agreement with Hussen (1997); El Soudany (2003) and Hassaan, (2004) they reported that GM chicken males had heavier BWG than females during 12 week period. The present results were also in agreement with those of Hassaan (2004) in chicken, Farahat (1998) and Shata (2001) in Japanese quail who reported that line significantly ($P<0.01$) influenced daily gain and growth rate and the heavy body weight line had higher daily gain values compared with the other lines.

Hemato-biochemical parameters

Hematocrit value "Ht"

The results show that at four weeks of age Ht value was slightly increased in LL than that of HL or CL and in males than females. However, at twelve week of age, Ht values increased for all chicks with significant increase ($P<0.01$) in the males than females Table (4). These results are in agreement with Fathi *et al* (2000); Hammouda *et al*. (2001) and Hassaan (2004) who confirmed the previous findings. These results may be due to the role of male hormone in growth and development of animals "testosterone" Malgor and Fisher (1970).

Plasma total protein (TP)

Plasma total protein (TP) was significantly increase ($P<0.05$) and highly significantly increase ($P<0.01$) in HL chicks at four and twelve weeks of age respectively Tables (3) and (4). These results indicated that increase in body weight was associated with increase in plasma proteins level. These results are in full agreement with those recorded by Rizkalla (1996) and Hassaan (2004) in chicken and Abdel-Azeem *et al* (2001) and Shata (2001) in Japanese quail chicks. They reported that heavy body weight line showed marked elevation in serum total protein than light body weight line. This may be due to the differences in metabolic activities between the two sexes (Patterson *et al* 1967).

Plasma calcium (Ca) and phosphorus (P)

The values of plasma calcium (Ca) and phosphorus (P) are presented in Tables (3) and (4) it could be observed that line showed significantly ($P<0.05$) difference on Ca and P levels which the "HL" exhibited high levels of both Ca and P compared with the other lines at 12 week of age. However, at 12 week of age plasma Ca level was significantly ($P<0.01$) higher in females than in males. These results are agreement with the results of Vo *et al* (1978); Meluzz *et al* (1992) and Krasnodebska *et al* (1999) who found significant differences between males and females in plasma concentration of calcium with higher values in the females. This may be attributed to the difference in Ca regulation and absorption between the two sexes.

Plasma Triiodothyronine (T_3)

The results presentd in Tables 3 and 4 showed that the levels of T_3 hormone were significantly ($P<0.05$) differences among lines and between sexes. HL and males exhibited significant elevation than LL and females at both four and twelve wk of age. These results are in harmony with the

previous reports of Hammouda *et al* (2001) in broiler chicks; Hassaan (2004) in local chicken and Shata (2001) in Japanese quail who reported that chicks exhibited the highest LBW (HL) showed the highest values of T_3 compared with those exhibited the lowest LBW and male had higher T_3 level than the females. This result is evident for T_3 as a physiological marker for detecting the difference among lines and between sexes according to their body weight.

Plasma insulin-like growth factor (IGFI)

Data presented in Tables 3 and 4 showed that the levels of IGF_1 were significantly ($P<0.05$) differences among lines and between sexes HL and males exhibited significant elevation than LL and females at 12 wk of age. However, at 4 wk of age showed that the HL exhibited significant elevation ($P<0.05$) than LL with slight increase in males than females. It is interest to note that these observed findings indicated that the increase in LBW was associated with the increase of the level of IGF_1. These results are in agreement with the previous reports of Goddard *et al* (1988) who reported that there is a positive correlation ($r=0.62$) between circulating concentrations of IGF_1 and LBW in chickens. Also, Scanes *et al* (1989); Beccovin *et al* (2001) and Mohamed (2004) reported that when plasma concentrations of IGF-1 were compared between genetic lines of chickens selected for low and high growth rate, IGF-1 was higher in the high growth line. Thus from data presented in Tables 3 and 4, it is clearly observed that the levels of IGF-1 were positively correlated with the levels of T_3 in hormone. These results are in accordance with Tsukada *et al* (1995) who reported that thyroid hormones are involved in IGF-1 production in the chicken.

In conclusion, it is worthy to note that there was a positive correlation relationship between the levels of IGF-1 and T_3 hormones and LBW. HL was associated with increase in the levels of *IGF-1 and* T_3 hormones, TP, Ca and P. Therefore, determination of blood parameters studied could be used as indices for growth performance and might also reflect physiological and biochemical differences among lines and between sexes in local and developed Egyptian chicken.

Table 1: Average of live body weight (gm) at different ages as affected by line (L) and sex (S) in Golden Montazah chicks.

Age (wk)	sex	Line			Overall mean	Prob.		
		Control	Heavy	Light		L	S	LS
4	M	232.30±1.56	280.30±3.65	195.90±3.27	236.17[a]	**	**	**
	F	181.60±2.56	218.40±3.15	155.20±2.66	185.07[b]			
	Overall	206.95[b]	249.35[a]	175.55[c]				
6	M	366.50±2.42	451.50±5.76	299.70±5.21	372.57[a]	**	**	**
	F	307.20±2.15	370.50±4.91	258.60±3.18	312.10[b]			
	Overall	336.85[b]	411[a]	279.15[c]				
8	M	514.70±2.97	629±12.21	426.40±8.05	523.37[a]	**	**	**
	F	442.60±2.60	516.30±5.49	372.30±3.43	443.73[b]			
	Overall	478.65[b]	572.65[a]	399.35[c]				
10	M	674.90±4.12	834.30±15.80	535±9.67	681.40a	**	**	**
	F	567.70±2.66	668.60±5.93	477.70±3.37	571.33b			
	Overall	621.30[b]	751.45[a]	506.35[c]				
12	M	883.70±4.18	1074±17.77	691±11.57	882.90a	**	**	**
	F	754.80±3.12	870.10±5.35	619.10±3.88	748b			
	Overall	819.25[b]	972.05[a]	655.05[c]				

a, b and c : Means within the same classification with no common superscript differ significantly
*P<0.05, ** P<0.01, NS : non significant M= Male F = Female

Table 2: Average of body weight gain (gm/ 2 weeks) at different periods as affected by line (L) and sex (S) in Golden Montazah chicks.

Period	sex	Line			Overall mean	Prob.		
		Control	Heavy	Light		L	S	LS
4-6	M	134.20±1.62	171.20±5.95	103.80±3.60	136.40a	**	**	**
	F	125.60±1.42	152.10±2.45	103.40±1.85	127.03b			
	Overall	129.90b	161.65a	103.60c				
6-8	M	148.20±1.86	177.50±9.60	126.70±5.20	150.80a	**	**	**
	F	135.40±1.28	145.80±1.16	113.70±1.25	131.63b			
	Overall	141.80b	161.65a	120.20c				
8-10	M	160.20±1.49	205.30±8.12	108.60±3.40	158.00a	**	**	**
	F	125.10±0.68	152.30±1.42	105.40±1.15	127.60b			
	Overall	142.65b	178.80a	107.00c				
10-12	M	208.80±1.55	239.70±6.90	156.0±7.40	201.50a	**	**	**
	F	187.10±1.95	201.50±1.92	141.4±1.96	176.67b			
	Overall	197.95b	220.60a	148.70c				

a, b and c : Means within the same classification with no common superscript differ significantly
*P<0.05, ** P<0.01, NS : non significant M= Male F = Female

Table 3: Average values of hematocrit (Ht%) and blood plasma total protein (TP) g/dl, calcium (Ca) mg/dl, phosphorus (P) mg/dl, triiodothtonine ((T_3) ng/ml and insulin-like growth factor I (IGF-I) ng/ml at 4 wk of age as affected by line (L) and sex (S) in Golden Montazah chicks.

Parameters	sex	Line			Overal l mean	Prob		
		Control	Heavy	Light		L	S	LS
Ht	M	33.5±0.56	33.2±0.40	34.16±0.60	33.62	NS	NS	NS
	F	32.5±0.43	32.0±0.37	33.0±0.37	32.50			
	Overall	33	32.60	33.58				
TP	M	3.56±0.46	3.84±0.59	3.22±0.27	3.54	*	NS	NS
	F	3.74±0.10	4.17±0.29	3.42±0.22	3.77			
	Overall	3.65ab	4.01a	3.32b				
Ca	M	11.53±0.30	11.62±0.68	11.34±0.53	11.49	NS	NS	NS
	F	11.82±0.24	11.94±0.48	11.57±0.30	11.77			
	Overall	11.68	11.78	11.46				
P	M	6.14±0.25	6.19±0.28	6.11±0.31	6.15	NS	NS	NS
	F	6.00±0.18	6.13±0.16	5.9±0.24	6.01			
	Overall	6.07	6.16	6.01				
T_3	M	2.43±0.16	2.77±0.44	1.83±0.13	2.346	*	*	NS
	F	1.83±0.30	2.01±0.29	1.72±0.11	1.85[b]			
	Overall	2.13ab	2.39a	1.78b				
IGF-I	M	31.10±0.52	35.88±0.70	29.43±0.65	32.14	*	NS	NS
	F	31.87±0.85	32.60±1.04	27.53±1.26	30.67			
	Overall	31.49ab	34.24a	28.48b				

a, b and c : Means within the same classification with no common superscript differ significantly
*P<0.05, ** P<0.01, NS : non significant M= Male F = Female

Table 4: Average values of hematocrit (Ht%) and blood plasma total protein (TP) g/dl, calcium (Ca) mg/dl, phosphorus (P) mg/dl, triiodothtonine ((T_3) ng/ml and insulin-like growth factor I (IGF-I) ng/ml at 12 wk of age as affected by line (L) and sex (S) in Golden Montazah chicks.

Parameters	sex	Line			Overall mean	Prob.		
		Control	Heavy	Light		L	S	LS
Ht	M	48.70±0.21	47.80±0.48	49.0±0.37	48.50a	*	**	NS
	F	46.20±0.31	45.70±0.42	47.0±0.29	46.30b			
	Overall	47.45b	46.75c	48a				
TP	M	4.16±0.14	4.63±0.45	3.80±0.04	4.20	**	NS	NS
	F	4.49±0.19	4.93±0.13	4.13±0.24	4.51			
	Overall	4.33b	4.78a	3.97c				
Ca	M	12.11±0.17	12.59±0.29	11.85±0.38	12.18b	*	**	NS
	F	12.75±0.26	13.5±0.32	12.68±0.17	12.98a			
	Overall	12.43b	13.05a	12.27c				
P	M	6.21±0.21	6.62±0.17	6.10±0.15	6.31	*	NS	NS
	F	6.12±0.16	6.66±0.16	5.63±0.20	6.14			
	Overall	6.17b	6.64a	5.87c				
T_3	M	2.43±0.22	2.62±0.37	2.01±0.32	2.35a	*	*	NS
	F	2.13±0.13	2.30±0.18	1.97±0.17	2.13b			
	Overall	2.28ab	2.46a	1.99b				
IGF-I	M	49.58±0.96	55.60±1.05	46.27±1.27	50.48a	*	*	NS
	F	48.25±1.39	52.28±1.45	42.93±0.98	47.82b			
	Overall	48.92[b]	53.94[a]	44.60[c]				

a, b and c : Means within the same classification with no common superscript differ significantly
*P<0.05, ** P<0.01, NS : non significant M= Male F = Female

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الملخص العربي

العلاقة بين هرموني التيروزين ثلاثي اليود وعامل النمو المشابه للأنسولين في الدجاج المصري المحلي أثناء فترة النمو

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أجريت هذه الدراسة لمعرفة العلاقة بين نشاط هرمون Triiodotyrosine (T_3) وعامل النمو المشابه للأنسولين Insulin-like growth factor (IGF-1). كما استهدفت هذه الدراسة تقييم الاختلافات في بعض المقاييس الفسيولوجية التي تنتمي لوزن الجسم بين ستة خطوط من سلالة دجاج المنتزة الذهبي المحلي تختلف في وزن الجسم. واستخدم في الدراسة عدد ٢٥٢ طائر عمر ٤ أسابيع من سلالة المنتزه الذهبي قسمت إلى ٦ خطوط (٣ خطوط داخل كل جنس) خط عالي أو ثقيل الوزن- منخفض- كنترول تبعاً لوزن الجسم وكل خط مثل بعدد ٣ مكررات كل مكرر به ١٤ طائر- وقد تم تحديد وزن الجسم الحي ووزن الجسم المكتسب وكذلك تحديد بعض معايير الدم مثل قييم الهيماتوكريت ومستويات بلازما الدم من البروتين الكلي- الكالسيوم- الفوسفور- هرمون T_3 وهرمون IGF_1 وذلك عند عمر ٤، ١٢ أسبوع- عليها أظهرت النتائج إختلاف وزن الجسم معنوياً بين الخطوط المختلفة وداخل كل جنس – متوسط وزن الجسم الحي ووزن الجسم المكتسب للخطوط الثقيلة الوزن والذكور عموماً كانت أعلى معنوياً عن تلك المنخفضة الوزن والإناث بصفة عامة وذلك خلال الفترة من ٤ وحتى ١٢ أسبوع من العمر. الزيادة في وزن الجسم للخطوط الثقيلة الوزن عموماً كانت مرتبطة بالزيادة في مستويات بلازما الدم من البروتين الكلي، الكالسيوم، الفوسفور، وهرمون T_3 ، والـ IGF_1

ولقد ارتبط مستوى هرمون T_3 ارتباطاً إيجابياً عالياً مع مستوى هرمون IGF_1 أثناء دورة النمو خلال الفترة من عمر ٤ وحتى ١٢ أسبوع خاصة في الخطوط الثقيلة الوزن.

وقد خلصت هذه الدراسة إلى أنه يمكن استخدام هذه النتائج والمقاييس الفسيولوجية كأدلة هامة للطيور الأعلى أداء إنتاجي بهدف تحسين إنتاج اللحم في السلالات المحلية وتقليل التكلفة الكلية للانتاج من خلال برامج الانتخاب المختلفة.