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EFFECT OF GENETICALLY IMPROVED ON PHYSIOLOGICAL, IMMUNE RESPONSE AND PRODUCTIVE PERFORMANCE IN NATIVE CHICKENS

Nouran M. Abdel-Monim , F. K. R. Stino, Abdel-Rahman Atta, Nagwa Abdel-Hadi A.
Anim. Prod. Dep., Fac. of Agric., Cairo Uni., Giza, Egypt.
Corresponding author: Nouran M. Abdel-Monim Email: nouranmohsen248@gmail.com

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ABCTRACT: The present study evaluated to assess genetic variability in performance traits, Blood Parameters and immune competence by using biotechnological methods on two Egyptian broiler lines Cairo-B2 and Random breed control (RBC). A total of two thousand chicks, from the ninth generation from lines, were reared in four replicated rooms under the same conditions until 8 weeks of age. Live body weight was determined weekly for Cairo-B2 and Random breed control (RBC) until 8 weeks, Blood samples were collected at 4 weeks of age from 20 chicks from each line to determined Triiodothyronine(T3), thyroxine (T4), total protein (TP), total lipids (TL), hematocrit (Ht), and Insulin-like Growth Factor-1 (IGF-1), The primary immune response of 30 chicks per line to Sheep red blood cells (SRBC) antigens was injected at 4 weeks and repeated at 6 weeks of age. 40 chicks from each line were slaughtered to determined carcass characteristics, the Cairo-B2 line had significantly higher than RBC line in body weight, carcass, breast meat, neck and wings weights. The results were the RBC line had significantly higher T3 and IGF-1 than the Cairo-B2 line and there was no significant difference in T4, TP, TL and Ht between the lines. The RBC line had higher antibodies titers to SRBC than the Cairo-B2 line that was shown in each injection. We are concluded that selection for high body weight over many generations can negatively effect on the immune response and carcass weight.

Key words: Triiodothyronine, Insulin-like Growth Factor-1, immune response

INTRODUCTION

Poultry production, in Egypt, has increased recently due to the increase in population, incomes and standard of living. Therefore, the poultry industry is under increasing pressure to produce more high-quality products for the consumers. Genetic improvement is considered as one of the most important methods used to increase the productivity of poultry by selecting the best birds and improving their genetic merit (Hermiz *et al.,* 2014). However, improving body weight, of native chicken by genetic selection might be slow and a time-consuming practice. Therefore, crossbreeding is the better option to obtain birds with a faster growth rate and well adapted to native environmental conditions. However, the increase in body weight in chickens, due to genetic selection, has been accompanied by other changes (Nassar *et al.,* 2008). These changes included growth rate, slaughter performance and immune response. In the poultry industry, with numerous commercially broiler crosses available, it is of a major economic importance to determine the performance of a broiler strain. Also, the yield of different parts is very important in evaluating the performance of the particular broiler cross and a normal growth rate requires critical or optimal concentrations of triiodothyronine (T3), thyroxine (T4), and insulin-like growth factor-1 (IGF-1) Also.

The objectives of the current study were to evaluate the effect of genetically improved selected Cairo B-2 line as a local chicken strain, through biotechnological techniques on productive performance, physiology, and immune response.

MATERIAL AND METHODS

1-Experimental measurements

In this study, two thousand of live body weights (LBW) at hatch, 14, 28, 42, and 60 days of age were obtained individually by using a digital scale for all birds. Blood Samples were collected at 4 weeks of age from 10 males and 10 females, from each of the Cairo-B2 and RBC lines, and were chosen randomly. These series were used to obtain total protein, total lipids, hematocrit, IGF-1, T3, and T4. They were analyzed in the Hormonal Laboratory at Cairo University Research Park (CURP), Faculty of Agriculture, Egypt. At 4 weeks of age 30 chicks per strain were randomly assigned for assessing humoral immune response. Collected sheep red blood cells (SRBCs) was washed 3 times in phosphate – buffer saline (PBS). After that, the packed cells were constituted at 7% vol/vol PBS solution.

At 4 weeks of age, chicks were injected into the thigh muscle with 1/2 ml/chick SRBC (7% suspension in (PBS). This was followed by a booster injection of SRBC suspension at 6 weeks of age (after14 days of the first injection). Blood samples were drawn at 3, 6, and 9 days from the first and second injections. Plasma was stored at (-20oC) until tested. Slaughter traits were obtained at 8 weeks of age. twenty males and 20 females, from each of the Cairo B2 and the RBC line, were chosen at random. Bird was weighed (LBW) and slaughtered after 8 hours of fasting as recommended by (Papa, 1991). The birds were slitting the throat, cutting the carotid arteries, jugular veins, esophagus and trachea hanged in a bleeding funnel for 3 minutes and weighed again to obtain the blood weight. Then the feathers were removed by an automatic circular feather pluckier. The

birds were then weighted again to get the feathers weight. The shanks and head (without neck) were then removed and the birds were eviscerated and shelled. Each empty shelled carcass was weighted to obtain the dressed weight. The wings with bones were then removed from the front parts and weighed. Also, the skinless pictorials of major and minor muscles were removed to obtain breast muscles weight. The bones from the thighs and drumsticks were removed then the skinless leg muscles were weighed as leg meat. The liver, heart, gizzard (empty), and abdominal fat we weighed. All previous muscles and organs were also calculated a percentage of LBW. Shank and keel bone lengths were measured using a vernier caliper.

2- Studied traits:

Blood samples were collected in tubes containing EDTA, from the wing vein (1/2 ml/bird).

The total protein, total lipid, and Hematocrit were measured Calorimetrically by using the device of Spectrophotometer Jenway 0300 U.K according to Cannon (1974), Eisemann (1986), Weber (2002) Respectively.

Insulin-like Growth Factor (IGF-1), Total Triiodothyronine (TT3), and Total thyroxin (TT4) Were obtained using the method of Stojevic (2000) using the device of Automatic Gamma Counter, Genesys TM, Genii TM gamma counters, LTI Laboratory Technologies, INC., 43W900 Route 64 Maple Park, IL 60134, US.

The antibody levels against SRBC were measured by hemagglutination test using 2% SRBCs suspension.

3- Statistical analysis:

Data were analyzed as a two-way analysis of variance using the SAS software, general linear model (SAS Institute, 2008). The main effects were line and sex. The following model was used: $Yijk= \mu + Li + Sj + LSij + eijk$ Where: Yijk:

The k th observation of the jth sex within the ith line.

μ: The overall mean. Li: The effect of the ith line.

Sj: The effect of the jth sex

LSij: The interaction between the i th line and the jth sex

Eijk: Random error.

All data are reported as least square means (LSM) ± standard errors (SE). Mean values were separated, when significance existed, using Duncan's multiple range test (Duncan's, 1955). Significance level was set at 5%

RESULTS AND DISCUSSION

1. Cairo B2 and RBC lines live body weight

Results indicated that after eight generations of selection for high live body weight at, 8 weeks of age, significant differences ($P<0.05$) in live body weight were observed between Cairo B2 and the RBC lines at all studied ages (Table 1).

We could attribute the results for the significant differences in body weight between Cairo-B2 and RBC lines to the genetic selection for eight previous generation. these results are in agreement with (Nasser.2013) who reported that for all generations of Cairo-B2 line had significantly($P<0.05$) higher live body weight (LBW) at hatch, 14, 28, and 42 days of age in comparison to the RBC-line. The average live body weight of Cairo B2 and RBC lines by generation at, 6 weeks of age were 731 g VS 555 g (G4), and 1085 g VS 700 g (G7). All the differences were significant within lines and generation.

2. Hormonal and Hematological profiles

a. The level of plasma thyroid hormones and their relationship to total protein, total lipids, and Hematocrit in Cairo-B2 and RBC lines in the ninth generation at 4 weeks of age

The results indicated that the concentration of Triiodothyoxine (T3) level in the Cairo-B2 was significantly higher than that of RBC line. It was also higher in females than that of males. Although the thyroxine (T4) concentration was slightly higher in the Cairo-B2 line than in the RBC line Table (7), however, it was similar for both females and males and shown that total protein, total lipids and hematocrit value at 4 weeks of age was not significantly in different Cairo-B2 and RBC lines. Similarly, there were not significantly differences between males and females (Table 2).

In this study, we could attribute the similarity between the two lines (Cairo-B2 and RBC line) for total protein, total lipids and hematocrit value due to the young age (28 days).

Scheel *et al*., (1991 and 1992) and Gilbert (1963) stated the low values of T3 and T4 especially at 4 weeks of age resulted in a retardation of all anabolic processes including protein synthesis, lipogeneses, lower heat production, and anemia impaired hemoglobin synthesis. Expect for anemia (low hematocrit values) these symptoms are consistent with most of the symptoms related to ascites.

b. The level of Plasma Insulin-like Growth Factor-1 in Cairo-B2 and RBC lines in the ninth generation at 4 weeks of age.

Data presented in Table (2) showed that the level of IGF-1 was significantly ($P<0.05$) higher in the Cairo-B2 line than in the RBC line. However, no significant difference were observed between sexes. Those results are in agreement with Kanacki et al. (2012), Yun et al. (2005) and Hassan et al. (2008).

Results indicated that the higher concentration of T3 at 4 weeks of age the concentration of IGF-1 was also high at the same time. Those results are in agreement with Tsukada *et al*. (1995); Hassan *et al*. (2008), who reported that thyroid hormones are involved in IGF-1 production in the chicken, We could also note that the increased LBW of the Cairo-B2 line was associated with the increase of IGF-1 level. These results are in agreement with Goddard *et al*.(1988) and Hassan et al. (2008).

c. Immune competence for sheep red blood cells (SRBC) in Cairo-B2 and RBC lines in the ninth generation at 4 and 6 weeks of age.

Evaluation of general immune competence traits at 4 and 6 weeks of age in RBC line and Cairo-B2 showed significant breed difference for antibody response to sheep red blood cells (SRBC). RBC line has a high antibody titer to SRBC while Cairo-B2 showed a low antibody titer (Table 3 and 4) these results are in agreement with Hanushi and Sharma (2002); and Pathak *et al*; (2018)

Samples were drawn at 3, 6, 9 days from the challenge injection. There was significant differences among lines and samples each time they were drawn. (Table 3 and 4). There was high antibody titer to SRBC in

between lines and samples at 4 and 6 weeks of age (Table 3 and 4). These results are in agreement with (Sivaraman *et al*., 2005; and Pathak *et al.,* 2018).

Based on the previous results, the selected line (Cairo-B2) had significantly higher body weight than the control line (RBC line). However, the immune competence against SRBC was significantly higher in the control line (RBC line) than in the selected line (Cairo-B2), These results are in agreement with (Cheng and Lamont 1988; Baelmans *et a.l*, 2005 and Pathak *et al*, 2018) who reported that the immune competence traits are under genetic control and are influenced by selection and breeding. Marked breed, strain and line differences have been reported for various immunological traits. Heritability estimates were high for body weight but low for immunological traits. Phenotypic correlations were high and positive among body weights, but were low between body weight and immunological traits (Sivaraman *et al*., 2005 and Pathak *et al*, 2018).

This can be attributed to the fact that intensive selection for production traits impairs the capability of poultry to generate a protective immune response and disease resistance (Adriaansen-Tennekes *et al*., 2009 and Osei-Amponsah *et al*., 2013).

3. Carcass, breast meat, neck, and wings with bones weights at 8 weeks of age The slaughter trial results, indicated that Cairo-B2 line had significantly higher carcass, beast meat, necks and wings with bones than RBC line at 8 week of age (Table 5). Also, these results are in agreement with Ramadan (2014) and Nassar (2013). They reported significant genetic improvement of six weeks live body and carcass weights o Cairo-B2 line, after six generation of selection over the RBC line. The Cairo-B2 line had higher body weight, breast meat, and carcass parts than the RBC line. Similar results were also reported by Schmidt *et al*. (2006), Henderson *et al*. (2009) and Ali *et al*. (2010).

Body weight is usually used as an indicator of growth in farm animals; however numerous studies have shown that other growth traits relating to body morphometric measurements such as body length, shank length and chest girth can serve as good indicators of growth (Ige, 2013; Yunusa and Adeoti, 2014 and Okoleh, 2017). Searle *et al.* (1989) and Okoleh (2017) reported earlier that skeletal growth and muscular development are interconnected. Thus, body morphometric measurements could be used to describe body conformation. It could also be used to predict live weight, examine relationships among economic traits, and evaluate breed and reproductive performance to study interactions between heredity and environment (Chineke,2005 and Okoleh, 2017). This indicates a significant improvement of the selected Cairo-B2 line in comparison with the RBC line (Table 5).

4. Liver, heart, gizzard, spleen and bursa weights at 8 weeks of age

Our results indicated that the Cairo-B2 line did not differ significantly in liver, gizzard, and heart and bursa weights than the RBC line at 8 weeks of age. However, the RBC line had significantly higher spleen, and bursa weights than the Cairo-B2 at 8 weeks of age (Table 6).

The weight of the liver, heart, gizzard, spleen and bursa are related to the bird's physiology. In the Cairo-B2 line, the carcass weight increased in response to selection to higher body weight. However, its organs weights didn't increase, which reduced the percentages of organs to live body weight.

Selection to increase body weight is not effective for increasing broiler organs weights such as liver, gizzard, spleen and heart. These results are in agreement with the results reported by Rance *et al.* (2002), Venturin (2014), Ramadan (2014) and Rosa *et.al* (2007).

COUNCLUSION

We are concluded that selection for high body weight over many generations can negatively effect on the immune response and carcass weight.

Table (1): Mean body weights ± SEM of the offspring of the Cairo-B2 selected and RBC lines of the 9th generation

Generation	Line	Age				
		Hatch	**2 week**	**4week**	**6 week**	**8 week**
G9	Cairo-B2	41±0.2[a]	156±1.2[a]	396±4[a]	728±8[a]	1040±12[a]
	RBC	40±0.3[b]	136±1.8[b]	355±6[b]	582±12[b]	821±18[b]

a….b means, within trait, followed by different superscripts, differ significantly (Duncan 1955).

Table (2): Least square means and SE of the hematological parameter at 4 weeks of age of Cairo-B2 and RBC lines from the ninth generation.

Line	T3 nmol/l	T4 nmol/l	IGF-1 ng/ml	TP g/dl	TL mg/dl	Ht %
Cairo-B2	1.5±0.06[b]	32±1[a]	18±1.3 [a]	6.17±0.2[a]	323.2±9.8[a]	44.8 ±0.8[a]
RBC	1.7±0.06[a]	30.5±1[a]	14.5±1.3[b]	5.83±0.2[a]	523 ±9.8[a]	42.8±0.8 [a]
Sex						
Male	1.5±0.06[b]	31±1[a]	17.5±1.4a	5.9±0.2[a]	517.4±9.8[a]	44.5 ±0.8[a]
Female	1.7±0.06[a]	31.4±1[a]	15 ±1.4a	6.1±0.2[a]	528.8±9.8[a]	43 ±0.8[a]

a and b means, within trait and source of variation (S.O.V), followed by different superscripts, differ significantly (Duncan 1955).

Table (3): Means of antibody titers against sheep red blood cells (SRBCs) of Cairo-B2 and RBC lines at 4-week (First injection) of the ninth generation.

Lines	**SRBCs titer**
Cairo-B2	2.8±0.1[b]
RBC	3.3±0.2 [a]
Sample	
3 days of challenge	3±0.2[ab]
6 days of challenge	3.4±0.2 [a]
9 days of challenge	3±0.2 [b]
Line * sample	
3 days Cairo-B2	2.7±0.2
6 days Cairo-B2	2.7±0.2
9 days Cairo-B2	3±0.2
3 days RBC	3.3± 0.3
6 days RBC	4± 0.3
9 days RBC	2.7± 0.3

a and b means, within source of variation (S.O.V), followed by different superscripts, differ significantly for each other (Duncan 1955).

Table (4): Means of antibody titers against sheep red blood cells (SRBCs) of Cairo-B2 and RBC lines at 6-week (second injection at the same chicken) lines from the ninth generation.

Lines	**SRBCs titer**
Cairo-B2	3.2±0.2[b]
RBC	4±0.2[a]
Sample	
3 days of challenge	3.6±0.2[ab]
6 days of challenge	4±0.2[a]
9 days of challenge	3±0.2[b]
Line * sample	
3 days Cairo-B2	3.3±0.3
6 days cairo-B2	3.6±0.3
9 days cairo-B2	3±0.3
3 days RBC	4 ± 0.4
6 days RBC	4.3±0.4
9 days RBC	3.4±0.4

A and b means, within the source of variation (S.O.V), followed by different superscripts, differ significantly (Duncan 1955).

Table (5): Least square means and SE of carcass parts weights(g) of 8-week-old Cairo B2 and RBC lines of the 8th generation

Trait / Line	Carcass Wt.	Breast meat Wt.	Neck Wt.	Wings Wt.
Cairo-B2	943.3± 32 [a]	166±10[a]	57±3[a]	128±8[a]
RBC	532.5±32[b]	97±6[b]	34±4[b]	85±6[b]

a…. b means, within trait and between lines, followed by different superscripts, significantly (P<0.05) differ (Duncan 1955).

Table (6): Least square means and SE of organs weights (g) of 8-week-old Cairo B2 and RBC lines of the 8th generation

Trait / Line	Liver Wt	Gizzard Wt	Heart Wt	Spleen Wt	Bursa Wt	Keel Length (cm)	Shank Length (cm)
Cairo-B2	15.3±3.7[a]	28±1.6[a]	8.5±0.6[a]	5±0.34[b]	4.4±3.4[a]	10.3±0.3[a]	8.4 ±0.2[a]
RBC	11±3.7[a] ج	25±2[a]	8.4±0.7[a]	6.5±0.6[a]	13±3.7[a]	8±0.3[b]	7±0.2[b]

a…. b means, within trait between lines followed by different superscripts, differ significantly (Duncan 1955).

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الملخص العربى

تأثير التحسين الوراثي على الاستجابات الفسيولوجية و المناعية و الأداء الإنتاجي لسلالات دجاج التسمين المحلي

المؤلفون : نوران محسن عبد المنعم ، أ.د/ فريد كمال رمزي إستينو ، أ.د/ عبد الرحمن عطا ، أ.د/ نجوى عبد الهادي أحمد

أجريت هذه الدراسة على خطين من سلالات التسمين المصرية كايرو بي 2 (Cairo-B2) و خط الكنترول (RBC)لتقييم التباين الوراثي في معدلات الأداء و تأثر معاملات الدم والكفاءة المناعية عن طريق التكنولوجيا الحيوية بإجمالي ألفي كتكوت من الجيل التاسع سلالة كايرو بي 2 (Cairo-B2) و سلالة الكنترول (RBC) تمت تربيتها في اربع غرف متعددة تحت نفس الظروف حتي عمر (8) أسابيع و تم قياس وزن الجسم الحي إسبوعيا خط كايرو بي 2 (Cairo-B2) و خط الكنترول (RBC) حتى(8) أسابيع . جمعت عينات الدم على عمر (4) أسابيع من عدد (20) كتكوت من كل سلالة لتقدير كلا من هرمونات الغدة الدرقية (هرمون ثلاثي أيودوثيرونين T3 و هرمون الثيروكسين T4) والبروتين الكلي (TP) و الدهون الكلية (TL) و الهيماتوكريت (HT) و عامل النمو الشبيه بالأنسولين (IGF-1) و كانت النتائج أن السلالة الكنترول (RBC) أكثرمعنوية في كلا من هرمون ثلاثي أيودوثيرونين (T3) و عامل النمو الشبيه بالأنسولين (IGF-1) و لم يكن هناك فرق معنوي كبير في نتائج كلا من هرمون الثيروكسين (T4) و البروتين الكلي (TP) و الدهون الكلية (TL) و الهيماتوكريت (HT) بين السلالتين. و لتحديد الاستجابة المناعية لدجاج كلا السلالتين تم حقن عدد (30) كتكوت من كل سلالة بخلايا الدم الحمراء للأغنام (SRBC)على عمر (4) أسابيع و تكررت هذه المعاملة علي عمر (6) أسابيع من العمر و كانت الاستجابة المناعية أكثر معنوية في سلالة الكنترول (RBC)عن سلالة كايرو بي 2 (Cairo-B2). تم ذبح عدد (40) كتكوت من كل سلالة لتحديد خصائص الذبيحة ، و وجدت خط كايرو بي 2 (Cairo-B2) أكثر معنوية في وزن كلا من الجسم و الذبيحة و الصدر و الرقبة و الأجنحة عن خط الكنترول (RBC).و لتقدير معاملات الدم . نستنتج من هذه الدراسة ان التحسين المستمر للعديد من الاجيال المتتالية قد يؤثر سلبا على الاستجابة المناعية وصفات الذبيحة للطائر.

الكلمات الدالة:
وزن الجسم، ، عامل النمو الشبيه بالأنسولين-1 ،الاستجابة المناعية، الدجاج التسمين، كايرو بي 2.