

A Comparative Study of Productive Performance and Immune Responses for Some Developed Egyptian Chicken Strains

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Abstract

This experiment aimed to compare and evaluate the productive performance and immunological responses of some developed Egyptian chicken strains. Eight hundred- of Matrouh, Silver Montazah, Mandarah and Inshas, one day old, unsexed-chicks, from hatch up to 12th week of age were equally divided into four groups, 200 chick strain per each. The obtained findings indicated that Inshas chicks had significantly ($P \leq 0.01$) the highest live body weight (at hatch, 4, 8 and 12 weeks of age) and body weight gain from 0-4, 4-8 and 0-12 weeks of age as compared with Mandarah strain. There were no significant strain differences in feed intake and feed conversion all over experimental period. Mandarah chickens showed significantly ($P \leq 0.05$) higher antibody titer against Newcastle Disease Virus (NDV) and Avian Influenza Virus (AIV) H5N1 vaccine, both primary and secondary antibody titers against Sheep Red Blood Cells (SRBC's) compared with Inshas strain. From these findings, could be concluded that Mandarah chicks have the highest immune responses, while the other developed chickens showed better growth performance.

Keywords: Chicken Strains; Productive Performance; Immune Responses;

Introduction

Local chicken breeds contain genetic system with high level of heterozygosity which may provide the chance for proper genetic selection with enhanced adaptability and productivity [1]. A cross reproducing was made between White Leghorn × Dokki-4 to give Matrouh strain, while Silver Montazah was created from a crossing between Rhode Island × Dokki-4. Mandarah strain was produced from a crossing between Alexandria × Dokki-4, while Inshas strain was created by crossing between Sinai and White Plymouth Rock breeds. Enhancing poultry modern have made many quick strides extraordinarily most recent 50 years. Although there are many questions needed to be research, the most interest one is the relationship between poultry immune tolerance and its performance and production [2]. The occurrence of disease is minimized by the use of chicken strains

with established disease resistance and suitable control of the immune system by vaccination [3]. However, few researches reported the negative connection between both high growth rate and disease protection [4].

Many researchers found a negative correlation between immune response and body mass increments [5]. In another study comparing the high and low lines of white leghorn selected to respond to antibodies against SRBC, this study showed that low antibody selection had higher hen/day egg production than those from high antibody selection lines [3]. The rise in immune response is known to be very stressful, so the cost of immunity is produced by converting energy away from reproductive and / or physical functions [6]. The broiler chickens were predominant in body weight and feed conversion ratio as compared to native chickens. On the other hand, the superiority in immunological abilities such as phagocytes movement and Heterophil/Lymphocyte ratio as a stress measure were obtained by Libyan native chicken [7]. The Sheep Red Blood Cells (SRBC's) were a complex, multi-determinant natural antigen provoking a T-B cell dependent antibody response [8].

Therefore the present work was carried out to characterize and compare some productive, physiological and immunological traits of some developed Egyptian chickens.

Materials and Methods

Ethical Approval

Chicks were used in this experiment has been approved by Inshas Poultry Research Station, Animal Production Research Institute, Agriculture Research Center, Giza, Egypt, from February to April, 2017.

Experimental Design

Eight hundred-one day old of mixed sexes local Egyptian chicken strains (Matrouh, Silver Montazah, Mandarah, and

Inshas) during the growing period were equally divided into four groups (200 chicks each) in a completely randomized design. All chicks in each group was housed in the floor pens under the same environmental conditions, they divided into four replicates, 50 chicks each.

At day 1 of age, all birds were wing-banded and daily exposed to 24 lighting hours' during the initial two days of age, 16 hours' light at 3-6 days of age and steady 14-hour light from 2 to 12 weeks of age.

The basal experimental diet was formulated according to composition tables for Animal And Poultry Feedstuffs used in Egypt to meet the nutrition requirements of chickens during the experimental period (from one-day old to 12 weeks of age) as shown in table 1 [9]. Birds were kept under similar management and hygienic conditions. Birds were examined against diseases and treated with antibiotics and vaccines to keep them healthy table 2.

Table 1: Ingredient and chemical composition of the basal diets

Ingredients	Starter diet (%) (0-8 weeks)	Grower diet (%) (8-12 weeks)
Yellow corn	59.84	65.4
Soya bean 44%	24.2	22
Wheat bran	8.2	3
Corn gluten 60%	4	----
Dicalcium phosphate	1.53	1.39
Limestone	1.52	7.44
NaCl	0.37	0.3
*Vitamin & mineral premix	0.3	0.3
L Methionine	0.04	0.17
Total	100	100
Calculated analysis:		
Crude protein (%)	19.46	15.88
Metabolizable energy (M.E./kg)	2800	2727
Ether extract	2.983	2.905
Crude fiber (%)	4.124	3.375
Calcium	1.037	3.24
Av. Phosphorous	0.356	0.321
Lysine	0.885	0.767
Methionine	0.375	0.428
*Premix added to the 1 kg of diet including Vit. A 10000 I.U; vit. D3 2000 I.U; Vit. E 15 mg; Vit. K3 1 mg; vit B1 1mg; vit. B2 5 mg; Vit. B12 10 µg; Vit B6 1.5mg; Niacin 30mg; Pantothenic acid 10mg; Folic acid 1mg; Biotin 50 µg; Choline 300 mg; Zinc 50mg; Copper 4mg; Iodine 0.3 mg; Iron 30mg; Selenium 0.1mg; Manganese 60mg; Cobalt 0.1mg and carrier CaCo3 up to 1kg.		
** Calculated analysis according to Feed Composition Tables for animal and poultry feedstuffs used in Egypt (2001).		

Table 2: Vaccination program of chicks

Age (days)	Type of vaccine	Route of vaccination
1	Marek's	K, Subcutaneous injection
1	IBV	L, Spray
7	IBV+NDV	K, Subcutaneous
9	AIV (H9N2)	K, Subcutaneous injection
10	Gumboro (d78)	L, Drinking water
12	AIV (H5N1)	K, Subcutaneous injection
18	Lasota	L, Drinking water
21	IBV+NDV	L, Spray
25	Gumboro	L, Drinking water
28	MA5 + CLONE 30	L, Drinking water
37	AIV (H5N1)	K, Subcutaneous injection
40	Avian Encephalomyelitis	Wing-wep
45	Gumboro	L, Drinking water
50	ILTV	L, Eye drop
70	MA5 + CLONE 30	L, Drinking water

Studied Traits

Productive Performance

All chicks were weighed on individual basis at day 1 post-hatch, 4, 8 and 12 weeks of age. Body weight gain, feed intake and feed conversion ratio were recorded every four week intervals up to 12 weeks of age. Feed conversion was calculated as g feed/g gain, as well as the mortality rate was calculated.

Immune Responses Evaluation

Humoral Antibody Titers against NDV and AIV virus

All chicks were vaccinated against Newcastle Disease Virus (NDV) at 7, 18, 28 and 70 days of age. While they were injected to vaccinate against Avian Influenza Virus (AIV) of the subtype (H5N1) at 12 and 37 days of age. At 84 days of age, blood samples (1 ml/bird) were drawn from wing vein at random from 20 birds from each strain. Non-heparinized tubes were used to collected blood samples, then they centrifuged at 3000 rpm for 15 minutes. Blood serum was separated and stored at -20°C until analyses were carried out. Serum antibody titer against NDV was determined using Log2 of the hemagglutination inhibition test [10]. Moreover, antibody titers against avian influenza virus by haemagglutination inhibition assays were done [11]. The type of antigens used to test HI against NDV and AI of the H5N1 subtype was purchased from Egy. Flow company. All vaccines were purchased from the Veterinary Serum and Vaccine Research Institute, Cairo, Egypt.

Evaluation of Primary and Secondary Humeral Immune Response against SRBCs

Sheep Red Blood Cells (SRBC's) are used as T-dependent antigens to quantify the primary and secondary humeral antibody titer. With regard to primary antibody titer (1ry Ab)

40 birds from each strain were injected intramuscularly with 0.5 ml of 10% SRBC's suspension at 4 weeks of age. Then the blood samples were collected twice at 7 and 14 days post-injection. Regarding secondary antibody titer (2ry Ab), booster injection of SRBC's suspension was induced using the same 40 birds/strain. Similarly the blood samples were drawn at 7 and 14 days post-booster injection. Approximately 2 ml of blood sample was drawn from the wing vein of each bird to be placed in non-heparinized tubes and allowed to clot. Then the samples were centrifuged at 3000 rpm for 15 minutes to separate serum. Antibodies against SRBC's were measured by the micro hemagglutination test [12]. Titers were expressed as the log2 of the reciprocal of the highest dilution giving complete agglutination.

Statistical Analysis

Data were statistically analyzed using the least square analysis of variance according to Snedecor and Cochran [13] using the General Linear Model Procedure (SAS) [14] at the 5% level of significance as the following model:

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

Where: Y_{ij} = any observation, μ = Overall mean, N_i = Effect of strains ($i = 1 \dots 4$), e_{ij} = Experimental random error.

All percentages, data were transferred to percentage angle using arcsine equation before subject to statistical analysis. Mortality rate was analyzed using the chi-square test to access the significance between different strains using SAS [14]. Significant differences among means were tested using Duncan Multiple New Range Test (Duncan) [15].

Results and Discussion

Productive Performance

Body weight, body weight gain, feed intake and feed conversion from hatch up to 12 weeks of age were summarized in table 3.

^{a,b,c}Means having different letters in the same row differ significantly. ** = ($P < 0.01$), NS= No significant.

Table 3: Productive performance of some developed Egyptian chicken strains from hatch up to 12 weeks of age

Items	Matrouh	Silver Montazah	Mandarah	Inshas	Sig.
Body weight (g)					
At hatched	29.35 ± 0.11b	28.67 ± 0.09c	28.27 ± 0.04c	30.40 ± 0.05a	**
4 weeks	217.07 ± 2.82b	210.18 ± 3.05bc	205.46 ± 2.62c	232.79 ± 2.89a	**
8 weeks	527.56 ± 6.36b	537.31 ± 5.42b	504.28 ± 4.15c	563.30 ± 5.86a	**
12 weeks	832.32 ± 5.67a	829.52 ± 8.03a	780.06 ± 7.14b	843.16 ± 5.67a	**
Body weight gain (g)					
0-4 weeks	187.72 ± 2.81b	181.51 ± 3.07bc	177.19 ± 2.62c	202.39 ± 2.9a	**
4-8 weeks	310.49 ± 6.49b	327.13 ± 6.19a	298.82 ± 5.12b	330.51 ± 6.03a	**
8-12 weeks	304.76 ± 8.06a	292.20 ± 9.47ab	275.78 ± 7.69bc	279.85 ± 7.80c	**
0-12 weeks	802.97 ± 5.67a	800.84 ± 8.03a	751.79 ± 7.14b	812.75 ± 5.67a	**
Feed intake (g)					
0-4 weeks	432.48a ± 11.88	430.39a ± 11.65	419.61a ± 13.83	455.58a ± 13.57	NS
4-8 weeks	1003.16a ± 22.22	992.58a ± 24.37	975.37a ± 18.84	1040.06a ± 22.42	NS
8-12 weeks	1502.70a ± 38.79	1474.91a ± 25.14	1516.93a ± 36.52	1485.43a ± 27.78	NS
0-12 weeks	2898.33a ± 21.95	2857.87a ± 55.52	2911.89a ± 67.12	2981.06a ± 26.05	NS
Feed conversion (g feed/ g meat)					
0-4 weeks	2.31a ± 0.06	2.38a ± 0.07	2.38a ± 0.15	2.26a ± 0.08	NS
4-8 weeks	3.24a ± 0.07	3.04a ± 0.08	3.27a ± 0.03	3.15a ± 0.09	NS
8-12 weeks	4.94a ± 0.14	5.06a ± 0.16	5.51a ± 0.17	5.31a ± 0.09	NS
0-12 weeks	3.66a ± 0.04	3.62a ± 0.10	3.88a ± 0.10	3.67a ± 0.05	NS

The obtained results showed that highest ($P \leq 0.01$) live body weight (at hatch, 4, 8 and 12 weeks of age) were recorded for Inshas, Matrouh, Silver Montazah chickens, while the lowest values were recorded in Mandarah chicken strains. The increase in body weight may be due to differences between different breeds, which reflect the differences between chicks, especially when hatching, where the results show that the superiority of Inshas, Matrouh,

Silver Montazah chicks when hatching compared to Mandarah. Referring to body weight gain all over experimental period (0-12), the results illustrated that highest body weight gain were recorded in Inshas chickens, While the lowest one was recorded in Matrouh chicken strains in table 3. This could be attributed to genetic effect, which reflects the differences among different chicken strains. These findings agreed with [16], who found no

significant differences in body weight for Golden Montazah and Matrouh chickens at 12 weeks of age. Also, the findings of [17] showed no significant differences between Matrouh and Golden-Montazah chickens at different ages.

However, there were no significant strain differences in feed intake and feed conversion thorough experimental period. Similar results showed no significant strain differences between Silver Montazah and Matrouh in feed conversion during all studied periods except, within the period from 8 -12 weeks of age [18]. It is well established the negative relationship between the powerful immunity of chicken and their feed intake as well as their growth rates [2]. Since the avian's immune system mild stimulation like those associated with vaccination can change greatly nutrient dynamics causing reduced feed intake and development [6]. Immune defenses are energetically expensive by multiple mechanisms. However, the most important one is protein turnover that is used to resist pathogen through lymphocyte proliferation, antibody production and cytokine release, in addition to repair of damaged cells and tissues. The accelerated protein catabolism leads to protein malnutrition and wasting of body tissue with subsequent loss of body weight [18,19].

All the previous maneuvers could confirm our results concerning superiority of Mandarah strain regarding immune response and trade off their productive performance. On the contrary, Inshas strain expressed superior Feed Intake (FI) and Body Weight Gain (BWG) with inferior immune responses. Similarly, the selection of chicken's strains having high body weight exhausted the energy needed for many vital traits including immune response [20].

The mortality rate of the testing strains along for the whole time of the experiment is expressed in figure 1. Mandarah strain showed the lowest ($P \leq 0.05$) mortality rate followed by Matrouh and Silver Montazah. Inshas strain had the highest ($P \leq 0.05$) mortality rate. These results may be attributed to the genetic make-up of Mandarah that demonstrated the superiority of both humoral and cell-mediated acquired immune responses. In this context, Egyptian Fayoumi breeds possess strong innate immune barriers that interfere with the entry of pathogens to target cells and proliferation within them and hence reducing occurrence of infection [21].

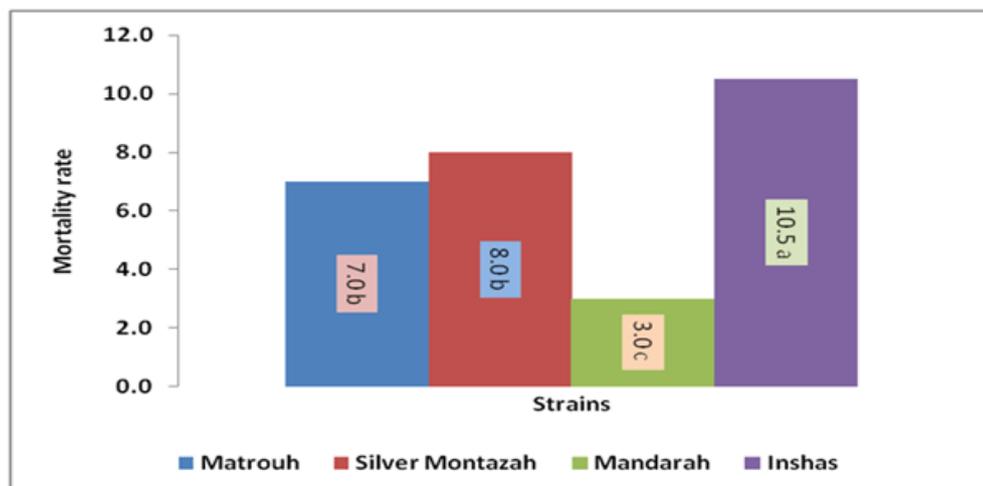


Figure 1: Mortality rate for chick's all over experimental period (12 weeks)

Humoral Immune Response

Primary and Secondary Antibody Titers against SRBC's

Figures 2 and 3 revealed the primary and secondary antibody titer against Sheep Red Blood Cells (SRBC's). The results showed that both primary and secondary antibody titers against SRBC's were significantly higher ($P \leq 0.05$) in Mandarah strain, while Inshas strain recorded the lower ($P \leq 0.05$) value. The best showed humoral immune response against SRBC's of Mandarah strain was attributed to its pedigree that results from crossing between Dokki-4 and Alexandria. The grandparents of both Dokki-4 and Alexandria originate from El-Fayoumi strain. As known, the disease resistance and immune responses in chicken

were controlled by the genetic effect [3], therefore, both of primary and secondary responses against SRBC's are regulated by the quantitative of the genetic [8]. Moreover, it is well established that Fayoumi breed shows the best immunological response among local native chickens, which has superiority in antibody production, due to better handling of antigen by macrophages [22] and high activity of lymphocytes [4]. Additionally, the results of [22] reported that Fayoumi chickens recorded the highest primary and secondary immune responses against SRBC's. On the contrary the worst antibody titers of Inshas strain are realistic, as Inshas is produced by crossing between Sinai strain and White Plymouth Rock breeds that are foreign strains having a genetically low immune response.

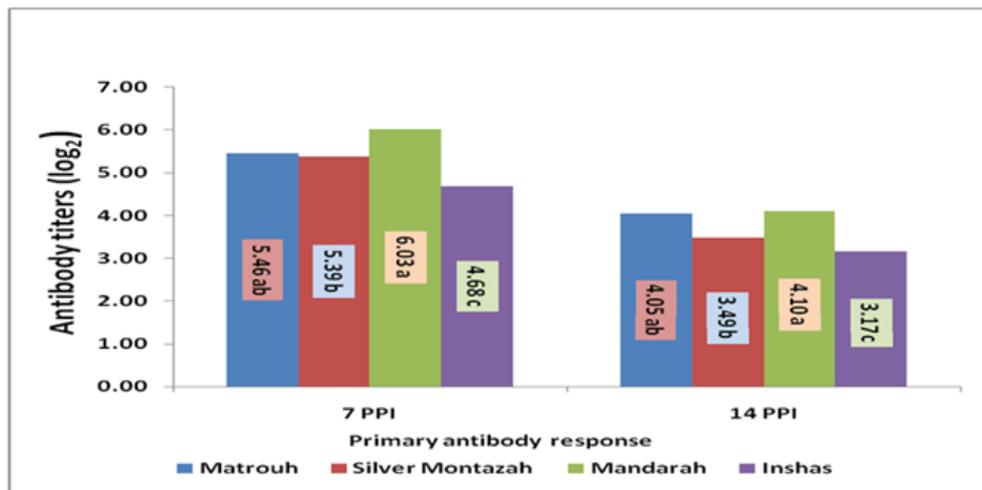


Figure 2: Primary antibody titers against Sheep Red Blood Cells (SRBC's) at different days post immunization*

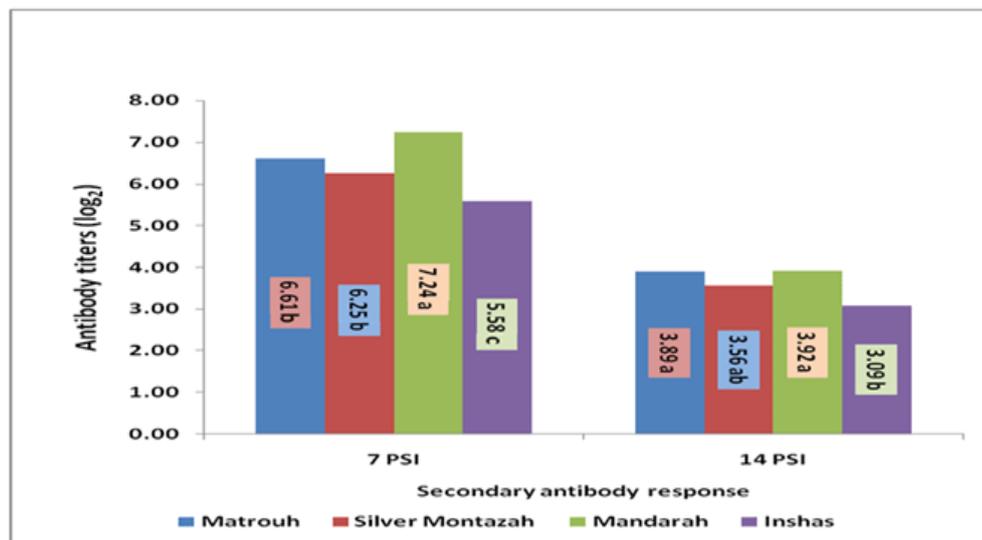


Figure 3: Secondary antibody titers against sheep red blood cells (SRBC's) at different days post immunization*

Antibody Titers against NDV and AIV

Antibody titers against NDV and AIV are presented in figure 4. The obtained results indicated that highest level ($P \leq 0.05$) of antibody titers was estimated in Mandarah chicken strain, while the lowest ($P \leq 0.05$) value was recorded in Inshas chicken strain. Also, Matrouh and Silver Montazah chicken strains were significantly less than Mandarah with NDV values, while they were significantly similar to Mandarah concerning AIV. The highest value could be attributed to improved immune responses of chickens. The selection for enhanced humoral immune response to SRBC's resulted in better response to antigenic components of several vaccines that are currently important in poultry husbandry [23].

These vaccines included NDV, Infectious Bronchitis Virus (IBV) and Infectious Bursal Disease Virus (IBDV). This could explained the superiority of Mandarah strain against NDV and AIV. It is worthy to mention that Fayoumi strain is involved in both sides of grandparents of Mandarah. The challenged four native Egyptian breeds (Gimmizah, Sina, Dandrawi and Mandarah) with very virulent IBV and virulent NDV, found that Mandarah chickens recorded higher genetic resistance to both viral infections, which indicated that the genetic constitution of Fayoumi strain provided better resistance against challenge with La-Sota NDV strain at 21 days of age than that of White Leghorn chickens [24].

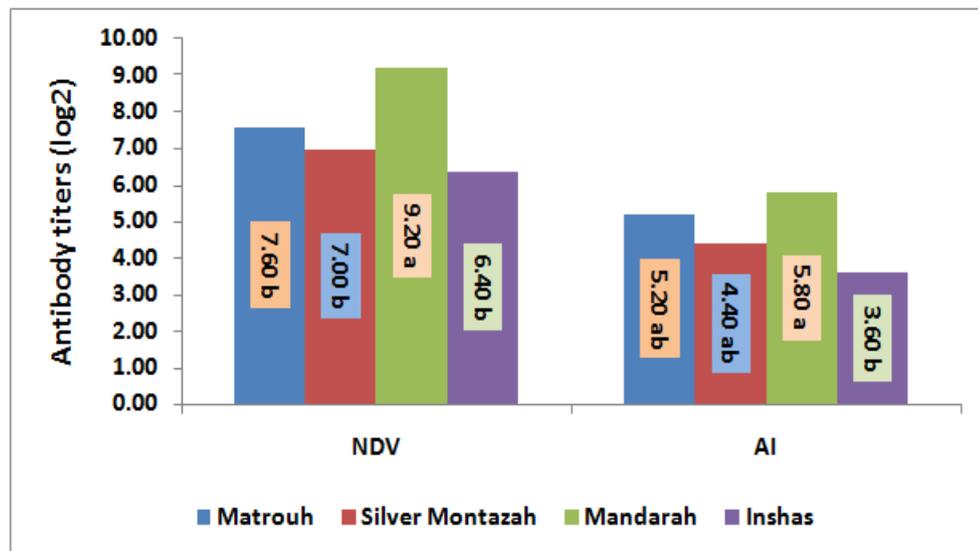


Figure 4: Antibody titers (log₂) against Newcastle Disease Virus (NDV) and Avian Influenza Virus (AIV)

Conclusion

The obtained results concluded that Mandarah chicks have the highest immune responses, which can be used for immune selection, while Inshas chicks can be selected for best strain in the production performance. Finally, it may be recommended to crossing between Mandarah and Inshas strains to produce new strain having both high immune response and great growth performance.

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Competing Interests

The authors declare that they have no competing interests.

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