INFLUENCE OF NAKED NECK GENE ON GROWTH PERFORMANCE AND IMMUNE RESPONSE IN CHICKEN

By

A. Nazmi, U.M. Ali, M.M. Fathi and A. H. El-Attar
Poultry Production Dept., Faculty of Agric., Ain Sham Univ., Cairo, Egypt

Receive: **26/ 12/ 2005** Accept : **13/ 02/ 2006**

Abstract: *An experiment was undertaken to evaluate the effect of naked neck (Na) gene in a single or double state on the growth performance and immune response in chickens. Two hundred and twenty (NaNa, Nana and nana) one day old chicks were used. They were reared under similar environmental, managerial and hygienic conditions from hatching to 16 weeks of age. The high and low ambient temperatures recorded during the whole experiment were 27 and 23C, respectively. The current results revealed that the Nana genotype had significantly heavier body weight compared to nana one. However, there were no significant differences between NaNa and nana genotypes for body weight. Also, The Nana genotype consumed more feed compared to nana and NaNa genotypes. The presence of Na gene in a single or double state significantly improved feed conversion ratio compared to nana sibs. With respect to cutaneous basophil hypersensitivity (CBH) response, the NaNa genotype significantly increased toe-web swelling at 48 and 72 hrs after PHA-P injection compared to Nana and nana genotypes.*

There were no significant differences among genotypes for relative weight of both spleen and thymus. However, the Nana genotype significantly increased relative bursa weight compared to both NaNa and nana genotypes. Also, the Nana genotype significantly increased hematocrit level compared to nana and NaNa genotypes. There was no significant difference among genotypes for plasma total protein, albumen, globulin and relative weight of both gizzard and liver. Concerning the phagocytic activity, the Nana genotype had significantly lower levels of carbon in their circulation as compared to nana genotype. Opposite trend was noticed for NaNa genotype.

There was positive relationship between plasma globulin and body weight was observed in Nana genotype, but inverse and low relationships were showed in both NaNa and nana genotypes. Negatively relationship between body weight and toe-web swelling measured at all times after PHA-

P injection was observed in NaNa genotype. Opposite trend was observed in nana genotype.

There was positive correlation between relative spleen weight and relative thymus weight was observed in both NaNa and Nana genotypes. Similar trend, but very low was observed in nana genotype. The relative bursa weight was negatively correlated with toe-web swelling for all genotypes at all times. There was highly significant positive relationship between toe-web swelling measured at 48h post PHA-P injection and toe-web swelling measured at 72h post PHA-P injection was observed in all genotypes.

INTRODUCTION

The economic importance of the Na gene is related to its effect on heat tolerance because it reduces feather cover by about 40 and 20% in the NaNa and Nana genotypes, respectively (Merat, 1986; Cahaner et al., 1993; Galal, 1999; Deeb and Cahaner, 1999). Numerous studies have supported the better growth, feed efficiency, carcass composition, meat yield, egg production and disease resistance by Na gene at high ambient temperature (Merat, 1986; Horst and Rauen, 1986; Galal, 1999; Fathi and Galal, 2001).

Reports on the influence of major genes, such as naked neck gene, on immunocompetence of chicken are few. Some other major genes such as dwarfism and slow feathering have been evaluated for their possible influence in Immunocompetence in chicken (Klingensmith et al., 1983; Bacon et al., 1986) and showed no adverse effect. Other reports on naked neck and frizzling genes are scanty in the literature.

Bird's immune response of individual consists of three major factors; antibody response (humoral immunity), T-cell mediated immunity and phagocytosis (Fathi et al., 2003). Coordination of these systems enables an individual to resist infection and diseases. Genetic control of these facets of the immune system may be independent of each other (Cheng and Lamont, 1988; Sarker et al., 2000; Lie et al., 2001). Marrow and Abplanalb (1981) reported the that *vivo* response of lymphocytes to phaytohemaglutinin-P (PHA-P) and Concanavalin-A (Con-A). The polygenic control of antibody response and cell mediated immunity was observed by Lamont and Dietert (1990). The defensive functions of phagocytosis come into effect immediately upon the invasion by the foreign material, whereas the T-cell need time to be stimulated and proliferated before they respond to invasion (Lamont, 1986; Cheng and Lamont, 1988). Alvarez et al.(2002) found that Nana chickens were the best responders to immunization with Salmonella gallinarium antigens and they also showed a

good innate immune response against salmonella infection. The current study was undertaken to find out the effects of naked neck gene on performance and immunocompetence of chicken.

MATERIALS AND METHODS

Genetic flock and husbandry

Heterozygous naked neck (Nana) females were artificially inseminated with heterozygous naked neck (Nana) males. The offspring produced (220 chicks) were wing-banded and brooded in electrical brooding batteries. At 4 weeks of age, they were transferred to rearing batteries. All chicks were brooded and reared under similar environmental, managerial and hygienic conditions. Feed and water were provided *ad libitum*. They were fed a diet containing 18% crude protein and 2870 kcal ME/kg. The average high and low ambient temperatures recorded during the experimental period were 27 and 23 ° C, respectively.

Measurements and observations

Phenotypic parameters

Individually body weight was determined for each genotype within sex at 8 and 12 weeks of age. Also, body weight gain was calculated from 8 to 12 weeks of age. Feed consumption and feed conversion ratio was determined from 8 to 12 weeks of age.

Immunocompetence measurements

Phytohemagglutinin Injection (In vivo cell-mediated immunity assay)

Response induced in vivo by mitogen was evaluated by injection of phytohemagglutinin-P (PHA-P) into the toe web between the second and the third digits of male chicks. Ten chicks from each sex within genotype at 7 weeks of age were used. Each chick was intradermally injected in the toe web of the left foot with 100 µg PHA-P (Sigma Chemical Co., St. Louis, MO 63178) in 0.1 ml of sterile saline measured with a constant tension caliper before injection and at 24, 48 and 72 hr after PHA-P injection. The toe-web swelling was calculated as the difference between the thickness of the toe web before and after injection.

Relative lymphoid organs and some organs weight

After completion of phytohemagglutinin assay, the same chicks were weighed and slaughtered. The bursa of Fabricius, spleen, thymus (all lobes from left side of the neck), liver, heart and gizzard were removed and weighed to the nearest milligram.

Blood parameters

At 7 weeks of age and after completion of phytohemagglutinin-P assay, a 2.0 ml blood samples was withdrawn from the jugular vein during slaughter. The resulting plasma was stored at –20 C for latter analysis. The frozen plasma was thaw prior to analysis. Plasma total protein and albumen were determined by enzymatic methods using available commercial kits (Stanbio Laboratory, 1261 North Main St. Boerne, Texas 78006, USA). The globulin was calculated as the difference between the total protein and albumen.

Carbon Clearance (Mononuclear Phagocytic System Function Assay)

The phagocytic ability of chicks was determined by the carbon clearance assay (CCA) based on the method of Cheng and Lamont (1988) and modified by Fathi et al. (2003). Briefly, the supernatant fraction of Black India ink (Design/Hggins, 4415, Sanford, Bellwood, Illinios 60104) was obtained through centrifugation (5000 rpm for 30 min). At 16 weeks of age, 5 males from each genotype were injected with ink at the rate of 1 ml/kg body weight into the left wing vein. The blood samples at 0, 3 and 15 min after ink-injection were taken from the opposite wing and immediately transferred into 2 ml of 1% sodium citrate. The samples were then centrifuged at 5000 rpm for 4 min. The relative amount of carbon particles remaining in the supernatant was measured spectrophotometerically at a wave length of 640 nm using samples at zero min as the zero value.

Statistical analysis

Data were subjected to a two-way analysis of variance with genotype and sex effects using the General Linear Model (GLM) procedure of SAS User's Guide, 2001. When significant difference among means were found, means were separated using Duncan's multiple range test. Correlation coefficients were calculated using PROC CORR to analyze the relationship between relative lymphoid organs weight and the response to PHA-P injection.

RESULTS AND DISCUSSION

Body weight, feed consumption and feed conversion ratio

Body weight, body weight gain, feed consumption and feed conversion ratio as affected by Na gene, sex and their interaction are summarized in Table 1. The Nana genotype had significantly heavier body weight at 8 and 12 weeks of age compared to NaNa and nana ones. Similar trend was noticed for body weight gain calculated from 8 to 12 weeks of age. There were no significant differences between NaNa and nana

genotypes for body weight and body weight gain. Concerning the sex effect, the male chickens showed significantly heavier body weight and body weight gain compared to female ones. However, the interaction effect between Na gene and sex was not significantly affected on either body weight or body weight gain.

With respect to feed consumption, results obtained indicated that the heterozygous naked neck genotype consumed more feed compared to NaNa and nana sibs by about 121.9 and 76.7 g, respectively. Similar trend, but statistically significant, was observed for male chickens compared to female ones. The presence of Na gene in a single or double state significantly improved feed conversion ratio compared to nana sibs. Also, the feed conversion ratio of male chickens was significantly better than that of female ones. Both feed consumption and feed conversion ratio were not significantly affected by interaction between Na gene and sex.

Cell-mediated immunity

There was good indications that cell-mediated immunity plays an important role in controlling and clearing intracellular bacterium (Kougt et al., 1994, 1995). Data listed in Table 2 and Figure 1 showed that PHA-P mediated swelling response in toe-web as affected by Na gene, sex and their interaction. The presence of Na gene in a double state increased toe-web swelling at all time compared to Nana and nana genotypes, but the differences were statistically significant at 48 and 72 hr after PHA-P injection. These findings were in agreement with Patra *et al.* (2004), who reported significantly higher CMI estimates in Nana and NaNa broilers compared to nana. Also, Fathi et al. (2005) reported that CMI response was found to be significantly higher in naked neck (Nanaff) and frizzled (nanaFf) genotypes at all interval time than to normally feathered (nanaff) ones. Likewise, El-Safty et al., (2005) found that the presence of naked neck gene significantly increased toe-web swelling compared to normally feathered genotype. In contrast, Martin *et al.* (1989), Kundu et al. (1999) and Haunshi (1999) reported non-significant effect of CMI response to Con-A on naked neck and frizzle gene. From genetic standpoint, Morrow and Abplanalp (1981) reported that at least two alleles control PHA-P response in birds, whereas a cross between PHA-P high responder and low responder lines was tested for mitogenic response to PHA-P, an intermediate result was seen. With respect to sex effect, it could be observed that the female chickens are significantly hyper responder to PHA-P at 24 and 72 hour post injection compared to male ones. Similar trend was noticed at 72h post PHA-P injection, but the difference was not statistically significant.

Relative lymphoid organs weight

Body weight and relative lymphoid organs weight of male chickens at 7 weeks of age as affected by Na gene are summarized in Table 3. The live body weight of Nana and nana males was significantly heavier than that of NaNa ones.

Lymphoid organ weights are easily measured and reflect body's ability to provide lymphoid cells during an immune response (Heckert *et al.*, 2002). Primary and secondary lymphoid organs weights provide the site for maturation lymphocytes, and for the interaction between lymphocytes and antigens. The spleen and bursa are the important lymphoid organs involved in the development and differentiation of T or B lymphocytes (Eerola *et al.*, 1987; Toivanen *et al.*, 1987). There were no significant differences among genotypes for relative weight of spleen. Opposite trend was noticed for relative bursa weight, where the presence of Na gene in a single state significantly increased relative bursa weight compared to both homozygous dominant (NaNa) and recessive (nana) genotypes. In contrast, Fathi et al. (2005) reported that the presence of Na gene in a single state significantly decreased the relative weight of both thymus and bursa by about 19.8% and 11.8%, respectively compared to normally feathered ones.

Blood parameters and some organs

Data listed in Table 4 showed the effect of Na gene on some blood parameters and some organs of chicken. The presence of Na gene in a single state significantly increased hematocrit level compared to nana sibs. Opposite trend was observed when compared between NaNa and nana genotype. The NaNa genotype was slightly increased total plasma protein, albumen and globulin compared to nana sibs. Opposite trend was noticed for Nana genotype. Conversely, Fathi et al. (2005) concluded that the total plasma protein, albumen and globulin of naked neck males were significantly higher than that of normal type by about 22.8, 31.6 and 10.4%, respectively.

The presence Na gene in a double state significantly increased relative heart weight compared to nana genotype by about 40.4%. However, there was no significant difference between Nana and nana genotypes for relative heart weight. The NaNa genotype increased relative weight of both gizzard and liver compared to nana counterparts. However, the Nana genotype was intermediate.

Phagocytic activity

The defensive functions of phagocytosis come into effect immediately upon the invasion by the foreign materials. The Phagocytic activity was measured by injection of India Ink into the birds for all three genotypes and comparing their ability to clear the injected carbon from circulating over a period of time. This was accomplished by obtaining optical density of the plasma samples collected at zero and after 3 and 15 min of ink injection. An increase in the percentage of OD value would be indicative of more carbon present in the sample at the time of quantification. Data listed in Table 5 showed that the Nana genotype had significantly lower levels of carbon in their circulation as compared to nana genotype. Similar trend was not observed in NaNa genotype. This result indicated that the mononuclear Phagocytic index for heterozygous naked neck birds was more efficient than those for NaNa and nana genotypes. However, Haunshi et al. (2002) did not detect a difference between naked neck and normally feathered genotypes for phagocytic ability.

Phenotypic correlation coefficients

Data presented in Table 6 showed the phenotypic correlation coefficients among body weight, relative lymphoid organs weight and toe-web swelling of NaNa, Nana and nana genotypes. Negative relationship (rp=-0.52) between body weight and relative spleen weight was observed in Nana genotype. However, this correlation was low and positive in both NaNa and nana genotypes. The body weight was positively correlated with relative weight of both bursa and thymus of NaNa genotype. Inversely, these relationships were inverse and moderate in Nana genotype. The relationship between body weight and relative bursa weight was very low in nana genotype. Muir and Jaap (1967) reported that bursa of Fabricius weight at hatching was negatively associated with post-hatching body weight. Similar relationship was observed for turkey (Li *et al.*, 2001), but the body weight was high positively correlated (rp=0.58) with relative thymus weight in the same genotype. Positive relationship between plasma globulin and body weight was observed in Nana genotype, but inverse and low relationships were observed in both NaNa and nana genotypes.

The body weight was negatively correlated with toe-web swelling measured at 24, 48 and 72h post PHA-P injection for NaNa genotype. Opposite trend was observed in nana genotype, whereas these correlations were positive. With respect to Nana genotype, it could be observed that the relationship between body weight and toe-web swelling at 24h post PHA-P

injection was inverse. Opposite trend was noticed at 48 and 72h post PHA-P injection.

Relative spleen weight was negatively correlated with relative bursa weight in both NaNa and nana genotypes. Inversely, this correlation was positive in Nana genotype. Positively correlated between relative spleen weight and relative thymus weight was observed in both NaNa and Nana genotypes. Similar trend, but very low, was observed in nana genotype. The relationship between relative bursa weight and relative thymus weight was highly positive correlated in Nana genotype. Similar trend, but low, was observed in both NaNa and nana genotypes.

Relative bursa weight was negatively correlated with toe-web swelling for all genotypes at all times. This suggests that the size of bursa did not affect the cell-mediated immune response (Fathi et al., 2003). Significant positively relationship between plasma globulin and toe-web swelling measured at all time was observed in NaNa genotype. Similar trend, but low, was observed in Nana genotype. However, these correlations were moderate in nana genotype.

The toe-web swelling measured at 24h post PHA-P injection was highly significant positively correlated with toe-web swelling measured at 48 and 72h post PHA-P injection. Similar trend, but not statistically significant, was observed in nana genotype. However, these relationship were moderate in Nana genotype. Highly significant positive relationship between toe-web swelling measured at 48h post PHA-P injection and toe-web swelling measured at 72h post PHA-P injection was observed in all genotypes. The previous results were confirmed by Fathi et al. (2003). They reported that there were significantly positive correlation coefficients between the swelling in toe-web measured after 72h post-injection and the swelling after 24h and 48hr for all studied strains.

Table 1. Body weight, weight gain, feed consumption and feed conversion ratio as affected by Na gene, sex and their interaction (Means±SE).

Trait	Sex	Genotype			Overall	Prob.		
		NaNa	Nana	nana		G	S	G*S
Body weight at 8 wk, g	Male	491.5 ±42.72	603.7 ±33.41	488.4 ±54.47	527.9	0.02	0.01	NS
	Female	409.5 ±20.62	474.0 ±10.27	437.2 ±18.63	440.2			
	Overall	450.5[b]	538.9[a]	462.8[b]				
Body weight at 12 wk, g	Male	1025.3 ±75.48	1145.0 ±44.25	989.2 ±33.36	1053.2	0.001	0.001	NS
	Female	783.2 ±25.19	901.9 ±16.29	779.9 ±28.08	821.7			
	Overall	904.3[ab]	1027.9[a]	884.6[b]				
Weight gain, g 8-12 wk	Male	533.8 ±39.39	541.3 ±15.40	500.8 ±32.95	525.3	0.03	0.001	NS
	Female	373.7 ±18.43	427.9 ±15.79	342.8 ±19.77	381.4			
	Overall	453.8[ab]	484.6[a]	421.0[b]				
Feed consumption, g 8-12 wk	Male	1345.8 ±129.28	1477.8 ±63.00	1380.0 ±56.39	1401.2	NS	0.001	NS
	Female	1069.0 ±11.66	1180.7 ±50.53	1125.2 ±35.63	1125.0			
	Overall	1207.4	1329.3	1252.6				
Feed conversion ratio 8-12 wk	Male	2.5 ±0.05	2.7 ±0.06	2.9 ±0.21	2.6	0.01	0.01	NS
	Female	2.9 ±0.12	2.8 ±0.08	3.3 ±0.12	3.0			
	Overall	2.7[b]	2.7[b]	3.1[a]				

[a,b] Means for the same trait without common superscripts differ significantly.
G = genotype
S = sex

Table 2. Means ±SE of PHA-P mediated swelling response in toe-webs as affected by Na gene, sex and their interaction at7 week of age .

Trait	Sex	Genotype			Overall	Prob.		
		NaNa	Nana	nana		G	S	G*S
Toe-web swelling after 24h(mm)	Male	0.21 ±0.03	0.18 ±0.01	0.14 ±0.02	0.18			
	Female	0.22 ±0.02	0.23 ±0.02	0.24 ±0.03	0.23			
	Overall	0.22	0.21	0.19		NS	0.01	NS
Toe-web swelling after 48h(mm)	Male	0.15 ±0.04	0.13 ±0.02	0.11 ±0.01	0.13			
	Female	0.18 ±0.02	0.17 ±0.02	0.17 ±0.02	0.17			
	Overall	0.17[a]	0.12[b]	0.14[b]		0.05	0.02	NS
Toe-web swelling after 72h(mm)	Male	0.11 ±0.03	0.08 ±0.01	0.06 ±0.01	0.08			
	Female	0.11 ±0.02	0.10 ±0.01	0.09 ±0.02	0.10			
	Overall	0.11[a]	0.09[b]	0.07[b]		0.03	NS	NS

[a,b] Means for the same trait without common superscripts differ significantly.
G = genotype, S = sex

Table 3. Means±SE of body weight and relative lymphoid organs weights for naked neck and normally feathered genotypes at 7 wk of age.

Trait	Genotype			Prob.
	NaNa	Nana	nana	
Body weight, g	315.6[b] ±20.34	396.7[a] ±24.16	377.3[a] ±15.21	0.02
Spleen weight, g	0.763 ±0.10	0.812 ±0.07	0.835 ±0.12	NS
Spleen, %	0.24 ±.0.03	0.21 ±0.02	0.22 ±0.03	NS
Bursa weight, g	0.429[b] ±0.09	0.741[a] ±0.11	0.621[ab] ±0.10	0.01
Bursa, %	0.13[c] ±0.02	0.19[a] ±0.03	0.16[b] ±0.02	0.01
Thymus weight, g	0.740 ±0.13	0.879 ±0.13	0.856 ±0.15	NS
Thymus, %	0.22 ±0.03	0.23 ±0.03	0.21 ±0.03	NS

[a,b,c] Means for the same trait without common superscripts differ significantly.

Table 4. Means ±SE of blood parameters and some organs weight of naked neck and normally feathered males at 7 week of age.

Trait	Genotype NaNa	Nana	nana	Prob.
Hematocrit level, %	36.11[b] ±1.26	41.54[a] ±1.53	37.05[b] ±1.39	0.02
Total plasma protein, g/dl	3.23 ±0.20	2.87 ±0.16	3.00 ±0.12	NS
Plasma albumin, g/dl	1.45 ±0.07	1.27 ±0.06	1.38 ±0.06	NS
Plasma globulin, g/dl	1.78 ±0.20	1.60 ±0.15	1.64 ±0.09	NS
Heart weight, g	2.21 ±0.17	2.13 ±0.14	1.99 ±0.15	NS
Gizzard weight, g	9.58 ±0.49	10.35 ±0.49	10.63 ±0.50	NS
Liver weight, g	12.47 ±0.80	13.31 ±0.92	12.61 ±0.74	NS
Heart, %	0.73[a] ±0.10	0.54[b] ±0.04	0.52[b] ±0.02	0.03
Gizzard, %	3.07 ±0.10	2.70 ±0.20	2.82 ±0.10	NS
Liver, %	3.99 ±0.20	3.48 ±0.30	3.37 ±0.20	NS

[a,b] Means for the same trait without common superscripts differ significantly.

Table 5. Carbon clearance for naked neck and normally feathered genotypes at 16 week of age.

Trait	Genotype NaNa	Nana	nana	Prob.
OD increase % (3min)	5.66[a] ±1.69	4.67[b] ±1.39	5.67[a] ±1.30	0.02
OD increase % (15min)	4.84[a] ±1.46	3.00[b] ±0.97	4.61[a] ±0.88	0.01

OD increase % =[(OD reading at a considered time - OD reading at 0 min)/ OD reading at 0 min] X 100.

a,b Means for the same trait without common superscripts differ significantly

Table 6. Phenotypic correlation coefficients among body weight, relative lymphoid organs weight and toe-web swelling of NaNa, Nana and nana genotypes.

Variable	SP	BP	THP	PG	T24	T48	T72	Genotype
Body weight, (BW)	0.03	0.42	0.57	-0.14	-0.43	-0.38	-0.43	NaNa
	-0.52	-0.39	-0.33	0.44	-0.27	0.20	0.12	Nana
	0.19	0.01	0.58	-0.07	0.65*	0.18	0.35	nana
Spleen, % (SP)		-0.52	0.06	0.02	-0.09	0.16	0.06	NaNa
		0.58	0.56	-0.05	0.17	-0.08	-0.23	Nana
		-0.17	0.58	0.18	-0.02	0.09	0.48	nana
Bursa, % (BP)			0.27	-0.16	-0.55	-0.63*	-0.60	NaNa
			0.56	0.11	-0.03	0.06	-0.38	Nana
			0.05	-0.39	-0.25	-0.62*	-0.48	nana
Thymus, % (THP)				-0.14	-0.69*	-0.50	-0.42	NaNa
				0.42	0.16	-0.15	-0.27	Nana
				-0.31	0.17	-0.03	0.27	nana
Plasma globulin					0.62*	0.74**	0.72*	NaNa
(PG)					-0.27	0.14	0.14	Nana
					0.12	0.38	0.38	nana
Toe-web swelling at						0.88***	0.84**	NaNa
24h (T24)						0.35	0.36	Nana
						0.60	0.58	nana
Toe-web swelling at							0.97**	NaNa
48h (T48)							0.78**	Nana
							0.88**	nana
Toe-web swelling at								NaNa
72h (T72)								Nana
								nana

* $p \leq 0.05$ ** $p \leq 0.01$ *** $p \leq 0.001$

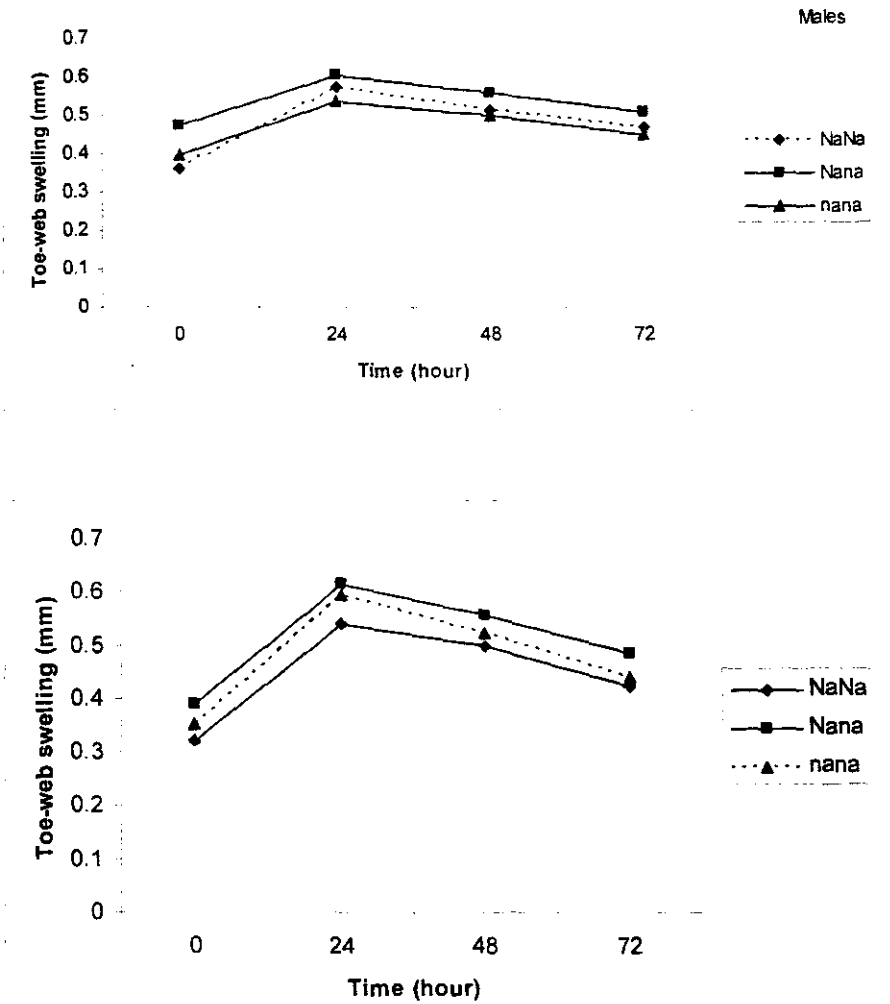

Fig. 1. Toe- web swelling as affected by naked neck gene and sex,

REFERENCES

Alvarez, M.T.; Téllez, G. and Tato, P. (2002). *Effect of broody hen on the immune response against Newcastle virus disease (NDV) vaccine of indigenous naked neck (Na) and normally feathered laying hens. Poultry Science Association (Abstracts), Newark, Delaware.*

Bacon, L.D.; Fadly, A.M. and Crittenden, L.B. (1986). *Absence of influence on immune response on immune competence by the sex linked gene (K) determining slow feathering in white Leghorn chickens. Avian Diseases, 30:751-760.*

Cahaner, A.; Deeb, N. and Gutman, M. (1993). *Effect of the plumage-reducing naked neck (Na) gene on the performance of fast growing broilers at normal and high ambient temperatures. Poult. Sci. 72:767-775.*

Cheng, S. and Lamont, S.J. (1988). *Genetic analysis of immunocompetence measures in a white Leghorn chicken line. Poult. Sci. 67:989-995.*

Deeb, N. and Cahaner, A. (1999). *The effects of naked neck genotypes, ambient temperature and feeding status and their interactions on body temperature and performance of broilers. Poult. Sci. 78:1341-1346.*

Eerola, E., Veromaa, T. and Toivanen, T. (1987). *Special feature in the structural organization of the avian lymphoid system. Pages 9-22 in: Avian Immunology. Basis and practice. A. Toivanen and P. Toivanen. Ed. CRC Press, Inc., BocaRaton.*

El-Safty, S.A.; Ali, U.M. and Fathi, M.M. (2005). *Immunological parameters and laying performance of naked neck and normally feathered genotypes of chicken under winter conditions of Egypt. 4th European Poultry Genetics Symposium. 6-8 Oct., Dubrovnik, Croatia.*

Fathi, M.M. and Galal, A. (2001). *Assessing the combined effects of naked neck and crest genes on growth performance and meat yield of chicken under high ambient temperatures. Egypt. Poult. Sci. 21:319-338.*

Fathi, M.M.; Ali, R.A. and Qureshi, M.A. (2003). *Comparison of immune responses of inducible Nitric Oxide Synthase (iNOS) hyper-and hypo-responsive genotypes of chickens. Int. J. of Poult. Sci. 2 (5): 280-286.*

Fathi, M.M.; Galal, A.; El Safty and Abd El-Fatah, S. (2005). *Impact of naked neck and frizzle genes on cell-mediated immunity of chicken. Egyptian Poult. Sci. 25:1055-1067*

Galal, A. (1999). *Use of reducing plumage genes in improving some economic traits in chickens. Ph.D. Thesis, Ain Shams University, Egypt.*

Haunshi, S. (1999). *Studies on general immune competence in specialized chicken populations. M.V. Sc. Thesis submitted in Poultry Sci., IVRI, Izatnagar, UP, India.*

Haunshi, S.; Sharma, D.; Nayal, L.M.S.; Singh, D.P. and Singh R.V. (2002). *Effect of naked neck (Na) and frizzle gene (F) on immunocompetence in chickens. Br. Poult. Sci. 43:28-32.*

Heckert, R.A.; Estevez, I.; Russek-Cohen, E. and Pettit-Riley, R. (2002). *Effects of density and perch availability on the immune status of broilers. Poult. Sci. 81:451-457.*

Horst, P. and Rauen, H.W. (1986). *Significance of the naked-neck (Na-gene) in poultry breeding in the tropics. Proc. 7th Eur. Poult. Conf., Paris, 191-195.*

Klingensmith, P.H.; Donahoe, J.P. and Strephens, J.F. (1983). *The effect of sex linked dwarfing gene, dw on the immune response of broiler breeder chickens. Poult. Sci. 62:733-740.*

Kougt, M.H.; McGrude, E.D.; Hargis, B.M.; Corrier, D.E. and Deloach, J.R. (1994). *Characterization of the pattern of inflammatory cell influx in chicks following the intraperitoneal administration of line Salmonella enteritidies-immune lymphokines. Poult. Sci. 74:8-17.*

Kougt, M.H.; McGrude, E.D.; Hargis, B.M; Corrier, D.E. and Deloach, J.R. (1995). *In vivo activation of heterophil function in chickens following injection with Salmonella enteritidies-immune lymphokines. Journal of Leukocyte Biology. 57:56-62.*

Kundu, A.; Singh, D. P.; Mohapatra, S. C.; Dash, B. B.; Moudgal, R. P. and Bisht., G. S. (1999). *Antibody response to sheep erythrocytes in Indian native vis-à-vis imported breeds of chickens. Br. Pout. Sci. 40:40-43.*

Lamont, S.J. (1986). *Genetic association of reticuloendothelial activity in chickens. Proc. 3rd world Congress on Genet. Applied to Livestock Production. Agricultural Communications, University of Nebraska, Lincoln, NB. Vol. XI: 643-647.*

Li. Z.; Nestor. K.E.; Saif. Y.M.; Anderson. J.W. and Patterson. R.A. (2001). *Effect of selection for increased body weight in turkey on lymphoid organ weights, phagocytosis, and antibody responses to fowl cholera and Newcastle disease-inactivated vaccines. Poult. Sci. 80:689-694.*

Martin, A.; Gross, W.B. and Siegel, P.B. (1989). *IgG and IgM responses in high and low antibody selected lines of chickens. J. Heredity 80:249-252.*

Merat, P. (1986). *Potential usefulness of the Na (naked neck) gene in poultry production. World's Poult. Sci. J. 42:124-142.*

Morrow, P.R. and Abplanalp, H. (1981). *Genetic control of T-lymphocyte mitogenesis of chickens. Immunogenetics 13:189-200.*

Muir, F.V. and Jaap, R.G. (1967). *A negative genetic correlation between bursa weight at hatching and post-hatching body growth of chickens. Poult. Sci., 46:1483-1488.*

Patra, B.N.; Bais, R. K .S.; Sharma D.; Singh B. P.; Prasad R. B. and Bhushan B. (2004). *Immunocompetence status of white plumage naked neck versus normally feathered broilers in tropical climate. Asian-Aust. J. Anim. Sci. 17:560-563.*

Sarker, N.; Tsudzuki, M.; Nishibori, M.; Yasue, H. and Yamamoto Y. (2000). *Cell-mediated and humoral immunity and phagocytic ability in chicken lines divergently selected for serum immunoglobulin M and G levels. Poult. Sci., 79:1705-1709.*

Sarker, N.; Tsudzuki, M.; Nishibori, M. and Yamamoto, Y. (1999). *Direct and correlated response to divergent selection for serum immunoglobulin M and G levels in chickens. Poult. Sci. 78:1-7.*

SAS Institute (2001). *SAS/STAT User's Guide Version 8.2 ed: Statistics. SAS Institute Inc., Cary, NC.*

Toivanene, P.; Naukkarinen, A. and Vainio, O. (1987). *What is the function of bursa of Fabricius? Pages 79-100 in: Avian Immunology: Basis and Practice. A. Toivanen and P. Toivanen. Ed. CRC, Press., Inc. BocaRaton. FL.*

الملخص العربي

تأثير العامل الوراثي المسئول عن عرى الرقبة على النمو والاستجابة المناعية في الدجاج

على نظمى على حسن – أسامة محمد على – معتز محمد فتحي احمد – احمد حاتم العطار

قسم إنتاج الدواجن- كلية الزراعة – جامعة عين شمس – القاهرة – مصر

أجريت هذه التجربة لتقييم تأثير العامل الوراثي المسئول عن عرى الرقبة في صورته الأصيلة أو الخليطة على الأداء الإنتاجي والاستجابة المناعية للدجاج. استخدم في هذه التجربة ٢٢٠

كتكوت سن يوم تحمل التراكيب الوراثية المحتملة: عاري الرقبة الأصيل (NaNa)، عاري الرقبة الخليط (Nana)، طبيعي التريبش(nana). تم رعاية الكتاكيت تحت نفس الظروف البيئية والرعاية الصحية من سن يوم وحتى ١٦ أسبوع من العمر. كانت درجات الحرارة العظمى والصغرى المسجلة أثناء فترة التجربة ٢٧، ٢٣ درجة مئوية على التوالي. تم عمل تجربة لتقدير الاستهلاك الغذائي والكفاءة التحويلية على عمر ٨-١٢ أسبوع. كما تم تقدير بعض المقاييس المناعية مثل المناعة الخلوية والقدرة الإلتهامية للجزيئات الغريبة بالدم بالإضافة للوزن النسبي للأعضاء الليمفاوية. سجل التركيب الوراثي عرى الرقبة الخليط وزن جسم اقل معنويا مقارنة بنظيرة طبيعي التريبش، بينما لا يوجد فروق معنوية بين التركيب الوراثي طبيعي التريبش ونظيرة عاري الرقبة الأصيل. استهلكت الطيور عارية الرقبة الخليطة معدلات علف أعلى من نظيرتها عارية الرقبة الأصيلة والأخرى طبيعية التريبش. يؤدى العامل الوراثي عرى الرقبة في صورته الخليطة والأصيلة إلى تحسين في معدل التحويل الغذائي. يصاحب العامل الوراثي عرى الرقبة في صورته الأصيلة بتحسن معنوي في المناعة الخلوية مقارنة بالتركيب الوراثية الأخرى. لا يوجد اختلافات معنوية بين التراكيب الوراثية بالنسبة للوزن النسبي لكل من الطحال والغدة الثيموسية. بينما سجل التركيب الوراثي عاري الرقبة الخليط تفوق معنوي في الوزن النسبي لغدة البرسا مقارنة بالتراكيب الوراثية الأخرى.

يصاحب العامل الوراثي عرى الرقبة الخليط بزيادة معنوية في حجم المكونات الخلوية مقارنة ببقية التراكيب الوراثية الأخرى. لا يوجد اختلافات معنوية بين التراكيب الوراثية بالنسبة لبلازما البروتينات الكلية، الالبيومين، الجلوبيولين والوزن النسبي للقانصة والكبد. سجل التركيب الوراثي عاري الرقبة الخليط مقدرة عالية معنوية على التهام الجزيئات الغريبة (حبيبات الكربون) في الدم.

وجد ارتباط موجب بين بلازما الجلوبيولين ووزن الجسم في التركيب الوراثي عاري الرقبة الخليط، بينما كانت هذه العلاقة سالبة ومنخفضة في التراكيب الوراثية الأخرى. وجد ارتباط سالب بين الورم الحادث في المنطقة الغشائية للقدم عند كل الأوقات مع وزن الجسم للتركيب الوراثي عاري الرقبة الأصيل، بينما شوهد عكس الاتجاه في التركيب الوراثي طبيعي التريبش. وجد ارتباط موجب بين الوزن النسبي للطحال والوزن النسبي للغدة الثيموسية في التركيب الوراثي عاري الرقبة الأصيل والخليط، بينما شوهد نفس الاتجاه في التركيب الوراثي طبيعي التريبش لكن كانت القيمة المسجلة منخفضة. وجد ارتباط سالب بين الوزن النسبي لغدة البرسا والورم الحادث في غشاء القدم عند كل الأوقات داخل كل التراكيب الوراثية. سجلت العلاقة بين الورم عند ٤٨ والورم عند ٧٢ ساعة قيما معنوية موجبة داخل كل التراكيب الوراثية.