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Research Paper

BIOLOGICAL AND PHYSIOLOGICAL RESPONSES OF LOCAL AND EXOTIC LAYERS EXPOSED TO SEASONAL CHANGES IN ENVIRONMENTAL TEMPERATURE OF SAUDI ARABIA

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Evaluation of the biological and physiological responses of the local breeds of Saudi Arabia to seasonal variation is not well documented in the literature. Due to the lack of such studies, this work was conducted in an attempt to study the biological and physiological response of two breeds of local layers, Saudi Local (SL) and Naked Neck local (NN) layers to seasonal variation in ambient temperatures and compare them with the single comb white leghorn layers exposed to the same environment. The results of the study indicated a significant breed X period interaction on egg production, egg mass, egg weight, body weight, feed conversion, egg shell thickness, egg specific gravity, livability, and respiration rate. Seasonal variations in temperature had a significant effect on feed consumption, Haugh unit, and body temperature, Naked neck performance was superior during hot weather in egg production, egg mass, feed conversion, egg shell thickness, specific gravity of the egg and respiration rate when compared to the white leghorn and Saudi local birds. Seasonal variation in temperature (periods) had a significant effect on blood PH, PCO_2, and TCO_2 of the birds in general, while breed effect was evident on Blood PO_2 and HCO_3 of the layers. It is concluded that naked neck birds can perform efficiently in areas where hot climate prevailed as in Saudi Arabia.

Keywords: Naked neck, Local birds, Respiration, Performance, Hot environment, Blood gases

INTRODUCTION

The effects of environmental temperatures on laying hen's performance are of major importance, especially in a country like Saudi Arabia where temperature in most parts of the Kingdom exceeds 40 ºC during summer time. The poultry industry of Saudi Arabia comprises of two important production systems, a commercial sector using exotic breeds of chickens with improved housing, management and nutrition (high-input, high-output system), and village type system, which mostly local chickens

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(low-input, low-output system). Local chickens have been adapted to the harsh environment of Saudi Arabia. Recently two lines have been established and characterized namely, Hajar 1 and Hajar 2 (Ahmad and Al-abbad, 2014). The effect of environmental temperature on performance of local birds has not be elucidated clearly. This work was an attempt to study the effect of different seasonal temperature on performance of exotic and local layers of Saudi Arabia.

Arad *et al*. (1981) found that white leghorn responded negatively to high temperature of 44 °C compared to the Egyptian Sinai breed. Mirat (1986) summarized Horst results (1980) and reported that naked neck gene at high ambient temperature was associated with 7.4% gain in total egg mass during the first three months of production.

Effect of breed and strain on egg weight was studied by many investigators. Fathi (1987) recorded that average egg weight under subtropical conditions in Egypt was 47.9 and 45.3 g for naked neck (Na:na) and normal layers (na:na) genotype, respectively. Egg weight mean of S.C. White Leghorn (57.7 g) was significantly higher than that of Saudi Arabian Baladi (45.6 g) layers (Basmaeil, 1985). Mohamed *et al.* (2005) reported that egg shell of bare-neck breed was significantly thicker than that of the local breed of Sudan. Effect of season on egg weight was studied by Shawer (1984) whom he collected eggs from Riyadh market. He reported that winter eggs (57.8 g) were significantly heavier than those of the fall (55.29). Al-Sobayel (1986) reported a significant month effect on Baladi eggs. He found that average egg weight ranged from 33.06 g to 46.66 g during the months from August to March. Hassanin (1990) reported that egg weight was significantly affected by season of the year. Average egg weight of their study were 58.87 g, 57.1 g, 58.1 g and 56.05 g for winter, summer, spring and fall, respectively. Effect of breed on feed consumption was reported by Monnet *et al.* (1979) whom they found that feed consumption was higher for naked neck birds than normal plumage at 31 ºC, from 4 to 10 weeks of age. Naked neck homozygous birds showed an increase in cumulative feed intake as compared with normally feathered ones under high ambient temperature (38 ºC). This inclination was reversed under cool temperature (21 ºC) (Hanzl and Somes, 1983). Shell thickness was highly affected by season of the year (Al-Sobayel, 1986; and Hassanin, 1990). Haugh unit was also affected by breed. El-Bahy (1994) and Shoureap (1991) found that Naked neck breed had a higher Haugh unit value than the local breed.

Effect of breed on rectal temperature was studies by Hamdi (1990). He found a significant higher rectal temperature of Hisex brown chicks exposed to 39 ºC for 48 hours compared to Fayoumi chicks exposed to the same treatment. Likewise, El-Bahy (1994) found that the differences in body temperature between naked neck breed (41.21 °C) and the Dandarawi were significant ($P<0.05$).

Average respiration rate was higher in the Egyptian Dandarawy hens (39.14) than the naked neck hens (38.60 min) and these values reached their peak in July month when average air temp. was 38.2 °C (El-Bahy, 1994).

When chickens pant to cool themselves, there is a loss in blood CO_2, causing an increase in blood PH, which is accompanied with loss of ionic calcium (Odom *et al.*, 1986). Likewise, El-Hadi and Sykes (1982) reported that when ambient temperature reached 41 °C, rectal temperature increased considerably and sever alkalosis developed (PH 7.65).

This work was an attempt to study and compare the biological and physiological response of two breeds of local layers, Saudi Local (SL) and Naked Neck local (NN) layers to seasonal variation in ambient temperatures and compare them with the single comb white leghorn layers exposed to the same environment.

MATERIALS AND METHODS

Two local breeds of chickens (naked neck and Saudi local) and an exotic breed (Single Comb White Leghorn) were used in this study. A total of 91 birds at 20 weeks of age in which 29 birds of naked neck breed, 34 birds of Saudi local breed and 28 birds of the white leghorn breed were used. They were randomly distributed among 12 pens, each of 9 to 10 birds of each breed. This resulted into 4 replications (pens) per breed. Individual chickens were weighed monthly to the nearest gram. Feed was given ad-libitum. Feed left was measured weekly to determine feed consumption. Ambient temperature and relative humidity were recorded twice daily. Natural and artificial light were used to maintain a 17 hours of daily lighting. Commercial layer ration containing 17% crude protein, 2780 Kilocalories (Kcal/Kg) of Metabolizable Energy (ME), 3.70% calcium, 0.42% available phosphorus. The composition of the basal diet is presented in Table 1.

Eggs were collected daily, however, egg production calculation was made on weekly basis. Egg weight, specific gravity, shell thickness, Haugh unit were made on eggs, collected during the last three days of each week. Egg shell thickness (plus membranes) was measured in three locations around the egg (upper and bottom tips and the middle region) using Ames micrometer. Specific gravity of the eggs was also determined based on North and Bell (1990). Albumin height was measured to the nearest 0.01 cm using Ames tripod micrometer at the highest region of the thick albumen attached to the yolk. Haugh unit was calculated by determining the logarithm of Albumen height corrected to standard egg weight of the local bird. Weekly and feed consumption and feed conversion were recorded per pen. Feed was added daily as

Table 1: Ingredients and Composition of the Basal Diet

Ingredients	Amount (%)
Yellow corn	65.95
Soybean meal, 48%	21.42
Fishmeal, 76%	1
Wheat bran	1.24
Sodium chloride	0.4
Calcium carbonate	7.78
Di-calcium phosphate	1.93
Vitamins and trace minerals premix[1]	0.2
DL-methionine	0.08
Composition	
Protein, %	17
Metabolizable Energy, Kcal/Kg	2780
Calcium	3.7
Available Phosphorus	0.42
Methionine	0.32
Met. & Cystine	0.64
Lysine	0.73

Note: [1] Vitamins mixture provides in milligram per kilogram of diet (except as noted): all-trans-retinyl acetate, 1.89; cholecalciferol, 27.5; all-ractocopheryl acetate, 11; riboflavin, 4.4; Ca-pantothenate, 12; nicotinic acid, 44; choline Cl, 220; vit. B12, 6.6; vit. B6, 2.2; menadione (as menadione sodium bisulfite), 1.1; folic acid, 0.55; d. biotin, 0.11; thiamin (as thiamin mononitrate), 2.2; Trace minerals mixture provided the following in milligram per kilogram of diet: Mn, 60; Zn, 50; Fe , 30; Cu, 5; I, 1.5.

necessary to each pen. Feed left was measured to determine feed consumption.

Body temperature and respiration rate was recorded at early morning and afternoon twice a week. Digital thermometer was inserted in to the cloaca to the depth of 3 cm and was left for a 1.5 minutes before reading the vent temperature. Respiration rate per minute was determined by visual observation (counting the movement of the chest in 30 seconds and then doubled).

One to 1.5 ml of blood was collected on a monthly basis from 5 layers of each breed at random for blood gasses analysis. The blood was taken by sterile disposable syringes from the wing artery in a heparinized tube (50 1 heparin/5 ml blood). Blood PH, PCO_2, PO_2, HCO_3, TCO_2 and O_2 saturation was carried out using Radiometer's S2001 QUALICHCK®Blood gas control system ABI330 (Radiometer A/S. EMDRUPVEJ 72. DK-2400 Copenhagen, NV.Denmark) according to the manufacturer recommendation.

Data of this experiment were subjected to the analysis of variance using the General Linear Models (GLM) procedure of SAS® (SAS, 2000). Means were compared using Duncan Multiple Range Test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Biological Parameters

Production Performance

The results of this study indicated a significant breed X period interaction in egg production, egg mass, body weight, feed conversion, egg shell thickness, egg specific gravity and livability (Table 2). During period 1 (40 °C), the Naked Neck (NN) breed had the highest egg production and egg mass values (56.82 and 20.14%, respectively) while the Saudi Local (SL) and White Leghorn (WL) had the lowest values (34.46 and 33.95%, respectively for egg production and 14.93 and 17.59% for egg mass). This finding was consistent with the results reported by Bordas and Merat (1984). However, in period 2 (25 °C) the WL breed had the highest value of egg production and egg mass (69.48% and 43.26, respectively), while the SL and NN had the lowest egg production values (51.88 and 46.84%, respectively). The depressed egg production in period 1, was in part due to the lower feed consumption which occurred during the same period (Table 1). The other possibility for the lower egg production could be the depressed activity of thyroid and parathyroid gland which occurred as a result of high environmental temperature. Bakir and Kotby (1984) indicated that high environmental temperature lowered the activities of thyroid and parathyroid glands resulting in reduction in the egg production. This study did not confirm this result because the internal organs of the birds were weighed only once at the end of the experiment and not on a monthly basis. Egg mass followed the same trend of egg production. It is evident from egg production and egg mass data that NN birds had better resistance to heat stress than the other breed. It is possible that the naked areas of the bird helped dissipating more heat during the hot hours of the day. Eberhart and Washburn (1993) indicated that in the large body weight broiler population the Na gene did confer resistance to chronic heat stress. Also this result agreed with Kyarisiima and Balnave (1995) who reported that birds reared at cool temperature (10 to 20 C) produced significantly more egg mass (between 18 and 50 weeks of age) than hens reared at the hot temperature (25-30 C).

Data on egg weight of SL, NN and WL reflect a highly significant interaction between period and

Table 2: Effect of Seasonal Temperature on Some Egg Production Traits

	HD Production %	Egg Mass (gm)	Egg Weight (gm)	Body Weight (gm)	Feed Intake (gm)	Feed Conversion Kg/Kg
Breed*period	**	**	NS	**	NS	**
NN 1	56.82±18.2	20.14±5.8	33.49±3.1	982±97	65.66±18.6	3.83±1.5
SL 1	34.46±20.0	14.93±7.9	35.78±5.0	978±93	60.02±20.8	5.72±5.3
WL 1	33.95±23.8	17.59±12.6	40.41±5.6	1269±125	66.60±26.9	5.66±2.1
NN 2	46.84±14.2	20.74±5.0	43.33±3.2	1176±98	107.99±29.5	5.27±1.6
SL 2	51.88±18.0	25.05±7.2	47.34±2.6	1338±178	112.84±32.8	4.91±1.7
WL 2	69.48±28.3	43.26±19.5	55.58±9.7	1512±178	120.27±36.8	3.71±1.8
Among breeds	NS	NS	NS	**	NS	NS
NN	51.97^a	20.48^a	39.06^b	1073^b	88.37^a	4.61^a
SL	44.13^a	21.06^a	42.35^{ab}	1115^b	88.25^a	5.26^a
WL	51.42^a	31.61^a	48.05^a	1366^a	93.05^a	4.73^a
Between periods	**	**	**	**	**	NS
1	42.27^a	17.69^a	36.45^a	1032^a	63.99^a	4.99^a
2	54.76^b	28.09^b	48.04^b	1286^b	112.99^b	4.77^a

Note: Means, within each column, having different superscript are significantly different. NN = Naked neck, SL = Saudi local chickens, WL = White leghorn. Average temp.of period 1 = 40 C (33.8 – 42.5 C) representing the months of June, July, Aug, Sept and Oct. Average temp.of period 2 = 25 C (21.4 – 29.5 C) representing the months of Nov, Dec, Jan, Feb m Mar and Apr. Kg/Kg = Kg feed/Kg eggs, HD = Hen-day production. * Significant $P<0.05$, ** Significant $P<0.01$. NS = Not significant $P>0.05$.

breed of the birds (Table 2). During period 1 and 2, the WL breed had the highest value 40.41 and 55.58 g, respectively. The effect of season was evident on egg weight. High temperature reduced the egg weight in the three breeds while cold weather, had improved it. This could be due to the increase in feed consumption during this period (Table 2). This table shows also that WL breed seemed to be the most benefited from the cold weather. Kyarisiima and Balnave (1995) reported that birds reared at the cool temperature produce significantly more and larger eggs between 18 to 50 weeks of age than hens reared under hot temperature.

A significant interaction between breed and period was observed on body weight. Despite that, overall means revealed a reduction in body weight of the three breeds during period 1 (Table 2). The naked neck breed recorded the lowest body weight and incidentally, the highest production rate during the hot weather. This result agreed with that of Shawer (1984) who found that Saudi baladi chickens had the lowest body weight and body weight gain at all ages and periods studied compared to the Single Comb White Leghorn layers. The lower body weight in period 1 could be the result of depressed protein synthesis. Mastaka and Rennels (1972) indicated that the anticipated decrease in growth hormone production and/or release under hot condition is a contributing factor in depressed protein synthesis and the consequent decline in body weight. Growth hormone was not detected in this study.

Feed consumption of the three breeds was significantly lower in period 1 (hot weather). Leeson and Summers (2001) considered that reduced feed intake under heat stress conditions is due to the lower energy requirements for keeping body warm and physical activities are reduced to a minimum, except for panting. Regardless of the breed, almost 50% of the normal consumption was reduced during the high environmental temperature (40 °C).

Feed conversion data on the other hand showed a significant interaction between period and breed (Table 2). The NN had the lowest value 3.83 kg/kg in period 1, while SL and WL had the highest values, 5.72 and 5.66 kg/kg in the same period, respectively. This result was in agreement with Darwish *et al.* (1992) who reported that feed efficiency was slightly better for naked neck birds at 31 and 38 °C, respectively, however, at moderate temperature, the feed efficiency of the naked neck birds was deteriorated in comparison with normally feathered birds. This could be due to the larger skin area, exposed to the environment; therefore, more heat will be dissipated in the naked neck birds.

Egg Quality Characteristics

Data from this study showed a highly significant interaction between period and breed in shell thickness (Table 3). The NN had highest shell thickness values 355.5 micrometer (m) in period 1 compared to that of the SL, 353.1 m and the WL, 328.3 m breeds. In general there was a reduction in shell thickness during the hot weather which can partially attributed to the increased

Table 3: Effect of Seasonal Temperature on Egg Quality Characteristics and Livability of the Birds

	Shell Thickness (um)	Specific Gravity	Haugh Units	Livability %
Breed*period	**	*	NS	**
NN 1	355.5±2.62	1.086±0.005	81.39±5.02	71.91±14
SL 1	353.1±2.71	1.086±0.006	78.95±5.73	73.87±25
WL 1	328.3±3.25	1.082±0.008	81.57±7.72	44.74±26
NN 2	344.4±2.22	1.084±0.006	81.20±4.84	75.77±22
SL 2	360.02±1.9	1.087±0.005	80.95±4.97	94.39±14
WL 2	336.3±2.03	1.082±0.006	84.57±5.60	78.57±24
Among breeds	NS	NS	NS	**
NN	349.9^{a}	1.085^{a}	81.29^{a}	74.23^{a}
SL	357.0^{a}	1.087^{a}	80.08^{a}	86.10^{a}
WL	336.4^{a}	1,082^{a}	83.09^{a}	64.90^{b}
Between periods	*	NS	*	**
1	346.2^{a}	1.084^{a}	80.61^{a}	63.51^{a}
2	351.0^{b}	1,085^{a}	82.00^{b}	82.91^{b}

Note: Means, within each column, having different superscript are significantly different. NN = Naked neck, SL = Saudi local chickens, WL = White leghorn. Average temp. of period 1 = 40 C (33.8 – 42.5 C) representing the months of June, July, Aug, Sept and Oct. Average temp.of period 2 = 25 C (21.4 – 29.5 C) representing the months of Nov, Dec, Jan, Feb m Mar and Apr. * Significant P<0.05, ** Significant P<0.01. NS = Not significant P>0.05.

Table 4: Effect of Seasonal Temperature on Respiration Rate and Body Temperature

	Respiration Rate (breath/min)		Body Temperature (°C)	
Breed*period	**	**	NS	NS
	6:00 AM	2:00 PM	6:00 AM	2:00 PM
NN 1	34.93±6	134.79±46	41.28±0.39	42.06±0.4
SL 1	33.58±6	130.20±42	41.25±0.42	42.04±0.5
WL 1	35.97±8	126.01±33	41.26±1.40	42.16±1.8
NN 2	34.32±3	34.62±3	41.15±0.13	41.24±0.1
SL 2	34.01±4	34.32±4	41.15±0.13	41.22±0.1
WL 2	37.49±6	38.56±5	41.16±0.14	41.26±0.1
Among breeds	**	NS	NS	NS
NN	34.61^b	80.00^a	41.217^a	41.63^a
SL	33.82^b	74.90^a	41.197^a	41.60^a
WL	36.56^a	89.51^a	41.222^a	41.82^a
Between periods	*	**	**	**
1	34.72^a	130.99^a	41.27^a	42.08^a
2	34.69^a	35.13^b	41.15^b	41.24^b

Note: Means, within each column, having different superscript are significantly different. NN = Naked neck, SL = Saudi local chickens, WL = White leghorn. Average temp.of period 1 = 40 C (33.8 – 42.5 C) representing the months of June, July, Aug, Sept and Oct. Average temp.of period 2 = 25 C (21.4 – 29.5 C) representing the months of Nov, Dec, Jan, Feb m Mar and Apr. * Significant $P<0.05$, ** Significant $P<0.01$. NS = Not significant $P>0.05$.

panting accompanied by alkalosis (increased blood PH, decreased pCO_2 and HCO_3). These signs were shown in the birds of this study (Table 4). The decrease in shell thickness could also be due to the reduction in calcium content of the blood (Unpublished data). Also, birds in in period 1 consumed less feed than birds in period 1 (Table 2). This could be another factor responsible for the poor shell quality. Specific gravity data followed closely shell thickness data with correlation coefficient of (R = 0.9758). North and Bill (1990) stated that specific gravity of the egg is related to its shell thickness.

Egg shell thickness and specific gravity of the WL seemed to be highly affected by hot weather. This could possibly be due to be breed effect, which was exaggerated by hot weather. Cold weather did not improve the situation. However, egg size of the same breed had become better in moderate temperature. I tis known that the amount of calcium deposited on the shell remain constant during the laying year (Roland, 1979), therefore, the shell will be thinner as birds get older and the eggs become larger. Mohammed *et al*. (2005) reported that naked neck birds failed to reach the local breed of Sudanese and Betwil chickens in average egg-shell thickness. There was no significant differences among breeds in this experiment.

The data presented in Table 3 revealed that the Haugh units of the experimental breeds were significantly lower in period 1 in comparison of that in period 2 with superiority of The WL breed in both periods. North and Bell (1990) stated that interior quality of the egg deteriorates in higher temperature.

During period 1, the SL and NN breeds had the higher rate of livability than the white leghorn (73.86 and 71.92 vs 44.74%, respectively) (Table 3). These results provided evidence that local breeds are more resistance to heat than the foreign ones which may probably be due to the genetic makeup of the local breed and the larger skin area, exposed to the environment in case of the naked neck birds.

Physiological Parameters

Body Temperature

Interaction between period and breed was not significant on body temperature. In general, body temperature at 6:00 AM and at 2 PM of the three breeds was significantly lower in period 2 as compared to period 1. No significant differences were found among breeds. Average temperatures of the three breeds were 41.21 °C and 41.66 °C at 6:00 AM and 2:00 PM, respectively. Marat (1986) showed that no difference in body temperature between naked neck and normal birds or a slightly lower body temperature (0.1 to 0.2 °C) for naked neck birds (Table 4).

Respiration rate was significantly affected by the interaction between period and breed (Table 4). At 2:00 PM, a highly significant difference was observed between period 1 and period 2 (130.99 vs 35.13 breath/min). However, these breeds exhibited similar rate at 6:00 AM (34.72 vs 34.69 breath/min). During period 1, the WL breed had the lowest value (126.01 breath/min) while the NN and SL had the highest values (134.79 and 130.20 breath/min, respectively which indicate that these birds are more efficient in dissipating heat through panting (Table 4).

H^+ Concentration

Average pH of the three breeds was significantly lower in period 2 compare to period 1 (Table 5). This result agreed with Darre *et al*. (1980) who observed that pH increased in a curvilinear fashion as leghorn hens were exposed to increasing ambient temperature. A numerically higher pH was found in WL breed in period 1 (7.503). This increase in pH during hot weather was due to the increased of respiration and loss of CO_2 as indicated in Table 4. Odom *et al.* (1986) observed that panting caused losses of blood CO_2 resulting in an increase in blood pH. Birds of this experiment were exposed to the hot weather for at least 5 months. This period was enough for these birds to be acclimatized to high temperature. By gradually acclimatizing laying hens to biweekly temperature increases up to 35 ºC, Kohne and Jones (1975) showed no change in blood pH or PCO_2 even though reductions in performance was observed.

Partial Pressures of Carbon Dioxide (PCO_2)

Average PCO_2 of the three breeds were significantly lower in period 1 compared to period 2 (Table 5). This result was partially due to the higher rate of panting (Table 4). Linsely and Burger (1964) and Calder and Schmidt-Neilsen (1966) reported that thermal polypnea associated with heat stress in birds increase evaporative cooling but over ventilation reduce arterial carbon dioxide partial pressure (PCO_2) and H^+ concentration, producing an acid-base disturbance, termed respiratory alkalosis. Alkalosis may decrease the amount of carbonate available for egg shell formation and thus contribute toward the thin shell, which are frequently seen in hot climates. Thinner shell was observed in the eggs of birds of this study (Table 3).

Partial Pressures of O_2(PO_2)

There was a significant differences among breeds (Table 5). The PO_2 values of NN, SL, and WL breeds in period 1 were 42.28, 42.74 and 46.82 mmHg, respectively. However, in period 2, the same breeds recorded 43.00, 40.44 and 44.43 mmHg, respectively.

HCO_3^-

Significant differences were observed in HCO_3^- values (Table 5). NN, SL and WL recorded 19.42, 19.35 and 20.71 mm/l in period 1, respectively, while in period 2 the same breeds recorded 22.32, 19.72 and 21.30 mm/l, respectively. Regardless of breed, differences between periods were not significant. Numerically, values of HCO_3^- in the hot months was lowered than in the cold months. This result may not be surprising since significantly higher panting was recorded in this period (Table 5). When hen, pants in hot weather, to increase heat loss by evaporative cooling, it also causes a reduction in CO_2 and HCO_3 ions (Austic and Nesheim, 1990).

Table 5: Effect of Seasonal Temperature on PH and Blood Gases

	PH	PCO_2 mm Hg	PO_2 mmHg	HCO_3- mm/l	TCO_2 mm/l	O_2 SAT %
Breed*period	NS	NS	NS	NS	NS	NS
NN 1	7.483±0.07	27.51±5.3	42.28±4.9	19.42±2.9	21.01±2.3	78.52±22
SL 1	7.481±0.06	27.19±4.5	42.74±6.8	19.35±2.2	20.69±1.7	82.38±6
WL 1	7.503±0.10	27.42±6.2	46.82±5.5	20.71±1.8	21.53±1.9	85.67±6
NN 2	7.441±0.05	34.42±5.8	43.00±5.2	22.32±2.0	22.89±1.4	72.02±27
SL 2	7.491±0.04	30.82±3.6	40.46±5.1	19.72±3.4	20.94±3.5	73.63±25
WL 2	7.432±0.04	34.03±4.0	44.34±7.1	21.30±2.7	22.50±3.0	78.88±7
Among breeds	NS	NS	*	*	NS	NS
NN	7.465^a	29.98^a	42.58^b	20.62^{ab}	21.76^a	75.98^a
SL	7.485^a	28.61^a	41.81^b	19.50^b	20.79^a	78.74^a
WL	7.480^a	29.9	45.99^a	20.91^a	21.80^a	83.09^a
Between periods	**	**	NS	NS	**	NS
1	7.489^a	27.39^a	43.95^a	19.84^a	21.09^a	82.11^a
2	7.455^b	33.14^b	42.43^a	21.10^a	22.02^b	74.65^a

Note: PO_2 = partial pressure of O_2, PCO_2 = partial pressures of CO_2, TCO_2 = total CO_2, SA % = O_2 saturation. Means, within each column, having different superscript are significantly different. NN = Naked neck, SL = Saudi local chickens, WL = White leghorn. Average temp. of period 1 = 40 °C (33.8 – 42.5 °C) representing the months of June, July, Aug, Sept and Oct. Average temp. of period 2 = 25 °C (21.4 – 29.5 °C) representing the months of Nov, Dec, Jan, Feb m Mar and Apr. * Significant P<0.05, ** Significant P<0.01. NS = Not significant P>0.05.

Total CO_2

Differences between periods were significant pertaining to CO_2 values. Total CO_2 in hot months (21.09 mm/l) was lowered than that of the cold months (2.02 mm/l), indicating higher rate of CO_2 losses due to panting (Table 5). Austic and Nesheim (1990) reported similar observation.

O_2 Saturation (SAT %)

No significant differences were found among breeds or between periods (Table 5). Numerically, higher SAT % of WL blood in period 1 and 2. The SAT % of NN, SL and WL breeds in period 1 was 78.52, 82.38 and 85.67%, respectively. However, in period 2, the same breeds recorded 72.02, 73.63 and 78.88%, respectively. SAT % in the hot months (82.11%) was numerically higher than in the cold months (74.65%).

CONCLUSION

Naked neck performance was superior during hot weather in egg production, egg mass, feed conversion, egg shell thickness, specific gravity of the egg and respiration rate when compared to the white leghorn and Saudi local birds. The lack of any physiological differences in some parameters tested herein, among breeds indicate that the superiority of Naked neck may be due to the large area of less feather and to some genetic elements, which enhanced their adaptability to the hot environment. Therefore, it is probably suggested that naked neck birds, after some genetic and nutritional improvement can be used efficiently in the hot region of Saudi Arabia.

REFERENCES

1. Ahmad A S and A-Abad A H (2014), "First Report about Growth, Partial Record Egg Production and Morphological Characters of a Newly Characterized Native Saudi Chicken Lines Hajar 1 and Hajar 2", in *Biotechnology and Conservation of Species from Arid Regions*, Vol. 1, Chapter 10, Nova Science Publishers, Inc.

2. Al-Sobayel A A (1986), "Some Egg Quality Characteristics of Baladi Chickens Kept Under Two Housing Systems in Saudi Arabia", *J. Coll. Agric.*, Vol. 8, pp. 79-87, King Saud Univ.

3. Arad Z, Marder J and Soller M (1981), "Effect of Gradual Acclimation to Temperature Up to 44 C on Productive Performance of the Desert Bedouin Fowl, the Commercial White Leghorn and the Two Reciprocal Crossbreeds", *British Poultry Sci.*, Vol. 22, pp. 511-520.

4. Austic R E and Nesheim M C (1990), *Poultry Production*, 13th Edition, Lea & Febiger, Philadelphia, London.

5. Bakir A A and Kotby E A (1984), "Thyroid and Parathyroid Glandular Cell Activities During Growth and Production of Certain Breeds of Chickens", 1st Nat. Conf. Physiol. Sci. Cairo, March-April.

6. Basmaeil S M (1985), "Egg Shell Thickness and Some Production Traits in Leghorn and Baladi Layers as Affected by Supplementing the Dietary Calcium Level", March 23-24, The Egypt Poultry Sci. Assoc., First Scientific Symposium, Evaluation of Economics Studies on Local Strains of Poultry, Alexandria.

7. Bordas A and Merat P (1984), "Effects of the Naked Neck Gene on Traits Associated with Egg Laying in a Dwarf Stock at Two Temperatures", *British Poultry Sci.*, Vol. 25, pp. 195-207.

8. Darwish A A, Attallah A A, Mohamed F R and Tantawy S M T (1992), "Effect of Naked Neck Gene (Na) on Performance of Chicks Raised Under Heat Stress", *J. Agric. Sci. Mansoura Univ.*, Vol. 17, No. 6, pp. 2068-2079.

9. El-Bahy Nadia M A (1994), "Productivity of Two Local Domestic Fowl Breeds Under Semi-Tropical Conditions", M.Sc. Thesis, Fac. of Agric., Cairo Univ., El-Fayoum, Egypt.

10. Ebehart D E and Washburn K W (1993), "Variation in Body Temperature Response of Naked Neck and Normally Feathered Chickens to Heat Stress", *Poultry Sci.*, Vol. 72, pp. 1385-1390.

11. El-Hadi H M and Sykes H A (1982), "Thermal Panting and Respiratory Alkalosis in the Laying Hen", *British Poultry Sci.*, Vol. 23, p. 49.

12. Fathi M M (1987), "Effect of Necked Neck Gene on Some Quantitative Characters in Chicks", M.Sc. Thesis, Agric. Ani Shams Univ., Cairo, Egypt.

13. Hamdi A M M (1990), "Heat Tolerance of Neonatal Chicks", Ph.D. Thesis, Faculty of Agric., Minia Univ., Egypt.

14. Hanzl C J and R G (Jr) Somes (1983), "The Effect of the Naked Neck Gene, Na, on Growth and Carcass Composition of Broilers Raised in Two Temperatures", *Poultry Sci.*, Vol. 62, pp. 934-941.

15. Hassanin M N F (1990), "Studied on Some Factors Influencing Some Egg Characteristics in Riyadh Vicinity", M.Sc. Thesis, Fac. of Agric., King Saud Univ., Riyadh, Saudi Arabia.
16. Horst P (1980), "Genetical Perspectives for Poultry Breeding on Improved Productive Ability to Tropical Conditions", *2nd World Congress of Genetics Applied to Animal Production*, Vol. 8, pp. 887-892.
17. Kyarisiima C C and Balnave D (1995), "Influence of Temperature During Growing on Responses of Hens to High or Low Temperatures During Lay", *British Poultry Sci.*, Vol. 37, pp. 553-562.
18. Leeson S and Summers J D (2001), *Scotts Nutrition of the Chicken*, 4th Edition, University Books, Guelph, Ontario, Canada.
19. Mastaka S and Rennels E C (1972), "Influence of High Ambient Temperature on the Reproductive Function of the Male Rat", *Tex. Rep. Biol. Med.*, Vol. 29, No. 3, pp. 313-330.
20. Merat P (1986), "Potential Usefulness of the Na (Naked Neck) Gene in Poultry Production", *World's Poultry Sci. J.*, Vol. 42, pp. 124-142.
21. Mohammed M D, Abdalsalam Y I, Kheir A M, Jin-yu W and Hussein M H (2005), "Comparison of the Egg Characteristics of Different Sudanese Indigenous Chicken Types", *International Journal of Poultry Science,* Vol. 4, No. 7, pp. 455-457.
22. Monnet L E, Bordas A and Merat P (1979), Gene cou nu et performance de croissanceselom la temperature chez le poulet, *Ann Genet. Sel. Anim.*, Vol. 11, No. 4, pp. 397-412.
23. North M O and Bell D D (1990), *Commercial Chicken Production Manual*, 4th Edition, AVI Book, Copyright by Van Nostrand Reinhol, USA.
24. Odom T W, Harrison P C and Bottje W G (1986), "Effect of Thermal Induced Respiratory Alkalosis on Blood Ionized Calcium Levels in the Domestic Hen", *Poultry Sci.*, Vol. 65, pp. 570-573.
25. Roland D A (1979), "Factors Influencing Shell Quality of Laying Hens", *Poultry Sci.*, Vol. 58, pp. 774-777.
26. SAS Institute (2000), SAS/STAT® User's Guide: Release 8.10 Edition, SAS Institute Inc., Cary, NC.
27. Shawer F M (1984), "Quality Characteristics of Eggs from Different Marketing Channels in Riyadh Vicinity", *Egypt. Poultry Sci.*, Vol. 4, pp. 17-133.
28. Shoureap U M (1991), "Effect of Some Mendelian Genes on Body Weight and Egg Production in the Fowl", Ph.D. Thesis, Dept. Animal Produ., Fac., Agric., Ain Shams Univ.
29. Steel R G D and Torrie J A (1980), "Principles and Procedures of Statistics", McGraw Hill, New York.