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Effects of Ambient Temperature, Flock Age and Breeding Stock on Egg Production and Hatchability of Broiler Hatching Eggs

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Abstract: Under strict hygienic control procedure, the effects of flock age, ambient temperature and hens stock and their interactions on egg production and hatchability of broiler hatching eggs were investigated on a total of 900 Lohmann brown hybrid and 900 Arbor Acres white of lay birds aged (24-65 weeks). Inside the environmental closed chamber, three different air temperatures (21, 30, 35°C) with 16 photoperiod daily and relative air humidity (RH) at 75%, were used in each trial. Broiler hatching eggs were stored for one only day at 18°C and 75% RH with no turning. Then they subjected to setting at 37.4°± 0.2 °C dry bulb temperature, while being turned 24 times per day.The hatcher was operated at 37.2°± 0.2°C dry bulb temperature. Results showed non significant difference between 9 treatment groups values related to two each of reared hens stocks aged 45 weeks with temperatures 30 and 21°C, but they differed significantly ($p>0.05$Z) also from treatment group values regarding the same two hens stocks aged 45 weeks with temperature 35°C. A higher egg hen production (%) and hatchability (%) of broiler hatching eggs was observed during the rearing periods of 40 and 45 weeks for Arbor Acres white and Lohmann brown hybrid lay birds raised under an ambient temperatures 30°C and 21°C consecutively.

Key words: Layers · Egg production · Hatching eggs · Percentage hatchability · Fertile eggs · Environmental conditions · Rearing strain · Birds age

INTRODUCTION

Broiler production has experienced significant technological development in the last 30 years. The broiler industry has reached a high degree of competitiveness in the 1980s and it is currently therefore in exports [1]. Improved live performance efficiency and implementation of quality control in the broiler chain has been constant in most of Arabian countries including of Syrian Arab Republic and Saudi Arabia Kingdom separately. Birds are naturally well adapted to cold due mainly to their highly efficient insulation provided by feathers [2]. However, production efficiency of poultry goes down at low ambient temperatures. Low ambient temperatures cause an increase in feed intake, but also result in decreased egg production and feed efficiency in laying hens [2-5]. Such cold conditions also cause decreases in serum concentrations of some vitamins, minerals and insulin and increases in serum corticosterone in poultry as well as humans [6]. Under intensive management both the direct and the indirect effects of high environmental temperatures can change not only the number of eggs produced by a hen in a given period but also the quality of these eggs [7]. Some of the direct physiological effects of environmental temperature on laying hens have been reviewed in previous paper [8, 9]. Egg production and hatchability of broiler eggs can be influenced considerably by age flock [10, 11], breed and strain of chickens used [12] and breeding programs, light stimulation, nutrition, or by a combination of the three [10]. A significant interaction of flock age x turning in storage for hatchability of fertile eggs in experiments suggested that eggs from an older broiler breeder flock that exhibit reduced fertility benefited more from turning during storage than did eggs from a young broiler breeder flock [11]. Bowman [13] used eggs from a white egg hybrid and brown egg hybrid and found that turning during storage significantly reduced mortality at all stages of embryonic development and the advantage due to turning increased with longer storage. Increases in early and late embryonic mortalities associated with improper turning during incubation per se have been previously reported [14, 15]. The literature has also clearly shown that good quality hatching eggs were less sensitive to

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decreased turning during incubation than poor quality eggs [16, 17]. These previous reports suggested that some variability in response to hatching egg storage may be expected. However, hatching eggs from a current strain of broiler breeder should respond positively to turning storage and the response should be better when an older broiler breeder flock produces the eggs. Eggs help in the provision of much needed animal protein in Arabic countries and are nutritious and complete food to man [18]. Eggs ae regarded as a wholesome diet because an egg contains adequate amounts of proteins, amino acids, vitamins and minerals to satisfy the body requirements [19]. Because little work has been done to determine the effects of flock age,ambient temperature and breeding stock on egg production and hatchability of broiler hatching eggs, the main objective of this study was to evaluate the ability of two strains of Lohmann brown hybrid and Arbor Acres white of lay hen birds aged different weeks to produce and hatch egg counts and quality during periods of different ambient temperatures throughout life rearing periods.

MATERIALS AND METHODS

Management of the Experimental Birds, Environmental Conditions and Experiential Design: The experiments was conducted from November, 2008 to November, 2009. A total of nine hundred (one hundred per trial) Lohmann brown hybrid and nine hundred (one hundred per trial) Arbor Acres white of lay hen birds aged (24, 30, 35,40, 45, 50, 55, 60 and 65 weeks) were randomly selected from those commercial flocks mentioned above and used in this investigation and their egg production and hatchability percentages were compared. The birds of each stock were divided into 9 treatment groups consisting of 100 birds each. Each treatment group was further replicated 3 times, made of 100 birds per replicate. The birds were reared on conventional deep litter system. Deep litter system affords one of the efficient means of commercial egg production. The litter was made of well-dried wood shavings of 10 cm in depth. The birds were provided water and layer feed *ad-libitum*. The feeding (Table 1) according to rearing periods and body weight (BW) programs were as described by Arbor Acres [20], Lohmann farms Breeders' guides [21] and Ndubuisi *et al.* [22] with some modifications. Laying nests were provided at strategic corners of the laying house for the birds. Inside the environmental closed chamber, three different air temperatures (21°, 30°, 35°C) with 16 hr. photoperiod daily were used in each trial. Relative air humidity (RH) was kept constant at 75%. Each environmental condition was kept stable for 24-65 weeks in order to observe egg production of birds and hatchability of broiler hatching eggs. Eggs collection was done three times daily and all the necessary medications were administered to the laying birds. Disease control is crucial and its prevention is through both strict bio-security and the use of recommended vaccination programs. Vaccination includes vaccine for different diseases (especially Newcastle Disease, Infectious Bronchitis, Gumboro and Fowl Pox) at different ages as advised by Arbor Acres Farm, B. V. and Lohmann farm experts. The litter was turned every morning after cleaning all feeders and washing the drinkers. The litter was changed according to the period designated for each treatment between 0700-1100 hours, 1100-1400 hours and 1400-1700 hours respectively.

Table 1: Composition of Layers Diet in the Experiments

Ingredient (%)	Mash Percentage
Maize	50.00
Soya bean meal	18.00
Fish meal	3.10
Wheat bran	19.00
Bone meal	2.15
Oyster shell	7.10
Salt	0.25
Vit/Premix *	0.20
Dc-methionine	0.20
Total	100
Calculated Analysis	
Crude protein (%)	16.31%
Metabolizable energy	2246
Calcium (%)	3.41%
Phosphorus available (%)	0.43
Lysine (%)	0.63%
Methionine+Cystine (%)	0.61
Crude fibre (%)	5.62

Premix supplied per kg of feed: Vit. A 10000 iu, Vit. D 2000 iu, Vit. E 5 iu. Vit. K 2 mg,* Riboflavin 4.20 mg, Vit B12 0.01 mg, Pantothenic acid 5 mg. Nicotinic acid 20 mg, Folic acid 0.5 mg, Chlorine 3 mg, Mn 55 mg, Fe 20 mg, Cu 10 mg, Zn 50 mg, Co 125 mg, iodine 0.8 mg

Handling of Hatching Eggs: Hatching eggs were produced from flocks of Arbor Acres white and Lohmann brown hybrid feather-sexable strains females mated to Arbor Acres white and Lohmann brown hybrid (consecutively) males. Males and females were grown sex –separate in light controlled facilities on an 16-hr photoperiod. In regard to handling of hatching eggs, hatching eggs were obtained from two Arbor Acres white and Lohmann brown hybrid flocks of lay birds aged

(24, 30, 35, 40, 45, 50,55, 60 and 65 weeks) of 100 birds each. Broiler hatching eggs were stored for one only day at 18°C and 75% relative humidity (RH) with no turning. Then the eggs were held in setter buggies and turning 24 times per day, in which the turning angle was 90 as in the sitter. The interval between of the experiments conducted on that two different broiler breeder flocks eggs was separated in time by 6 months. In all experiments, an incubation tray of 150 eggs constituted a replicate. There were 64 trays in each trial. Treatment groups had four replicate trays. Regularly, macroscopic examinations of hatching eggs for fertility were carried out on the seventh day of incubation and the unfertilized eggs were eliminated. The machines used were a Petersime model 576 setter and a model 192 hatcher. The setter was operated at 37.4°±0.2°C dry bulb temperature and 28.9°+ 0.2°C wet bulb temperature. The hatcher was operated at 37.2°± 0.2°C dry bulb temperature and 30°±0.2°C wet bulb temperature. Sterilization procedures with formaldehyde for setter, hatcher and hatching eggs were made throughout the experiments. Machines were monitored by computer four times daily for proper operation. Trays representing all flock age-storage days-turning treatment combinations were distributed throughout all positions in the setter and hatcher to account for possible small machine position effects that could be due to differences in air flow. In other words, random trays representing all treatment combinations were equally placed in all areas of the machines. Incubation period and hatching period were 18 and 3 days respectively. At the time of removing the chicks from the hatchers, all unhatched eggs were opened and examined macroscopically by a single experienced individual to determine percentage fertility, percentage embryonic mortality [early (0 to 6 d), middle (7 to 17 d), late (18 to 21 d plus pipped)] and percentage hatchability of fertile and total eggs. Hatchability of fertile eggs was calculated as the number of chicks hatched per fertile egg set. The percentage middle dead embryos was low and showed no treatment effects, therefore these data were omitted for brevity. It has been reported that macroscopic evaluation to differentiate fertility and early embryonic mortality becomes more difficult with extended periods of storage [23]. Therefore the fertility results were reported as "apparent fertility" and presented in concert with hatchability of fertile and total eggs and early dead mortality to provide an unbiased view of the data.

Statistical Analysis: The results for the incubation variables were analyzed by ANOVA with the general linear model procedure [24], while the treatment means were compared using Duncan's New Multiple Range Test as described by Obi [25]. Between-tray variation (residual) was the source of the error term. Flock age, ambient temperature treatments, handling of hatching eggs and breeding stock were the main effects.

RESULTS

Results Are Presented in Tables 2, 3 and 4: Both Lohmann brown hybrid and Arbor Acres white of lay birds aged 24, 30, 35, 40, 45, 50, 55, 60 and 65 weeks started to lay eggs at 22 weeks of age and reached sexual maturity (50% egg production) at 24 weeks of age. Egg production, hatchability of fertile eggs and embryonic mortality hatching eggs in experiments are shown in the above Tables 2, 3 and 4. The data indicates that the egg production, hatchability of fertile eggs and embryonic mortality hatching eggs of Lohmann brown hybrid and Arbor Acres White layers aged (24, 30, 35, 40, 50, 55, 60 and 65 weeks) were not similar from the 24 weeks of age till 65 weeks of age and then it was clear that egg production and hatchability of fertile eggs of Arbor Acres white layers were higher than that of Lohmann brown hybrid layers. Ambient temperatures above 30°C are considered to have detrimental effect on the performance of laying hens. Furthermore, it has been found that the ambient temperatures inside poultry closed houses of 30°and 21°C, respectively, were more beneficial than the ambient temperature of 35°C, with high egg production and hatchability of fertile eggs for both of Arbor Acres white and Lohmann brown hybrid strains layers of ages (24, 30, 35, 40, 45, 50, 55, 60 and 65 weeks) which are suitable for poultry keeping ; since it provide with all requirements of hens layers raising for increasing egg production and hatchability of fertile eggs.

Concerning the apparent fertility, hatchability and embryonic mortality results of experiments recorded in tables 2,3 and 4, apparent fertility and hatchability of total eggs were increased significantly by 24 week of age till 45 week of age, then decreased clearly by 50 week of age until 65 week of layers age, according to rearing strains bred which are Arbor Acres white and Lohmann brown hybrid (consecutively) stocks. However,hatchability of fertile eggs, then egg production were affected significantly by ambient temperatures, flock age and breeding strains. There were significant interactions of flock age x ambient temperature x breeding stock for apparent fertility, hatchability of fertile eggs and percentage late dead. The interaction means for apparent

Table 2: The effect of flock age (wk), ambient temperature (30°C) and breeding stock on egg production and hatchability of fertile eggs and embryonic mortality of broiler hatching eggs for Arbor Acres white and Lohmann brown hybrid layers in experiments

				Hatchability (%)				
Flock age	HDEP (%)	HHP (%)	Apparent Fertility (%)	Of total eggs	Of fertile eggs	Early dead (%)	Late dead (%)	SEM
24	84.74	83.43	95.4	84.3	87.4	5.1	4.9	0.18
	83.29	81.82	94.5	83.3	86.6	5.3	5.0	0.20
30	85.54	84.79	96.7	85.7	88.8	4.2	4.1	0.13
	84.19	82.88	95.6	84.9	87.6	4.5	4.3	0.42
35	87.86	85.89	97.5	86.8	90.9	3.8	3.7	0.55
	86.56	84.60	96.1	85.9	98.8	4.0	3.9	0.61
40	88.96	87.90	98.3	87.8	96.5	2.7	2.9	0.44
	87.76	85.64	96.9	86.7	93.4	3.1	3.1	0.46
45	90.14	88.72	98.7	88.9	97.6	2.5	2.7	0.0.5
	99.63	87.33	97.3	87.6	94.7	2.8	2.9	0.09
50	83.51	80.20	91.4	84.7	88.5	4.9	4.3	0.21
	81.30	78.29	88.5	82.4	86.6	5.4	4.5	0.29
55	81.75	78. 54	88.3	83.3	87.4	5.2	4.7	0.33
	77.65	74.73	86.4	81.2	83.3	5.6	4.9	0.59
60	76.85	73.36	86.6	80.9	82.1	5.4	5.0	0.14
	72.22	70.29	84.8	80.1	81.8	5.7	5.1	0.25
65	70.41	68.52	83.7	79.4	80.7	5.6	5.3	0.88
	66.71	64.91	80.3	78.5	80.4	5.8	5.5	0.98

Abbreviations: HDEP, hen-day egg production (%) ; HHP, Hen-housed production (%) Note:1- Mean values within each upper and lower row of each one of column indicate number (%), for Arbor Acres white and Lohmann brown hybrid layers respectively. 2- Means with different superscripts differ significantly ($p < 0.05$) and are shown in each row of the above table, beginning of 40 weeks till 65 weeks of age for Arbor Acres white and Lohmann brown hybrid layers consecutively. 3-Significant interactions: apparently fertility: flock age x ambient temperature x breeding strain. Hatchability of fertile eggs: flock age x ambient temperature x breeding strain. Early dead: flock age x ambient temperature x breeding strain. Late dead: flock age x ambient temperature x breeding strain.

Table 3: The effect of flock age (wk), ambient temperature (21°C) and breeding stock on egg production and hatchability of fertile eggs and embryonic mortality of broiler hatching eggs for Arbor Acres white and Lohmann brown hybrid layers in experiments

				Hatchability (%)				
Flock age	HDEP (%)	HHP (%)	Apparent Fertility (%)	Of total eggs	Of fertile eggs	Early dead (%)	Late dead (%)	SEM
24	81.41	80.33	92.3	81.3	84.4	5.5	5.1	0.22
	80.21	78.71	91.4	80.4	83.5	5.7	5.2	0.29
30	82.44	81.72	93.6	82.7	85.9	4.5	4.6	0.33
	81.11	79.87	92.5	81.7	84.5	4.7	4.9	0.36
35	84.77	82.84	94.6	83.9	87.8	4.0	3.8	0.18
	83.45	81.58	93.5	82.8	85.7	4.2	4.1	0.29
40	85.91	83.88	95.4	84.9	93.6	2.9	3.1	0.31
	84.66	82.59	93.8	83.5	90.6	3.4	3.2	0.61
45	87.11	85.62	95.8	85.9	94.7	2.7	2.9	0.71
	86.53	84.23	94.4	84.7	91.5	2.9	3.0	0.74
50	80.41	77.13	84.4	77.5	81.3	5.1	4.5	0.81
	78.28	75.02	81.3	75.5	79.3	5.6	4.6	0.92
55	78.65	75.43	81.4	76.7	80.2	5.5	5.2	0.38
	74.51	71.69	79.1	74.6	77.2	5.7	5.1	0.42
60	73.71	70.29	79.5	73.2	75.9	5.6	5.3	0.55
	69.13	67.91	77.15	72.2	74.1	5.9	5.5	0.62
65	67.15	65.42	76.7	72.6	77.7	6.2	5.6	0.88
	63.67	61.81	71.2	68.4	73.6	6.7	5.9	0.90

Abbreviations: HDEP, hen-day egg production (%) ; HHP, Hen-housed production (%) Note:1- Mean values within each upper and lower row of each one of column indicate number (%), for Arbor Acres white and Lohmann brown hybrid layers respectively. 2- Means with different superscripts differ significantly ($p < 0.05$) and are shown in each row of the above table, beginning of 40 weeks till 65 weeks of age for Arbor Acres white and Lohmann brown hybrid layers consecutively. 3-Significant interactions: apparently fertility: flock age x ambient temperature x breeding strain. Hatchability of fertile eggs: flock age x ambient temperature x breeding strain. Early dead: flock age x ambient temperature x breeding strain. Late dead: flock age x ambient temperature x breeding strain.

Table 4: The effect of flock age (wk), ambient temperature (35°C) and breeding stock on egg production and hatchability of fertile eggs and embryonic mortality of broiler hatching eggs for Arbor Acres white and Lohmann brown hybrid layers in experiments

				Hatchability (%)				
Flock age	HDEP (%)	HHP (%)	Apparent Fertility (%)	Of total eggs	Of fertile eggs	Early Dead (%)	Late dead (%)	SEM
24	73.51	73.42	84.4	73.3	75.3	5.8	5.5	0.07
	72.29	70.74	83.6	72.4	74.5	6.1	5.4	0.19
30	74.34	73.42	85.7	74.6	77.8	4.8	4.8	0.21
	73.16	71.62	84.3	73.7	76.6	5.0	5.2	1.09
35	76.57	74.76	86.7	75.3	79.9	4.4	4.2	0.11
	75.33	73.29	85.5	75.8	77.6	4.8	4.7	0.27
40	77.55	75.46	87.4	76.9	85.8	3.1	3.2	0.30
	76.26	74.14	85.7	75.7	85.8	3.6	3.7	0.10
45	79.10	77.51	87.8	77.8	86.9	3.4	3.2	0.81
	78.36	76.21	86.5	76.6	83.7	3.6	3.4	0.12
50	73.21	69.12	76.4	69.7	73.8	5.6	5.2	0.6
	70.20	67.18	73.4	67.9	71.4	6.1	5.9	4.0
55	70.23	67.16	73.3	68.5	72.1	6.5	6.2	7.0
	66.42	63.27	71.2	66.5	69.9	6.8	6.4	9.0
60	65.55	63.24	71.3	65.6	67.8	6.9	6.6	8.0
	61.11	59.51	69.7	64.8	66.3	7.0	6.9	5.0
65	59.19	57.32	68.6	64.5	69.4	7.2	7.1	7.0
	55.17	53.19	63.4	61.5	65.8	7.5	7.3	3.0

Abbreviations: HDEP, hen-day egg production (%) ; HHP, Hen-housed production (%) Note:1- Mean values within each upper and lower row of each one of column indicate number (%), for Arbor Acres white and Lohmann brown hybrid layers respectively. 2- Means with different superscripts differ significantly ($p < 0.05$) and are shown in each row of the above table, beginning of 40 weeks till 65 weeks of age for Arbor Acres white and Lohmann brown hybrid layers consecutively. 3-Significant interactions: apparently fertility: flock age x ambient temperature x breeding strain. Hatchability of fertile eggs: flock age x ambient temperature x breeding strain. Early dead: flock age x ambient temperature x breeding strain. Late dead: flock age x ambient temperature x breeding strain.

fertility and hatchability of total and fertile eggs are presented in tables 2,3 and 4. Interactions that affect apparent fertility can confound hatchability data and must be carefully considered.

The assessment results (Tables 2, 3,and 4)of the factors influencing egg production and hatchability of broiler hatching eggs, i.e. the ambient temperature, flock age and hen stock, showed no significant difference ($p > 0.05$) between 9 treatment groups values related to two each of hens layers stocks reared aged 45 weeks with temperatures 30°C and 21°C, but it differed significantly ($p < 0.05$) also from treatment group values regarding the same two hen layers stocks aged 45 weeks with temperature 35°C.

As shown in tables (2, 3), the results reveal no significant difference ($p > 0.05$) in age flock, ambient temperatures (21°and 30°C) and breeding stock between treatments regarding the factors variables of the experiments carried out on egg production and hatchability of broiler hatching eggs for Lohmann brown hybrid and Arbor Acres white of lay birds aged (24, 30, 35, 40, 45, 50, 55, 60 and 65 weeks), however, the experiments results were declared that the ambient temperature (35°C), age flock and rearing strains mentioned above in relation to treatments differed significantly ($p < 0.05$) from treatments periods of experiments conducted in ambient temperatures (21°and 30°C) and at layers ages (24, 30, 35, 40, 45, 50, 55, 60 and 65 weeks) and on the same breeding stocks pointed out previously, in all the parameters evaluated (Table 4). This significant difference which mainly might be due to the high temperature, then age flock and birds strains bred. The results in Tables (2 and 3) show also the effects of ambient temperature, age flock and breeding stock on egg parameters. At age 45 week, the hen-day egg production (%) and hen-housed egg production (%) of [(87.11, 85.62);(86.53, 84.23)] and [(90.14, 88.72) ; (99,63, 87,33)] in experiments carried out under thermal conditions (21°and 30°C) for Arbor Acres white and Lohmann brown hybrid layers respectively were similar ($p > 0.05$), but it differed significantly ($p < 0.05$) from that related with hen-day egg production (%) and hen-housed egg production (%) of [(87.8, 77.8) ; (86.5, 76.6)] at age 45 weeks and under thermal condition (35°C) for the same mentioned strains (Arbor Acres white and Lohmann brown hybrid layers consecutively) subjected to study and treatments of the experiments done under the ambient temperature 35°C.

The data established that the birds laid more eggs in the ambient temperatures (30°and 21°C consecutively) and especially in the ages (40 and 45 weeks definitely) for

Arbor Acres white and Lohmann brown hybrid layers respectively. In general, the results of this study showed that the birds laid more eggs when the ambient temperature and relative humidity were within the thermoneutrality zone, but the flock age and breeding strains have a good effect upon the egg production and hatchability of broiler hatching eggs.

A higher egg hen production (%) and hatchability (%) of broiler hatching eggs was observed during the rearing periods of 40 and 45 weeks for Arbor Acres white and Lohmann brown hybrid layers raised under an ambient temperatures 30°C and 21°C consecutively. It could be concluded that the egg production and hatchability of broiler hatchability of broiler hatching eggs were the most important parameters influenced by the flock, environmental temperature and laying hens stock. These indicators must have taken into account for husbandry programs of lay hens in different climatic conditions. A fact which may be of economic value during breeding programs application.

DISCUSSION

Birds, like most mammals, are considered to be homeothermic, meaning that they maintain their deep body temperature at about the same level over a wide range of ambient temperatures. The body temperature of the adult fowl is normally in the range of 41°to 42°C [2, 7-9, 26-29]. In order to maintain this body temperature at different ambient temperatures, the fowl (like other homeotherms) has developed some physical and chemical (metabolic) mechanisms for thermoregulation.

Poultry Production is affected by such factors as breed and strain of chickens used, environmental conditions in the poultry house, management practices and feed and feeding management [12]. Different breeds and strains vary in their genetic makeup. A strain is a group of birds, within a breed, that is selected for specific criteria, such as age at sexual maturity, livability,egg production, or egg quality or a combination of more than one. Recently, different strains of Leghorn that lay brown eggs in addition to strains that lay white eggs were developed. Strains such as Lohmann (LSL, white), Lohmann Brown, Hy-Line-W-36 and W-98 and Hy-Line Brown, have been developed from the Leghorn breed. The different strains vary in the different criteria of egg production and quality [12,30-34]. As well as, the stress response to handling is greater in white Leghorn than that in brown Leghorn as reported by Fraisse and Cockrem [35]. The brown strains were developed because there was an apparent demand for consumption of brown eggs. Moreover, there was an apparent problem with shell quality in white eggs. This problem was more evident in the egg industry in Syria. Therefore, there was interest to use strains of laying hens that lay better quality eggs. Hence, Several breeders in Syria were used various strains of laying hens such as Arbor Acres white and Lohmann brown hybrid lay hens birds for egg production of high quality.

In comparing strains used for production of white and brown eggs, Scott and Silversides [36] found that eggs from ISA-Brown hens were heavier than those from ISA-White hens and had more shell and albumen, but less yolk and albumen weight. In addition, Silversides and Scott [37] reported that eggs from ISA-Brown hens had greater percentage of shell than those from ISA-White hens. As well, Grobas *et al*. [38] compared production performance of ISA-Brown hens with DeKalb Delta, a White Leghorn egg layer. They found that egg weight and egg mass from ISA-Brown were more than that from DeKalb Delta and feed efficiency was also better for the ISA-Brown hens. As regards egg production and quality anderson [39] provided detailed information on the differences in egg production and quality between different white and brown egg strains. Strains used were Hy-Line-W-36, Hy-line-W-98, Bovans (white) and DeKalb (Brown) for brown eggs. He detected that the average age at sexual maturity for the brown hens was 132.7 days, which was shorter than that of white hens (137.8 days). He also found that the overall average of hen-day egg production for brown hens was 85.6%, which was higher than that of white hens (83.2%). It is important to emphasize that any improvement in egg production of laying hens would be translated to economic benefits to the company. An increase of egg production in Syria or any other Arabic country would reflect and affect again national product and income. Anderson [39] also declared that egg weight was more for brown hens (61.1g) than that of white hens (58.3 g). On the other hand, he concluded that feed efficiency was similar in both brown and white hens and percent mortality was higher in brown hens than in white hens. However, he reported that net income per hen (egg income – feed cost) was more for the brown hen than the white hen.

In many countries of the world, particularly in the hot and humid tropics, broiler chickens are often maintained at environmental temperatures above the zone of thermo-neutrality. In practice, this has a negative influence on performance. It is well documented that the temperature to which birds are exposed will affect performance: high environmental temperatures depress food intake and body weight and also cause deterioration in the food conversion ratio [29]. Very often, the reduction in performance is attributed to the birds rapidly reducing their food intake at higher temperatures to reduce heat stress. However, when production is depressed at higher temperatures, the role of limiting food intake is not always clear, although pair-feeding experiments [8, 9] suggest that it rarely provides a complete explanation. Further, the fowl, like many other animals, can undergo a number of complex and imperfectly understood physiological changes which enable it to minimize the adverse effects of hot climates [40]. To understand better the relationship between elevated ambient temperature, nutrition and performance, the physiological mechanisms must also be considered. Acute physiological responses to high environmental temperatures are obviously directed to the maintenance of homeothermy, but small increases in body temperature may be tolerated [26, 29, 40].

Egg production, the apparent fertility and hatchability of eggs and embryonic mortality results of experiments carried out on Lohmann brown hybrid and Arbor Acres white of lay birds aged (24, 30, 35, 40, 45, 50, 55, 60 and 65 weeks) are shown in Tables (2, 3 and 4). Apparently egg production,hatchability of broiler hatching eggs and fertility were significantly affected by flock age, ambient temperature and breeding stock. Clearly, egg production was increased due to flock age beginning from age 24 weeks until age 45 weeks according to each of lay birds strains subjected to different treatments of experiments carried out under various thermal conditions, but was affected significantly by different ambient temperatures used in closed chambers. Egg production increases as flock age and environmental temperature increase, but it is more better in age flock 45 and ambient temperature 30°C than in the others ages of lay birds (Table 2) and in thermal conditions of 21 and 35 consecutively (Tables 3 and 4). It observed decreased egg production among Lohmann brown hybrid and Arbor Acres white layers hens aged than more 45 weeks, especially those birds of the ages 50, 55, 60 and 65 weeks (Tables 2, 3 and 4). This decreased egg production related also with ambient temperatures. In those ages and thermal conditions, egg production, the apparent fertility and hatchability of eggs and embryonic mortality ; presented significant statistical differences ($p < 0.05$) as function of environmental temperature being more evident at 21°C and decreasing slightly as environmental temperature increased to 35°C. Further, the variables that most influenced egg production, the apparent fertility and hatchability of eggs and embryonic mortality, were environmental temperature, flock age and rearing strain. Furthermore, it has been found that the birds exercised more their muscles by exposing to high temperature (35°C) as mechanical reaction to stress and fatigue. At the high environmental temperature, birds presented the behaviors of laying prostrating. Younger birds showed higher frequency of movements, such as running and chasing behaviors were correlated both to age flock and environmental temperature, it is possible to build similar of welfare assessment based on the frequency of specific behaviors, such as preening, stretching and laying down. These findings are compatible with those reported by Pereira *et al.* [1].

Much of the present discussion deals specifically with the chicken, though in general terms it is applicable to other domestic species. After the first egg, production rises sharply and a peak of 90% or more is reached. Thereafter egg production gradually falls to a level of about 50% at the end of the first year of production. Since there is an early period of growth and development during which reproduction does not occur and since the hen's reproductive phase lasts for a limited periods, the number of eggs that can produced by a hen depends on when her sexual maturity starts, when it ends and her rate of laying during this period [40].Reproductive potential of any animal depends on genetic makeup, which can be altered by selective breeding. In poultry, breeders have concentrated on selecting for early sexual maturity. The most important factor in breeding about sexual maturity is an increasing daylight, since the hypothalamus-pituitary axis is regulated by this [40]. However, light strength, above a very low level and wavelength are unimportant. Hence, there is a direct correlation between day-length during the rearing period and the age at onset of sexual maturity [41]. Many problems arise with egg quality during the early periods: among them are the production of defective eggs or soft-shelled eggs and 40% of the ova produced may fail to enter the oviduct. Hatchability is generally poor [40]. After the first period, hens typically lay regular sequences, the length of the sequence being a characteristic of the hen. This period lasts about one year; though eggs may be produced longer, production levels are low (and uneconomical) and egg quality deteriorates. Commercially it is customary to kill birds at this time or to induce a cessation of lay for several months followed by a shorter second year's production, when egg quality and performance are improved over those at the end of the first year. Total production depends on the length of the day period, but rate of lay is also important and this depends on the length of the sequence, e.g. a hen laying three-egg sequences can only attain a maximum of 75% production, whereas one having sequences of 24 eggs can reach 96%. Other factors are important [42]. There appears to be an optimal egg size for production; large and small eggs are associated with poorer production figures. Since one important factor controlling egg size is the size of the yolk, yolk transport is related to total production [40].

Physical environment, nutrition and disease affect reproductive performance, but little is known of the way in which they affect the bird's physiology [26]. Below 10 hours of daylight and/or 10 lux at the food trough, reproductive performance is curtailed. Somewhat, the obtained results showed that temperature 21°C is also suitable and optimal ambient temperature for rearing, egg production and egg hatching for Arbor Acres white and Lohmann brown hybrid layers aged (24, 30, 35, 40, 45, 50, 55, 60 and 65 weeks). The result of the present work are in agreement with those reported by Gilbert [40], who mentioned that temperatures between 13°C and 21°C are recommended as optimal for egg production, though higher temperatures may lead to increased production figures. Altitude, gaseous environment, humidity and noise may also affect egg production [40].

The best results were recorded in regard to egg production and hatchability of broiler hatching eggs for Arbor Acres white and Lohmann brown hybrid (respectively) of lay birds aged (24, 30, 35, 40, 45, 50, 55, 60 and 65 weeks) reared at ambient temperature of 30°C with 16 photoperiod daily and relative humidity kept constant at 75%.

Research regarding the effect of seasonal variation on egg production and egg quality in different geographic locations has shown that high environmental temperature is one of the major causes of decline in egg production and quality during summer [43]. The maximum temperature associated with satisfactory laying performance of hens is approximately 30°C at high relative humidity [44]. Ambient temperatures above 32°C are considered to have a detrimental effect on the performance of laying hens. In particular, high temperature results in reduced feed intake, egg production, egg weight, Haugh units and yolk index [8]. Furthermore, de Andrade *et al.* [45], observed a significant decrease in egg weights when hens were exposed to 32°C. The decrease in egg weight was observed even though hens were fed highly nutrient dense diets having 25% more of most nutrients, except for energy, which was increased by 10%. Therefore, it seems that the effect high temperature exposure (HTE) has on egg weight cannot be overcome by the highly nutrient dietary treatments [46]. The decline in egg production and egg weight is primarily due to reduced feed intake, resulting from exposure to high environmental temperatures. Temperature normally exerts its effect on egg production by influencing feed or nutrient intake rather than by changing nutrient requirements; although a direct effect of temperature on growth and egg mass may change nutrient requirements [47]. Because feed intake and egg production were similarly affected by heat exposure, it is likely that the reduced feed intake had an impact on the decline in egg production. Further, specifically, Wolfenson *et al.* [43] indicated a decline in yolk viscosity, foam stability, angel cake volume and emulsification capacity of yolk as a result of birds being exposed to elevated environmental temperatures (35°C).

On the other hand, Samara *et al.*, [48], stated that the feeding time and temperature did not markedly affect rate of egg production; however, hens at high temperatures (21°to 39°C) fed two meals per day, produced the fewest eggs. Moreover, Samara *et al.* [48] also proved that high temperature caused significant reductions in egg weight, specific gravity and shell thickness. As well as, Samara *et al.* [48] pointed out that the feeding time and temperature; had no effect on time of oviposition, ovulation, or the transit time of the egg through the oviduct. In addition to that, the mentioned workers have been established that significant body weight loss occurred in hens at high temperature and fed at 0700 h and both high temperature and feeding one-half of the daily feed at 0700 h and the other half at 1800 h, caused a reduction in feed consumption.

It is well known that growth rate and egg production decrease when ambient temperature goes below thermo-neutral zone [2, 4, 49]. At temperatures above or bellow thermo-neutral zone, corticosteroid secretion increases as a response to stress [50]. Kutlu and Forbes[51], reported that ascorbic acid supplement reduces the synthesis of corticosteroid hormones in birds under stress conditions. By decreasing synthesis and secretion of corticosteroids, vitamin C alleviates the negative effects of stress such as cold stress-related depression in poultry performance [52]. It has been also postulated that the improved performance of stressed-poultry fed a vitamin C –supplemented diet results from a decrease in protein-derived gluconeogenesis [53].

The figures presented in tables (2 and 3), revealed that the ambient temperature (30°C and 21°C respectively) inside layers houses were gave a good egg production and high hatchability rates of broiler hatching eggs for Arbor Acres white and Lohmann brown hybrid layers consecutively,which are suitable for poultry; since it lies within the comfort zone recommended by Milligan and Winn [54] who stated that the average favorable temperature inside poultry houses was between 15°and 27°C. Further, Samaha [55] established that the mean ambient temperature inside layer and broiler houses were 25.32±6.7 and 25.67±5.3°C, respectively which are considered to be higher than the recommended temperature by Sainsbury [56]. However, at high ambient temperature, a considerable heat loss through vaporization was recorded and consequently poultry consumed a large quantity of water, the rate of both egg production, egg weight and body gain were decreased which might be due to high respiratory rate through increased, dropped wings and loss of appetite [57,58].

Egg number is the major index of performance of commercial layer. It accounts for about 90% of the income in egg production farms [59]. Egg qualities particularly egg size is another important economic trait. It determines to a large extent the price received in any market and the standard range should be between 53 and 63 grams [19]. Omeje, [60], indicated that mean percentages hen-day production reported in Nigeria for most exotic and hybrid layers ranged from 48.05 to 53.3 grams.

Oluyemi and Robert [59] indicated that egg number and qualities are affected by some environmental factors: nutrition, egg, ambient temperature, humidity, photo period and ventilation. Another factor affecting egg production is age of sexual maturity of the lay birds.

Age of sexual maturity of pullets can be advanced considerably by breeding programs, light stimulation, nutrition, or by a combination of the three. Decreasing the age of sexual maturity increases the number of eggs laid with the potential disadvantage of the production of a greater proportion of small eggs. Numerous investigations have focused on methods to increase egg weight through diet manipulation at the beginning of the laying period [10]. Obioha [19], demonstrated that management systems and management conditions to which the birds are exposed affect egg production and egg qualities. Anyaehie and Madubuike [61] showed that egg appearance, size, texture and shape appealed to customers. Egg production is highest when temperatures are within neutrality range [62]. According to Poultry International [63] at air temperature of 25.5°C and above, a drop in egg number, weight and egg size have been observed and a high temperature of 30 C decreases the productivity of layers. Under high ambient temperature, core blood supply to the egg synthesizing rate is reduced through the neuro-endocrine mechanism. Under this condition, the nutrients needed for egg production will not be adequately supplied [64]. Depending the results of Grobas *et al.* [10], the period between 41 and 57 weeks of age, corresponded to summer conditions in which temperatures inside the poultry house often reached 32°C and more. Under these circumstances, feed intake was significantly improved by supplemental fat (SFAT). These results indicate that SFAT consistently improves productivity of hens and egg weight and that the linoleic acid (LIN) concentration of the diet requirement for maximal productivity is 1.15% or less. The beneficial effects of adding SFAT to diets containing more than 1.15% LIN are due to the fat itself rather than to an increase in LIN or the influence of energy (AMEn) of the diet [10]. Intensively managed birds, under high temperatures, often practice all sorts of vices, which include feather pecking and sucking of egg yolk due to stress.Layers managed intensively in deep litter building are always in physical and close contact with the litter [22].

Generally, from the above mentioning results and discussion ; it can be concluded that egg production and hatchability of broiler hatching eggs were the main parameters influenced by the flock age, ambient temperature and laying hens strain. Further, the previous factors, i.e., flock age, environmental temperature and breeding stock, may be a cause of several physiological changes in the lay birds bodies which predisposing the reducing of eggs production and then, lowering hatchability of broiler hatching eggs produced, so, periodical observation of environmental conditions, public health care, good management and optimal genetic selection of rearing strains ; must be done regularly, for high egg production and for high rates of hatchability of broiler hatching eggs.

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