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EFFECT OF ARTIFICIAL MODIFICATIONS IN ENVIRONMENTAL AND MANAGEMENTAL CONDITIONS ON EGG QUALITY OF CHICKENS

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The effect of some managerial treatments on egg quality of winter and summer production was studied in the following procedure :

(*a*) At the beginning of October, 1964, 500 hens and 50 cocks were divided into 10 equal groups (50 females + 5 males per group). This study was designed to study the effect of artificial light (from 3 to 7 a.m.), night heating (65°F), warm feeding, mash and grain feeding and deep litter on egg quality during winter.

(*b*) At the beginning of March, 1965, the birds were turned to conventional managment system. By first of May, ten new groups (40 females + 4 males) were randomly formed for the summer treatments which lasted until the end of August, 1965. Summer treatments included the study of the effect of artificial light (from 3 to 7 a.m.), mid-day darkness (from 12 noon to 4 p.m.), ventilation, shading and cold feeding.

Results obtained could be summarized as follows :

1. The control birds laid eggs of inferior quality in summer than in winter. This was mostly seen in yolk percent, shell percent and thickness, meat spots and Haugh Units grading.

2. During winter, the treated groups generally gave eggs of thicker shell and more densed yolk and albumen contents than the control. The differences were more apparent when light was supplied.

3. Summer treated groups showed increases in shell thickness, and yolk and albumen density.

4. During summer, Haugh Units increased when light was accompanied with (shade + cool feeding) or (shut-in + ventilation + cool feeding). Meanwhile, those same two groups gave the lowest yolk index.

5. Groups tending to lay more eggs gave the lighter yolks. The colour bleaching was more obvious in summer than in winter trials.

6. The percentages of blood spots were higher in winter than summer. On the reverse, the percentages of meat spots were higher in summer than in winter.

The severe climatic changes that occur during winter and summer are normally known to reduce egg quality. In this study some treatments were suggested that may improve egg quality.

Highest albumen quality was recorded under constant levels of 12 hours daily light and 60°F air temperature (Mueller, *et al*; 1960). Maturing Pullets started and kept on all-night light laid significantly more waste eggs than those kept on 14 hours light daily or those changed to 14 hours light daily after being started on all-night (Asmundson, *et al*; 1951). Pigarev, *et al*; (1962), found that hens subjected for their first week to 7.5 to 9 hours light per day and subjected thereafter to an additional 15–30 minutes light each week, laid more higher-grade eggs than birds kept under natural light. Hens subjected to 14 hours of light and 12 hours of darkness laid eggs of thicker shells than those subjected to 14 hours of light and 10 hours of darkness (Vanalbade, 1958). Meanwhile, Payne and Simmons (1934). found that illumination produced larger percentage of thin shelled eggs, whearas King, (1962), stated that pullets reared and maintained in darkness produced thicker-shelled eggs than those kept under natural conditions.

Lorenze and Almquist, (1936), observed that summer eggs were inferior in quality, and related this to the action of high temperature on the albumen, immediately after the eggs were laid. Exposing infertile eggs to 90-100°F for short periods decreased thick albumen percent (Olsen, 1939). At temperature as low as 10°F, Haugh Units decreased (Campos, *et al.* 1961). According to Bennion and Warren (1933) egg components decreased in weight when hens were exposed to high environmental temperature. The shell and albumen were more affected than the yolk in proportion to their weights. The explanation was that the oviduct may be more sensitive than the ovary to high environmental temperature. High summer temperature was reported to decrease egg shell thickness (Warren and Schnepel, 1939 ; Warren, 1948; Warren *et al.* 1950 ; Ota, *et al.* 1953, Froning and Funk, 1957 ; and Vanalbade, 1958). A 24 hours exposure to 100°F air temperature using a fast rise (4°F/hour) and a slow rise (5°F/day) decreased shell thickness. The decline was more pronounced under the gradual than under the fast rise (Campos, et al ; (1959). When the air temperature decreased to 10°F, shell thickness declined temporarily (Campos, *et al.* 1961).

Birds reared on a slatted floor laid fewer eggs with blood and meat spots than those reared on litter (Yao, 1959, Johnson and Zindel, 1963). However, no such difference was found by Rosenberg and Tanaka, (1962). Haugh Units were better but shells were thinner for birds housed on litter than those kept on slatted floor (Jonhson and Zindel, 1962). Meanwhile, Magruder and Nelson (1963), observed little difference between slatted floor and litter regarding Haugh Units or shell thickness. There was no difference in Haugh Units between hens on slats and litter, but the incidence of blood spots appeared to be lower on slats than litter (Osborn, *et al.* 1959).

Materials and Methods

This work was carried out at the Poultry Experimental Centre, Animal Production Department, Faculty of Agriculture, Cairo University. Birds used in this study were hatched in late December, 1963. At the beginning of October, 1964, the birds were divided into 10 groups each composed of 50 hens.

and 5 cocks for winter treatment (Table 1). Winter treatment lasted until the end of February, 1965 where the birds were turned to conventional management system during March and April, 1965. By first of May ten new groups each consisting of 40 females and 4 males were randomly formed for summer trials (Table 2), which ended on the 31st of August, 1965.

General Procedure:

Each group was housed separately in brick houses with open, fenced yards. Trapnests, feeders and waterers were supplied with adequate number.

The ration used for all groups was composed of 10% barley, 25% maize, 10% wheat, 10% horse beans, 12.5% wheat bran, 12.5%rice bran, 15% decorticated cottonseed meal, 4% fish meal and 1% meat meal. Half percent salt, 2% bone meal, 1% vitamin $A+D_3$ and 0.1% terramycin egg forumulae were added as feed supplements. Meals were offered twice daily as whole ration or in separate portions of mash and grains, as experimentally designed.

Experimental Treatments :

Treatments given in Table (1) and (2), were followed besides the control groups which were treated under normal conditions of whole feeding, day-length and temparature, and were kept with no floor litter or roosts

TABLE 1.—GENERAL OUTLINE OF EXPERIMENTAL MODIFICATIONS FOR WINTER TREATED AND CONTROL GROUPS (FROM OCTOBER, 1964 TO FEBRUARY, 1965)

Groups	Specifications				
	Light L	Night heating H	Warm feeding WF	Mash and Grain feeding MGF	Deep litter dL
1	+	−	−	−	−
2	+	+	+	−	−
3	+	+	−	+	−
4	+	+	−	−	+
5	−	+	−	−	−
6	−	−	+	−	−
7	−	−	−	+	−
8	−	−	−	−	+
9	+	+	−	+	+
Control	−	−	−	−	−

A. *The Atmospheric Trials* :

1. The birds were shut-in from 12 to 4 p.m. inside their houses. House openings were throughly covered with heavy canvas for complete inside darkness.

TABLE 2.—GENERAL OUTLINE OF EXPERIMENTAL DESIGN FOR SUMMER GROUPS (FROM MAY TO AUGUST, 1965)

Groups	Specifications				
	Light L	Darkness D	Ventilation V	Shading S	Cool feeding CF
1	—	+	—	—	—
2	—	—	+	—	—
3	—	—	—	+	—
4	+	+	—	—	—
5	+	+	+	—	—
6	+	—	—	+	—
7	+	—	—	+	+
8	+	+	—	—	+
9	+	+	+	—	+
Control	—	—	—	—	—

2. Houses were artificially lighted during winter treatment (October, 1964 to February, 1965), for four hours. from 3 to 7 a.m. in October, five hours, from 2 to 7 a.m. in December and January and four hours, from 3 to 7 a.m. in February. During summer treatments (May to August, 1965), the houses were lighted for four hours from 3 to 7 a.m. A 60-watt lamp were used that allowed a light exposure of nearly 0.5 foot-candle in the illuminated houses.

3. An electric thermostatic heater was used to keep the inside temperature almost constant at 65°F at night during the winter months.

4. Yards were shaded by mat to prevent any direct sunshine during summer.

B. *Feed Trials*:

1. *Whole feeding*: Meals were offered containing the whole mixtures of mash and grain feed ingredients at the two feeding times.

2. *Mash and grain feeding*: Meals were offered in separate mixtures of mash or grains at feeding times. The mash was given in the morning while the grains were given in the afternoon.

3. *Wetted feeding*: The mash meals were warmed, or cooled by adding water (boiled or tap) according to winter or summer treatments.

C. *Floor Trials* :

1. *Deep litter* : Rice straw deep litter was maintained all through the whole months of experiment.
2. *Fresh litter* : Fresh rice straw was supplied weekly, allowing 5 c.m. in depth in winter and 3 c.m. in summer.
3. *Roosts* : Houses were provided with ample roosts of wire and wood, the legs of which were dipped in gamatox-solution containers.

TABLE 3.—AVERAGE AIR TEMPEATURE DAY-LENGTH AND AIR VELOCITY DURING WINTER AND SUMMER MONTHS

Months	Air temperature °C	Daylength		Air Velocity "Knots"
		hr.	m.	
October . .	23.3	11	27	5.9
November. .	18.4	10	36	4.9
December .	13.9	10	12	4.0
January . .	12.5	10	30	4.5
February . .	14.0	11	7	4.3
May	23.5	13	35	5.6
June	28.2	13	59	5.0
July	27.4	13	49	4.3
August . . .	26.7	13	11	5.0

Data collection and statistical analysis :

Egg quality tests were done in January (winter) and July (summer), on 100-egg sample per group, collected within one week. The characters studied were, weights and percentages of egg albumen, yolk and shell, yolk colour (using colour chart method); yolk index (after Funk, 1948); Haugh Unites (after Haugh, 1937), number and percents of meat and blood spots, and shell thickness (after Brant and Shrader, 1952).

Analysis of variance was used for testing the differences of Haugh Units, shell thickness, and yolk colour. For testing the differences of yolk index and percentages of albumen, yolk and shell, percentages were transferred to their corresponding arcsins before applying analysis of variances. Two-way-experiment methods were followed after Snedecor (1956). The observed differences were significant or highly significant when the probability was less than 0.05 or 0.01 respectively.

Results and Discussion

Effect of treatments on egg quality during winter and summer :

The results of egg tests are shown in Tables (4) and (5). It could be stated that the control birds laid eggs of inferior quality in summer than in winter. This was mostly remarkable in yolk percent, shell percent and thickness, and albumen quality, as judged by Haugh Units. This is an indication to the effect of summer stress in reducing egg grade and internal quality. It also means that the internal deterioration of the eggs, bounds to take place in summer, could be reduced by trying some applicable management modification. Such deterioration seemed to be more pronounced in shell formation, tending to be thinner, and yolk and albumen condensation, being less firm. These differences in egg quality and egg components were significant (Tables 6, 7, 8, and 9).

This change in egg formation may be due to the fact that calcium metabolism and deposition is slow in summer and that egg water in general tends to be more in summer, as a means for extra heat dissipation. Also, yolk colour to fade somewhat in summer, probably due to lack of pigment assimilation, (Mueller, et al; 1950, King and Hall ,1954 ; May and Stadelman, 1959 ; and Cunningham, et al ; 1960)

Although the birds showed no signs of severe stress in winter, the treated groups generally gave eggs of thicker shells, and more condensed yolk and albumen contents. Specially when light was practised within the treatments, the differences were more apparent. This may be due to the expected initiative stimulation of light on the parathyroid gland, associated with calcium metabolism, and on the ovary and oviduct functions in egg secretion (Mueller, et al; 1950 and Leighton, et al; 1961). Yolk pigmentation seemed to be more dependant on egg rate, as where egg number per treatment seemed to be fewer, yolk seemed to be more colourful, a fact which might be associated with xanthophyll storing and drainage in egg formation.

With the summer treatments, although shell thickness and yolk and albumen density seemed to get thinner by season, birds helped with shade and light treatments seemed to show the least reduction in this respect. This may be again due to a more efficient egg formation process, resulting from better stimulated feed assimilation and transformation. The figures discussed early, (Ghany et al, 1969), on feed/egg ratio indicated the advantages of such treated birds. The relative decrease in yolk index in groups 7 and 9, where light was applied with either shade or other cooling devices, may be due to the relatively bigger yolk percents in egg samples for these two groups. There seems to be certain limits for solid materials to be secreted per yolk, to avoid straining the ovary and thus the water content of such bigger yolks would be relatively greater than usual. Meanwile, those same two groups gave the highest albumen Haugh Units, an observation which might be due to some sort of balance in the water content of such eggs.

The groups tending to lay more eggs in summer also showed the lighter yolks. Colour bleaching in this connection was more obvious than in winter, a fact which could be reflected to the less assimilation and deposition of pigments in hot weather in general (Munro, 1938).

The results secured on meat and blood spots indicate that the percentage of blood spots were higher in winter than summer. On the reverse, the percentages of meat spots were higher in summer than winter. This may be due to the fact that during summer more of blood spots change to bigger meat spots (Nalbandov and Card, 1944).

TABLE 4.—AVERAGE EGG COMPONENTS AND EGG QUALITY OF GROUPS DURING WINTER TRIALS

Items	GROUPS										L.S.D.	
	L	L+H+WF	L+H+MGF	L+H+dL	H	WF	MGF	dL	L+H+MGF+dL	Control	5%	1%
Egge Weight (Gram)	43.44	44.52	44.74	43.04	43.46	44.07	44.41	44.74	43.91	41.41	—	—
Albumen . . . %	53.77	52.097	52.60	52.49	52.76	52.89	53.78	52.71	52.50	53.01	—	—
Yolk . . . %	32.37	32.90	33.40	33.41	33.42	33.33	32.54	33.61	32.90	33.35	0.45	0.59
Shell . . . %	13.86	14.13	14.00	14.10	13.82	13.78	13.68	13.63	14.60	13.64	0.26	0.34
Shell thickness	0.01511	0.01527	0.01513	0.01527	0.01501	0.01495	0.01534	0.01417	0.01534	0.01381	0.0003	0.0004
Haugh Units	80.4	82.0	80.4	81.2	78.3	77.4	76.5	75.8	82.7	73.7	4.35	5.76
Yolk Index	48.33	48.14	47.88	47.52	47.11	47.33	47.45	46.86	48.24	44.27	0.52	0.68
Yolk Colour	6.82	6.44	6.79	6.75	6.93	7.20	7.27	7.40	5.60	7.46	0.30	0.47
Blood spots . . . %	11	7	9	5	7	11	11	15	6	14	—	—
Meat spots . . . %	1	1	3	4	5	2	5	1	2	2	—	—

TABLE 5.—Average egg components & egg quality of groups during summer trials

Items	GROUPS										L.S.D.	
	D	D+V	S	L+D	L+D +V	L+S	L+S+ cF	L+D+ cF	L+D+ V+cF	Control	5%	1%
Egg Weight (Gram)	45.65	43.99	47.58	46.68	46.85	47.62	46.84	47.11	46.81	44.55	—	—
Albumen %	53.91	53.37	52.77	53.04	53.03	52.43	52.32	52.62	52.33	54.64	0.42	0.56
Yolk %	33.12	33.39	33.92	33.65	33.66	34.09	34.19	33.92	34.19	32.96	0.39	0.52
Shell %	12.97	13.24	13.31	13.31	13.31	13.48	13.49	13.45	13.48	12.40	0.28	0.37
Shell thickness	0.01156	0.01189	0.01213	0.01212	0.01212	0.01229	0.01263	0.01216	0.01247	0.01077	0.0007	0.0010
Haugh Units	69.1	71.0	72.5	71.5	72.0	73.0	75.2	72.8	74.6	65.5	4.44	5.89
Yolk Index	45.55	45.49	44.88	45.36	45.33	44.07	39.77	44.81	42.85	45.97	0.69	0.91
Yolk Colour	6.21	6.20	6.07	6.13	6.11	5.98	5.81	6.07	5.95	0.26	0.23	0.30
Blood Spots %	7	10	8	3	9	3	2	3	2	11	—	—
Meat Spots %	18	13	13	20	14	15	19	18	16	19	—	—

TABLE 6.—ANALYSIS OF VARIANCE OF ANGLE OF ALBUMEN PERCENT, YOLK PERCENT AND SHELL PERCENT FROM EGGS TAKEN IN JANUARY (WINTER)

Items	S.V.	d.F.	S.S.	M.S.	F. Value
Albumen . . %	Groups . .	9	28.13	3.12	1.68*
	Error . . .	990	1850.27	1.86	
	Total . . .	999	1878.40		
Yolk . . . . %	Groups . .	9	74.12	8.23	3.09**
	Error . . .	990	2633.91	2.66	
	Total . . .	999	2708.03		
Shell . . . . %	Groups . .	9	25.41	2.82	3.06**
	Error . . .	990	913.37	0.92	
	Total . . .	999	938.78		

* Not significant.

** Highly significant at 1% level.

TABLE 7.—ANALYSIS OF VARIANCE OF ANGLE OF ALBUMEN PERCENT YOLK PERCENT AND SHELL PERCENT FROM EGGS TAKEN IN JULY (SUMMER)

Items	S.V.	d.F.	S.S.	M.S.	F. Value
Albumen . . %	Groups . .	9	132.79	14.75	6.25**
	Error . . .	990	2340.57	2.36	
	Total . . .	999	2473.36		
Yolk . . . . %	Groups . .	9	67.99	7.55	3.66**
	Error . . .	990	2043.90	2.06	
	Total . . .	999	2111.89		
Shell . . . . %	Groups . .	9	75.80	8.42	7.79**
	Error . . .	990	1070.85	1.07	
	Total . . .	999	1146.65		

** Highly significant at 1% level.

TABLE 8.—ANALYSIS OF VARIANCE OF DIFFERENT EGG CHARACTERS STUDIED, AS EFFECTED BY TREATMENTS, DURING WINTER

Items	S.V.	d.f.	S.S.	M.S.	F. Value
Yolk Index	Groups	9	411.78	45.75	12.88**
	Error	990	3519.75	3.55	—
	Total	999	3931.53	—	—
Haugh Units	Groups	9	699.4	77.7	3.6**
	Error	80	1720.3	21.5	—
	Total	89	2419.7	—	—
Yolk Colour	Groups	9	272.3	30.2	17.7**
	Error	990	1737.8	1.7	—
	Total	999	2010.1	—	—
Shell thickness	Groups	9	0.0002342	0.0000260	17.3**
	Error	990	0.0015360	0.0000015	—
	Total	999	0.0017702	—	—

** Highly significant at 1% level.

TABLE 9.—ANALYSIS OF VARIANCE OF DIFFERENT EGG CHARACTERS STUDIED, AS EFFECTED BY TREATMENTS, DURING SUMMER

Items	S.V.	d.f.	S.S.	M.S.	F. Value
Yolk Index	Groups	9	1027.63	114.18	18.00**
	Error	990	6282.29	6.34	—
	Total	999	7309.92	—	—
Haugh Units	Groups	9	617.9	68.6	3.04**
	Error	80	1804.2	22.5	—
	Total	89	2422.1	—	—
Yolk Colour	Groups	9	16.8	1.8	2.50**
	Error	990	730.3	0.7	—
	Total	999	747.1	—	—
Shell thickness	Groups	9	0.0002490	0.0000276	3.6**
	Error	990	0.0075979	0.0000076	—
	Total	999	0.0078469	—	—

** Highly significant at 1% level.

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تأثير بعض التحسينات فى الظروف البيئيـة والرعاية على صـفات بيضة الدجاج

جمال قمر ومحمد عبد الغنى ومختار قيقه

الملخص

أجرى هذا البحث بمركز أبحاث الدواجن بكلية الزراعة جامعة القاهرة سـنة ١٩٦٤/١٩٦٥ على الدجاج الفيومى لدراسـة تأثير بعض العوامل البيئية على صفات البيض خلال أشهر الشتاء والصيف . وقد اسـتعمل الضوء الصناعى وبعض التحورات الأخرى لأجل تدفئة الدجاج أثناء الشتاء وتقليل شـدة الحرارة أثناء الصيف .

ففى أول أكتوبر سنة ١٩٦٤ قسمت ٥٠٠ دجاجة ، ٥٠ ديكا تقسيما عشوائيا الى عشرة مجاميع متساوية لدراسة تأثير الضوء الصناعى (من ٣-٧ صباحا) والتدفئة أثناء الليل الى ٦٥°ف ، الغذاء المبتل بالمـاء الدافىء ، الغذاء الناعم والحبوب ، والفرشة المستديمة على صفات البيض أثنـاء أشهر الشتاء بالمقارنة مع المعاملة العادية التى خلت من هذه المعاملات .

وفى أول مارس ١٩٦٥ وضعت المجاميع تحت الظروف البيئية العادية حتى أول مايو حيث بدأت التجربة الثانية التى اسـتمرت حتى أواخـر اغسـطس ١٩٦٥ ، وفيها قسم الدجاج عشوائيا الى عشرة مجاميع متساوية لدراسة تأثير الضوء الصناعى (من ٣ – ٧ صباحا) ، الاظلام (من ١٢ – ٤ مساء) ، التهوية التظليل ، الغذاء المبتل على صفات البيض أثناء الصيف.

ويمكن تلخيص النتائج التى تم الحصول عليها فى الآتى :

١ – لوحظ أن نسبة الصفار والقشرة وسمك القشرة ومعامل البياض لمجموعة المقارنة فى الصيف أقل من الشتاء .

٢ – لوحظ أثناء الشتاء أن المجاميع المعاملة أعطت قشرة سـميكة وكانت نسبة الصفار والبياض أكثر من المقارنة .

٣ – ادت المعاملات الى زيادة سمك القشرة ونسبة الصفار والبياض يوضح فى أى التجربتين .

٤ ــ وجد اثناء الصيف ان معامل الصفار انخفض فى المجاميع التى أعطيت ضوء مع تظليل وغذاء مبتل أو ضوء مع قيلولة وتهوية وغذاء مبتل ، ولكن هذه المعاملات أعطت معامل بياض عالى .

٥ ــ المجاميع التى أعطت انتاجا عاليا من البيض كان لون الصفار فيها أصفر باهت وهذا الشحوب فى اللون كان واضحا جدا أثناء الصيف عن الشتاء .

٦ ــ كانت نسبة البقع الدموية عالية أثناء الشتاء فى كل المجاميع عن الصيف . اما البقع اللحمية فكانت على العكس من ذلك .

٧ ــ ينصح عموما باتباع وسائل الاضاءة الصناعية والتدفئة فى نظام المعيشة شتاء والتظليل والترطيب فى المسكن والغذاء صيفا لضمان جودة صفات البيضة .