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HEAT REGULATION OF CHICKENS DURING SUMMER

By

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SUMMARY

Fayoumi males were used to study the effect of environmental conditions on body reactions for a whole year. The highest increase in body temperature was associated with the increase in the relative humidity when the air temperature was high, while the air temperature is the main factor in reducing body temperature at low environmental temperatures. The wide diurnal variations in body temperature were found when there were also wide variations in air temperatures. The lowest feather and skin temperatures were during the winter, while the highest values were during late spring and summer months. Diurnal variations in feather temperature coincide with similar variations in climatic temperatures. Respiration rate increased in summer and decreased during late winter. The exposure of birds to direct sun of summer for 2 : 30 hours caused them to have higher body, skin and feather temperatures and respiration rates than the shaded birds. The greatest change of skin temperature between the exposed and shaded birds was in the comb. Respiration rate in the exposed birds reached the stage of panting.

Fayoumi males were also used to study the effect of cutting long feathers on heat regulation during summer. Wider diurnal variations in the studied heat regulating charaeters were more obvious in the normal birds than in the cutted feathers ones which were able to dissipate the excess of heat. Cocks and hens of Fayoumi breed were available to study the effect of sprinkling birds with cold water during summer. It was found that sprinkling lowered respiration rate, feather ans skin temperatures than the control group. The greatest decrease was insured by the comb and the greater the drop the more lasting the cooling effect. The cooling effect induced by sprinkling was insured more in females than in males.

INTRODUCTION

I.—*Seasonal variations* :

One of the major problems in poultry raising in the subtropics is the deleterious effect of hot summer months on the productivity and behaviour of birds.

At air temperature of 32.2°C, the cloacal temperature of the birds begins to increase above the normals (Baldwin and Kendeigh, 1932 and Yeates *et al*, 1941). As air temperature rises, the effect upon cloacal temperature becomes more pronounced until air temperature of 40.6°C, when body temperature rises sharply (Heywang, 1938 and Lee *et al.*, 1945), and most hens are unable to withstand an air temperature of 40.6°C for seven hours exposure, while none is unable to withstand 43.3°C (Lee *et al.*, 1945).

2.—*Exposure to solar radiation during summer effects* :

Exposure to hot weather increases body temperature. When body temperature rises, the respiration rate also rises and the bird whose respiratory rate rises more freely in response to the rise in body temperature may have the advantage in being able thereby to increase evaporation and facilitate cooling. The evaporation of water from the bird remains low as long as the respiratory rate is only moderate and panting does not occur. With high respiration rate, and especially with panting a marked increase in evaporation occurs. This may indicate therefore, that a bird is reacting well with the environment or that the cloacal temperature is getting dangerously high. When the cloacal temperature reaches 45° C, the hen shows marked distress and deep sighing respiration. This is followed by inability to stand and complete collapse with pale comb and outstreched legs. Death rapidly follows unless relief is given (Krusic, 1928 ; Lee *et al.*, 1945). The birds at air temperature of 32.2° C to 35° C are unable to lose much body heat from the surface of their feathers, as at that level the temperature of the air and their feathers are practically the same. Most of the heat will be lost by evaporation of water rather than convection or radiation (Wilson and Plaister, 1951 ; Wilson *et al.*, 1952). Exposure to extreme heat, sends the bird into a state resembling partial moult. If exposure is not repeated, the partial moult soon passes off. If exposure is repeated, moulting may become a little more clear but does not return to normal untill at least after four months (Krusic, 1928 ; Lee *et al.*, 1945). Eggs laid during exposure to severe heat are often soft-shelled and misshapen. At high air temperature, layers have higher body temperature, respiration rate and water consumption, than the non-layers (Krusic, 1928 ; Lee *et al.*, 1945 and Hillerman and Wilson, 1955).

In turkeys, Kosin (1953) indicated that Pullman conditions of frequently intense solar radiation during summer, the actual temperature on top of back feathers in the Broad Breasted Bronze birds can be as high as 15° C above the corresponding ambient temperature. Such a differential cannot help but have a direct effect on skin temperature, frequently raising it above that of the surrounding environment. These birds when exposed to summer sun showed skin temperature of 1.5 to 2° C above the cloacal temperature on days when the reading on top of feathers ranged above 45° C mark. The rather sudden and persistant rise in ambient temperature registered during the first half of July by Kosin and Mitchell (1955), and was accompanied by intense solar radiation, produced a series of high readings taken on top of feathers. While no parallel skin temperature readings were made, the fact that the skin temperature of Broad Breasted Bronze, essentialy a black feathered variety, under the conditions of heat stress as represented by high ambient temperature and direct solar radiation, closely follows the temperature readings on top of feathers would indicate rather high skin temperature of the environment. When the ambient temperature was above 30° C, the intensity of solar radiation measured by the temperature on top of bird,s back feathers, appeared to be the major factor responsible for raising the body temperature of birds exposed to such environment.

The shading of birds reduces the mal effects of exposures on body and skin temperatures as Wilson *et al* (1955) found that rectal temperature of turkeys was associated inversily with the amount of shade per bird at means air temperature above 95°F, while at lower temperature the results were not consistant. The principal function of animal shade shelters according to Kelly *et al.* (1950) is to reduce the heat incident to the absorption of radient energy from the sun.

3.—*Effect of cutting feathers*

Birds from which the feathers covering has been very largely removed, by cutting the larger feathers and plucking the smaller ones, show somewhat less rapid and extensive rises of temperature and respiration rate than normal fowls as when both are subjected to extreme heat. Also, heat loss through evaporation in plucked birds is not influenced by variations in air temperature (Lee *et al.*, 1945).

4.—*Effect of sprinkling birds with water during hot weather.*

The practice of immersing or sprinkling chickens suffering from hot weather with cold water as a means of resuscitation is widespread. White Leghorn hens kept in an ambient temperature of 32.2°C can be cooled either by immersing in water, mist spraying or by head wetting. Immersing the bird in 23.9°C water reduces body temperature about 0.55°C and the cooling effect lasts for about 2 hours. Mist spraying reduces body temperature about 0.3°C, but head wetting reduces temperature only about 0.1°C. Skin temperatures of the neck and breast are decreased to a greater extent than body temperature. Head wetting decreased the temperature of the neck to a greater extent than mist spraying. Comb temperature is reduced to a greater extent by immersion than any other location. A 2.2°C drop in comb temperature is observed by the immersion treatment. The cooling effect of the various treatments lasts only for to hours. The greater the drop in temperatures, the more lasting the cooling effect (Yeates *et al.*, 1941 ; Seath and Miller, 1947 ; Ittner and Kelly, 1948 ; Sinka and Minett, 1947 and Wilson and Hillerman, 1952).

MATERIALS AND METHODS

General Procedure :

Housing : The normal and control birds were kept in small wired houses with open yards. These houses were also used for the seasonal variations studies. The yards were half shaded. The houses were only covered with canvas during winter.

Management : The birds were set free at sunrise, and shut in at sunset. Throuhgout the period of the experiment, the birds were not transferred from their places. The cocks were kept with hens to prevent any change in behaviour.

Feeding : All the birds were fed the same ration the period of study. The ration was composed of 19% corn, 15% barley, 10% wheat, 15% wheat bran, 15% rice bran, 11% broad beans 15% cotton seed cake. The grains were crushed. 1.5% of lime stone and 0.5% salt were added to the ration. The grain part of the ration was given in the morning, while the mash was given at noon. Fresh liquid blood was mixed with the mash part of the ration. Green foodder was supplied as chopped green maize leaves during summer and as Egyptian clover during winter.

METHODS AND TECHNIQUES :

1. Body temperature was measured by clinical mercury thermometer. It was inserted in the cloaca to the depth of 3.5 cm., and left for 1.5 minute.

2. Skin and feather temperatures were measured by a touch thermocouple apparatus (Electric Thermometers Light Laboratories, Brighton, Sussex, England), according to the instructions of the manufacturers. In general, the metal plate was put on the skin to record skin temperature. Each reading was only taken after the apparatus was stabilized. Skin temperatures were recorded at the following body regions : Under leg, under wing, abdomen, comb and back. The same technique was used to measure feather temperature for the back region.

3. Respiration rate was measured by counting the movements of the abdomen. A stop watch and a counter were used to count the rates per minute. In general, there was no excitation or rough handling during the tests. The birds were held by an assistant on a table to prevent movements.

4. Air temperature was measured by maximum and minimum mercury centigrade thermometers. Daily maximum and minimum temperatures were recorded. Also, air temperature in the shade and in the sunshine were recorded at the time of measuring each item for each individual.

5. Relative humidity was measured by wet and dry bulb centigrade thermometers during measuring each item for each individual.

6. The speed of wind (kilometers per hour) during the period of tests were obtained from the meteorological records of the farm.

7. The duration of bright sunshine was obtained from the meteorological records of the farm.

8. Analysis of variance was calculated for the different items as influenced by treatment by the three-way tables method of analysis and the equal subsample method (Snedecor, 1956).

Experiment 1.

This experiment was carrieb out to study the thermal reaction of Fayoumi males under normal seasonal variations. At the begining of the study, the birds were of 12 months of age. The different reactions of the birds were

studied for a whole year, begining from April until March. During the period of study, air temperature, relative humidity, wind speed and daylength as bright sunshine were recorded (Table 1). Cloacal temperature, respiration rate, skin and feather temperatures were recorded for each bird, every week throughout the whole period of sudy. The weekly tests were done at 7-9 a.m., 1-3 p.m. and 7-9 p.m. to study the diurnal variations.

Experiment 2.

This experiment was designed to study the effect of exposure to direct sunshine and shading during hot summer months on the reaction of birds. Four males and four females, 18 months of age, of the Fayoumi breed were used in each exposed and shaded groups. The test was done from 1-3 : 30 p.m. once weekly for six times during August and September. The period of exposure to sun was 20 minutes. All the birds were managed and fed the same. The control and treated birds were kept in wire boxes either in the sun or in the shade. The wire boxes were equipped with mercury centigrade thermometers of dry and wet types. Body temperature, respiration rate, feather and skin temperatures were measured and recorded. Air temperature, relative humidity, wind speed and day length were recorded during the period of study. During the period of exposure to sun, air temperature ranged from 44 to 52° C with an average of 48°C and relative humidity of 28-45 with an average of 38 %. For the shaded group the noon air temperature ranged from 30 to 36°C with an average of 33°C and relative humidity of 33 to 47 with an average of 42%. For both groups, wind speed ranged from 4 to 10 km./hr. with an average of 116.66 m./sec. and sunshine duration ranged from 10.6 to 11.5 with an average of 11.0 hours.

Experiment 3.

This experiment was designed to study the effect of cutting the long feathers of the birds during summer on their thermal reaction. Five Fayoumi males were used for each of the treated and control group. The long and medium feathers of wing and tail were cut up to their calamus. The back and abdomen feathers were plucked. The plucked feathers represented about one third of the total feathers. All the birds were treated, managed and fed the same all over the period of study. Also, the birds were of the same age, being 18 months old. The tests were done once weekly for six times during August and September. The tests were done at 7-9 a.m., 1-3 p.m. and at 7-9 p.m. The morning air temperature was 31°C, relative humidity 59% and wind speed 3km/hr. The noon air temperature was 36°C, relative humidity was 41% and wind speed was 7 km/hr. The evining air temperature was 28°C, relative humidity was 63% and wind speed was 7 km/hr. In general, sunshine lasted for about 11 hours. Body, feather and skin temperatures and also respiration rate were measured.

Experiment 4.

This experiment was designed to study the effect of sprinkling birds during summer on heat regulation reactions. Eight Fayoumi females and four Fayoumi males were used for each of the sprinkled and control group. The

TABLE 1.—MONTHLY VARIATIONS IN CLIMATIC CONDITIONS.

Months	Tests	Air temp. C	Rel humidity %	Wind speed km/hr	Max. and min. temp.	Day-length* hrs.
March	1	19	48	1	38	9.1
	2	22	34	9	5	
	3	13	67	6		
April	1	25	39	3	42	10.3
	2	32	21	6	10	
	3	20	16	4		
May	1	28	44	3	44	11.0
	2	34	23	5	12	
	3	25	37	6		
June	1	29	53	5	44	12.4
	2	36	29	9	18	
	3	27	55	5		
July	1	30	51	5	47	12.1
	2	37	28	9	20	
	3	28	17	7		
August	1	30	66	5	41	11.5
	2	36	39	8	19	
	3	29	60	6		
September	1	27	60	3	37	10.6
	2	30	44	8	15	
	3	26	53	6		
October	1	28	52	3	44	9.5
	2	31	36	9	15	
	3	24	65	6		
November	1	23	67	2	38	8.4
	2	24	51	6	11	
	3	18	81	2		
December	1	19	74	2	33	7.4
	2	21	59	6	5	
	3	14	83	2		
January	1	19	65	1	26	7.2
	2	19	52	5	6	
	3	10	87	0		
February	1	17	57	5	13	8.1
	2	18	48	7	6	
	3	9	85	5		

1: 7–9 a.m.
2: 1–3 p.m.
3: 7–9 p.m.

* Duration of sunshine.

weekly test was done once at noon from 1 to 3 p.m. for six times during August and September. All the birds were of 18 months old. They were treated, managed and fed in the same way during the period of study. Body temperature, respiration rate, skin and feather temperatures were measured and recorded. All the climatic components were also recorded. The birds were sprayed by tap water for 30 seconds, using a hand pump sprayer. Readings were recorded after 10 minutes from spraying. The temperature of tap water was 11-12°C less than the air temperature. The noon temperature averaged 35°C, relative humidity 37%, wind speed 11 km/hr and sunshine 11 hours.

RESULTS AND DISCUSSION

Seasonal variations :

The lowest level of body temperature observed in the late winter and early spring seems to be the normal for chickens (about 41.4°C) as reported by several investigators (Heywang, 1938, Robinson and Lee, 1946). These results showed that the environmental conditions during February to April were the most favourable part of the year for maximum physiological activity. By the end of April and the beginning of summer a severe wave of hot but dry weather invades Egypt. This is accompanied by the Khamasein stormy and sandy winds which have a harmful effect on the birds. This caused the increase in body temperature during this period. Although maximum air temperature and brightsunshine occurred during this period, yet the increase in body temperature was not correspondingly high. This may be due to that this period is accompanied by the fastest winds of the year which enables the birds to lose a good amount of heat by evaporation through the increased breathing and the skin. At late autumn, the increase in relative thumidity caused the increase in body temperature although air temperature relatively high. It seems that relative humidity and wind speed have significant effect on body temperature only when air temperature is high, but at was not low temperatures they have no effect and the major factor is the air temperature as found in this work and other studies (Yeates *et al*, 1941).

The diurnal variations in body temperature seems to be mainly due to the variations in air temperature. When the air temperature is constant during the day nore or less diurnal variations are observed (Heywang, 1933 and Wilson, 1948).

Clear monthly variations were observed in the temperature of the feather and skin. The degree of response varies according to the region and from the feather to the skin. Air temperature was the major factor that affected the temperature of both skin and feathers.

Monthly and diurnal variations in skin and feather temperatures of the different regions varied according to the intensity of feathers convering the skin. Accordingly the comb showed the highest variations, while the bach and abdomen regions showed lower variations.

TABLE 2.—MONTHLY VARIATIONS IN BODY REACTIONS.

(Temperature grades in centigrades)

Months	Tests	Cloacal temp.	Back feather temp.	Abdomen temp.	Leg temp.	Back skin temp.	Wing temp.	Comb temp.	Respiration rate/minute
March	1	42.0	35.4	39.8	40.0	39.7	40.0	34.3	44
	2	42.0	36.2	40.8	40.6	40.4	40.6	36.2	42
	3	41.0	34.5	39.7	39.6	39.7	39.4	31.4	45
April	1	41.5	38.5	40.1	41.2	40.5	39.6	34.1	34
	2	41.9	41.1	42.6	43.2	42.6	42.3	41.1	49
	3	41.1	37.8	40.2	40.3	39.9	39.2	32.7	37
May	1	42.0	39.0	41.2	41.7	41.1	40.5	35.8	35
	2	41.7	40.3	41.8	42.2	41.6	41.5	39.2	40
	3	41.5	39.9	41.3	41.6	41.4	40.8	37.3	35
June	1	42.1	37.3	40.2	41.0	39.6	39.4	34.0	38
	2	41.9	39.4	40.9	41.1	40.6	40.3	39.1	40
	3	42.0	39.3	40.8	41.4	40.7	40.4	37.0	38
July	1	41.9	38.6	40.8	41.1	40.8	40.1	37.5	37
	2	42.3	40.4	42.0	42.4	41.6	41.6	39.8	51
	3	41.6	39.4	40.8	41.0	40.6	40.8	35.5	37
August	1	42.2	38.6	40.6	40.7	40.6	40.0	35.3	44
	2	42.2	39.8	41.3	41.6	41.3	40.7	39.1	47
	3	42.0	39.2	40.7	41.1	41.0	40.2	36.6	44
September	1	42.2	38.0	40.2	40.5	40.2	40.1	36.1	43
	2	42.5	39.6	41.3	41.3	40.9	41.0	38.0	47
	3	42.2	38.9	40.5	40.9	40.9	40.3	34.2	48
October	1	42.3	38.6	40.3	40.6	40.3	40.4	36.4	46
	2	42.4	39.6	41.3	41.2	40.9	40.9	38.2	51
	3	41.5	37.8	40.0	40.2	39.7	39.8	32.0	48
November	1	42.2	36.6	39.7	39.5	39.5	39.3	33.4	46
	2	42.3	37.8	40.3	40.1	40.0	39.9	36.7	52
	3	41.7	37.1	39.8	39.9	39.7	39.5	31.5	48
December	1	42.1	34.2	38.0	37.6	38.1	38.3	29.4	43
	2	42.2	36.2	39.7	39.4	39.6	39.6	36.0	46
	3	41.3	34.6	38.5	38.3	38.1	38.2	28.2	53
January	1	42.1	32.2	36.7	37.3	36.2	37.6	31.0	42
	2	41.9	35.4	38.7	38.0	37.5	38.4	31.6	52
	3	41.2	32.8	37.3	37.7	36.6	37.7	28.1	39
February	1	42.0	33.5	40.0	40.1	39.3	40.2	27.9	38
	2	41.6	32.9	39.6	40.1	39.1	39.4	32.6	41
	3	40.9	33.6	40.3	40.1	40.2	38.7	28.7	44

The rise in air temperture also caused the rate of respiration to increase. However, during the coldest months of the year a slight increase in respiration was observed. This may be due to the fact that during cold weather the metabolic (Hutchinson and sykes, 1953) activities of the birds increase to withstand the cold weather and this increase in activity is reflected upon the respiration rats.

Effect of exposure to solar radiation during summer :

The exposure of birds to direct sunshine during the summer months in Egypt caused the exposed birds to have higher body, skin and feather temperatures and also respiration rate than the shaded ones and all the differences were highly significant (Tables 3 and 4). Most of these results were due to the greater increase in air temperature and to the higher intensity of light under the direct sun than under the shade. The exposed birds increased greatly their respiration rate to the stage of panting to dissipate the excess heat, either of the body or of the skin and feathers while the shaded birds did not. Panting in the Fayoumi males and females occurred when respiration rate reached 114 and 143 per minute respectively at an environmental temperature ranging from 44 to 52° C and body temperature of 43.7° C. Randall and Hiestand (1939). Randall (1943) and Wilson (1948) found that panting occurred when respiration rate reached 155 breaths per minute or an environmental temperature of 43°C. The increase in respiration rate helped in cooling the blood circulation in the lungs. Also, the great increase in respiration rate enabled the bird to lose some of the excess heat by evaporation through the respiraton mechanism. The greatest change of skin temperature between the exposed and shaded birds was observed in the comb region. This may be due to the free exposure of the comb to the air temperature as it is bare from feathers and also due to the extensive blood supply of the comb. The differeneces between the two groups were also more pronounced in the body and skin temperatures than in the feather temperature. Thus, it seems that the increasse in body temperature was due to the increase in skin and feather temperatuer as these parts were exposed to direct sunshine thus being of higher temperature than the body.

No sex differences were observed and this may be due to the wide individual differences within males and females in their response to the exposure treatment which overlap the variations due to treatemnt (Table 4). The studied heat regulating reactions of the shaded birds were found to be almost the same as that of winter and autumn months (Table 2). It seems that the shading reduced the environmental temperatures during hot summer months, which also in turn, reduced the body, skin and feather temperatures and also respiration rate of the shaded birds. On the other hand, it seems that the mal effect of hot weather on birds during summer months was mainly due to their exposure to direct sunshine. It can be suggested that the availability of intensive shade is of a good use during hot summer months.

TABLE 3.—THE EFFECT OF EXPOSURE TO DIRECT SUNSHINE AND SHADING ON HEAT REGULATING REACTIONS IN FAYOMI BREED

(Temperature grades in centigrades).

Treatment	Sex	Body temp.	Resp./ min.	Back skin temp.	Back feather temp.	Leg temp.	Wing temp.	Abdo-men temp.	Comb temp.
Exposed	Male	43.6	114	42.7	41.0	43.1	42.6	42.8	41.0
	Female	43.8	143	42.2	40.8	43.0	42.2	42.5	40.5
	Average	43.7	129	42.5	40.9	43.1	42.4	42.7	40.8
Shaded	Male	42.3	38	41.0	39.8	41.3	40.7	41.1	38.8
	Female	42.4	47	41.1	40.0	41.7	40.9	41.0	38.3
	Average	42.4	43	41.1	39.9	41.5	40.8	41.1	38.6
Average	Male	43.0	76	41.9	40.4	42.2	41.7	42.0	39.9
	Female	43.1	95	41.7	40.4	42.4	41.6	41.8	39.4
	Average	43.1	86	41.8	40.4	42.3	41.6	41.9	39.7

TABLE 4.—ANALYSIS FOR VARIANCE FOR HEAT REGULATION REACTIONS AS INFLUENCED BY EXPOSURE TO DIRECT SUNSHINE AND SHADING DURING SUMMER

(Mean squares)

Items	Source of variation			
	Treatment	Sex	Error	Total
	d.f 1	1	77	79
Body temperature	37.2645*	0.5120	0.5182	0.9832
Back feather temperature . .	20.6045*	0.0405	1.6011	1.2955
Abdomen temperature	49.2980*	1.3005	1.1025	1.7150
Leg temperature	46.2080*	0.5120	1.4541	2.0086
Back skin temperature . . .	43.2180*	0.9680	1.5421	2.0625
Wing temperature	50.8805*	0.0605	1.3026	2.2941
Comb temperature	96.8000*	4.4180	1.9155	3.1483
Respiration rate per minute . .	147748*	6771	3382	5252

(*) Highly significant at 1% level.

Effect of cutting feathers :

Cutting the wing feathers of the birds had no effect on the heat regulating reactions studied in this work, since the differences between the treated and control group with respect to the different items were not significant (Tables 5 and 6). This may be due to that the treated and control groups were not kept under stress which may clarify the differences between the two groups due to feather cutting. Nevertheless, in other studies, when the cut-feathered and control birds were subjected to extreme heat, the cut-feathered birds showed somewhat less raipd and extensive rises of temperature and respiratory rate than normal fowls (Lee *et al.*, 1945). In this study, however, narrower diurnal variations were observed in the cut-feathered than in the control birds under the hot weather of summer and the variations were found to be highly significant (Table 6). This may be attributed to that cutting feathers enabled the birds to dissipate the excess of heat from their body or skin directly without further insulation action of the different feather types as in the normal birds. This treatment enables the birds to maintain the variations in the studied heat regulating reactions within narrow limits which enabled them also to withstand or react well to the hot climatic conditions of summer months of Egypt more than the normal birds.

Effect of sprinkling water on birds during summer :

During the summer months, chicken felt uncomfortable when air temperature was high, while sprinkling treatment gave them some relief by avoiding heat prostration. This was insured in this work, as the sprinkling lowered the respiration rate and the feather and skin temperature of back, wing, abdomen and comb regions, except that of body temperature, more than the control group. The differences due to treatment were found to be significant (Table 7 and 8). Other studies, also concluded that sprinkling as a method of cooling causes reduction in higher respiration rate or skin temperatures (Yeates *et al.*, 1941). When the high temperature of summer was accompanied by low humidity as found in this work, effective cooling by sprinkling was secured. It seems that the respiration rate is related to skin temperature more than it is to body temperature. The greatest decrease in temperature by sprinkling was insured in the comb. This may be due to the fact that it is bare from feathers and in direct exposure to air. Also, sprinkling provides birds with artificial sweat, enabling them to lose heat more efficiently than by panting alone (Wilson and Hillerman, 1952). No decrease in leg temperature was observed, however, it seems that the water sprinkling had not reached this region in sufficient quantities to induce the effect.

The females were of more productive activity than males, which caused them to be more sensitive to any changes in the environment than the males. Accordingly, the respriation rate and skin temperatures of females were lowered more by sprinkling than males.

TABLE 5.—The effect of cutting feathers in Fayoumi males on heat regulating reactions during summer months.

(Temperature grades in centigrades)

Items	Treatment	Tests			
		1	2	3	Average
Body temperature	Cut-feathered	42.3	42.3	41.9	42.2
	Normal	42.3	42.4	41.6	42.1
	Average	42.3	42.4	41.8	42.2
Back feather temperature	Cut-feathered	39.0	40.3	39.7	39.7
	Normal	39.2	40.1	39.2	39.5
	Average	39.1	40.2	39.5	39.6
Abdomen temperature	Cut-feathered	41.0	41.5	40.8	41.1
	Normal	41.3	41.6	40.3	41.1
	Average	41.2	41.6	40.6	41.1
Leg temperature	Cut-feathered	41.0	41.7	41.0	41.2
	Normal	41.4	41.9	40.6	41.3
	Average	41.2	41.8	40.8	41.3
Back skin temperature	Cut-feathered	40.9	41.4	40.6	41.0
	Normal	41.0	41.3	40.5	40.9
	Average	41.0	41.4	40.6	41.0
Wing temperature	Cut-feathered	40.2	40.8	40.1	40.4
	Normal	40.3	41.0	39.8	40.4
	Average	40.3	40.9	40.0	40.4
Comb temperature	Cut-feathered	35.6	39.2	35.0	36.6
	Normal	36.4	39.0	33.6	36.3
	Average	36.0	39.1	34.3	36.5
Respiration rate per minute.	Cut-feathered	41	40	36	39
	Normal	40	38	34	37
	Average	41	39	35	38

Test 1. 7–9 a.m.

Test 2. 1–3 p.m.

Test 3. 7–9 p.m.

TABLE 6.—ANALYSIS OF VARIANCE FOR THE EFFECT OF CUTTING FEATHERS IN FAYOUMI MALES AND ON HEAT REGULATION REACTIONS DURING SUMMER MONTHS.

(Mean Squares)

Items	Source of variations			
	Treatment d.f. 1	Diurnal 2	Error 146	Total 149
Body temperature	0.2482	4.5867*	0.1354	0.1959
Back Feather temperature . .	0.8664	15.4322*	0.5061	0.7088
Abdomen temperature	0.0354	13.0433*	0.4785	0.6442
Leg temperature	0.0295	12.2699*	0.3967	0.5537
Back skin temperature	0.0171	8.0096*	0.4707	0.5688
Wing temperature	0.0562	11.4889*	0.4861	0.6309
Comb temperature	2.8843	293.1234*	6.5058	10.3287
Respiration rate per minute .	96.0000	356.0600*	50.7455	55.1473

* Highly significant at 1% level of probability.

TABLE 7.—THE EFFECT OF SPRINKLING ON HEAT REGULATING REACTIONS DURING SUMMER ON FAYOUMI FOWLS.

(Temperature grades were in centigrades)

Treatments	Sex	Body temp.	Back skin temp.	Back feath. temp.	Leg temp.	Wing temp.	Abdo-men temp.	Comb temp.	Resp. per minute
Sprinkled	Male	42.2	40.5	38.4	41.7	40.3	41.2	35.8	42
	Female	42.2	39.7	38.3	41.7	39.6	39.6	36.0	50
	Average	42.2	40.1	38.4	41.7	40.0	40.4	35.9	46
Control	Male	42.0	41.0	40.0	41.4	40.6	41.2	38.9	46
	Female	42.2	40.9	39.9	41.5	40.6	40.9	38.7	59
	Average	42.1	41.0	40.0	41.5	40.6	41.1	38.8	53

TABLE 8.—ANALYSIS OF VARIANCE FOR THE EFFECT OF SPRINKLING TREATMENTS IN FAYOUMI FOWL ON HEAT REGULATING REACTIONS DURING SUMMER.

(Mean squares)

Items	Source of variation			
	Treatment	Sex	Error	Total
	d.f. 1	1	67	69
Body temperature	0.1001	0.0006	0.1567	0.1544
Back feather temperature . .	40.3014**	0.0086	1.8089	2.3406
Abdomen temperature	13.4850**	19.1921**	1.2092	1.6477
Leg temperature	0.9401	0.0006	0.3653	0.3683
Back skin temperature	19.2217**	6.4348*	0.9843	1.3283
Wing temperature	15.6103**	3.0932	1.1142	1.3530
Camb temperature	127.0201**	0.6762	2.6006	4.3757
Respiration rate/minute . . .	853*	1312	191	217

** Highly significant at 1 % level of probability.

* Significant at 5 % level of probability.

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التنظيم الحرارى فى الدجاج خلال الصيف

الملخص

استعملت الديوك الفيـومى لدراسة تأثير الظروف البيئية المختلفة على التنظيم الحرارى للجسم خلال عام كامل. ووجد أن أكبر ارتفاع فى درجة حرارة الجسم كان عندما ارتفعت درجة الحرارة الجوية مصحوبة بارتفاع فى الرطوبة النسبية . وكانت درجة الحرارة الجوية هى الأساس ــ فى انخفاض درجة حرارة الجسم فى الشتاء . وقد لوحظ اختلافات كبيرة فى درجات حرارة الجسم خلال النهار عندما كانت مصحوبة بتغيرات كبيرة فى درجات الحرارة أثناء النهار . كذلك لوحظ أن أعلى درجات الحرارة فى الجلد والريش كانت فى الصيف وأولها كانت فى الشـتاء كما ارتفع معـدل التنفس فى الصيف وانخفض فى الشتاء .

والطيور التى عرضت فى الصيف للشمس المباشرة لمدة ساعتين ونصف زادت درجة حرارة جسمها وجلدها وريشها وسرعة تنفسها زيادة كبيرة عن الطيور التى وضعت فى الظل . وكانت أعلى زيادة فى درجة الحرارة الخاصة بالعرف . ووجد أن معظم التأثير الضار لفصل الصيف الحار على الانتـاج والتنظيم الحرارى ــ راجع للتعرض للشمس المباشرة وعند دراسة تأثير قص الريش الطويل فى الجناح والذيل وبعض ريش الجسم وجد أن هذه المعاملة لا تؤثر على التنظيم الحرارى فى الجسم الا عنـدما ترتفع الحرارة فى النهار وتزيد معدلات التغير خلال اليوم فى درجات الحرارة . وعند دراسة تأثير رش الطيور بالماء خلال الصيف كما وجد أن هذه المعاملة تخفض درجة حرارة الجلد والريش وسرعة التنفس وتساعد الطيور على تحمل درجة الصيف العالية .