

Effect of Hot and Cold Weather on Body Reactions of Chickens

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BODY, skin and feather temperatures and respiration rate in Fayoumi, Rhode Island Red and their cross were studied for a whole year. Body temperature was slightly higher in the hot than in the cold season. Relative humidity and wind velocity reduced body temperature during hot weather. Wide diurnal variations in body temperature were observed in hot weather. Fayoumi and its cross were of higher body temperatures than the Rhodes. The lowest feather and skin temperatures were during cold, while the highest values were during the hot season. Diurnal variations in feather and skin temperatures were observed. Breed differences were similar to body temperature. Males had higher feather temperature than females when air temperature was high, while the females had the highest values during cold weather. Respiration rate increased during hot, while it decreased during cold weather. Breed and cross differences were observed in respiration rate. Males were of lower respiration rate than females. Body, skin and feather temperatures and respiration rate were within narrow limits at air temperatures of 5 to 30°. Over 31° the values of different characters increased greatly. The difference between body-skin, skin-feather, feather-air and body-air temperatures decreased with the increase in air temperature.

Air temperature up to 29.4° is without any significant effect on body temperature (Lee *et al.*, 1945). At air temperature of 32.2° body temperature begins to increase above the normal (Ycates *et al.*, 1941). Diurnal variation seems to be mainly attributed to the variation in air temperature (Wilson, 1948). Breed differences in body temperature is observed in chickens (Scholes and Hutt, 1942). When humidity increases, body temperature slightly increases (Lee *et al.*, 1945). The rate of respiration is low in cold weather, but increases gradually as the air temperature rises to 32.2° (Lee *et al.*, 1945). The increase in air movement is an important factor in cooling the birds in hot humid or dry weather (Lee *et al.*, 1945). Skin temperature is higher than feather temperature and it differs according to body regions (Wilson *et al.*, 1952). Above air temperature of 32.2 to 35°, the birds are not longer able to lose heat from their body feather, however still a small amount of heat is lost from the unfeathered portions through evaporation (Wilson *et al.*, 1952).

Material and Methods

The birds were kept in wired houses and open yards which were provided with shade only during hot weather. During cold weather, the wired houses were covered with canvas. The birds were fed a ration composed from 19%

corn, 15% barley, 10% wheat, 15% wheat bran, 15% rice bran, 11% broad beans, 15% cotton seed cake, 1.5% lime stone and 0.5% salt. Fresh liquid blood or skim milk was supplied. Green fodder was supplied as Egyptian clover in winter and chopped green maize leaves in summer. Body temperature was measured by inserting a thermometer in the cloaca. Skin and feather temperatures were measured by a touch thermocouple apparatus. Respiration rate was measured by the movement of the abdomen. Air temperature, relative humidity and wind velocity were measured at the time of each test.

Four males and eight females of 12 months of age, from Fayoumi (F), Rhode Island Red (RIR) and the cross of Fayoumi male with Rhode females (FR) were used. The different reactions were studied for one year. The studied characters were recorded for each bird every week during the period of study. The weekly tests were done at 7-9 am (M), 1-3 pm (N) and at 7-9 pm (E). The weekly tests were grouped into two categories, namely, the hot and the cold seasons, which is a characteristic of the weather in this locality.

Results and Discussion

Body temperatures were slightly higher in the hot than in the cold season (Table 1). It seems that the coincidence of dry weather and fast winds with the high air temperature enables the birds to practice efficient evaporative cooling that reduced the rise in body temperature during the hot season. yeates *et al.* (1941) also concluded that relative humidity and wind velocity have significant effect on body temperature, only when air temperature is high. The highest body temperatures were observed in the noon, whilst the lowest were observed in the evening. Diurnal variations were more obvious during the hot than during the cold season. Body temperatures during the hot evenings were lower than those of the cold noons. It seems that the most effective factor in the differences between the two seasons is the noon temperature of the hot season. Breed differences in body temperatures were observed between the two breeds and the cross used. Other workers, such as Ohamoto *et al.* (1956), also observed these breed differences. No sex differences were observed in body temperatures in the two seasons.

The lowest feather and skin temperatures were during the cold season, while highest were during the hot season (Table 1). The degree of response to climatic changes varied according to body regions.

The widest variations were observed in comb temperature. Diurnal variations in feather and skin temperatures coincided with similar variations in air temperatures. The greatest diurnal variations were observed during the hot season. Breed differences were observed in feather and skin temperatures. Males had almost higher skin temperatures than females in both seasons. However, males were of higher feather temperatures than females during the hot season; while the females had the higher ones during the cold season.

There were no differences in respiration rate between the two seasons, as far as the morning and evening tests were concerned. However, respiration rates were higher in the noons of the hot season than the noons of the cold season. This trend was more obvious in the Rhodes and their cross with the Fayoumi, especially in the females. The Fayoumi birds were of almost faster respiration rates than the other birds in the two seasons. FR birds

TABLE 1. Effect of season on different body reactions.

Item	Breed and sex	Hot season (May — October)			Cold season (November — April)		
		M	N	E	M	N	E
Air temp. °C	—	29	34	27	20	22	14
Rel. Humidity % . .	—	54	83	53	58	44	75
Wind velocity km/hr	—	4	8	6	2	6	3
Body temp. °c	F ♂	42.1	42.2	41.8	42.0	42.0	41.2
	F ♀	41.9	42.3	41.6	41.8	42.0	41.1
	FR ♂	41.8	42.4	41.5	41.8	41.7	41.0
	FR ♀	41.8	41.5	41.3	41.8	42.0	41.0
	R ♂	41.9	41.9	41.2	41.7	41.6	40.8
	R ♀	41.8	42.4	41.3	41.6	41.6	40.9
Comb. temp. °c . . .	F ♂	35.9	38.9	35.4	31.7	36.7	30.1
	F ♀	35.7	38.4	35.9	32.2	34.0	31.0
	FR ♂	37.3	39.4	35.5	35.1	35.9	29.8
	FR ♀	37.0	39.1	36.0	34.0	35.4	31.5
	R ♂	37.1	38.9	35.0	35.0	35.8	29.8
	R ♀	37.3	38.9	36.1	33.5	34.3	30.7
Abdomen skin temp °c.	F ♂	40.6	41.4	40.6	39.1	40.3	39.3
	F ♀	40.1	41.1	40.1	39.0	40.0	28.8
	FR ♂	40.5	41.6	40.5	39.8	40.7	39.3
	FR ♀	40.5	41.6	40.0	39.7	40.2	29.0
	R ♂	40.6	41.2	40.1	40.0	40.3	39.1
	R ♀	40.3	41.4	40.0	39.3	39.7	38.3
Back skin temp °c.	F ♂	40.4	41.2	40.7	38.8	39.9	39.0
	F ♀	40.1	41.1	40.1	39.1	40.0	38.8
	FR ♂	40.3	41.3	39.1	39.4	40.1	39.1
	FR ♀	40.3	41.5	39.9	39.6	40.0	38.8
	R ♂	40.4	41.0	40.1	39.6	39.8	38.8
	R ♀	40.2	41.3	39.9	39.5	39.7	38.2
Back feather temp °c.	F ♂	38.4	39.9	39.0	35.1	36.6	35.1
	F ♀	38.5	39.8	38.8	36.0	36.9	35.8
	FR ♂	38.5	39.9	38.8	35.7	36.3	35.1
	FR ♀	38.6	40.0	38.4	36.3	36.7	35.0
	R ♂	38.5	39.8	38.5	35.7	35.7	34.3
	R ♀	38.5	39.8	38.1	35.7	34.9	34.5
Respiration rate per min.	F ♂	39	46	42	41	47	44
	F ♀	50	64	50	55	61	59
	FR ♂	30	45	28	32	31	30
	FR ♀	44	83	40	47	54	45
	R ♂	27	30	25	28	30	27
	R ♀	37	52	31	38	39	6

were of medium respiration rate between the two purebreeds. Males were of lower respiration rate than females.

Interrelationships

Body, back skin, feather and comb temperatures increased slightly with the increase in air temperature at cold weather, but they increased greatly with the increase of air temperature at hot weather (Table 2). Respiration rate was somewhat high at low temperatures. This may be due to the increased metabolic activity which caused that increase in respiration rate (Hutchinson).

TABLE 2. The effect of air temperature gradients on heat regulation reaction.

Temperature °c						
Air temperature	Breeds	Rectal	Respiration rate/min.	Back skin	Back feather	Comb
5 — 10	Fay.	41.0	54	38.5	32.9	27.4
11 — 20		41.7	51	39.0	35.4	31.7
21 — 30		41.9	48	40.4	38.6	35.8
31 — 40		42.2	55	41.5	40.2	39.3
5 — 10	FR	40.8	38	38.9	33.5	28.5
11 — 20		41.5	39	39.2	35.3	32.8
21 — 30		41.7	36	40.3	38.3	36.7
31 — 40		42.3	57	41.7	40.1	39.9
5 — 10	R.I.R.	40.8	32	38.5	32.4	28.4
11 — 20		41.2	33	38.8	34.5	32.1
21 — 30		41.6	32	40.1	28.0	36.4
31 — 40		42.1	40	41.5	40.2	39.6
5 — 16	Average	40.9	41	38.6	32.9	28.1
11 — 20		41.5	41	39.0	35.1	32.2
21 — 30		41.7	39	40.3	38.3	36.3
31 — 30		42.2	51	41.6	40.3	39.6

and Sykes, (1953). Respiration was slightly lowered at the warm weather (21-30°). Over the air temperature of 30°, respiration rate increased greatly to aid in heat loss by evaporative cooling.

The values of the four gradients decreased with the increase in air temperature intervals (Table 3). The differences were high between body or feather and air temperature, while they were low between body-skin or skin-feather gradients. The highest differences in body-air and feather-air, and the least differences in body-skin and skin-feather gradients were observed for the Fayoumi and its cross with the Rhode. This may indicate that these birds were able to keep the variations in the internal temperature within narrow limits irrespective to varying air temperatures.

TABLE 3. The relationship between the environmental temperature and internal temperatures.

Breeds	Temp. gradients	5—10°	11—20°	21—30°	31—40
Fay.	B-S	2.5	2.7	1.5	0.7
	S-F	5.6	3.6	1.8	1.3
	F-A	25.4	20.4	13.6	5.2
	B-A	33.5	26.7	16.9	7.2
FR	B-S	1.9	2.3	1.4	0.6
	S-F	4.4	3.9	2.0	1.3
	F-A	26.0	20.3	13.3	4.5
	B-A	33.3	26.5	16.7	7.3
R.I.R.	B-S	2.3	2.4	1.5	0.6
	S-F	6.1	4.3	2.1	1.3
	F-A	24.9	10.5	13.0	5.2
	B-A	33.3	26.2	16.6	7.3
Average	B-S	2.2	2.5	1.5	0.6
	S-F	5.7	3.9	2.0	1.3
	F-A	25.4	20.1	13.3	5.3
	B-A	33.4	26.5	16.7	7.2

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تأثير الاجواء الحارة والباردة على درجات حرارة جسم الدجاج

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درست درجات حرارة الجسم والجلد والريش في كل من الدجاج الفيومي والروود أيلاند رد وخليطهما طوال ١٢ شهر ووجد أن حرارة الجسم ترتفع قليلا في الجو الحار وكان لنسبة الرطوبة المنخفضة وسرعة الرياح العالية تأثير ملطف لدرجة الحرارة في الصيف * وتختلف درجة حرارة الجسم للدجاج أثناء النهار ودرجة حرارة جسم الفيومي والخليط أعلى من الدجاج الأجنبي وهو الروود أيلاند رد * وتنخفض درجة حرارة الريش والجلد في الشتاء في الجو البارد وترتفع في الصيف في الجو الحار وحرارة جسم وريش وجلد الذكور أعلى من الإناث وذلك خلال الجو الحار بينما تكون الإناث أعلى في الجو البارد * ويزيد معدل التنفس في الجو الحار وينخفض في الجو البارد والديوك تنفس بسيط عن الإناث في جميع الأجواء * عندما تكون درجات الحرارة معتدلة في الربيع والخريف لا يحدث اختلاف في درجات الحرارة في الجلد والجسم والريش ولا بين الذكور والإناث *