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EFFECT OF ENVIRONMENTAL TEMPERATURE ON PHYSIOLOGICAL BODY REACTIONS OF RABBITS UNDER SUB-TROPICAL CONDITIONS

By

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This work has been carried out in the Poultry Research Station, Faculty of Agriculture, Cairo University, Giza, during the period from January 1963 till December 1964. Thirty nine rabbits of White "Giza" and "Seds" breeds were used in this study. Rabbits were individually housed in a brick battary building and were fed on concentrate ration composed of wheat bran and barley. Egyptian clover, and chopped green maize leaves were supplied during winter and summer respectively.

The effects of climatic fluctuations in air temperature on the thermoregulatory reactions of the animals were tested at three day times, 7 a.m. 1 p.m. and 7 p.m. on one day at monthly period throughout the year. The effect of exposure to direct sun rays on the body reactions of different natural and artificialy coloured animals was studied in July 1963. Exposure time was 30 minutes starting at 2 p.m. Air temperature and body reaction , body and skin and hair temperatures, respiration rate and pulse rate were measured simultaneously at each test.

The results could be summarised in the following :

With an animal under average air temperature of 23.5°C., average values of 39.4°C, 38.1°C, 38.1°C and 34.1°C. were obtained forbody, abdomen skin and abcomen hair temperatures respectively. The average ear lobe temperature was 29.1°C. The average respiration and pulse rates were 168 and 235 respectively. Breed differences were highly significant for respiration and pulse rate but not for body temperature.

Different colour varieties of fawn, brown and white "Seds" rabbits showed highly significant differences for different studied physiological reactions, skin hair and ear lobe temperatures, respiration and pulse, rates, while the differences in body temperature were not singificant. The fawn coloured rabbits always showed the highest values while the brown animals showed the lowest values,

Direct solar radiation had a great effect on rabbits. Body, skin, hair and ear lobe temperatures increased significantly and in a high rate by direct exposure to solar radiation. Skin temperature and also body temperature reached their maximum values after 30 minutes exposure to solar radiation. Skin temperature was higher than body temperature after 10 minutes of exposure.Rabbits of brown furs reached their maximum hair temperature very rapidly, after 10 minutes exposure, followed by fawn rabbits and the latest were the white coloured animals. Artificial colouring of white rabbits by black, violet and red colours induced no increase in body temperature and a slight increase in skin and ear lobe temperatures by exposure to direct solar radiation.

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Rabbits are sensitive to environmetal temperature Increasing the environmontal temperature from 10°C to 35°C increased both temperature and pulse rate of New-Zeland white rabbits from 39.4°C to 40.5°C and from 122–156 pulse per minute. The respiration rate increased enormously, from 69 to 190 breaths per minute by raising air temperature from 18.3°C to 33.3°C (Johnson *et al.*, 1957). The high environmental critical temperature was reported as 35 °C by Giaja (1938), however, Lee (1939) stated that it ranges between 28°C and 32°C. Lee *et al.* (1941) stated that the respiration rate of Angora rabbits increased enormously by exposure to air temperature above 24°C, for short periods. At 40°C considerable panting and salivation occured.

The aim of this work was to test the effect of the seasonal, month and diurnal fluctuation in climatic temperature on native rabbit breeds. The results of this study may give better understanding for the problems of raising standard breeds in Egypt. It also helps in the improvement of managerial methods to eliminate the disastrous effect of hot seasons on the reproduction and production of rabbits.

Material and Methods

This work was carried out in the Poultry Research Station, Faculty of Agriculture, Cairo University, Giza, during the period from January 1963 till December 1964. Egyptian native White Giza" rabbits were used in this study. These rabbits are a uniform breed selected from indigenous rabbits by the Animal Breeding Department, Faculty of Agriculture, Cairo University, since 25 years ago. All rabbits are white in uhen adult colour weighe 3 to 4 Kilograms on the average for males and females respectively. Another native breed has been used, it was also selected from the indigenous rabbits at "Seds" Agriculture Research Station, Ministry of Agriculture, Upper Egypt. These rabbits are of fawn and brown in colour weighing about 3 kilograms and 4 kilograms for adult males and females respectively Litter size of both breeds is about 5 to 7, and they produced 4 to 5 litters per year according to seasonal variations.

Each rabbit was kept separately in one compartment of brick building and concrete measuring 96 × 85 centimetres and 42 centimetres in height. Also wooden boxes of 120 × 52 × 36 centimetres were used for parturation and for protecting rabbits from severe cold during winter. Each adult rabbit was fed 100 grams daily of concentrate ration composed of equal parts of wheat bran and barley. Egyptian clover at winter and shopped green maize leaves at summer were supplied. Water for drinking was offered ad libitum. Young rabbits were fed on the same concentrates and green fodder. weaning was practiced after 30 days of birth.

Respiration rate was estimated by the frequency of the flank movements per minute. A hand counter was used to count the flank movement frequencies. The pulse rates were taken by putting the left hand on the left side of abdominal surface of the rabbit over the heart position and counting the pulse rates for one minute by a hand counter. Skin temperature was mesaured by surface thermocouple laid softly on the tested area for half a minute to measure the skin surface temperature. This technique was thought to be better and more accurate than shearing an area of the skin to use the flat probe. Hair temperature was measured by a thermocouple pointed probe laid into the fur coat, far from its surface by about five millimetres for half a minute. The air temperature was recorded at the same time of the test.

The study comprised two exeriments :

1. *Effect of seasonal Monthty and Diurnal Variations on Body Reaction* : fifteen adult (2 years old) White "Giza" Egyptian rabbits of both sexes were used for this study throughout a whole year 1963. The test was carried out at weekly intervals for three diurnal day times, 7 a.m., 1 p.m. and 7 p.m. Air temperature, body temperature, skin and hair temperatures of both back and abdomen, ear lobe temperatures of external and internal surfaces at the tip and mid regions of the ear lobe were measured. Respiration rate and pulse rate were also recorded for every individual.

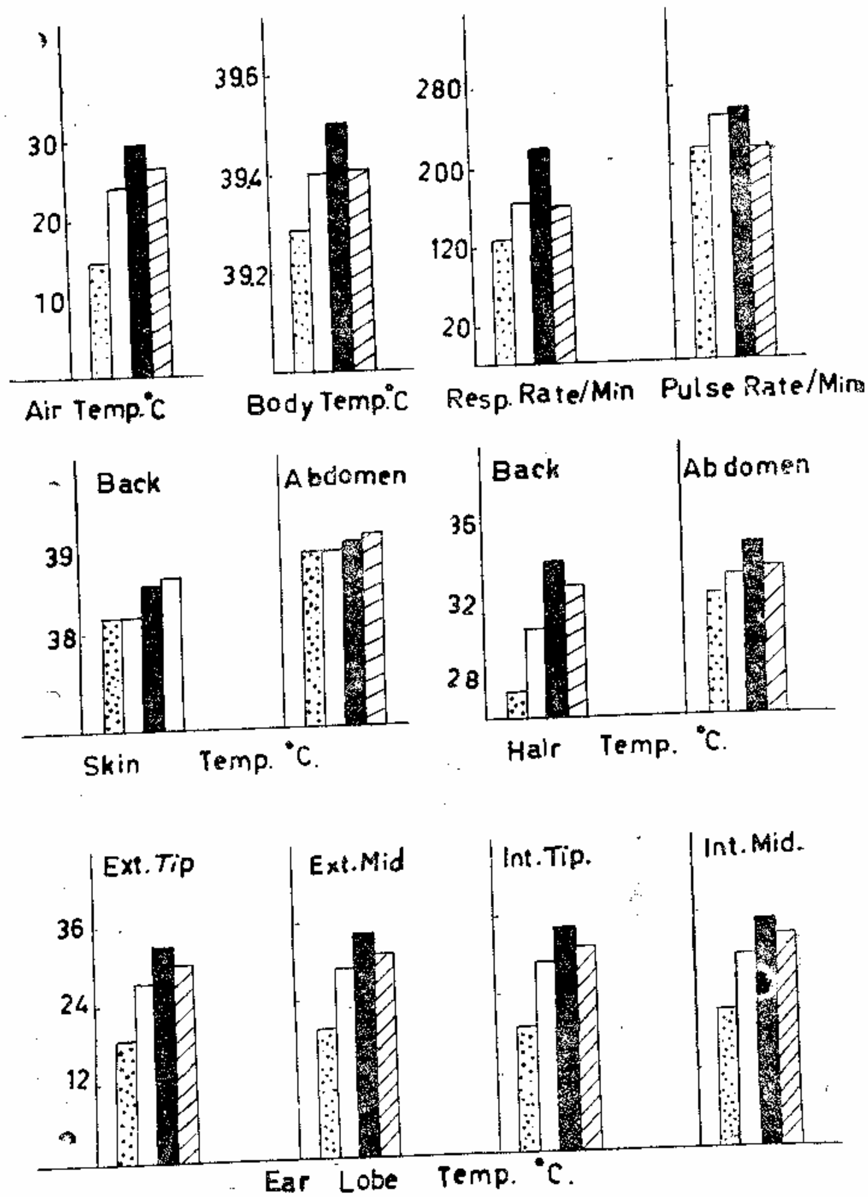
2. *Effect of Exposure to Direct Solar Radiation on Body Reactions* : This experiment was carried out on 24 female native rabbits in six groups of four animals each. Sixteen White "Giza" adult females were divided into four equal groups, the furs of the first group were coloured in red, the second were coloured in violet, the third in black, while the last group was natural kept white as acontrol. Eight females of "Seds" rabbits were divided into 2 groups of natural fur colours, fawn and brown. One animal at a time, of each group was exposed to direct sun-shine for 30 minutes starting at 2 p.m. for one day in the month of July. Air temperature, body, skin, hair and ear lobe temperatures, respiration rate and pulse rate were recorded for each individual at every ten minutes through the exposure time, and extended for two and half hours every minute after shading.

Results and Discussion

Effect of Environmental Temperature on the Physiological Body Reactions of Rabbits

Seasonal Variations : Under an annual average of air temperature of 23.5°C., white Egyptian "Giza" rabbits showed average values of 39.4°, 38.4°, 39.1°, 34.1° and 29.1°C for body temperature, abdomen hair temperature and the mean ear lobe temperature.

Respectively (Fig. 1). Lee (1939) and Davson (1960) reported that the average body temperature of rabbits is about 39.5°C. which is close to our estimate of body temperature. The average respiration rate and pulse rate per minute were 168 and 235 respectively. It is interesting to note that the white New-Zealand rabbits gave a similar average body temperature at the same environmental air temperature as that in the peesent study, while its respiration rate and pulse rate were nearly half the values in the Egyptian breed, 85 and 137 respectively (Johnson *et al.*, 1958).



(Fig. 1) Effect of Seasonal Variation on Physiological Body Reactions of Rabbits.

When the data were classified according to seasonal periods, slight variation was found in body and skin temperatures while respiration rate and ear lobe temperatures showed great positive relation with seasonal air temperature changes, but pulse rate and hair temperature showed slight changes (Fig. 1).

When air temperature increased twofolds from winter to summer, respiration rate increased by 70% of its winter average, this is in agreement with Brody (1945) who stated that in nonsweating animals like rabbits, respiration rate goes up enormosuly by 5–6% for each 1°C. increase in air temperature to increase heat dissipation by water vaporization. Johnson et al. (1958) noticed that the respiration rate of New-Zealand rabbits was tripled when air temperature was doubled, while it increased inly 70% in white "Giza" rabbits, less difference could be attributed to the initial low respiration rate in New-Zealand rabbits (half the value in Egyptian breed) which provides a wide range to the maximum level (Brody, 1945). Also the air temperature at the begining of the two experiments was not the same as it was 10°C. controlled temperature in case of the New-Zealand rabbits while the average air temperature in case of white "Giza" rabbits at winter was 14.5°C., in the present study.

The ear lobe temperature increased at summer by 70% of its value at winter (15°C. difference). The ear lobe temperature is affected by the environmental temperature through the physiological pathway of temperature. It is also affected by body temperature through the control of the blood criculation from the body core to the special blood vessels bed in the ear lobes (Fig. 1). The lobes of the ears are supplied with a very big meshwork of blood capillaries (Konradi, 1960), and arteriovenous shunts which could be dialtaed or constricted by the vasomotor mechanism Brody (1949); Johnson *et al.* (1957) and Konradi (1960). The tip region of the ear lobe was always of lower temperature than the middle region because the blood vesels of the tip are less abundant and of smaller calliber than that of the middle, so the blood circulation in vasodialation is more effective on the surface temperature of the middle ear lobe region. The temperature of the internal surface of the ear lobe is higher than that of the external surface at the same region. This is more clear during winter time due to the easier contact and exposure of the external surface with the ambient air and surrounding surface which increase heat dissipatoin by convection and radiation. It is interesting to notice the behaviour of the animal in this respect. During winter it folds the ear pinnae to cut away its internal surface from contact with air, at the same time it drags the ear to bring it closer to the body. Meanwhile, at summer it stretches the ear pinnae and releases it far from the body exposing both surfaces to the surrounding air to increase the radiating and evaporating surface to the maximum.

At the same time, the pulse rate and hair temperature increased by only 15%. This means that the former two reactions (respiration rate and ear lobe temperature) are the major physiological processes which regulate body temperature against any environmental changes (Table 1). These results are in agreement with Brody (1945); Johnson *et al.* (1958); Dawson (1960) and Solonim (1960). The slight change in pulse rate due to variation in air temperature is probably a counter mechanism to the vasodialation in the ear lobe. The pulse rate is related to other vital physiological conditions which oppose great variation in the pulse rate (Brody, 1945).

Skin temperature was nearly stable all over the year due to the efficient insulation by hair coat (Brody, 1945). It was observed that the coat was denser and taller at winter seasion than at summer. This enables rabbits to conserve heat during winter, while at summer hair density was less because of hair shedding seasion which enables rabbits to dissipate more heat Johnson *et al.*,(1957) and Harrison *et al.*, (1959). The average skin temperature of abdomen was higher than that of the back due to several factors. As the length of the abdominal hairs was longer than the hair of the back, it established a more efficient isolator layer. Besides, the body heat must be transformed from the core to the obdomen surface through lymph fluids of the abdominal cavity and the thin body wall, in contrast to the thick muscles coating the vertebral column of the back.

Hair temperature of the abdomen was always higher than that of the back due to the high temperature of abdomen skin. Also the radiation between the abdominal surface and the very near floor induces a greater effect on skin temperature than in the case of radiation between the back surface and the far sealing and walls.

Monthly Variations: When the data were classified according to monthly periods, the physiological reactions were more apparent. Changes in body temperature during each month occurred systematically according to air temperature changes (Table 1). This is in agreement with the results obtained by Johnson *et al.* (1958). These changes in body temperature are very small because they are regulated by other physiological reactions which act to keep body temperature constant. Skin temperature changes occurred in a small range due to the previous reason. It is directly affected by body temperature, by conduction through body tissues and by convection through the blood and other body fluids in addition to radiation. Skin temperature appeared also to be almost constant due to its insulation by air coat from air temperature changes (Table 1). Accordingly it could be observed that abdominal skin temperature was higher than the temperature of the back skin due to thicker hair coat of the abdomen than that of the back. For this reason, hair temperature of back was also lower than hair temperature of abdomen (Fig. 1). Although this difference was not more than only 1°C. during summer months (June, July and August), yet the difference reached seven folds at winter months (December, January and February); (Fig. 1). These large differences occurring during winter might be due to the high rate of heat dissipation, the short hair coat of the back and the cold outside air. Meanwhile, the long hair of abdomen conserve a thick layer of still air which keeps heat and prevents its loss to the ambient air (Fig. 1).

In contrast, respiration rate, pulse rate and ear lobe temperature were highly affected by air temperature differences coincinding with monthly changes. This is mainly due to the fact that these three physiological reactions are considered the major means which can react physiologically, due to variations in the environmental air temprature to keep body temperature within the

TABLE 1.—EFFECT OF SEASONAL VARIATIONS ON PHYSIOLOGICAL BODY REACTIONS IN RABBITS

Month	Air temp.	Body temp.	Skin temp. of back	Hair temp. of back	Ear lobe temp. mid.	Resp. rate	Pulse rate
December . .	17.5	39.3	38.3	28.9	23.2	132	227
January . . .	12.5	39.3	38.4	28.3	16.9	123	211
February . . .	14.0	39.3	38.0	28.1	18.9	122	213
March	18.5	39.4	38.0	29.4	24.9	130	228
April	23.5	39.4	38.2	29.4	27.7	162	254
May	28.5	39.4	38.6	33.0	32.9	201	263
June	28.5	39.4	38.3	32.8	32.9	226	261
July	29.5	39.5	38.4	34.3	33.8	229	265
August	31.0	39.5	38.9	35.1	34.7	206	243
September . .	29.5	39.4	38.9	34.7	33.8	193	236
October . . .	27.5	39.4	38.8	33.2	31.8	168	213
November . .	22.9	39.4	38.6	30.6	27.7	137	206
Average . .	23.5	39.4	38.4	31.3	28.2	169	235

normallimits (Table 1.) These results are similar to the findings of Johnson *et al.* (1958). During the summer months, the maximum values of these three items were observed. However, the rate of increment was not similar in pulse rate as compared with respiration rate and ear lobe temperatures. Although winter values of the latter two variables were half to that of summer month June, July and August), yet the changes were very small in pulse rate. This is due to that the heart acts as a pump which is of a limited ability for changing its rate. Its change must occur within the smallest limit as blood is of a differential physiological role and the flow of blood into the blood vessel in a very high rate would be harmful. This must induce the friction whichs damage the blood vessels, causes heat increment and also inhibtis vital reactions and processes occurring between the blood components and every cell of the body. Meanwhile, slight increase in the pulse rate during summer months increase the flow of blood into the ear lobe blood vessels to icrease heat dissipation to the environmental air by conduction, convection, evaporation and radiation. Also, to give a reasonable amount of blood supply to the brain. At summer, rabbits accelerate their respiration rate greatly in order to increase evaporative cooling effect from the respiratory surface. The respiratory centers are heat sensitive controlled by thermoregulating centers at the hypothalamus Brody (1945); Johnson *et al.* (1957); Davson (1960) and Soloinm (1960). This may be an important channel for heat dissipation because rabbits are non-sweating animals Pitts (1946) and Johnson *et al.* (1957). However, it could be observed that although air temperature continued its increase during August and September, respiration rate decreased (Table 1). These results are in agreement with Kozolv (1957) who reported that respiratory movements became restricted due to excessive overheating and this occurred due to adaptation to overheating, moreover, exhaustion occurred to respiratory system due to its high rate after spring and early summer months. The same findings were noticed in pulse rate for the same previous reasons (Table 1).

The ear lobe temperatures differ greatly during different months. They show almost the same trend like air temperature changes (Table 1). The ear lobe temperature is greatly affected by air temperature as the ear lobe is a very thin hairless tissue with a high vascularity which covers all the ear lobe (Konradi, 1960). This type of composition facilitates heat dissipation by evaporative and non-evaporative cooling from the ear lobes to the environmental air. These findings are in agreement with the results obtained by Johnson *et al.* (1957). It appears that at high enviornmental air temperature, heat exchange between ear lobes and the envrionmental air is controlled by the physical laws of heat exchange. At summer blood flows into the blood vessels of the ear lobes at its full capacity to increase heat loss by evaporation, conduction, convection and radiation. It can be seen from Table (1) that ear lobe temperature continued to be high during September, October, November and December. This trend also occurred in both respiration rate and pulse rate during this period. Respiration and pulse rates are controlled by physiological laws in addition to physical laws, while the ear lobe temperature may be mainly controlled by physical laws of heat exchange. The analysis of variance for all these previous physiological reactions showed that all differences were highly significant (Table 2).

Diurnal Variations: The diurnal variations of climatic temperature induced cyclic variations in the physiological reactions (Duke, 1955). Highly significant difference in body teperature occurred due to environmental diurnal variations all over the day (Table 3). The total average of body temperature went up from morning till night while environmental air temperature went up from morning till noon then it decreased at night (Table 3). These results show that body temperature was not affected instantly by changes in air temperature but it was affected by the long period of high air temperature during the day. Diurnal variations in body temperature between minimum and maximum, varied within a very short range, the difference being between 0.2°C and 0.3°C. only. This shows high efficiency of body heat regulation in rabbits (Table 3).

TABLE 2.—ANALYSIS OF VARIANCE OF DIFFERENT BODY REACTIONS AS INFLUENCED BY MONTH, DIURNAL VARIATIONS ANDT HEIR INTERACTIONS

Body reactions	Source of variation	d. f.	M.S.
Body temperature..	Month	11	0.34**
	Diurnal	2	6.26**
	Interaction . . .	22	0.07*
	Error	1044	0.04
Skin temperature (back)	Month	11	5.40**
	Diurnal	2	30.85**
	Interaction . . .	22	1.43**
	Error	1044	0.11
Hair temperature (back)	Month	11	743.10**
	Diurnal . . .	2	1214.16**
	Interaction . . .	22	11.70**
	Error	1044	1.10
Ear lobe temperature (ext.mid.)	Month	11	3394.20**
	Diurnal	2	4870.99**
	Interaction . . .	22	103.61**
	Error	1044	5.16
Respirate rate	Month	11	149105.73**
	Diurnal	2	64732.00**
	Interaction . . .	22	2057.00**
	Error	1044	1003.69
Pulse rate	Month	11	42815.20**
	Diurnal	2	9412.50**
	Interaction . . .	22	392.09*
	Error	1044	248.65

** Significant at 1% level of probability.

* Significant at 5% level of probability.

TABLE 3.—CHANGES IN PHYSIOLOGICAL BODY REACTIONS DUE TO DIURANL VARIATIONS IN RELATION TO SEASONAL VARIATIONS

Items	Day time	Season				Average
		Winter	Spring	Summer	Autumn	
Air temp.	Morning	12.0	19.5	25.0	24.0	20.0
	Noon	17.0	26.0	33.0	28.5	26.0
	Evening	15.0	24.5	31.0	26.5	24.5
Body temp.	Morning	39.2	39.2	39.3	39.3	39.3
	Noon	39.4	39.4	39.5	39.4	39.4
	Evening	39.4	39.5	39.6	39.6	39.5
Skin temp. (back)	Morning	37.9	37.9	38.1	38.4	38.1
	Noon	38.3	38.4	38.7	38.8	38.5
	Evening	38.4	38.4	38.8	39.0	38.7
Hair tepm. (back)	Morning	25.7	28.1	31.8	31.3	29.2
	Noon	29.1	32.0	35.5	33.3	32.5
	Evening	28.5	31.7	34.8	33.7	32.2
Ear lobe temp.	Morning	12.4	23.4	31.2	28.1	24.0
	Noon	23.8	31.0	35.4	32.4	30.6
	Evening	21.8	31.0	34.9	32.8	30.1
Resp. rate	Morning	120	151	199	148	155
	Noon	127	164	227	161	170
	Evening	130	177	236	180	181
Pluse rate	Morning	211	242	250	215	230
	Noon	220	250	255	215	235
	Evening	221	250	254	222	240

The rate of increase in body an skin temperatures was very small as compared with monthly air temperature changes specially at noon. Although the air temperature in summer was double that of winter, the rate of incrase in body and skin temperatures was very small. Body and skin temperatures are regulated by other physiological reactions. It can be noticed that in winter, body and skin temperatures decreased slightly at night than at noon due to the short time of sunshine and the less effectiveness of thermal rays during tese months. In generl, both skin and hair temperature of abdomen allover the year were higher than temperatures measured at the same time from the back (Fig. 1), because the flow of heat from the core to the skin surface of abdomen is easier than its flow through thick tissues and muscles of the back.

There was highly significant difference in ear lobe temperature at different day times. As a general trend, the total average of ear temperature was small at morning and reached the maximum at noon and then went down at evening (Table 3). As ears are highly affected by environmental air temperature (Konradi, 1960), wide diurnal variations had been observed between months due to air temperature changes as it reched at summer its triple value of winter.

Respiration rate and pulse rate duirnal changes were highly significant (Table 2). At summer months (June and July), respiration rate reached its double values of winter months (January and February), at different day times. In December, respiration rate and pulse rate were smaller at evening than at noon similarly to body and skin temperatures. Respiration and pulse rates were affected mainly by body temperature rather than by air temperature.

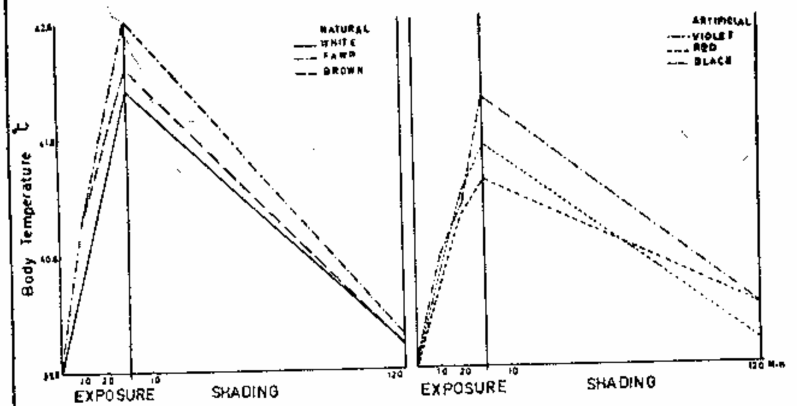
In general, it could be remarked that the diurnal variations in pulse rate were lower than respiration rate (Table 3).

Effect of Solar Radiation Exposure: Rabbits are highly affected by direct exposure to solar radiation. Air temperature at direct sunshine ragned between 45° and 46°C., while it was 31.5° to 33.5°C. under shade before and after the experiment. In gneral, body, skin, hair and ear lobe temperatures increased steeply by exposing rabbits to direct solar radiation (Figs. 2-7). Rabbits of natural fawn colour showed the highest increase in body, skin, hair and ear lobe temperatures followed by brown rabbits while the least values were observed for the white rabbits (Fig. 2). Skin temperature was higher than body temperature after solar exposure for 10 minutes and until 30 minutes of exposure. Skin temperature increased to its aximum in brown and fawn rabbits after 20 minutes of exposure while their body temperature reached the maximum after 30 minutes of exposure (Figs. 2 and 3). Similar results were observed when comparing ear lobe and body temperatures in rabbits of natural colour. The brown hair temperature reached the maximum very rapidly after ten minutes of direct solar exposure, followed by fawn rabbits then by rabbits of white furs. Artificial colouring of the white rabbits by black, violet and red colours induced no increase in body temperature, and very slight increase in skin and ear lobe temperatures was noticed. In contrary, in rabbits of natural fur colours, their body temperature was higher during exposure than ear lobe temperature (Figs. 2 and 5).

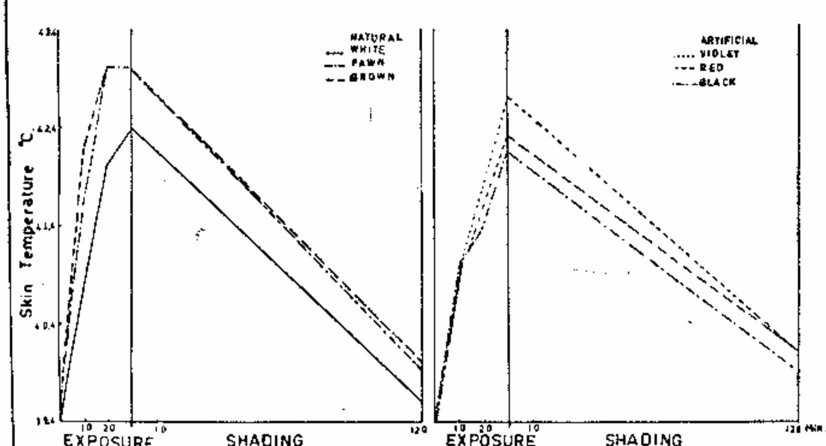
The artificially coloured furs, black, red, violet and the natural white "Giza" rabbits showed the least hair temperature compared with rabbits of natural fur colours (Fig. 4). Shading the rabbits after 30 minutes of exposure induced a decrease in body, skin and hair temperatures. The rate of decrease was slow in the first 15 minutes of shading followed by a rapid decrease until 30 minutes, then by a radual decrease until two hours of shading. At the end of shading period, body, skin and hair temperatures of artificially coloured rabbits were higher than in the natural ones (Figs. 2,3 and 4). However, these temperatures were lower in the artificially coloured groups after the exposure period than in the natural groups. This means that the colouring material works as a heat barrier to the animal body during exposure and from the body during shading. Besides, the natural colours have more perfect phipial status for heat conditioning as it intermingles in the cells of hair cortex while artificial colour stains the hair surface only. Also, the skin of naturally coloured rabbits contains some dark pigmentations which absorb more quantity of heat and work as a mediator for heat transformaion to and from the body which is not the case in white or artifically coloured rabbits (Fig. 4).

Respiraion rate and pulse rate showed a trend, due to solar radiation exposure, different from that of the previous reactions (Figs. 2-7). Rabbits of brown and fawn natual colours showed the peak of respiration rate after 20 minutes of exposure followed by a decrease during the last 10 minutes of exposure and the first 15 minutes of shading and then, another peak, higher than the first one, during the following 30 minuts of shading followed by a gradual decrease. Rabbits of artificailly coloured group showed only one peak in respiration rate after the 30 minutes of exposure. It seems that respiration rate is evoked in the naturally coloured animals through the rapid sensation of heat in the coloured skin. The first peak is to counteract the effect of heat rays on body temperature, which is mostly induced by the uncoloured skin of originally white but artificially coloured hair animals. The second peak in respiration rate of the naturally coloured animal and the single peak in white and artificailly coloured ones is due to the physiological participation of the respiratory system in heat regulation. This peak may be augmented by the increase of carbon dioxide in blood due to the elevation of metabolic rate by the high body temperature, or even by the great activity of the respiratory muscles. The variations in pulse rate due to solar radiation and shading was slight, although it showed the same trend like that of the respiration rate (Fig. 7). This synchrinisation of the pulse rate with respiration rate is due to the increase in blood supply to the lungs during the peak of respiration. This synchrontation between the two would cosequently increase the efficiency of heat dissipation, to control both body temperature and carbon dioxide depletion from the blood to regulate the acid base balance in the body.

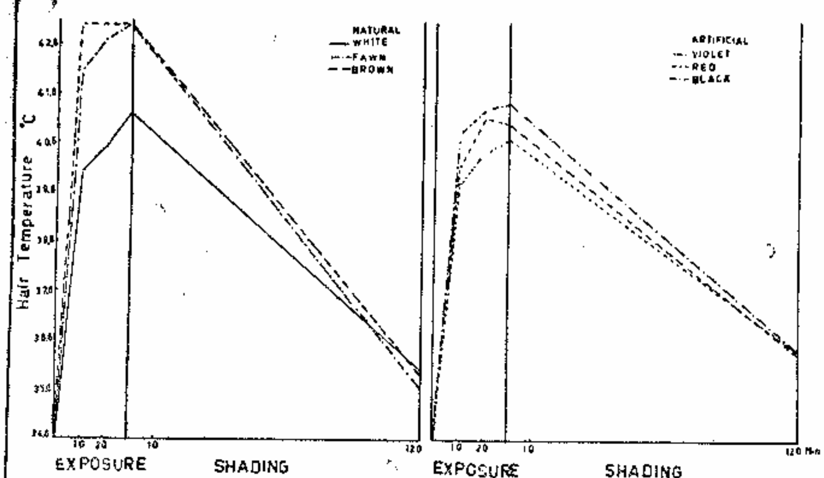
Exposure to solar radiation was accompanie by symptoms of discomfort. Salivation and nostril drippings started after about ten minutes of exposure and panting was clearly observed. These resuls are in agreement with Lee *et al.* (1941) and Johnson *et al.* (1958). The lower lip dropped and became congested.The animals rubbed their furs with their fore limbs and moistened their heads with saliva, in agreement with Schmidt-Nielson (1964) observations. During the last period of exposure time, the animals showed irritation and moved birksly. The animals sometimes yawned or jumped. At the end of exposure time, some animals showed signs of sun stroke, hind limbs paralysis, respiratory failure, convulsions and screaming. These symptoms mostly ended by the death of these animals. This death may be due to the failure in acid-base balance more than to failure in heat balance. It is intresting to note that the death occurred only in the naturaly coloured animals of which 50% of the brown and 25% of the fawn one died.



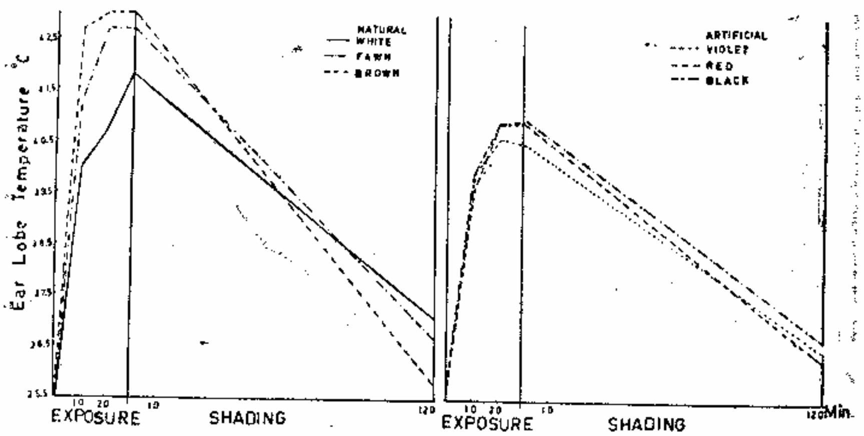
(Fig. 2) Effect Of Exposure To Solar Radiation Body Temperature Of Male Rabbits Of Different Natural And Artificial Fur Colours



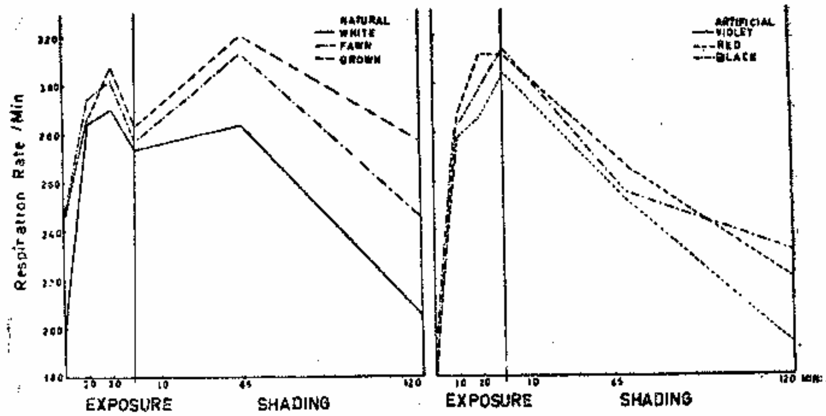
(Fig. 3) Effect Of Exposure To Solar Radiation On Skin Temperature Of Male Rabbits Of Different Natural And Artificial Fur Colours.



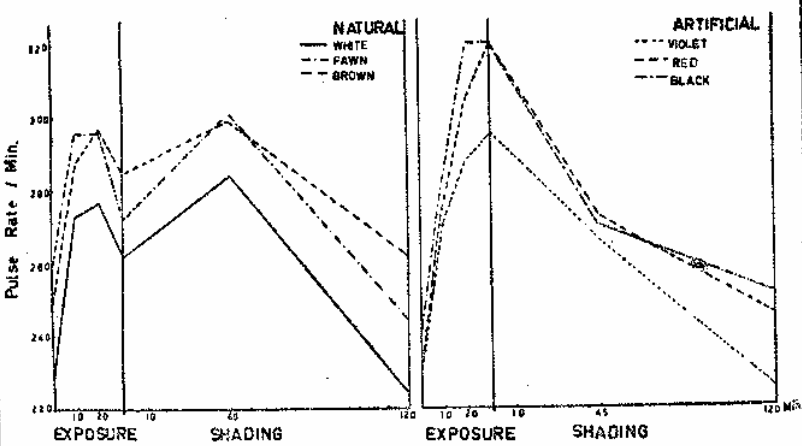
(Fig.4) Effect Of Exposure To Solar Radiation On Hair Temperature Of Male Rabbits Of Different Natural And Artificial Fur Colours.



(Fig.5) Effect Of Exposure To Solar Radiation On Ear Lobe Temperature Of Male Rabbits Of Different Natural And Artificial Fur Colours



(Fig.6) Effect Of Exposure To Solar Radiation On Respiration Rate Of Male Rabbits Of Different Natural And Artificial Fur Colours



(Fig. 7) Effect Of Exposure To Solar Radiation On Pulse Rate Of Male Rabbit Of Different Natural And Artificial Fur Colours.

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تأثير الحرارة الجوية على التنظيم الحرارى فى الأرانب فى المناطق شبه الحارة

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الملخص

أجرى هذا البحث فى محطة ابحاث الدواجن بكلية الزراعة بجامعة القاهرة بالجيزة فى الفترة من يناير سنة ١٩٦٣ الى ديسمبر سنة ١٩٦٤ ، وقد استخدم فى هذا البحث ٣٩ أرنبا من الجيزة أبيض والأرانب المنتخبة من محطة تربية الدواجن بسدس بمصر العليا ، وقد وضع كل أرنب انفراديا فى مساكن مبنية بالطوب الأحمر وغذيت بعلائق مركزة مكونة من الردة والشعير بنسب متساوية هذا الى جانب البرسيم المصرى فى الشتاء وأوراق عيدان الذرة الخضراء الشامية فى الصيف .

وطبقا لخطة البحث كانت تقاس درجات الحرارة الجوية والظواهر الجسمية المرتبطة بتنظيم الحرارة ثلاث مرات ،٧ص ، ١م ، ٧م فى يوم معين على فترات شهرية بطول السنة : درجة حرارة الجسم كانت تقاس بواسطة الترمومتر الطبى ،كما قيست درجات حرارة الجلد والشعر بواسطة ترمومتر خاص يقيس المسطحات ذو طرف مدبب يصل الى الجلد بدون حلاقة الفروة . وقدرت سرعة التنفس والنبض . كما تمت دراسة أثر تعريض الحيوانات لأشعة الشمس المباشرة لمدة ½ ساعة ابتداء من الساعة ٢م فى شهر يوليه فى الأرانب الملونة طبيعيا وصناعيا .

ويمكن تلخيص نتائج البحث فى النقط التالية .

بمتوسط درجة حرارة جوية سنوية قدرها ٣٣٫٥م كانت درجة الجسم وجلد البطن وشعر البطن ٣٩٫٤م، ٣٩٫١م ٣٤٫١م . وكان متوسط درجة حرارة الاذن ٢٩٫١م وقد وجد اختلاف بسيط غير معنوى بين الأنواع فى حرارة الجسم واختلاف معنوى فى التنفس والنبض .

الألوان المختلفة لأرانب سدس المختلفة اللون (البيج والبنى الفاتح والبنى القاتم) اظهرت اختلاف فى الظواهر المدروسة . وكان اللون البنى الفاتح أعلاها والبنى القاتم اقلها .

التعريض لضوء الشمس المباشر سبب زيادة كبيرة فى حرارة الجلد والشعر وحرارة الجسم التى بلغت اقصاها بعد ٣٠ دقيقة من التعرض للشمس . وقد وصلت حرارة الجلد الى درجة أعلى من حرارة الجسم بعد ١٠ دقائق من التعريض للشمس . وكانت الأرانب البنية القاتمة أسرع فى التأثر متبوعة بالبنية الفاتحة ثم البيضاء. التلوين الصناعى للأرانب البيضاء باللون الأسود والبنفسجى والأحمر لم يسبب زيادة فى حرارة الجسم وزيادة طفيفة فى حرارة الجلد والأذن عند التعريض للشمس المباشرة .