A C T A T H E R I O L O G I C A

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Piotr POCZOPKO

# The Development of Resistance to Cooling in Baby Rabbits

[With 3 Tables & 4 Figs]

The studies were carried out on baby rabbits born in autumn or spring in cages kept in an open shed. The air temperautre in the shed varied from 2 to 25°C but the nest temperature was almost independent of these changes and in the coldest part of nest amounted to 20—26°C. The normal body temperature of baby rabbits 1 hr after birth was equal to 34.2°C. During the first day it rose to approximately 37°C but then the increase was more slow and after 1 month it reached the normal temperature of adult rabbits (39.6°C). New-born rabbits kept separately are not able to maintain a constant body temperature even at relatively high ambient temperatures. The resistance to cooling, however, develops rather quickly. In 20°C 6-day-old rabbits retain constant body temperature and in 8°C 12-day-old specimens. The rate of body cooling of baby rabbits exposed to cold decreases with the age and this decrease is faster than the reduction of the relative body surface area ($cm^2/g$). The increase of resistance to cooling in baby rabbits during first 8 days after birth may be partly explained by the improvement in the mechanism of vasomotor regulation of the heat losses and probably also by the augmented rate of heat production. From the eighth day after birth the hair cover plays more important role in thermal economy of baby rabbits.

## I. INTRODUCTION

In one of the methods of rabbit keeping, recommended even by recent manuals (Kvapil & Serebrjakov, 1960; King Wilson, 1964), cages for these animals are left in open sheds or directly on the open air. Rabbits kept in such conditions are bred in the period from early spring till autumn and sometimes even in winter. Both in the early spring or late autumn the temperature at night is often close to 0°C. Hence one can assume that newly born and almost bare baby rabbits are occasionally exposed to cold despite protection provided by the nest. As a rule, however, they grow and develop normally and after 2 weeks they leave the nest occasionally, and after 3 weeks permanently. The new-born baby rabbits are not able to maintain a constant body temperature, even at relatively high ambient temperatures, but at the time of leaving of the nest they became fully homoiothermic animals. Rather numerous publications concerning the development of thermoregulation in baby rabbits (cited in the subsequent chapters of this study) do not provide the data on the nest temperatures in cold seasons of the year, on average body temperatures of young rabbits staying in the nest, as well as on the rate of changes of body temperature during cooling or warming up and on the development of physical thermoregulation. The investigations described here represent an attempt of filling this deficiency.

## II. MATERIAL AND METHOD

The experiments were carried out in autumn and spring on 93 rabbits of the White Popielno Breed deriving from 14 litters. In the autumn experiments 47 baby rabbits (from 6 litters) born between 19 and 22 September and 13 young rabbits (from 2 litters) born in early August were used. The spring experiments were carried out on 43 baby rabbits (from 6 litters) born between 25 and 29 April.

Cages with rabbits were kept in a shed with three wooden walls and the fourth wall, facing South-East, made of wire net. Adult rabbits were fed *ad libitum* with green feed (clover, vetch, bird's foot) and fodder beets, white carrot and oat seeds. The rye straw was used as a litter and nest material.

The experimental procedure included: recording of the air temperature in the shed, of the temperature in the nest and of the rectal temperature of baby rabbits in various age. This last measurement was carried out immediately after taking an animal out of the nest whereas additional determinations of rectal and skin temperatures were made during 1 hr cooling period and successive 1 hr warming up. The cooling was carried out in most cases by exposure of baby rabbits to 8°C. A less numerous group of animals was cooled at 20°C and very few at 16°C. The warming was carried out in all cases in 30°C.

Recording of the air temperature in the shed was achieved by using a clock--work thermograph placed in an empty rabbit cage. The rectal and skin temperatures were measured with a thermistor thermometer (Yellow Springs Instrument Co., Model 46).

The effect of cooling or warming on the body and skin temperature of the baby rabbits was studied in the following manner: the selected animal was taken out of the nest, placed on a wooden lath and covered with a little box made of a soft wire net and attached to the lath. The box was adjusted to the animal's size to prevent him from turning round or crawling but without complete restriction of movements. The thermistor probe was put into the rectum and fixed with an adhesive tape. Then the animal was placed in a wire net cage and transferred to a cold room or to a thermostatic room. It was possible to read off continuously the rectal temperature during cooling. Skin temperature was measured every 15 minutes with a suitably adapted probe which was consecutively applied to selected points on the body surface. After 1 hr cooling the animal was transferred into a small thermostatic chamber set on 30°C and the measurements were continued. The animal could be observed by a glass wall of the chamber while the skin probe was placed in a proper position by using an attached sleeve and a glove. Skin temperature was measured in every case on the forehead, poll, back and flank.

## III. RESULTS

### 1. Air Temperature in the Shed and the Nest Temperature

In the autumn experiments, carried out between 19th September and 21 October, the air temperature in the shed remained within the range of 2 to 14°C. In warmer days it raised to 20—25°C in a midday, whereas in two exceptionally fine days it reached 31°C in the afternoon.

The nest temperature is difficult to be determined accurately, but in general it does not depend on the ambient temperature. The temperature of the nest bottom (under baby rabbits) varied within the range of 24

**Table 1.**
Deep (rectal) body temperature in rabbits of different age.

| Age | Body weight (g) | Number of determinations | Temperature °C | | |
|---|---|---|---|---|---|
| | | | Mean | S.D. ± | S.E. ± |
| 1 hr | 30—42 | 3 | 34.2* | | |
| 2 | 32—41 | 5 | 35.5 | 0.47 | 0.21 |
| 16 | 31—45 | 8 | 35.9 | 0.61 | 0.21 |
| 27 | 37—58 | 8 | 37.1 | 0.39 | 0.14 |
| 3 days | 43—80 | 8 | 37.3 | 0.52 | 0.18 |
| 4 | 70—110 | 12 | 37.2 | 0.39 | 0.11 |
| 5 | 69—115 | 10 | 37.3 | 0.60 | 0.19 |
| 7 | 90—140 | 10 | 37.1 | 0.25 | 0.07 |
| 9 | 135—164 | 15 | 37.6 | 0.45 | 0.11 |
| 11 | 142—208 | 21 | 38.6 | 0.23 | 0.05 |
| 12 | 145—217 | 15 | 38.5 | 0.17 | 0.04 |
| 17 | 162—311 | 21 | 38.5 | 0.34 | 0.07 |
| 18 | 170—320 | 16 | 38.5 | 0.18 | 0.05 |
| 22 | 201—350 | 16 | 38.3 | 0.49 | 0.12 |
| 25 | 240—365 | 20 | 38.6 | 0.37 | 0.08 |
| 29 | 282—415 | 28 | 39.8 | 0.26 | 0.05 |
| 90—120 | 965—1820 | 36 | 39.6 | 0.16 | 0.03 |

*) Individual temperatures of three specimens: 34.0, 34.2, 34.4

and 33°C. The temperature measured in the space between baby rabbits was close to their body temperature while in the upper part of the nest, 1—2 cm above the rabbits, but under the cover, it remained within limits of 20 to 26°C. The effect of the baby rabbits age on the nest temperature was only small. Slightly lower temperatures (19—23°C) were recorded in the upper part of nests occupied by new-born rabbits during the first day after birth. Lower temperatures were also found in the nests, usually uncovered, with 9 days old, or older rabbits.

The air temperature in the shed varied in a broad range during spring studies. During rather cold nights (25th April — 16th May) the temperature remained within limits of 8 to 12°C, but during a day, already at 10 a.m., increased to 20°C, and during the afternoon even to 30°C. The nest temperature, however, showed a similar pattern as in autumn. It was observed, that in midday the nests remained uncovered; this never occurred in morning hours, or in autumn.

### 2. Body Temperature

Body temperature was measured between $8^{30}$ and $9^{30}$ in the morning. The baby rabbits were individually taken out of the nest and immediately the thermistor probe was inserted into the rectum, approximately 1.5 cm in the youngest specimens, and 2 cm in older ones (above 5 days old). Reading of the temperature was made within not more than half a minute after taking a baby rabbit out of the nest. The lowest temperature, 34.2°C on the average, was observed in baby rabbits 1 hr after birth (Table 1). Later the body temperature increased reaching 39.8°C in 29-day-old rabbits. In young rabbits in the age of 90—120 days the rectal temperature amounted to 39.6°C, hence exactly the same as in adult specimens kept on the farm.

### 3. Changes of the Body and Skin Temperatures During Cooling and Warming

The course of alterations of the body and skin temperatures in baby rabbits during cooling in 8°C and warming in 30°C is illustrated in Figs 1 & 2 representing a typical record of results obtained for 8 and 17-day--old specimens. The mean rectal temperature in youngest rabbits cooled in 8°C promptly decreases, with the rate of fall inversely proportional to the animal's age (Fig. 3) In two 2-day-old specimens the body temperature decreased during 45 min. by approximately 16.5°C, hence the mean rate approached 0.37°C/min. After the body temperature had reached 17°C baby rabbits fell into the state of torpidity, did not react to touching by the probe and appeared as dead. The rate of warming up in these rabbits was slightly lower than cooling but already after 10 min. the body temperature increased to 21°C. Then they started to move and react to touch. In 4-day-old baby rabbits the fall of body temperature occurred at a mean rate of 0.17°C/min., and in 8-day-old at 0.06°C/min. The reaction of 10-day-old animals to cooling at 8°C varied: in four out of six specimens a decrease of the body temperature by 0.8 to 2.0°C took place within first 30 min. but later no change was observed. In the remaining specimens cooling did not produce any fall of body temperature. Very slight changes in the body temperature during cooling in 8°C were observed in all groups of older rabbits (12, 15 and 17-day-old) and in some cases even the increase by 0.5 to 0.9°C occurred.

A slight shivering could be detected already in 4-day-old baby rabbits. It appeared also in all specimens at the age of 8 and 10 days and in two 12-day-old ones, but never in older. On the other hand all the baby rabbits above 8th day showed during cooling the phenomenon of pilo-erection.

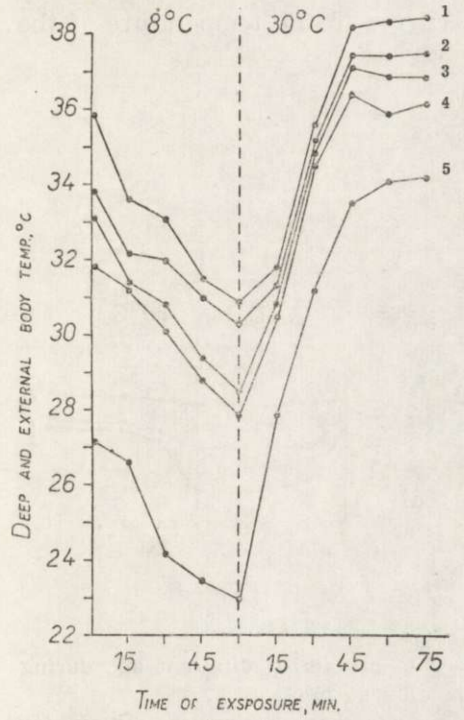


Fig. 1.

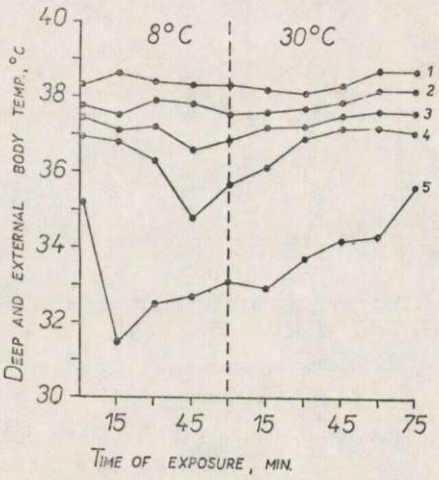


Fig. 2.

Fig. 1. The changes of rectal and skin temperature in 8-day-old rabbit during cooling at 8° and reheating at 30°C.
1 — rectal, 2 — poll, 3 — flank, 4 — back, 5 — forehead.

Fig. 2. The changes of rectal and skin temperature in 17-day-old rabbit during cooling at 8° and reheating at 30°C.
1 — rectal, 2 — poll, 3 — flank, 4 — back, 5 — forehead.

Cooling of baby rabbits at 16°C was carried out on very limited material, hence the results are not conclusive. It seems, however, that at this temperature 8-day-old baby rabbits are able of maintaining the homoiothermy. In one of the two studied 8-day-old rabbits the body temperature was not altered during exposure to 16°C while in the second one it decreased by 1.6°C during 15 min. but later remained constant.

In the temperature of 20°C even 2-day-old rabbits after an initial drop by 2.2°C showed later signs of stabilization. Specimens at the age of 6 days demonstrated in these conditions fully developed homoiothermy (Fig. 4).

Changes of temperature in the individual skin points during cooling and warming were different. The smallest changes were observed for the poll skin, and they were almost parallel to alterations of the body temperature. Slightly bigger changes occurred in the temperature of the

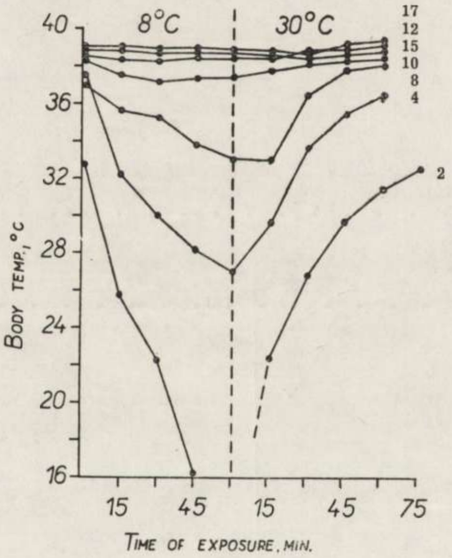


Fig. 3.

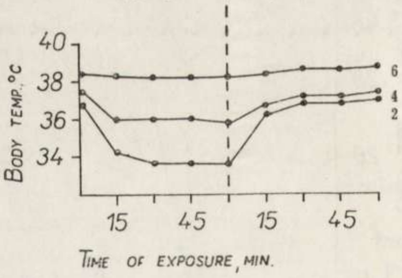


Fig. 4.

Fig. 3. Average changes of rectal temperature in rabbits of different age during cooling at 8°C and reheating at 30°C.
Numerals at the curves denote the age of rabbits in days. Each curve (except for 2-day-old animals) represents mean for 6 individuals.

Fig. 4. Average changes of rectal temperature in 2, 4 and 6-day-old rabbits during cooling at 20°C and reheating at 30°C.
Each curve represents mean for 4 individuals.

flank skin, even more pronounced changes in the back and highest in the forehead. The differences between the mean skin temperature calculated from the results of determinations in the 4 above mentioned points and the rectal temperature are given in Table 2.

## IV. DISCUSSION

According to Adamson (1959) the thermonautrality zone for 6-day--old baby rabbits is within 26 and 27°C. More convincing data were provided by Hull (1965) who found this zone for rabbits in the first day after birth around 35°C, for 3 to 4-day-old rabbits between 32—33°C and for 9 to 10-day-old ones between 29 and 30°C. Irrespectively of the fact which of these data are taken into consideration one can conclude that temperatures recorded at the nest bottom (24—33°C) or at the nest surface (20—26°C) are in the range of physiologically low temperatures. This does not necessarily mean, however, that baby rabbits in the nest feel cold. The reported thermoneutral temperatures were determined for a baby rabbit kept alone whereas the litter in the nest may be regarded as one fairly large organism of rather low body surface area. The low critical temperature for the whole litter is certainly lower by a few degrees than that of an individual specimen. Hence the actual nest conditions provide thermal comfort for baby rabbits.

The temperature of foetus *in utero* must be close to the body temperature of the mother, that is approximately 39.6°C. One hour after birth the body temperature of a baby rabbit was found to be 34.2° thus it markedly dropped. A fast decrease of the body temperature after birth was observed in piglets (Newland *et al.*, 1952), and after hatching in the gosling (Poczopko, 1967). In piglets, however, this temperature quickly increased and in 2 days, at most, reached the level found in an adult pig. In baby rabbits staying in the nest the rise of the body temperature was also fairly rapid but only after one month it stabilized on the level of adult rabbits. Since we assume that the nest provides thermal comfort for baby rabbits the lower body temperature observed during the first month of life cannot be regarded as a state of light hypothermia but as normal physiological phenomenon. It is not at all an exceptional case. Lower body temperature in relation to adult animals was found in young rats (Hill, 1947; Poczopko, 1961), chicken (Randall, 1943) and goslings (Poczopko, 1967). The normal body temperature in rats is achieved within one month similarly to baby rabbits whereas in chicken it takes 20 days and in gosling 5 days.

The ability of new-born rabbits to maintain constant body temperature is negligible. In Hull's experiments (1965) the mean body temperature of baby rabbits kept in 25°C was 35.9 ± 0.24°C while those in 35°C approximately 2°C more, that is 38.1 ± 1°C. An isolated baby rabbit remains in hypothermia even in such thermal conditions as found in the nest, and out of the nest the temperature in early spring and autumn often does not exceede 10°C. It happens sometimes that baby rabbits attached to mother's nipples are dragged out of the nest and remain there for some time. Thus it would be interesting to investigate changes in the body temperature of baby rabbits in temperatures close to those found in cages outside the nest. As it is apparent from Fig. 4, cooling of baby rabbits in 20°C results in a prompt fall of the body temperature in the youngest animals. However, even 2-day-old specimens after the decrease of body temperature by 2.3°C on the average in the initial period of cooling are able to maintain constant body temperature on this lower level. During cooling in 8°C such situation exists only in the case of 10-day-old specimens (Fig. 3). In younger baby rabbits, 2, 4 and 8-day-old, 1 hr exposure in 8°C leads to a steady decrease of body temperature. The rate of fall of body temperature is significantly different in baby rabbits of various age. The mean rate of cooling of the body in 4-day-old animals (in °C/min) was more than two times lower comparing with 2-day-old ones. Similarly this rate in 8-day--old rabbits was almost three times lower than in 4-day-old and approximately six times lower than in 2-day-old. Hence the resistance to cooling develops fairly quickly in baby rabbits.

The homoiothermy results from the equilibrium between the heat production and its loss. The decrease of body temperature in rabbits exposed to 8°C indicates that the heat loss from the organism exceeds heat production. This disproportion is larger in younger animals. Some changes in heat production or its loss, or even in both parameters, must occur during animal's growth to explain the fact that 12-day-old baby rabbits are already able to maintain homoiothermy in the ambient temperature of 8°C. Numerous studies on heat production by baby rabbits indicated that these animals even during the first day after birth produce more heat in cold surroundings than in thermoneutral conditions (Adamson, 1959; Blatteis, 1964; Dawkins & Hull, 1964; Hull, 1964, 1965; Hull & Segal, 1965a, b, c; Moore & Underwood, 1963). The increase of heat production in response to cold occurs despite the fact that shivering in new-born rabbits is not very intensive and even after blocking of motor nerves of muscles by some pharmacological drugs (Dawes & Masyán, 1963). Hence one can conclude that the non-shivering thermogenesis plays a significant role in baby rabbits. According to authors cited above this thermogenesis is possible due to local oxidation of fat accumulated in the interscapular region under the form of brown adipose tissue. This oxidation of fat is mediated by noradrenalin. The increase of heat production in baby rabbits in response to cold does not prevent the drop of the body temperature to occur and when this is significant it must result in the reduction of metabolic rate. Hull (1965) holds an opinion that inability of baby rabbits to maintain a constant body temperature, despite of capability of increased heat production in response to cold, depends on relatively large body surface area devoid of thermal insulation. This conclusion is not too well documented since it appears that heat production in baby rabbits, even increased by cold, is rather limited. According to

Adamson (1959) consumption of oxygen by baby rabbits in the age of 0—5 days and in thermoneutral conditions amounts to 17.2 ml/kg/min and increases two times in response to cold. Assuming the heat equivalent of oxygen equal to 4.8 kcal/l it is possible to calculate that maximal heat production by a rabbit weighing approximately 50 g amounts to 142 kcal/kg/day whereas the heat production by a rat of the same weight (with hair cover) is equal to 150 kcal/kg/day in basal conditions (Kleiber, 1961), and in cold surroundings must be significantly higher. These calculations indicate that heat production of new-born rabbits is relatively small. Of course this conclusion is only approximative since some objections may be raised concerning the validity of calculation of one mean value from experiments carried out on baby rabbits in age of 1 and 5 days. One ought to remember that during first days of postnatal life the metabolism rate is subjected to significant changes.

**Table 2.**

The difference between rectal and mean skin temperature in baby rabbits at the end of cooling (for 60 min.) at 8 or 20°C, and after reheating at 30°C for 30 and 60 minutes.

| Age, days | No. of rabbits | End of cooling | at 30°C (30 min) | at 30°C (60 min) |
|---|---|---|---|---|
| | Cooling at 8°C | | | |
| 2* | 1 | 1.60 | 0.7 | 1.0 |
| 2* | 1 | 1.30 | 0.6 | 0.8 |
| 4 | 6 | 1.47±0.15 | 0.60±0.11 | 1.22±0.10 |
| 8 | 6 | 3.55±0.26 | 1.75±0.10 | 1.97±0.16 |
| 17 | 7 | 2.55±0.11 | 1.65±0.06 | 1.60±0.09 |
| | Cooling at 20°C | | | |
| 2 | 4 | 1.37±0.09 | 0.75±0.005 | 0.70±0.005 |
| 4 | 4 | 1.37±0.13 | 0.80±0.004 | 0.70±0.005 |
| 6 | 5 | 1.50±0.15 | 0.80±0.004 | 0.80±0.006 |

*) Cooled for 45 minutes only.

Despite some objections concerning Hull's (1965) explanations the conclusion may be partially valid. The scanty pelage of baby rabbits constitutes a very weak thermal insulation at least up to the eighth day of life. The regulation of heat losses from the body surface may occur only by vasomotor changes of blood circulation in the skin. In new-born rats the mechanism of vasomotor regulation of heat losses is not developed (Taylor, 1960; Poczopko, 1961) but in baby rabbits the situation is different. Already in 2-day-old rabbits, and perhaps in younger as well, the difference between skin and rectal temperatures is more pronounced in cold than in warm surroundings (Table 2). This indicates that cold produces a relative decrease of blood circulation in the skin. However, the decrease of peripheral circulation is relatively small. In the applied conditions it increased with the age to a maximum at 8 days and then decreased. A possible explanation of this decrease may lie in the fact that improved thermal insulation due to the development of pelage replaces the insulative cooling related to the decrease of blood circulation. The obtained results indicate on the existence of vasomotor regulation of heat losses even in the youngest rabbits. In comparison to other animals this mechanism is, however, poorly developed. The biggest difference between the mean skin and rectal temperatures amounted to 3.55°C in baby rabbits exposed to 8°C whereas in bare men exposed to 10°C this difference reaches approximatively 14°C (Girling, 1964) and in young pigs (also in 10°C) it reaches approximatively 12°C (Ingram, 1964). On the other hand the insulative cooling of baby rabbits is more advanced than that of goslings in which the maximum difference between the mean temperature of skin (with the exception of the extremities) and the body temperature amounted to 2.1°C only, during exposure to 6°C (Poczopko, 1968). The skin of goslings, however, is covered with a dense down protecting from the cold while almost bare skin of baby rabbits does not constitute a significant barrier for the flow of heat from the organism to outside despite some decrease of blood circulation in the skin.

The surface area of new-born rabbits is relatively large and may be calculated from the Meeh formula (1879):

$$S = kW^{2/3}$$

where $S$ = body surface area in cm², $k$ = empirical constant, $W$ = body weight in grams.

Assuming $k = 10$ the body surface area of baby rabbits used in the experiments was calculated (Table 3). It appears that the relative area (in cm²/g) in 4-day-old baby rabbits is 1.32 times smaller than in 2-day--old, whereas the body cooling rate in 4-day-old rabbits was over 2 times lower than in 2-day-old. Similarly, the relative surface area in 8-day-old baby rabbits is 1.10 times lower than in 4-day-old but the rate of body cooling is almost three times smaller. Hence it is clear that the resistance of baby rabbits to cooling increases much faster that the reduction of body surface area occurs.

The decrease of relative body surface of baby rabbits is probably even smaller than it appears from the presented calculations since the constant $k$ value was applied. The value of this coefficient depends on the shape of animal's body and one can suppose that in new-born rabbits with very small ears and disproportionally short limbs this value is below 10 while in older ones is certainly higher. This supposition may derive from results obtained for rats (P o c z o p k o, 1965) where in calculations of body surface area of new-born specimens $k$ value equal to 7.4 is being used while in older animals (weight over 30 g) $k = 11$. Contemporary literature is lacking in the data on changes of $k$ value in postnatal development of rabbits. S p e c t o r (1956) reports, after various authors, 4 different $k$ values for rabbits with the lowest equal to 5.7 and the highest $= 11$. K u d r j a v c e v (1951) gives the value of 12.9 which may be suitable for fairly exact calculation of body surface area in adult rabbits but is certainly too high for new-born ones. The surface area of a baby rabbit of 89 g, computed by employing two coefficients $k = 5.7$ and 12.9, differed by as much as 44%. This example illustrates the range of magnitude of miscalculation when one assumes indiscriminately coefficient values reported even by generally accepted manuals.

**Table 3.**

Surface area of baby rabbits as calculated from the formula $S = 10W^{0.67}$

| Age (days) | Average body weight (g) | Total surface area ($cm^2$) | Relative surface area ($cm^2/g$) |
|---|---|---|---|
| 2 | 38 | 114.5 | 3.01 |
| 4 | 89 | 202.3 | 2.27 |
| 8 | 122 | 250.0 | 2.05 |
| 10 | 152 | 289.6 | 1.90 |
| 12 | 168 | 309.8 | 1.84 |
| 15 | 211 | 372.0 | 1.76 |
| 17 | 242 | 395.4 | 1.63 |

On account of the possibility of committing a serious error in calculation of the body surface area in animals differing in age the values reported in Table 3 should be treated as approximative. They enable, however, a conclusion to be drawn that the development of resistance of baby rabbits to cooling is faster than the decrease of relative body surface of these animals. Hence explanation of this resistance by the decrease in the ratio of body surface area to body weight (H u l l, 1965) cannot be completely satisfactory. Results of the present study indicate that the increase of resistance of baby rabbits to cooling in the period preceding the appearance of pelage may partially depend on the development of vasomotor mechanism of regulation of the heat losses. The gradual increase of heat production in the baby rabbit organism during the first week of postnatal life may also play a prominent role in this respect. This problem, however, requires more accurate investigations to be carried out.

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*Received, May 21, 1969.*

Polish Academy of Sciences,
Institute of Animal Physiology and Nutrition,
Jabłonna near Warsaw.

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Piotr POCZOPKO

## ROZWÓJ OPORNOŚCI KRÓLICZĄT NA CHŁODZENIE

### Streszczenie

Doświadczenia przeprowadzono na króliczętach rodzonych jesienią (19—22 września) i wiosną (25—29 kwietnia), w klatkach trzymanych w otwartej szopie.

Mimo znacznych wahań temperatury powietrza w szopie (2—25°C) temperatura w gniazdach nie ulegała większym zmianom i w najchłodniejszych miejscach gniazda mieściła się w granicach od 20 do 26°C. Mniema się, że wymienione temperatury otoczenia zapewniają komfort termiczny skupionym w gnieździe króliczętom.

Normalne temperatury ciała królicząt różnego wieku podano w tabeli 1. W godzinę po urodzeniu temperatura ciała wynosi około 34,2°C, lecz wzrasta dość szybko w przeciągu pierwszej doby, a następnie wolniej, by w ciągu miesiąca osiągnąć poziom normalny dla dorosłych królików (39,6°C).

Zmiany temperatury ciała i temperatury poszczególnych punktów skóry królicząt w czasie chłodzenia w 8°C i rozgrzewania w 30°C ilustrują przykładowe rysunki 1 i 2. Średnie zmiany temperatury ciała królicząt chłodzonych w 8 i 20°C ilustrują rysunki 3 i 4. Ostatnio wymienione rysunki informują, że zdolność do utrzymania stałej temperatury ciała w temperaturze otoczenia 20°C rozwija się w ciągu 6 dni, a w temperaturze otoczenia 8°C w ciągu 12 dni.

Zestawione w tabeli 2 dane o różnicach między średnią temperaturą skóry a temperaturą rektalną królicząt trzymanych w zimnym i ciepłym środowisku, świadczą o tym, że nawet 2 dniowe króliczęta reagują na chłód względnym zubożeniem krążenia skórnego. Reakcja ta ma największą siłę u królicząt 8 dniowych.

Rozwój oporności królicząt na chłodzenie w ciągu pierwszych 8 dni po urodzeniu da się w części wytłumaczyć rozwojem naczynio-ruchowej regulacji strat ciepła. Prawdopodobnie jednak ten wzrost oporności jest w części uwarunkowany zwiększaniem się tempa produkcji ciepła w ciągu pierwszego tygodnia po urodzeniu. Od ósmego dnia życia coraz poważniejszą rolę w termoregulacji królicząt zaczyna odgrywać okrywa włosowa skóry.

Znajdowane w literaturze tłumaczenie rozwoju stałocieplności królicząt zmniejszaniem się stosunku powierzchni do rozmiarów ciała, w świetle przeprowadzonych kalkulacji (Tabela 3) nie jest zadowalające. Zmniejszanie się względnej powierzchni ciała (cm²/g) jest bowiem wolniejsze niż zmniejszanie się tempa ostygania zwierząt przy ekspozycji do tej samej temperatury otoczenia.