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RELATIONSHIP AMONG THE CLIMATE OF RABBIT HOUSE, THE MIKROCLIMATE OF NEST-BOXES AND SOME BIOPHYSICAL PARAMETERS OF MEAT RABBITS

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Introduction

Important losses in large scale rabbit production throughout the world show that housing, production and nutritional conditions do not meet the environmental requirements of intensive rabbit breeds. Thorough investigation of environmental physiology of rabbits and economics of rabbit production is needed to decide if present large scale production conditions can or could assure microclimatic parameters to which meat rabbits could adapt themselves with profitable production. The aim of this paper is to assess the environmental temperature in the immediate vicinity of rabbits of different ages and the animals' reactions to changes of environmental temperature in a large scale rabbit farm, where rabbit house climate is not controlled. Special attention is paid to the nest-box, the only environment of suckling rabbits up to the age of 17-2o days. There are very few exact data on nest-box temperature; Szuman and Leraczyk /1975/ measured nest-box temperature of mink, Papp et al. /1987/, Ádám and Borka /1985/ reported similar data for meat rabbits.

Material and methods

Temperature measurements were carried out in a large scale rabbit farm in winter /December-February/ and in summer /July-September/. Rabbit houses were not heated except some restricted heating on extremely cold days and no artificial ventilation was applied. The experimental animals /of New Zealand White breed/ were kept in one level breeding cages during suckling. After weaning at the age of 35 days, the young rabbits were placed into two level wire cages, by two. In the breeding barn type "Bikal" nest-boxes were used with a bedding of wood shavings. House temperature and relative air humidity was measured by a thermohygrograph between the birth of rabbits and the end of fattening. Hair nest, bedding and nest-box air temperatures were measured by a thermistor /type TM-25/

between 1-5 and 15-16 days of age in 12 nests. Nest temperature was an average of 3 measurements, one among the young rabbits and two other measurements at two points at the edge of the nest. The temperature of bedding was measured in the four corners of the nest-box, while air temperature was calculated from three measurements, each about 5 cm above the nest. These data were collected in two house temperature ranges: 2-12°C and 16-24°C. Skin temperature and body weight of the experimental animals were also taken between 1-5, 15-16, 33-36, 59-6o and 89-9o days of age. Skin temperature was measured by a type TM-25 thermistor on withers, hindquarters, two sides, belly and on the periphery at four points /on the side of the ears, on the pad of the right forefoot and of the left hind foot/. Data were processed with an IBM Series-I computer. Average values were compared by Student's t-test. Relationship between environmental factors and the reactions of the animals were examined with a regression analysis.

Results and Discussion

Environmental temperature

1. House temperature /table 1./ during winter months/ outside temperature -1o,o° - +13,o°C/ was found to be rather low. Breeding barn temperatures between +2,o°C and +12,5°C, $\bar{x}\pm s$ = 7,5±2,1°C/ are much lower than that of the optimal 15-2o°C /Papp et al., 1981, 1983, 1987/ and they often do not even reach 1o°C, the lowest recommended temperature of production /Schlolaut, 1971, 1982, 1987; Schley and Thiel, 1973; Scheelje et al, 1975; Gippert, 198o/. Winter temperatures of the fattening house /11,3°±1,32°C, and 9,3±2,7o°C during the first and second month of fattening, respectively /are not favourable either, as minimum 22-24°C is recommended for some weeks after weaning, 18°C is acceptable for the second part of fattening /Löliger, 197o; Schlolaut, 1971, 1982, 1987; Scheelje et al, 1975; Gippert, 198o; Papp et al, 1981/, while 12°C is satisfactory at the end of fattening /Papp et al, 1981/. In summer /outside temperature between 8°and 33°C/ 24,1±3,1o°C was measured in the breeding barn, which is satisfactory for the young rabbits but milk production of mothers decreased considerably above 2o°C /Papp et al, 1983/. In the fattening house both daily average temperature and temperature extremities fell into the thermoneutral zone, to the vicinity of the optimal temperature.

2. Nest-box temperature /table 2./

Relationship between nest-box and rabbit house temperatures was studied at low /2,o-12,o°C/ and neutral /16,o-24,o°C/ house temperatures. Significant correlation was found between the temperatures of the house and those of the bedding, and the air of the nest-box both at low and neutral house temperatures /r=o,8o8 and o,763, o,74o and o,713, respectively/. Correlation between house temperature and nest temperature was significant /r=o,791/ at low house temperature and non-significant /r=o,412/ at neutral house temperature. The average nest-box temperature was satisfactory /27,9±1,21°C/ even at low house temperature / 2,o°-12,o°C/ and it was only slightly different of that measured at neutral house temperature /28,9±1,41°C/, showing well the protective role of the nest-box. On the other hand, temperatures of bedding and nest-box air at low house temperatures /16,2±1,51°C and 15,7±2,13°C, respectively/ did not meet the requirement of rabbits /24,6±2,4o°C and 24,4±2,8o°C, respectively, measured in the neutral temperature zone/. Summing up, although the nest-box can compensate unfavourable climatic effects in the rabbit house, climatic control is not unnecessary; new-born rabbits need at least 14-16°C in the house. In spite of different methods of measurement and calculation, our results, regression and correlation coefficients are in accordance with those published by Szuman and Leraczyk /1975/ and Papp et al. /1987/.

Some biophysical reactions, body weight gain and mortality of rabbits of different ages

1. Skin temperature /table 3./ - Beside studying the climate of the environment of rabbits, skin temperature of the animals was measured in the centre and at the periphery of the body. These biophysical parameters reflect heat control of the animals, they show their comfort feeling and heat load. Although temperature of young rabbits of 1-5 days was measured outside their real environment, the nest, our data confirm the conclusion of Gippert /1971/, Nichelmann et al. /1973,c/ and Rott et al. /1973/: body temperature of some days old rabbits depend on the environmental temperature. Skin temperature of young rabbits taken out of the nest decreased considerably at 2o°C and to a great extent at 1o°C. Data collected at the time of weaning, in the middle and at the end of fattening show that growing rabbits tolerate much better low environmental temperature at the age of 8o-9o days than at the age of 3o-4o days. Difference of skin temperatures measured at low and neutral house temperatures decreased by 6o % in the centre of the body and by 5o % in the periphery between the age of 33 and 9o days. Linear correlation was found between house temperature and temperatures of trunk, ears and pads in the temperature zones studied. Nichelmann et al. /1973, a, b/ also found linear correlation between environmental and trunk temperatures but ear temperature /environmental temperature between o°C an 4o°C/ gave an S-like curve. This conclusion does not necessarily contradict our results: the difference between temperature zones studied explains well the difference between the results.

2. Body weight gain and mortality

Average daily gain of experimental animals was 18,27±3,86 g and 18,42±2,41 g during suckling, 28,28±5,54 g and 28,76±3,o4 g during fattening at low and neutral environmental temperatures, respectively. These data, measured in an insufficient number of animals are confirmed by our other studies with big populations /Ádám et al., 1987/.

Postnatal mortality up to the age of 9o days in the population studied was 39,5 % in winter, at low temperature, and 35,3 % in summer, at neutral temperature. The distribution of mortality during suckling, after weaning and in the last month of fattening: 9,3 %, 23,3 %, 6,9 % and 8,3 %, 18,7 %, and 8,3 %. respectively. Increased mortality after weaning in winter months is undoubtedly due to suboptimal environmental temperature.

Conclusions

Several physiological observations /Gippert, 1971; Rafai et al., 1977; Nichelmann et al., 1973 a, b, c; Rott et al., 1973; Papp et al., 1981; Habibulov and Baumana,1982/ confirm that the most crucial weeks in rabbit raising are those of post-weaning. It is obviously advisable to satisfy the temperature requirement of growing rabbits in this period. Reasonable decrease in energy consumption can be achieved in the last month of fattening, utilizing the growing capacity of heat control in the rabbit, or during suckling, supposing the use of closed, well isolated, abundantly littered nest-boxes, good hygienic condition and healthy well-nourished animals.

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Table 1.: Temperature of breeding and fattening houses without climatic control in winter /December–February/ and in summer /July–September/

		Breeding house		Fattening house			
		Between 1-35 days of age		Between 36-60 days of age		Between 61 - 90 days of age	
House temperature, °C		In winter	In summer	In winter	In summer	In winter	In summer
Daily average	$\bar{x}$	7,5	24,0	11,3	25,6	9,3	22,3
	±s	2,10	3,10	1,92	3,15	2,70	3,75
Daily maximum	$\bar{x}$	9,1	26,9	13,7	28,9	11,8	26,1
	±s	2,00	2,85	1,82	2,02	2,39	3,01
Daily minimum	$\bar{x}$	6,0	21,1	8,9	22,2	6,5	18,4
	±s	2,04	2,73	1,47	2,70	2,44	3,51
Absolute maximum		12,5	34,0	17,0	31,0	18,0	31,0
Absolute minimum		2,0	14,5	7,0	16,5	2,0	14,0

Table 2.: Correlation between house temperature and nest-box /nest, bedding and air in the nest-box/ temparature in low /2-12°C/ and neutral /16-24°C/ temperature zones /measured at 1-5 and 15-16 days of age in 12 nest-boxes/

		Nest temperature, °C		Bedding temperature		Air temperature in the nest-box	
House temperature, °C		$\bar{x}$ ±s	Regression to house temperature	$\bar{x}$ ±s	Regression to house temperature	$\bar{x}$ ±s	Regression to house temperature
Low	$\bar{x}$= 8,5 ±s= 1,86 min= 2,0 max=12,0	27,9 1,21	y = 23,510 + 0,516x r = 0,791/xx/	15,7 2,13	y = 7,752 + 0,929x r = 0,808/xx/	16,2 1,52	y = 10,877 + 0,624x r = 0,763/xx/
Neutral	$\bar{x}$= 21,6 ±s= 1,76 min= 16,0 max= 24,0	28,9 1,42	y = 21,738 + 0,331x r = 0,412/NS/	24,4 2,81	y = -1,139 + 1,179x r = 0,740/xx/	24,6 2,41	y = 3,573 + 0,973x r = 0,713/x/

/xx/ P = 5,0 %
/x/ P = 10,0 %

Table 3.: Correlation between environmental temperature and skin temperature of suckling and fattening rabbits at low / 7 – 13°C/ and neutral /18 – 25°C/ house temperature /measured on 18 individuals at 1-5, 33-36, 59-6o and 89-9o days of age/

	House temperature °C x±s	Skin temperature, °C x+s			House temperature °C x±s	Skin temperature, °C x+s			P%		
		Trunk	Ear	Pad		Trunk	Ear	Pad	Trunk	Ear	Pad
Suckling rabbits	9,9	32,9	29,5	29,4	20,1	35,5	33,6	33,8	0,1	0,1	0,1
	1,76	0,63	1,59	1,38	1,56	0,46	0,68	0,56			
Weaned rabbits	10,8	34,7	20,0	27,2	23,7	36,8	33,5	35,1	0,1	0,1	0,1
	1,34	0,90	2,65	1,77	1,73	0,46	1,21	0,72			
Fattening rabbits	11,2	35,1	23,6	29,3	23,6	35,8	29,9	33,3	5,0	0,1	0,1
	1,48	0,20	2,31	0,87	2,92	0,81	2,71	1,24			

	REGRESSION TO HOUSE TEMPERATURE					
	At low house temperature /7–13°C/			At neutral house temperature /18–25°C /		
	y = A + Bx	r	P%	y = A + Bx	r	P%
Trunk temperature						
Weaned rabbits	y = 29,845 + 0,445x	0,667	10,0	y = 31,386 + 0,2o3x	0,760	5,0
Fattening rabbits	y = 34,243 + 0,072x	0,520	NS	y = 30,449 + 0,225x	0,810	5,0
Ear temperature						
Weaned rabbits	y = 0,373 + 1,822x	0,923	1,0	y = 18,752 + 0,553x	0,785	5,0
Fattening rabbits	y = 8,566 + 1,346x	0,861	1,0	y = 11,271 + 0,789x	0,850	1,0
Pad temperature						
Weaned rabbits	y = 17,711 + 0,875x	0,665	10,0	y = 26,123 + 0,337x	0,806	5,0
Fattening rabbits	y = 24,541 + 0,422x	0,713	5,0	y = 26,035 + 0,309x	0,727	5,0

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Microclimate examinations and biophysical measurements were carried out in breeding and fattening rabbit house of a large-scale farm. A close linear correlation was found between the temperature in the house and the temperature of air and nest in the nest box, both at low /2-12°C/ and neutral /16-24°C/ temperature zones. Data registered in the 12 nest boxes on 1-5. and 15-16. days of age were submitted to regression analysis. Our measurements and the regression equations both indicate, that the nest box can significantly temper the unfavourable effects of the house. At lasting low temperature however the nest box itself cannot meet the temperature demand of suckling rabbits. Skin temperatures of New Zealand White rabbits together with rate and temporal distribution of mortality in the experimental populations suggest: only rabbits older than 7o days can satisfactorily adapt themselves to low environmental temperature; therefore economizing on heating energy is possible mainly in the last month of fattening.

ZUSAMMENHÄNGE ZWISCHEN DEM STALLKLIMA, DEM NISTKASTENMIKROKLIMA UND EINIGEN BIOPHYSISCHEN PARAMETERN DER FLEISCHKANINCHEN

Es wurden Mikroklimauntersuchungen und biophysische Messungen in Zucht- und Mastkaninchenställen eines Grossbetriebes durchgeführt. Zwischen der Stalltemperatur und den Luftraum- und Nesttemperaturen im Nistkasten /die Messungen fanden am 5 bis 6., und am 15 bis 16. Lebenstage statt/ wurde eine enge Korrelation festgestellt, sowohl bei einer in niedrigem /2 bis 12°C/, als auch bei einer in neutralem /16 bis 24°C/ Intervall schwankenden Stalltemperatur. Die Ergebnisse der Messungen und der Regressionsanalyse weisen darauf hin, dass der Nistkasten die ungünstigen Veränderungen des Stallklimas wesentlich dämpfen kann, trotzdem können die Temperaturansprüche der Saugkaninchen im Falle einer anhaltend niedrigen Stalltemperatur ohne Raumheizung nicht befriedigt werden. Auf Grund der an Kaninchen von verschiedenem Alter /Rasse: Weisse Neuseeländer/ durchgeführten Hauttemperaturmessungen und der Grösse und der zeitlichen Verteilung der Mortalität meinen die Verfasser, dass sich nur die Kaninchen, die älter als 7o Tage sind, der niedrigen Umwelttemperatur gut anpassen können, infolgedessen ist das Sparen mit der Heizungsenergie erst in dem letzten Monat der Mastzeit empfehlenswert.

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