EFFECTS OF DIFFERENT ENVIRONMENTAL TEMPERATURES ON THE REPRODUCTIVE PERFORMANCE OF RABBIT DOES DIVERGENTLY SELECTED FOR TOTAL BODY FAT CONTENT

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ABSTRACT

The experiment was conducted at Kaposvár University with Pannon Ka (maternal line) rabbits which were divergently selected for low (Lean) or high (Fat) total body fat content. Rabbit does in the fifth generation were housed in two identical rooms (30 Lean and 30 Fat does/room) which were only different in temperature (normal: 20°C or warm: 30°C). The performance of does was examined during two consecutive reproductive cycles. Kindling rate was significantly higher in the Fat line only in the first cycle (P<0.05). The 21-day litter size was higher for the Fat group in both cycles (P<0.05). Litter weight at 21 day was higher at the normal temperature (P<0.001). The feed intake of the does was higher in normal temperature (P<0.001). The milk yield of does was measured during the first cycle, and it was lower in the warm room (P<0.001), but difference between lines was not observed. Ultimately, high temperatures are less detrimental to the production of rabbit does with more fat reserves than lean rabbits.

Key words: Ambient temperature, Fat reserves, Reproduction, Rabbit

INTRODUCTION

In intensive and semi-intensive reproductive rhythms, the rabbit does are inseminated 1-3 and 11 d after kindling, respectively during lactation, and therefore energy and nutrients are required simultaneously for milk production and fetal development. If the need of the doe is not sufficiently met with the requirement, energy used for milk production may also inhibit fetal growth and vice versa (Fortun-Lamothe, 2006). It is expected that the performance of does with higher body fat depots does not deteriorate so much at the end of pregnancy and at the peak of lactation. According to Kasza *et al.* (2016), the selection for total body fat content based on computer tomography (CT) estimation was successful, the amount of perirenal fat was significantly increased at the age of 11 weeks. Kasza *et al.* (2017) also investigated the effect of divergent selection for total body fat content, and it was demonstrated that does selected for higher body fat content had better reproductive performance; in the 4th generation the kindling rate was higher and mortality of suckling kits was lower in Fat does compared to the Lean line.

Heat stress can cause significant changes in the biological functions of rabbits: dehydration, reduced feed intake, and disrupted metabolic processes, energy balance, and enzymatic reactions (Abo-El-Ezz *et al.*, 1987). Elevation of the ambient temperature above 26-28 ° C already causes a significant decrease in feed intake (Szendrő *et al.*, 2018). Adult rabbits exposed to heat stress may adversely affect reproductive parameters such as sexual maturity, pregnancy rate, litter size and weight, milk production, fetal and suckling mortality (Marai *et al.*, 2002). In heat, the rabbits lack energy and their condition may deteriorates more than at normal temperatures.

The aim of the study was to examine the effect of heat stress on the reproductive performance of rabbit does divergently selected for total body fat contents.

MATERIALS AND METHODS

Animals and experimental design

The experiment was conducted at Kaposvár University with Pannon Ka (maternal line) rabbits which were divergently selected for total body fat content during five generations (Kasza *et al.*, 2017). The 3rd and 4th parturitions of the does were examined (first and second cycle). The does were individually housed in flat deck cages (86 x 38 x 30 cm, included the nest box /28.5 x 38 cm/). Commercial pellet (DE: 11MJ/kg; CP: 18.1%; CF: 15.3%) and drinking water from nipple drinkers were available *ad libitum*. The daily lighting was 16 hours. Fat (n=30) and Lean (n=30) multiparous rabbit does were housed in the two rooms. The experiment was conducted in summer. In one of the two rooms, the ambient temperature was about 20 ° C provided by an air conditioner (C: 18.5-24.9 °C), while in the other room there was no cooling from the parturition in the first cycle (warm; 30 °C: 26-32.3 °C), and then continuously until the end of the second cycle. The rabbits were inseminated at 25 days after parturition. Cross-fostering was applied within groups (max. 10 kits per litter). The results of two consecutive reproductive cycles were evaluated. During the first cycle when controlled nursing was applied, milk production of does was measured at 3, 5, 7, 9, 12, 14, and 16 days of lactation. Feed intake was measured between 3-9, 10-16, 17-21 days.

Statistical Analysis

Production data were evaluated using the GLM test (fixed factors: line, temperature), kindling rate and mortality was compared using the Chi^2 test. For statistical analysis version 3.4.1 of the R program package was used.

RESULTS AND DISCUSSION

The kindling rate of Fat does was significantly higher than that of Lean does in cycle 1 (P<0.05), however in the cycle 2 no significant difference was found between the lines (Table 1). According to Bonnano *et al.* (2008), the poorer fertility of rabbits is caused by excess fat rather than poor condition, however in our study the higher fat depots did not mean obesity. Probably does with higher reserves may have higher leptin levels, which may have facilitated fertility (Arias-Álvarez *et al.*, 2010).

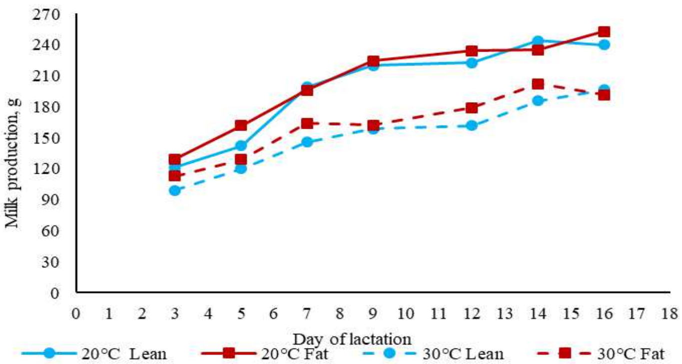
There was no difference in the number of total, born alive, and stillborn kits between the lines and temperatures (Table 1). However, the 21-day litter size was higher for the Fat group in both cycles (P<0,05). The litter weights at 21 d were unaffected by the line, but they were significantly lower at high temperature than that on normal temperature (P<0.001) (Table 1). Hassan *et al.* (1994) found that temperature had no effect on 21-day litter weight, while Marai *et al.* (2002) found that the litter weight at 21 d was significantly lower in summer than at normal or low temperatures. In the first cycle, there was no significant difference between the lines in the mortality of suckling rabbits (Table 1). Kasza *et al.* (2017) found lower mortality in Fat line than in Lean line. Bonnano *et al.* (2008) observed that does with poorer conditions raised smaller litters because during the first 11 days of lactation they had a higher rate of suckling mortality than does in good condition. The suckling mortality was significantly affected by the temperature. In the second cycle higher mortality rate was observed in higher temperature (P<0.001) which is consistent with literature (Bonnano *et al.*, 2008) (Table 1). The difference between the two cycle may have been due to the fact that does were allowed to nurse the kits once a day during the first cycle, whereas free nursing was used in the second cycle.

Table 1: Effect of the different temperatures on the performance of does

Temperature	20°C		30°C		*SEM*	*Prob.*		
						Line	*Temperature*	*Line x Temperature*
Line	**Lean**	**Fat**	**Lean**	**Fat**				
1st cycle								
Kindled does/AI*	21/28	32/36	22/31	28/33	-	-	-	-
Kindling rate, %	75.0	88.9	71.0	84.8	-	0.045	0.504	-
Litter size								
total	10.3	9.48	9.05	9.63	0.32	0.907	0.346	0.457
born alive	9.60	9.35	8.43	9.30	0.31	0.629	0.400	0.375
at 21 d	7.45	7.84	6.95	8.33	0.16	0.007	0.793	0.124
Litter weight at 21 d, kg	2.71	2.73	2.14	2.27	55.6	0.431	<0.001	0.144
Mortality 0-21 d, %	18.6	15.6	14.1	8.20	-	0.074	0.008	-
Feed intake 3-21 d, g/day	410	406	292	296	7.02	0.970	<0.001	0.620
2nd cycle								
Kindled does/AI*	20/24	28/36	19/28	26/30	-	-	-	-
Kindling rate, %	83.3	77.8	67.9	86.7	-	0.368	0.748	-
Litter size								
total	7.67	9.69	8.64	8.96	0.35	0.093	0.866	0.251
born alive	7.50	8.72	7.64	8.36	0.35	0.185	0.795	0.733
at 21 d	6.67	7.96	5.29	5.57	0.19	0.010	<0.001	0.113
Litter weight at 21 d, kg	2.42	2.71	1.67	1.67	69.5	0.123	<0.001	0.515
Mortality 0-21 d, %	13.0	10.1	30.8	29.1	-	0.566	<0.001	-
Feed intake 3-21 d, g/day	355	364	265	260	7.35	0.791	<0.001	0.519

*AI: Artifical insemination

Feed intake (Table 1) and milk production (Figure 1) showed a similar trend, which confirms the literature Szendrő *et al.* (2018). The high temperature significantly reduced milk production in both lines, as found by Marai *et al.* (2002) and Szendrő *et al.* (2018). Milk production of does was strongly influenced by the ambient temperature through the lower feed intake made by does at high temperature, but milk production of Fat does showed less fluctuation than that of Lean does.



Probability

Day	*3*	*5*	*7*	*9*	*12*	*14*	*16*
Line	0.151	0.072	0.424	0.651	0.133	0.729	0.732
Temperature	0.011	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Line x Temperature	0.708	0.526	0.24	0.958	0.758	0.264	0.437

Figure 1: The milk production of divergently selected does at different temperature

CONCLUSIONS

Higher ambient temperature adversely affected the feed intake and as a consequence the milk production and the reproductive performance of rabbit does. At the same time, rabbits selected for higher body fat content achieved better results due to more energy reserves. Ultimately, high temperatures are less detrimental to the production of rabbit does with more fat reserves than lean rabbits.

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