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Izvirni znanstveni prispevek

REPRODUCTION OF RABBIT DOES DIVERGENTLY SELECTED FOR BODY FAT CONTENT

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ABSTRACT

Body fat content of Pannon White rabbits was determined at 10 weeks of age using an EM-SCAN SA-3152 type Small Animal Body Composition Analyser (TOBEC method). Based on the fat determined content, the best and worst 16% of does and the best and worst 8% of bucks were chosen and mated with each other (a fatty doe with a fatty buck and a lean doe with a lean buck). Changes in the conception rate showed that rabbits selected for a high body fat content became pregnant at a higher rate compared to rabbits with a low body fat. In contrast to this non-fatty does showed better results in the case of litter size at birth. In the case of alive born pups also the superiority of non-fatty does was observed, but the differences between the groups were less important in this case. The reason of this may be in the changes of dead born pups. The mortality rate of pups during the suckling period (till 21 days of age) showed that the mortality of the offspring of non-fatty does was higher compared to the offspring of fatty ones. As conclusion it was established, that does selected for high body fat content have mostly higher conception rate, produce smaller litters at birth, but because of the lower mortality rate of their offspring during the suckling period they have larger and heavier litters at 21 day after parturition as compared to the non-fatty ones.

Key words: rabbits / reproduction / selection / fat / TOBEC

REPRODUKCIJSKE LASTNOSTI KUNK GLEDE NA RAZLIČNO VSEBNOST TELESNE MAŠČOBE

IZVLEČEK

Pri pasmi panonski beli kunec je bila določena vsebnost telesne maščobe s pomočjo aparata za merjenje telesne maščobe pri malih živalih tipa EM-SCAN SA-3153 (po metodi TOBEC). Glede na izmerjeno vsebnost maščobe je bilo izbranih 18 % najboljših in najslabših kunčjih samic ter 8% najboljših in najslabših samcev, ki so jih med seboj parili (zamaščene samice z zamaščenimi samci in suhe samice s suhimi samci). Samice z visoko vsebnostjo telesne maščobe so imele boljšo stopnjo oploditve kot samice z malo telesne maščobe. Nasprotno pa so samice z manj telesne maščobe imele večja gnezda. Prav tako so imele samice z manj telesne maščobe več živorojenih mladičev, vendar pa se je razlika med skupinama spremenila v primerjavi s skupnim številom rojenih mladičev. Smrtnost mladičev v sesnem obdobju (do 21. dneva starosti) je bila pri potomcih manj zamaščenih samic večja kot pri potomcih zamaščenih samic. Kunčje samice z več telesne maščobe so imele v večini večji delež oploditve, manjše potomce ob rojstvu, vendar pa zaradi manjše smrtnosti mladičev v sesnem obdobju večje in težje potomce po 21. dnevu starosti v primerjavi z manj zamaščenimi samicami.

Ključne besede: kunci / reprodukcija / selekcija / maščoba / TOBEC

INTRODUCTION

It is widely known that the reproductive traits of rabbit does are markedly affected by several genetic and environmental factors. Among them were the effects of housing, rearing and nutritional conditions, the effect of season and genotype, the maternal effect and the effect of actual reproductive status the often studied in former experiments. The effect of body composition (particularly the effect of body fat reserves) was, however, not a focus of these works, but in other species (O'Dowd *et al*., 1997; Adamczewski *et al*., 1998), and also in some human cases (Norman and Clark, 1998) it was already studied. As a result of these works it was concluded that body fat content has a significant effect on the reproductive performance of animals and women. It was pointed out that the extreme high and extreme low body fat content are equally unfavourable for the reproductive performance, which results in lower conception rate and litter size at birth and in grievous cases in the outage of oestrus. In this experiment we used the TOBEC (Total Body Electrical Conductivity) method for selecting rabbit does based on their body fat content to compare the reproductive performance of fatty and non-fatty animals.

MATERIAL AND METHODS

The experiment was carried out with Pannon White rabbits, which were kept in a closed building, in a cages of 800x500mm, under artificial lighting conditions (16 hours per day). For the *ad libitum* feeding of the animals a commercial pelleted diet (DE 10.30 MJ kg^{-1}, crude protein 17.5%, crude fat 3.6%, crude fibre 12.4%) was used. Drinking water was available continuously from self-drinkers.

At 10 weeks of age the animals were weighed and those representing the average (average ± standard deviation) in the live weight and in the daily weight gain between 6 and 10 weeks of age were chosen for the experiment. Their fat content was determined by an EM-SCAN SA-3152 type small animal body composition analyzer, by the so-called TOBEC method. All of the animals were measured three times and the average of these measures was used for further calculations. The coefficient of variation was under 2% in every case. The fat content of the rabbits was calculated from the values measured using a prediction equation developed formerly (Milisits *et al*., 2000).

Based on the predicted fat contents the extreme 16–16% from the does and the extreme 8–8% from the bucks were chosen for the experiment. Fatty does were inseminated with the sperm of fatty bucks and lean does with sperm of lean bucks. For every insemination fresh, attenuated sperm was used. At the first insemination (at 17 weeks of age) does were inseminated with sperm of bucks outside the experiment, since bucks chosen did not reach their breeding ability (maturity) yet. For this reason the first kindling of the does was not evaluated.

During the experiment following data were recorded: conception rate, number of alive born pups, number of dead born pups, litter size at 21 days, litter weight at 21 days and mortality of pups till the 21st day.

Data were evaluated by Independent Samples T-Test and Chi²-test using the SPSS statistical software package (SPSS for Windows, 1999).

RESULTS

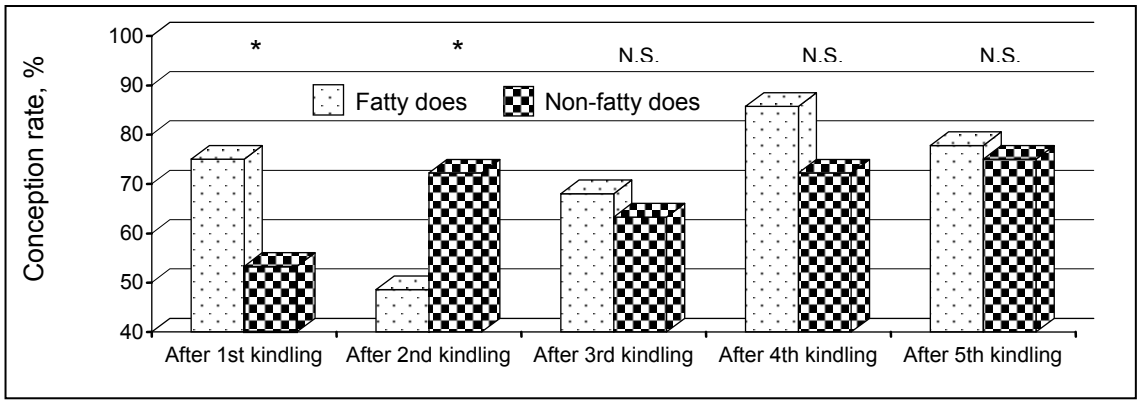
The most important data of the selected animals are summarized in Table 1.

From these details it could be established that the predicted body fat content of fatty and non-fatty animals differed markedly. The differences observed between fatty and non-fatty does and fatty and non-fatty bucks were also statistically proven ($P<0.05$).

Table 1. Liveweight and body fat content of the rabbits selected for the experiment

Traits	Fatty				Non-fatty			
	Does (n=63)		Bucks (n=33)		Does (n=57)		Bucks (n=36)	
	Avg.	S. D.	Avg.	S. D.	Avg.	S. D.	Avg.	S. D.
Liveweight at 10 weeks of age, g	2280	140	2346	191	2305	174	2277	166
Body fat, %	7.5	1.4	8.4	1.3	4.2	1.4	3.6	1.4

The examination of changes in the conception rate showed that rabbits selected for high body fat content became pregnant at a higher rate than rabbits with low body fat, except the insemination after the second kindling (Figure 1).



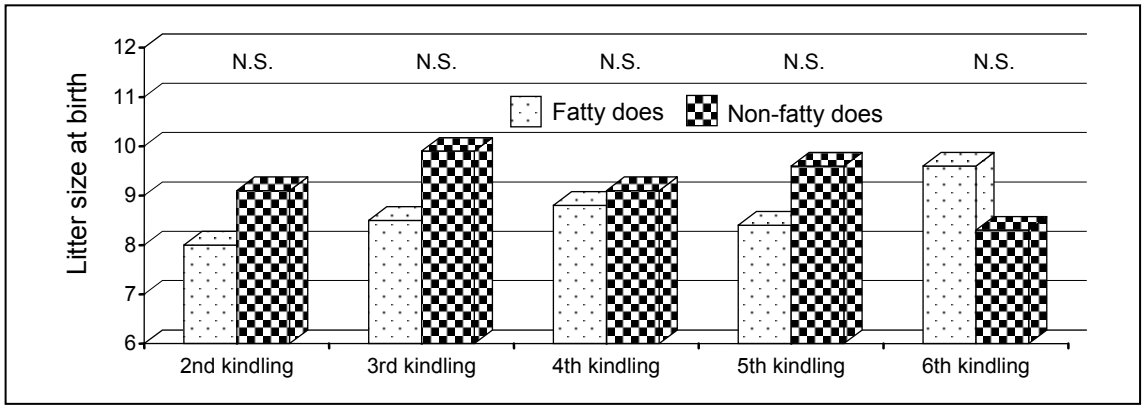
N.S. = non significant difference; * = P<0.05

Figure 1. Changes in the conception rate of fatty and non-fatty does.

In the case of fatty does the conception rate reached or exceeded the 75% three times from the five inseminations, while rabbit does selected for low body fat could realize this rate only once. The required inseminations for pregnancy were 1.3, 1.5, 1.3, 1.1 and 1.1 in the group of fatty does and 1.5, 1.2, 1.3, 1.1 and 1.1 in the group of non-fatty does, respectively.

At the same time it was interesting to see that the fatty does, which showing better conception rates four times from the five inseminations, reached only a significantly lower (P<0.05) conception rate after the second kindling as the non-fatty ones. The possible reason of this could be that the does selected for high body fat content had enough body reserves at the insemination after the first kindling to produce one more normal litter, but they used this reserve during their pregnancy and some days after the next parturition they did not have enough reserves to become pregnant again. In spite of this some of the does selected for low body fat content became pregnant only at the second or third insemination after the first parturition (31–32 and 52–53 days after kindling respectively) so they had much more time to restore their reserves before the next pregnancy. Presumably they did not use all of these reserves during their second pregnancy and they had enough fat in their body 10–11 days after parturition to become pregnant again.

In spite of the tendency observed in conception rate the non-fatty does showed better results in the case of litter size at birth (Figure 2).

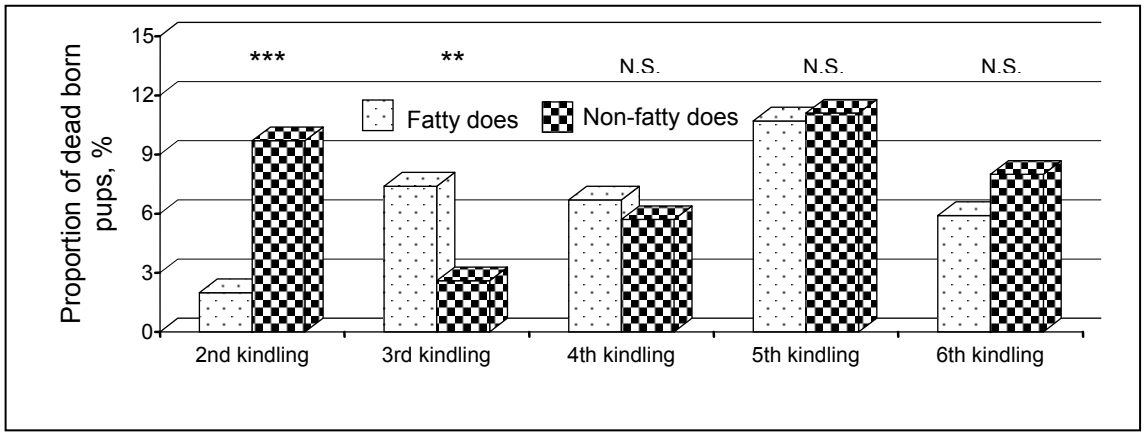


N.S. = non significant difference

Figure 2. Changes in the litter size at birth of fatty and non-fatty does.

Non-fatty does produced litters with 9 or more pups in four cases, while fatty does reached this litter size only once, at their sixth kindling. Because of the high variance of these values within the groups the most important (greater than one) differences between the groups could not be proven statistically.

Also in the case of alive born pups the superiority of non-fatty does could be observed up to the fifth kindling, but the differences between the groups were not so important in this case. The reason of this could be find in the changes of dead born pups, which is shown on Figure 3.



N.S. = non significant difference; ** = P<0.01; *** = P<0.001

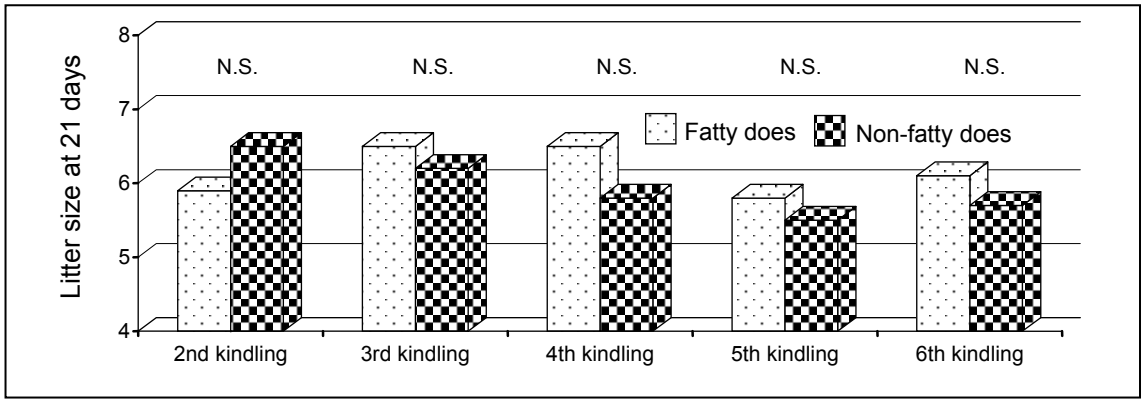
Figure 3. Changes in the proportion of dead born pups of fatty and non-fatty does.

From this figure it can be seen, that the ratio of dead born pups in both group changes in line with the assumed changes of the body fat reserves. By the conception rate it was assumed that fatty does did not have enough reserves to become pregnant for some days after the second kindling. This assumption was confirmed also by the ratio of dead born pups, because its ratio highly increased at the third kindling at that does, which became pregnant after their second parturition in spite of their low body reserves.

By the non-fatty does, the worst conception rate was observed after the first kindling, which was explained also by low body reserves. This assumption was also confirmed by the changes of the ratio of dead born pups, due to important increase of the ratio of dead born pups observed at the second parturition.

Before the fourth kindling it seems that the body reserves returned to normal in both groups, because fatty and non-fatty rabbits produced almost the same ratio (about 6%) of dead born pups at that parturition. Due to the intensive production of these animals it could be observed that the regeneration of body reserves was not for long enough, because the ratio of dead born pups exceeded 10% at the fifth kindling again. Before this high ratio of dead born pups no low conception rates were observed in both groups of animals and therefore it could be assumed that the lack of the body reserves became a mitigating factor only during the pregnancy of these animals.

The lack of the body reserves was proven also by the changes of litter size at 21 days, because the worst results was obtained after the fifth kindling in both groups (Figure 4).



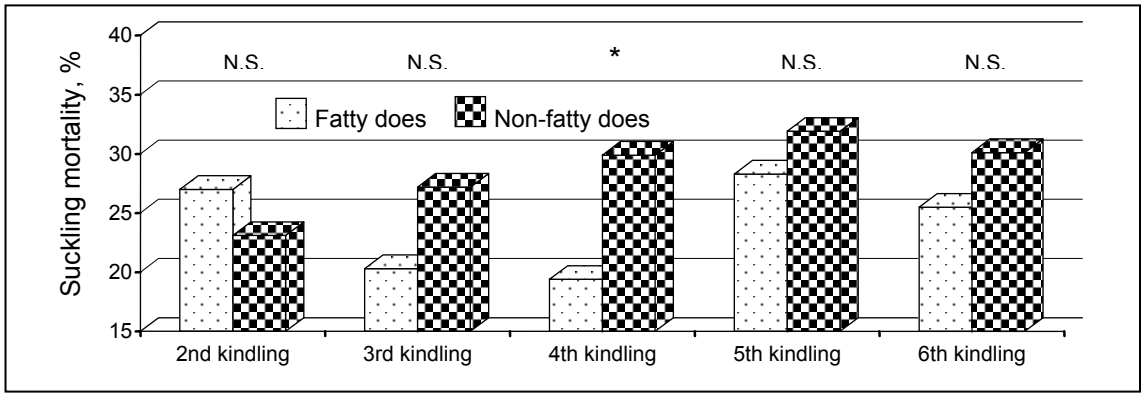
N.S. = non significant difference

Figure 4. Changes in the litter size at 21 days of fatty and non-fatty does.

This low production could also be seen in the litter weight at 21 days in the case of non-fatty does, but fatty does produced litters with the same weight as before (2103, 2113, 2112, 2156, and 2345 in the case of fatty does and 2183, 2166, 2045, 1948 and 2023 in the case of non-fatty does).

We examined the mortality rate of pups during the suckling period (till 21 days of age) and it was established that the mortality of the offspring of non-fatty does was higher as that of the offspring of fatty does, except the suckling period after the second kindling (Figure 5).

The between-group differences were not significant in most cases, only after the 4th kindling.



N.S. = non significant difference; * = P<0.05

Figure 5. Changes in the suckling mortality of fatty and non-fatty does.

DISCUSSION

The most higher ratio of conception rate observed in the fatty does is in agreement with the findings of Adamczewski *et al*. (1998) in muskoxen. In their work it was found that all measures of body mass, fatness and lean body mass were positively related to the probability of pregnancy, but the strongest relationships were found for total fat mass and kidney fat mass. The positive effect of kidney fat mass on the probability of pregnancy was pointed out also by Heard *et al*. (1997) in moose.

As a result of this experiment it was also established that the probability of having twins is also related to kidney fat mass and age. Cows required 1.68 kg of kidney fat to achieve a 50% probability of conceiving twins but only 0.257 kg to achieve a 50% probability of conceiving a single fetus.

In an other work by Wahner *et al*. (1995) it was observed that gilts with high backfat have a higher ovarian activity with more follicles compared with those having low backfat. In accordance with this the results of O'Dowd *et al*. (1997) indicated that the use of nutritional strategies to increase body fat reserves can improve fertility and longeveity in genetically lean, young breeding sows. It was also established that in piglets from sows given fat-supplemented diets the percentage survival as well as the average daily body weight gain to weaning was greater (Knezo *et al*., 1996).

Similar to the pigs, the high-fat diets had a positive effect on the litter size and litter weight at 21 days also in rabbits (Pascual *et al*., 1998) as well.

CONCLUSIONS

Based on the results of this experiment it could be established, that rabbit does selected for high body fat content have mostly higher conception rate and produce smaller litters at birth, but because of the lower mortality rate of their offspring during the suckling period they have larger and heavier litters at 21 days after parturition than the non-fatty does. To determine the optimal body fat content of rabbit does for a long and effective production the evaluation of more details is needed.

ACKNOWLEDGEMENT

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