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## Session
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**Kasza R., Donkó T., Szendrő Zs., Radnai I., Gerencsér Zs., Kacsala L., Farkas T.P., Matics Zs.**

DIVERGENT SELECTION FOR TOTAL BODY FAT CONTENT
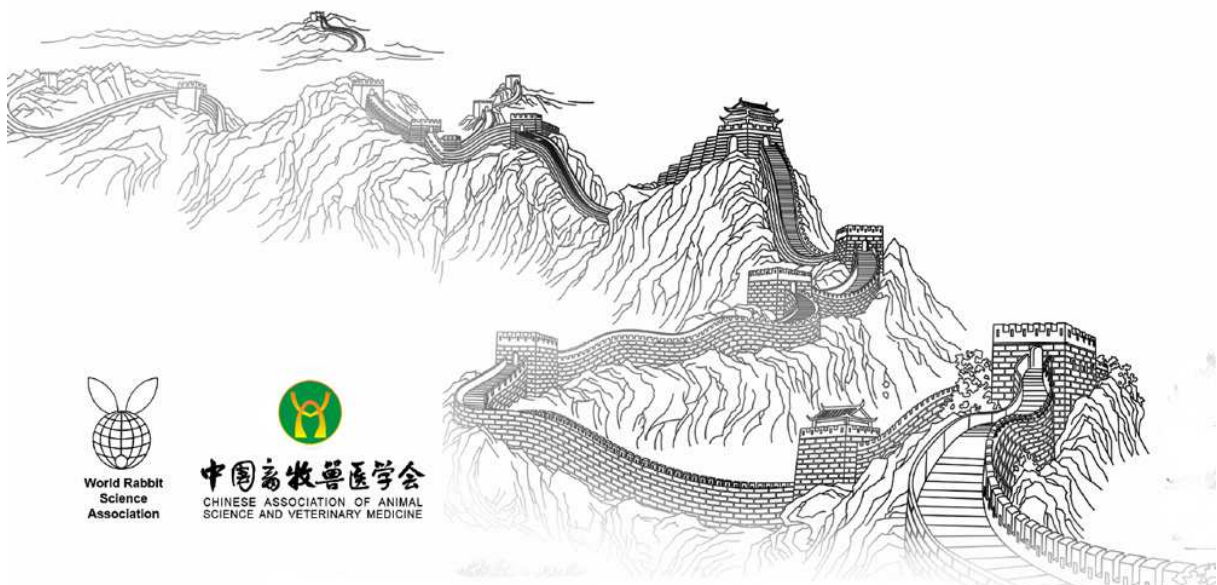1. EFFECT ON THE REPRODUCTIVE PERFORMANCE OF RABBIT DOES

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# DIVERGENT SELECTION FOR TOTAL BODY FAT CONTENT 1. EFFECT ON THE REPRODUCTIVE PERFORMANCE OF RABBIT DOES

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## ABSTRACT

The aim of the research was to perform a divergent selection experiment for total body fat content of rabbits using computer tomography (CT), and to investigate the effect of selection on performance of rabbit does. The experiment was conducted at Kaposvár University with Pannon Ka (maternal line) rabbits. Fat index was calculated at 10 weeks of age by determining the ratio of the total body fat volume (ml) measured by CT to the body weight (kg). The divergent selection significantly affected the fat index and perirenal fat content (Szendrő et al., 2016). The reproductive performances of the does in Generation 1 (Gen1) and Generation 2 (Gen2) were examined during the first 4 consecutive reproductive cycles, while in Generation 3 (Gen3) data of the first two kindlings were evaluated. There were no significant differences between the selected lines in the body weight of the does at kindling at any generation. The reproductive performances of Gen1 and Gen2 were not affected by the divergent selection. In Gen3, the does selected for increased fat content (Fat) had 9 % more total kits born (P<0.1) and 16 % more kits born alive (P<0.01) and 43 % less stillborn (P<0.05) than the does selected for reduced fat content (Lean). Litter size at 21 d was higher in Fat than in Lean line of selection (P<0.05), but it did not differ at 35 d. Litter weights at 21 and 35 d were similar in both lines, but due to difference in prolificacy, the individual weight of kits from Fat line was lower than that of kits from the Lean line. Kit mortality till weaning was independent of the direction of selection. Based on the promising preliminary results of the third generation the divergent selection work will be continued.

**Key words**: Body fat content, Computer tomography, Divergent selection, Rabbit, Reproductive performance

## INTRODUCTION

One problem in animal husbandry is the inadequate condition of breeding females. Does start their reproductive life when they reach about 75-80% of their adult body weight, therefore they still need energy for growth. During the last third of the pregnancy and on the top of the lactation does cannot ingest enough feed to meet their energy requirement, so their body fat deposits are mobilized and their condition deteriorates (Xiccato, 1996).

Castellini *et al.* (2006) observed that does with larger perirenal fat depots were heavier at kindling and produce more milk than those with less perirenal fat. Theilgaard *et al.* (2007) compared a line founded by hyper selection for reproductive longevity and average prolificacy to a line selected for litter size at weaning during 31 generations, considered to be a control line. Does from the first line were heavier, had higher body weight and greater litter size and milk production than control line.

Milisits *et al.* (1998) divergently selected rabbits for total body fat content by TOBEC method. According to Romvári *et al.* (1996) and Milisits *et al.* (1999) the body fat content of rabbits can be determined by computer tomography (CT) with reliable accuracy. Donkó *et al.* (2016) described an improved CT measurement method for total body fat content.

The aim of this study was to investigate the effect of divergent selection for total body fat content on the reproductive performance of does.

## MATERIALS AND METHODS

### Animals And Experimental Design

The experiment was conducted at Kaposvár University with Pannon Ka (maternal line) rabbits. The selection method is described by Kasza *et al.* (2016) and the method of CT measurement is described by Donkó *et al.* (2016). Divergent selection process was based on the fat index. It was calculated at 10 weeks of age by determining the ratio of the total body fat volume (ml) measured by CT to the body weight (kg). The rabbits with the lowest fat index (females: 54.4, 59.2 and 49.1; males: 47.0, 57.0 and 56.6 in generations 1, 2 and 3, respectively) belonged to the group of "Lean" selected animals and those with the highest values (females: 96.4, 86.0 and 90.6; males: 89.7, 90.2 and 86.6 in generations 1, 2 and 3, respectively) belonged to the group of "Fat" selected animals.

Eighteen weeks old does (60 Lean and 60 Fat) were randomly housed in flat deck cages (86 x 38 x 30 cm, included the nest box /28.5 x 38 cm/). Commercial pellets and drinking water from nipple drinkers were available *ad libitum*. The temperature varied between 15-25 °C, depending on the season. Daily lighting was fixed to 16 hours.

Does were first inseminated at the age of 19 weeks. Artificial insemination (AI) was applied at 11 day *post partum* (42 days reproductive rhythm, single batch system). Fat and Lean selected rabbit does were inseminated with the semen from selected bucks of the same line and generation. Cross-fostering was applied within groups with a maximum of 8 kits/litter at first kindling and 10 kits/litter at following parities. Does nursed their kits freely.

The reproductive performances of the does in Generation 1 (Gen1) and Generation 2 (Gen2) were examined during the first four consecutive reproductive cycles. Body weight of does at kindling, kindling rate, litter size (total, alive, at equalization, at 21 and 35 days of age), litter weight and individual body weight of kits at 21 and 35 days of age, suckling mortality between 0-21 and 0-35 days were examined. Overall productivity based on the four parturitions was calculated on the basis of recommendation of IRRG (2005). In Generation 3 (Gen3) similar traits were examined based on the data of the first two parturitions.

### Statistical Analysis

The reproductive traits were compared by GLM procedure and t-test (generation, treatment /fat content/ and insemination order were fixed factors), and the kindling rate and mortality by Chi-square test using SPSS 10.0 software package.

## RESULTS AND DISCUSSION

Reproductive performances of Gen 1 and 2 are shown in *Table 1*. There were no significant differences in the kindling rate between the selected groups and generations. Although at 10 weeks of age there was a notable difference in fat deposition of the Fat and Lean selected rabbits (Szendrő *et al.,* 2016), the body weight of the does after kindling did not differ. The litter sizes (born total, stillborn, at day 21 and 35) showed no significant differences among the groups. Significant difference was only found in the individual weight of kits at 21 d between Fat-Gen1 and Lean-Gen2, Fat-Gen2; and between Lean-Gen2 and Lean-Gen1, Fat-Gen1. The litter weight at 21 and 35 d was not affected by the direction of selection. Mortality of kits between 0-21 and 0-35 days were independent of the direction of selection and the generations.

Quevedo *et al.* (2005) selected rabbits for litter size at weaning and Theilgaard *et al.*, (2006, 2007) selected for prolificacy and they found that, after 12 generations, litter size and milk production increased significantly. Castellini *et al.* (2006) observed that those rabbit does which had larger perirenal fat depots were heavier at kindling and their milk production was higher than that of does with smaller perirenal fat.

**Table 1**: Reproductive performance of rabbit does in Gen 1 and 2 selected divergently for higher or lower body fat content based on the first four reproductive cycles

| | Generation | | | | SE[2] | P |
|---|---|---|---|---|---|---|
| | **1** | | **2** | | | |
| | **Divergent selection** | | | | | |
| | **Lean** | **Fat** | **Lean** | **Fat** | | |
| n (kindled does/AI) | 196/255 | 210/262 | 160/216 | 141/185 | --- | --- |
| Kindling rate, % | 76.9 | 80.2 | 74.1 | 76.2 | --- | 0.461 |
| Weight of the does after kindling[1], kg | 4.26 | 4.21 | 4.20 | 4.24 | 0.02 | 0.529 |
| Litter size[1] | | | | | | |
| total | 10.8 | 10.3 | 10.6 | 10.9 | 0.13 | 0.319 |
| born alive | 10.0 | 9.67 | 9.76 | 9.91 | 0.13 | 0.767 |
| stillborn | 0.81 | 0.63 | 0.83 | 1.01 | 0.07 | 0.243 |
| at equalization | 9.25 | 9.19 | 9.29 | 9.33 | 0.04 | 0.563 |
| at 21d | 8.37 | 8.40 | 8.46 | 8.36 | 0.05 | 0.915 |
| at 35d | 8.17 | 8.14 | 8.26 | 8.11 | 0.06 | 0.814 |
| Individual weight[1], g | | | | | | |
| at 21d | 358[bc] | 360[c] | 340[a] | 344[ab] | 2.06 | *<0.001* |
| at 35d | 806 | 808 | 786 | 788 | 4.15 | 0.130 |
| Litterweight[1], g | | | | | | |
| at 21d | 2.90 | 2.95 | 2.84 | 2.82 | 0.02 | 0.094 |
| at 35d | 6.57 | 6.57 | 6.42 | 6.32 | 0.05 | 0.202 |
| Mortality[1], % | | | | | | |
| 0-21d | 9.48 | 8.63 | 8.92 | 10.3 | --- | 0.444 |
| 0-35d | 11.6 | 11.4 | 11.1 | 13.1 | --- | 0.419 |

[1]Data of does kindled only died kits were not taken into consideration.

[a,b,c]: means with different letters on the same row differ significantly at P<0.05 level.

[2] Standard Error of Mean

There were 6-9 % difference between the generations and only 1-4 % difference between the Lean and Fat groups in the total weight of the weaned rabbits per 100 AI (527 kg; 505 kg; 482 kg; 476 kg in Fat-Gen1, Lean-Gen1, Fat-Gen2, and Lean-Gen2, respectively).

**Table 2**: Reproductive performance of Gen3 rabbit does selected divergently for higher or lower body fat content based on the first two reproductive cycles

| | Divergent selection | | SE[2] | P |
|---|---|---|---|---|
| | **Lean** | **Fat** | | |
| n (kindled does/AI) | 91/111 | 96/117 | --- | --- |
| Kindling rate, % | 82.1 | 82.0 | --- | 0.989 |
| Weight of the does after kindling[1], kg | 4.09 | 4.07 | 0.03 | 0.698 |
| Litter size[1] | | | | |
| total | 8.91 | 9.70 | 0.21 | 0.057 |
| born alive | 7.85 | 9.11 | 0.22 | *0.004* |
| stillborn | 1.06 | 0.60 | 0.12 | *0.047* |
| at equalization | 8.23 | 8.69 | 0.08 | *0.004* |
| at 21d | 7.46 | 7.93 | 0.12 | *0.047* |
| at 35d | 7.37 | 7.65 | 0.12 | 0.242 |
| Individual weight[1], g | | | | |
| at 21d | 350 | 329 | 4.11 | *0.009* |
| at 35d | 818 | 790 | 7.28 | 0.053 |
| Litterweight[1], g | | | | |
| at 21d | 2.57 | 2.60 | 0.04 | 0.766 |
| at 35d | 6.01 | 6.04 | 0.11 | 0.878 |
| Mortality[1], % | | | | |
| 0-21d | 9.33 | 8.77 | --- | 0.712 |
| 0-35d | 10.5 | 11.9 | --- | 0.407 |

[1]Data of does kindled only died kits were not taken into consideration.    [2] Standard Error of Mean

Currently, only the data of the first two parturitions are available for Gen3 (*Table 2*).
The kindling rate and body weight of the does at kindling was not affected by the divergent selection. The Fat selected does had 9 % higher litter size born total (P<0.1) and 16 % higher number of kits born alive (P<0.01), 6% at 21 d, while the number of stillborn kits was lower (P<0.05) compared to the Lean selected group. However, the litter sizes at 35 d did not differ. The litter weights at 21 and 35 d were similar in Lean and Fat groups, but due to the higher litter sizes, the individual weight of kits in Fat group was lower than that of the Lean rabbits. Mortality of kits between 0-21 d and 0-35 d were independent of the direction of selection.

## CONCLUSIONS

The effect of divergent selection for lower and higher fat content (weaker and better body condition) on reproductive performance of does was not effective in the first two generation.

## ACKNOWLEDGEMENTS

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## AIM

In the experiment the effect of divergent selection for total body fat content on reproductive performance of rabbit does was investigated.

## MATERIAL AND METHODS

Divergent selection process was based on the fat index. It was calculated at 10 weeks of age by determining the ratio of the total body fat volume (ml) measured by CT to the body weight (kg).
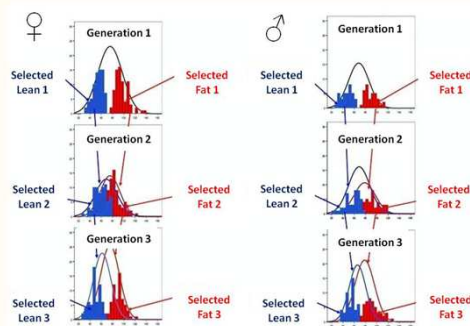


Two groups:

- ■ **„Lean"**: rabbits with the lowest fat index
- ■ **"Fat"**: rabbits with the highest  fat index

**Gen1 & Gen2** were examined during the first four consecutive reproductive cycles of does.

**Gen3** was examined based on the data of the first two parturitions of does.

## RESULTS

**Table 1**: Reproductive performance of rabbit does (during the first four reproductive cycles) in Gen 1 and 2 selected divergently for higher or lower body fat content at 10 weeks of age

| Traits | Generation | | | | P |
|---|---|---|---|---|---|
| | 1 | | 2 | | |
| | Divergent selection | | | | |
| | Lean | Fat | Lean | Fat | |
| n (kindled does/AI) | 196/255 | 210/262 | 160/216 | 141/185 | --- |
| Kindling rate, % | 76.9 | 80.2 | 74.1 | 76.2 | 0.461 |
| Weight of the does at kindling, kg | 4.26 | 4.21 | 4.20 | 4.24 | 0.529 |
| Litter size | | | | | |
| total | 10.8 | 10.3 | 10.6 | 10.9 | 0.319 |
| born alive | 10.0 | 9.67 | 9.76 | 9.91 | 0.767 |
| stillborn | 0.81 | 0.63 | 0.83 | 1.01 | 0.243 |
| at equalization | 9.25 | 9.19 | 9.29 | 9.33 | 0.563 |
| at 21d | 8.37 | 8.40 | 8.46 | 8.36 | 0.915 |
| Individual weight, g | | | | | |
| at 21d | 358[bc] | 360[c] | 340[a] | 344[ab] | **<0.001** |
| Litterweight, g | | | | | |
| at 21d | 2.90 | 2.95 | 2.84 | 2.82 | 0.094 |
| Mortality, % | | | | | |
| 0-21d | 9.48 | 8.63 | 8.92 | 10.3 | 0.444 |

**Table 2:** Reproductive performance of Gen3 rabbit does (the first two reproductive cycles) selected divergently for higher or lower body fat content az 10 weeks of age

| Traits | Divergent selection | | P |
|---|---|---|---|
| | Lean | Fat | |
| n (kindled does/AI) | 91/111 | 96/117 | --- |
| Kindling rate, % | 82.1 | 82.0 | 0.989 |
| Weight of the does at kindling, kg | 4.09 | 4.07 | 0.698 |
| Litter size | | | |
| total | 8.91 | 9.70 | 0.057 |
| born alive | 7.85 | 9.11 | **0.004** |
| stillborn | 1.06 | 0.60 | **0.047** |
| at equalization | 8.23 | 8.69 | **0.004** |
| at 21d | 7.46 | 7.93 | **0.047** |
| Individual weight, g | | | |
| at 21d | 350 | 329 | **0.009** |
| Litterweight, g | | | |
| at 21d | 2.57 | 2.60 | 0.766 |
| Mortality, % | | | |
| 0-21d | 9.33 | 8.77 | 0.712 |

## CONCLUSION

The effect of divergent selection for lower and higher body fat content (weaker and better body condition) on reproductive performance of does was not effective in the first two generation. Some significant different can be seen in Gen 3.