CONNECTION BETWEEN THE COMPUTED TOMOGRAPHY (CT) ESTIMATED TOTAL BODY FAT CONTENT OF RABBITS AT 10 WEEKS OF AGE AND BEFORE THE FIRST INSEMINATION

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ABSTRACT

The experiment was conducted at Kaposvár University with Pannon Ka rabbits. Divergent selection process was made during four generations for estimated total body fat content. Fat index was calculated at 10 weeks of age by determining the ratio of the total body fat volume (cm^3) estimated by computer tomography (CT) to the body weight (kg). Based on the fat index two lines were formed: the rabbits with the lowest fat index belonged to the Lean selected and that of the highest values belonged to the Fat selected lines. The fat index of rabbit does was checked before the first artificial insemination at the same way. In the 1st and 2nd generations there were low positive correlations found between the fat indexes at 10 weeks and before the first AI (R = 0.570 and 0.510 respectively; P<0.001). In the 3rd and 4th generations correlations were medium (R = 0.740 and 0.830 respectively; P<0.001). According to the results obtained, the selection method based on 10-week-old fat indexes is suitable for selecting rabbits for breeding. It may be worthwhile to carry out the selection in two steps, by filtering out the "outlier" individuals based on the estimated body fat content before breeding.

Key words: divergent selection, rabbit does, body fat content, computer tomography

INTRODUCTION

At the time of first insemination, the body weight of the does reaches only the 75-80% of their adult weight. During the first gestation and then lactation, the bodyweight of does increases, which requires energy and nutrient uptake. In young does, this multiple energy deficiency state (nursing, pregnancy with the next litter, and the body increases simultaneously) can lead to severe deterioration of the body condition, poorer production results and often culling (Xiccato, 1996; Rosell and De La Fuente, 2009).

The body condition of the rabbits can be characterized by the amount of fat deposits (Pascual et al., 2013), which can be most accurately determined by chemical analysis of the whole body after slaughtering. From the procedures that can be performed on live animals, ultrasound and total body conductivity (TOBEC) measurements are less reliable. Magnetic resonance imaging provides much more accurate information but it is costly and time consuming which does not allow their use in selection programs (Parigi-Bini and Xiccato, 1998; Pascual et al., 2000; Milisits et al. 1999). In contrast, computer tomography (CT) provides a fast, accurate, reliable image of the composition and fat content of the entire body and, last but not least, has an acceptable price value ratio (Romvári et al., 1996; Milisits et al., 1999; Donkó et al., 2016).

In rabbits, the selection of future breeding animals is usually done at 10 weeks of age, because the slaughter weight (2.5 kg) is reached at 10-11 weeks and rabbits which are not selected for breeding animals are slaughtered. Therefore, CT measurements should be performed at 10 weeks of age at the latest. However, the deposition of fat in rabbits becomes very intense after the age of 10 weeks

(Szendrő et al., 1998), so the body fat content of the rabbits' can change significantly till the time of breeding (16-20 weeks of age).

The aim of this study was to examine the relationship between the fat indexes (total body fat content) estimated at two different ages (at 10 weeks of age and before breeding at 16-19 weeks of age).

MATERIALS AND METHODS

Animals and experimental design

The experiment was carried out at the Kaposvár University with Pannon Ka (maternal breed) rabbits, to control inbreeding rate, this breed was divided into 4 groups and these groups have been maintained over time. Females from one group are always mated with males from another group. After parturition, the born progeny receive the group number of the sire. The descendents of any buck will be thus be placed back in their group only after 4 generations (Matics *et al.*, 2014). To form the 1st generation from 527 Pannon Ka rabbits 142 males and 209 females were selected to examination with CT at 10 weeks of age. CT examinations for the divergent selection were performed as described by Donkó et al. (2016). Fat index was calculated by determining the ratio of the total body fat content volume (cm^3) estimated by CT to the body weight (kg). The rabbits with the lowest fat index belonged to the Lean selected and that of the highest values belonged to the Fat selected animals (lines had ~ 40 males and 60 females per generation), thus two lines with different body fat content were created (Kasza et al., 2017a, b). The second CT scan of the female rabbits selected for breeding was performed before the first insemination. The divergent selection was continued during 4 generations, the Lean does were inseminated with the semen of Lean bucks and Fat does were inseminated with the semen of Fat bucks.

At each generation after weaning at 5 weeks of age, the animals were housed in wire mesh cages (3 rabbits/cage; 16 rabbits/m^2). Rabbits which were selected for future breeding animals were individually housed from 11 weeks of age in cages (32 cm x 62.5 cm x 30 cm), in the first 3 generations does were first inseminated at 19.5 weeks of age but there were not any differences between the production of Fat and Lean rabbits in these generations so in the 4^{th} generation does were first inseminated in a younger age (16.5 weeks of age). Commercial pellet and drinking water from nipple drinkers were available *ad libitum*. The temperature varied between 15-25 °C, depending on the season. The daily lighting was 16 hours.

Because the deposition of fat in rabbits becomes very intense after 10 weeks of age the condition of the Lean rabbits could relatively improve, and the body condition of Fat rabbits could reduce, so the difference between lines was not such pronounced before the first insemination as it was at 10 weeks of age. Moreover, in the body condition of some rabbit remarkable changes were observed so we reduced the database with the data of these "outliers" and the individuals that "slip" into the other line (they did not have sufficiently low fat index in the Lean line, or enough high fat index in the Fat line of that generation). This means that 5.8% of the rabbits were leave out from the 1st generation and 11% from the other three generations.

Statistical Analysis

The relationship between fat indexes was evaluated by Spearman rank correlation coefficient. Analysis has been performed using R software (ver.3.6.0) (R Core Team, 2018).

RESULTS AND DISCUSSION

The relationship between the total body fat content estimated at 10 weeks of age and before breeding in different generations is shown in Table 2. There was a moderate relationship between the estimated fat index of future breeding females at 10 weeks of age and before the first insemination in the 1st and 2nd generations (Table 2). In order to select higher number of future breeding animals, rabbits from two consecutive parturitions were selected for the 3rd and 4th generations. In order to avoid inbreeding, the future breeding rabbits were selected in equal proportion from the 4 groups of the initial breed (Matics *et al.*, 2014). So occasionally, rabbits from the different lines had to be selected for breeding animals, which did not have sufficiently low fat index in the Lean line, or enough high fat index in the Fat line. This may partly explain the low correlation. As a result, in these generations medium-strength relationship was found (Table 2).

Table 1: The average fat indexes estimated ± standard deviation at 10 weeks of age and before the first insemination in Lean and Fat female rabbits

	10 weeks of age		Before 1st insemination	
	Lean	Fat	Lean	Fat
Gen1	54.5 ± 9.24	96.8 ± 11.7	114 ± 29.7	151 ± 31.4
Gen2	59.5 ± 10.9	86.6 ± 12.0	108 ± 26.0	139 ± 26.8
Gen3	49.9 ± 10.5	90.7 ± 10.8	89.6 ± 27.0	136 ± 28.6
Gen4	67.6 ± 11.5	108 ± 16.3	110 ± 20.3	169 ± 31.0

Table 2: The Spearman rank correlation coefficient between the body fat indexes estimated at 10 weeks of age and before the first insemination in female rabbits

	Gen1 (n = 138)	Gen2 (n = 117)	Gen3 (n = 117)	Gen4 (n = 100)
Correlation	0.570*	0.510*	0.740*	0.830*

* P <0.001

After the database was reduced by "outliers" and the individuals that "slip" into the other line between the two examination the difference between lines and the tightness of the fat index estimation at the two different times slightly increased (Table 3).

Table 3: The Spearman rank correlation coefficient between the body fat index estimated at 10 weeks of age and before the first insemination in female rabbits without the filtered "outliers"

	Gen1 (n = 130)	Gen2 (n = 100)	Gen3 (n = 104)	Gen4 (n = 89)
Correlation	0.640*	0.620*	0.810*	0.860*

* P <0.001

In the 4th generation, as described above, and as a result of the first insemination at a younger age (16.5 weeks), closer relationship was found between the fat indexes at 10-week and at pre-breeding.

After three generations, Zomeño et al. (2013) reported a median inheritance (0.37) of intramuscular fat content, and after a seven-generation analysis, Martínez-Álvaro et al. (2016) reported its high (0.70) heritability value. The deposition of fat in rabbits becomes very intense after the age of 10 weeks (Fekete et al., 1997; Szendrő et al., 1998), so the body fat content of the rabbits' can change significantly till the time of breeding (16-20 weeks of age). In our investigation, a similar trend has been observed: the correlation between the estimated fat index calculated at 10 weeks of age and before the first AI in successive generations has become higher. The effectiveness of the selection for total body fat content was also demonstrated by the results of Szendrő et al. (2016), where the weight of perirenal fat and the fat content of fore leg and abdominal wall were higher in Fat line rabbits than in Lean line.

CONCLUSIONS

According to the results obtained, the selection method based on 10-week-old fat indices is suitable for selecting future breeding rabbits. The effectiveness of this method can be enhanced if the first insemination occurs at an earlier age (16.5 weeks) and if a second selection step would be applied by filtering out the "outliers" based on the estimated body fat content before breeding.

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