In Vivo Examination of Fat Deposition in Growing Rabbits Selected for High and Low Body Fat Content

Gábor MILISITS
András LÉVAI
Gabriella ANDRÁSSY-BAKA
Róbert ROMVÁRI

SUMMARY

Pannon White rabbits of average ± 1 S.D. live weight at 10 weeks and of average ± 1 S.D. daily weight gain between 6 and 10 weeks of age were chosen from the experimental stock of our university, and their fat content was determined with an EM-SCAN SA-3152 type small animal body composition analyser (by means of TOBEC method) at 10 weeks of age. Based on the fat content determined, the best and worst 16% of the does and the best and worst 8% of the bucks were chosen and mated with each other (fatty doe with fatty buck and lean doe with lean buck). Their offspring were examined by computer tomography (CT) weekly between 6 and 11 weeks of age. Cross-sectional images (scans) were taken from the scapular arch to the end of the femur on each animal. From this scans the amount of fat was determined and its ratio to the total amount of body was calculated in the scapular, perirenal and pelvic region. In the most cases it was established that the total body fat content and also fat content in the scapular, perirenal and pelvic regions are significantly higher in the offspring of fatty rabbits as in the offspring of non-fatty ones. In the group of non-fatty rabbits the scapular fat increased intensively from the age of 7 weeks. The perirenal fat content began to grow rapidly at 8 weeks in fatty group and at 10 weeks of age in the non-fatty rabbits. Based on the results of this experiment TOBEC method seems to be a useful thing for selecting rabbits based on their body fat content.

KEY WORDS

rabbit, fat, TOBEC, selection, body composition)

University of Kaposvár, Faculty of Animal Science
H-7400 Kaposvár, Guba S. u. 40., Hungary
E-mail: milisits@mail.atk.u-kaposvar.hu

Received: June 20, 2003

ACKNOWLEDGEMENT
This research project was supported by a Hungarian OTKA grant (F 032594).

INTRODUCTION

The TOBEC (Total Body Electrical Conductivity) method (Van Loan and Mayclin, 1987), which was developed principally for pediatric research, can be useful mostly for the determination of fat-free mass of the body. Based on the results of former experiments it seems, that this technique is very accurate (r=0.88-0.99) in determining fat-free mass in living animals (Cunningham et al., 1986; Fiorotto et al., 1987; Fekete and Brown, 1993; Staudinger et al., 1995), but it can be used only with medium accuracy (r=0.59) to predict the ratio of fat in the body (Fekete et al., 1995).

Because this latter is more informative for the practice, several experiments have been focused on this topic recently. These results showed that the fat content of the whole body can be predict only with medium accuracy in the case of newborn (Milisits et al., 1999) and growing rabbits (Milisits et al., 2000) and also in the case of rabbit does (Szendrő et al., 1998).

Based on this medium accuracy we have tried in a former experiment, if the TOBEC method is useful in the selection of rabbits based on their body fat content or not. In that trial it was established that the body fat content of the offspring of fatty and non-fatty rabbits does not differ at birth, but it differs significantly at 10 weeks of age. In this experiment we have tried to use computer tomography (CT) to follow the fat deposition and also to determine the anatomical places and also the intensity of fat deposition in the offspring of fatty and non-fatty rabbits.

MATERIAL AND METHODS

The experiment was carried out with Pannon White rabbits, weaned at the age of 6 weeks and housed in a closed building, in groups of 5 or 6 per cage (800x500mm). The animals were kept under artificial lighting conditions (16 hours per day) and at a room temperature of 15-20°C prior to the TOBEC measurement. For the ad libitum feeding of the rabbits a commercial pelleted diet (DE 10.30 MJ/kg, 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 that represented 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. 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 sperm of fatty bucks and lean does with sperm of lean bucks.

CT scanning of the offspring of these parents was performed at 6, 7, 8, 9, 10 and 11 weeks of age (n=8 fatty rabbits, n=7 non-fatty rabbits). The animals chosen for the scannings were fixed with belts in a lying position in a special plexi-glass container. In this position their movement was restricted and the legs were well separated from the rump.

The examinations began with the taking of a so-termed overall topogram, which resembles a conventional two-dimensional X-ray image. In this image the anatomical levels of the later scans could be marked with horizontal lines as markers.

In this experiment a total of 21 scans were taken from each animal, with 8 mm thickness and with different distances between the scans, depending on the length of the vertebral column. In this way scans with the same serial number represent the body composition at the same anatomical points, and so animals of different sizes could be compared. The scanning range extended from the scapular arch to the end of the femur in each case.

The evaluation of the images obtained was performed in accordance with Romvári et al. (1996), using only the density values corresponding to muscle, water and fat. The extreme values (i. e., air and bone) were excluded from the evaluation.

The analysis of the images began with the determination of the frequency of pixels (elements of images) at every density value between -200 and +200 on the Hounsfield scale. These 400 values were then reduced to 40 so-termed Hounsfield variables (HUv) by totalling the number of pixels corresponding to 10 consecutive density values on the scale (HUv1=∑(-200)-(-191), HUv2=∑(-190)-(-181), … HUv40=∑(+190)-(+199)). These variables were then used to calculate the so-called fat indices (∑HUv7-12 / ∑HUv1-40 x 100), which were used for estimating the amount of fat of the animals.

Differences between the determined fat content of fatty and non-fatty rabbits were evaluated by independent samples t-test using the SPSS statistical software package (SPSS for Windows, 1999).

RESULTS

Based on the results obtained it could be established that in spite of the same body fat content observed at one day of age in a former experiment, the total body fat content of the offspring of fatty parents was already higher at 6 weeks of age as that of the offspring of non-fatty ones (13.5% vs. 12.4%, Figure

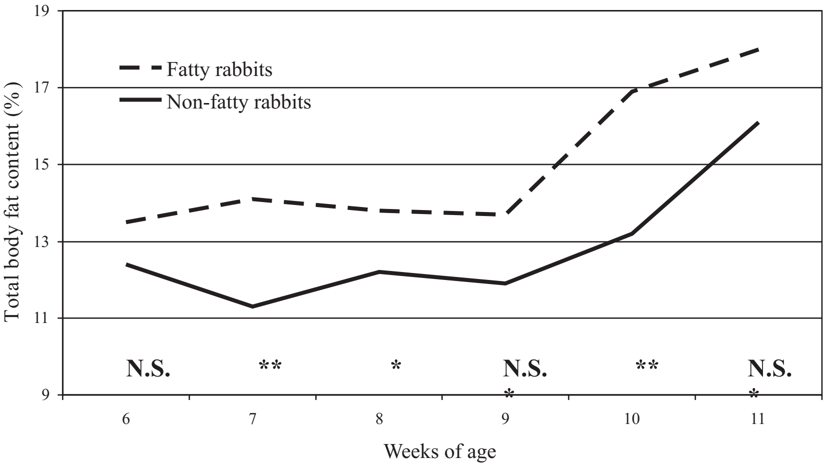

Figure 1.
Changes of the estimated total body fat content of fatty and non-fatty rabbits
N.S. = The difference is not significant
* = The difference is significant at P<0.05 level
** = The difference is significant at P<0.01 level

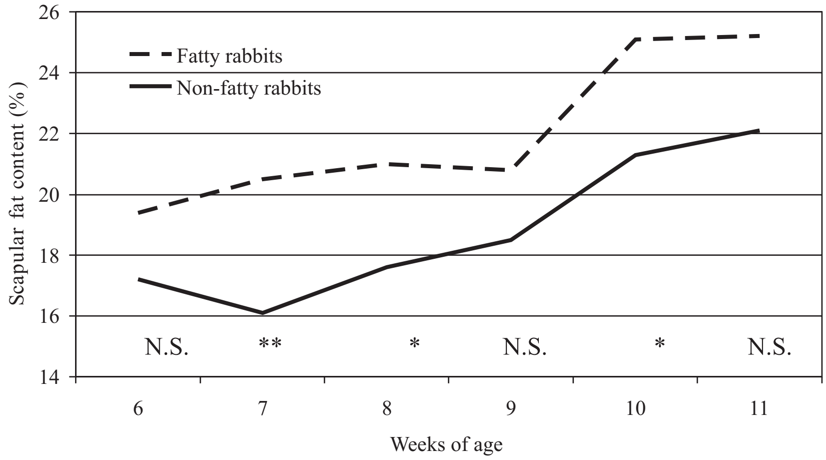

Figure 2.
Changes of the estimated scapular fat content of fatty and non-fatty rabbits
N.S. = The difference is not significant
* = The difference is significant at P<0.05 level
** = The difference is significant at P<0.01 level

1). Till 9 weeks of age the body fat content in the two experimental groups did not change significantly, but because of the little changes in the groups, the differences were significant at 7 and 8 weeks of age. From the 9th week of age the fat deposition was very intensive in both group and the total body fat content reached 18.0% in the offspring of fatty rabbits and 16.1% in the non-fatty ones at 11 weeks of age. The difference between the groups was significant at P<0.01 level at 10 weeks of age.

In the scapular region of the body a slightly fat deposition was observed between 6 and 9 weeks of age in both experimental groups (Figure 2).

The ratio of fat in this body region changed from 19.4% to 20.8% in the fatty rabbits and from 17.2% to 18.5% in the non-fatty rabbits during this time. The differences between the groups were significant at 7 and 8 weeks of age. Between 9 and 10 weeks of age a very intensive deposition of scapular fat was observed in both group of the animals. The scapular fat content of the fatty rabbits reached its maximum level of 25.1%, while the fat content of the non-fatty rabbits was 21.3% at that time. In the last week of the experiment the fat content in the scapular region did not change in the fatty rabbits while a slight, but non significant increase was observed in the offspring of non-fatty animals.

In the most important fat depot of the rabbits (in the region of kidneys) it was interesting to see that the fat content of both fatty and non-fatty rabbits was relatively low till the 8th week of age (Figure 3).

After this time a very intensive fat deposition was started in the offspring of fatty parents, while the fat content of the non-fatty rabbits did not increase significantly till the 10th week of age. At 9 and 10 weeks of age the fat content in the perirenal region was significantly higher in the offspring of fatty rabbits as in the offspring of non-fatty ones. In the last week of the experiment a dramatic increase of kidney fat was observed in the group of the non-fatty animals and therefore they almost reached the same amount of fat like fatty rabbits at 11th week of age. After the significant superiority of fatty-animals at 9 and 10 weeks of age no significant difference was observed between the two experimental groups at the end of the experiment.

In spite of the scapular and perirenal fat the ratio of pelvic fat showed a decreased tendency during the examined period (Figure 4).

It reached its maximum level at 6 weeks of age in both group of the animals (12.4% in the fatty and 11.9% in the non-fatty rabbits) and a significant decrease was observed thereafter till the 7th week of age. Between 7 and 9 weeks of age no significant

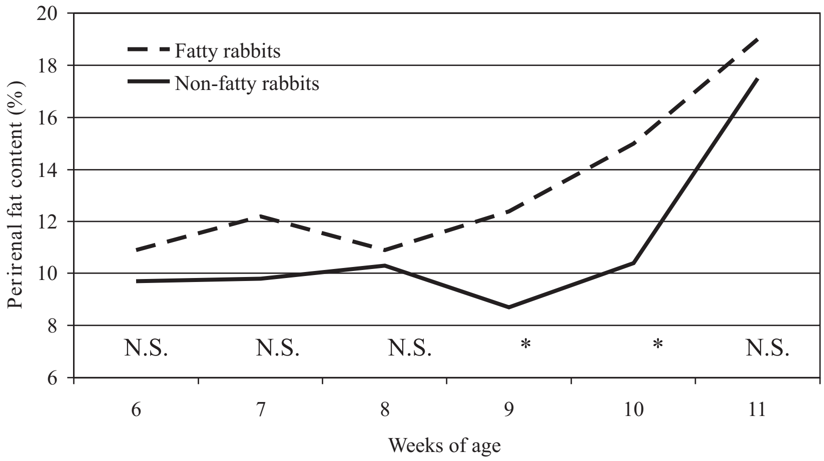

Figure 3.
Changes of the estimated perirenal fat content of fatty and non-fatty rabbits
N.S. = The difference is not significant
* = The difference is significant at $P<0.05$ level

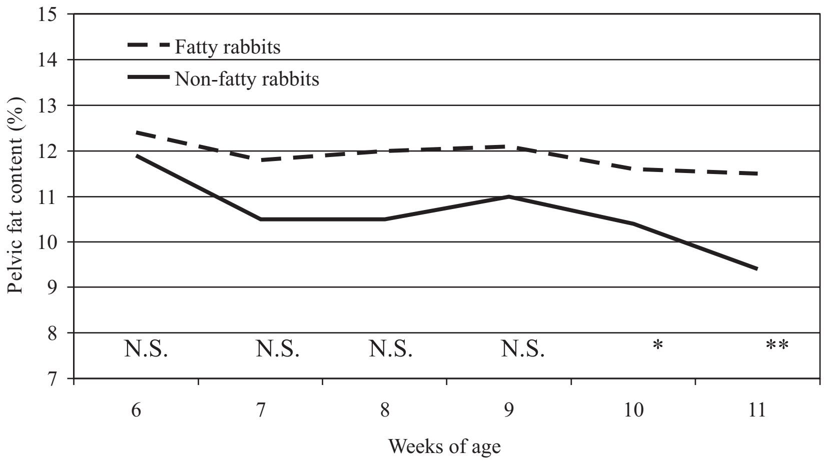

Figure 4.
Changes of the estimated pelvic fat content of fatty and non-fatty rabbits
N.S. = The difference is not significant
* = The difference is significant at $P<0.05$ level
** = The difference is significant at $P<0.01$ level

changes were established in the pelvic fat content of the fatty and non-fatty rabbits, but in the last two weeks of the experiment the fat content decreased in both group of the animals. This decrease was higher in the offsping of non-fatty rabbits and therefore the pelvic fat content of the fatty and non-fatty animals already differed significantly at 10 and 11 weeks of age.

CONCLUSION

As conclusion of this work it could be established that the total body fat content and also fat contents in the scapular, perirenal and pelvic regions are significantly higher in the offspring of fatty rabbits as in the offspring of non-fatty ones. The intensive fat deposition in the scapular and perirenal region started at 9 weeks of age in both group of the animals, while the ratio of fat in the pelvic region decreased from that time forth. Based on the results of this experiment TOBEC method seems to be a useful thing for selecting rabbits based on their body fat content.

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