# Genetic Parameters Of Growth In Vivo Computer Tomography Based And Reproduction Traits In Pannon White Rabbits

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## Introduction

In rabbit breeding Computer Tomography (CT) -aided selection is exclusively applied at Kaposvár to improve the slaughter value of Pannon white rabbits. Estimated genetic parameters for the average cross-sectional area of the m. Longissimus dorsi and dressing out percentage were reported by Nagy *et al.* (2006). From 2004 selection criteria changed to thigh muscle volume and data evaluation with BLUP methodology was also introduced. The Pannon white rabbit population at Kaposvár was selected for average daily gain (ADG) for cca 17 generations that was replaced by litter weight at 21 days of age since 2009. Although the efficiency of the breeding programme was proved (Gyovai *et al.* 2008) so far the effects of the CT based selection on the reproductive performance has not yet been examined. Objective of the present study was therefore to estimate the genetic correlation between the thigh muscle volume (TMV) and litter weight at 21 days of age (LW21).

## Materials and methods

The present analysis was based on data of Pannon White rabbits born between 1992 to 2009 at the rabbit farm of the University of Kaposvár. The evaluated animals were reared in 3732 litters and the total number of the pedigree file was 9772. Descriptive statistics are presented in Table 1.

**Table 1: Descriptive statistics for the traits**

| Trait | No. of records | Mean | S.D. |
|---|---|---|---|
| LW21 | 3143[a], 2588[b], 2161[c], 1746[d] | 2.2[a], 2.7[b], 2.8[c], 2.8[d] | 0.5[a], 0.6[b], 0.7[c], 0.7[d] |
| TMV | 3878 | 338 | 38.67 |
| ADG | 6462[a], 6020[b], 5600[c], 5251[d] | 45.5[a], 45.8[b], 46.0[c], 46.3[d] | 6.1[a], 6.1[b], 6.0[c], 5.9[d] |
| LS21 | 3144[a], 2589[b], 2163[c], 1745[d] | 7.0.[a], 7.6[b], 7.6[c], 7.6[d] | 1.7[a], 1.5[b], 1.6[c], 1.5[d] |
| BWCT | 3878 | 2.62 | 0.24 |

LW21: litter weight at 21 days of age; TMV: thigh muscle volume; ADG: average daily gain; LS21d:litter size at day 21; BWCT: body weight at CT scan; [a] 1th parity, [b] 2nd parity, [c] 3rd parity, [d] 4th parity,

Growing rabbits were kept in a closed rabbit house, in fattening cages (2-3 rabbits per cage). After weaning at 5 weeks of age they were fed a commercial pellet. In the winter the rabbit house was heated to a minimum temperature (16 °C), during summer the temperature occasionally reached levels as high as 28 °C. The selection of growing rabbits was performed in two-step procedure. The first was the daily weight gain between 5 and 10 weeks of age, and the next one was the thigh muscle volume obtained from the CT scanning. The animals

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were weighed at 5 and 10 weeks of age, to calculate the daily weight gain. Rabbits showing the best weight gain (30-40%) were subjected to CT examination at 10.5 weeks of age. The methodology of the CT scans are given in detail by Gyovai et al. (2008).
The daily gain between the age of 5-10 weeks, litter weight at day 21 and CT-based thigh muscle volume were evaluated with the REML and BLUP procedures in order to estimate genetic parameters and breeding values. The successive parities (1-4) were considered separately. The applied softwares were PEST (Groeneveld *et al.* 1990) and VCE 5 (Kovac and Groeneveld 2003.). The structure of the used models are given in Table 2.

**Table 2: Multi-trait animal models and number of observation**

| Factor | Type[a] | Observation | Trait | | |
|---|---|---|---|---|---|
| | | | LW21 | TMV | ADG |
| litter size at day-21 | C | 1 | x | – | – |
| year-month | F | 188[b]; 195[c]; 193[d];184[e]; | x | – | – |
| animal | A | 9772 | x | x | x |
| litter | R | 3732[b]; 3515[c]; 3240[d];2981[e]; | x | x | x |
| body weight at CT-scan | C | 1 | – | x | – |
| sex | F | 2 | – | x | x |
| year-month of CT | F | 48 | – | x | x |
| pixel | F | 4 | – | x | – |

[a] Type of factors: F, fix factor; A, random factor with covariance matrix; R, random effect; C, covariable;
[b] 1th parity; [c] 2nd parity; [d] 3rd parity; [e] 4th parity;

## Results and discussion

Litter weight at 21 days of age in the fourth parity had a higher heritability in comparison to litter weight at 21 days of age in the first, second and third parity (Table 3).

**Table 3: Estimate of heritability (diagonal blocks) and genetic correlation (off-diagonal blocks) at the first, second, third and fourth parity. Standard errors of estimates are given in brackets.**

| Trait | Parity | LW21 | TMV | ADG |
|---|---|---|---|---|
| LW21 | 1 | 0.14 (0.02) | -0.31 (0.14) | -0.02 (0.08) |
| | 2 | 0.10 (0.02) | -0.33 (0.14) | 0.23 (0.05) |
| | 3 | 0.08 (0.02) | -0.83 (0.17) | 0.15 (0.10) |
| | 4 | 0.16 (0.03) | -0.86 (0.11) | 0.10 (0.09) |
| TMV | 1 | | 0.21 (0.02) | 0.22 (0.10) |
| | 2 | | 0.21 (0.02) | 0.10 (0.05) |
| | 3 | | 0.21 (0.02) | 0.18 (0.10) |
| | 4 | | 0.22 (0.02) | 0.14 (0.09) |
| ADG | 1 | | | 0.30 (0.02) |
| | 2 | | | 0.30 (0.02) |
| | 3 | | | 0.31 (0.02) |
| | 4 | | | 0.36 (0.02) |

García and Baselga (2002) have reported heriability of 0.22 for individual weaning weight at 28 day of age in a maternal rabbit line. Gómez *et al.* (1998) found 0.41 heritability of individual weaning weight at 32 days of age at first parity in a specialized dam line in rabbits. Rastogi *et al.* (2000) have reported 0.08 heritability of litter weight at 21 days. Estimates of heritability for 28-d weaning weight was 0.04 in the study of Lukefahr *et al.* (1996) in rabbit. Our estimestes of heritabilities for ADG were higher than García and Baselga (2002) found (0.198) in a maternal rabbit line but it was very similar with the value reported by Nagy *et al.* (2006) and Gyovai *et al.* (2008) in Pannon white rabbit and by Gómez *et al.* (1998) in a specialized dam line in rabbits.
Moura *et al.* (1997) found higher (0.48) heritability of ADG while Lukefahr *et al.* (1996) have reported lower (0.17) estimates of heritability for ADG in rabbit.
Heritability estimates were moderately low for TMV. Hermesch *et al.* (2000a) have reported similar heritability (0.22) for weight of whole left back leg in White Large and Landrace pig breeds. In her study this weight measurement includes skin, bones and fat of the back leg and is an indicator of the growth rate of an animal.

Random litter effects were low for LW21 and TMV but were moderate for ADG (Table 4).

**Table 4: Common litter effect estimates of the traits (diagonal blocks) and correlation (off-diagonal blocks). Standard errors of estimates are given in brackets.**

| Trait | Parity | LW21 | TMV | ADG |
|---|---|---|---|---|
| LW21 | 1 | 0.04 (0.02) | -0.40 (0.40) | -0.10 (0.05) |
| | 2 | 0.02 (0.02) | -0.00 (0.05) | 0.11 (0.04) |
| | 3 | 0.07 (0.03) | -0.56 (0.31) | -0.13 (0.11) |
| | 4 | 0.12 (0.04) | -0.18 (0.26) | -0.24 (0.07) |
| TMV | 1 | | 0.13 (0.01) | -0.03 (0.04) |
| | 2 | | 0.13 (0.01) | -0.03 (0.06) |
| | 3 | | 0.14 (0.01) | -0.03 (0.06) |
| | 4 | | 0.13 (0.01) | -0.01 (0.06) |
| ADG | 1 | | | 0.33 (0.01) |
| | 2 | | | 0.36 (0.01) |
| | 3 | | | 0.35 (0.01) |
| | 4 | | | 0.30 (0.01) |

Estimates of common litter effect of 21-d litter weight was 0.01 in the study of Chen *et al.* (2001) in a syntetic line of Yorkshire – Meishan pigs. García and Baselga (2002) have reported common litter effect of 0.41 for individual weaning weight at 28 day of age in a maternal rabbit line. Crump *et al.* (1997) have reported common litter effect of 0.05 for ADG in pigs.
Literature estimates of common litter effect for ADG were 0.29, 0.11, 0.40 and 0.22 (García and Baselga (2002); Moura *et al.* (1997); Lukefahr *et al.* (1996); Nagy *et al.* (2006), respectively) in rabbits.
Estimates of common litter effect of weight of whole left back leg was 0.14 in the study of Hermesh *et al.* (2000a) in pig. Gómez *et al.* (1998) estimated medium- low genetic correlation between ADG and individual weaning weight at 32 days (0.31) in a specialized dam line in rabbits. Estimates of the genetic correlation of lean growth rate (kg/d) with

LW21 were low and averaged -0.06 across the four different pig breeds (Chen *et al.* 2003). Chen *et al.* (2001) reported a positive correlation of 0.13 for lean growth rate (kg/d) with LW21 from a selection experiment in a syntetic line of Yorkshire – Meishan pigs. Tholen *et al*. (1996) estimated positive correlation of 0.06 between ADG and LW21 in pig. Hermesh *et al*. (2000b) reported a positive correlation of 0.83 for weight of whole left back leg with ADG from 3 to 18 weeks in pig.

## Conclusion

The results show that the CT based selection can efficiently improve thigh muscle volume. However a strong negative genetic correlation was found between the thigh muscle volume and 21 day litter weight which suggest that the reproductive performance is deteriorating. The Pannon white rabbit breed should mainly be used as a terminal line.

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