

COMPARISON OF PRODUCTIVE AND CARCASS TRAITS AND ECONOMIC VALUE OF BREEDS SELECTED FOR DIFFERENT CRITERIA, SLAUGHTERED AT SIMILAR WEIGHTS

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1. INTRODUCTION

Most of the publications showed that rabbits originated from larger-sized parents (terminal lines) had better growth rate (RAMON *et al.*, 1996; LARZUL and ROCHAMBEAU, 2004), but lower values of carcass traits (DALLE ZOTTE, 2002; HERNÁNDEZ *et al.*, 2006), since they were not as mature when slaughtered at the same age or weight as progeny of maternal lines which had lower adult weights.

In Hungary, Kaposvár University has a special breeding program, in which two breeds (Pannon White; PWhite; Pannon Large; PLarge [terminal line of the Pannon Breeding Program]) have been selected for a long time for carcass traits, based on the data of computer tomography (CT). Since 1992, CT selection was based on two scans (junction of the 2nd and 3rd, and the 4th and 5th lumbar vertebrae), and the L-value (average of the two surfaces of cross section of *m. longissimus dorsi*) was measured and expressed in cm². In 2004 L-value was replaced by thigh muscle volume (TMV). TMV was estimated on the basis of 11-12 scans taken every 10 mm between the *crista iliaca* of the *os ilium* and the patella by CT. Summing the values of 11-12 scans, the TMV was estimated in cm³. Both methods were effective to improve meat content in growing rabbits (MATICS *et al.*, 2014).

In weight gain and body weight of growing rabbits a clear order could be seen: PKa (Pannon Ka, the maternal line of the Pannon Breeding Program) < PWhite < PLarge (SZENDRŐ *et*

al., 2009a). The successfulness of the CT based selection for improving meat production was justified by estimated genetic trends (GYOVAI *et al.*, 2008; NAGY *et al.*, 2013), divergent selection (SZENDRŐ *et al.*, 1996; SZENDRŐ *et al.*, 2012), and comparison of breeds or their crossing combinations (SZENDRŐ *et al.*, 2009b; SZENDRŐ *et al.*, 2010).

The aim of the experiment was to compare three genotypes (PKa x PKa, PWhite x PKa, PLarge x PKa) slaughtered at similar weights, to examine their productive performance, carcass traits and economic values. Our hypothesis was that rabbits selected for TMV by CT are matured for slaughtering at younger age and achieve good slaughter and economic results at an earlier age.

2. MATERIALS AND METHODS

The study was approved by the Institutional Animal Welfare Committee as the animal-welfare body of the Kaposvár University.

Animals and housing

The experiment was carried out at the rabbit farm of Kaposvár University. Three breeds of Pannon Breeding Program, selected for different criteria, were examined in a crossing experiment. PKa does were inseminated with semen of PKa (selected for litter size), PWhite (selected for litter weight at 21 d and TMV) or PLarge (selected for weight gain and TMV) bucks. Randomly selected crossbred kits (PKa x PKa, PWhite x PKa, PLarge x PKa; n=60 in each genotype, sex ratio 1:1) were weaned at 35 days of age and reared until 88, 83 and 79 days, respectively, when they reached similar body weights for slaughtering (2.8 kg).

Rabbits were housed in a closed building in wire-mesh cages (3 rabbits/cage). They were fed with commercial pelleted diets *ad libitum*, and they could drink water freely from nipple drinkers. The temperature in the building was between 16 and 25 °C, and the photoperiod was 16 hours light and 8 hours dark.

3. RESULTS AND DISCUSSION

Productive traits

Results of productive traits are shown in Table 1. Weight of PKa x PKa at weaning was lower than that of PWhite x PKa, and it was the largest in PLarge x PKa rabbits ($P < 0.001$). Weight gain of kits till they began to consume solid feed depended on their mother (milk production/kit), however, after that age the growth rate was determined by their own ability, as it was proven several years ago by VENGE (1953), who compared the growth of dwarf and giant breeds depending on which genotypes were the foster mother.

Table 1. Effect of different crossing combinations on productive traits of rabbits slaughtered at similar body weight

Traits	Genotypes			SE	Prob.
	PKa x PKa	PWhite x PKa	PLarge x PKa		
Weight at 5 wk, g	889 ^a	947 ^c	923 ^b	5.1	<0.001
Age at the end of the experiment, d	88	83	79	-	-
Weight at the end of the experiment, g	2785	2793	2795	9.7	0.906
Weight gain, g/d	35.6 ^a	39.2 ^b	42.8 ^c	0.31	<0.001
Feed intake, g/d	127 ^a	129 ^a	135 ^b	1.1	0.005
Feed conversion ratio	3.55 ^b	3.38 ^{ab}	3.24 ^a	0.05	0.032
Mortality, %	5.0	3.3	0.0	-	0.237

^{a, b, c}: Means in the same row with unlike superscripts differ ($P < 0.05$).

Significant differences were found in weight gain; the growth rate of PLarge x PKa was the largest and that of PKa x PKa was the smallest, the PWhite x PKa rabbits had intermediate values, so they reached similar slaughter weights (2.8 kg) at different ages (88, 79 and 83 days, respectively). Similar results were achieved by other authors (RAMON *et al.*, 1996; LARZUL and ROCHAMBEAU, 2004; PILES *et al.*, 2004; METZGER *et al.*, 2006a, b) who compared breeds or lines with different adult weights. They revealed strong connection between the adult body weight and growth rate. SZENDRŐ *et al.* (2009a, b) also showed

Measurements

Body weight and feed intake were measured at every second week (at 5, 7, 9, and when they reached a similar body weight of 2.8 kg), therefrom weight gain and feed conversion ratio were calculated. Body weight of rabbits was measured individually, but in the case of feed intake and feed conversion ratio the experimental unit was the cage. At the end of the experiment rabbits were slaughtered. The slaughtering and carcass dissection procedures followed the recommendations of World Rabbit Science Association (WRSA) described by BLASCO and OUHAYOUN (1996).

Financial indicators

All financial figures were calculated in Euro. The first cost factor was the price of a weaned rabbit. Data for weaned and slaughter rabbit price (1.83 and 1.53 €/kg, respectively) were gained from Olivia Ltd. (ODERMATT, personal communication). According to MAERTENS (personal communication) feeding cost may represent 80% of total production costs calculated on the basis of only growing rabbits. Mortality cost, as a loss of revenue, was considered as the price of the weaned rabbit and the cost of feed consumed till death. Hence, total expenses included the price of the weaned rabbit, the production cost and the cost of mortality. Since cost of feed may vary significantly year by year, or even during a year depending on the weather (thus the quantity of production) and the market, the cost analysis was carried out based on the average cost of feed (0.275 €/kg, DEMETER/Cargill, personal communication), and 10% lower and 10% higher prices than the average price as well (low, medium=med, high price). Price of rabbits at slaughter was considered as revenue. Besides, profit, cost to revenue, profit to cost ratios and cost effectiveness were calculated. Profit was calculated as the difference between the revenue (price at slaughter) and total costs.

Statistical analysis

Statistical analysis was conducted using the SPSS 10.0 software package. The productive and carcass traits were evaluated by one-way ANOVA:

$$Y_{ij} = \mu + T_i + e_{ij}; \text{ where:}$$

μ = general mean, T_i = effect of the Genotype ($i = 1-3$), e_{ij} = random error.

Mortality was analysed by Chi²-test.

correlation between adult weight and growth rate of purebred Pannon rabbits (PKa, PWhite and PLarge).

Daily feed intake of PLarge x PKa rabbits was significantly higher than that of PKa x PKa and PWhite x PKa rabbits (Table 1). These results were in accordance with those published in the literature (FEKI *et al.*, 1996; RAMON *et al.*, 1996). However, the number of feeding days was less in the PLarge x PKa and more in PKa x PKa group, this is why the total feed consumption of PLarge x PKa rabbits was lower than that of PKa x PKa. Significant differences were found in feed conversion ratio between weaning and the end of the fattening period, with the best result for PLarge x PKa and the weakest in PKa x PKa group. According to previous results (SZENDRŐ *et al.*, 2012), selection for TMV by CT also improved the feed conversion ratio. Mortality was low and no significant differences existed among the genotypes (Table 1).

Carcass traits

The dressing out percentage was the highest in PWhite x PKa and the lowest in PKa x PKa rabbits, while PLarge x PKa rabbits were between the other two groups ($P < 0.01$; Table 2).

Table 2. Effect of different crossing combinations on ratios of carcass and carcass parts of rabbits slaughtered at similar body weights

Traits	Genotypes			SE	Prob.
	PKa x PKa	PWhite x PKa	PLarge x PKa		
Dressing out percentage, %					
Warm carcass	61.3 ^a	62.4 ^b	61.8 ^a	0.13	0.007
Ratio to chilled carcass, %					
Perirenal fat	1.51 ^b	1.38 ^{ab}	1.25 ^a	0.04	0.008
Scapular fat	0.43	0.42	0.37	0.02	0.314
Ratio to reference carcass, %					
Fore part	30.0 ^b	29.3 ^a	30.2 ^b	0.10	<0.001
Mid part	30.9 ^b	30.9 ^b	30.4 ^a	0.09	0.020
Hind part	36.8 ^a	37.7 ^b	37.5 ^b	0.09	<0.001

^{a, b}: Means in the same row with unlike superscripts differ ($P < 0.05$).

In general, breeds with larger adult weight, grow faster and are slaughtered at a younger age, and they are not at the same level of maturation as medium sized breeds. This is why breeds with smaller adult body weights had higher level of maturity at slaughter and had better dressing out percentages, but with a lower ratio of the fore part, and higher ratio of the hind part to reference carcass compared to large bodied breeds (PLA *et al.*, 1996, 1998; GÓMEZ *et al.*, 1998; HERNÁNDEZ *et al.*, 2006). This phenomenon can explain the substantial differences found in slaughter traits between rabbits selected for number of kits born alive or growth rate, evaluated at 9 wk or at a body weight of 2 kg (PLA *et al.*, 1996, 1998; GÓMEZ *et al.*, 1998; HERNÁNDEZ *et al.*, 2006). Comparing our results to Spanish publications (PLA *et al.*, 1996, 1998; HERNÁNDEZ *et al.*, 2006), we did not detect any similar difference between breeds selected for litter size (PKa) or selected for growth rate (PLarge). In contrast, in the present experiment both genotypes with higher adult body weights (PWhite x PKa and PLarge x PKa) had better dressing out percentages and higher ratios of hind part, and lower or similar percentages of fore parts compared to PKa x PKa rabbits ($P < 0.001$). In the selection centers of hybrid companies the maternal lines are selected for improving reproductive performance (litter size at birth or at weaning), and the objective of selection of the terminal lines is the weight gain (BASELGA, 2004; GARREAU *et al.*, 2004; KHALIL and AL-SAEF, 2008). Generally, carcass traits are not included among the selection criteria. However, the aim of the CT based selection is to improve the meat content in most valuable parts of carcass. PWhite rabbits were selected for L-value (surface of cross section of *m. longissimus dorsi*, MLD) between 1992 and 2004, which was closely correlated with the weight and ratio of MLD (SZENDRŐ *et al.*, 1992), and since 2004 PWhite and PLarge rabbits have been selected for TMV which was highly correlated with weight and ratio of hind part, hind legs (MATICS *et al.*, 2014). The results of the present experiment were in accordance to the purpose of CT based selection since significant difference was found in ratio of MLD between groups of PWhite x PKa and PLarge x PKa (with higher value in PWhite x PKa rabbits, because PWhite rabbits were selected for L-value), and the ratio of hind part to reference carcass was similar in PWhite x PKa and PLarge x PKa rabbits, because both breeds (PWhite and PLarge) were selected for improving TMV. The results of the present experiment showed that during the past few years we were able to increase the meat content of the hind legs.

This was the first time when it could be shown that PLarge, as a large-bodied breed, had better results in meat production (dressing out percentage and ratio of hind part to reference carcass) than PKa rabbits when these breeds were compared at similar slaughter weight range.

Financial indicators

Cost of production, as well as profitability indicators of different crossing combinations slaughtered at similar weights are shown in Table 3.

The average difference in production costs (0.02 €/rabbit) was negligible between the PKa x PKa and PWhite x PKa groups, while a larger difference in total cost (0.30 €/rabbit) was found between the former crossing combinations and PLarge x PKa in favor of PLarge x PKa rabbits, due to their shorter fattening period. Profit of PKa x PKa rabbits was 88.0 and 42.4% than that of the PWhite x PKa and PLarge x PKa group on a medium feed price, respectively. Results show that PLarge x PKa rabbits were able to exceed the average economic indicators on each feed price compared to the other groups.

Table 3. Profitability of different crossing combinations (slaughtered at similar body weights) at farm level

Indicators	Genotypes											
	PKa x PKa						PLarge x PKa					
	Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High
Cost of feeding (€/r)	1.68	1.85	2.02	1.61	1.77	1.94	1.49	1.63	1.78	1.49	1.63	1.78
Cost of mortality (€/r)	0.09	0.09	0.09	0.06	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00
Total cost (€/r)	3.87	4.04	4.20	3.86	4.02	4.17	3.59	3.73	3.88	3.59	3.73	3.88
Price at slaughter (€/r)	4.27	4.27	4.27	4.28	4.28	4.28	4.29	4.29	4.29	4.29	4.29	4.29
Profit (€/r)	0.40	0.23	0.07	0.43	0.27	0.11	0.70	0.55	0.41	0.70	0.55	0.41
Cost to revenue (%)	90.6	94.5	98.3	90.0	93.8	97.4	83.7	87.1	90.4	83.7	87.1	90.4
Profit to cost (%)	10.40	5.80	1.72	11.08	6.62	2.66	19.50	14.77	10.57	19.50	14.77	10.57
Cost efficiency	1.10	1.06	1.02	1.11	1.07	1.03	1.20	1.15	1.11	1.20	1.15	1.11

Notes: Low, Med and High: low, medium and high price of pellets; €/r = €/rabbit

4. CONCLUSIONS

It can be concluded that the production performance of growing rabbits was affected by the adult weight, but the carcass traits were influenced by the CT-based selection. The results of the present experiment showed new evidence, since the breeds (PWhite and PLarge) which have been selected for carcass traits by CT for shorter or longer periods had better dressing out percentage, ratio of hind part to reference carcass and profitability ratios than the maternal line (PKa) when they were compared at similar slaughter weight range.

5. SUMMARY

The aim of the experiment was to compare three genotypes, slaughtered at similar weights, to examine their productive and carcass traits and economic value. Three breeds of Pannon Breeding Program, selected for different criteria, were examined in a crossing experiment. Pannon Ka (PKa, maternal line) does were inseminated with semen of PKa, Pannon White (PWhite) or Pannon Large (PLarge, terminal line) bucks. The crossbred kits (PKa x PKa, PWhite x PKa, PLarge x PKa; n=60 in each genotype) were weaned at 35 days of age and reared until 88, 83 and 79 days, respectively, when they reached similar body weights for slaughtering (2.8 kg). The weight gain of PLarge x PKa was the largest (42.8 g/d) and that of PKa x PKa was the smallest (35.6 g/d) and PWhite x PKa (39.2 g/d) was intermediate (P<0.001). Difference was found in feed conversion ratio between weaning and the age of slaughter (PKa x PKa: 3.55 and PLarge x PKa: 3.24, P<0.05). Dressing out percentage and ratio of hind part to reference carcass of PWhite x PKa, PLarge x PKa, and PKa x PKa were 62.4 and 37.7, 61.8 and 37.5, 61.3 and 36.8%, respectively (P<0.001). Results show that PLarge x PKa rabbits were able to exceed the average economic indicators compared to other groups. Production performance of growing rabbits was affected by the adult weight, but the carcass traits were influenced by the CT-based selection. The results of the present experiment showed new evidence, since the breeds (PWhite and PLarge) which have been selected for carcass traits by CT for shorter or longer periods had better dressing out percentage, ratio of hind part to reference carcass and profitability ratios than the maternal line (PKa) when they were compared at similar slaughter weight range.