ECONOMIC EVALUATION OF RABBIT GENOTYPES DIFFERING IN GROWTH RATE AND CARCASS CHARACTERISTICS

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ABSTRACT

The aim of the study was to carry out an economic evaluation of different genotypes based on the most important cost factors of feed and the revenue from processed products. Pannon White (PW) and maternal line (M) does were inseminated with the sperm of 3 genotypes: M, PW, or a large body line (LB), each selected on different criteria (M: litter size, PW: weight gain and carcass traits, LB: weight gain and carcass traits). Progeny of 7 genotypes of different crossing combinations (n=224) were evaluated: MM, MPW, MLB, PWPW, PWM, PWLB, LBLB. Rabbits were weaned at the age of 5 wk. Body weight was measured at 5 and 11 wk and the feed intake fortnightly. The weight of whole carcass, head, heart and lung, liver, kidneys, fore part, loin fillet, mid part's bone, thigh meat, and thigh bone were quantified. The revenue from whole carcass and carcass parts were based on the Italian market price. Gross profit was calculated on the level of production chain (including farm and slaughterhouse) based on the actual weight at slaughtering and of 2.5 kg. Cost to revenue and gross profit to cost ratio, also the efficiency were determined on equal weight in all genotypes. MM performed the lowest values in terms of cost of weaned and slaughter rabbits, production cost and total expenses, followed by PWPW, while LBLB was the most expensive. LBLB realized the highest total revenue from carcass parts (9.31 €/kg) and the highest gross profit (5.58 €/rabbit), based on the actual slaughter weight, followed by PWLB (8.94 and 5.54 €, respectively). While calculating on equal slaughter weight of 2.5 kg, the highest gross profit was found in PWPW (4.65 €), followed by PWLB (4.57 €). The best cost to revenue ratios (42.66 and 43.12%) and gross profit to cost ratios (134 and 132%) were found in the case of PWLB and PWPW, respectively. Despite the general negative correlation between adult weight and carcass traits, on average, the performance of progenies of PW does and the progenies of LB males were superior. Comparing the pure genotypes, Pannon White rabbits reached the best results, followed by the large body line and the maternal line. In general, long-term CT-based selection on carcass traits leads to the development of more valuable genotypes in terms of cost to revenue, gross profit to cost ratios and efficiency.

Key words: Rabbit, genotypes, meat value, cost to revenue, gross profit, efficiency.

INTRODUCTION

Reduction of feeding cost is of primary importance of rabbit producers, and the main possibilities include using efficient stock and good quality feed, besides effective farm management and the limitation of losses (Maertens, 2009). On the other hand, slaughterhouses are interested in realizing yet higher profit from the products sold. By focusing on individual aspects to obtain better results, there is a lack of complex, interdisciplinary thinking along the supply chain of rabbit meat production: feed (raw materials) production, feed mill, in addition to breeding and the slaughterhouse. Influencing the development of genotypes by the evaluation of carcasses traits for merit and taking advantage of CT-selection could lead to substantially improved values. Thus far, publications mainly focus on evaluating production and carcass traits. Reports on economic evaluation for growth and carcass traits are rare (Mikó *et al*., 2010; Verspecht *et al*., 2011). Therefore, the aim of the present study was to carry out an economic evaluation of rabbit genotypes differing in growth rate and carcass characteristics based on the most important cost factors, including feed and the revenue from processed products.

MATERIALS AND METHODS

The study was based on an experiment carried out at Kaposvár University (Szendrő *et al.*, 2009) with the aim of studying the effect of female and male genotypes on the production and slaughter performance of growing rabbits. Pannon White (PW) and maternal line (M) does were inseminated with the sperm from 3 genotypes:

1. Maternal line (M): established in 1999 and selected for litter size using BLUP methods; adult body weight (ABW): 4.0 to 4.5 kg;
2. Pannon White rabbits (PW): selected for daily weight gains (DWG) and carcass traits measured by CT since 1992; ABW: 4.3 to 4.8 kg;
3. Large body line (LB): selected for DWG and carcass traits measured by CT since 2005; ABW: 4.8 to 5.4 kg.

The present study involved progeny of 7 genotypes of different crossing combinations (n=224): MM, MPW, MLB, PWPW, PWM, PWLB, LBLB (first letter/s represents the genotype of dam and the second is the sire). Rabbits were weaned at the age of 5 wk. Body weight was measured at 5 and 11 wk and feed intake fortnightly.

The price of a slaughter rabbit (1.66 €/kg) was based on French data (Coutelet, 2011). Weaned rabbit's price (2.0 €/kg) was considered 20% above that of slaughter rabbits. The price of feed (0.22 €/kg) was also obtained from Coutelet (2011). Total cost of production was based on feeding cost, which may represent 70% of total production costs (Maertens, 2009). Other costs (including slaughtering) were not considered in this study as these are mostly constant, regardless of genotypes. Hence, total expenses include the price of the weaned rabbit and the total cost of rearing until slaughter. The following carcass weights were measured: head; heart and lung; liver; kidneys, fore part; loin fillet; mid part's bone; thigh meat and bone, and whole carcass. Revenue from the whole carcass and different carcass parts were Italian market-specific; data were gained from the owner of a Hungarian rabbit slaughterhouse in €/kg: whole carcass (4.3), loin fillet (12.0), thigh meat (11.0), liver (2.8), kidney (2.5), fore part (2.6), head, bone, heart, and lung (0.45). Gross profit was calculated based on the whole production line costs as the difference between the revenue from rabbit products and total expenses (excluding the cost of slaughtering). Gross profit was determined based on the actual weight at slaughter and on equal 2.5 kg weight basis. Least-squares means for cost to revenue and profit to cost ratios, as well as feed efficiency were estimated for all genotypes. The average effects of dam and sire genotypes on progenies were also evaluated.

Statistical Analysis

Slaughter characteristics were evaluated with one-way ANOVA using SPSS 10.0 software.

RESULTS AND DISCUSSION

Table 1 shows the production and carcass trait results of rabbits between the ages of 5 and 11 wk. At weaning and at 11 wk of age, LBLB had the heaviest, while MM represented the lightest body weights. MM consumed the least amount of feed (4.82 kg), while LBLB rabbits had the highest consumption level (5.80 kg) between 5 and 11 wk of age. When considering the most valuable carcass parts (loin fillet and thigh meat), PWPW had the highest ratios to carcass weight (7.41 and 16.88%, respectively), whereas MLB achieved the lowest values (6.98 and 15.87%, respectively).

In terms of prices, weaned rabbits of MM had the lowest cost, followed by PWPW, while LBLB was the most expensive by 14% compared to MM (Table 2). Due to the higher feed intake of the large-bodied genotypes - and therefore costs - the price difference of values between MM and LBLB increased to 18% by the age of 11 wk. In general, feed costs represent 70% of total costs (Maertens, 2009). Total cost of production and total expenses (including the price of rabbit at 5 wk) of MM appeared to be the lowest, followed by PWPW. The highest value was for LBLB. In terms of the difference between the price of rabbit at 11 wk and total expenses, PWLB performed the highest value, while MM was worth the least as a live fryer.

Table 1: Production and carcass traits of different rabbit genotypes

Dam		M			PW		LB		
Sire	M	PW	LB	PW	M	LB	LB	SE	P
Genotype	MM	MPW	MLB	PWPW	PWM	PWLB	LBLB		
				Body weight, kg					
5 wk of age	0.83^{a}	0.89^{ab}	0.96^{b}	0.85^{a}	0.87^{ab}	0.87^{ab}	0.95^{b}	0.008	<0.001
11 wk of age	2.46^{a}	2.68^{b}	2.79^{bc}	2.67^{b}	2.70^{b}	2.79^{bc}	2.95^{c}	0.019	<0.001
				Feed intake, kg/period					
5-7 wk of age	1.12^{a}	1.37^{ab}	1.44^{b}	1.22^{ab}	1.23^{ab}	1.41^{ab}	1.52^{b}	0.03	0.002
7-9 wk of age	1.72	1.94	1.76	1.72	1.77	1.82	1.94	0.03	0.052
9-11 wk of age	1.99^{a}	2.05^{a}	2.18^{ab}	2.14^{ab}	2.10^{ab}	2.14^{ab}	2.33^{b}	0.02	0.004
5-11 wk of age	4.82^{a}	5.37^{bc}	5.39^{bc}	5.08^{ab}	5.10^{ab}	5.37^{b}	5.80^{c}	0.05	<0.001
				Weight of carcass parts, kg					
Whole carcass	1.47^{a}	1.59^{ab}	1.64^{bc}	1.60^{b}	1.61^{b}	1.68^{bc}	1.76^{c}	0.0126	<0.001
Heart + lung	0.02^{a}	0.02^{ab}	0.02^{ab}	0.02^{a}	0.02^{a}	0.02^{ab}	0.03^{b}	0.0002	0.001
Liver	0.07	0.08	0.09	0.08	0.09	0.09	0.08	0.0013	0.069
Kidney	0.02^{a}	0.02^{ab}	0.02^{b}	0.02^{a}	0.02^{ab}	0.02^{ab}	0.02^{b}	0.0002	<0.001
Head	0.13	0.14^{bc}	0.14^{bc}	0.13^{a}	0.13^{ab}	0.14^{b}	0.14^{c}	0.0008	<0.001
Fore part	0.31^{a}	0.35^{b}	0.36^{b}	0.34^{ab}	0.35^{b}	0.37^{b}	0.39^{c}	0.0028	<0.001
Loin fillet	0.18^{a}	0.19^{ab}	0.19^{ab}	0.20^{ab}	0.20^{ab}	0.20^{ab}	0.21^{b}	0.0020	0.003
Mid part's bone	0.24^{a}	0.26^{a}	0.27^{b}	0.26^{a}	0.26^{ab}	0.28^{b}	0.29^{bc}	0.0023	<0.001
Thigh meat	0.40^{a}	0.43^{ab}	0.44^{b}	0.45^{bc}	0.44^{b}	0.46^{bc}	0.48^{c}	0.0034	<0.001
Thigh bone	0.05^{a}	0.06^{ab}	0.06^{b}	0.06^{b}	0.06^{ab}	0.06^{bc}	0.07^{c}	0.0005	<0.001

^{a,b,c}: different subscripts within a row show significant differences (P<0.05)

Table 2: Total expenses and prices depending on the genotypes (€/rabbit).

Dam		M			PW		LB
Sire	M	PW	LB	PW	M	LB	LB
Genotype	MM	MPW	MLB	PWPW	PWM	PWLB	LBLB
Price of rabbit at 5 wk	1.67	1.79	1.72	1.70	1.74	1.74	1.90
Cost of feed (5-11 wk)	1.04	1.16	1.19	1.10	1.10	1.16	1.28
Other costs	0.45	0.50	0.51	0.47	0.47	0.50	0.55
Total cost of production	1.49	1.66	1.70	1.57	1.57	1.66	1.83
Total expenses	3.16	3.44	3.41	3.27	3.31	3.40	3.73
Price of rabbit at 11 wk (revenue)	4.11	4.45	4.56	4.41	4.48	4.65	4.85

Notes: Total cost of production = cost of feed (70%) + other costs (30 %).
Total expenses = price of rabbit at 5 wk + cost of production.

When total revenue from the whole carcass was calculated, the income from LBLB was 7.56 €/kg, while for MM was lower by 16% (Table 3). On the other hand, selling different portions of the carcass lead to a higher total income, ranging between 7.78 and 9.31 €/kg (MM and LBLB, respectively). Loin fillet and thigh meat are the most valuable carcass parts with 12 and 11 €/kg. Since the proportion of the thigh meat is between 26.5 and 28% of the whole carcass, the revenue from this product is of the highest interest for the slaughterhouse. The income from thigh meat was the highest (5.24 €/kg) for LBLB.

When total expenses of and revenue from rabbit products were calculated on actual slaughter weights, the highest difference (gross profit) per rabbit was found for LBLB and PWLB, while the lowest was for MM rabbits (Table 4). Results showed a 17% difference between values of MM and LBLB, meaning that 17% more rabbit product of MM should be sold in order to obtain the same revenue as of LBLB. On average, progenies of PW dams achieved a higher gross profit than that of M. On the other hand, the progenies of LB sires had the highest gross profit, while the progenies of M achieved the lowest profit value.

Table 3: Total revenue from whole carcass and carcass parts depending on genotypes (€/kg).

Dam	M			PW			LB		
Sire	**M**	**PW**	**LB**	**PW**	**M**	**LB**	**LB**	**SE**	**P**
Genotype	**MM**	**MPW**	**MLB**	**PWPW**	**PWM**	**PWLB**	**LBLB**		
Revenue from whole carcass	**6.31^{a}**	**6.84^{ab}**	**7.06^{bc}**	**6.89^{b}**	**6.93^{b}**	**7.21^{bc}**	**7.56^{c}**	**0.054**	**<0.001**
Revenue from different carcass parts									
Thigh meat	4.39^{a}	4.77^{ab}	4.80^{b}	4.94^{bc}	4.84^{b}	5.09^{bc}	5.24^{c}	0.037	<0.001
Loin fillet	2.12^{a}	2.28^{ab}	2.31^{ab}	2.37^{ab}	2.35^{ab}	2.38^{ab}	2.51^{b}	0.024	0.003
Fore part	0.82^{a}	0.90^{b}	0.94^{b}	0.88^{ab}	0.91^{b}	0.95^{b}	1.02^{c}	0.007	<0.001
Liver	0.20	0.22	0.24	0.24	0.24	0.24	0.24	0.004	0.069
Kidney	0.05^{a}	0.05^{abc}	0.06^{bc}	0.05^{ab}	0.05^{abc}	0.05^{abc}	0.06^{c}	0.0006	<0.001
Heart + lung	0.01^{a}	0.01^{ab}	0.01^{ab}	0.01^{a}	0.01^{a}	0.01^{ab}	0.01^{b}	0.0001	0.001
Head	0.06^{a}	0.06^{bc}	0.06^{bc}	0.06^{a}	0.06^{ab}	0.06^{b}	0.06^{c}	0.0003	<0.001
Mid part's bone	0.11^{a}	0.12^{ab}	0.12^{bc}	0.12^{ab}	0.12^{abc}	0.12^{bc}	0.13^{c}	0.0010	<0.001
Thigh bone	0.02^{a}	0.03^{ab}	0.03^{bc}	0.03^{bc}	0.03^{ab}	0.03^{ab}	0.03^{c}	0.0002	<0.001
Total revenue from carcass parts	**7.78^{a}**	**8.44^{ab}**	**8.57^{b}**	**8.69^{bc}**	**8.62^{bc}**	**8.94^{bc}**	**9.31^{c}**	**0.070**	**<0.001**

^{a,b,c}: different subscripts within a row show significant differences (P<0.05)

The effect of slaughter weight could be significant; therefore, we also calculated the gross profit and related ratios on an equal slaughter weight basis. The largest difference between revenue and total expenses was obtained for PWPW and the lowest was for MM. The best cost to revenue ratio was found for PWLB and PWPW (42.66 and 43.12 %). Therefore, these genotypes achieved the highest gross profit to cost ratio (134 and 132%, respectively). MM ranked last for each of the calculations.

Table 4: Profitability of production lines calculated on the actual and equal slaughter weight as affected by genotype

	Effect of genotype							Effect of dam		**Effect of sire**		
Dam	M			PW			LB	M	PW			
Sire	M	PW	LB	PW	M	LB	LB			M	PW	LB
Genotype	MM	MPW	MLB	PWPW	PWM	PWLB	LBLB					
	Calculated on the actual weight at 11 wk											
Rabbit slaughter weight (kg)	2.48	2.68	2.75	2.66	2.70	2.80	2.92	2.64	2.72	2.59	2.67	2.78
Revenue from rabbit products (€/r)	7.78	8.45	8.57	8.69	8.62	8.94	9.31	8.26	8.75	8.20	8.57	8.75
Total expenses (€/r)	3.16	3.44	3.41	3.27	3.31	3.40	3.73	3.34	3.33	3.23	3.36	3.41
Gross profit (€/r)	4.62	5.00	5.15	5.42	5.31	5.54	5.58	4.93	**5.42**	**4.97**	**5.21**	**5.35**
	Calculated on equal weight of 2.5 kg											
Revenue from rabbit products (€/r)	7.85	7.88	7.79	8.17	7.98	7.98	7.97	7.84	8.04	7.92	8.02	7.88
Total expenses (€/r)	3.53	3.49	3.42	3.52	3.47	3.40	3.57	3.48	3.46	3.50	3.51	3.41
Gross profit (€/r)	4.32	4.39	4.37	4.65	4.52	4.57	4.39	4.36	**4.58**	**4.42**	**4.52**	**4.47**
Cost to revenue (%)	45.01	44.28	43.91	43.12	43.42	42.66	44.86	44.40	43.07	44.21	43.69	43.28
Gross profit to cost (%)	122	126	128	132	130	134	123	125	132	126	129	131
Feed efficiency	2.22	2.26	2.28	2.32	2.30	2.34	2.23	2.25	2.32	2.26	2.29	2.31

Note: €/r = €/rabbit.

When analyzing the effect of dam, progeny of PW does had a higher value than that of M does. When comparing the progenies of M, PW and LB sires, LB sires raised their profitability ratios, while progenies of PW sires were superior in terms of its average value compared to the other groups.

The adult weight and the selection criteria of the three genotypes were different. M rabbits had the lowest adult weight as they were selected for prolificacy. The adult weight of PW rabbits was heavier as they have been also selected for carcass traits based on CT data since 1992. The LB genotype had the heaviest adult weight as they have been selected for daily weight gains and carcass traits since 2005. Szendrő *et al.* (2009 a,b,c) compared the three genotypes and their crossbred combinations. It was shown that the adult weight and the selection method had significant effects on final weight and carcass traits of growing rabbits. Most of the publications have shown that rabbit lines that originated from larger-sized parents had better growth rate (Ramon *et al.*, 1996; Larzul *et al.*, 2004), but lower carcass trait values (Dalle Zotte, 2002; Hernandez *et al.*, 2006), since they are not mature enough when slaughtered at the same age or weight than progeny of maternal lines (which have lower adult weights). Despite the general negative correlation between adult weight and carcass traits, on average, the performances of progenies of PW dams and the progenies of LB sires were superior, being more competitive in terms of cost to revenue and profit to cost ratios and feed efficiency. Comparing the pure genotypes, Pannon White rabbits achieved the best results, followed by large body line and then the maternal line. In general, long-term CT-based selection on carcass traits has led to more valuable genotypes in terms of cost to revenue and gross profit to cost ratios and feed efficiency.

CONCLUSIONS

Comparing the pure genotypes, Pannon White rabbits demonstrated the best results, followed by a large body line and a maternal line. It can be concluded that long-term CT-based selection on carcass traits leads to the development of more valuable genotypes in terms of cost to revenue, gross profit to cost ratios and efficiency.

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