Ann. Anim. Sci., Vol. 11, No. 2 (2011) 309–322

STUDY ON THE POSSIBILITY OF USING THE NATIVE POPIELNO WHITE RABBIT BREED IN COMMERCIAL FARMING

Dorota Kowalska, Paweł Bielański

Department of Animal Genetic Resources Conservation, National Research Institute of Animal Production, 32-083 Balice n. Kraków, Poland

Abstract

The aim of the study was to analyse reproductive and meat performance of Popielno White (PW) rabbits (the only native breed of rabbits in Poland that easily adapts to adverse environmental conditions and is recommended for backyard farming) and New Zealand White (NZW) rabbits (a typical meat breed recommended for farm use). The results obtained allow a conclusion that in terms of productivity, PW rabbits are comparable with NZW rabbits, which are a typical meat breed. PW rabbits are characterized by high prolificacy and fertility but despite larger litters, which is associated with lower weaning weight, these animals have body weights that are comparable to those of NZW rabbits during the growth period between 35 and 90 days of age (when fed complete diets). The carcasses from PW rabbits have a lower fat content ($P \leq 0.01$). Highly significant differences were found between the breeds in the composition of some fatty acids in meat and in water holding capacity. These differences may be due to the fact that the meat of rabbits reaches full maturity at different times, because the breeds differ in time to sexual maturity, litter size and rate of growth.

Key words: rabbit, breed, reproductive performance, meat performance

Popielno White (PW) rabbits are the only native breed of rabbits in Poland. They have been included in the scheme for conservation of threatened breeds not only because of the dwindling population but also because this breed is not used in commercial farming. Efforts to create PW rabbits began in 1950 at the Experimental Station of the National Research Institute of Animal Production in Chorzelów under the guidance of Prof. Kamiński. The work was continued at the Experimental Station of the Polish Academy of Sciences in Popielno, which lent its name to the breed. The aim of the breeding work was to create a breed characterized by improved body weight, rate of growth, fertility and prolificacy.

In most EU countries, various efforts are made to conserve or restore and use the native breeds of farm animals. The popular view that these breeds are characterized by low productivity prompted us to carry out this study. In recent years, the National

Research Institute of Animal Production conducted research to compare the productivity of PW rabbits with New Zealand White (NZW) rabbits, which is a typical meat breed commonly raised in commercial farms.

Material and methods

Subjects were rabbits of two breeds: New Zealand White (NZW), a typical meat breed recommended for farm use; and Popielno White (PW), the only native breed of rabbits in Poland that easily adapts to adverse environmental conditions and is recommended for backyard farming.

The foundation stock was caged individually on deep litter in a closed facility. Young rabbits were kept in tiered, wire-mesh cages, with 4 animals of the same breed per cage. Infant rabbits were reared with mothers until 35 days of age. After sexing, weighing and individual tagging to determine group, date of birth and individual number, the animals were moved to cages in a facility for young rabbits. The hygienic and technological conditions were compatible with the general principles of this type of production. The animals were covered by a veterinary prophylactic programme for this group of animals.

Females of the foundation stock were subjected to rationed feeding with complete pelleted diets and received from 150 g during the rest period to 300 g during gestation and when rearing young rabbits to 21 days of age. Then the mixture was increased according to the requirements of growing rabbits. From weaning at 35 days to 90 days of age, young rabbits were fed *ad libitum* the same complete pellets as their mothers.

The complete pelleted diets given to rabbits contained: soybean meal, 10%; wheat bran, 18.6%; ground maize, 19%; ground barley, 25%; alfalfa meal, 23%; Prelak milk replacer, 2%; NaCl, 0.4%; dicalcium phosphate, 1%; and vitamin-mineral premix, 1% (LNB Poland Ltd., Kiszkowo).

The complete diets were made according to experimental formulas, and nutrient content was calculated based on Nutrient requirements of carnivorous and herbivorous fur animals (Normy…, 1994).

Seven subsamples were taken from each batch of the mixture to perform basic chemical analyses. Analysis was made of the content of dry matter (SOP M.011:2006[1]), crude protein (SOP M.007:2006), crude fat (SOP M.013:2006), crude fibre (SOP M.012:2006) and ash (SOP M.014:2007).

The study was carried out with farm-born animals. For this reason, the foundation stock females of both breeds were mated, and when young rabbits were 35 days old (weaning), 20 NZW and 20 PW does were selected for further research. Females were first mated at 5 months of age and the next two matings were performed within 10 and 14 days of kindling, with overlapping periods of lactation and subsequent gestation.

[1]SOP – Standard Operation Procedure; M = number of procedure at the Main Laboratory of the NRIAP.

The following parameters were determined to evaluate doe performance: percentage of does kindled, litter size at birth and at 21 and 35 days of age, litter weight at birth and at 21 and 35 days of age, body weight of one animal at 21, 35, 56, 77 and 90 days of age, weight gains to 21, 35, 56, 77 and 90 days of age, and feed conversion (kg/kg gain).

A production efficiency index was developed for the purposes of this experiment to determine the production potential of the rabbit herd and to compare production efficiency among different breeds:

$$PEI = \frac{P \times PC}{D \times ZP} \times 100$$

where:

PEI – production efficiency index of meat rabbits;

P – survival percentage (mean per litter);

PC – body weight gain from weaning to end of fattening (mean per litter/animal);

D – days of fattening;

ZP – total feed intake per rabbit in litter, kg (mean from weaning to end of fattening).

When young rabbits were 90 days old, 10 females and 10 males were randomly selected from the second litter of does of each breed and slaughtered. Animals were slaughtered after 24-h feed withdrawal in an experimental slaughterhouse, in accordance with the current methodology for this group of animals and under the same technological conditions for all the groups. Throughout slaughter and post-slaughter processing, carcasses were individually tagged for easy identification.

Slaughter analysis was performed immediately after slaughter. The following data were collected: fasting body weight, weight of edible parts (carcass without head, liver, heart, kidneys, lungs), waste (fur, blood, legs, digestive tract), weight of head, and slaughter loss. Dressing percentage was calculated as the ratio of hot carcass weight with head to preslaughter weight (after 24-h feed withdrawal) using the following formula:

$$DP\ (\%) = CW \times 100/BW$$

where:

DP – dressing percentage;

CW – carcass weight without offal (liver, kidneys, lungs, heart) (g);

BW – preslaughter weight (g).

After dividing the carcasses into three parts (front part – cut at the last rib, saddle – cut at the last lumbar vertebra, hind part – including legs and the loin part), they were dissected according to the method described by Bieniek (1997).

Analysis of meat quality

The analysis of meat quality included the following groups of traits:

a) measurement of pH 45 min postmortem (pH_{45}) and after 24-h chilling at 4°C (pH_{24h}),

b) basic chemical composition (content of water, protein, fat, and ash),

c) determination of total collagen,

d) mechanical properties of texture (hardness, springiness, cohesiveness, chewiness, resilience, shear force).

Measurements of meat pH were always performed at the level of *musculus gluteus medius* using a CyberScan pH 10 pH/mV meter.

Chemical properties of rabbit meat were determined in samples of *musculus longissimus dorsi*. Water determinations were made according to the PN-ISO 1442:2000 standard, fat content using the Soxhlet method according to PN-ISO 1444:2000, protein content by Kjeldahl analysis according to PN-75/A-04018, and total ash content according to PN-ISO 936:2000.

Collagen was determined by the method of Stegemann modified by Hurych and Chvapil, using hydrolysis according to Möhler and Volley.

The mechanical properties of texture were analysed with a Stable Micro Systems TA-XT2 Texture Analyser fitted with a 50 mm cylinder probe and a Warner-Bratzler shear force attachment with a triangular notch in the blade. The measurement results were processed by Texture Expert for Windows Version 1.05 (Stable Micro Systems).

Following dissection, hind (left) leg muscles were sampled to determine the level of higher fatty acids in meat lipids, TBA-RS in frozen meat after 14 and 90 days of cold storage at –10°C, and total cholesterol.

The composition of higher fatty acids in meat lipids was determined using gas chromatography by determining acids in the form of esters on a VARIAN 3400 gas chromatograph with a detector (250°C; range=11; Rtx 2330 column, 105 m × × 0.32 mm × 0.2 μ).

The degree of fat oxidation (TBA-RS) was measured according to the P 025:2001 method in mg of malonaldehyde per kg meat.

Cholesterol was determined with the P 026:2001 colorimetric method using a colour reaction with 10% $FeCl_3$ solution diluted 100-fold with sulphuric acid.

The results were analysed statistically using a one-factorial ANOVA design. Significant differences between the groups were estimated using Duncan's multiple range test. The calculations were made with a Statistica 7.0 PL package.

Results

Basic chemical analysis of the feed showed a relatively low level of crude fibre in the complete pelleted diet, but animals kept on deep litter (wheat straw) are able to adjust crude fibre levels by themselves. The other nutrients were within the generally accepted range of values for this group of animals (Table 1).

A total of 20 females of each breed and their three successive litters were studied. The conception rate for two matings in all the groups was 100%. Table 2 gives data on litter size and litter weight at birth and at 21 and 35 days of age, and weight gains of young rabbits to 21 and 35 days in three successive litters.

Table 1. Nutrient content of the feed (%)

Dry matter	Crude ash	Crude protein	Crude fat	Crude fibre	Organic matter	NFE
89.23	6.23	15.37	3.55	10.07	83.00	54.01

Highly significant differences in litter size at birth and at 21 and 35 days of age were found between the NZW and PW breeds (in favour of the PW breed) for all three litters.

Table 3 shows the body weight of rabbits at 35, 56, 77 and 90 days of age and their daily gains and feed intake for the whole rearing period. In the first litter, the body weight of young rabbits was similar at 35 days of age but showed highly significant differences at 56, 77 and 90 days of growth in favour of the NZW breed. In the second and third litters, the body weight at 90 days of age was similar. Feed intake during the whole period of growth was at a similar level for both the breeds and successive litters.

The body weight of animals slaughtered at 90 days of age was uniform for both breeds. The results of slaughter analysis (Table 4) showed that the only differences occurred in liver weight ($P \leq 0.01$).

The results of dissection (Table 5) showed that the carcasses of PW rabbits had a lower fat content, with significant ($P \leq 0.01$) differences between the breeds. Based on the tissue composition of rabbit carcasses, the proportion of meat was 74.8% for the NZW breed and 78.1% for the PW breed ($P \leq 0.05$). The analysis of tissue composition in individual carcass components showed that meat content was the lowest in the front part in both breeds (NZW – 66.8, PW – 70.3%), with significant ($P \leq 0.05$) differences between the breeds. The highest meat percentage was found in saddle for the PW breed (83.7) and the differences between the breeds were significant ($P \leq 0.01$).

The composition of fatty acids in the samples of rabbit meat differed between the breeds for some groups of acids, with highly significant differences in the content of PUFA, $PUFA_{n-6}$, DFA and OFA (Table 6). A significantly ($P \leq 0.05$) higher content of linoleic acid $C_{18:2n-6}$ and DHA $C_{22:6n-3}$ was found for the NZW breed. The $PUFA_{n-6}$ to $PUFA_{n-3}$ ratio did not differ between the breeds and only showed a downward trend for PW rabbits.

When analysing the effect of PUFA proportion in rabbit meat on the susceptibility of these acids to oxidation (Table 7), no differences between the breeds were found, as was the case with cholesterol content.

Table 8 presents the physicochemical properties of rabbit muscles. The pH 45 min postmortem (pH45) was 6.57 for the NZW breed and 6.56 for the PW breed. The pH_{24h} was 5.70 for NZW and 5.71 for PW rabbits.

Table 2. Litter size and weight at birth and at 21 and 35 days of age, and weight gains to 21 and 35 days of age (litters 1, 2 and 3)

Item	Breed								
	NZW	PW	SEM	NZW	PW	SEM	NZW	PW	SEM
	Litter 1			Litter 2			Litter 3		
Litter size at birth (head)	5.9A	8.6 B	0.2	6.5 A	8.3 B	0.2	6.1 A	8.3 B	0.3
Litter weight at birth (g)	367.0 A	451.0 B	20.7	402.0	416.5	9.1	387.0 A	450.0 B	9.2
Litter size at 21 days (head)	5.6A	7.8 B	0.2	5.8 A	7.9 B	0.2	5.4 A	7.7 B	0.23
Litter weight at 21 days (g)	1885.0 a	1961.0 b	98.9	2001.0	2117.0	49.5	1759.0 A	1944.0 B	61.5
Litter size at 35 days (head)	5.6A	7.2 B	0.2	5.8 A	7.5 B	0.2	5.2 A	7.3 B	0.2
Litter weight at 35 days (g)	4515.0 A	4988.0 B	205.2	4751.0 A	5189.5 B	108.6	3912.0 A	4825.0 B	129.9
Weight of 1 animal at birth (g)	62.8 A	52.6 B	2.0	62.7 A	50.9 B	0.6	64.3 A	54.7 B	0.8
Weight of 1 animal at 21 days (g)	332.3 A	252.5 B	11.8	344.6 A	269.1 B	3.7	320.4 A	253.8 B	3.9
Weight of 1 animal at 35 days (g)	808.3 A	695.43 B	14.5	825.4 A	692.7 B	4.8	754.8 A	689.8 B	5.5
Weight gains to 21 days (g)	269.4 A	199.9 B	11.4	281.9 A	218.2 B	3.8	256.2 A	199.2 B	3.8
Weight gains to 35 days (g)	745.4 A	645.9 B	14.1	762.6 A	641.8 B	5.0	690.5 a	635.2 b	5.2

A, B, C – values with different letters differ highly significantly ($P \leq 0.01$).
a, b, c, d – values with different letters differ significantly ($0.01 < P \leq 0.05$).

Table 3. Body weight of rabbits at 35, 56, 77 and 90 days of age (g), daily weight gains (g) and feed conversion (kg/kg gain) for the whole rearing period (litters 1, 2 and 3)

Item	Breed								
	NZW	PW	SEM	NZW	PW	SEM	NZW	PW	SEM
	Litter 1			Litter 2			Litter 3		
Body weight at 35 days (g)	776.3	754.5	3.1	789.3	756.3	5.0	758.8	757.0	2.2
Body weight at 56 days (g)	1581.3 A	1371.0 B	7.9	1487.0 A	1378.0 B	15.5	1448.5 a	1396.0 b	4.3
Body weight at 77 days (g)	1961.5 A	1762.5 B	7.9	1928.0A	1766.0B	10.5	1838.3 a	1783.8 b	4.7
Body weight at 90 days (g)	2523.5 A	2400.3 B	8.7	2376.8	2403.3	15.9	2418.5	2434.3	4.7
Daily gains to 56 days (g)	38.2 A	29.4 B	0.3	33.9	29.6	0.7	32.8	30.4	0.2
Daily gains to 77 days (g)	28.2a	24.0b	0.2	27.1	24.0	0.2	34.2 A	24.5 A	0.1
Daily gains to 90 days (g)	31.2	29.4	0.1	28.9	29.4	0.2	29.6	29.9	0.1
Feed conversion (kg/kg gain)	3.5	3.6	0.01	3.7	3.7	0.01	3.6	3.7	0.01

Table 4. Slaughter results (litter 2)

Item	Breed		SEM
	NZW	PW	
Body weight of rabbit (g)	2619.5	2500.5	51.0
Carcass weight without head (g)	1232.0	1212.0	27.3
Carcass weight with head (g)	1411.0	1374.0	30.8
Liver (g)	90.0 A	66.5 B	3.2
Heart, kidneys, lungs (g)	45.5	44.5	1.2
Total edible parts (g)	1382.5	1335.5	30.6
Fur (g)	450.5	430.5	9.3
Blood (g)	47.0	51.0	4.2
Legs (g)	77.5	76.0	1.3
Digestive tract (g)	479.5	445.5	15.7
Total waste (g)	1054.5	1003.0	20.7
Head (g)	179.0	162.0	3.4
Dressing percentage	53.8	54.9	0.3

Table 5. Carcass dissection results (litter 2)

Item	Breed		SEM
	NZW	PW	
Weight of cold carcass (g)	1213.5	1182.5	19.8
Tissue composition of front part (g)	449.5	424.0	9.7
Weight of muscles (g)	300.5	298.0	7.8
Weight of bones (g)	109.0	104.0	2.5
Weight of fat (g)	40.5 A	22.0 B	2.5
Proportion of meat in front part (%)	66.8a	70.3 b	2.6
Tissue composition of saddle (g)	322.0	333.5	8.6
Weight of muscles (g)	248.0 a	279.0 b	7.4
Weight of bones (g)	54.0	45.5	2.1
Weight of fat (g)	20.0 A	9.0 B	1.4
Proportion of meat in saddle (%)	77.0 A	83.7 B	2.5
Tissue composition of hind part (g)	442.0	425.0	5.9
Weight of muscles (g)	360.0	347.0	4.8
Weight of bones (g)	76.0	73.0	2.8
Weight of fat (g)	6.0	5.0	1.2
Proportion of meat in hind part (%)	81.4	81.6	2.3
Weight of muscles in carcass (g)	908.0	924.0	16.7
Weight of bones in carcass (g)	239.0	222.5	4.7
Weight of fat in carcass (g)	66.5 A	36.0 B	4.1
Proportion of meat in carcass (%)	74.9 a	78.1 b	2.1

For explanations, see Table 2.

Table 6. Composition of some fatty acids in samples of rabbit meat (% of total acids) (litter 2)

Acid	Breed		SEM
	NZW	PW	
$C_{12:0}$	0.117 A	0.512 B	0.03
$C_{14:0}$	2.734 a	3.422 b	0.09
$C_{16:0}$	27.642	29.022	0.39
$C_{16:1}$	4.619 a	3.381 b	0.17
$C_{18:0}$	6.060	5.757	0.19
$C_{18:1}$	25.062	26.260	0.39
$C_{18:2n-6}$	28.270 a	24.163 b	0.46
Gamma $_{18:3}$	0.102 A	0.049 B	0.01
$C_{20:0}$	0.091	0.099	0.01
$C_{18:3n-3}$	2.420	2.799	0.06
$C_{22:0}$	0.000 A	0.640 B	0.02
$C_{20:4n-6}$	1.991 a	2.352 b	0.10
$C_{22:1}$	0.007 a	0.152 b	0.02
$C_{20:5n-3}$(EPA)	0.106	0.063	0.01
$C_{22:6n-3}$(DHA)	0.414 a	0.065 b	0.01
SFA	36.758	39.887	0.54
UFA	63.541	60.112	0.54
MUFA	29.689	29.793	0.47
PUFA	33.552 A	30.318 B	0.51
$PUFA_{n-6}$	30.363 A	26.565 B	0.50
$PUFA_{n-3}$	2.941	2.927	0.07
DFA	69.302 A	65.869 B	0.52
OFA	30.697 A	34.130 B	0.52
$PUFA_{n-6/n-3}$	10.283	9.075	0.18

Table 7. TBA-RS of rabbit meat after 2 weeks and 3 months of storage (mg malonaldehyde/kg sample) and cholesterol content of meat (mg/100g) (litter 2)

Item	Breed		SEM
	NZW	PW	
TBA-RS, 14 days	0.349	0.349	0.01
TBA-RS, 90 days	0.532	0.531	0.01
Cholesterol	62.9	62.4	1.19

The water content of rabbit meat averaged 73.25% (NZW) and 72.32% (PW). The determinations of free water content were much lower for the NZW breed compared to the PW breed (8.22% vs 12.41%). The protein content of meat was similar for both breeds and averaged 25.43% for the NZW breed and 25.44% for the PW breed. The fat content of *musculus longissimus dorsi* samples was 2.11% for the NZW breed and 2.02 for the PW breed.

Table 8. Physicochemical properties of rabbit muscles (litter 2)

Parameter	Breed		SEM
	NZW	PW	
Dry matter (%)	27.44	27.13	0.10
Protein (%)	25.43	25.44	0.03
Fat (%)	2.11	2.02	0.01
Ash (%)	1.15	1.17	0.03
Water holding capacity (%)	73.25	72.32	0.06
Free water (%)	8.22 A	12.41 B	0.06
% total collagen	2.51	2.52	0.07
pH_{45}	6.57	6.56	0.03
pH_{24h}	5.70	5.71	0.02
Hardness (kg/cm^2)	2.09	1.94	0.11
Springiness	0.56	0.55	0.01
Cohesiveness	0.47	0.49	0.01
Chewiness (kg/cm^2)	0.57	0.61	0.04
Resilience	0.23	0.25	0.01
Shear force (N/cm^2)	18.70	18.35	0.47

Table 9. Production efficiency index of meat rabbits (PEI)

Litter	Breed		SEM
	NZW	PW	
1	49.05	48.38	0.78
2	48.86	47.88	0.68
3	47.76	49.44	0.63
Average for 3 litters	48.55	48.56	0.69

Meat quality is affected by texture (tenderness) parameters such as hardness, springiness, cohesiveness, chewiness and shear force. Meat hardness was lower in the PW breed but the differences were not significant. No statistically significant differences were found between the analysed breeds in the other parameters of texture.

The production efficiency index (PEI) estimated for rabbits of both breeds from all three litters was similar and averaged 48.55 for the NZW breed and 48.56 for the PW breed.

Discussion

Satisfactory production results were recorded for both breeds studied. The positive results of the study may suggest that under the experimental conditions, the composition of the complete pelleted mixture was sufficient to obtain optimum reproductive and rearing performance of young rabbits. Well-balanced rations for does, especially during the first lactation, play a very significant role because the body energy reserves are depleted after mobilization of fat reserves (Parigi-Bini et al., 1991, 1992; Xiccato et al., 1995), with the amount of protein remaining practically unchanged.

The results of slaughter analysis were comparable with the findings of Zając (1999). The dissection revealed that the carcasses of PW rabbits were less fat. Deposition of fat in the body is determined by fatty acid saturation of the feed. Low saturated fats can have an effect on lower fatness. Low fatness may also result from the stimulating effect of polyunsaturated fatty acids on the enzymes that degrade fatty acids (β-oxidation) (Crespo and Esteve-Garcia, 2002).

Considering the increasing consumption of rabbit meat, the quality of the product obtained takes on increasing significance. This concerns both meat technologists and consumers. Both technologists and consumers are united in the demand for limiting the carcass content of fat, which is slaughter waste. For the modern consumer who looks for healthy food, fat may limit the consumption of meat because consumers largely rely on visual inspection of foods. Compared to other animal fats, the fat of rabbit meat has a very favourable composition of fatty acids with an increased proportion of unsaturated long-chain fatty acids, although kidney and shoulder fats have always been treated by technologists as production waste.

The analysis of the tissue composition of NZW rabbit carcasses showed comparable results with those reported by Zając (1999). It was demonstrated that PW rabbits were characterized by higher carcass meat percentage. In terms of conformation, these rabbits resemble the wild rabbit in which there are no differences between the front and hind parts (Rybarczyk et al., 2006). In typical meat rabbits, the hind part is more developed as a result of breeding work. Despite visual differences, the proportion of meat in the hind part was comparable for both breeds.

The degree to which muscle tissue is rich or deficient in certain fatty acids is influenced by several factors. Although tissue lipid composition in animals is considerably dependent on the fatty acid content of feeds, the efficiency with which fatty acids are physiologically transformed from the feed to the tissue may show different tendencies. Our study was carried out with two breeds of rabbits that differ in the time to sexual maturity, litter size and rate of growth. As a result, the differences obtained may be because their meat may reach full maturity at different times.

pH value is the most important and common indicator of meat quality and technological suitability. Changes in pH are due to chemical processes, and the resulting physical and structural changes that take place in muscle (Barrőn et al., 2004). According to Blasco and Piles (1990), the qualitative evaluation of raw meat should include the measurements of pH_{45} and ultimate pH (pH_{24h}).

The pH_{45} and pH_{24h} of the meat from NZW and PW rabbits corresponded to the values reported for good quality rabbit meat, which vary between 6.10 and 6.80 for pH_{45} (Blasco and Piles, 1990) and between 5.60 and 5.85 for pH_{24h} (Zając, 1999; Maj et al., 2008).

For rabbit meat, Cavani et al. (2000) obtained a pH_{24h} value of 5.79, and Blasco and Piles (1990) a value of 5.82. Our determinations of the pH_{45} and pH_{24h} value obtained for the analysed meat samples show that postmortem changes in pH were correct and typical of normal meat.

The interaction between water and protein structures of the muscle cell is responsible for the physical, organoleptic and technological properties, including tenderness, which is a highly desirable quality trait of meat and meat products (Dolatowski et al., 2004). Many authors found tenderness to be positively correlated to hydration and capacity of the muscle proteins to hold water (O'Halloran et al., 1997; Pospiech et al., 2003; Fraga et al., 1989).

The meat water content in rabbits of both breeds fell within the range (66.2–75.3%) reported by Szkucik and Pyz-Łukasik (2009). Bieniek (1997) and Milisits et al. (2000) reported age at slaughter and growth rate to be factors differentiating meat water content.

The determinations of free water were much lower for the NZW breed (8.22%) compared to the PW breed (12.41%). Compared to the NZW breed, higher water holding capacity of meat was reported for Californian rabbits by Cavani et al. (2000) (17.65%) and similar by Zając (1999) (8.78%). The lower water holding capacity of meat is indicative of poorer processing suitability of the meat and poorer quality of the meat product obtained. In this case, the lower water holding capacity may be due to the lower resistance to stress, which is a strong stimulator of postmortem changes.

The protein content of meat was higher than that reported by Cavani et al. (2000), Maj et al. (2008) and Szkucik and Libelt (2006) for the meat of purebred rabbits and their hybrids.

The fat content of samples from the rabbit *musculus longissimus dorsi* was 2.11% for the NZW breed and 2.02 for the PW breed. For NZW rabbits, other authors reported the fat content to be 1.71% (Łapa et al., 2008), 1.60% (Maj et al., 2008), and 1.12% (Szkucik and Libelt, 2006).

In general, meat texture depends on many different factors, both biological (breed, age, structure of muscle fibres, water and fat content of meat) and environmental (nutrition, preslaughter stress, meat chilling and maturation conditions). The meat of primitive breeds has smaller tenderness compared to the breeds characterized by more rapid muscle development (Łapa et al., 2008).

There were no statistical differences between the analysed breeds in texture parameters. Similar shear force values of meat were reported by Łapa et al. (2008). Other authors (Cossu et al., 2004; Dal Bosco et al., 1997, 2000) reported much higher shear force values for *musculus longissimus dorsi*, namely from 21 to 33 and from 35.1 to 39.8 N/cm^2. Such large differences are probably due to the different measurement methods used, because in this case it matters if the sample was shorn along or across muscle fibres.

In summary, it is concluded that the PW breed, the only Polish conservation breed, is comparable to the typical meat breed of NZW rabbits in terms of production results. PW rabbits are characterized by high prolificacy and fertility, but despite larger litters and the resulting lower weaning weight, these animals obtain similar body weights to NZW animals when fed complete diets during the growth period from 35 to 90 days of age. The carcasses of PW rabbits are lower in fat ($P \leq 0.01$). Highly significant differences were found between the breeds in the composition of some fatty acids in meat and in water holding capacity. These differences may be due to the fact that the meat of rabbits reaches full maturity at different times, because the breeds differ in time to sexual maturity, litter size and rate of growth.

The present study is a proposal for a model comparison of productivity and product quality in animals of native breeds, varieties and species. Studies of this type should be carried out under uniform environmental conditions compared to those involving the most popular breeds or varieties.

References

Barrőn G., Rosas G., Sandoval Ch., Bonilla O., Reyes G., Rico P., Cardona L., Zamora F. (2004). Effect of genotype and sex on pH of *Biceps femoris* and *Longissimus dorsi* muscles in rabbit carcasses. Proc. 8th World Rabbit Congress, Puebla, Mexico, pp. 1349–1353.

Bieniek J. (1997). Wpływ czynników genetycznych i środowiskowych na użytkowość mięsną królików w warunkach chowu tradycyjnego. Zesz. Nauk. AR Kraków. Rozpr., 233.

Blasco A., Piles M. (1990). Muscular pH of the rabbit. Ann. Zootech., 39: 133–136.

Cavani C., Bianchi M., Lazzaroni C., Luzi F., Minelli G., Petracci M. (2000). Influence of type of rearing, slaughtering age and sex on fattening rabbit: II Meat quality. Proc. 7th World Rabbit Congress, Valencia, Spain, pp. 1–32.

Cossu M.E., Cumini M.L., Lazzari G. (2004). Effect of corn processing and level of inclusion on growth of meat rabbits. Proc. 8th World Rabbit Congress, Puebla Mexico, pp. 785–791.

Crespo N., Esteve-Garcia E. (2002). Nutrient and fatty acid deposition in broilers fed different dietary fatty acid profiles. Poultry Sci., 81: 1533–1542.

Dal Bosco A., Castellini C., Bernardini M. (1997). Effect of transportation and running method on some characteristics of rabbit carcasses and meat. World Rabbit Sci., 5: 115–119.

Dal Bosco A., Castellini C., Bernardini M. (2000). Productive performance and carcass and meat characteristics of cage- or pen-raised rabbits. Proc. 7th World Rabbit Congress, Valencia, Spain, pp. 579–584.

Dolatowski Z.J., Twarda J., Dudek M. (2004). Zmiany uwodnieniowe mięsa podczas dojrzewania. Ann. UMCS Lublin, sect. E, 59 (4): 1595–1606.

Fraga M.J., Blas J.C., Perez E., Rodriguez J.M., Perez C.J., Galvez J.F. (1989). Effect of diet on chemical composition of rabbits slaughtered at fixed body weights. J. Anim. Sci, 56 (5): 1097–1104.

Łapa P., Maj D., Bieniek J. (2008). Barwa i tekstura mięsa królików ras mięsnych i ich mieszańców. Med. Wet., 64 (4A): 454–456.

Maj D., Bieniek J., Łapa P. (2008). Jakość mięsa królików rasy białej nowozelandzkiej i kalifornijskiej oraz ich mieszańców. Med. Wet., 64 (3): 351–353.

Milisits G., Romvari R., Szendro Zs., Masoero G., Bergoglio G. (2000). The effect of age and weight on slaughter traits and meat composition of Pannon White growing rabbits. Proc. 7th World Rabbit Congress, Valencia, Spain, pp. 629–636.

O'Halloran G.R., Troy D.J., Buckley D.J. (1997). The relationship between early post mortem pH and the tenderization of beef muscles. Meat Sci., 45: 239–251.

Ortiz Hernández J.A., Rubio Lozano M.S. (2001). Effect of breed and sex on rabbit carcass yield and meat quality. World Rabbit Sci., 9: 51–56.

Parigi-Bini R., Xiccato G., Cinetto M. (1991). Utilization and partition of digestible energy in primiparous rabbit does in different physiological states. Proc. 12th Int. Symp. Energy Metabolism, Zurich, pp. 284–287.

Parigi-Bini R., Xiccato G., Cinetto M., Dalle Zotte A. (1992). Energy and protein utilization and partition in rabbit does concurrently pregnant and lactating. Anim. Prod., 55: 153–162.

Pospiech E., Grześ B., Łyczyński A., Borzuta K., Szalata M., Mikołajczyk B. (2003). Muscle proteins and their changes in the process of meat tenderization. Anim. Sci. Pap. Rep., 21, 1 (S): 133–151.

Rybarczyk A., Mysłek P., Kalisińska E., Gardzielewska J., Jakubowska M.,

Karamucki T., Natalczyk-Szymkowska W. (2006). Charakterystyka wartości rzeźnej dzikiego królika *Oryctolagus cuniculus*. Rocz. Inst. Przem. Mięsn. Tłuszcz., XLIV/1: 63–67.
Szkucik K., Libelt K. (2006). Wartość odżywcza mięsa królików. Med. Wet., 62 (1): 108–110.
Szkucik K., Pyz-Łukasik R. (2009). Jakość zdrowotna mięsa królików. Med. Wet., 65 (10): 665–669.
Xiccato G., Parigi-Bini R., Dalle Zotte A., Carazzolo A., Cossu M. E. (1995). Effect of dietary energy level, addition of fat and physiological state on performance and energy balance of lactating and pregnant rabbit does. Anim. Sci., 61: 387–398.
Zając J. (1999) Effect of slaughter weight on slaughter value and meat quality in the rabbit. (In Polish). Rocz. Nauk. Zoot., 26, 3: 59–69.

Accepted for printing 15 III 2011

DOROTA KOWALSKA, PAWEŁ BIELAŃSKI

Badania nad możliwością wykorzystania w chowie towarowym królików rodzimej rasy popielniańskiej białej

STRESZCZENIE

Celem pracy była analiza użytkowości rozpłodowej i mięsnej królików ras: popielniańskiej białej (PB) – jedynej rodzimej rasy królików, łatwo adaptującej się do niekorzystnych warunków środowiskowych, polecanej do chowu przyzagrodowego, oraz nowozelandzkiej białej (NB), rasy typowo mięsnej, zalecanej do hodowli fermowej. Uzyskane wyniki badań pozwalają na stwierdzenie, że rasa królików popielniańskich białych, jeżeli chodzi o wyniki produkcyjne, jest porównywalna z rasą typowo mięsnej, jaką są króliki nowozelandzkie białe. Króliki rasy PB charakteryzuje wysoka plenność i płodność, ale mimo liczniejszych miotów, co wiąże się z niższą masą ciała w dniu odsadzenia, zwierzęta te w okresie odchowu od 35. do 90. dnia życia (przy żywieniu pełnoporcjowymi mieszankami paszowymi) uzyskują masę ciała porównywalną z rasą NB. Tuszki królików rasy PB są mniej otłuszczone ($P \leq 0{,}01$). Stwierdzono wysoko istotne różnice pomiędzy rasami w składzie wybranych kwasów tłuszczowych w mięsie oraz zdolności do wiązania wody wolnej. Ponieważ porównywane rasy królików różnią się między sobą czasem dojrzewania do rozpłodu, liczebnością miotów oraz tempem wzrostu, w związku z tym ich mięso może w niejednakowym czasie uzyskiwać pełną dojrzałość, w czym można upatrywać otrzymane różnice.