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The effect of breed and sex on the texture of rabbit meat*

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The aim of this study was to determine the influence of breed and sex on texture parameters of rabbit meat. The study was conducted on rabbits of the breeds Belgian Giant Grey (n=30; 18♂, 12♀), Californian Black (n=26: 18♂, 8♀), New Zealand White (n= 19: 12♂, 7♀), Popielno White (n=64; 31♂, 33♀) and Blanc de Termonde (n= 39; 17♂, 22♀). The animals were slaughtered at 12 weeks of age. After 24-hour ageing under refrigeration, samples of the loin (*m. longissimus lumborum*) were collected for analysis. Texture Profile Analysis (TPA) was performed using a TA.XTplus texture analyser (Stable Micro Systems). Shear force (kg), hardness (kg), springiness, cohesiveness and chewiness (kg) were measured. All texture parameters were calculated automatically using Exponent for Windows ver. 6.1.10.0 (Stable Micro Systems). The analysis showed that the breed significantly influenced only the hardness of the rabbit meat, which was highest for Blanc de Termonde (12.06 kg) and lowest for Belgian Giant Grey (8.87 kg). Sex had no significant influence on texture parameters.

KEY WORDS: rabbit / sex / breed / shear force / texture

Consumers are increasingly choosing 'white meat', due to awareness of its nutritional value. In Poland, poultry meat remains the leading white meat, but production of rabbits is increasing [5]. Rabbit meat is easily digestible and has low cholesterol content. Consumers who choose are also interested in the physicochemical and sensory characteristics of the meat, such as its colour, aroma, flavour and succulence. For this reason breeding should be focused not only on the quantity of livestock produced, but also on the technological characteristics (pH and water-holding capacity) and texture (shear force, hardness, sprin-

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giness, cohesiveness, and chewiness) of the meat. Texture is one of the most important parameters for evaluating meat quality. It can be tested by instrumental methods, which provide a rapid and objective evaluation. The disadvantage of this method is that it requires costly texture measuring equipment (a texturometer) and suitable computer software [7].

The aim of the study was to determine the effect of breed and sex on the shear force and profile texture analysis (TPA) of the *m. longissimus lumborum* of rabbits.

Material and methods

The experimental material consisted of rabbits of the breeds Belgian Giant Grey (n=30; 18♂, 12♀), Californian Black (n=26; 18♂, 8♀), New Zealand White (n=19; 12♂, 7♀), Popielno White (n=64; 31♂, 33♀) and Blanc de Termonde (n=39; 17♂, 22♀). During their first 35 days of life the rabbits stayed with their dams in wooden hutches in a building with a water supply (nipple drinkers), lighting (14L:10D) and forced ventilation. After weaning at 5 weeks, until the age of 12 weeks, they were housed in a battery system for commercial rearing of rabbits, in metal cages without litter, in the same building. Both during the period with their dams and in the later period the rabbits were fed ad libitum commercial complete pelleted feed with 10.2 MJ of metabolic energy, 16.5% total protein and 14% raw fibre. The rabbits were slaughtered at 12 weeks of age, at an average body weight of 3.6 kg for the Belgian Giant Grey breed and 2.6 kg for the remaining breeds, after 24-hour fasting with constant access to drinking water. The animals were slaughtered according to the method described by Barabasz and Bieniek [2]. The rabbit carcasses were chilled for 24 hours at 4°C.

A sample of the right *m. longissimus lumborum*, in the shape of a cylinder with a minimum diameter of 15 mm, was taken from each carcass for analysis. The samples were vacuum-packed in plastic film for frozen storage of food, frozen in a freezer for 72 hours at –18°C, and then thawed at room temperature and boiled in a water bath at 80°C for 40 minutes according to Kozioł et al. [7]. The shear force was measured using a TA.XTplus texture analyser (Stable Micro Systems) fitted with a Warner-Bratzler shear blade with a triangular hole. The shear force (kg) of 10 x10 mm samples was measured at a blade speed of 2 mm/s, perpendicular to the muscle fibres, until the sample was cut through. Texture profile analysis (TPA) was performed using the same device fitted with a cylindrical probe 50 mm in diameter. Hardness (kg), springiness, cohesiveness and chewiness (kg) were measured for cubic samples with 10 mm sides. Each sample was compressed twice to 70% of its thickness, at a probe speed of 5 mm/s, parallel to the muscle fibres, with a 5 s interval between compression cycles. All parameters were calculated automatically using Exponent ver. 6.1.10.0.

The results were analysed using the SAS statistical package [13]. Two-way analysis of variance with interaction was performed for a model in which breed and gender were

fixed effects. In addition, the significance of differences between means was tested by the Tukey-Kramer test.

Results and discussion

Texture parameters, in addition to sensory characteristics, are one of the most important indicators of meat quality for the customer. The textural quality of meat is influenced by many factors, such as the breed, sex, and age of the animal, diet, pre-slaughter stress, carcass cooling and meat storage conditions, and the meat ageing process [7].

There was no significant interaction between the sex and breed of the rabbits.

The study showed that only the hardness of the meat differed statistically significantly between breeds. There were no statistically significant differences between breeds in shear force, springiness, cohesiveness or chewiness. The highest hardness was noted for the meat of the Blanc de Termonde rabbits (12.06 kg) and the lowest for the Belgian Giant Grey (8.87 kg) (table). This may have been due to the fact that all rabbits were slaughtered at the same age, and the Belgian Giant Grey rabbits, as a large breed, reach maturity later than medium breeds, and in consequence their meat was the least hard.

May et al. [9] found that the shear force and TPA of the meat of New Zealand White rabbits at the age of 12 weeks were as follows: shear force - 34.4 N/cm^2 (3.51 kg); hardness – 58.69 N (5.98 kg); chewiness – 12.69 N (1.29 kg); springiness – 0.57; cohesiveness – 0.37. The significantly higher shear force as compared to our results could have been due to the use of raw meat in the tests. Ortiz Hernandez and Rubio Lozano [10], who compared the shear force of the meat of New Zealand White and Californian Black rabbits, obtained values of 2.81 kg and 2.45 kg, respectively. The shear force was higher than in the present study because the measurement was made on raw meat with reduced ageing time. Ariño et al. [1] have shown statistically significant differences between the shear force, cohesiveness, springiness and chewiness of the meat of synthetic lines of rabbits selected for litter size and growth rate. The average values for these parameters were as follows: shear force – 3.57 kg, cohesiveness – 0.466, springiness – 0.49, and chewiness – 2.70 kg. These results were higher than those obtained in the present study, possibly due to the use of rabbits of synthetic lines subjected to strict selection in one direction. In a study by Pascual and Pla [12] on rabbits of the synthetic line R, the shear force was 36.0 N/cm^2, while the other meat texture parameters were evaluated by sensory methods. The shear force was higher than for the breeds analysed in our experiment.

Kowalska et al. [6], in an experiment on the relationship between carcass fat and the intramuscular fat content, fatty acid profile and tenderness of meat, also tested shear force in New Zealand White and Popielno White rabbits, obtaining values of 16.5 N/cm^2 (1.68 kg) and 16.1 N/cm^2 (1.64 kg). The lower shear force values in that study may have

been due to the shorter boiling time, in a water bath set at a lower temperature. The influence of temperature and cooking time on meat quality was presented in a study by Combes et al. [3]; meat cooked at 60°C had the lowest shear force values, which increased with the temperature in the water bath.

Łapa et al. [8] performed texture profile analysis (TPA) in a study on the colour and texture of meat from rabbits of meat breeds and their crosses. Among the pure breeds, they studied New Zealand White and Californian rabbits. The following values were obtained for the New Zealand White breed: hardness – 2.98 kg/cm^2; springiness – 0.81; cohesiveness – 0.46; chewiness – 1.19 kg/cm^2; shear force – 15.90 N/cm^2 (1.62 kg). For the Californian breed, the texture parameters were as follows: hardness – 2.41 kg/cm^2; springiness – 0.80; cohesiveness – 0.45; chewiness – 0.94 kg/cm^2; shear force – 12.3 N/cm^2 (1.25 kg). The values differed from those shown in our study because the texture parameters were measured on raw meat.

Hernández and Pla [4], in a study on the effect of selected fatty acids on the texture parameters of the meat of three-breed rabbit crosses, obtained the following results: shear force – 3.19 kg/cm^2; hardness – 12 kg; cohesiveness – 0.49; springiness – 0.48; chewiness – 2.82 kg. The higher shear force than in our study may be due to the longer cooking time. The values for chewiness and hardness are most similar to the results for Blanc de Termonde, which may be indicative of Blanc de Termonde blood in the crossbred.

Table

Means and standard deviations (in brackets) depending on the breed and sex of rabbits

Texture parameters	Breed					Sex	
	BOS n=30	Kc n=26	NB n=19	PB n=64	TB n=39	♂ n=96	♀ n=82
Shear force (kg)	1.95 (0.96)	1.81 (0.53)	1.77 (0.44)	1.73 (0.51)	1.97 (0.65)	1.86 (0.70)	1.81 (0.55)
Hardness (kg)	8.87^{a} (4.35)	10.43^{abc} (1.74)	9.99^{ab} (2.64)	10.61^{b} (2.31)	12.06^{c} (0.70)	10.82 (3.31)	10.22 (3.00)
Springiness	0.49 (0.09)	0.48 (0.05)	0.47 (0.06)	0.47 (0.04)	0.46 (0.06)	0.48 (0.06)	0.46 (0.05)
Cohesiveness	0.43 (0.07)	0.43 (0.03)	0.42 (0.03)	0.43 (0.03)	0.42 (0.04)	0.43 (0.04)	0.42 (0.04)
Chewiness (kg)	2.11 (1.50)	2.23 (0.52)	2.06 (0.72)	2.18 (0.65)	2.45 (1.21)	2.35 (1.06)	2.07 (0.84)

BOS – Belgian Giant Grey,
Kc – Californian Black,
NB – New Zealand White,
PB – Popielno White,
TB – Blanc de Termonde
a, b, c – means in rows with different letters are significantly different (P≤0.05)

Our research showed that sex did not influence meat texture parameters. Similar conclusions have been reached by Maj et al. [9], Pałka et al. [11], Ortiz Hernández and Rubio Lozano [10] and Trocino et al. [14], whereas Kozioł et al. [7] showed that the meat of male Blanc de Termonde rabbits was harder than that of females (9.10 kg in males and 7.95 kg in females).

It can be concluded from the study that breed had a significant effect only on the hardness of rabbit meat, but did not affect the shear force, springiness, cohesiveness and chewiness of the meat. Sex did not differentiate meat texture parameters.

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