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Bull Vet Inst Pulawy 57, 357-363, 2013
DOI: 10.2478/bvip-2013-0062

Wild boar meat sensory attributes contributing general meat quality

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Received: May 31, 2013 *Accepted: September 12, 2013*

Abstract

The purpose of the study was to establish relationship between different sensory attributes of wild boar meat, as well as to develop a prediction model of sensory attributes demanded. The sensory analysis of 40 samples of wild boar meat (the loin) was performed. For wild boar meat, tenderness, juiciness, colour, taste, aroma, and off-flavours are significantly correlated with general quality of meat, assessed by the sensory panel. The results from the study indicate that wild boar meat reveals characteristic sensory traits; however, texture as well as off-flavours do not play an important role in creating general quality, but the most important factors influencing the general quality of wild boar meat included juiciness, colour, taste, and aroma.

Key words: wild boar meat, sensory attributes, general quality, aroma, colour, juiciness.

Introduction

Nowadays, consumers are increasingly concerned about the nutritional value of meat and its impact on health, but they also expect meat products to be characterised by demanded sensory attributes such as tenderness, juiciness, aroma, or flavour (12). Consumers' wish is to eat tasty and juicy meat with low fat and cholesterol content as it is generally recommended. Moreover, types of meat consumed rarely until now, currently are getting popular (9). Wild boar meat has less fat than pork meat and therefore becomes to be increasingly preferred by the consumer (5).

Wild boar meat is chosen due to its sensory attributes described as an intense, sweet, and nutty flavour, as well as due to its general nutritional value (11). As a consequence, there is a growing interest in the production and marketing of wild boar meat. In some countries, special farms have been established for wild boar meat production (2).

The information on the physicochemical properties of wild boar meat is available in the literature; however, there are just a few publications available regarding the relationship between the sensory attributes of wild boar meat and the consumer demand. In the mentioned research, the authors focused on improving texture attributes achieved by marinating; however, the final effects were diverse in the case of applying various ingredients (kefir, wine, lemon, pineapple juice). The research indicates that meat ageing with the addition of pineapple juice causes the worst general attractiveness although the best textural attributes were observed (16). Therefore, it is very important to understand the relationship between the sensory attributes of wild boar meat and to be aware of the most important traits that contribute to its general quality.

The purpose of this study was to establish the relationship between different sensory attributes of wild boar meat as well as to develop a prediction model on the basis of an model of sensory attributes demanded.

Material and Methods

Sensory analysis was conducted on 40 samples of wild boar meat (the loin), from different animals, originating from the same region of Poland and

characterised by the same age (10.6 ±2.0 months) and similar body mass (34.2 ±12.5 kg). Animals were hunted in Lubelszczyzna region near Annopol. In the case of body mass, distribution different than normal was observed (verification on the basis of W Shapiro-Wilk test – $P \leq 0.05$).

The quantity and characteristics of animals guaranteed diverse samples, typical to the natural variety for the analysed age group of wild boar (Table 1).

Table 1. Characteristics of analysed wild boar meat samples

	Median	Minimum value	Maximum value
Water content (%)[(1)]	60.71	57.37	62.14
Fat content (%)[(1)]	7.80	6.25	8.85
Protein content (%)[(1)]	30.44	29.63	31.90
Ash content (%)[(1)]	4.15	3.88	4.69
L* colour component (-)[(2)]	41.49	29.88	44.46
a* colour component (-)[(2)]	20.66	16.80	25.11
b* colour component (-)[(2)]	11.97	3.02	14.62
Hardness (kN)[(3)]	36.63	24.17	55.17

[(1)] measured using near-infrared spectroscopy method
[(2)] measured using chromametric method
[(3)] measured using Warner-Bratzler Shear Force Procedures

Members of the sensory panel consisted of meat consumers aged over 25, familiar with issues of meat quality due to their educational background (Warsaw University of Life Sciences) and performed work (European Union projects associated with meat quality assessment and enhancement). Members of the sensory panel were of diverse gender (50% male and 50% female) and different level of monthly income per person. The research was conducted in Warsaw in the first quarter of 2012, after hunting the animals, typical veterinary control (confirmed negative *Trichinella spiralis* control), and cutting.

Wild boar steaks, prepared from loin as one of the principal elements of wild boar carcass, were the subject of the sensory analysis. Loin was cut into cubes (2.54 cm × 2.54 cm × 2.54 cm) and subjected to identical thermal treatment – cooked in water of a temperature of 80 ±1°C, to 71 ±1°C in the central point of sample, which guarantees the sensory value of meat, accompanied by microbiological safety. The meat was cooked without addition of fat, salt, and spices.

Sensory evaluation was conducted under controlled conditions. The steaks labelled with three-digit random numbers, were presented warm to the panellists. From each animal, the same samples consisting of 2 cubes were prepared, which resulted in 40 samples of wild boar meat. Then, samples were served to the panellists. The entire serving procedure was controlled so that it took less than 5 min. Meat from each wild boar was planned to be evaluated by more than one panellist, to guarantee obtaining a representative material evaluation.

The consumers did not add salt or spices to the plate. Simultaneously with the samples, consumers received a questionnaire of sensory survey. Completed questionnaires were the basis of the conducted analysis. Panellists conducted sensory evaluation using the hedonic scale. They estimated the acceptance of wild boar quality attributes (tenderness, juiciness, colour, taste, aroma, off-flavours, general quality) on a 10-cm scale anchored at the ends by the words "dislike extremely"/"like extremely". The investigative material gathered enabled an estimation of the dependencies between variables of wild boar quality attributes.

The wild boar meat quality attributes for each panellist and each sample were determined after measurement of the distance between "dislike extremely" end of the scale (0 cm) and the tick-point chosen by the panellist. Measurement was conducted correct to 0.1 cm, while 0 cm was 0 points – the lowest grade ("dislike extremely") and 10 cm was 10 points – the highest grade ("like extremely").

Simultaneously, the water, fat, protein, and ash content were presented (measured using near-infrared spectroscopy method – NIR device – NIR Flex Solids N-500 (Büchi, Flawil, Switzerland) – spectral range – 800-2500 nm), as well as L*, a* and b* components of colour (measured using chromametric method – Hunter Lab chromometer Minolta CR-400 (Minolta Camera Co., Japan), 8 mm diameter measurement area, D65 standard illuminant), and hardness of analysed samples (measured using Warner-Bratzler Shear Force Procedures, Instron 4301 Universal Testing Machine – Instron, USA, crosshead speed of 200 mm/min).

For each attribute, the normality of distribution was assessed using W Shapiro-Wilk test. To define relationships between analysed factors, they were tested using Pearson's correlation coefficient and R Spearman's rank correlation coefficient. To characterise multifactorial influence on the general quality of wild boar meat, the standard least squares method was used. Analysis was conducted using the Statistica software version 8.0 by StatSoft Inc and Gretl software version 1.9.9 by Allin Cottrell (Department of Economics, Wake Forest University, USA). To define the significance of relationships, the level of significance $\alpha = 0.05$ was accepted. The figures (3-dimensional diagrams) were created using the graph creator of the Gretl software version 1.9.9 by Allin Cottrell.

Results

It was observed, that all analysed attributes (tenderness, juiciness, colour, taste, aroma, off-flavours) were correlated with the general quality of wild boar meat (Table 2). Not all factors were characterised by normal distribution, but for all of them significant correlation was revealed using Pearson's correlation coefficient or R Spearman's rank correlation coefficient ($P = 0.0000$ for all analysed factors). For tenderness and off-flavours, correlations were moderate (R coefficient 0.6-0.7), while for other

factors – juiciness, colour, taste, aroma, they were strong (R coefficient 0.7-0.9). All of the most important sensory attributes, which were observed by consumers, affected the general quality perceived by them – there was no insignificant attribute in the case of wild boar meat.

Table 2. Analysis of correlation between analysed attributes and general quality attribute of wild boar meat (for normal distribution – Pearson's correlation coefficient, for distribution different than normal – R Spearman's rank correlation coefficient)

	P-value	R coefficient
Tenderness	0.0000(1)	0.6441
Juiciness	0.0000(1)	0.8101
Colour	0.0000	0.7860
Taste	0.0000	0.8774
Aroma	0.0000	0.8465
Off-flavours	0.0000(1)	0.6796

(1) distribution different than normal (verification on the basis of W Shapiro-Wilk test – $P \leq 0.05$)

Further analyses were associated with multifactorial influence on the general quality of wild boar meat. The analysis was conducted using two steps – primary (for all the attributes), and secondary (for chosen attributes). The primary step of multifactorial influence on the general quality of wild boar meat assessment is presented in Table 3.

Table 3. Primary step of multifactorial influence on general quality of wild boar meat assessment for tenderness, juiciness, colour, taste, aroma, off-flavours (analysis for all the attributes – standard least squares method)(1)

	P-value	Significance	Coefficient for analysed attribute
Constant	0.3707	-	0.2965
Tenderness	0.6282	-	-0.0499
Juiciness	0.0086	***	0.3374
Colour	0.0035	***	0.2493
Taste	0.0002	***	0.3345
Aroma	0.0123	**	0.1794
Off-flavours	0.4488	-	0.0464

(1) * $P \leq 0.1$; **$P \leq 0.05$; ***$P \leq 0.01$, threshold according to Gretl software

Taking into account tenderness, juiciness, colour, taste, aroma, and off-flavours, only juiciness, colour, taste, and aroma exerted a significant influence on the general quality of wild boar meat. The influence of other factors in the multifactor model turned out to be insufficient.

The elaborated predictive equation for wild boar meat general quality was:

Q = 0.29 – 0.05*Te + 0.34*Ju + 0.25*Co + 0.33*Ta + 0.18*Ar + 0.05*Of, where Q is general quality, Te – tenderness, Ju – juiciness, Co – colour, Ta – taste, Ar – aroma, and Of – off-flavours, in panellists' evaluation in 10-point hedonic scale. The coefficient of determination (R^2) for the presented formula was 0.9363, which means that the general quality of wild boar meat was explained by the presented equation in 94%.

After removing tenderness and off-flavours from the predictive equation, it would be:

Q = 0.29 + 0.34*Ju + 0.25*Co + 0.33*Ta + 0.18*Ar, where Q is general quality, Ju – juiciness, Co – colour, Ta – taste and Ar – aroma, panellists' evaluation in 10-point hedonic scale.

However, removing attributes from the equation must be associated with its adaptation. To perform this, the secondary step of multifactorial influence on general quality of wild boar meat assessment was conducted. The results are presented in Table 4. It was concluded that taking into account juiciness, colour, taste, and aroma, all analysed attributes exerted a significant influence on the general quality of wild boar meat. Moreover, as in the primary step of analysis, only juiciness, colour, and taste were characterised by a P-value lower than 0.01, in the secondary step, also aroma was characterised by such a P-value. It may be concluded that the influence of aroma was modified by the presence of tenderness and off-flavours in the model. It should be emphasised that in the secondary analysis, the coefficient of determination (R^2) for the elaborated model was 0.9343, meaning that the general quality of wild boar meat was explained by the elaborated equation in 93% - almost the same as in the previously presented model.

Table 4. Secondary step of multifactorial influence on general quality of wild boar meat assessment for juiciness, colour, taste, aroma (analysis for the attributes significant in the first step – standard least squares method)

	P-value	Significance	Coefficient for analysed attribute
Constant	0.2832	-	0.3175
Juiciness	0.0006	***	0.2925
Colour	0.0033	***	0.2430
Taste	0.0000	***	0.3749
Aroma	0.0068	***	0.1847

* $P \leq 0.1$; **$P \leq 0.05$; ***$P \leq 0.01$, threshold according to Gretl software

The elaborated predictive equation for wild boar meat general quality in the secondary analysis was:

Q = 0.32 + 0.29*Ju + 0.24*Co + 0.37*Ta + 0.18*Ar, where Q is general quality, Ju – juiciness, Co – colour, Ta – taste and Ar – aroma, panellists' evaluation in 10-point hedonic scale. It must be concluded that after removing tenderness and off-flavours from the equation, the influence of taste on the general quality, turned out to be more significant and the influence of juiciness and colour – less important, while the influence of aroma remained unchanged.

The analysis revealed, that the taste of meat has the highest impact on the general quality of wild boar meat, juiciness and colour has lower impact, and aroma – the lowest, but also significant. The relation of the mentioned attributes in creating wild boar meat general

quality may be presented as 37: 29: 24: 18 for taste: juiciness: colour: aroma.

Bifactorial influence of wild boar quality attributes on the general quality of wild boar meat was also observed. It was only analysed for factors being the most important in creating the general quality of wild boar meat – taste, juiciness, colour, and aroma (Fig. 1). It was observed that for each two attributes, the higher they were graded, the more attractive wild boar meat was for consumers. However, it must be concluded that for (B) aroma and colour, (D) colour and taste, as well as (F) taste and aroma, the highest grade of attributes and the highest general quality grade were denoted simultaneously, as it is presented on the Fig. 1. For (A) aroma and juiciness, (C) colour and juiciness, as well as (E) taste and juiciness, this relationship was not observed – there was no sample that was characterised by the aroma and juiciness, colour and juiciness or taste and juiciness both ranked the highest notes, as well as the general quality grade. It resulted from the fact, that juiciness for the analysed samples was ranked as rather low – for 85% its acceptance was ranked as 5 or lower (in 10-point hedonic scale). As a result, diagrams for (A), (C), as well as (E) are more horizontal than for (B), (D), and (F).

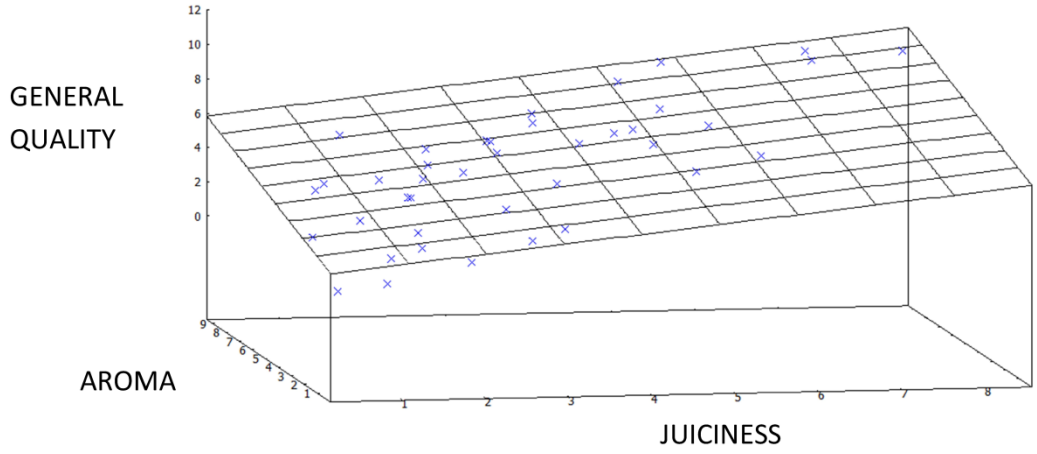


Fig. 1 (A). Bifactorial influence of wild boar quality attributes on general quality of wild boar meat – influence of aroma and juiciness

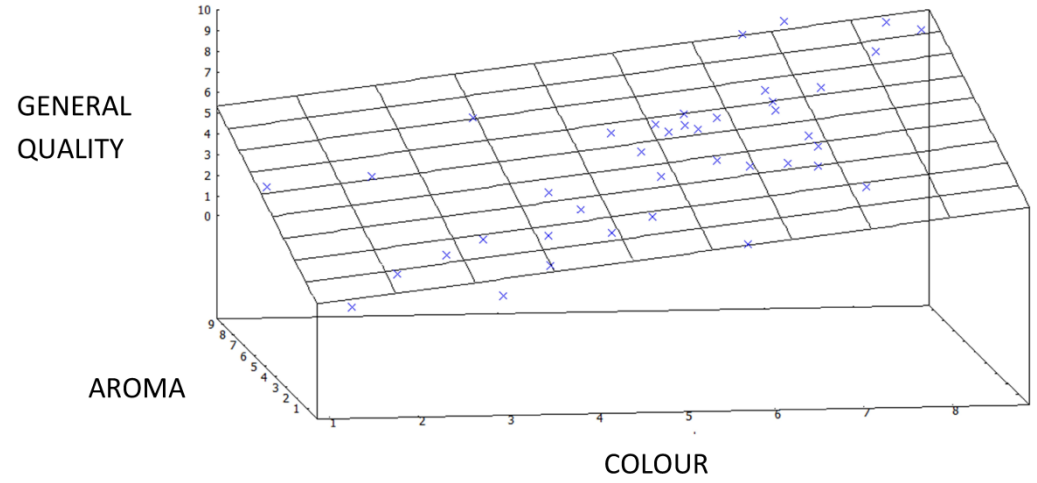


Fig. 1 (B). Bifactorial influence of wild boar quality attributes on general quality of wild boar meat – influence of aroma and colour

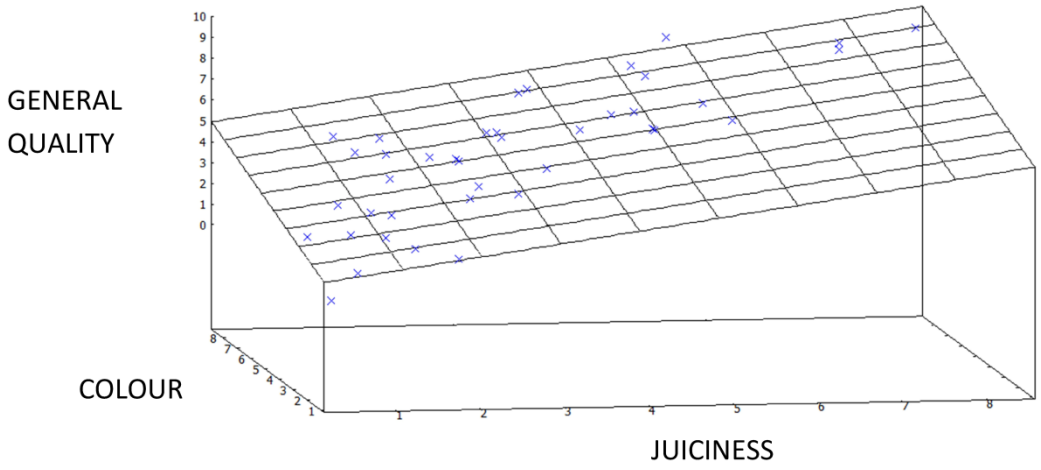


Fig. 1 (C). Bifactorial influence of wild boar quality attributes on general quality of wild boar meat – influence of colour and juiciness

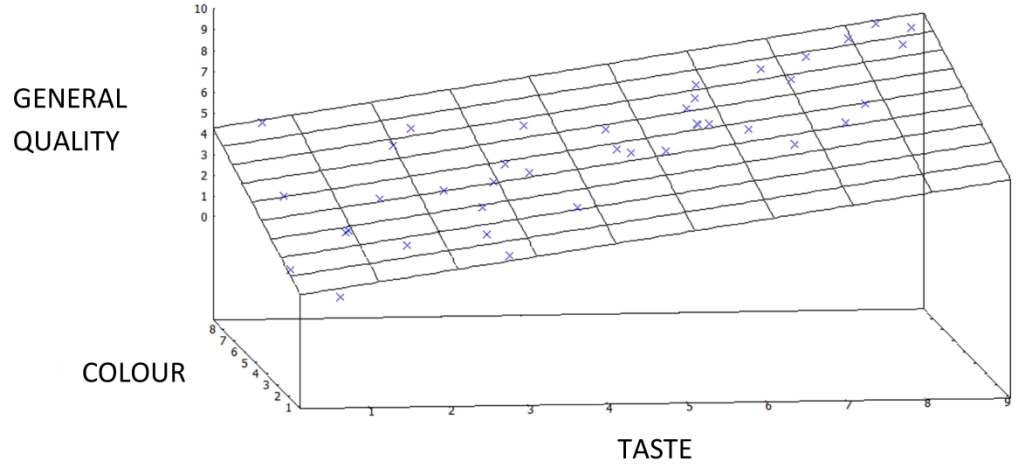


Fig. 1 (D). Bifactorial influence of wild boar quality attributes on general quality of wild boar meat – influence of colour and taste

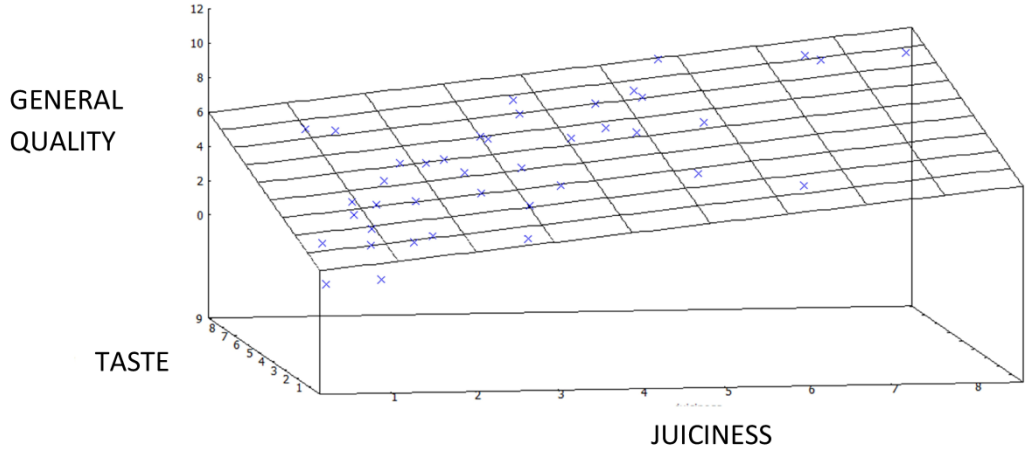


Fig. 1 (E). Bifactorial influence of wild boar quality attributes on general quality of wild boar meat – influence of taste and juiciness

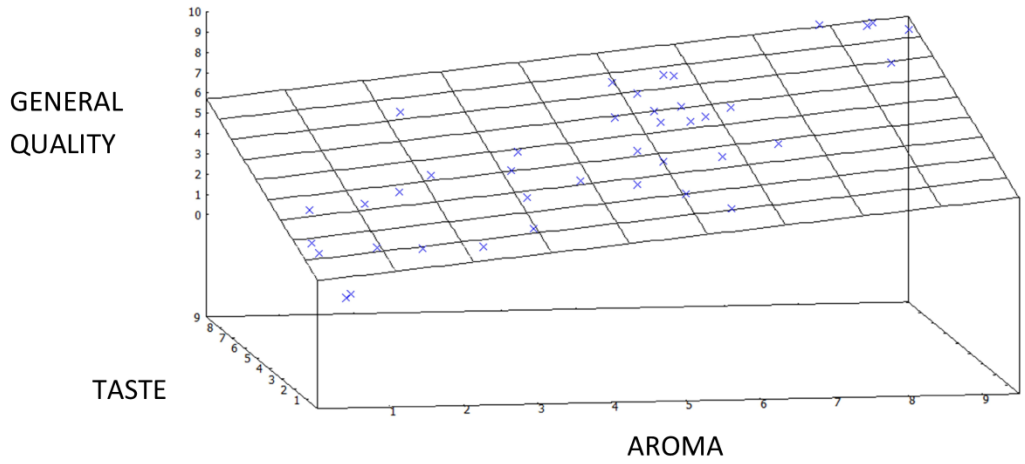


Fig. 1 (F). Bifactorial influence of wild boar quality attributes on general quality of wild boar meat – influence of taste and aroma

Discussion

Different than normal distribution of body mass may suggest that animals of a similar age displayed various body mass, which was also stated by other researchers (15) and may be attributed to seasonal variation of the body mass, climate, as well as the geographic characteristic of the hunting ground (15 310 ha).

The results from the study indicate that wild boar meat shows characteristic sensory traits; however, texture as well as off-flavours do not play an important role in creating general quality. This observation is important, as in the case of meat from domestic livestock, tenderness is one of the most important quality attributes for consumers (6). However, physicochemical and sensory properties of wild boar meat and domestic livestock meat may differ (4). Especially, characteristic texture and taste of game meat differs from that of poultry and farmyard animals – the texture is tougher and meat has a stronger taste (14).

Wild boar meat is highly appreciated by consumers in the Central Europe, in spite of its tough texture, due to tradition and unique taste, as well as the nutritional value (11).

The second interesting observation was that particularly taste and aroma from all sensory attributes have a major influence on general quality perception by panellists. The sensory traits determined by the senses of taste and smell combined are called flavour and it is a complex attribute of meat palatability (1). In a multiple-city study it was stated that flavour is the most important factor affecting consumers' meat preferences when tenderness is constant (13). Similarly, in this study, aroma and taste had the greatest influence on general quality. Flavour depends on the quantity and composition of fat in the meat (8); however, some studies have found no correlations between beef flavour intensity and chemical characteristics (7).

On the other hand, juiciness of the analysed samples was ranked as rather low and it may partly explain the important role of juiciness in the elaborated predictive equations – it was an attribute ranked as rather low, however, when it was ranked better, it caused significantly higher general quality of wild boar meat. It should be analysed in further study, whether the observation showing that ranking juiciness as very low caused a minor role of tenderness in the elaborated model, is a general correlation observed for Polish wild boar meat, or only for analysed population of animals.

Many studies concern beef and pork meat, but only a few concern game meat. Numerous studies in the world are also associated with sensory attributes of meat in terms of quality features prediction, but there is no research regarding the wild boar meat. In the case of the beef prediction model in Meat Standard Australia, tenderness rating is multiplied by 0.4, juiciness is multiplied by 0.1, flavour is multiplied by 0.2, and overall liking is multiplied by 0.3, to create a meat quality score (10). As regards Polish beef, it is also possible to predict the tenderness, fibrousness and juiciness attributes on the basis of tenderness and fibrousness (3). Such a prediction is of a great value in practice, as consumer analysis of limited attributes will suffice to estimate with a high precision the rest of attributes or general perception of meat.

As wild boar meat is not produced on such a mass scale as beef meat, such research for wild boar meat is not conducted to improve its production, but it would enrich our understanding of meat quality and attributes determining the consumer perception, not only of beef or pork, but also of game meat. Attributes creating the general quality of meat are influenced by many conditions, including pre- and post-mortem handling, but also consumers' individual preferences. The knowledge concerning the relationship between individual sensory attributes of wild boar meat seems to

be necessary, taking into account the increasing consumer interest in this type of meat.

It may be concluded that tenderness, juiciness, colour, taste, aroma, off-flavours are significantly correlated with the general quality of wild boar meat, assessed by the sensory panel, however in the case of wild boar meat different quality attributes are important, in comparison with other types of meat. Taste-related sensory attributes, namely taste and aroma are very important factors. Out of texture attributes, only juiciness is important, while tenderness does not have a significant impact on general quality. Colour is also important – as in the case of most types of meat and meat products. In the case of most analysed samples of wild boar meat, juiciness was ranked rather low, thus better juiciness attribute may be associated with higher general quality, which may partly explain the important role of the mentioned attribute in creating the general quality of wild boar meat samples.

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