

COMPARISON OF SARCOMERE LENGTH FOR TWO TYPES OF MEAT FROM ANIMAL FAMILY *SUIDAE* – ANALYSIS OF MEASUREMENTS CARRIED OUT BY MICROSCOPIC TECHNIQUE

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ABSTRACT

The aim of the research was to evaluate the sarcomere length variation in *Psoas major* muscle in pork and wild boar tenderloin. Microscopic slides were prepared and muscles were evaluated in Nomarski contrast – there were made measurements with the number of 150. Subsequently, sarcomeres length of three different, representative myofibrils were measured for each kind of meat. Values of sarcomere's lengths of myofibrils were characterized by a normal distribution. The mean length of sarcomere was $3.28 \pm 0.23 \mu\text{m}$ for pork meat and $2.51 \pm 0.14 \mu\text{m}$ for wild boar meat – difference between animals was statistically significant ($p = 0.0000$). It was stated that sarcomere length for pork meat was dependent on the myofibril. A lower variation in the sarcomere's length of wild boar meat in comparison with pork meat has been shown. This difference is reflected in tougher wild boar meat texture.

Keywords: sarcomeres, myofibrils, pork meat, wild boar meat, microscope.

INTRODUCTION

Wild game meat is a product, which is still not widely known to consumers, especially when taking into account its health-promoting qualities, as well as distinctive taste and aroma. In comparison with livestock meat, wild game meat contains definitely lower fat content with an average of 3.3 g/100g, while for pork it equals 35 g/100g (average for entire carcass). These values are similar only for the less fattened element with 3.5 g/100g. Such fat content is also reflected in mean energetic

value of boar carcass, which is 122 kcal/100g, whereas mean energetic value for pork carcass is 376 kcal/100g [13].

The characteristic intensive sweet and nutty taste and aroma of boar meat [9] result from the wild animals diet, that is defined by the season and availability of the natural food in animal habitat area. In consequence within last years, wild boar meat and processed products were gaining more popularity in Europe what was followed by the higher carcasses acquisition and wild game meat processing in countries such as Poland, Austria,

Hungary and Slovenia [1]. However, boar meat is generally described as tough in instrumental analysis, as well as in sensory measurement [11]. One of the factors determining the structure and crispness of meat is sarcomere length, which is indicated by some authors as intermediate feature of toughness. Despite sarcomere length explains only approximately 54% of toughness [14], it can serve as predictor of the texture, and as a result of the general sensory quality [2]. The aim of this work was to evaluate the degree of sarcomere length differentiation of the *Psoas major* muscle from pork tenderloin, as well as from boar, using the microscopic technique.

MATERIALS AND METHODS

The research material were samples of *M. Psoas major* originated from *Sus scrofa domestica* (as an example of meat from slaughtered animals) and from *Sus scrofa scrofa* (as an example of the wild game). *Sus scrofa scrofa* is an ancestor of the domestic swine and the only representative of the wild suidae in Europe. Meat was obtained from the animals, which were characterized by the similar age, but in view of the species specificity, as well as growth conditions, animals weight were different. Pork originated from the representative in the age of 6 months and weight about 100 kg, whereas boar meat- in the age of 9 months and weight about 25 kg.

From the properly collected sample of *M. psoas major* (5 g), there were prepared cubes with dimensions 0.5×0.5×0.5 cm in the cold 0.25M sucrose solution, in which thanks to homogenization carried out in low speed (5000 rpm, 60 sec.), single myofibrils were isolated. In evaluation Carl Zeiss Axio Imager.M2 microscope with objective EC Plan-Neofluar 100x/1.30 Oil Ph 3 M27 and AxioCamMR5 camera were used. Microscopic observations were established in Nomarkı contrast (DIC – *differential interference contrast*).

After homogenization, myofibrils were visible in the microscopic preparation as single structures, as well as 2- or 3-myofibrils clusters. However, aiming at higher precision of measurements, only myofibrils isolated as fully separate structures were taken into account. For both made preparations there were 15 photos taken from the randomly selected areas, 3 photos with single and unaffected myofibrils were taken out of them. AxioVision Rel.4.8.2 (Carl Zeiss) program was used

to assess sarcomere length within the analysed myofibrils. For every myofibril at least 25 sarcomere were measured. There were carried out 150 measurements at all, 75 for every sample (3×25), to enable proper estimation of the average sarcomere length in the sample.

Shapiro-Wilk test was used in statistical analysis to evaluate normality of the distribution. T-student test (Hypothesis Test) was applied to compare the distributions. Statistical analysis were carried out using Statistica 8.0 (StatSoft, Inc.) software. To determine significance of differences, the significance level $\alpha = 0.05$ and level $\alpha = 0.1$ as close to statistical significance were adopted.

RESULTS AND DISCUSSION

In case of all the analysed myofibrils for the pork, as well as for boar meat, it was stated that sarcomere length is the characteristic with normal distribution. It is consistent with the former observations, which referred to sarcomere length for beef [4]. The average sarcomere length for pork and boar meat (analyzed independently basing on myofibrils) was also characterized by normal distribution.

For pork, as well as for boar meat, the average sarcomere length for the separate myofibrils was compared and it was concluded that average sarcomere length for pork differs according to myofibril (Fig. 1), whereas such differences were not observed for boar meat (Fig. 2). Statistically significant differences in sarcomere length for pork were noticed between “1” and “3” myofibrils ($p = 0.0033$), as well as “2” and “3” ($p = 0.0063$). Such differences did not exist when comparing “1” and „2” myofibrils ($p = 0.2673$). This fact can indicate, that measured statistically significant differences result from the sarcomere length in “3” myofibril, which is smaller than in other myofibrils.

For the boar meat, the comparison of the average length of the sarcomere from different myofibrils was performed. No statistically significant differences were identified between “1” and “2” ($p = 0.1909$), “1” and “3” ($p = 0.1478$), as well as “2” and “3” ($p = 0.9523$) myofibrils. This result indicates, that there is less sarcomere length diversity between separate myofibrils for boar meat, but not for pork. Sarcomere length diversity for single myofibrils was also higher for beef, rather than boar meat what was proved in

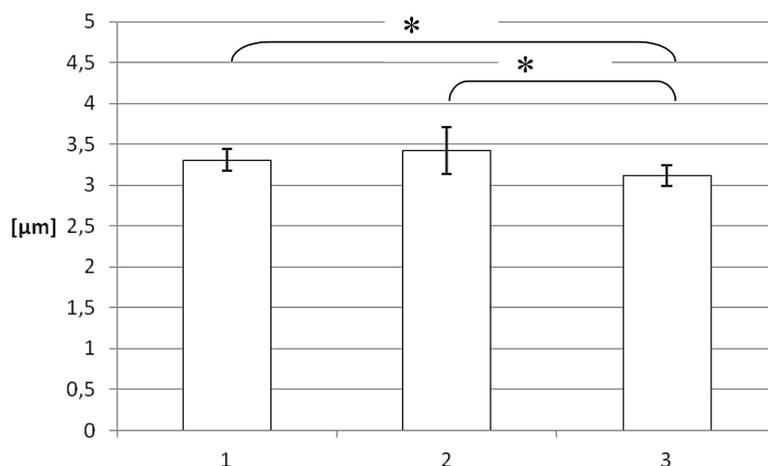


Fig. 1. Sarcomeres length, measured for each miofibrils from the analysed pork meat [μm]
* statistically significant differences ($p \leq 0.05$, t-Student test)

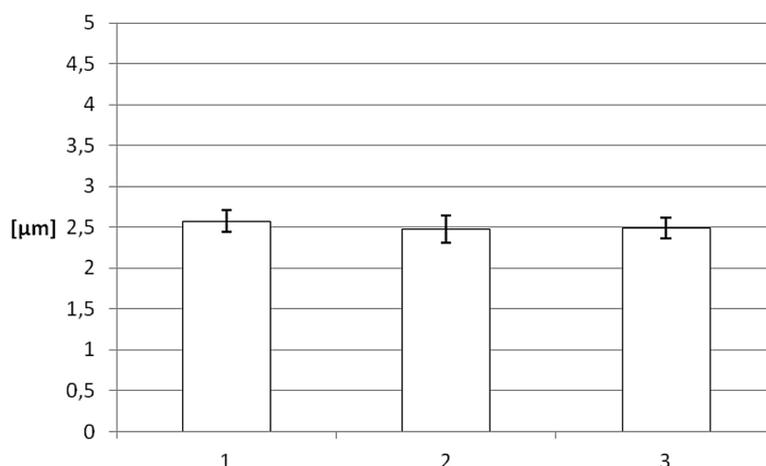


Fig. 2. Sarcomeres length, measured for each miofibrils from the analysed wild boar meat [μm]
Lack of statistically significant differences ($p > 0.05$, t-Student test)

the previous research [4]. Moreover, it was stated, that in comparison to pork, there is less sarcomere length diversity within the single myofibril. The diversity for boar meat did not exceed $0,6 \mu\text{m}$ (20–26% of sarcomere length), whereas for pork the value reaches $0.9 \mu\text{m}$ (24–32% of sarcomere length) (Table 1). In case of beef, as it was shown in the previous research, these differences were

even smaller than for pork meat- they did not exceed $0.48 \mu\text{m}$ (22% of sarcomere length) [4].

In the previous research [4] it was indicated that, for beef samples, the average sarcomere length was also more than $2 \mu\text{m}$ what, on the basis of the research of other authors [13], was interpreted as confirmation of meat crispness. The sarcomere length values for pork presented in lit-

Table 1. Diversity of sarcomeres length, measured for each miofibrils from the analysed pork and wild boar meat

Type of meat	Miofibrils	Min [mm]	Max [mm]	The difference in length between the longest to the shortest sarcomere		
				[mm]	[% of the shortest sarcomeres length]	[% of the longest sarcomeres length]
Pork meat	1	2.90	3.29	0.39	13.4	11.8
	2	3.08	3.50	0.42	13.6	12.0
	3	2.92	3.85	0.93	31.8	24.1
Wild boar meat	1	2.30	2.71	0.41	17.8	15.1
	2	2.32	2.75	0.43	18.5	15.6
	3	2.22	2.79	0.57	25.7	20.4

erature are varied and depend not only on muscle type (for example for *Longissimus lumborum* it is 1.78 μm ; for *Semitendinosus* it is 2.5 μm or for *Triceps brachii* it is 2.4 μm [14]), but also on breed (*Longissimus dorsi* muscle for Pulawska breed it is 2.81 μm [5]; for crossbreed Amerykanska Biala Zwisloucha x Duroc it is 1.52 μm [10] and for crossbreed *Korean native black pig* \times *Ko-reanska Biala Zwisloucha* it is 2.0 μm [6]).

Difficulties in obtaining samples results in small number of publications concerning wild game meat, but available data show less variation of sarcomere length for boar meat (their lengths were indicated in the research of Kasprzyk *et al* [5] as 2.43 μm for *Longissimus dorsi* muscle and 2.51 μm for *Semimembranosus* muscle).

These results are confirmed by presented observations which can be related to the fact, that meat of these animals is generally evaluated as more tough than meat from other species [11] and this feature is partially influenced by shorter sarcomere.

Comparison of the average sarcomere length between pork and boar meat samples also indicated the existence of statistically significant differences ($p = 0.0000$). It was stated that, for the assessed pork samples, sarcomere are significantly longer ($3.28 \pm 0.23 \mu\text{m}$) than in case of boar meat ($2.51 \pm 0.14 \mu\text{m}$). Sarcomere length in meat of animals and of wild game can influence meat crispness to a greater or lesser extent [3]. It is also claimed, that sarcomere length depend not only on breed, but also on the muscle type [8, 12]. These results are reflected in research of the other authors, who proved by both instrumental evaluation and sensory analysis, that boar meat was more tough. Some of the researchers indicate, that sarcomere length analysis and energy measurement under the curve in the instrumental analysis (razor blade energy) can be an adequate predictor of sensory quality [2]. This dependence was confirmed in the research on poultry, which similarly to the boar meat, is not strongly varied in respect of toughness, but on the contrary to boar meat is more crispy. The further analysis on precise evaluation of sarcomere length influence on boar meat crispness can settle an interesting direction of the research aimed at quality characteristics prediction.

CONCLUSIONS

Results analysis made it possible to draw following conclusions:

1. The average sarcomere length for boar meat was shorter than for pork with the statistical significance.
2. For pork and boar meat, as well as for beef, sarcomere length within muscle can vary considerably, depending on myofibril.
3. For the proper evaluation of sarcomere length, it should be carried out in reproducible conditions for at least several myofibrils, although in analysed boar meat samples measurement within one myofibril was reliable, because of repetitive results.
4. Techniques, which enable evaluation of separate myofibril and comparison between myofibrils, are particularly useful for the sarcomere length analysis.

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