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KVALITA BRAVČOVÉHO MÄSA OBOHATENÉHO ORGANICKÝM SELÉNOM HODNOTENÁ V TECHNOLOGICKÝCH A NUTRIČNÝCH UKAZOVATEĽOCH
QUALITIES MEAT PORK ENRICHED ORGANIC SELENIUM VALUATION IN TECHNOLOGICAL AND NUTRITIONAL INDICATORS

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Abstract: The work results clearly confirmed the suitability to use organic selenium in feed mixture for pigs with the purpose of improving production indicators, the slaughter value of animals as well as physical-chemical, technological and nutritional quality characteristic of pork meat. The results point out the main advantages of organic selenium application in pig rearing. These advantages are selenium retention in muscles and tissues of pigs, positive effect on meat quality with lower occurrence of pale, watery meat (PSE) syndrome, lower loses by dripping from slaughter halves and better nutritional value of meat which is significantly enriched by selenium. The occurrence of individuals with non typical development of physical-chemical and technological quality characteristic was monitored, based on pH_1, pH_{24}, pH_{48} and 7 days values. Results indicate that in test group in MSM pH_1 value was 6.24, s 0.22 and EV_1 6.12 μS, s 1.36 and EV_{24} 8.46 μS, s 1.35, the difference between groups was statistically significant at $P<0.05^+$. As far as the results are concerned, we can conclude that there has been an improvement in the nutritional quality of pork in the total protein level of 22.32 ± 0.91 $g.100g^{-1}$, in the intramuscular fat content of 2.95 ± 1.35 $g.100g^{-1}$ at significance $p<0.05$, as well as by the lower energy value of 484.46 ± 46.63 $KJ.100g^{-1.}$ In the pork enriched with organic selenium the concentration was higher 1.045 ± 0.10 $mg.kg^{-1}$ compared with the control group 0.701 ± 0.05 $mg.kg^{-1}$ at significance $p<0.001$. According to the present knowledge, higher selenium content in groceries has the positive effect on people's health by lowering the occurrence of cardio-vascular diseases, brain and thyroid disorders and by improving of a body immune system.
Keywords*:* pigs, physical-chemical value, technological value, nutritional value, pork.

INTRODUCTION

Pork keeps prominent spot in the framework of its consumption in the world, representing almost 40% at an average daily consumption of approximately 35 kg/person/year. **(Kvapilík, 2006, Kováčik 2006).** The total meat consumption, based on available statistical data in Slovakia, amounts to 60 kg/person/year, with pork sharing over 50 %, which suggests that this type of meat is significantly preferred by our population due to its quality characteristic enabling various ways of meal preparation as well as processing for meat products including pork specialities. Significant, even extreme musculature of slaughter carcasses of pigs is accompanied by lesser quality of meat, mainly from the viewpoint of dynamics of pH and EV changes in the process of meat ripening with potential occurrence of PSE and DFD meat and with subsequent lower ability to retain water, as well as lower ability to preserve it. **Šímek et al. (2002*)*** outlines that pork with quality deviation PSE has lower technological utilization. Products of ham type from meat have no typical, pale

colour, blank taste and mainly worse ability to retain water, which results in direct production loses along with quality deterioration of meat products.

For increase in oxidation stability of fats, the possibilities of utilizing some natural antioxidants are tested, for example rosemary extract added during mixing of meat products. The possibilities to utilize food supplements show centrain positive effect of E vitamin in combination with organic selenium. **(Ľahučký et al. 2001, Bobček et al. 2008, Mrázová et al. 2009).** Utilizing specific feed complements for fattening of pigs can be accompanied with positive but also negative effect on quality characteristic of meat. The subject for examination of these effects is also the submitted contribution, aiming at utilizing supplemental organic selenium. The goal of this experiment was to evaluate the effect of organic selenium supplement addition into pig feed components with aim at basic quality characteristic of pork meat and its technological utilization.

MATERIAL AND METHODS

In submitted work was elaborated the analysis of selected slaughter and qualitative meat indicators of slaughter pigs. Product Sel-Plex consists of dried beer brewery leaven with organically bound selenium. In our experiment we used organic selenium product additive in amount of 0,300 $mg.kg^{-1}$ of feed in experimental group, which was applied to standard feed component OŠ-3, OŠ-6 at slaughter pigs. After the completion of fattening, randomly selected individual animals of test control group of 20 and test group 20 animals. Then they were processed by standard procedure in accordance with the State Norm STN 46 6164 and STN 46 6150. After slaughter processing of pigs, approximately 60 minutes after slaughtering. Also pH_1 value of meat was determined by the needle insertion type of pH meter as well as meat electric conductivity EV_1. Slaughtered carcasses were placed in a refrigerator for 24 hours at + 4°C. After 24 hours in a refrigerator, the pH_{24} and EV_{24} values were determined in MLT (*musculus longissimus thoracis*) and MSM *(musculus semimembranosus*). Within the subsequent disjointing of carcasses, a meat sample was taken weighing 700 g for analysis of technological quality of meat. Meat samples of experimental and control group were stored by hanging on a hook in laboratory refrigerator at the temperature from +2°C to +4 °C during 7 days, by which was limited the required time for ripening of pork meat before treatment for consumption or before further technological processing. During the process of meat ripening, in set time intervals were determined selected marks of physical-chemical, technological and nutritional quality in pork meat samples. After the completion of 7 day ripening process, the test was performed on individual samples by thermal treatment (70°C) with aim to ascertain loses as well as meat texture and to determine the shear strength on Warner – Bratzler device. The achieved results were statistically processed and evaluated by Anova programme and t-test.

RESULTS AND DISCUSSION

Tab. 1 The characteristic of physical-chemical indicators in pork meat

Indicator	Control group (n=20)			Test group – SE (n=20)			Difference CG : TG	Tukey test
	$\bar{x}$	s	min. – max.	$\bar{x}$	s	min. – max.		
Weight of slanghter (kg)	40.82	0.66	39.64 – 42.69	41.30	0.77	39.89 – 42.85	+ 0.48	
pH_1 MLT	6.17	0.12	5.95 – 6.41	6.28	0.20	5.95 – 6.75	+ 0.11	
pH_{24} MLT	5.58	0.15	5.38 – 5.85	5.69	0.08	5.57 – 5.88	+ 0.01	
pH_1 MSM	6.09	0.24	5.58 – 6.48	6.24	0.22	5.67 – 6.79	+ 0.15	C : SE^{+}
pH_{24} MSM	5.71	0.08	5.47 – 5.83	5.76	0.17	5.59 – 6.40	+ 0.05	
EV_1 MLT (μS)	3.40	0.36	2.60 – 4.30	3.27	0.35	2.80 – 3.80	+ 0.13	
EV_{24} MLT (μS)	4.46	1.06	3.20 – 6.90	3.92	0.69	2.90 – 5.45	+ 0.54	C : SE^{+}
EV_1 MSM (μS)	6.74	3.14	3.60 – 16.30	6.12	1.36	4.20 – 8.78	+ 0.62	C : SE^{+}
EV_{24} MSM (μS)	10.12	2.22	6.94 – 15.90	8.46	1.35	5.75 – 10.20	+ 1.66	C : SE^{++}

$^{+}$ P<0,05; $^{++}$ P<0,01

The weight of slaughter processed pig carcasses, determined in warm condition 60 min after slaughter, in test group reached 41.30 kg, s 0,77 within the range from 39.89 kg to 42.85 kg.

In the control group the average weight of 40.82 kg, s 0,66 was determined ranging from 39.64 kg to 42.69 kg. The difference among the groups of slaughter processed carcasses represented + 0,48 kg in the test group.

The occurrence of individuals with non typical development of physical-chemical quality characteristic was monitored, based on pH_1 and pH_{24} values. The obtained results indicate that in test group in MLT the average pH_1 value was 6.28, s 0.20 ranging from 5.95 to 6.75. In control group the average pH_1 value was 6.17, s 0.12, ranging from 5.95 to 6.41. From presented data it is obvious that in the evaluated files of pigs in test and control group, there was no individual present with PSE meat characteristic. pH_{24} MLT test group values reached an average value of 5.69, s 0.08 in test group, ranging from 5.57 to 5.88. In control group was detected average value of pH_{24}, ranging from 5.58, s 0.15 ranging from 5.38 to 5.85. Results indicate that in test group in MSM the average pH_1 value was 6.24, s 0.22 ranging from 5.67 to 6.79. In control group the average pH_1 value was 6.09, s 0. 24, ranging from 5.58 to 6.48. This difference was statistically significant at P<0,05. From presented data it is obvious that in the evaluated files of pigs in test and control group, there by evaluation of meat electrical conductivity in MLT, test group reached lower values EV_1 = 3.27 μS, s 0,35 ranging from 2.80 to 3.80 μS in comparison with control group EV_1 = 3.40 μS, s 0.36 ranging from 2.60 to 4.30 μS; and EV_{24} test group showed 3.92 μS, s 0.69 ranging from 2.90 to 5.45 μS and with control group 4.46 μS, s 1.06 ranging from 6.20 to 6.90 μS. This difference was statistically significant at P<0,05. In MSM, test group reached lower values EV_1 = 6.12 μS, s 1.36 ranging from 4.20 to 8.75 μS in comparison with control group EV_1 = 6.74 μS, s 3.14 ranging from 3.60 to 16.30 μS; and EV_{24} test group showed 8.46 μS, s 1.35 ranging from 5.75 to 10.20 μS and with control group 10.12 μS, s 2.2 ranging from 6.94 to 15.90 μS. This difference was statistically significant at P<0,01.

Tab. 2 The characteristic of technological indicators in pork meat

Indicator	Control group (n=20)			Test group – SE (n=20)			Difference CG : TG	Tukey test
	$\bar{x}$	s	min. – max.	$\bar{x}$	s	min. – max.		
Drip losses 24-48 h. (%)	7.10	2.17	3.03 – 10.71	5.82	2.16	3.61 – 10.33	+ 1.28	C : SE^{+}
Meat colour Specol (%)	27.29	2.23	24.20 – 32.80	28.40	3.23	22.40 – 35.20	+.1.11	C : SE^{+}
pH_{48}	5.52	0.13	5.30 – 5.81	5.58	0.16	5.33 – 5.91	+ 0.06	
$pH_{7\ days}$	5.62	0.05	5.53 – 5.78	5.59	0.07	5.47 – 5.75	- 0.03	
Loses by dripping 7 days (%)	9.38	1.51	6.48 – 11.00	7.64	1.24	5.19 – 8.93	+1.74	C : SE^{+}
Loses cooking 70 °C (%)	25.20	5.56	16.10 – 33.11	24.00	2.61	20.20 – 28.78	+ 1.20	C : SE^{+}
Shear strength W-B (kg/cm^{-2})	6.88	1.40	4.40 – 10.75	5.73	0.84	4.90 – 8.00	+ 0.95	C : SE^{+}

$^{+}$ P<0,05; $^{++}$ P<0,01

Drip loses of unbound water in 24-48 hours from samples weighing 50 g in test group reached 5.82 %, s 2.16 ranging from 3.61 to 10.33 %; in control group 7.10 % , s 2.17 ranging from 3.03 to 10.71 %, P<0,05. As to the meat colour indicator, the test group gained higher values of 28.40, whereas control group 27.29, P<0,05. Control group contained 4.83 % of dripped water ranging from 2.38 to 6.59 %. The difference between groups was statistically significant at P<0.05^{+}. The obtained results indicate that the average pH value of samples measured 48 hours after slaughtering of animals reached 5.58 in test group and 5.52 in control group. The pH value of meat samples after 7 days of ripening was 5.59 in test group and 5.62 in control group. Loses by dripping and drying of sample surfaces weighing 700 g in drying period from 24 to 48 hours, in test group represented 7.64 %, s 1.24 ranging from 5.19 % to 8.93 %; control group 9.38 %, s 1.51 ranging from 6.48 to 11.00%. The difference between groups was statistically significant at P<0.01. Loses cooking by thermal treatment of meat samples (70°C for 10 min) represented in the total sample volume 24.00 % , s 2.61, ranging from 20.20 to 28.78 % with test group. With control group, the loses cooking were 25.20 % , s 5.56 ranging from 16.10 to 33.11 %. The difference between groups was statistically significant at P<0.05^{+}. The texture of thermally processed meat samples, expressed as shear strength value by Warner-Bratzler was in test group 5.93 kg/cm^{-2} , s 0,84 ranging from 4.90 to 8.00 kg/cm-2; control group 6.88 kg/cm^{-2}, s 1.40 ranging from 4.40 to 10.75 kg/cm^{-2}. which was the same in both groups. This represents approximately 5.7 kg.$^{-2}$. The difference between groups was statistically significant at P<0.05.

Based on the analysis of individual 150 g meat samples, performed on device Infratec, the basic nutritional value indicators were monitored – total water, total protein, total fat, and energetic value and concentration selenium. During the comparison of individual monitored indicators, the values were total water in test group 72.08 g/100g and control group 73.10 g/100g; total protein test group 21.91 g/100g and control group 21.51 g/100g; total fat test group 3.79 g/100g and energetic value 486.91 KJ/100g, control group 4.22 g/100g and energetic value 518.90 KJ/100g. The difference between groups was statistically significant at P<0.05. During the evaluation of selenium concentration in dry meat content were found higher values in test group in thigh (MSM) 1.045 mg/kg an in cutlet (MLT) 1.364 mg/kg in comparison with control group, where lower MSM values were discovered (0.701 mg/kg and MLT 0.506 mg/kg). In the test group meat with addition of organic selenium, the selenium content was 2.0 times higher, which we regard as a positive sing. Higher selenium content in

meat with feed of higher organic selenium content in rationed feeding was also confirmed by ***Mahan et al.*** **(1999**). The obtained results confirmed the statements of other authors like ***Combs*** **(2001),** ***Bobček et al.*** **(2004),** ***Ľahučký et al.*** **(2001),** ***Vernerová*** **(2008) and** ***Mrázová*** **(2009).** According to them, the addition of selenium substances during pig fattening increases selenium content in meat, while at the same time it does not make worse the technological and nutritional value.

Tab. 3 The characteristic of nutritional values in pork meat

Indicator	Control group (n=20)			Test group – SE (n=20)			Difference CG : TG	Tukey test
	$\bar{x}$	s	min. – max.	$\bar{x}$	s	min. – max.		
Total water content in g/100g	73.10	1.77	69.60 – 76.00	72.08	2.75	63.30 – 76.50	+ 1.02	
Total protein in g/100g	21.51	0.80	20.30 – 23.30	21.91	0.84	20.0 – 23.20	+ 0.40	
Total fat in g/100g	4.22	2.10	1.50 – 8.80	3.79	1.05	1.10 – 5.70	+ 0.43	
Energetic value in KJ/100g	518.90	76.62	405.3 – 672.4	486.91	54.84	394.3 – 592.1	+ 31.99	C : SE^{+}
Selenium MSM in dry meat mater in mg/kg	0.701	0.05	0.620 – 0.780	1.045	0.10	0.920 – 1.180	+ 0.344	C : SE^{+++}
Selenium MLT in dry meat mater in mg/kg	0.506	0.036	0.443 – 0.562	1.364	0.206	1.124 – 1.463	+ 0.858	C : SE^{+++}

$^{+}$ P<0,05; $^{+++}$ P<0,001

CONCLUSION

The work results clearly confirmed the suitability to use organic selenium in feed mixture for pigs with the purpose of improving production indicators, the slaughter value of animals as well as physical-chemical, technological and nutritional quality characteristic of pork meat. The results point out the main advantages of organic selenium application in pig rearing. These advantages are selenium retention in muscles and tissues of pigs, positive effect on meat quality with lower occurrence of pale, watery meat (PSE) syndrome, lower loses by dripping from slaughter halves and better nutritional value of meat which is significantly enriched by selenium. According to the present knowledge, higher selenium content in groceries has the positive effect on people's health by lowering the occurrence of cardio-vascular diseases, brain and thyroid disorders and by improving of a body immune system. The organic selenium form features enable effective transfer through the food chain and it is beginning to be utilised worldwide with modern concept of production, so called functional groceries, among which we can list also animal products enriched by organic selenium.

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