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Effect of dietary nettle extract on pig meat quality

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Summary

The effect of nettle extract supplement for fattening pig feed on meat quality was assessed on 42 pigs initially weighing about 60 kg and about 110 kg at the end of the experiment. All pigs were fed with a standard finisher feed mixture with no supplement in group I (control) and supplemented with 500 mg or 1000 mg of nettle extract per 1 kg of feed in groups II and III, respectively. Commercial water extract from common nettle containing 5.6 mg of tannins per 1 kg was used as a supplement.

The meat of pigs receiving a higher dose of extract contained significantly more protein and less fat than those from both remaining groups. A supplement of nettle extract increased the lightness of meat and stabilized meat color for 6 months of storage at –20°C. Moreover, it slightly improved meat oxidative stability during frozen storage and raised polyunsaturated fatty acids (PUFA) content mainly due to diminishing monounsaturated fatty acids (MUFA) content. It was claimed that water extract from nettle had a positive effect on meat quality improving oxidative stability and the polyunsaturated / saturated fatty acids ratio.

Keywords: nettle extract, pig, meat quality

There is a tendency in present farm animals feeding, to withdraw feed supplements such as antibiotics or chemical growth promoters and to replace them by natural products namely by fermented products or herb mixtures (9). Herbal extracts are used as growth promoters also in pig feeding, especially for young, weaned animals (21). Herbal preparations can also be used in grower-finisher pig feeding. It was found that they can improve feed conversion ratio but their effects depend on species of a plant used (4). Such extracts have also health-related activity. They can be used as immunostimulants (19) and as hypocholesterolemic preparations (5). Nettle is one of plants used in folk veterinary medicine (22). Dugenci et al. (6) found its immunostimulant activity and according to Kanter et al. (12) it decreases the lipid peroxidation and increases the antioxidant defense system. In the experiment on pigs Krusiński (14) found that dry herb of nettle improve animals body weight gains.

The objective of this study was to determine the effect of nettle extract supplement to fattening pigs feed on meat quality.

Material and methods

Water extract from nettle (*Urtica dioica L.*) was commercial product produced by Phytopharm, Klęka, Poland. It contained 5.6 g of tannin per kg.

The experiment was carried out on 42 fattening pigs weighing about 60 kg. Animals originated from PL × PLW sows mated with a Duroc × Pietrain boar. They were kept individually in straw bedded pens. All pigs received standard finisher feed mixture containing 13.2 MJ ME and 151 g of crude protein in 1 kg (tab. 1). Each group comprised of 7 gilts and 7 barrows.

Tab. 1. Composition and nutritional value of the feed mixture for pigs (%)

Component	Content in mixture (%)
Barley	62.81
Wheat	10.00
Soybean meal	16.00
Wheat bran	5.00
Rapeseed oil	4.00
Dicalcium phosphate	0.27
Limestone	1.10
Salt (NaCl)	0.22
Premix 0.5%, standard	0.50
L-Lysine	0.10
Nutrient content in 1 kg of mixture:	
Metabolizable energy (MJ)	13.2
Crude protein (g)	151
Lysine (g)	7.91
Met + Cys (g)	5.29
Ca (g)	6.47
P (g)	4.57

Group I (control) received feed mixture with no supplement. Groups II and III received feed mixture supplemented with nettle extract in amount 500 mg and 1000 mg per 1 kg of feed, respectively.

Pigs were slaughtered at about 110 kg of body weight and right sides of carcasses were evaluated. Samples of *longissimus* muscle taken from the area of the last thoracic and first lumbar vertebra were collected for chemical analysis (2) and fatty acids profile analysis (gas chromatograph Varian 3400). Cholesterol content in meat was analyzed according to Rhee et al. (18). TBA RS content was measured after 6 month of storage at –20°C (17). Meat colour in the samples of *longissimus* muscle was estimated using the Minolta colorimeter after slaughter and after 6 months of frozen storage. Water holding capacity was estimated according to Grau and Hamm (7). All data were subjected to one-way analysis of variance and the differences between mean values were estimated using Duncan test (Statistica 5.1).

Results and discussion

Herb mixtures and extracts are actually used in farm animals ecological feeding mainly because their antioxidant activity (1). Apart from this activity plant preparations and extracts have other positive effects – they can improve feed tastiness and are effective in modifying gastrointestinal ecosystem increasing lactobacilli : enterobacteria ratio (15). Nettle is one of the most popular plants used in herbal mixtures for pigs (8, 20). Because of its high content of nutritive substances such as amino acids, minerals and vitamins and active compounds such as tannins, formic acid and salicylic acid, nettle is used in folk veterinary medicine. In Italy it is fed to pigs to protect them from contagious diseases (22).

Results of the present experiment show that samples of *longissimus* muscle taken from pigs receiving higher doses of nettle extract contained more protein and less fat than those taken from both remaining groups and in the case of protein differences were statistically significant (tab. 2). In the case of fat differences between the control and both experimental groups were significant. Fat content of meat, already low in the control group, was lowered by nettle extract addition. It is generally considered that fat level determines tenderness of meat. In some countries high levels of intramuscular fat are deemed necessary for optimum tenderness, although poor relationships between fat content and tenderness have generally been found in European studies, where fat levels are often very low, e.g. below 1% in United Kingdom pigs (23). Thus fat content, both in control and experimental pigs, was higher than that minimum but lower than level recommended in Poland i.e. about 2%.

According to Booth and Bradford (3) nettle is a good source of antioxidants, particularly vitamin E, while Karakaya et al. (13) found that also phenolic compounds can be antioxidant in this plant. In this experiment it was also found that nettle extract had antioxidant activity, especially when its lower dose was used. It is in accordance with the results of Payne et al. (16) who found that plant active substances had beneficial effect when fed within dietary concentrations found in natural plant material but not when fed at higher concentration. In the present experiment extract supplement slightly improved meat oxidative stability lowering the TBA RS content during 6 months of storage, especially when its lower amount was used (tab. 3). Similar improvement of oxidative stability of pork was found in the earlier experiment using the extract from sage (11). Antioxidative ability of the nettle extract was confirmed also by the meat colour determination results (tab. 3). After slaughter meat obtained from pigs receiving this supplement in amount of 1000 mg/kg characterized of higher lightness and redness. After 6 months of frozen storage meat from these pigs was significantly lighter in comparison to control group. The undesirable changes in meat colour appeared during storage were clearly reduced when nettle extract was added to feed mixture, especially in amount of 1000 mg/kg (fig. 1). In spite of lower dry matter content of experimental groups slightly better water holding capacity was observed in the group receiving lower amount of extract but this difference was also not significant.

Tab. 2. Basic chemical analysis of *m. longissimus*

Components	Groups			SEM
	control	nettle extract 500 mg/kg	nettle extract 1000 mg/kg	
Dry matter, %	25.17^{B}	24.40^{A}	24.72^{AB}	0.109
Crude protein, %	22.36^{a}	22.40^{a}	22.99^{b}	0.108
Crude fat, %	1.89^{b}	1.53^{a}	1.45^{a}	0.076

Explanations: a, b, A, B – values in rows with different small letters differ significantly at $p \leq 0.05$, with capital letters at $p \leq 0.01$.

Tab. 3. Some indices of *m. longissimus* meat quality and stability

Indices	Groups			SEM
	control	nettle extract 500 mg/kg	nettle extract 1000 mg/kg	
Meat colour. Hunter scale:				
– after slaughter				
lightness (L)	45.20	45.21	47.04	0.447
redness (a)	12.86	12.66	12.53	0.120
yellowness (b)	2.81	3.17	3.20	0.116
– after 6 months of storage (–20°C)				
lightness (L)	43.20^{a}	43.39^{a}	45.50^{b}	0.447
redness (a)	11.76	11.68	11.77	0.112
yellowness (b)	5.29	5.04	5.24	0.102
pH_{45}	6.25	6.35	6.35	0.030
pH_{24}	5.52	5.54	5.57	0.017
Water holding capacity, %	23.22	22.73	23.04	0.454
TBA-RS after 6 months of frozen storage, mg/kg	0.502	0.462	0.494	0.018
Total cholesterol, mg/100 g	71.85	69.90	67.65	1.005

Explanations: a, b – $p \leq 0.05$

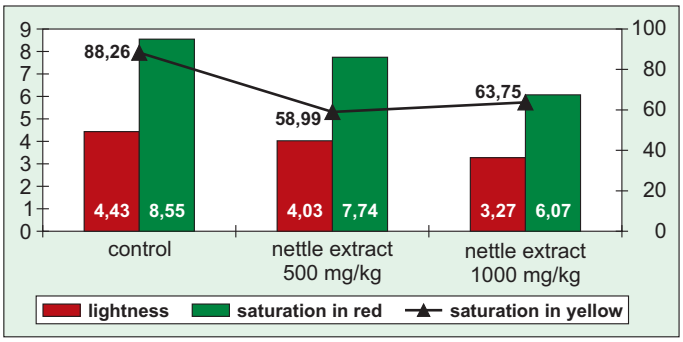

Fig. 1. Percentage changes in meat colour during 6 months of frozen storage at –20°C

In the previous experiment, using the sage extract, the lower content of MUFA but higher content of SFA in pigs *musculus longissimus* was found (10) what is not in accordance with present results, when nettle extract lowered MUFA content in meat especially palmitoleic acid ($C_{16:1}$) and raised PUFA content especially linoleic acid (tab. 4). Consequently the PUFA : SFA ratio in meat was the highest in meat of animals receiving the higher nettle extract supplement. It suggests that extracts from different plants have different effect on fatty acids content but these differences in most cases are not significant.

It is worth to be mention that in this experiment the level of total cholesterol in meat decreased when nettle extract was added. Although the difference was not significant the lowest cholesterol level was noticed in group receiving 1000 mg/kg of herb additive.

Summing up it can be stated that water extract from nettle had beneficial effect on meat quality improving colour and oxidative stability as well as polyunsaturated : saturated fatty acids ratio.

Tab. 4. Composition of some fatty acids in meat of *m. longissimus* (g/100 g of all estimated acids)

Fatty acids	Groups			SEM
	control	nettle extract 500 mg/kg	nettle extract 1000 mg/kg	
C14	1.188	1.129	1.034	0.031
C16	24.17	23.37	22.77	0.361
C16:1	2.13^{B}	1.95^{AB}	1.74^{A}	0.060
C18	11.58	11.88	11.99	0.111
C18:1	44.92	43.64	42.99	0.360
C18:2	12.16^{a}	13.77^{ab}	14.95^{b}	0.524
C18:3	0.431	0.442	0.464	0.013
gamma C18:3	0.081	0.099	0.106	0.006
C20:4	1.837	2.084	2.381	0.127
SFA	37.13	36.59	35.64	0.375
UFA	62.86	63.40	64.36	0.375
UFA/SFA	1.698	1.752	1.791	0.030
MUFA	47.06^{B}	45.60^{A}	44.54^{A}	0.398
PUFA	15.81^{A}	17.81^{AB}	19.81^{B}	0.668
MUFA/SFA	1.268	1.252	1.246	0.012
PUFA/SFA	0.430^{a}	0.500^{ab}	0.544^{b}	0.024
PUFA n-6	14.08^{A}	15.96^{AB}	17.93^{B}	0.642
PUFA n-3	0.671^{aA}	0.813^{bAB}	0.872^{bB}	0.034
PUFA n-6/n-3	21.14	19.89	20.45	0.351
EPA	0.185^{aA}	0.268^{bAB}	0.305^{bB}	0.018
DHA	0.055^{a}	0.102^{b}	0.083^{ab}	0.009
CLA	1.071	1.056	0.986	0.021

Explanations: as in tab. 2.

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