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Gallic acid or sage extract supplement in feed mixtures for finishing pigs

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ABSTRACT

The effects of supplementing mixtures for 42 fattening pigs (60-113 kg of body weight) with gallic acid, GA, (50 mg kg^{-1}) or sage extract, SE, (800 mg kg^{-1} of mixture) on fattening results, meat quality and oxidative stability were investigated. The supplements had no effect on body weight gains. Pigs receiving GA deposited significantly less meat and more fat but GA was a better antioxidant than SE. After 6 months of storage, TBA-RS in meat of GA pigs were significantly lower than in controls. GA also significantly lowered the cholesterol level in meat. The sage extract supplement distinctly increased meatiness and loin eye area when compared with the GA group.

KEY WORDS: gallic acid, sage extract, fattening pigs

INTRODUCTION

Common plant phenolic compounds are active antioxidants. Sage (*Salvia officinalis)* is a popular medicinal plant containing phenolics, mainly rosmaric and caffeic acids and has a high antioxidant activity (Lu and Foo, 2001). Gallic acid, a tannin hydrolysis product, is common in plants (knotgrass, billberry). Its antioxidant activity is comparable to that of ascorbic acid (Yen et al., 2002). Due to this activity phenolics can improve the oxidative stability of fat (Gu and Weng, 2001). Another health-related property of phenolics is their hypocholesterolaemic (Yugarani et al., 1993) and hypotriglyceridaemic activity (Demonty et al., 2002). On the other hand, they can reduce protein digestibility by forming complexes with gut enzymes and dietary proteins, thus lowering body weight gains of animals. The objective of this experiment was to estimate the effect of the antioxidant activity of gallic acid and sage extract supplements to feed mixture for fattening pigs on fattening results and meat quality.

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MATERIAL AND METHODS

The experiment was performed on 42 fattening pigs originated from PL × PLW sows mated with a Duroc × Pietrain boar, kept and fed individually. Fattening was carried out from 60 to 113 kg body weight. All pigs received a standard mixture supplemented with rapeseed oil (4%). It contained 13.2 MJ of ME, 15.1% of crude protein and 0.8% of lysine. Each group comprised 14 animals (7 gilts and 7 barrows). The control group (I) received a mixture without supplement. Group II was fed a mixture supplemented with gallic acid (GA) (50 mg kg^{-1} of mixture) and group III received a supplement of sage extract (SE) (800 mg kg^{-1} of mixture). SE contained 3.2% phenolic acids, 3.4% tannins and 0.8% flavonoids (DM basis).

Meat colour was measured with Minolta colourimeter in samples of *longissimus dorsi* muscle taken near the last thoracic and first lumbar vertebrae. Water holding capacity was estimated according to Grau and Hamm (1953), cholesterol content in meat according to Rhee et al. (1982) and the fatty acid profile, using a Varian 3400 gas chromatograph. TBA-RS were analysed after 2 weeks and again after 6 months of storage at -20°C. Meat samples were prepared according to a modified method of Salih (Pikul, 1989). Significance of differences between the groups was calculated with statistical one-way analysis of variance (ANOVA) and Duncan's multiple range test using the STATISTICA 5.1 software package.

RESULTS

The supplements had no effect on animals' body weight gains (Table 1). Pigs receiving GA had a significantly lower content of meat in carcass and smaller loin eye area than the SE animals. They had also thicker backfat in point C and higher mean from 5 measurements than the SE animals, but these differences were not statistically significant. There were no significant differences in carcass quality between the control and experimental groups.

Table 1. Results of the analysis of carca

Item	Kind of supplement			SEM
	no supplement	gallic acid	sage extract	
Average daily weight gains, g	898	894	901	0.03
Meat of primal cuts, kg	25.72	25.45	25.84	0.31
Loin eye area, cm^2	52.84^{ab}	51.50^{a}	57.01^{b}	1.06
Meat content in carcass, %	56.90^{ab}	54.41^{a}	57.47^{b}	0.64
Backfat thickness of 5 means., cm	2.64	2.73	2.69	0.05
Backfat thickness at point C, cm	1.34	1.49	1.33	0.06

$^{a, b}$ - ($P \leq 0.05$)

The meat of pigs receiving SE was darker and had a higher water holding capacity than in both remaining groups but these differences were not statistically significant (Table 2). The GA supplement gave the highest oxidative stability of meat, which was significantly higher than in that of control animals after 6 months of freezing. The cholesterol content in meat of pigs from the experimental groups was lower than in controls, but this difference was significant only between the control and GA groups. Both supplements increased the polyunsaturated fatty acid content of meat when compared with controls, but these differences were not significant. A significant difference between the control and GA groups was found in the PUFA n_6/n_3 ratio.

Table 2. Meat and fat quality

Item	Kind of supplement			SEM
	no supplement	gallic acid	sage extract	
Meat colour, Hunter: lightness	45.19	45.22	43.83	0.39
redness	12.86	12.86	12.75	0.11
yellowness	2.81	2.81	2.81	0.10
Water holding capacity, %	76.78	77.31	78.49	0.58
TBA-RS after 2 weeks, mg/kg	0.318	0.264	0.282	0.01
TBA-RS after 6 months, mg/kg	0.502^{b}	0.407^{a}	0.425^{ab}	0.02
Cholesterol , mg/100g	71.84^{b}	63.21^{a}	65.35^{ab}	1.48
Composition of fatty acids in meat, g/100 g of all estimated acids				
MUFA	47.06	46.22	47.13	0.41
PUFA	15.81	17.16	16.55	0.63
PUFA n-6	14.07	15.18	14.71	0.61
PUFA n-3	0.67	0.80	0.72	0.03
PUFA n-6/n-3	21.14^{b}	19.13^{a}	20.46^{ab}	0.37
SFA	37.13	36.62	36.32	0.34
UFA	62.87	63.38	63.68	0.34

^{a,b} - ($P \leq 0.05$), ^{A,B}- ($P \leq 0.01$)

DISCUSSION

GA, unlike SE, decreased the loin eye area and meat content in carcasses. Lower accumulation of meat and higher accumulation of fat in carcasses could result from the lower activity of digestive enzymes, especially proteases, due to the formation of phenolics x enzyme complexes (Rohn et al., 2002). On the other hand, meat from the animals receiving GA had a lower TBA-RS index. High antioxidant activity of GA was also found by Yen et al. (2002). Fat extracted from this meat had a higher PUFA content too. The meat of pigs receiving SE showed slightly better oxidative stability than the control. Improvement of oxidative stability of meat after feeding animals with plant extract (rosemary) was also found by Karpińska et al. (2000).

CONCLUSIONS

The supplements used did not significantly added carcass quality. Animals receiving GA had less meat in carcass and a smaller loin eye area than these in the SE group. The antioxidant stability of control meat was lower than in the experimental groups, but this differences was significant only in the case of gallic acid. A similar relationship was found for meat cholesterol content.

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STRESZCZENIE

Dodatek kwasu galusowego lub ekstraktu z szałwii do mieszanek dla tuczników

W doświadczeniu na 42 tucznikach w drugim okresie tuczu porównywano wpływ dodatku do paszy kwasu galusowego (50 mg kg^{-1} mieszanki) lub ekstraktu z szałwii (800 mg kg^{-1} mieszanki) na wyniki tuczu, jakość i stabilność oksydacyjną mięsa.

Zastosowane dodatki nie miały wpływu na przyrosty tuczników. Kwas galusowy (GA) wpłynął istotne na odłożenie mięsa w tuszy i większe jej otłuszczenie, natomiast okazał się lepszym przeciwutleniaczem od ekstraktu z szałwii. TBA-RS po 6 mies. przechowywania mięsa zwierząt z grup doświadczalnych było istotnie niższe niż w mięsie zwierząt kontrolnych. Dodatek GA wpłynął też istotnie ($P<0,05$) na obniżenie poziomu cholesterolu w mięsie. Dodatek szałwi istotnie zwiększył mięsność i powierzchnię oka polędwicy tuczników w porównaniu ze zwierzętami otrzymującymi GA.