

EFFECT OF DIFFERENT DIETARY AROMATIC ESSENCES ON MEAT QUALITY OF RABBIT

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ABSTRACT

The effect of dietary supplementation of oregano, rosemary and oregano+rosemary on rabbit growth performance and meat quality was analyzed. Five groups of twenty New Zealand White (NZW) weaned rabbits were submitted to the following dietary treatments: Standard diet (S); Standard diet +150 ppm vitamin E (E); Standard diet + 0.2% oregano extract (O); Standard diet + 0.2% rosemary extract (R); Standard diet + 0.1% oregano extract + 0.1% rosemary extract (OR). Each diet contained integrations of: 50 ppm vitamin E, CLA 0.5% (from soy oil), 3% Omega Lin[®] (Mignini & Petrini) and 0.5% mixed vitamins. The rabbit were slaughtered at 80 d of age and slaughter yield and carcass traits were determined. On *Longissimus dorsi* (LD) muscle, the ultimate pH was measured, the cooking loss and the Water Holding Capacity (WHC) were estimated, the L*, a* and b* color parameters and the antioxidant status (TBARs) were measured. Slaughter weights, carcass weights and pH values were not affected by dietary treatment. The cooking loss decreased (P=0.002) in O, R and O+R groups, whereas the WHC value increased, mainly in O group, which showed the highest (P=0.04) value. The LD meat color showed a strong (P=0.05) reduction of a* for all the antioxidant supplementations; even the b* value of R and O+R groups (P=0.05) lowered. The TBARs concentration of meat was slightly affected by dietary treatment. In conclusion, the studied natural extracts showed beneficial effects on color traits of meat; the color parameters highlighted the effectiveness of spice integrations on improving appearance traits of rabbit meat.

Key words: Rabbit, oregano, rosemary, meat quality.

INTRODUCTION

The food industry has used synthetic antioxidant for over 50 years (Brand-Williams *et al.*, 1995), but these compounds have been shown to be related to health risks and for this reason their use in food is now strictly regulated (Hettiarachchy *et al.*, 1996). Barlow (1990), cautioning about the long-term effect of some commonly used synthetic antioxidants (BHT, propyl gallate), reported that consumer preference for “natural” ingredients has motivated extensive research on effective plant-derived antioxidants. Lipid oxidation is one of the causes for the deterioration of meat because their appearance determines changes in flavor, texture and nutritional value (Gil *et al.*, 2001). Meat color has been reported as the most important factor when consumers assess meat quality since they relate color to freshness. However, color does not correspond to differences in eating satisfaction (Carpenter *et al.*, 2001). Some herbs and spices (rosemary, sage, green tea, clove, cinnamon, nutmeg, rose petals) could be efficient feed ingredients to improve the *shelf-life* of meats particularly vulnerable to oxidative changes (Zhang *et al.*, 2010), considering that they not negatively affect the physical and sensory characteristics of meat. The compounds responsible for the anti-oxidative effect have been identified for many spices like rosemary (Inatani *et al.*, 1983), in which the phenolic compounds, mainly carnosic and rosmarinic acids with carnosol, are the major antioxidants (Hermann, 1973). The supplementation of rosemary extract in the diet increased the lipid stability and improved the color of

the carcasses in pigeon meat (Dal Bosco *et al.* 2005), and was a good antioxidant in lard (Arouma *et al.*, 1996), too. The supplementation of oregano extract (*Origanum vulgare L.*) in drinking water positively influenced the physicochemical properties and the amino acid composition of rabbit meat (Pogàni Simonova *et al.*, 2010). Oregano essential oil contains phenolic antioxidants (78-82% carvacrol, thymol; Vekiari *et al.*, 1993); the effect of dietary supplementation on meat lipid oxidation has been widely studied in poultry with successful results (Botsoglou *et al.*, 2003). Castellini *et al.* (1998) analyzing the effect of dietary of α -tocopheryl acetate supplementation (200 mg/Kg diet) on rabbits, showed an increase in oxidative stability in both raw and cooked meat, and an increase of its water-holding capacity.

The aim of this study was to analyze the dietary rosemary and oregano extracts on meat quality and oxidative stability of rabbit meat.

MATERIALS AND METHODS

Animals and experimental design

The experimental protocol was planned according to guidelines of the animal committee of the University of Perugia and the research was carried out at the experimental farm of the Department of Applied Biology of the University of Perugia (Italy). A total of 200 NZW mixed-sex rabbits were weaned at 30 days of age and split into five homogeneous groups (weight, sex ratio), submitted to the following dietary treatments until 80 days old:

- Standard diet – negative control (S);
- Standard diet + 150 ppm Vit - positive control (E);
- Standard diet + 0.2% oregano extract (O);
- Standard diet + 0.2% rosemary extract (R);
- Standard diet + 0.1% oregano extract + 0.1% rosemary extract (OR).

Every diet contained a integration of 50 ppm of Vitamin E, 0.5% of conjugated linoleic acid (from soy oil), 3% of Omega Lin[®] (Mignini & Petrini) and 0.5% of mixed vitamins. The oregano and rosemary extract were obtained with an enzyme aided extraction of oregano and rosemary leaves using water as solvent. Dry plants were suspended in water, heated at 85 °C for 15 minutes and the enzyme process was performed with food grade preparations at room temperature. The solid matter was filtered away and the extracts were added with citric acid (1% w/w), pasteurized and stored at room temperature (Phenbiox[®]).

All the rabbits were housed individually in flat-deck cages (600 x 250 x 330 mm).

The feeding program was adjusted according to previous records of voluntary feed intake. Water was supplied *ad libitum*. The applied temperature and lighting schedule in the rabbit house were 15-18 °C and 16L:8D, respectively.

The rabbits were slaughtered at 80 d of age and the carcass weight was determined according to Blasco and Ouahyoun (1996). After refrigerating the carcasses (24 h at + 4°C), the two *Longissimus dorsi* (LD) muscles were removed and carefully freed from connective and adipose tissues.

Chemical Analyses

Ultimate pH (pHu) was measured at 24 h *post mortem* with a Knick digital pHmeter (Broadly Corp., Santa Ana, CA, USA) after homogenization of raw muscles (1 g) with iodoacetate (Korkeala *et al.*, 1984). To evaluate cooking loss, muscle samples of about 20 g were placed in open aluminium pans and cooked in an electric oven (pre-heated at 200 °C) for 15 min to an internal temperature of 80 °C (Cyril *et al.*, 1996). Cooking loss was estimated as the difference between the weight of the cooked samples (cooled for 30 min at 15 °C) and the weight of the raw samples expressed in percentage of the raw sample. The Water Holding Capacity (WHC) was estimated by centrifuging 1 g of muscle, placed on tissue paper inside a tube, for 4 min at 1.500 x g (Nakamura and Katoh, 1985). The water remaining after centrifugation was quantified by drying the samples at 70 °C overnight. The WHC was calculated as follows: (weight after centrifugation - weight after drying) x 100/initial weight. The

color parameters were measured on the raw muscles using a tristimulus analyser (Minolta Chroma Meter CR-200, Azuchi-Machi Higashi-Ku, Osaka 541, Japan), with the CIElab Colour System (1976), which gives the average of three measurements of lightness (L*), redness (a*) and yellowness (b*).

The extent of muscle lipid peroxidation was evaluated by spectrophotometer (set at 532 nm, Hitachi U-2000), measuring the adsorbance of Thio-Barbituric Reactive substances (TBARs) and using a tetraethoxypropane calibration curve in sodium acetate buffer (pH = 3.5, Dal Bosco *et al.*, 2009). Results were expressed as mg MDA/kg of muscle.

Statistical Analysis

Data are given as mean and least significance difference at 5 %. They were processed by GLM procedure of STATA (StataCorp, 2005), based on a linear model evaluating the fixed effect of dietary treatments.

RESULTS AND DISCUSSION

The effect of dietary supplementation of oregano and rosemary extract on meat traits are presented in Table 1. Live weights at 80 days of age and carcass weights were similar in all the groups, confirming the absence of effects of dietary antioxidants on growth performances, in agreement with Dalle Zotte *et al.* (2009) in a trial with integration of tannin extract from red quebracho trees (*Schinopsis spp.*). The LD pHu values did not show differences between dietary treatments in agreement with values found in literature (Castellini *et al.*, 1998; Pla, 2008); on the contrary Viràg *et al.* (2008) reported higher value of pHu on LD muscle of rabbits fed 300 mg/kg of vitamin E independently by source (synthetic dl- α -tocopherylacetate or natural vitamin E obtained from a by-product of the oil industry). The cooking loss decreased in all experimental groups in comparison with group S, whereas the WHC increased only in E and O groups, the R and OR groups have similar values of group S. The improvement in such meat physical parameters was probably due to the positive effect of the antioxidants on the integrity of the muscle fibers (Stanley, 1991). Asghar *et al.* (1989), in poultry meat, suggested that α -tocopherol preserves the functionality of membranes and increases their role as a semipermeable barrier against exudative loss; according to Cheah *et al.* (1995) the beneficial effect of vitamin E on drip loss is due to its ability to stabilize membranes. On the contrary, Meineri *et al.* (2010) observed an increased cooking loss (+ 4.32%; P<0.05) on rabbit meat with a dietary supplementation of 10 % of Chia seeds (*Salvia hispanica L.*). Analyzing color parameters, it is possible to note, in all the experimental groups, a reduction (P<0.05) of the red value (a*) of LD muscle with the addition of antioxidants (vit E, rosemary extract and oregano extract).

Table 1: Effect of oregano and rosemary integrations on rabbit performance and *Longissimus dorsi* muscle parameters

		S	E	O	R	O+R	Pooled SE	P-value
Live weight at 80 days	g	2408	2541	2517	2481	2517	143	0.386
Carcass weight	g	1514	1491	1539	1477	1518	80	0.592
pHu		5.80	5.85	5.84	5.72	5.78	0.12	0.307
Moisture	%	76.46	76.09	76.71	75.55	76.45	0.89	0.338
Cooking loss	%	31.14 ^B	30.28 ^A	30.08 ^A	29.89 ^A	30.25 ^A	5.06	0.002
WHC	%	56.74 ^a	59.64 ^b	61.16 ^b	57.62 ^a	56.92 ^a	3.95	0.042
<i>Color</i>								
L*		59.22	58.79	59.08	58.30	58.82	5.13	0.331
a*		5.31	3.88	2.99	3.17	2.97	1.88	0.056
b*		1.95	1.16	1.85	0.49	0.75	0.75	0.054
TBARs	mg MDA/kg	0.24 ^b	0.17 ^a	0.21 ^{ab}	0.21 ^{ab}	0.20 ^{ab}	0.09	0.045

A, B: P<0.01; a, b: P<0.05

It is known that meat color depends on the state of the myoglobin (reddish), on the degree of iron oxidation in the heme pigment found in myoglobin (Hulot and Ouhayoun, 1999) and that antioxidant

compounds retards the conversion of reduced myoglobin and oxy-myoglobin to meta-myoglobin (brownish color). Another possible explanation could be related to the iron chelation action of rosemary extracts due to its ability to inhibit the redox activity of transition metals through chelation (Reeder *et al.*, 2008). Moreover, some authors reported that plant extracts with antimicrobial properties, as oregano essential oil, may be used to increase meat shelf-life (Chouliara *et al.*, 2007). For example, active films containing oregano essential oil can reduce the growth of total flora and *Pseudomonas*, thus inhibiting the growth of lactic acid bacteria in beef (Zinoviadou *et al.*, 2009). Moreover, oregano-based films were effective against *Salmonella typhimurium* and *E. coli* O157:H7 inoculated in beef muscle slices (Oussalah *et al.*, 2006). Thus, beef shelf-life can be increased twice when employing active films containing 1.5% oregano oil (w/w) (Zinoviadou *et al.*, 2009). The yellowness (b*) value showed a reduction ($P < 0.05$) in R and OR groups. As expected, the vitamin E supplementation significantly reduced the oxidative processes in meat. Contrary to expectations the different herbage antioxidant supplementations had no substantial effect on oxidative status of rabbit meat. Indeed TBARs concentration did not show significant difference between groups, but it was always lower than in the S group. In our previous study we observed that dietary vitamin E markedly inhibited oxidative processes of meat with lower values of peroxide and TBARs (Dal Bosco *et al.*, 2001). Concerning vegetal extracts (1000 mg of rosemary. kg^{-1} diet) a previous research (Dal Bosco *et al.*, 2005) in pigeon improved physical traits of meat and reduced lipid oxidation during storage. Also Tanabe *et al.* (2002) obtained an inhibition of lipid oxidation by 73 and 58% in pork homogenate with a dietary supplementation of rosemary and oregano.

CONCLUSIONS

Compared to the S group the dietary supplementation with oregano and rosemary improved some physical traits of meat. Cooking loss and WHC values (mainly with oregano) support the hypothesis that the spice integration is effective on improving appearance of rabbit meat and could be used as a strategy for increase rabbit meat consumption. Further research is needed to study the effect of different levels or combinations of spices supplementation on the oxidative stability of rabbit meat.

ACKNOWLEDGEMENTS

This study was supported by Ministry of Economic Development (Industries 2015 Project PM01_00148). The authors acknowledge the helpful advice of PHENBIOX s.r.l. and Mignini & Petrini S.p.A.

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