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OXIDATIVE RESISTANCE OF THE PORCINE AND BOVINE MEAT TREATED WITH SEVERAL TYPES OF VEGETABLE POLIPHENOLIC EXTRACTS

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Abstract

Extracts of vegetable origin are used widely nowdays in the food industry in the role of antioxidants, especially in the meat processing industry and in the industry of its byproducts. Subject of this study have been porcine and bovine meat samples, which have been subjected to poliphenolic extracts, such as those from: tea, rosemary conserved in a timeframe of 1, 4, 7 and 10 days. TBA (thiobarbituric acid) assay shows that poliphenolic extracts tend to increase oxidative endurance of meat sample. Lipids oxidation degree of the samples of porcine and bovine meat treated with rosemary, oregano and tea poliphenolic extracts is lower than the control samples in both types of meat (eather in treated or not teated in 85°C samples). The samples wich have been subjected to tea poliphenolics extract shows a lower lipid oxidation degree copared not only to control samples but eather to the samples treated with the other poliphenolic extracts, in both types of meat eather in cooked and raw conditions. Lipid oxidation degree in bovine and porcine meat results greater in temperature treated samples compared to those in raw state. Comparative assessments of poliphenolic extracts in both types of meat indicate that use of poliphenolic extracts of natural vegetable origin serves as antioxidant contributing to the prolonged duration of meat conservation and to the increase of its nutritional value, seen in relation to physiological and health effects.

Introduction

Lipid oxidation in meat is one of the reasons for quality degradation during storage. This process is associated with the presence of free radicals that lead to the production of aldehydes responsible for the development of rancid flavours and changes in the colour of meat (Gullien-Sans & Guzman-Chozas, 1998). The complex mechanism by which the oxidation takes place, apart from membrane phospholipids, also affects

proteins. This may lead to loss of proteine solubility, loss of colour and reduced nutritional value. Vitamins are also oxidised during this process and, for this reason, vitamin E (α-tocopherol) is often used as an antioxidant(Farhoosh, R., Golmovahhed, G. A., & Khodaparast, M. H. H. 2007). Vitamins A, β-carotene and ascorbic acid are also susceptible to oxidation. Vitamin oxidation may protect the fatty acids; however, the nutritional value of meat is negatively affected as a result of a general reduction in the avaibility of vitamins A,D,E and C (Madhavi, Deshpande, & Salunkhe, 1996). Various antioxidants, such as BHA (butilated hydroxyanisole), BHT (butilated hydroxytoluene) and TBHQ (tertiary butil hydruquinone) have been widely used to help meat preservation. However, over the past few years, increasing consumer demand for more natural, "preservative free" products has led the food industry to consider the incorporation of natural antioxidants in a range of products. The use of natural antioxidants has the advantage of being more acceptable by the consumers as these are considered as "non chemical". In addition, they do not require safety tests before being used. Their drawbacks are that they are more expensive and less effective than are synthetic antioxidants. A quality consistency issue may also arise since antioxidants level and composition found in plants can be affected by the time of harvesting (Badi, Yzdani, Ali & Nazari, 2004) and the variety (Loziene, Vaiciuene & Venskutonis, 2003). Literature shows that an assessment of the antioxidant activity of 22 herbs, such as oregano, sage thyme cinnamon, basil, black and white pepper, incorporated (as liquid extract) at levels ranging from 0.2% to 2.5% w/w, on homogenized samples of porcine and bovine meat, revealed that lipid oxidation was prevented by all the extracts (Tanabe, Yoshida & Tomita, 2002). Various plants that contain lycopene, such as tomato and red pepper, have been shown to have significant antioxidant activity (Sanchez-Escalante, Torrescano, Djenane, Beltran, & Roncales, 2003). Tea catechins (Tang, Sheehan, Buckley, Morrissey, & Kerry, 2001) and various carotenoids (Viljanen, Sundberg, Ohshima, & Heinonen, 2002) could also prevent lipid oxidation. It is possible that animal nutrition can serve as a route to pass antioxidant activity from the diet to the meat. This has been confirmed in experiments conducted in broilers (Kulisic, Radonic, Katalinic, & Milos, 2004; Sarraga & Garcia Regueiro, 1999; Wong, Hashimoto, & Shibamoto, 1995) and turkeys with dietary oregano essential oil and α-tocopheryl acetate included in feed at concentrations ranging

from 100 to 200mg/kg feed (Botsoglou, Fletouris, Florou-Paneri, Christaki, & Spais, 2003; Botsoglou, Grigoroloulou, Botsoglou. Govaris, & Papageorgiou, 2003). Meat processing and storage, prior to consumption can have a significant effect on meat quality (Pokorny, Yan-ishlieva, & Gordon, 2001). The aim of this work was to assess the antioxidant activity of three popular herbs (namely rosemary oregano and tea) in porcine and bovine meat samples upon storage at 4 °C, in the raw or cooked state, over a 10 day period using the TBA (thiobarbituric acid) assay.

Materials and Methods

Extracts Preparation

Minced fresh leaves of rosemary, oregano and tea acquired from the local market were extracted with distilled water at room temperature overnight. The extracts were filtered and stored at 4 °C.The extracts were used as liquid on porcine and bovine meat samples. No extract was added to the control samples.

Determination of Total Phenolic in the Extracts

Total phenolic content (TPC) of rosemary, oregano and tea extracts (0.1 g for each) were determined using the Folin–Ciocalteau assay (Zoecklin, Fugelsang, Gump, & Nury, 1995). Results were expressed as grams of gallic acid equivalents per 100 ml of extract.

Samples Preparation

Fresh porcine (Biceps femoris) and bovine (Biceps femoris) samples (1 kg) from one pig and cattle were obtained from the local market and visible fat was removed. Samples from each meat were then divided into four groups and were homogenized with 200mg/1kg of rosemary, oregano and tea extracts in a multi-functional food blender (Moulinex Multi-moulinette, France). No extract was added to the control samples (CONTROL). All samples were packed in polyethylene film from a local market and stored at 4 °C in darkness for 24 h, than each sample was split into two. One portion remained in the raw state and the other was cooked at 85 °C in an oven for 30 min (Fasseas et al., 2007). Both raw and cooked samples were assayed for lipid oxidation as described below at 1, 3, 7 and 10 days of storage at 4 °C in darkness, in a polyethylene film.

TBA assay

The TBA assay followed the method of Fasseas et al. (2007) with slight modification. In brief, 0.03 g of sample was mixed with 0.6 ml deionised H2O, 0.9 ml of phosphoric acid (pH 2.0) and 0.9 ml 0.8% (w/w) of thiobarbituric acid (TBA) in 1.1% (w/w) sodium dodecylsulfate (SDS) in a test tube, and then vortexed and heated at 100 °C for 60 min in a water bath. After cooling, butan-1-ol (3 ml) was added and the solution mixed. Samples were then centrifuged at 8960×g for 10 min. The absorbance of the upper layer was determined at 532 nm. Butan-1-ol was used as blank. The results were expressed as TBA values (the relative absorbance of each sample on day 1).

Results

Regarding the total phenolics content of rosemary, oregano and tea extracts, the results agree with the previous research on the antioxidant activity that suggested a relationship between antioxidant activity and phenolic compound content (Hu & Skibsted, 2002; Huang et al., 2010). Rosemary, oregano and tea extracts exhibited different concentrations of total phenols, which could be responsible for the differences noted between the TBA data. Rosemary, oregano and tea treatments resulted in less oxidation than those found in the CONTROLs in both meats stored at 4 °C, with tea extracts demonstrating, by the TBA assay, the greatest protective effect. Conversely this data showed that tea and oregano treatment gave the greatest antioxidant activity perhaps because of the higher total phenolic content. The results further demonstrate that the rosemary, oregano and tea extracts contain different types of phenolic compounds. However, the detailed structures of the phenolic compounds of rosemary, oregano and tea extracts still need to be defined. Lipid oxidation is characterized by the formation of conjugated dienes, hydroperoxides and aldehydes (Kagan, 1988). Aldehydic products of lipid oxidation, especially MDA (malondialdehyde) can be estimated by the reaction with TBA (thiobarbituric acid) and the TBA value is routinely used as an index of lipid oxidation in meat products (Raharjo & Sofos, 1993).

The TBA value was decreased in all samples on the addition of rosemary, oregano and tea extracts, but tea was more effective against lipid oxidation.

Table 1. Total poliphenolic content (TPC)

Sample	TPC (mg/100ml)
Rosemary	1.94
Oregano	3.01
Tea	3.88

Table 2. TBA data for the lipid oxidation of porcine and bovine meat, raw and cooked, treated with rosemary, oregano and tea poliphenolic extracts (absorbance value in 532nm)

Sample	Day 1	Day 4	Day 7	Day 10
BRM C	0.309	0.564	0.551	0.442
BCM C	0.257	0.341	0.301	0.453
BRM+R	0.294	0.202	0.162	0.059
BCM+R	0.208	0.212	0.118	0.172
BRM+O	0.080	0.263	0.167	0.098
BCM+O	0.093	0.176	0.146	0.187
BRM+T	0.069	0.241	0.220	0.091
BCM+T	0.100	0.144	0.108	0.215
PRM C	0.189	0.202	0.250	0.210
PCM C	0.381	0.395	0.410	0.400
PRM+R	0.124	0.088	0.103	0.081
PCM+R	0.338	0.250	0.220	0.210
PRM+O	0.120	0.140	0.160	0.065
PCM+O	0.160	0.241	0.325	0.286
PRM+T	0.061	0.084	0.121	0.088
PCM+T	0.180	0.202	0.309	0.285

BRM = bovine raw meat**, BCM** = bovine cooked meat**, PRM** = porcine raw meat**, PCM** = porcine cooked meat**, R** = rozemary**, O** = oregano**, T** = tea

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Table 3. TBA data for the lipid oxidation of porcine and bovine meat, raw and cooked, treated with rosemary, oregano and tea poliphenolic extracts related to day 1(the relative absorbance of each sample on day)

Sample	Day 1	Day 4	Day 7	Day 10
BRM C	1	1.83	1.78	1.43
BCM C	1	1.33	1.17	1.76
BRM+R	0.95	0.65	0.52	0.19
BCM+R	0.81	0.83	0.46	0.67
BRM+O	0.26	0.85	0.54	0.32
BCM+O	0.36	0.68	0.57	0.73
BRM+T	0.22	0.78	0.71	0.29
BCM+T	0.39	0.56	0.42	0.84
PRM C	1	1.07	1.32	1.11
PCM C	1	1.04	1.08	1.05
PRM+R	0.66	0.47	0.54	0.43
PCM+R	0.89	0.66	0.58	0.55
PRM+O	0.63	0.74	0.85	0.34
PCM+O	0.42	0.63	0.85	0.75
PRM+T	0.32	0.44	0.64	0.47
PCM+T	0.47	0.53	0.81	0.75

BRM = bovine raw meat**, BCM** = bovine cooked meat**, PRM** = porcine raw meat**, PCM** = porcine cooked meat**, R** = rozemary**, O** = oregano**, T** = tea

Fig 1. Lipid oxidation degree of the samples of bovine (A = raw, B = treated on 85°C) and porcine (C = raw, D = treated on 85°C) treated with rosemary, oregano and tea poliphenolic extracts.

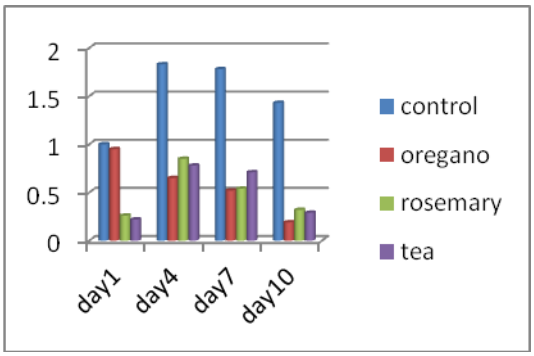

Fig. A.

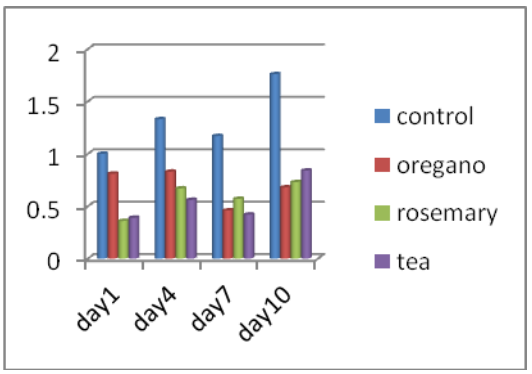

Fig. B.

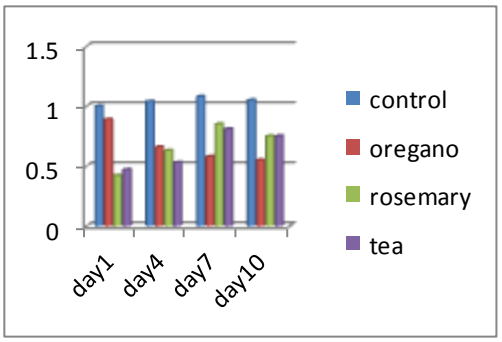

Fig. C.

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Discussion

The TBA assay can be effectively used to investigate oxidation occurring during cooking and storage of meat, because the lipids are dramatically affected. This is in agreement with Kanatt, Chander, and Sharma (2008) and Fasseas et al. (2007) Extracts from rosemary, oregano and tea are effective antioxidants and the tea extracts were more effective in inhibiting meat oxidation. Another use of this antioxidant plants may be the addition in animal food in way to enrich the antioxidant content of the animals and to prevent the oxidatin of lipid before the meat consumption. Additional studies should be conducted to determine the composition and structure of the active polyphenolic compounds in these products.

Conclusions

The results of this study using three different treatments (rosemary, oregano and tea), gave generally higher antioxidant activity compared to the control. The treated samples resulted in lower oxidation of porcine and bovine meat upon storage at 4°C, with the tea treatments being the most potent. This is generally in agreement with other research studies that have investigated the effects of tea in meat protection from oxidation through feeding (Botsoglou, Fletouris et al., 2003)

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