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Antioxidative effect of hop extract in a meat model.

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Background

During the last years much attention has been paid on a number of antioxidants from "natural" sources. These antioxidants include tea extracts (Yen *et al.*, 1997), dried and fresh spices (Ramanathan & Das, 1993) and general vegetables (Vinson *et al.*, 1997).
The antioxidant effect in many of these extracts is related to the content of phenols especially the flavonoids. In some investigations the effect of polyphenols as such has been observed (Ramanathan & Das, 1993; Hoshino *et al.* 1997). Tagashira *et al.* (1995) observed an antioxidative effect of humulone and lupulone in test systems.
The effect of polyphenols is a suppression of lipid peroxidation especially of the phospholipids. And this oxidation of the phospholipids is the basis of the warmed over flavor (WOF) measured in reheated meat balls.

Objective

This work was undertaken in order to investigate the antioxidative effect of hop extract in a minced meat model system, by measuring factors related to Warmed Over Flavor (WOF), i.e. thiobarbituric reactive substances (TBARS) and hexanal.
The effect of hop extract was investigated both at refrigerated temperatures, 5°C and 10°C; and during shot time incubation at -20°C.

Methods

Meat balls were produced using porc meat, shoulder with 5 % fat, which was minced one time. The mince was added sodium chloride to a level of 1 %, water to 10 % and approx. 0.5 ml ethanol. The meat balls were added different levels of hop extract. The hop extract consisted of 52.2 % α-acids, 23.3 % ß-acids; 5.2 % volatile oil and 4.0 % water (English Hop Products Lim.). The hop extracts were diluted in ethanol and added to the mix.
64 meat balls were produced with 0%; 0.0125%; 0.025% and 0.05 % hop extract for storage at 5°C. Another 64 meat balls were produced with 0%; 0.05%; 0.5% and 1 % hop extract for storage at 10°. Finally 32 meat balls were made with 0%; 0.05%; 0.025% and 0.05% hop extract for storage at -20°C. All the meat balls were formed with a spoon, weighed and cooked for 10 min in water.
Oxidation of the meat balls was followed by measuring TBARS and hexanal development.
Duplicate samples were investigated at all times.
TBARS
For TBARS, the extraction procedure of Vyncke (1975) was used on reheated meat balls. The reheating was done in a microwave oven for 1 min. One meat ball was subsequently homogenized using an Ultra Turrax T-25(Janke & Kunke) for 1 min with 30 ml 7.5% trichloracetic acid (containing 0.1 % propylgallate and 0.1 % EDTA). The homogenate was filtered through a Whatman filter paper into a bottle. 5 ml extract was mixed with 5 ml 0.02 M thiobarbituric acid in a screw cap tube and placed in a water bath at 95°C for 45 min. Cooling was done on ice-water for 10 min and the absorbance measured using a Hiachi U-1100 spectrophotometer at 532nm.
A standard curve was made on acid hydrolyzed tetraethoxypropan. The range was 0-0.0025 mg/5ml of malonaldehyde (MDA).
SPME
Solid phase micro extraction (SPME) was used for determining aldehydes especially hexanal. The fiber used was a 100μm polydimethylsiloxane coated fiber (Supelco). Sampling was done using 0.6 g minced meat ball in a 4 ml glas vial.
Equilibration was done for 30 min at 45°C followed by adsorption for 20 min with the fiber exposed to the head space.
The fiber was desorped in a HP 5890 Ser II gas chromatograph with injection port at 200C, FID detector at 270C. N_2 was used as column carrier gas and the temperature program was 40C for 1 min, 12C/min until 150C; 5C/min until 200C and 30C/min until 250 with a hold of 7 min. Desorption was done for 15 min in the injection port.
Analysis of variance (GLM) was done using Statgraphic (Manugistic,Inc 1996).

Results and discussion

The development in MDA during storage at 5°C is seen in Fig. 1. It is clearly seen that the addition of hop extract retards WOF development as measured by TBARS. The addition of hop significantly retarded MDA ($p<0.06$), but the actual concentration was not important. There was a significant increase in MDA in all samples ($p<0.02$), but MDA content in the hop added meat balls was approx. 2/3 and 1/3 of those without hop addition after 11 and 18 days respectively. At 10°C (Fig.2) there was a significant increase with time ($p<0.03$) and a significant lower MDA with hop addition ($p<0.00$); where 0.5 and 1% levels were significantly lower than the other two series. Fig. 3 shows that storing the samples for 3 weeks at -20°C did not result in any marked influence of hop addition. All samles had slightly ($p<0.08$) lower MDA concentrations at day 21 compared to 7 days samples, but hop concentration was not significant.
The hexanal concentration as measured by SPME increased in all samples from day 1 to 5. In the hop added samples, the increase continued throughout day 18, while samples without hop had lower hexanal counts after day 5. A reduction of the hexanal content in the samples without added hop, could be the result of microbial activity resulting in the metabolic degradation of hexanal. In the hop

added samples, the hop would inhibit microbial growth of spoilage organisms (Smith & Smith, 1993) . The samples stored at 10°C showed again the tendency of a reduction in hexanal after 5 days without hop adddition; in the samples added 0.5 % hop extract there was a continued increase although slower than without hop, and in the samples added 1 % hop a very low level of hexanal was observed throughout the storage period (Fig. 4). The 2 highest hop concentrations had significantly lower hexanal levels than the other two ($p < 0.001$). At -20°C the hexanal level was significantly ($p < 0.03$) lower at day 21 than at day 7. Only the 0.05 % hop level had significantly lower levels of hexanal than the non- hop samples. The heptanal content showed the same trend as the hexanal at 5 and 10°C (results not shown). In the study the antioxidative effect of hop extract could be observed in the meat balls both measuring TBARS and hexanal. Tagashira *et al.*(1995) showed in other systems that humulone and lupulone from hop coones had antioxidative effect equivalent to tocopherol and ascorbic acid.

Conclusion

The study showed that hop extract possess antioxidative power, which may be used in a meat product in order to lower WOF. Both at refrigerated temperature and at temperature abuse, the addition of hop extract results in a marked reduction of TBARS and of hexanal measured in the head space above the meat ball. Storage of meat balls in the frozen state for 3 weeks was not influences by added hop.

Literature

Hoshino,C., Tagawa,Y.,Wada,S.,Oh,J-H, Park,D-K, Nagao,A. and Terao,J.(1997) Antioxidant activity of quercetin against metmyoglobin-induced oxidation of fish oil-bile salt emulsion. Biosci. Biotech. Biochem. 61, 1634-1640.

Ramanathan, L. and Das, N.P. (1993) Natural produts inhibit oxidative rancidity in salted cooked ground fish. J.Food Sci. 58, 318-320.

Smith,N.A. and Smith,P. (1993) Antibacterial activity of hop bitter resins derived from recovered hopped wort. J.Inst. Brew. 99, 42-48.

Tagashira,;. Watanabe,M. and Uemitsu,N. (1995). Antioxidative activity of hop bitter acids and their analogues. Biosci.Biotech.Biochem. 59,740-42.

Vinson, J.A., Hao,Y.,Su,X. and Zubik,L. (1997) Phenol Antioxidant quantity and quality in foods: vegetables. J.Agric.Food Chem. 46, 3630-64.

Vyncke,W. (1975). Evaluation of the direct thiobarbituric acid extrwaction method for determining oxidative rancidity in mackerel (Scomber scombrus L.) Fette Seifen Anstrichmitteln 77, 239-40.

Yen, G-C, Chen,H-Y. and Peng,H-H.(1997). Antioxidant and pro-oxidant effect of various tea extracts. J.Agric.Food Chem. 45, 30-34.

Fig. 1 Malonaldehyde in meat balls stored at 5C

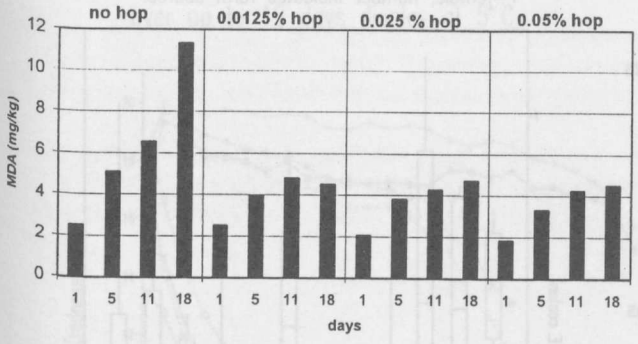

Fig. 2 Malonaldehyde in meat balls stored at 10C

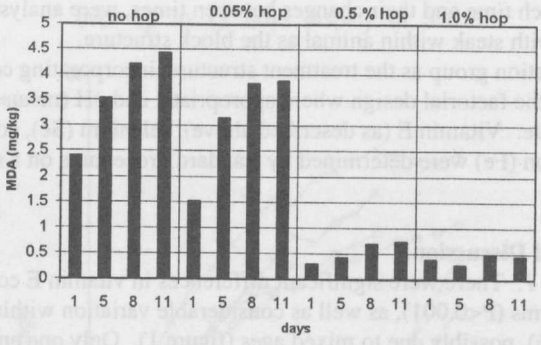

Fig. 3. Malonaldehyde in meat balls stored at -20C

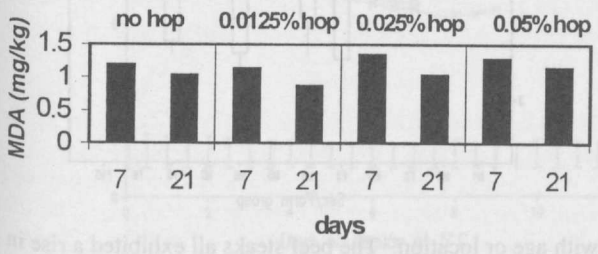

Fig. 4. Hexanal, content, in meat balls stored at 5C, 10C and -20C