TURAL ANTIOXIDANTS IN A COOKED, MINCED MEAT PRODUCT.

L. S. NIELSEN, A. L. HANSEN and H.V. LUDVIGSEN.

Technical Section, The Engineering Academy of Denmark, DK-2800, Lyngby, Denmark.

mary

e antioxidative properties of soy protein and pea fiber were tested and compared in a cooked, minced pork meat product during rigerated storage. Both the soy protein and the pea fiber had an antioxidative effect, although the influence of the soy protein was re pronounced. The effect was observed using objective methods i.e. fluorescence and testing for thiobarbituric acid reactive stances and by using organoleptic analysis as well. No effect was observed on the color of the product during storage.

oduction

eral studies have been made in order to reduce the off flavor developing in heated meat products during refrigerated storage. dition of polyphosphates has proven beneficiel (CHOI et al. 1987). ZIPRIN et al. (1981) showed that a substitution of 10 % of the f, in ground beef patties, with soy protein among other proteins, retarded oxidative changes during refrigerated storage. Pea fiber been shown in a study to exert an antioxidative effect on frozen minced beef and in a model system (BERTELSEN et al.1991). This dy was undertaken in order to see if an antioxidative effect due to pea fiber could be observed in a cooked meat product, and if this ct was similar to the effect of soy protein.

terials and Methods

e meat consisted of lean pork loin with 2 % fat, which was mixed with back fat during grounding."Natural" antioxidants were: 1,5 % ated soy protein (SFK, Denmark) suspended in water (1:4) and 3 % pea fiber (Nutrio Braband, Denmark) suspended in water (1:8). ther 1 % sodium chloride. Meat and fat was grounded in a meat mincer, and a suspension of protein/fiber was added together with . The meat was formed to balls each of 50g. As meat balls with added protein or fiber retained more water after cooking than meat s without an addition, the fat content on the former were lower. Therefore fat content of these balls were adjusted to a higher level fore cooking (22% fat compared to 20%). The meat balls were cooked in a water bath for 9 min. Storage was done aerobically in s covered with polyethylene film or anaerobically in anaerobic jars in a nitrogen atmosphere. Different jars were used at each sampling e. The meat balls were heated in a microwave oven to a center temperature of 75°C.

emical analysis

iobarbituric acid reactive (TBRA) substances were measured using the distillation method by TARLADGIS et al. (1960) with difications. Preliminary experiments showed that a 0.02 M thiobarbituric acid(TBA) solution in water, gave similar results as a lution in acetic acid. A 20 g meat sample was taken for analysis, and mixed with 50 ml water/propylgallate/EDTA solution for 1 min ng an Ultra-Turrax. (Janke & Kunkel). The solution was transferred with another 25 ml to a Kjeldahl distillation unit and 2 ml HCl 2 mixture with water) was added. During destillation different volumes of distillate were collected. In the results shown 250 ml of stillate was collected. A sample of 5 ml was transferred to tubes with 5 ml TBA solution. The K-factor was determined using raethoxypropan.

e tubes were heated on a water bath at 100°C for 45 min, cooled on ice, and TBA-reactive substances were measured using a orometer (Kontron SFM25). Values reported are for λ_{exc} 532nm, λ_{em} 553nm.

uorescence: A modified Bligh and Dyer extraction was used for this analysis. A 5g sample was mixed with 35 ml chloroform/methanol 1) for 1 min using an Ultra Turrax, 14 ml water was added and a further 1 min mixing was done. The solution was centrifuged for 5 n at 10.000 rpm at 5°C. Fluorescence was measured on the chloroformic phase and on the methanolic/water phase. Emmission was easured at 580-380nm with λ_{exc} 350nm. An excitation scan was done at 410-250nm with λ_{em} 425nm. Reported values are for λ_{exc} 0nm and λ_{em} 423nm. All the chemical tests were made in duplicate.

lor measurements

is was done using a Minolta Chroma Meter Cr-200. The Hunter Lab coordinates were collected. Measurements were done at 6 ferent positions on the meat ball, each time 3 measurements were done on the same spot.

ganoleptic analysis

ter 3 days incubation an organoleptic test was done on the meat balls, after heating to a center temperature of 75°C. The taste panel

evaluated taste and flavor on the heated meat balls. A hedonic scale from 1 to 9 was used. Results were tested using Duncan Multiple Range test (DUNCAN 1955).

Results and Discussion

Fig 1. shows that aerobic incubation results in higher TBA numbers than anaerobic storage. Addition of pea fiber exerted a positive and after 2 and 4 days significant, effect on TBA reactive substances during aerobic storage (Fig.1, standard deviations are shown in the graphs). These results are similar to those by BERTELSEN et al. (1991) , who reported lower TBA numbers on surface samples of frozen minced beef stored in polyethylene tubes. During anaerobic storage there was not a positive influence of pea fiber regarding TBA reactive substances.

Fluorescence has been shown to indicate lipid oxidation (GUTTERIDGE et al. 1982). In this study fluorescent values on methanolic extract did not show any increase during storage (Fig.3). Scanning of the chloroformic phase showed that there was one peak at λ_{exc} 350nm, λ_{em} 423. This value clearly showed a positive influence of pea fiber addition during aerobic incubation. Anaerobic samples had more or less the same values during storage irrespective of fiber addition.

Soy protein addition exerted a strong antioxidative effect looking at the TBA numbers (Fig. 2). This effect was observed both during aerobic and anaerobic storage. A similar picture was observed looking at the fluorescent values (Fig. 4), lower values with soy protein both on aerobically and anaerobically incubated samples. Preliminary experiments done at 10°C indicated, that fluorescent values were highest on aerobically stored samples without protein addition. The positive influence observed with soy protein addition is similar to results with beef patties by ZIPRIN et al. (1981), who showed that TBA numbers doubled in patties without soy addition, but remained more or less constant with soy addition during storage at 4°C. Also RAY et al. (1981) observed a positive influence on TBA numbers in beef patties with soy protein.

Color measurements

The L, a, b and Δ E values for anaerobic incubated meat balls were similar during storage regardless of storage condition. During aerobic storage the L factor rose and the a and b factors fell both with and without pea fiber addition. The results (not shown) did not indicate an influence of fiber on color during storage. Similar results were obtained with the soy protein added meat balls.

Organoleptic analysis

The mean values for taste and flavor were similar (Table 1), and only taste scores are shown. It could be shown , using Duncan Multiple Range test (DUNCAN 1955) that addition of pea fiber resulted in significantly higher scores , than without addition during aerobic storage. The combinations + fiber + air and -fiber-air were not significantly different. Problems with the temperature of the meat balls during the taste sessions, made another experiment necessary. The results shown are from this experiment. Also soy protein exerted a positive and significant effect during storage.

Conclusion

This study showed, that addition of "natural" antioxidants to a heated minced meat product had a positive effect on lipid oxidation during refrigerated storage. It was shown, that addition of pea fiber or soy protein had a positive influence in minced pork meat balls. During aerobic storage, where the changes would be largest, lower TBA numbers were observed in fiber or protein added products. Also measurements of fluorescence showed that this was stronger without addition of pea fiber or soy protein during aerobic storage. The results were confirmed by organoleptic tests, where the meat product with added fiber or protein had higher scores.

References

BERTELSEN,G.,OHLEN,A. and SKIBSTED,L.H. 1991. Pea fiber as a source of natural antioxidants in frozen minced beef. Z.Lebensm. Unters .Forsch. 192, 319-322.

CHOI,Y.I., KASTNER,C.L. and KROPF,D.H. 1987. Effects of hot boning and various levels of salt and phosphate on microbial, TBA and pH values of preblended pork during cooler storage. J.Food Prot. 50 (12), 1037-1043.

DUNCAN,D.,B. 1955. Multiple range and multiple F tests. Biometrics 11, 1-42.

GUTTERIDGE,M.C., KERRY,P.J. and ARMSTRONG,D. 1982. Autoxidized and lipoxidase-treated polyunsaturated fatty acids: Autofluorescence associated with the decomposition of lipid peroxides. Biochim.Biophy.Acta 711, 460-465.

RAY,F.K., PARRETT, N.A., VAN STAVERN, B.D. and OCKERMAN,H.W. 1981. Effect of soy level and storage time on the quality characteristics of ground beef patties. J. Food Sci. 46,1662-1664.

TARLADGIS,B.G., WATTS, B.M. and YOUNATHAN, M.T. 1960. A distillation method for the quantitative determination of malonaldehyd in rancid foods. J.AOCS. 37, 44-48.

ZIPRIN,Y.A., RHEE,K.S., CARPENTER,Z.L., HOESTLER,R.L., TERRELL,R.N. and RHEE,K.C. 1981. Glandless cottonseed Peanut and soyaprotein ingredients in ground beef patties: Effect on rancidity and other quality factors. J.Food Sci. 46, 58-61.

Table 1 Taste scores on meat balls stored at 5°C, with or without fiber or protein aerobic or anaerobic incubation

fiber	oxygen	taste	taste	protein	oxygen
+	+	5.00	4.89	+	+
+	-	6.14	6.89	+	-
-	+	3.29	3.11	-	+
-	-	5.71	6.11	-	-

Figure 1 TBA number of meat balls with/without pea fiber.

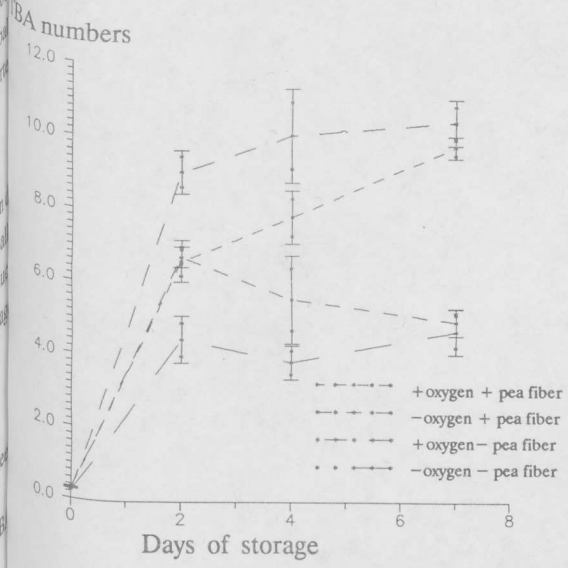

Figure 2 TBA numbers of meat balls with/without soy protein .

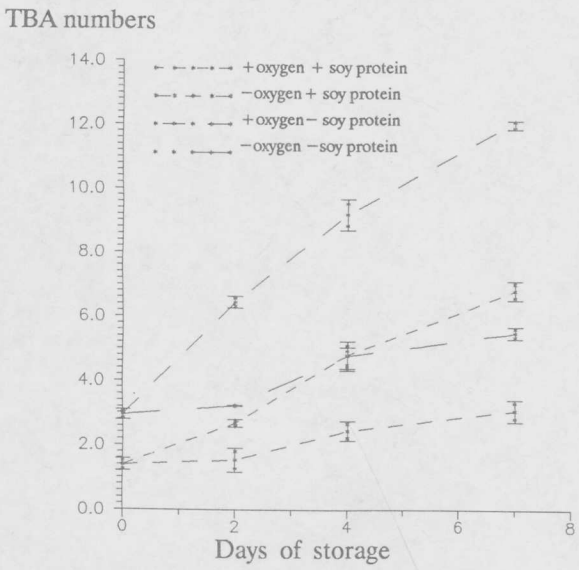

Figure 3 Fluorescence of chloroformic fraction, meat balls with/without pea fiber.

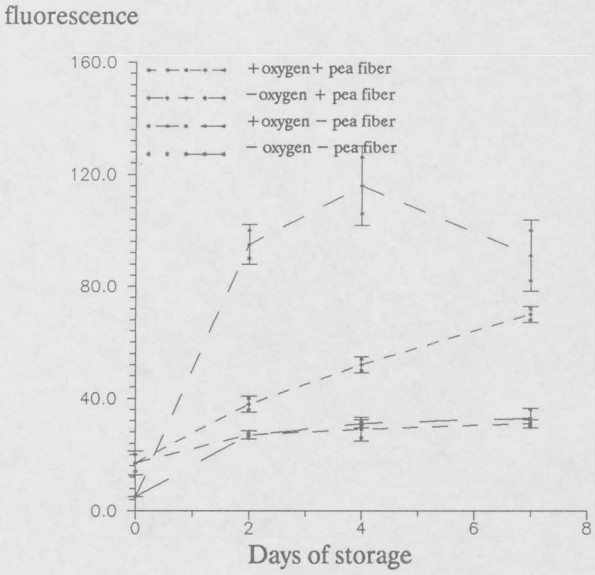

Figure 4 Fluorescence of chloroformic fraction meat balls with/without soy protein.