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HEAT-TREATED MUSCLE FOOD SYSTEMS FOR THE INNOVATIVE PRODUCTION OF ANTIOXIDANTS AND FLAVOR ENHANCERS

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I. INTRODUCTION

A significant challenge in the meat industry is chemical spoilage caused by lipid peroxidation. It's essential to consider the presence of oxidizing substances throughout food handling, from storage to cooking, and during digestion. These substances can adversely affect the texture, appearance, and nutritional value of food, which may ultimately impact human health. There is a need for a new, easily produced, high-quality component that can effectively protect against lipid oxidation in meat while enhancing or at least not compromising texture and taste. Currently, food additive companies primarily offer expensive plant extracts with limited effectiveness in inhibiting oxidation and maintaining the food's appearance and texture, and could also alter the original taste of the muscle food. Our objective was to demonstrate that controlled heat-generated meat crust (subjected to temperatures above 100ºC) may serve as a potent antioxidant (1). Additionally, we have strong evidence that this crust enhances taste, leading to better palatability.

II. MATERIALS AND METHODS

The grounded meats: turkey, chicken and entrecote were purchased at local retailers. For the preparation of the crust meat, the meat was placed for 1-2 minutes per side on a hot pan 155ºC without oil. The crust was separated by cutting 2.5 mm of the outer surface of a meat patty (1 cm in thickness) or by flattening the grounded meat to 2.5 mm thickness and placing it on a hot metal surface. Meat crust was used as a powder.

Lipid Oxidation Determination

Lipid peroxidation was determined by measuring TBA reactive substances (TBARS), which were calculated as malondialdehyde (MDA) equivalent. Post incubation, each sample of the oxidation systems was mixed immediately with 12% TCA at a 1:1 ratio and centrifuged (Thermo Fisher, Heraeus Megafuge 16 R) for 10 min at 15,000 RPM at 4 ℃. The supernatant was mixed with TBA (10 mM) at a 1:1 ratio, and the samples were heated in a boiling water bath for 15 min. Then, the samples' absorbances were measured at 532 nm (Shimadzu UV-1700, PharmaSpec), and the MDA concentration was calculated according to the extinction coefficient of 1 µmol/L = 0.156 and expressed as MDA equivalents (nmol/ g meat).

Oxidation system of meat membranes: fresh entrecote meat was homogenized with four portions of pH 6.5 acetate buffer 0.05 M. The liquid was taken to a centrifuge at 14,000 RPM at 4℃ for 30 minutes. Then, the supernatant was pulled out and the residue was weighed and suspended in buffer (4 times dilution). The washing process was repeated 3 times to produce the membrane phase (MP). The entrecote or turkey MP (0.5 g) was homogenized, and the crust 25-100 mg was added followed by adding 10 μM of $FeCl_3$ and 100 μM of ascorbic acid (AA), each tube had a final volume of 5 ml, and the MDA levels were quantified via TBARS before and after 60 minutes at 37ºC. Beef Crust, Cathchin and middle of the beef patty were used to study their effect on lipid peroxidation.

The soybean oil commercial emulsion (Intralipid®, 20% I.V. Fat Emulsion) was oxidized by the addition of 10 μM of $FeCl_3$ and 100 μM of AA and supplemented with crust at concentrations of 0.5 or 2 %. Each tube had a final volume of 5 ml, and the MDA levels were quantified via TBARS assay at various intervals of incubation at 37ºC.

III. RESULTS AND DISCUSSION

Using isolated meat membrane phase (MP, washed meat) we have demonstrated the antioxidant activity of meat crust. Incubation of MP supplemented with iron/AA resulted in increased MDA levels. The addition of crust to MP inhibited the lipid peroxidation effect of AA/iron as effectively as catechin and has led to significantly lower accumulation of MDA levels (Fig.1). As another control to crust we used the middle of the beef patty (MB). The addition of the MB resulted in an increase in MDA accumulation compared to only iron/AA, and compared to the crust (Fig. 1), thus indicating a prooxidant effect of the MB and an antioxidant effect of the crust.

Soybean oil contains a high amount of polyunsaturated fatty acids. Using a soybean oil oxidation system, we have demonstrated that the crust produced from variety of meats (beef, turkey, or chicken) can directly prevent lipid

peroxidation in oils and act as an effective antioxidant (Fig.2). In addition, the crust has been shown through specific hedonic evaluation to enhance the flavour of ready-to-eat meat products.

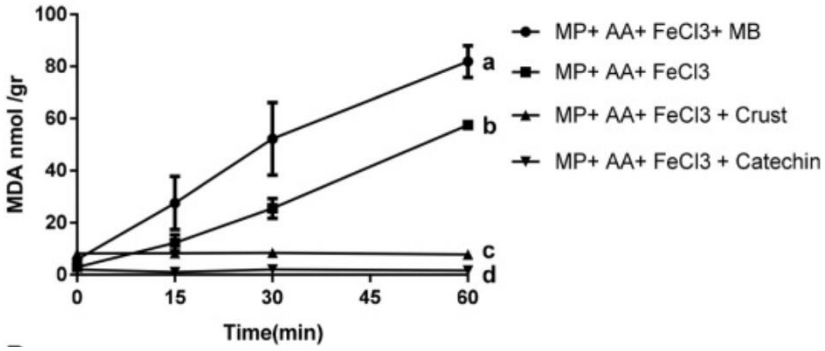


Fig. 1. MDA accumulation within 60 minutes in membrane phase (MP) with crust 100 mg. Comparison of the antioxidant effect of crust 100 mg, middle of the beef Pattie (MB) 100 mg and cathchin (400 µM). Experiments were repeated twice with duplicates (n = 4). The statistical tests compared the difference in MDA after 60 min of treatments using the Tukey−Kramer HSD test (1). Differences were considered significant at $p \leq 0.05$ and indicated by different letters.

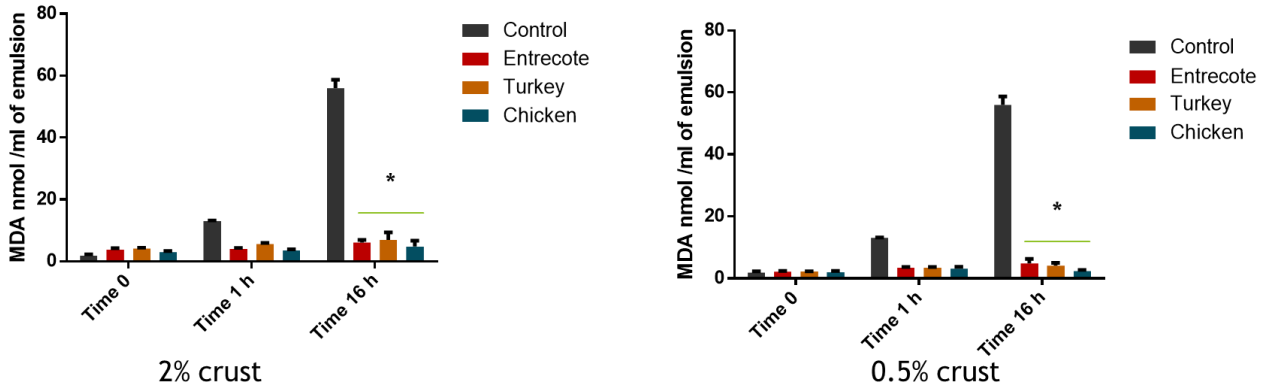


Fig. 2. Crust generated from different meat sources and added to intralipid at two concentrations (2 and 0.5% w/v). MDA was evaluated in 20% soybean oil emulsion (Intralipid) 1:5 in water with 10 μM of $FeCl_3$ and 100 μM of AA as oxidation system and after incubation at 37ºC for 0, 1 and 16 hours. The statistical differences between the crust treatments and the control with no crust were evaluated. Tests compared the MDA levels after 16 hours of incubation using the Tukey−Kramer HSD test. Differences were considered significant at $p \leq 0.05$ and indicated by an *.

CONCLUSION

Meat crust may serve as a natural antioxidant, making it useful in various applications within the food industry, especially in meat products. It can help reduce lipid peroxidation and extend the shelf life of products. However, further characterization is needed to identify the specific compounds in the crust that possess antioxidant properties.

REFERENCES

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