# OXIDATIVE STABILITY OF FROZEN STORED MECHANICALLY DEBONED MEAT (MDTM) EFFECTED BY COMMERCIAL ANTIOXIDANTS

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## Background

The rancidity caused by lipid oxidation poses a serious problem as the number of processed food products containing high levels of unsaturated fatty acids, increases. Lipid oxidation in meat is greatly accelerated by metallic catalysts and pigments, incorporated oxygen or added salt and depends also on the processing and storage conditions (Fennema, 1996). Mechanically deboned turkey meat (MDTM) is a typical example of processed meat highly prone to oxidation. The relatively high oxidative potentials of MDTM are due to the aeration and extraction of considerable quantities of unsaturated lipids and heme-components from bone marrow during the deboning process (Dawson and Garner, 1983). Therefore, oxidative stability of MDTM incorporated into emulsified meat products such as sausages and loaf meat, influence the shelf life and total quality of these products. The major strategies for preventing lipid oxidation are the use of free radical terminators such as phenolic antioxidants and restricting the access to oxygen during storage by vacuum-packing. Antioxidants are classified as compounds capable of delaying, retarding or preventing autooxidation processes (Shahidi & Wanasundara, 1992). However, antioxidants cannot reverse the oxidation process, nor suppress hydrolytic rancidity.

## Objective

The purpose of the present study was to examine the antioxidative effects of commercial antioxidant products on the oxidative stability of MDTM, frozen stored for 7.5 months.

## Material and Methods

Mechanically deboned turkey meat (MDTM) was produced in a commercial processing plant. Hand-boned frames including backs with natural portions of skin, were processed through a Beehive RSTC separator. The meat was vacuum-packed in Cryovac bags as 20-kg blocks, transported to the laboratory in a cooling carry, frozen at -30°C and stored at -25°C. After one week, MDTM was thawed for 48 hours at 4°C, followed by dividing into 2000-g aliquots and blending with the antioxidants in a "Stephan" mixer for 2 min. Four different antioxidants were incorporated into MDTM. Trolox (800 mg/kg), a water-soluble analogue of alpha–tocopherol, and ascorbic acid (2.4 g/kg) were dissolved in 20 ml distillate water before added to the meat. Mustard seeds (20 g/kg) were added directly to the meat together with water without initial dissolving. Rosemary oleoresin (2.4 g/kg) was blended with 20 ml soy oil prior to mixing with the meat. Batches of 2 kg MDTM each were blended with the appropriate amount of antioxidant. Besides, 2000-g batches without antioxidant were formulated. All experimental batches were divided into smaller portions (200 g). Five batches (four with antioxidants and one without) were packaged in transparent polyethylene plastic boxes while one (without antioxidant) was vacuum-packaged in impermeable plastic bags. Samples for each sampling period were frozen-stored at -25°C for 2.5, 5.0 and 7.5. The extent of lipid oxidation was monitored by the increases of thiobarbitur-reactive substances (TBARS) and hexanal formation as described earlier (Mielnik et. al. 2002). The samples were thawed at 4°C for 24 hours prior to TBARS and GC-MS analyses. All data were subjected to analysis of variance (ANOVA). Tukey's test was used to determine significance of means for multiple comparison.

## Results and Discussion

Antioxidant activities of Trolox, rosemary oleoresin, ascorbic acid and mustard seeds were evaluated in MDTM frozen stored for 7.5 months by means of TBARS and hexanal formation. Analysis of variance showed significant ($P<0.001$) effects of treatment and storage time as well as significant interactions between these factors (Table 1). Lipid oxidation increased continuously during the storage period at -25 °C. The highest rises in TBARS and hexanal over time were seen in control samples without antioxidants added and which had been packaged in air (Table 2 and 3). All antioxidant treatments effectively enhanced oxidative stability, although not with the same intensity. Trolox and rosemary oleoresin exerted the strongest antioxidative activities, which resulted in 90 % lower TBARS in these samples than in the control after 7.5 months. Trolox and rosemary oleoresin were followed by ascorbic acid, which showed slightly higher levels of TBARS and hexanal. Mustard also suppressed formation of TBARS and hexanal but not to the same extent as the other antioxidants. Mustard added to meat at a level of 2 % effectively retarded the oxidation process up to 2.5 months while longer storage periods seemed to require higher amounts to prevent oxidation. The vacuum packaging samples had the lowest TBARS values, nevertheless they did not differ significantly from antioxidant- treated meat except for mustard seed. According to Jantawat and Dawson (1980), removal of oxygen by vacuum packaging improves oxidative stability of the freeze samples compared to aerobic packaging condition.
Generally, supplementation of MDTM with antioxidants before the formulation of meat products intended for frozen storage in the presence of air proved to be advantageous in regard of lipid stability of raw material. Antioxidants-treatment could be an alternative method to prevent oxidative degradation of the meat during frozen storage when vacuum packaging is not practical.

## References

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Table 1. Analysis of Variance for TBARS and hexanal assessed in MDTM treated with and without antioxidants, and frozen stored for 7.5 months

| Source of variance | Factor | TBARS mg/kg Mean | TBARS mg/kg F-value | Hexanal ng/(g*L) Mean | Hexanal ng/(g*L) F-value |
|---|---|---|---|---|---|
| Treatment (A) | Without antioxidant-air | 1.485 | 230.78*** | 3830 | 79.14*** |
| | Trolox | 0.157 | | 3 | |
| | Rosemary oleoresin | 0.168 | | 16 | |
| | Ascorbic acid | 0.265 | | 98 | |
| | Mustard seeds | 0.370 | | 293 | |
| | Without antioxidant-vacuum | 0.148 | | 282 | |
| Storage time (B) | 0 month | 0.138 | 103.21*** | - | |
| | 2.5 months | 0.242 | | 168 | 18.73*** |
| | 5.0 months | 0.630 | | 930 | |
| | 7.5 months | 0.719 | | 1163 | |
| Treatment x storage time (AxB) | | | 55.84*** | | 12.9*** |

***significant at $P < 0.001$.

Table 2. Development of TBARS values (mg malondialdehyd/kg meat) during frozen storage in MDTM with or without antioxidants added

| Treatment | Storage time - months | | | |
|---|---|---|---|---|
| | 0.0 | 2.5 | 5.0 | 7.5 |
| Without antioxidant-air | 0.127 c | 0.582 a | 2.571 a | 2.661 a |
| Trolox | 0.108 d | 0.158 c | 0.158 d | 0.203 c |
| Rosemary oleoresin | 0.117 cd | 0.140 c | 0.195 d | 0.222 c |
| Ascorbic Acid | 0.208 a | 0.250 b | 0.269 c | 0.333 c |
| Mustard seeds | 0.158 b | 0.187 bc | 0.438 b | 0.699 b |
| Without antioxidant-vacuum | 0.111 d | 0.135 c | 0.149 d | 0.199 c |

Table 3. Development of hexanal ng/(g*L) during frozen storage in MDTM with or without antioxidants added

| Treatment | Storage time - months | | |
|---|---|---|---|
| | 2.5 | 5.0 | 7.5 |
| Without antioxidant-air | 784 a | 5037a | 5668 a |
| Trolox | 0 c | 0 b | 7 b |
| Rosemary oleoresin | 0 c | 0 b | 49 b |
| Ascorbic Acid | 0 c | 104 b | 189 b |
| Mustard seeds | 0 c | 155 b | 722 b |
| Without antioxidant-vacuum | 225 b | 281 b | 340 b |