QUALITY LOSS IN MECHANICALLY DEBONED POULTRY MEAT AT DIFFERENT STORAGE TEMPERATURES

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BACKGROUND

Higher storage temperatures raise the velocity of quality loss reactions in foods. The influence of each reaction type on the quality loss depends on the temperature. A reaction that ends the shelf life of a food at one temperature may not be that which does this at another temperature. Lipid and pigment oxidation and microbial growth are the major problems in the quality loss of mechanically deboned poultry meat (MDPM). In mechanical deboning the fibrous structure of the meat is broken into small particles, causing the release of lipid and heme compounds, an elevation in temperature causes protein denaturation, oxygen is incorporated and the surface area is increased. These factors, associated with the highly unsaturated fatty acids of the skin and bone marrow, are the major causes of oxidative rancidity (MOERK & BALL, 1974). Hemoglobin from the marrow and myoglobin from the muscle determine the red color of the MDPM. After mechanical deboning, when oxygen binds to the pigments, the cherry red color is formed. Accumulation of an undesirable brown color is due to the oxidation from Fe^{+2} to Fe^{+3} of the molecular nuclei of the pigments. High concentrations of metals, amines, sulphydryl and phenolic compounds may catalyse the undesirable color changes in MDPM (FIELD, 1988). Microbial deterioration can easily occur in MDPM due to the larger exposed surface area and redistribution of the microbial contaminants. Refrigeration slows the rate of auto-oxidation and reduces microbial growth; freezing inhibits microbial growth but does not completely stop lipid oxidation (BARBUT *et al.*, 1990).

OBJECTIVES

The objective of this study was to determine the effects of different storage temperatures on the microbiological, oxidative and sensory quality of MDPM.

METHODS

Forty kilograms of broiler backs with necks were obtained from a local processing plant. This material was stored at –10°C in plastic boxes over-wrapped with polyethylene film, until the extraction of MDPM (approximately 24hs). A POSS PDE 1000 machine was used for the MDPM extraction and the yield was about 60%. Three treatments were carried out: MDPM stored at –20°C, MDPM stored at –10°C and MDPM stored at 0°C, with different intervals between the analyses for each treatment: 105, 56 and 15 days of total storage time, respectively.

MDPM quality loss during the experiment was determined using the following analyses: MICROBIOLOGICAL ANALYSIS: the total psychrotrophic bacterial count was determined using the method of VANDERZANT & SPLITTOESSER (1992). SENSORY ANALYSIS: quantitative descriptive analysis was carried out by a trained 10 member sensory panel. The quantification of the descriptors was done using a non structured scale scoring from 0 to 10, where zero indicated absence and 10 maximum intensity. The descriptors were rancid odor, spoiled odor and pink color. PROXIMATE COMPOSITION: protein, lipids, moisture and ash were determined in fresh MDPM as described by CUNNIF (1998). LIPID OXIDATION: the thiobarbituric acid (TBA) test (TARLADGIS, 1960) was used to determine malonaldehyde by distillation. Readings of absorbance were converted to mg of malonaldehyde / kg of sample (TBA number) using a standard curve constructed using tetraethoxipropane (TEP) solutions. COLOR: a MINOLTA CM508d portable colorimeter was used to obtain a* readings. The colorimeter was set up with illuminant C and 2° standard observer. Six readings at different points were taken from each sample, directly over a PVC film.

RESULTS AND DISCUSSIONS

PROXIMATE COMPOSITION: the values for moisture, protein, lipid and ash of the MDPM were 59.26; 12.74; 27.64 and 0.80%, respectively.

PIGMENT OXIDATION: samples stored at –20°C (Figure 1) and –10°C (Figure 2) lost most of their pink color after 56 and 29 storage days, respectively. The panelists gave scores below 1 to these samples. The sample stored at 0°C (Figure 3) maintained most of its pink color, with a sensory analysis score ranging from 7 to 4 and a* values ranging from 15 to 11, from the beginning to the end of the study. Panelists gave low scores for the attribute pink color when a* was lower than 10. There was a high correlation between increases in metmyoglobin concentration and decreases in a* values (DEMOS & MANDIGO, 1996). This shows that when a* values were lower than 10, most of the myoglobin and hemoglobin pigments were in the oxidized state.

LIPID OXIDATION: DHILON & MAURER (1977) indicated a TBA number in the range 3.0 – 3.9 as the acceptable level for rancidity. Therefore, MDPM stored at –20°C became unacceptable after 105 days of storage (Figure 4) and the –10°C sample after 43 days (Figure 5), but the 0°C sample (Figure 6) kept close to the limit up to the end of the study (15 days). When in the oxidized state (Fe^{+3}), the main lipid oxidation catalyst is the heme iron of hemoglobin and the myoglobin pigments (SCHAICH, 1980; POLLONIO, 1994). This fact is related to results obtained for freeze stored MDPM. In the intervals where the sensory panel observed a great reduction in pink color (56 and 29 days for the –20 and –10°C samples, respectively), the rancid odor and TBA number showed great increases.

MICROBIAL GROWTH: the samples stored at –20°C (Figure 7) and –10°C (Figure 8) showed a small decrease in the psychrotrophic bacterial plate count. These results disagree with the small increase in spoiled odor detected by the sensory panel. After a discussion with the panelists we detected some confusion between the detection of a spoiled odor and other odors which were formed or absorbed by the samples during storage. In other words, the sample stored at 0°C (Figure 9) showed a considerable increase in microbial growth and spoiled odor throughout the whole study. The sensory evaluation was not repeated after 15 days due to the extremely bad odor the sample showed at that time. According to MOERK & BALL (1974) high microbial counts remove

malonaldehyde and possibly other dicarbonyl compounds which are formed during autoxidation. This fact could explain the trend for a decrease in the TBA number in the 0°C sample after 15 days of storage.

CONCLUSIONS

The main factor determining the end of the shelf life of MDPM stored at 0°C was microbiological growth. On the other hand the loss of quality in frozen stored MDPM was caused by lipid and pigment oxidation. Lower storage temperatures reduced the velocity of the oxidation reactions, extending the MDPM storage time.

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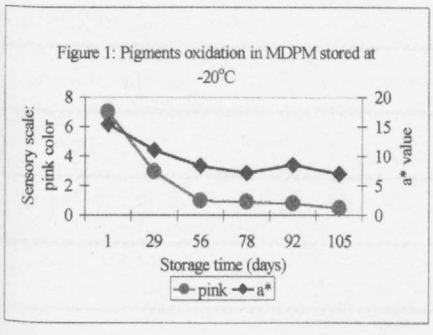

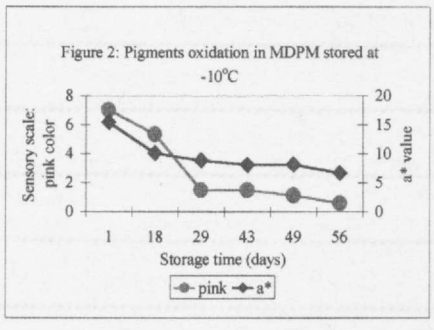

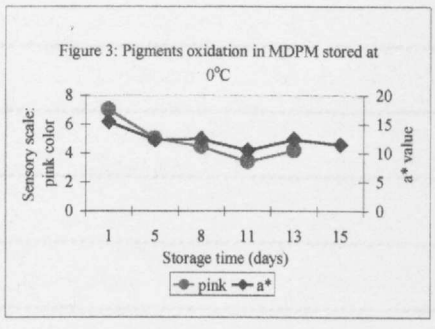

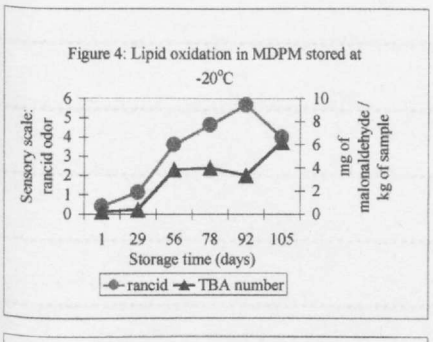

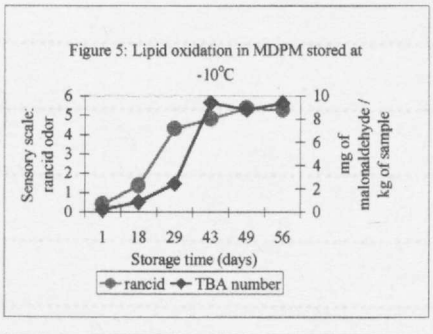

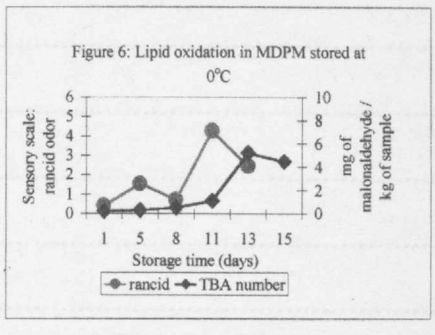

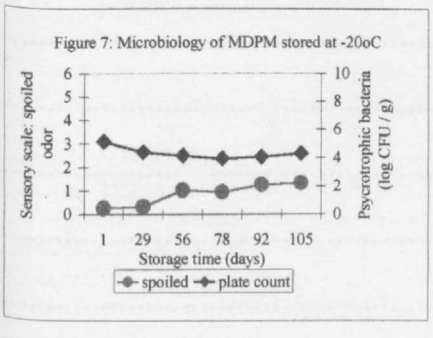

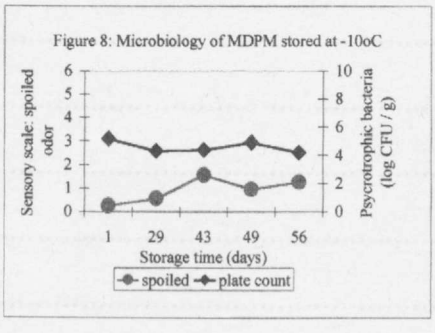

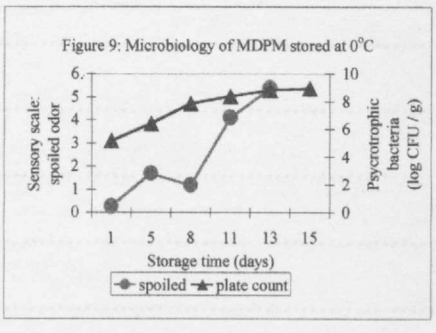

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