THE EFFECT OF GARLIC ON OXIDATIVE STABILITY OF FROZEN MECHANICALLY DEBONED TURKEY MEAT.

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ABSTRACT

Frozen mechanically deboned turkey meat (MDTM) is often used in processed poultry products. The quality change that occurs during frozen storage of MDTM is rapid development of rancidity. The aim of this study was to evaluate whether addition of garlic to MDTM prior to freezing can improve its oxidative stability. Freshly produced MDTM was treated with fresh or dried garlic (0.25 % w/w), and then stored at -20 °C for 2 months. The extent of lipid oxidation was measured by the following changes in TBARS-values and the sensory quality. The control samples (without garlic) had the highest TBARS-values and the highest scores for rancid flavour and odour after 2 months storage. The TBARS-values of the control samples increased more than 4 times comparing with 0 time values, while the TBARS-values of samples with dried or fresh garlic increased 2 and 3 times, respectively. Dried garlic was more effective than fresh garlic in reducing rancidity in frozen samples, expressed as TBARS-values. The sensory evaluation did not distinguish between samples with dried or fresh garlic, however both of them were judged significantly less rancid than the control sample. MDTM with garlic as antioxidant may be applied in products where its characteristic smell and taste is desirable.

INTRODUCTION

Mechanically deboned turkey meat (MDTM) is readily available for use in various further processed products. However, MDTM is highly susceptible to oxidative deterioration. Cell disruption and excessive aeration during the process as well as extraction of heme and lipids from bone marrow, are the main reasons for rapid development of rancidity (Dawson and Gartner, 1983, Barbut et al., 1989).
In the recent years, natural antioxidants attracted the attention of many food manufacturers by the obligation to produce healthy foods. There exist a wide range of natural antioxidants, some of which are currently used effectively for the protection of foods against oxidative degradation. Many spices including garlic exhibit antioxidative activities in a variety of food systems (Jurdi-Haldeman et al., 1987; Kyung Hee and Ki Sook ,1993; Yang et al., 1993).
Since ancient times, garlic (Allium sativum) has been used world-wide, not only as food, but also as medicine. Garlic is clearly one of the best natural antibiotics. It was used as an antiseptic in both World Wars. Garlic is rich in a variety of sulphur-containing compounds which are also potential antioxidants (Yang et al., 1993; Imai et al. 1994). Japanese studies have shown antioxidant properties in garlic mixed with mince pork. This property is even said to increase following heating in microwave ovens. The aim of this study was to evaluate whether addition of garlic to MDTM prior to freezing can improve its oxidative stability during frozen storage.

MATERIALS AND METHODS

Mechanically deboned turkey meat (MDTM) was obtained from a commercial processing plant. The meat was processed from hand boned turkey's skeleton including neck, frame and back without skin through a Beehive deboner. Chilled MDTM (standard) was transported to the laboratory within 2 hours. Unpeeled garlic bulbs and pulverised dried garlic were purchased from the retail market. The garlic bulblets were peeled, washed and crushed before use. MDTM was divided into three batches: the control group was without any additives, the second group was mixed with squeezed fresh garlic (0.25 % w/w) and the third group was treated with dried garlic (0.25 % w/w). Every experimental MDTM lot was packed in 20 small plastic boxes (200 g) and then stored at -20 °C.

Analytical methods

Composition
Proximate composition, including moisture, fat, total protein and connective tissue protein was determined on three replicates for untreated MDTM according to AOAC methods (1990). Calcium was determined by Inductively Coupled Plasma Emission Spectrometer (Thermo Jarrel Ash ICAP 1100). All analyses were carried out on the samples stored for 1 week.

Lipid oxidation. Frozen MDTM samples were thawed at 4 °C prior to analysis. The thiobarbituric acid reactive substances (TBARS) were determined in 3 replicate samples by the distillation procedure of Tarladgis et al. (1960). The TBARS values expressed as mg of malondialdehyde per kilogram of meat were calculated using a constant of 7.8. The samples were examined after 0 (1 week), 1 and 2 months of storage.

Sensory analysis: Sensory analysis was performed on experimental samples stored for 2 months and new reference-untreated MDT stored at -25 for 3 days. The sensory panel of 9 well trained assessors scored samples using a descriptive test (ISO 6564 -1985 E). Stored MDTM were thawed overnight at 4 °C. Samples of 20 g was vacuum-packed in a plastic bag, cooked in a water bath at 85 °C for 40 min and served immediately in a locked bag at approx. 50 °C. Assessors evaluated the intensity of 12 attributes, i.e.: intensity of odour, odour of turkey, odour of garlic, fresh odour, rancid odour, off-odour, intensity of flavour, flavour of turkey, flavour of garlic, fresh flavour, rancid flavour, off-flavour. Randomly served samples in 2 replicates were assessed according to a continuous non-structured scale ranging from the lowest intensity of each attribute (value 1.0) to the highest intensity (value 9.0).

Data analysis: Data were subjected to the analysis of variance (ANOVA) using the software package STATISTIX.4.

RESULTS AND DISCUSSION

Proximate composition of MDTM used in experiment is shown in Table 1. The changes of TBARS during 2 months of frozen storage are presented in Table 2.

Table 1. Composition of MDTM

Component	%
Fat	26.9
Moisture	57.3
Total protein	16.0
Connective tissue protein	6.6
Calcium	0.08

Table 2. Effect of storage time on TBARS -values in MDTM with and without garlic.

Storage time (months)	Control	Fresh garlic	Dried garlic	p-values
0	0.61 a x	0.48 b x	0.67 a x	0,005
1	1.27 a y	1.33 a y	0.82 b y	0,000
2	2.71 a z	1.85 b z	1.21 c z	0,000
p-values	0,000	0,000	0,000	

abc- means in the same row with the same subscript are not significantly different; xyz- means in the same column with the same subscript are not significantly different.

During 2 months storage TBARS increased progressively in all samples, however the highest increase was noted in the control group without added garlic. There were no significant differences between the control samples and the samples with dried garlic in the beginning of the experiment. After one month of storage the opposite situation occured, only samples with dried garlic differed significantly from the control samples, showing the lowest value. A positive effect of both fresh and dried garlic was found after 2 months frozen storage. This indicated that natural antioxidants contained in garlic had repressed the oxidative rancidity in MDTM when the oxidative process was considerably advanced. The control samples contained a significantly higher amount of TBARS compared to the garlic samples. However, dried garlic appeared to be more effective than fresh garlic in reducing rancidity in frozen samples, expressed as TBARS-values.

The mean values of the sensory attributes and results of the analysis of variance are shown in Table 3. New MDTM (standard) was used as reference sample (new control) to detect changes in MDTM during 2 months frozen storage. Assessment by a sensory panel showed that the oxidative rancidity in control samples of MDTM increased considerably during storage and they were significantly different from new MDTM as well as stored MDTM containing garlic. Rancid odour in samples with fresh garlic obtained the lowest score and was judged significantly less rancid than the samples with dried garlic. However, the samples containing garlic could not be differentiated on the basis of rancid flavour. It is emphasised that no significant difference in rancid flavour was found between samples with dried or fresh garlic and new MDTM. Both fresh and dried garlic affected odour and flavour intensity in treated samples very strongly. Garlic significantly depressed the natural odour and flavour of turkey meat while the garlic odour and flavour became considerably emphasised.

In conclusion, MDTM with garlic as antioxidant may be applied in products were its characteristic smell and taste is desirable.

TABLE 3. Mean scores and p-values for MDTM

SENSORY ATTRIBUTES	NEW	STORED SAMPLES			
	Control	Control	Fresh garlic	Dried garlic	p-values
Odour intensity	6.17 b	6.54 b	7.79 a	7.96 a	0.0000
Odour of turkey	5.84 a	4.55 a	2.60 b	2.43 b	0.0000
Odour of garlic	1.19 b	1.09 b	7.55 a	7.45 a	0.0000
Fresh odour	5.11 a	3.96 b	4.44 ab	3.96 b	0.0100
Rancid odour	1.64 b	2.96 a	1.28 c	1.79 b	0.0002
Off-odour	1.86	3.42	2.97	3.28	0.2969
Intensity of	6.09 b	6.17 b	7.47 a	7.49 a	0.0000
Flavour of turkey	6.09 a	4.49 b	3.06 c	2.94 c	0.0000
Flavour of garlic	1.07 b	1.08 b	6.78 a	7.53 a	0.0000
Fresh flavour	5.81 a	4.23 b	4.23 b	4.03 b	0.0052
Rancid flavour	1.78 b	3.14 a	1.79 b	1.81 b	0.0000
Off-flavour	2.07	3.35	4.02	3.47	0.0959

abc- mean values in the same column with the same subscript are not significantly different.

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