Effect of mustard seed on fatty acids composition and lipid oxidation of cooked meat products

Karwowska M. and Dolatowski Z.J.

Department of Meat Technology and Food Quality, University of Life Sciences in Lublin,
ul. Skromna 8, 20-704 Lublin, Poland

Abstract - **The objective of the study was to evaluate the influence of ground mustard seed on fatty acids composition and lipid oxidation of meat products made of pork during storage. Investigations were carried out on cooked sausages produced from organic pork meat (*m. biceps femoris*). Three variants of meat products samples were obtained: control, mustard seed 0.2% containing 0.2% of ground mustard seed and mustard seed 0.5% containing 0.5% of ground mustard seed. One day after production and then on 5 and 10 day the following characteristics were tested: oxidation-reduction potential values, lipid oxidation by the TBARS method and fatty acids composition. The oxidation–reduction potential tended to decrease with the increasing of level of mustard seed. Since oxidation-reduction potential is dependent on the total concentration of oxidants and reductants in a system it is suggested that the addition of ground mustard seed could increase the oxidation stability of cooked meat product.**

Keywords – **meat product, mustard, oxidation**

I. INTRODUCTION

The addition of natural antioxidants is a major way to inhibit oxidation processes in meat products. Spices are excellent source of phenolic compounds which show antioxidant activity. Among spices, mustard seed is rich in tocopherols, therefore it is reported to have antioxiadant capacity [1]. According to the data published in literature mustard seed characterized by an advantageous chemical composition such as high protein content (28–36%), well-balanced amino acid composition. Moreover, mustard seeds have 28–32% oil with a special fatty acid composition dependent on mustard genotypes [2]. Turgis et al. [3] suggested, that mustard essential oil can be used as an effective antibacterial agent since it contains a large number of components that has been effective antibacterials.

Since less is known about effectiveness of mustard seed in retarding oxidation processes of meat product, the aim of the study was to evaluate the effect of mustard seed on fatty acids composition and lipid oxidation of meat products.

II. MATERIALS AND METHODS

Investigations were carried out on cooked meat products produced from organic pork meat (*m. biceps femoris*). Three variants of cured stuffed meat products samples were obtained: *control* (no antioxidants), *experimental 1* containing 0.2% of ground mustard seed and *experimental 2* containing 0.5% of ground mustard seed. Fresh pork was obtained from the local meat plant in Lublin region and stored at 4°C prior to use (48 hours). The meat was cured using 2% curing mixture (99.5% NaCl, 0.05% sodium nitrite) and was stored at 4°C for 24 hours. Then, the meat was ground through a 10 mm plate. Since the presence of a erucic acid has been the limiting factor of use mustard in human food, low erucic acid content mustard variety (Bamberka variety) was applied in experiment. All ingredients were then blend in hand. After that, meat patties has been stuffed into synthetic collagen casings. The cooking of the stuffed product was carried out to an internal temperature of 72°C. The measurements of the meat products quality were carried out 1, 5, 10 day after production and included: oxidation-reduction potential, fatty acids compositions and lipid oxidation.

Oxidation- reduction potential (ORP)

ORP measurements of meat product homogenates were carried out using a digital pH-meter CPC-501 (Elmetron) equipped with redox electrode (ERPt-13, Elmetron).

Lipid oxidation

Thiobarbituric acid reactive substances (TBARS) were measured to evaluate lipid oxidation of meat products. The rose-pink color obtained by the reaction between malondialdehyde and 2-thiobarbituric acid was measured at 532 nm (Nicole Evolution 300, Thermo Electron Corporation). The amount of TBARS was expressed as milligrams of malondialdehyde per kilogram of meat product.

Fatty acid composition

Fatty acid composition of total lipid was determined by gas chromatography. The analysis was performed in accordance with the AOAC procedures [4,5]. Gas chromatograph (Varian 450-GC) was used.

Statistical analysis

One-way analysis of variance was carried out. Significance of differences between samples at the same storage time and the same sample at different storage times was determined (at the significance level $p \leq 0.05$) using T-Tukey's test.

III. RESULTS

Results for redox potential of the meat products with mustard seed addition were not significantly different compared to the control sample (Fig. 1). It was indicated that the oxidation–reduction potential tended to decrease with the increasing of level of mustard seed. It was also noticed that ORP values varied slightly during storage for the samples with mustard seed addition while it significantly increased for control sample.

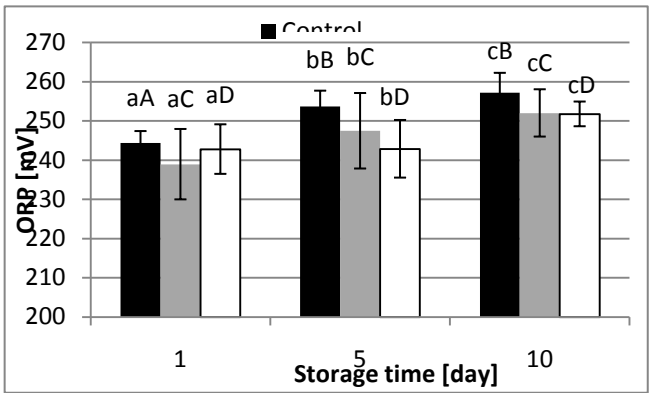

Fig. 1 Oxidation-reduction potential (ORP) of meat products during storage. Means followed by the same lower case letters between the samples at the same storage time and capital letters between the same sample at different storage times are not significantly different at $p \leq 0.05$.

The results of TBARS values show that application of ground mustard seed did not significantly improve the lipid stability of meat products (Table 1). It was also noticed that TBARS values significantly increased on 5 day of storage and then decreased on 10 day of storage.

Table 1 Lipid oxidation (mg MDA/kg meat product) of meat products during storage. Means followed by the same lower case letters between the samples at the same storage time and capital letters between the same sample at different storage times are not significantly different at $p \leq 0.05$.

	Storage time [day]		
	1	5	10
Control	0.74^{aA}	0.93^{bB}	0.78^{cA}
Mustard seed 0.2%	0.72^{aC}	0.91^{bD}	0.79^{cC}
Mustard seed 0.5%	0.79^{aE}	0.89^{bF}	0.84^{cEF}

The concentration of saturated and monounsaturated fatty acids was not significantly different between control meat product and with ground mustard seed addition (Table 2). The percentage of PUFA was significantly higher for meat product sample containing 0.5% of mustard seed compared to control and sample with 0.2% addition of mustard seed. It was also noticed, that n-3 fatty acids significantly increased with the increasing of level of mustard seed.

Table 2 Fatty acids composition of meat products [%]. Means followed by the same lower case letters between the samples are not significantly different at $p \leq 0.05$.

Fatty acid	Control	Mustard seed 0.2%	Mustard seed 0.5%
16:0	25.22^{a}	24.65^{a}	24.64^{a}
18:0	12.66^{a}	12.70^{a}	13.07^{a}
18:1 (n-9)	50.94^{a}	51.81^{a}	50.72^{a}
18:2 (n-6)	4.01^{a}	3.96^{a}	4.31^{a}
18:3 (n-3)	0.21^{a}	0.30^{b}	0.40^{c}
SFA	39.87^{a}	39.15^{a}	39.75^{a}
MUFA	55.60^{a}	56.36^{a}	55.29^{a}
PUFA	4.31^{a}	4.32^{a}	4.76^{b}
n-3	0.21^{a}	0.30^{b}	0.40^{c}
n-6	4.01^{a}	3.96^{a}	4.31^{a}

IV. DISCUSSION

Obtained results pointed out that the addition of mustard seed to the composition of cooked sausage had little effect on TBARS values but had a positive influence on their oxidation-reduction potential and fatty acids composition of cooked meat products.

Quantity and quality of dietary fat is strongly related to human health. Two important fatty acids, which belong to two independent families of PUFA are linoleic acid (LA, 18:2n-6) and α-linolenic acid (ALA, 18:3n-3) [7]. According to Bazard et al. [8] it is important to provide these two fatty acids in the diet because they are precursors for long chain

polyunsaturated fatty acids. The results of present study showed, that incorporation of mustard seed to the composition of experimental meat products increased the amount of n-3 fatty acids.

The research of Manda et al. [3] indicated that mustard seed include biothiols, which protect cells from oxidative damage. According to their study mustard seed contained the highest level of γ-glutamylcysteine out of fenugreek, ginger, turmeric, cardamom and coriander. The results of present study did not show that application of ground mustard seed improve the lipid stability of meat products.

V. CONCLUSIONS

Incorporation of spices into meat products can improve their functional value for consumers. Mustard seed contains several antioxidant compounds that may play role in human health protection.

Obtained results pointed out that the addition of mustard seed at the level of 0.2 and 0.5% to the composition of cooked sausage had little effect on TBARS values but it improved fatty acid composition.

ACKNOWLEDGMENTS

This work was financially supported by the Ministry of Science and High Education. Project IP2010 017170

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