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Changes in myofibrillar proteins during processing of pastirma (Turkish dry meat product) produced with commercial starter cultures

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Abstract

The effects of different commercial starter cultures (*Staphylococcus carnosus*, *S. carnosus* + *Lactobacillus pentosus* and *Staphylococcus xylosus* + *Lactobacillus sakei*), on myofibrillar proteins were investigated using differential scanning calorimetry (DSC) during the processing of pastirma. The stage of pastirma production significantly decreased the thermal stabilities of myosin and actin. Actin was less affected than myosin. The myofibrillar fraction of pastirma was hardly denaturated by *S. carnosus*, but more pronounced denaturation was obtained with *S. carnosus* + *L. pentosus*.
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Keywords: Pastirma; Myofibrillar proteins; Denaturation characteristics; Starter culture; Proteolytic activity; Differential scanning calorimetry

1. Introduction

Pastirma, a traditional Turkish meat product, is the most popular dry-cured meat product produced in Turkey. It is categorized as an intermediate moisture food (Leistner, 1988). Pastirma is produced from whole muscle obtained from certain parts of beef and water buffalo carcasses. Muscles are cleaned from tendon and fat and then cured, dried, pressed and coated with garlic, paprika, red pepper and water-containing paste (cemen), and again dried. The production process of pastirma approximately extends over a month-period. In this period, significant structural changes take place in meat, including breakdown of the proteins by means of muscle proteinases (Anon., 1983; Gökalp, Kaya, & Zorba, 1999; Molina & Toldra, 1992; Toldra, Rico, & Flores, 1993).

Over the past decade, interest in the starter cultures in the meat products has greatly increased and numerous studies have been carried out. Various workers report that, using starter cultures in dry-cured raw meat products, such as pastirma, improved quality properties of the end-product (Aksu & Kaya, 2001, 2002; Katsaras, Launtenschläger, & Bosckova, 1996a, 1996b). Some members of the *Micrococcaceae* family utilized as starter cultures in meat products are *Staphylococcus carnosus*, *Staphylococcus xylosus*, *Micrococcus varians* (Hammes & Hertel, 1998; Hammes & Knauf, 1994; Jessen, 1995; Lücke, 1985; Lücke, 2000). These microorganisms have proteolytic and lipolytic activity (Fadda, Sanz, Vignola, Conception, Aristoy & Toldra, 1999; Geisen, Lücke, & Kröckel, 1992; Johansson, Berdague, Larsson, & Borch, 1994; Lücke, 1985). Lactic acid bacteria used as starter cultures (*Lactobacillus plantarum*, *Lactobacillus sakei*, *Lactobacillus curvatus*, *Lactobacillus pentosus*) had weaker lipolytic and proteolytic activity than the *Micrococcaceae* (Johansson, Berdague, Larsson, & Borch, 1994; Kröckel, 1995; Lücke, 1985; Schiefer & Schöne, 1978).

It is well known that the quality of meat products depends on the extent and character of the denaturation changes in muscle proteins. At present, one of the most informative physicochemical methods used for studies of the thermally induced conformational changes in muscle proteins is differential scanning calorimetry

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(DSC). The method allows the determination of the number of the structural transitions, their temperature intervals, and their enthalpies and measures the extent of denaturation under various processing conditions.

There is some research on pastirma produced with starter cultures (Aksu & Kaya, 2001, 2002). But, until recently, there is no information regarding the effects of commercial starter cultures on the myofibrillar proteins of pastirma. The aim of this research was to determine, by DSC, whether or not myofibrillar proteins are susceptible to degradation of pastirma produced with commercial starter culture.

2. Materials and methods

2.1. Production of pastirma

The production process of pastirma is given in Table 1. Three trials (treatment 1, treatment 2 and treatment 3) were carried out in this study. *Longissimus dorsi* muscles (24 h *post mortem*) from beef, carcasses were used as raw material. After removing fat and connective tissue from the surface, muscles were cut vertically into two pieces. Four pastirma were produced from a carcass. For each treatment one carcass were used. In treatments, commercial preparations of *S. carnosus* (Bactoferm^{TM} C-P-77), *S. carnosus+L. pentosus* (Bactoferm^{TM} C-P-77 S) and *S. xylosus+L. sakei* (Bactoferm^{TM} B-FM) were used as starter culture (CHR HANSEN, Rudolf Muller, Germany). Starter culture (25 g starter/100 kg meat) was introduced into muscle with curing compounds (47.250 g NaCl, 0.750 g KNO_3, 1.0 g glucose, 1.0 g saccharose) and the curing process was employed in different trays for each group. As control group, pastirma samples made without starter cultures were also used. Paste mixture (cemen) used in this study contained 500 g flour, *Trigonella foenum graecum* seed, 350 g smashed fresh garlic, 75 g paprika, 75 g red pepper and 1200 ml water. After the second drying step, dried meat samples were mounted with paste (cemen) and stored for 4 days. Then the surface of the meat was shaved to give 3–4 mm of paste mixture thickness on the surface of the meat.

2.2. Isolation of myofibrillar proteins

Myofibrillar proteins were isolated by using the procedure of Claeys, Uytterhaegen, Buts, and Demeyer (1995). 2.5 g minced meat were homogenized, using an Ultra-Turrax in 25 ml buffer solution (pH 7.6, 3 °C, 0.05 M sucrose, 0.05 M Tris, 1 mM EDTA). After centrifugation (1000*g* for 10 min) the supernatant was decanted. Myofibrils were resuspended in 25 ml of a buffer solution (pH 7.6. 3 °C, 0.05 M Tris, 1 mM EDTA) and again centrifuged at 1000*g* for 10 min. The supernatant was decanted and the treatment was repeated with 25 ml of KCl solution (3 °C, 0.15 M KCl). After isolation, the pellet was lyophilized and stored until required for analysis.

2.3. DSC analysis of myofibrillar proteins

The endothermal transitions of myofibrillar proteins were determined by using the DSC-50 (Shimadzu Corporation, Kyoto, Japan). Approximately 10 mg of sample from the myofibrillar proteins were weighed into an aluminium hermetic cell (Shimadzu, 201-53090) and sealed with a crimper. Samples were heated from 20 to 90 °C, at rate of 5 °C/min, using an empty cell as a reference. For temperature and heat flow calibration Indium was used (T, 156.4 °C; ΔH, 28.47 J/g). The temperature at which the maximum rate of heat input occurred in an endothermic peak was expressed by T_p. For reproducibility, the temperature of the peak maximum was taken as the transition temperature. Denaturation enthalpies (ΔH_d) were estimated by measuring the area under the DSC transition curve.

2.4. Statistical analysis

This experiment was conducted according to a completely randomized block design, using three replicates.

Table 1
The stages of pastirma production

Production stage	Time	Temperature (°C)	Relative humidity (%)
1 Curing[a]	2 d	6 ± 1	80–90
2 First Drying	4 d	15 ± 1	80–85
3 First Pressing[b]	17 h	7 ± 1	
4 Second Drying	3 d	20 ± 1	70 ± 2
5 Second Pressing[b]	7 h	25 ± 1	
6 Paste Cemening	4 d	7 ± 1	
7 Last Drying	2 d	15 ± 1	70 ± 2
	2 d	18 ± 1	65 ± 2
	6 d	20 ± 1	60 ± 2

[a] For 1 kg meat and fat, 50 g curing material.
[b] For 1 kg meat and fat, 25 kg weight.

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