IMPROVEMENTS IN FUNCTIONAL PROPERTIES OF DRY CURED MEAT USING FERMENTED SOY PASTE

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Abstract- Consumers expect less odour and more nutritional value from meat products. Chemen is a wrapping material used in regionally popular dried meat pastirma, but presents a strong odour. To meet the consumer preference, this paper proposes fermented soy paste (Miso) as a potential coating material alternative to chemen. We investigated potential properties of miso to improve the functional, eating quality and nutritional properties of a new product named miso-pastirma (MP). Results suggested that the incorporation of miso as coating material for pastirma has increased both of the fat content and dry matter in MP when compared to commercial pastirma. The increase in the total dry matter indicated that there was an improvement in some of functional properties related to lipids and flavour. MP and M samples were free of the pathogens such as *Salmonella* and *L. monocytogenes.* Results demonstrated that certain proteins were degraded by enzymes derived from meat itself and M that are activated during the processing. All the degradation occurred in MP could improve the flavour, and produce bioactive components that may serve as nutraceuticals. Miso can be an important ingredient for covering pastirma and offers the capacity to improve the functional, nutritional properties and preservation of meat.

I. INTRODUCTION

The Anatolian region has traditional meat products including Kayserian Pastirma which is the most famous and consumed in abundance. Pastirma is a sort of cured meat with an attractive exterior and interior appearances, delicious taste, unique smell and muscle-like shape (1). Pastirma is covered with a paste of grounded spices known as chemen. The mixture of chemen contains 12, 20 % milled fenugreek seeds, crushed garlic, respectively. The potent of garlic and fenugreek in chemen produces strong undesirable odour. Garlic is often called “stinking rose” for its odour as much as for its flavor. After its cells are ruptured, distinctive odours come primarily from sulfur compounds such as allicin that at the end breaks down into diallyl disulfide, which is largely responsible for the garlic’s odor. Fenugreek contains an extremely potent aromatic compound called solotone. It can prompt a sweet maple-odour present in sweat and urine. The odour issue can be tackled by dismissing the unpleasant smell: either through using additional chemicals but it may increase the amount of health risk, or through incorporating other flavouring agents into the paste, but at the expense of increasing the cost. So to minimize the level of odour in pastirma, we have been developing new approaches involving natural wrapping materials. In this article, we present our odour masking strategies for improving the flavour and functional properties of the pastirma.

II. MATERIALS AND METHODS

Meat cuts: Meat (*M. latissimus dorsi)* of bulls obtained from a local butcher, Kayseri, Turkey. The pH of the muscle was around 5.6. Samples were kept in refrigerature temperature for 48 hours prior to experimental processes, and the commercial pastirma was also purchased from a local retailer. *Miso*: Miso was purchased from a supermarket in Tokyo area, Japan. It is generally prepared with *koji* (barley grains fermented for 2-3 months by fungi belonging to the *Aspergillus* genus), steamed beans, water, salt, and some starters (*halotolerant* yeasts and lactic acid bacteria).
Protein extraction: Proteins were extracted from samples by adding 28ml of solution (GS-ATP and WSP) to 2g of the samples. Proteins were

also extracted from the fresh samples by adding 5g meat to 20ml D.H_2O. Concentrations of the proteins were determined using the Biuret method.

Proximate analyses and pH values: Ten grams of samples measured using evaporating dish and dried at 105 °C for 4 hours in drying oven (Nüve FN 120, Ankara, Turkey) to determine dry matter of samples. The following equation used to value the dry matter: DS_2 – D/ DS_1 – D x 100. (Where D: dish weight, DS_1: dish and samples weight before drying, DS_2: dish and samples weight after drying). Total fat was determined by extracting fat using Soxhelet extraction method. The pH was determined using a pH meter (Mettler Toledo) by embedding probe into minced meat and extracts.

Enumeration of Microorganisms: Twenty-five grams of the sample was mixed with 225mL of sterilized maximum recovery diluents solution and then homogenized using stomacher for 3 min, and then 0.1mL of each dilution was pour plated in specific culture media. Total mesophilic aerobic bacteria were enumerated in the plates of Plate Count Agar (2, 5). Enterobacteriaceae counts were determined using (VRBGA), yeasts and moulds were also enumerated in pour plates of (DRBC) after incubation at 25ºC/5 days and (BPA, Fluka) with egg yolk was used for enumeration of *S. aureus*. *Salmonella* and *L. monocytogenes* (2).

Color measurement: Color measurements of meat cuts and water soluble proteins (WSP) samples were carried out with a Chromometer (Konika Minolta Chromameter CR-5, Japan).

Sodium dodecyl sulphate-polyacrylamide gel electrophoresis (SDS–PAGE): SDS–PAGE was used to separate the extracts of proteins according to their size. Electrophoresis was carried out using two different acrylamide gel gradients: 7.5-17.5%. *Fatty acid composition:* The major fatty acids composition was determined with gas chromatography system (Agilent 6890, USA), (3).

Aromatic compound analysis: Aroma analysis performed with slight modifications using GC–MS (Agilent 7890A GC system, Agilent, Avondale, USA) equipped with a mass selective detector and DB-WAX column (60m × 0.250mm) (4).

Texture analysis: The texture analyzer (TA. XT. Plus, Stable Micro-System, Surray, England) was used for measurements of textural properties.

III. RESULTS

Chemen is the wrapping material for pastirma, and it is full of fenugreek and garlic which are delicious ingredients that can greatly enhance a dish, but the smell often comes at the cost of human breath. They have an irritant effect, due to their pungent smell. We tried to get rid of the distinctive smell of pastirma, by incorporating Japanese fruity flavors, the miso taste. The purpose was also to improve the functional and nutritional properties by examining the physicochemical properties of the newly developed product miso-pastirma (MP). Many soy products are being created every year due to research efforts conducted across the world and particularly in Japan.

Proximate: The pH values have not changed much among both pastirma types, slight changes occurred but that was insignificant. The protein content in MP was relatively decreased compared to CP which perhaps refers to the degradation of proteins and peptides into amino acids due to miso action (Table 1). The incorporation of miso as a coating material for pastirma has increased both of the fat content and dry matter in MP. The increase in the total dry matter indicates that there was an improvement in some of functional properties related to lipids and flavour. Results suggest that addition of fermented soy paste may have a positive impact on the dry cured meat products.

Microbial analysis: MP had a higher microbiological count of TMAB. Enterobacteriaceae was under detectable limits in MP and M samples. Yeast was under detectable limits in both MP and M samples. Likewise, mould counts of both samples were under detectable limits. The both samples had insignificant *Enterobacteriaceae* levels. Furthermore, *S. aureus* was detected in the proposed samples, but the contamination level is rather safe. MP and M samples were free of the contamination of the pathogens, *Salmonella* and *L. monocytogenes* (Table 2). The miso covering the pastirma is an important element in terms of both flavour and preservation. Organoleptically, the mixture improves the appearance, colour, texture, taste, and flavour of pastirma, and is also effective against microbial contamination.

Colour analysis: There was a slight difference in *L* values among the tested samples. However, values of *a* and *b* among the three samples did not show any significant difference (Fig. 1). This indicates that miso treatment restored dry meat colour.

SDS-PAGE: Most major small and big water soluble proteins did not retain their native structure as some changes occurred: for instance the WSP, bovine serum albumin 66kDa band disappeared or split to two sub-units in the CP samples (Fig.2). Glutamic dehydrogenase with a molecular weight 55kDa was apparently degraded in MP. Additionally, proteins such as Glyceraldehyde-3-phosphate dehydrogenase 37kDa, Trypsin inhibitor 20kDa and α-lactalbumin 14kDa were degraded in MP samples. All the degradation occurred in MP is a positive rather than negative, as major protein may split into small peptides that could improve the flavour or serve as bioactive components. These results thus demonstrate that certain proteins were degraded by enzymes derived from Miso that are activated during or after the processing. Thus the traditional pastirma-making process results in the degradation of many proteins into peptides, which might then be obtainable to treat some diet-related diseases (1). However, Aprotinin 6.5 kDa existed in all samples CP, MP and M that explains aprotinin is a stable peptide against heat and enzymatic treatment. The trend is going towards foods which not only taste and smells good, but are also beneficial to our health by preventing certain illnesses.

Aromatic analysis: The results indicate that pastirma flavour is formed during protein degradation and derived from some aromatic amino acids because of drying and miso treatment. However, it is likely that additional compounds may also contribute to the overall flavour quality of the MP. In the commercially acquired pastirma, we detected 17 compounds, while miso-pastirma showed 14 compounds. Only one compound was found common, which indicated that pastirma was highly affected by the wrapping materials. Organoleptically, MP also exhibited a fruity and cheesy flavour that is typically derived from miso.

Fatty acid composition: Miso-pastirma showed higher values of miristic, palmitic, stearic, and total saturated fats. Oleic and linoleic acids were higher in CP than MP. However, the commercial pastirma showed higher values of palmitoleic, linolenic, and arachidic acids (Table 3). Content of stearic acid was high in MP which belongs to saturated fatty acids group that is not preferred by nutritionists as affect on human health. Saturated level is high which is related to stearic acid.

IV. CONCLUSIONS

Questionable opinions are always brought up on a large-scale diffusion of meat products supplying potential bioactive components. Consumers recently do not only care about the cost, access and quality of products, simply they have more attention to nutritional values. Incorporation of miso with meat is not a nonsense mixture or confusion of food making, but a unique extension of traditional Japanese miso paste into European meat products to bring healthier and tastier food to the consumer's table. The miso treatment affects the structure of protein and enzyme mechanisms of dry cured meat, and thus potentially increasing the nutritional and sensory values of pastirma. Miso treatment has improved the functional, eating quality, palatability and nutritional properties of dry cured meats, and found to be a good wrapping material alternative to chemen.

REFERENCES

1. Ahhmed, M. A. (2014). Traditional cured meat-making process degrades the proteins of *M. latissimus dorsi* of bovine. Inter. Food Res. J. 21(1): 139-148.

2. AOAC. (1998). Bacteriological analytical manual, FAD administration, 8th Ed. Gaithersburg, MD, USA.

3. Yüksel, F., Karaman S., Kayacier A. (2014). Enrichment of wheat chips with omega-3 fatty acid by flaxseed addition textural and some physicochemical properties, *Food chem*. 145: 910-917.

4. Törnük, F., Karaman S., Öztürk İ. et al., (2013). Quality characterization of artisanal and retail Turkish blossom honeys: determination of physicochemical, microbiological, bioactive properties and aroma profile, *Indus. crops prod* .46:124-131.

5. AOAC (2000) Official Methods of Analysis, (17th Ed.). Association of Official Analytical Chemists, Inc., Arlington, VA.

Table 1. Protein and fat contents and dry matter of commercial pastirma, miso-pastirma and miso.

Sample	Protein content mg/ml		Fat content g/100g		Dry matter g/100g	
	Means	SEM	Means	SEM	Means	SEM
Commercial Pastirma	4.25	-	11.18	2.07	50.25	0.30
Miso-Pastirma	3.66	-	25.25	1.0	80.18	4.12
Miso	1.52	-	5.83	0.65	45.07	0.20

Table 2. Microbial content of miso-pastirma and miso / 0.1mL(diluted samples).

Sample	TMAB	Yeast and Mold	*S. aureus*	Enterobacteriaceae	*Salmonella*	*L. monocytogenes*
Miso-Pastirma	$7x10^3$	$<10^2$	$<10^2$	$<10^2$	0/25 g	0/25 g
Miso	$2x10^3$	$<10^2$	$<10^2$	$<10^2$	0/25 g	0/25 g

TMAB: Total mesophilic aerobic bacteria

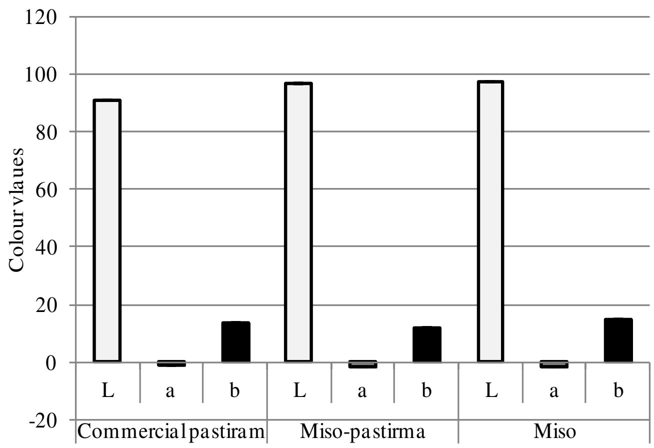

Fig. 1. Colour values of water soluble protein of commercial pastirma, miso-pastirma and miso.

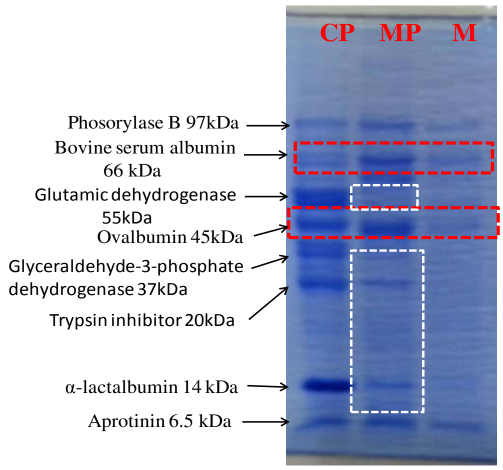

Fig. 2. SDS-PAGE pattern shows the WSP bands in commercial pastirma: CP, miso-pastirma: MP and miso: M. White box shows the absent bands.

Table 3. Fatty acids composition and lipids in commercial pastirma, miso-pastirma and miso.

Fatty acid and lipids	Sample		
	Commercial Pastirma	Miso-pastirma	Miso
Miristic acid (C14:0)	2.95	3.88	-
Palmitic acid (C16:0)	30.63	31.46	12.97
Palmitoleic acid (C16:1)	4.00	3.63	-
Stearic acid (C18:0)	14.32	17.75	4.39
Oleic acid (C18:1)	43.96	41.21	21.96
Linoleic acid (C18:2)	3.71	1.89	52.29
Linolenic acid (C18:3)	-	-	8.39
Arachidic acid (C20:0)	0.42	0.18	-
Total saturated (%)	48.33	53.27	17.36
Total unsaturated (%)	51.67	46.73	82.64