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Improvement of the Technological and Sensory Properties of Meat by Whey Marinating

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Running title: **Quality of Whey Marinated Poultry Fillets**

Abstract
The objective of this work was to study the technological and sensory properties of poultry fillets marinated in whey. Six samples were examined, as following: two control samples (C), stored in refrigerator (0 - 4°C) for 12 and 24 hours; two experimental samples (A) poultry fillets marinated 12 or 24 h in whey with addition of 2% NaCl (0 - 4°C); and two experimental samples (B) poultry fillets marinated 12 or 24 h in and 50% whey water solution with addition of 2% NaCl (0 - 4°C). Comparing to control sample (C), every one of fourth experimental samples (A and B, resp. marinated for 12h or 24h) characterize with higher marinade pick up and weight gain. The lactic acid bacteria count in marinated fillets decreased pH and extended the shelflife of the studied test samples (A and B). While the marinating with 50:50 water and whey, and 2% salt for 24 hours (B) improves tenderness, the scores for aroma and flavour in this samples were found lower ($p<0.05$). The best sensory properties (aroma and flavor) were obtained after mrinating with whey and 2% NaCl for 12 hours (samples B) ($p<0.05$).

Practical applications
The whey individually or as 50 % water solution with addition of 2% of sodium chloride can be used as a marinating agent for processing the poultry fillets with comparatively higher quality. They show good water holding capacity with beneficial effect on sensory characteristics of poultry during 12 or 24 h storage at 0 - 4ºC. In general, results suggest that whey with the combination of NaCl can be successfully applied to produce tender and tasty grilled white meat.

Key words: whey, poultry fillets, marination, technological characteristics, sensory quality

Introduction

Marinating is a simple method used to improve the water holding capacity, tenderness and yield in poultry (Alvarado & McKee, 2007; Latif, 2011; Petracci et al., 2012).

Depending on ingredients, there are two basic types of marinating. The first type is alkaline marinating with salt-phosphate mixtures and the second is acid marinating with organic acids or their salts (Alvarado & McKee, 2007).

Nonmeat proteins are widely used as additives in the meat industry, to improve the sensory characteristics and nutritional value of the meat products (Pietrasik et al., 2007). The use of milk proteins during sausage processing improves the water holding capacity and shows a good emulsifying ability (Marchetti et al., 2014).

As a by-product in the cheese manufacture, whey contains approximately 93% water and 6.85% dry matter, representing with 0.88% protein and 0.55% fat (Edgaryan and Panaiotov, 2011).

Whey is rich in nutrients and contains approximately 50% of the beneficial substances in whole milk, but only about 60% of this product is utilized (Marriott et al., 1998).

There are different possibilities for the application of whey in the meat industry.

The whey addition to the filling mass during the sausages production improves texture and nutritional value of the finished product (Yetim et al., 2005).

There is a lack of information for use of whey for meat marinating in the available literature.

Therefore, the aim of this study is to establish the changes of technological and organoleptic characteristics of poultry fillet after whey marinating.

Materials and Methods

Materials

Meat raw materials

Poltury fillets was purchased from a poultry company "Gradus" Ltd, Stara Zagora. Meat (poltury fillets, 48h p.m, pH 6.28) was transportated and stored to the laboratory at 0-4°C until used.

Additives

Cheese whey was purchased by "Dimitar Madjarov-2" Ltd, Plovdiv. The chemical composition of the whey is presented in the Table. 1. Salt (NaCl) was purchased from the local market.

Experimental design

The fillets were placed in a plastic boxes with marinated solution (1:2) at 0-4 °C. Control samples (C) were stored in air conditions for 24 h (0-4 ° C). After 12h and 24h marinating the samples (sample A - poltury fillets, marinated in whey and 2% salt, sample B - poltury fillets, marinated in solution containing whey and water (50:50) and 2% salt) were removed from boxes and measured. For sensory analysis the samples were placed separately in polymer thermal bags and were roasted in a conventional oven at 180°C until the temperature in the center of the meat reached 80°C. The cooked meat samples were cooled to room temperature and tested immediately (Ergezer and Gokce 2011).

Analysis

pH determination

pH of the sausage samples was determined by pH-meter MS 2004, equipped by pH combination recorder S 450 CD (Sensorex pH Electrode Station, USA) (Young et al. 2004).

Water holding capacity

Water holding capacity (WHC) was determined by measuring the difference in weight of the samples before and after marinating (Aktas et al., 2003). WHC of the test samples was compared with control samples placed in water (CH_2O) and in salt solution containing water and 2% salt (CNaCl).

Sensory analysis

The sensory characteristics of poltury fillets control or marinated were determined by five members panel with proven tasting abilities (Brooks, 2005). The samples were scored using 1 to 5 scales.

Microbiological tests

Bacteriological tests were conducted in compliance with microbiological criteria (NEN-EN-ISO / DIS 4833, 2001) of Annex I. "Microbiological criteria for foodstuffs." The results are measured according to the Regulation (EO) № 1441/2007, the Annex I. "Microbiological criteria for foodstuffs" Chapter II. "Hygienic criteria for treatment."

Statistical analysis

Nine repetitions (n=9) for each sample were carried out. Data were processed by the ANOVA method with a $p < 0.05$. Duncan's multiple comparison test (SPSS) with a significant

difference set at $p \geq 0.05$ was used to compare sample means. Significant differences between means less than 0.05 were considered statistically significant (Draper & Smith 1998).

Results

Sensory analysis

The data obtained from sensory analysis of the raw poltury fillets resulted that marinating in whay and 2% sodium chloride (samples A) or marinating in whey as 50 % water solution with addition of 2% of sodium chloride (samples B) did not have significant ($p > 0.05$) influence on meat surface view (Fig. 1). Samples B, marinated for 24 h had the highest score for consistence of raw marinated meat. Samples B were awarded for best ($p < 0.05$) odour in raw marinated meat for 24h, followed by samples A, marinated for 12h (Fig. 1).

After roasting (Fig. 2), the top rated by the indicator consistency were samples B (marinated in 50% whey and 50 % water) marinated for 12 h and samples A (fillets in whey and 2% salt) marinated for 24h. The tasting committee awarded best scores for taste and smell after roasting (Fig. 2) to samples A, marinated for 12 h, as well as samples B, marinated for 24 h.

The lowest sensory score for odour, flavour and consistence after heat treatment was evaluated in test sample C.

The use of whey for marinating did not affect statistically significant the meat surface view in the raw (Fig. 1), and in the grilled samples (Fig. 2).

Water holding capacity (WHC)

WHC of the test samples (Fig. 3) was compared to second type control samples – soaked in water (C_{H2O}) and soaked salt solution containing water and 2% salt (C_{NaCl}).

After 12 h marinating compared with the control samples (CNaCl), WHC increase the most significantly in poultry fillets marinated in whey (samples A), followed by fillets marinated in whey-water solution (samples B). The same trend was established after 24h maintaing (Fig. 3). At the end of the experiment (24 h), compared to control samples (CNaCl), WHC in samples A and B increased 7.8 and 5.8 times respectively (Fig. 3).

pH

Compared with the control C after 12 h marinating pH in test samples A (poltury fillets marinated in whey and 2% sodium chloride) and B (marinated in whey as 50 % water solution with addition of 2% of sodium chloride) increased by 4, 9% and 4,6% resp. (Table. 2). Different trend

was established after 24h marinating (Table. 2). With extending the marinating time to 24h, pH in test samples A decreased with 4,6% ($p < 0.05$). Similarly, but less decrease in pH with 2.3% was found in samples B after 24 h marinating. A probable reason for pH decrese in samples A and B after 24h marinating was the increase of lactic acid (Table. 2).

Microbiological analysis

The microbiological status of marinated poltury fillets showed dominantion of lactic acid microflora (Table. 2). The results are confirmed by data obtained for pH, according to which with a growing lactic acid bacteria after 48 h marinating, pH in samples A (poltury fillets marinated in whey and 2% sodium chloride) and B (poltury fillet, marinated in whey as 50 % water solution with addition of 2% of sodium chloride) decreased significantly (Table. 2).

Conclusions

The use of whey individually or as 50 % water solution with addition of 2% of sodium chloride for poultry marinating improve the sensory properties (odour, flavor, consistence) of grilled fillet.

The use of whey does not affect on meat surface view before and after roasting. Further more, as organic by-pruduct, whey can be used successfully for enhancing water holding capacity and yield in marinated meat.

In general, results suggest that whey with the combination of NaCl can be applied to produce tender and tasty roast white meat in accordance to client requirements.

References

Aktas N, Aksu M, Kaya M (2003) The Influence of Marination with Different Salt Concentrations on the Tenderness, Water Holding Capacity and Bound Water Content of Beef. *Beef Turk J Vet Anim Sci,* **27**:1207-1211.

Alvarado, C and McKee S (2007) Marination to improve functional properties and safety of poultry meat. *Journal of Applied Poultry Research,* **16**: 113–120. http://japr.fass.org/content/16/1/113.short.

Brooks, J.C., 2005. Tender is the bite – *Meat Marketing and Technology.* **13(**10): 101-104.

Draper NR, Smith H (1998) Applied Regression Analysis, 3-rd edn, New York: Wiley. pp. 124-

148 http://www.amazon.com/Applied Regression-Analysis-Probability-Statistics/ dp/0471170828

Ergezer H, Gokce R, (2011) Comparison of marinating with two different types of marinade on some quality and sensory characteristics of Turkey breast meat. J. *Anim. Vet. Adv.,* **10:** 60-67.

Marchetti L, Andrés SC, Califano AN (2014) Low-fat meat sausages with fish oil: Optimization of milk proteins and carrageenan contents using response surface methodology. *Meat Science,* **96**(3): 1297-1303.

Marriott NG, Wang H, Claus JR, Graham PP (1998) Evaluation of restructured low-fat ham containing whey. *Journal of Muscle Foods*, **9**: 201–207.

NEN-EN-ISO/DIS 4833:2001. Microbiology of food and animal feeding stuffs - Horizontal method for the enumeration of microorganisms - Colony-count technique at 30 °C.

Petracci M, Laghi L, Rocculi P, Rimini S, Panarese V, Cremonini MA, Cavani C (2012) The use of sodium bicarbonate for marination of broiler breast meat. *Poultry Science,* **91**:526-534.

Pietrasik Z, Jarmoluk A, Shand PJ (2007) Effect of non-meat proteins on hydration and textural properties of pork meat gels enhanced with microbial transglutaminase. *LWT-Food Science and Technology*, **40**(5): 915-920.

Yetim H., Müller WD, Dogan M, Klettner P G, (2006). Using fluid whey in comminuted meat products: effects on textural properties of frankfurter-type sausages. *Journal of Muscle Foods***, 17**(3):354-366.

Young, OA, West J, Hart AL and van Otterdijk FFH (2004) A method for early determination of meat ultimate pH. *Meat Sci.,* **66**: 493–498. doi: 10.1016/S0309-1740(03)00140-2; PMID: 22064153.

Table 1. Chemical composition of whey

Parameter	**Value**
pH	5,83 ± 0,01
Water, %	93,10 ± 0,20
Dry matter, %	6,90 ± 0,04
Proteines, %	1,20 ± 0,03
Carbohydrates, %	4,80 ± 0,06
Lipids, %	0,30 ± 0,01
Minerals,%	0,30 ± 0,01

Data were expressed as Mean ± SD (n = 9).

Table 2. Changes in pH after 12h and 24h marinating

Sample	**pH**	
	12 h	**24 h**
C	$6,34^{a,x}$±0,03	$6,42^{a,x}$±0,05
A	$6,65^{b,x}$±0,05	$6,36^{a,y}$±0,05
B	$6,63^{b,x}$±0,08	$6,48^{b,y}$±0,04

Data were expressed as Mean ± SD (n = 9).

$^{a, b}$ - different letters indicated that values of the means in the rows are significantly different ($p < 0.05$).

^{x,y} - different letters indicated that values of the means in the columns are significantly different ($p < 0.05$).

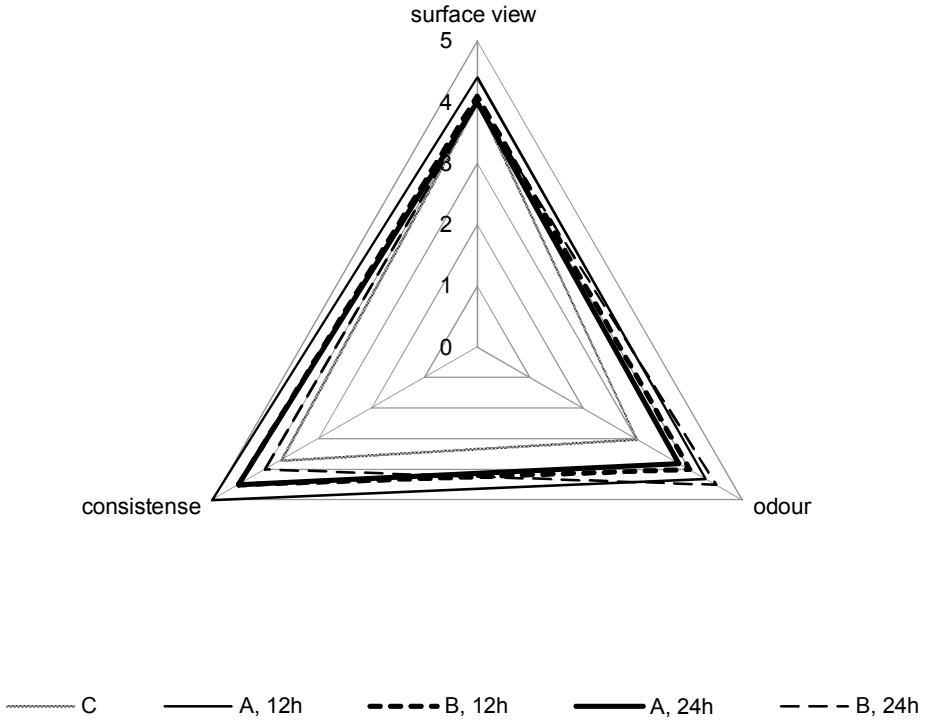

Figure 1. Sensory properties of raw marinated poultry fillets (12h and 24h, 0-4°C)
(C-control samples; A - poltury fillets, marinated in whey and 2% salt; B - poltury fillets, marinated in solution containing whey and water (50:50) and 2% salt)

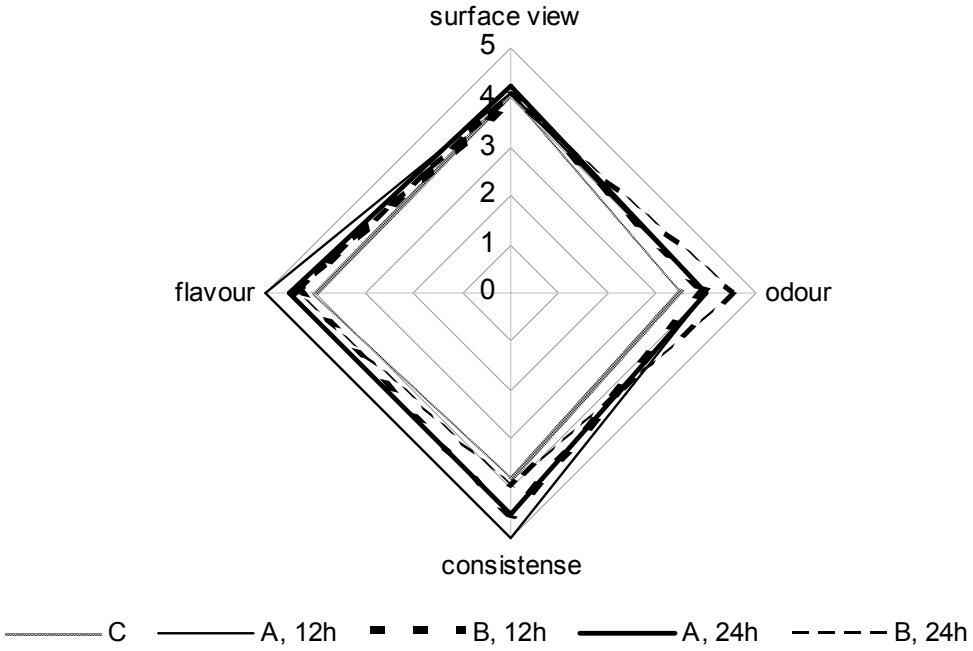

Figure 2. Sensory properties of grilled marinated poultry fillets (12h and 24h)
(C-control samples; A - poltury fillets, marinated in whey and 2% salt; B - poltury fillets, marinated in solution containing whey and water (50:50) and 2% salt)

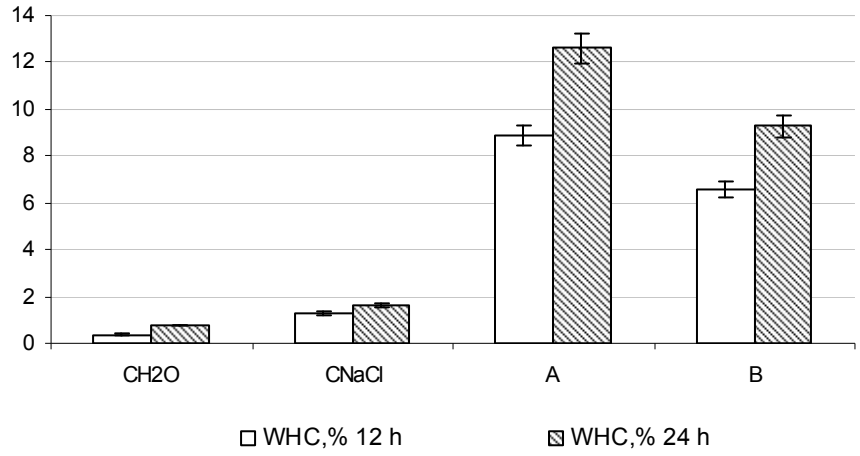

Figure 3. Water holding capacity of marinated poultry fillets (12h and 24h)
(C-control samples; A - poltury fillets, marinated in whey and 2% salt; B - poltury fillets, marinated in solution containing whey and water (50:50) and 2% salt; C_{H2O}– soaked in water; C_{NaCl} - soaked salt solution containing water and 2% salt)