EFFECT OF GROUND PAPRIKA AND ITS OLEORESIN ON MARINATED CHICKEN BREAST MEAT QUALITY

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The still-marinating process is a simplified technology used to tenderize and to improve the flavour, colour and juiciness of meat products. The effects of marinade type, addition of ground paprika (P) or paprika oleoresin (O), on the instrumental and sensory properties of cooked marinated chicken fillets were investigated.

It was observed that marinade uptake was greater ($P > 0.05$) for the fillets marinated with paprika oleoresin. Cooking loss was lowest for experimental group O, and significantly lower ($P<0.05$) comparing to control group. Determined $L^*$ value of cooked fillets was significantly ($P<0.05$) higher for control (C) group than for P and O groups. Also, the obtained shear force value (19.15 N) for C group was significantly higher ($P<0.05$) comparing to the experimental groups P and O. Marinating processes were found to produce final products with increased scores for sensory attributes of taste, juiciness and tenderness comparing to control group. Chicken fillets marinated with addition of paprika oleoresin were evaluated with significantly ($P<0.05$) better mark for taste, and highly significant ($P<0.001$) better marks for sensory attribute of juiciness and tenderness, as well as, for overall sensory quality comparing to control and experimental group P.

KEY WORDS: marinating, chicken fillets, paprika, quality

INTRODUCTION

One of the most widely used techniques for enhancing or complementing meat flavour is via marinating (1). Marinating is being adopted by industry and restaurants to give meats new and exciting flavours (2), and is especially used for poultry products (3). Marketing of marinated poultry parts is one of the fastest growing segments of the food industry around the world (2). Also, the demand for marinated chicken products has been growing continuously in Europe (1). It has been estimated by the Finnish meat processing industry that about 80% of poultry sold at the retail level is marinated (4). For consumers, marinated meat is convenient in meal preparing since only heat treatment is needed.

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without further handling or spicing of the meat. The word “marinate” comes probably from the Latin word “marine” to Italian, Spanish and French languages referring to soaking/pickling in salt brine. What is being meant by marinating today varies a great deal between countries (4). Marinades are typically water–oil emulsions containing salt, sugar and acids (acetic, citric), rheology improving additives (such as xanthan and guar gum), antimicrobial agents (such as sorbate and benzoate) spices and aroma enhancers (4).

In the case of commercial marinades, there has been a recent increase in the range of marinated products which include, ready to use forms (e.g. dry rubs, glazes and single shot marinades) or those requiring simple preparation (e.g. powder and liquid marinade). The emergence of a diverse range of marinades in the market, allows consumers to complement their culinary skills at home, as well as making mealtimes more interesting (1). Consumers generally incorporate marinades into meat via immersion. This consists of immersing the meat in a liquid marinade and allowing penetration of the marinade through diffusion over time (1).

When buying marinated meat, consumers select individual food product primarily based on the appearance, colour, shape, size and surface defects (5). Of these characteristics, colour may be the most influential, because off-colour food is likely to be rejected even when it has good flavour or texture. Therefore, the development of foods with an attractive colour is an important goal in the food industry (5).

Because of specific red colour and flavour worldwide interest in capsicum spices is increasing. These are either pungent or non-pungent spices, such as pimiento, paprika, and chilli that are produced from dried fruit and are ground into powders (6). Ground paprika is a spice prone to microbial spoilage. According to microbiological results of Tepić et al. (7) total colony counts in ground paprika were under maximal limit set by national regulation, but moulds number was above set limit, so as the number of sulphite-reducing Clostridium, which could represent a health risk. However, paprika extracts showed no microbial contamination (7). Capsicum oleoresins from paprika contain a complex mixture of essential oils, waxes, coloured materials, and several capsaicinoids, and can completely replace ground paprika in food products, in order to improve sensory properties (7).

The development of new products, including fresh meat products, should be integrated with consumer demands. Knowledge about the consumers’ preferences, acceptance and choice behaviour is therefore crucial to the industry in its aim to produce meat of high culinary quality (8).

Having all mentioned in mind the objective of the present research was to investigate the potential replacement of ground paprika with paprika oleoresin, for still-marinating process of chicken breast meat, comparing: marinade uptake, cooking loss, as well as, shear force, colour parameters and sensory attributes of cooked chicken breast meat.
EXPERIMENTAL

Raw materials

The chicken fillets used in the present study were obtained from Ross 308 hybrids raised under production conditions. During fattening chickens were fed with standard mixture, feed and water supply was ad libitum applying floor stocking system.

Marinating process

Weighed and individually identified fillets were still-marinated at 2°C in vessels containing marinades composed of: oil (500 ml), salt (2% of meat weight) and red ground paprika (3.5% of oil weight) - experimental group P; and oil (500 ml), salt (2% of meat weight) and paprika oleoresin (1% of oil weight) - experimental group O. The proportion between the chicken fillets and the marinade was fixed at 2:1. The marinating times, for both groups, was 20 h. Chicken fillets from control group were cooked without prior marinating.

Marinade uptake

The samples weight was recorded before and after marinating. After the determined marinating time, the parts were removed from the marinade and drained for 10 min before determining the marinade retention. Calculation for marinade uptake was as follows:

\[
\% \text{ marinade uptake} = \left( \frac{\text{marinated weight} - \text{raw weight}}{\text{raw weight}} \right) \times 100
\]

Cooking procedure

Before cooking, the samples were individually weighed, enwrapped in aluminum foil and introduced in the convection air oven when temperature reached the preset value. The cooking temperature was set at 175°C for 45 min. After cooking, samples were cooled at room temperature for 1 h and then analysed for cooking loss, colour, texture and sensory characteristics.

The calculation of cooking loss was as follows:

\[
\% \text{ cooking loss} = \left( \frac{\text{marinated weight} - \text{cooked weight}}{\text{marinated weight}} \right) \times 100
\]

Colour determination

The colour was determined instrumentally, on the fresh cut of cooked and cooled fillet, on the device Minolta Chroma Meter CR-400. Colour characteristics were expressed by CIE L*a*b* system (lightness-L*, redness and greenness - a*; yellowness and blueness - b*).
**Mechanical texture analysis**

Shear force evaluation was conducted on cylinder samples taken from the centre of each fillet, longitudinal to the muscle fibres. The cylinders were 1.27 cm in diameter. A Warner-Bratzler blade, using testing machine Texture Analyser TA XP (Stable Micro System, Godalming, England), was used to shear the samples across to the muscle fibres. Six measurements were performed on each sample to obtain mean values. A cross speed of 5mm/s was applied using the 5 kg load cell. Mean values were expressed as shear force (N).

**Sensory analysis**

Six trained panelists, experienced in the sensory evaluation of various meat products were employed. The panelists recorded descriptive sensory evaluations. The structured linear scales were coded on a seven-point basis (Table 1). Attributes included odour, taste, tenderness and juiciness. The overall sensory quality was evaluated as total sum of mean scores for the sensory attributes.

![Table 1. Sensory analysis of cooked chicken fillets](image-url)

All data are presented as mean values. Analysis of variance (Duncan test and t - test) was used to test the hypothesis about differences among obtained results. The software package STATISTICA 8.0 (9) was used for the analysis.

**RESULTS AND DISCUSSION**

The effects of marinade type (ground paprika or paprika oleoresin) on the marinade uptake and cooking loss of experimental groups are shown in Figure 1. Higher marinade uptake was observed for experimental group O (2.02%) comparing to experimental group P (1.65%), but with no significant difference ($P > 0.05$). The amount of marinade remaining on the surface depends on the selected poultry part, and it should increase as the marinating time increase (10). On the other hand, Yusop et al. (1)
reported that marinate uptake was not significantly affected by marinating time, but was 
affected by marinate pH, being higher (3.34%) for pH 4.0, than for lower marinate pH. 
Lemos et al. (10) reported that salt concentration ranging from 3 to 4%, presented the 
best yields with no negative effects on sensory quality (10). Polyphosphates are sugges-
ted for the achievement of a higher marinate retention (10). Also, these authors (10) 
showed that tumbling resulted in a higher marinate absorption as compared to the still-
marinating.

Cooking loss is of great interest because it is expected to explain the part of the varia-
tion in meat juiciness, and also because it influences the appearance of the meat. A high 
cooking loss gives an expectation of a less optimal eating quality. Also, it is of great eco-
nomic importance to the industry (8). As it can be seen (Figure 1) marinating increased 
water binding capacity of meats, thus reduced cooking losses. The highest cooking loss 
(22.46 %) was obtained for the control group of fillets, and it was significantly (P< 0.05) 
higher than for the experimental group O. Marinade type, usage of ground paprika or 
paprika oleoresin, did not significantly affect cooking loss. Even though the cooking loss 
was lower for the experimental group O, comparing to group P, the difference was not 
significant (P > 0.05). Salt is considered to be the most important ingredient in a marina-
de. It improves the flavour and tenderness of the meat, and also improves the binding 
properties of poultry meat by increasing the solubility of the myofibrillar proteins (10). 
Also, cooking loss depends on the raw meat quality, centre temperature and cooking pro-
cedure (8).

Figure 1. Marinade uptake and cooking loss of experimental groups

Table 1. The instrumentally determined colour and texture properties of marinated 
cooked chicken breast fillet as affected by marinade type

<table>
<thead>
<tr>
<th>Group</th>
<th>Colour attributes</th>
<th>Texture Shear force (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$L^<em>$, $a^</em>$, $b^*$</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>84.86$^a$, 2.78$^c$, 11.99$^b$</td>
<td>19.15$^a$</td>
</tr>
<tr>
<td>P</td>
<td>81.96$^b$, 5.28$^a$, 13.49$^b$</td>
<td>16.63$^b$</td>
</tr>
<tr>
<td>O</td>
<td>83.12$^b$, 3.65$^b$, 15.84$^a$</td>
<td>16.15$^b$</td>
</tr>
</tbody>
</table>

$^{a,b,c}$ means within a column with different superscripts differ (P < 0.05)
Instrumentally determined colour and texture characteristics of cooked fillets are shown in Table 1. Marinating processes, both with ground paprika and paprika oleoresin produced a lower $L^*$ (lightness) value, i.e. darker products. The difference between $L^*$ value for control (C) and marinated groups (P and O) of fillets were significant ($P < 0.05$). Cooked fillets marinated with ground paprika were darker than the ones marinated with paprika oleoresin, but the difference was not significant ($P > 0.05$). On the other hand, marinade type had significant effect on $a^*$ (redness) values, and it was the highest ($P < 0.05$) for the experimental group P, which at the end was the darker and redder product, of all. Yusop et al. (1) found that prolonged marinating times, using Chinese-style marinades, had significant effects in producing a product with lower $L^*$ (lightness) and higher $a^*$ (redness) value. Lower marinade pH was found to produce significantly ($P < 0.05$) lighter fillets (1).

The results of Warner-Bratzler test show that the fillets of control group were the least tender. The obtained value of shear force (19.15 N) for C group was significantly higher ($P < 0.05$) comparing to experimental groups P and O. These results could be correlated with the results of cooking loss, thus control group had the higher cooking loss. Barbanti and Pasquini (3) outlined statistically significant correlations between the shear force and cooking loss values. Water evaporation and melted fats escaping from meat sample reduced the meat tenderness, hence possibly reducing the consumers' acceptability (3). Marinade type did not have significant effect on cooked fillets firmness. The mean shear force value was lower for the experimental group O, than for group P, but the difference was not significant ($P > 0.05$). The data evaluated by Lemos et al. (10) indicate that the still-marinating process aids in tenderising fillets. These authors (10) reported that shear force values of the treated samples were smaller than those of the control (fillets not still-marinated). Also, Barbanti and Pasquini (3) concluded that the marinating process enhances the texture of fillets, and marinated samples showed a lower shear force value (i.e. better tenderness) than control samples, irrespective of the cooking technique.

### Table 2. Sensory quality of marinated cooked chicken breast fillet as affected by marinade type

<table>
<thead>
<tr>
<th>Group</th>
<th>Sensory property</th>
<th>Overall sensory quality</th>
<th>% of max. overall quality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odour</td>
<td>Taste</td>
<td>Juiciness</td>
</tr>
<tr>
<td>C</td>
<td>6.00</td>
<td>5.50</td>
<td>4.45</td>
</tr>
<tr>
<td>P</td>
<td>6.00</td>
<td>5.50</td>
<td>5.00</td>
</tr>
<tr>
<td>O</td>
<td>6.00</td>
<td>6.00</td>
<td>6.67</td>
</tr>
</tbody>
</table>

a,b,c means within a column with different superscripts differ ($P < 0.05$); A,B,C means within a column with different superscripts differ ($P < 0.001$)

Sensory investigations of cooked fillets (Table 4) showed no differences ($P > 0.05$) in odor estimations for all three experimental groups, which was in average evaluated as „very good“. In general, other evaluated sensory properties of cooked fillets were found to be more affected by the marinade process, as well as marinade type, usage of ground paprika or paprika oleoresin, than instrumentally determined properties. Taste of cooked fillets from the experimental group O was marked significantly higher ($P < 0.05$) comparing to the control and experimental group P. Also, samples from the experimental
group O were highly significant \((P < 0.001)\) better evaluated, than samples from C and P groups, for sensory properties of juiciness and tenderness, reaching mark “extremely good”. Higher marks for juiciness and tenderness of experimental group O, than for group P, can be explained by higher marinade uptake, and lower cooking loss for group O. The higher sensory mark for tenderness for group O is, also, in correlation with lower shear force value for this sample, than for samples in group P. Experimental group O had the highest (91.07\% of maximum quality) \((P < 0.001)\) and control group had the lowest mark for the overall sensory acceptability (74.82\% of maximum quality).

**CONCLUSION**

It was observed that the marinade uptake was greater \((P > 0.05)\), and cooking loss lower \((P > 0.05)\) for the fillets marinated with paprika oleoresin. Marinating processes had a positive effect on cooked meat texture, both experimental groups had lower \((P < 0.05)\) shear force, than the control group, but the differences in shear force values between experimental groups P and O were not significant \((P > 0.05)\). Marinating chicken fillets with addition of paprika oleoresin was found to produce more acceptable end product with significantly \((P < 0.05)\) better mark for test, and highly significant \((P < 0.001)\) better marks for sensory attribute of juiciness and tenderness, and overall sensory quality comparing to control and experimental group P. According to the results obtained in this research, ground paprika could be replaced with paprika oleoresin for still-marinating of chicken breast meat.

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Маринирање је једноставан поступак који се често користи да се побољша мекоћа, сочност, арома и боја производа од меса. У овом раду је испитан утицај млевене зачинске паприке (П) и олеоризина паприке (О) на инструментално одређена својства (боја приказана у CIEL*a*b*систему и текстура приказана као сила пресецања) и сензорна својства квалитета печених маринираних пилећих филеа.

Утврђено је да су узорци филеа маринирани са додатком олеоризина паприке усвојили већу (P > 0,05) количину маринаде. Губитак масе печењем био је најмањи за филе узорка контролне групе, а то статистички мањи (P < 0,05) у односу на контролну групу. Измерена L* вредност, на пресеку печених филеа, била је значајно већа (P < 0,05) у проценету са обе мариниране контролне групе узорака. Такође, измерена сила пресецања (19,15 N) за узорке филеа контролне групе била је значајно већа (P < 0,05) у поређењу са узорцима експерименталних група П и О. Печени маринирани пилећи филе сензорно су оцењени вишим оценима за својства сочност и мекоћа у поређењу са узорцима контролне групе. Пилећи филе маринирани уз додатак олеорезина паприке оцењени су значајно (P < 0,05) бољом просечном оценом за својство укус и високо значајно (P < 0,001) боље за сензорна својства сочност и мекоћа, као и за укупну оцену сензорног квалитета у односу на контролну и експерименталну групу П.

Кључне речи: маринирање, пилећи филе, паприка, квалитет

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