EFFECT OF WHOLE MILK AND PAPRIKA OLEORESIN ON THE MARINATION PERFORMANCE AND SENSORY ACCEPTABILITY OF POULTRY MEAT

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Abstract— **The effects of whole milk addition (0, 25, 50, 75 and 100%) and paprika oleoresin (1, 3%) on the physical and sensory properties of cooked marinated chicken were investigated. Marinade absorption, cooking loss, surface colour (*L**, *a**, *b** values), maximum force, moisture and fat content were measured. Sensory properties including surface colour (orange, red), colour penetration, aroma, toughness, juiciness, flavour acceptability, paprika flavour, saltiness, hotness and overall acceptability were also evaluated using 25 naïve assessors. The effect of paprika level was found to separate products on the basis of the physical and sensory qualities. A 3% paprika level produced greater surface CIE *a** (redness) and *b** (yellowness) as well as sensory surface orange, red and colour penetration attributes. The effect of milk addition on cooked colour properties, while significantly ($P < 0.05$) increased CIE value, was not as influential as paprika level, as the naïve assessors did not perceive ($P > 0.05$) any differences between treatments. The use of 100% milk-based marinades was shown to increase ($P > 0.05$) marinade absorption and reduced cooking loss. As the raw-marinated meat pH were relatively unchanged after treatments, the effect of milk incorporation into marinades on the instrumental and sensory properties of cooked marinated chicken may be contributed by the constituents of milk itself, including fat, protein and lactose. Regardless treatments, the effect of milk addition and paprika oleoresin in marinades on the overall acceptability of cooked marinated chicken were found to be positively similar by the naïve panelists.**

Keywords: Milk, Paprika oleoresin, Marinating, Sensory Evaluation, Naive Assessors

I. INTRODUCTION

Poultry meat has become a mass consumer product throughout the world (Magdelaine *et al.* 2008), with the demand for marinated chicken in Europe, continuously growing (Yusop *et al*., 2009a b). Marination, in definition, is a process of incorporating marinades to meat to improve flavour, texture and juiciness. A marinade may contain any materials added to enhance the eating quality and appearance of the finished product. In industrial level, the most commonly used poultry marinades include salt and sodium tripolyphosphate, which have been established to increase meat yield and water-holding capacity, as well as improve colour and texture (Alvarado & McKee, 2007). However, currently, polyphosphate addition is perceived as a negative and unpopular among consumers because of the clean labelling issue. A recent trend in the food industry is the omission on food labels of chemically descriptive words such as in the list of declared ingredients and non-meat binders. Thus, there is a vital need for alternative meat marinades which do not rely on polyphosphates and which are capable of enhancing yield, texture and overall appearance of meat products.

The incorporation of whole milk and colouring agents such as paprika into marinades is one way of increasing the development of value-added meat products and meeting the consumer demand for variety, new flavours, spiciness, and good presentation. According to many culinary experts, milk serves as a good marinade's base for its effectivity in tenderizing meat (Kerrigan, 1999). However, the scientific literature on the use of whole milk as functional ingredients in marination is scarcely available. The phenomenon of milk marination is still poorly understood despite its extensive use in home-cooking and food service. The addition of such product in meat also needs to be clearly identified on the food labels for milk allergen labelling. The understanding of the effectivity of milk as the marinade delivery system for colour ingredient

like paprika oleoresin is still new and unexplored. More interestingly, the paprika oleoresin used in the present study was a concentrated water- and fat soluble solubilisate with a uniformed nano-meter sized micelles structure.

Thus, the aim of this study was to determine the effects of addition of milk and paprika oleoresin in marinade on the instrumental and sensory acceptability of cooked marinated chicken.

II. MATERIALS AND METHODS

A. Raw material

Fresh skinless chicken breast fillets were obtained locally from Shannonvale Foods, (Clonakilty, Co. Cork, Ireland). Fillets were received free from visible blood splash or bruising and ranged in weight from 130 to 200 g and in pH from 6.0 to 6.2. Any remaining surface fat was physically removed after visual inspection. Meat samples were vacuum-packaged, cold-stored and used immediately or shortly after purchase.

Prepared test marinades were prepared for tumbling (10% meat weight basis, MWB) into the breasts. All solutions consisted of water, fresh whole milk, salt and paprika oleoresin. Paprika oleoresin (Aqua nova AG, Darmstadt, Germany) was added at 1 or 3% meanwhile milk was substituted for water in the marinades at 25, 50, 75 and 100%. All marinades were prepared on the same day of trials and held at 4°C until required.

B. Marinating and cooking

Preliminary trials were conducted to establish the appropriate marinade formulation, marination method and cooking conditions to be used in this study. Marinating was carried out by atmospherically tumbling the fillets using a commercial tumbler (Inject Star, USA) with test marinades for 20 min at 10 rpm. The samples were subsequently cooked in a Zanussi convection oven (C. Batassi, Conegliano, Italy) following an industrial cooking program, comprising a combination of dry heating and steam cooking for approximately 15 min. The internal temperature, as measured by a temperature probe (Testo 110, Lenzkirch, Germany) was also carried out to ensure the samples were completely cooked to an internal temperature of 74°C.

C. Quality measurements

Marinade pH, meat pH (before and after marination), marinade absorption, cooking loss, surface colour (*L**, *a**, *b** values), maximum force, moisture and fat content were measured. Sensory properties including surface colour (orange, red), colour penetration, aroma, toughness, juiciness, flavour acceptability, paprika flavour, saltiness, hotness and overall acceptability were also evaluated using 25 naïve assessors.

D. Statistical analysis

The spatial relationships between sensory attributes and physicochemical properties of the marinated products were summarized using ANOVA Partial Least Squares Regression (APLSR) employing the Unscrambler software, version 9.7 (CAMO ASA, Trondheim, Norway).

III. RESULTS AND DISCUSSION

The association of groups of sensory attributes and the physical properties with the main design indicators, particularly paprika level was clearly observed. The effect of paprika level was found to divide the plot into two clusters; the 1% on the left quadrant and the 3% on the right of the plot (Fig. 2). The colour *a** (redness) was found to located very closely to 3% paprika level, illustrating their high correlation to each other. Also, these indicators were found to be highly correlated with colour *b** (yellowness) values, as well as colour penetration, red and orange sensory surface colour. Meanwhile, the 1% paprika level was found to be highly correlated with colour *L** (lightness), cooking loss and fat content. Interestingly, neither one of the paprika levels was located adjacent to hotness nor flavour and overall acceptability; indicating that no correlation exists between the indicators with the afore-mentioned sensory attributes. Therefore,

paprika level greatly influenced the surface colour CIE value ($P < 0.05$) and colour penetration attributes, but the changes did not affect the flavour or overall acceptability of the products. The result is in agreement with the previous works (Yusop *et al*., 2009a, b; Yusop *et al*., 2010a, b), in which flavour-related attributes has been consistently revealed as the most important drive in determining the overall acceptability of the product than colour-related attributes.

There was a good correlation between the 100% milk-based marinades with marinade absorption property (Fig. 1). Additionally, these samples had a relatively lower cooking loss (19.04%), indicating that the addition of milk in marinades had a positive effect in increasing marinade uptake and lowering cooking loss. As the addition of milk in marinades has little to no effect on the pH of the raw-marinated chicken (result not shown), this marination phenomenon by milk was clearly not pH-dependant. The changes on the marinade absorption and cooking loss by the 100% milk-based marinades could be due to the ingredients in milk itself, particularly that of fat and protein; that contribute to the unique ability of milk in retaining marinade uptake and loss of moisture from meat during cooking and storage.

The milk-based marinades, particularly that of 75% and 100% milk addition was also found to obtain lower colour penetration, but greater instrumental surface redness and yellowness as well as reduced lightness value. This may be due to the resultant properties of Maillard reactions during the cooking of milk-based marinated chicken. The addition of whole milk would also, in some extent, promote toughening effect on samples. Although there may be a slight increase in the meat toughness, the changes were found to be unapparent and somewhat undetectable as perceived by sensory evaluation.

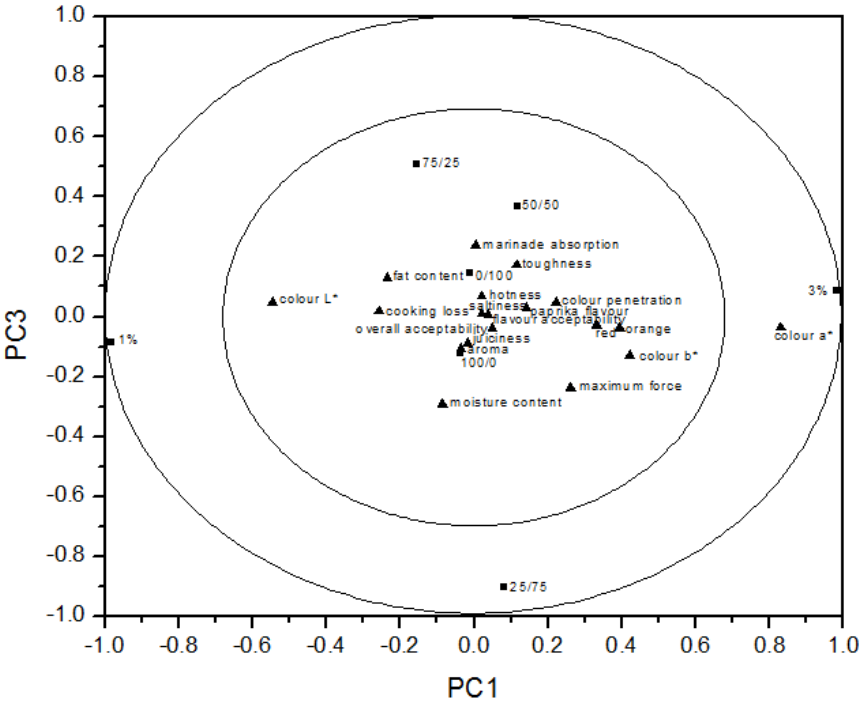

Fig.1. Overview of the variation found in the data from the ANOVA-Partial Least Squares Regression (APLSR) correlation loadings plot for the individual effect of milk addition (100/0, 75/25, 50/50, 25/75 and 0/100) and paprika level (1 and 3%). Shown are the loadings for the X- and Y-variables for PC1 (Principal Component 1) versus PC2 (Principal Component 2). ▲ = Instrumental and sensory descriptor, ■ = Milk addition/paprika level.

IV. CONCLUSION

Overall, the study demonstrates the potential of milk and paprika oleoresin as another functional ingredient for marination of meat products. The utilization of 100% milk-based marinades was shown to increase marinade absorption and reduced cooking loss meanwhile the paprika oleoresin produced a good quality surface colour and colour penetration without the need of a prolong marination holding time. Nevertheless, a greater colour penetration and intense surface cooked colour by the 3% paprika level did not have any effect on the flavour or overall acceptability of the product. Therefore, it was established that among all quality attributes measured, flavour quality consistently played a bigger role in determining the sensory acceptability of cooked marinated chicken than the colour quality attributes.

Due to the fact that the milk addition in marinades did not significantly ($P > 0.05$) increase the fat content of the final cooked products, the utilization of whole milk as functional meat ingredients for marination should be further explored for its high availability, cheap cost and most importantly for the ability to enhance colour characteristics and product's yield. This study also concluded that the nano-sized paprika oleoresin in use has been successfully delivered into the meat by the marinade delivery system to develop the desired red-orangish colour quality of cooked marinated chicken products.

ACKNOWLEDGEMENT

This work was part of the project titled "Development Use and Functions of Marinade in Meat Systems". It is partly funded by The Ministry of Higher Education (MOHE) of Malaysia and lead by Dr. Joe Kerry. The authors also thank Mr Matthias Preuss for his great assistance in this work.

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