

# EFFECT OF PROCESSING METHOD AND HOLDING TIME ON THE PHYSICAL AND SENSORY QUALITY OF COOKED MARINATED CHICKEN

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**Abstract**—The effects of different processing methods and marinating holding times on the physical and sensory properties of cooked Chinese-style marinated chicken were investigated. Factors including marinade treatment (CM = coarse + mixing; CMH = coarse + mixing + homogenizing; FM = fine + mixing; FMH = fine + mixing + homogenizing) marinating method (immersion only, injection and immersion, tumbling) and holding time (0, 18 hours) were applied to samples before cooking under simulated commercial conditions. Marinade absorption, cooking loss, maximum force and surface colour ( $L^*$ ,  $a^*$ ,  $b^*$  values) were measured. Sensory properties including colour, colour penetration, aroma, toughness, flavour acceptability, saltiness, sourness, sweetness, juiciness and overall acceptability were also evaluated using 20 naïve assessors. Homogenized marinades, CMH and FMH increased surface CIE  $a^*$  (redness) and  $b^*$  (yellowness) values. Conversely, CM had the lowest colour penetration. Employing a tumbling method and an 18 hours holding period was found to be positively correlated with most sensory attributes measured; surface colour, colour penetration, aroma, saltiness and sweetness. The individual effect of tumbling produced a significantly ( $P < 0.05$ ) higher overall acceptability, whereas samples held for 18 hours were least preferred by the assessors due to lower flavour and overall acceptability scores.

*Index Terms*—Homogenization, Marinating, Tumbling, Injection, Immersion, Holding Time

## I. INTRODUCTION

Marination of chicken breast meat has become an integral part of the poultry industry due to the increase in consumer, retailer, and restaurant demand for further-processed, ready-to-eat, convenience foods (Alvarado & McKee 2007). In Europe, the demand for marinated chicken has been continuously growing (Yusop et al., 2009a b). Although has been employed in the industry for several decades (Xiong 2005), aspects like marinade ingredients, techniques, process conditions and equipment continue to be refined and updated to improve the quality characteristics of the final products as well as consumer satisfaction. Little information is available on the effect of marination treatment and holding time as most prior research was more focused on the incorporation of various marinade ingredients such as phosphate in enhancing marination performance. The understanding of treatments, method and holding time of marination technology is very crucial as it may improve yield and sensory quality of marinated products and also benefit the manufacturer with reduced operational costs, greater profits and increased customer satisfaction.

Thus, the aim of this study was to determine the effects of marinade treatment, marination method and marination holding time 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.

Test marinades were prepared following two steps including milling the commercial Chinese marinade mix to a finer mix (Buchi Mixer, Switzerland), and then mixing and homogenizing at a high shear rate with the other marinade ingredients comprising water, oil, salt, starch, lecithin and colorant by using a Limitech mixer (Limitech, Fristrup, Denmark).

#### B. Marinating and cooking

Marinating was carried out following three different marination methods; Immersion - by individually immersing fillets into test marinades in a plastic container, Injection and Immersion - by injecting the fillets with 1% salt solution by using a multi-needle injector (Inject Star, USA) and then subsequently immersing the injected fillets with 10% of the test marinades in a plastic container, and Tumbling – by atmospheric-tumbling the fillets using a commercial tumbler (Inject Star, USA) with test marinades for 20 min at 10 rpm. Holding time (0 or 18 hours) at 4°C was applied to all marinated samples. The samples were subsequently cooked in a Zanussi convection oven (C. Batassi, Conegliano, Italy) following an industrial cooking program for approximately 15 min.

#### C. Quality measurements

Marinade absorption, cooking loss, maximum force and surface colour ( $L^*$ ,  $a^*$ ,  $b^*$  values) were measured. Sensory properties including colour, colour penetration, aroma, toughness, flavour acceptability, saltiness, sourness, sweetness, juiciness and overall acceptability were also evaluated using 20 naïve assessors.

#### D. Statistical analysis

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

### III. RESULTS AND DISCUSSION

The tumbling method and 0 hour holding time were found to significantly ( $P < 0.05$ ) produce more acceptable end products with increased scores for colour, aroma and flavour attributes. An interesting trend was found for the effect of marinating method on marinade absorption and cooking loss, following the order of; Immersion < Tumbling < Injection and Immersion (Table 2). Although the injection and immersion combination method produced the highest marinade absorption (8.02%), it also had the highest cooking loss (30.77%) and was the least preferred by the assessors. There was no clear effect of homogenization on the marinade absorption or overall acceptability of the cooked marinated chicken.

The tumbling method was found not only to produce a better surface colour and colour penetration, but also obtained a greater score for flavour and overall acceptability ( $P < 0.05$ ). 18 hours of holding time was found to be highly correlated with most of the sensory quality attributes including colour penetration, aroma, sourness and sweetness; however the 0 hour holding scored better in flavour and overall acceptability of the cooked marinated products.

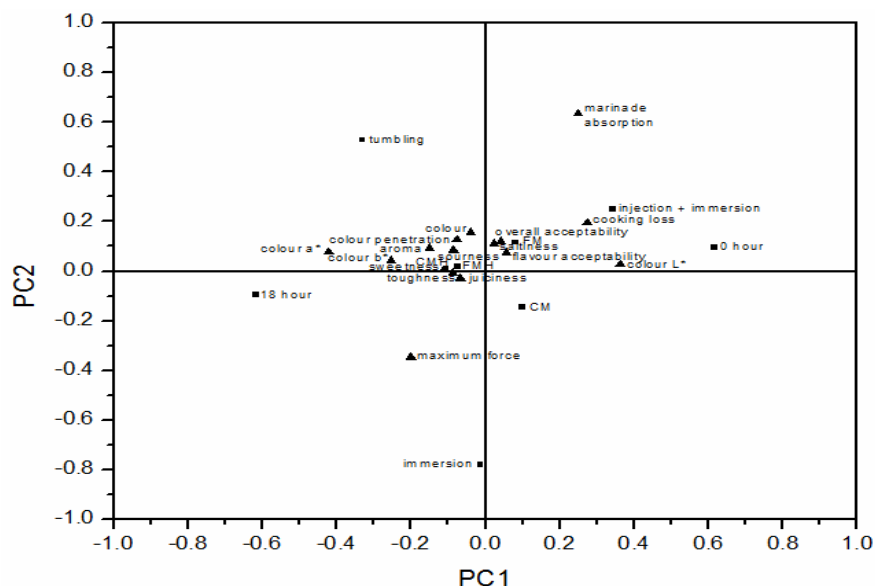


Fig.1. Overview of the variation found in the data from the ANOVA-Partial Least Squares Regression (APLSR) correlation loadings plot for the effect marinade processing (CM, CMH, FM, FMH), marination method (immersion only, injection and immersion and tumbling only) and holding time (0 and 18 hour). ▲ = Physical and sensory descriptor, ■ = Marinade processing/marination method/holding time.

#### IV. CONCLUSION

The tumbling method and 0 hour holding time were found to produce the more acceptable end products with increased scores for colour, aroma and flavour attributes and overall acceptability. There was no clear effect of homogenizing the marinades on the marinade absorption or overall acceptability of cooked marinated chicken. Longer holding times for marination do not necessarily produce a better product with greater overall acceptability.

The manipulation of marinade and optimization of marinating processes can benefit the processor in improving product quality as well as reducing the process time of marinating. The effect of marinade treatment particularly marinade homogenization also needs to be further explored as it has the potential of enhancing marinade flavour delivery to meat.

#### 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.

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