OPTIMIZATION OF THE STILL-MARINATING PROCESS OF CHICKEN PARTS

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1. BACKGROUND

Marinating, a traditional culinary technique used to tenderise and to improve the flavour and succulence of meat, is used to satisfy the consumer demand. However, in recent years, there has been a growing interest in marinated meat products within the food industry.
Salt is known for being the most important ingredient in a marinade as it improves the flavour and tenderness of meat. Sodium chloride has been observed to improve the binding properties of poultry meat by increasing the solubility of the myofibrillar proteins (Babdji et al., 1982).
Polyphosphates have a marked effect on the characteristics of poultry products. They help to stabilise colour and flavour (Farr and May, 1970), they improve the tenderness of the product (Farr and May, 1970) and they also improve cook yield (Brotsky, 1976).
Products are usually treated with polyphosphates in combination with NaCl because the polyphosphates effect is enhanced in the presence of NaCl (Farr and May, 1970).
Marinade pick-up varies according to the poultry part selected. Chen (1982) reported that chicken breasts pick-up marinade the most, followed by thighs, wings and drumsticks.
The still marinating process requires more space and time than the traditional processes of marination. However, the investment cost is much lower, as injection and tumbling need more sophisticated equipment.

2. OBJECTIVES

The objective of the present research was to obtain still-marinated chicken parts of good quality. To attain this aim, the effects of the main factors concerning the referred process were optimised making use of the surface response methodology.

3. METHODS

The chicken parts used in the present study were refrigerated skinless deboned breast meat (SDBM) and legs obtained from a local processor.
The effects optimised were: salt content in the marinade (ranging from 4 to 6%), polyphosphates content in the marinade (ranging from 1 to 3%) and marinating time (ranging from 8 to 16 hours for legs and from 4 to 12 hours for SDBM). The proportion between the chicken part and the marinade was fixed in 1:2 and the temperature in 2°C. The levels of the factors studied were chosen based on a previous research from Lemos et al. (1997).
Weighed and individually identified chicken parts were still marinated at the specified conditions above. After the predesignated marinating time, parts were removed from the marinade and drained for 30 minutes at 10°C before having their marinade pick-up determined. Immediately after the determination of the marinade pick-up, marinated chicken parts were placed inside polyethylene bags to have their loss of weight during storage estimated 4 days later. Subsequently, the parts were baked in an industrial air oven at 180°C to an internal temperature of 84°C in order to have their cooking loss determined. Twenty-four hours later, refrigerated cooked SDB pieces had their shear force evaluated on a longitudinal strip, cut parallel to the fibers from the centre of each muscle. The strip was 12 x 20 mm in cross section. About 6 strips for each experimental unity were sheared with a Warner Bratzler shear press.
The process was optimised to higher weight gain, lower loss of weight during storage and lower cooking loss based on a surface response methodology. The experiment presented 3 replications per treatment for breast and 6 replications per treatment for legs. Levels of significance were based on a $p \leq 0,05$.

4. RESULTS AND DISCUSSION

The effects of marinating time and salt content on the marinade pick-up by the SDBM, fixing polyphosphates concentration in 2%, is showed in Figure 1, where the fitted surface response is presented. The weight gain concerning the different treatments are well adjusted to the model, since the R value was 0.93468. The analysis of variance ANOVA revealed a significant linear effect of the marinating time. It was noted that marinating time above 8 hours and salt content ranging from 3 to 4,5% produced weight gains above 14%. These values are comparable to those obtained in traditional processes such as tumbling or injection. Although the effect of polyphosphates concentration was not statistically significant concerning the response weight gain, the increase in marinade pick-up with increasing polyphosphates concentration appears to have great practical importance. Consequently, polyphosphate concentration ranging from 3 to 4 are suggested to achieve greater marinade pick-up. As would be expected from previous studies Lemos et al (1998) salt content above 6% provided salty products that would not be approved by consumers. Thus, salt concentration ranging from 3 to 4,5% could be recommended for the still marinating process of SDBM.
Figure 2 presents the fitted surface response of the effects of marinating time and salt content on cooking losses by the SDBM fixing polyphosphates concentration in 2%. The cooking losses predicted by the fitted surface response were very close to the experimental data obtained, as the R value was 0.70226. A statistically significant linear effect of the polyphosphates concentration, a quadratic effect of salt content and also an interaction of marinating time x salt concentration were observed. However, these effects were not great enough to be of practical significance. Even so, it is interesting to note that the weight gain advantage carries through to the cooked products. Moreover, marinating times above 8 hours and salt concentration ranging from 2 to 4% presented the best yields.
Figure 3 presents the fitted surface response of the effects of marinating time and salt content on marinade pick-up of legs with polyphosphates concentration fixed in 2%. The low R value obtained (0.51507) indicates that the model does not fully explain the experimental data. The analysis of variance ANOVA revealed that none of the effects studied were statistically significant. For legs, the area without the skin exposed to the marinade seems to be one of the most important factors concerning weight gain, since the marinade did not penetrate the greasy skin to any extent. However, some trends could be of practical importance such as the increase in the weight gain with increasing marinating time and polyphosphates concentration. The fitted surface indicated that marinating times ranging from 2 to 8 hours, salt concentration ranging from 4 to 4,5% and polyphosphates concentration of about 2% are recommended for the still marinating process of chicken legs in order to attain weight gains above 5%.
The effects of marinating time and salt content on the cooking loss by legs fixing polyphosphates concentration in 2% is showed in

figure 4 where the fitted surface response is presented. The cooking loss concerning the different treatments are well adjusted to the model, since the R value was 0.81064. Although none of the effects tested was considered statistically significant according to the analysis of variance ANOVA, there were important practical differences between the cooking loss attained in the various treatments. The fitted surface indicates that the cooking loss decreases with decreasing marinating time in the period considered the most adequate concerning greater weight gains. In addition, the weight gains by the marinated chicken leg were better carried through the cooking process for treatments in which the legs were still marinated for shorter periods of time.

High salt concentrations could produce a "salting out" effect which affects the functional properties of meat proteins, reducing its binding properties. This could be the explanation for the decrease in weight gains with increasing salt concentrations for both parts studied.

There were no statistically significant loss of weight during storage in any treatment. For legs the storage losses ranged from 1 to 2% but the treatments did not appear to influence data.

The shear force values of the treated samples were smaller than the ones from the control (SDBM not still marinated). The differences between the treatments were not great enough to be of practical significance; moreover, previous experience has shown that none of these samples would be considered tough by a consumer. Therefore , data indicates that the still marinating process aid tenderising SDBM but the different levels of marinating time, salt content in the marinade and polyphosphates concentration studied did not affect tenderness.

An informal sensory panel analysis were conducted to evaluate the saltiness of the products. Panelists scored flavour of all marinated parts as acceptable.

5. CONCLUSIONS

The results of this study indicate that marinating times above 8 hours, salt concentration ranging from 2 to 4% and polyphosphates concentration ranging from 2 to 3% are recommended for the still marinating process of SDBM at 2°C. In addition, marinating times ranging from 4 to 8 hours, salt concentration ranging from 2 to 4% and polyphosphates concentration of about 2% can be suggested for the still marinating process of chicken legs at 2°C.

6. REFERENCES

Babdji, A.S.; Froning and D.A. Ngoka, 1982. The effect of short-term tumbling and salting on the quality of turkey breast muscle. Poultry Sci. 61: 300-303.

Brotsky, E., 1976. Automatic injection of chicken parts with polyphosphate. Poultry Sci: 55: 653-660.

Chen, T.C., 1982. Studies on the marinating of chicken parts for deep fat frying. Poultry Sci. 47: 1016-1017.

Farr, A. J. and K. N. May, 1970. The effect of polyphosphates and sodium chloride on cooking yields and oxidative stability of chicken. Poultry Sci: 49: 268-275.

Lemos, A.L.S.C. and D.R.M. Nunes, 1997. Estudos para a otimização do processo de obtenção de marinados por imersão. II Congreso Iberoamericano de Ingeniaria de Alimentos.

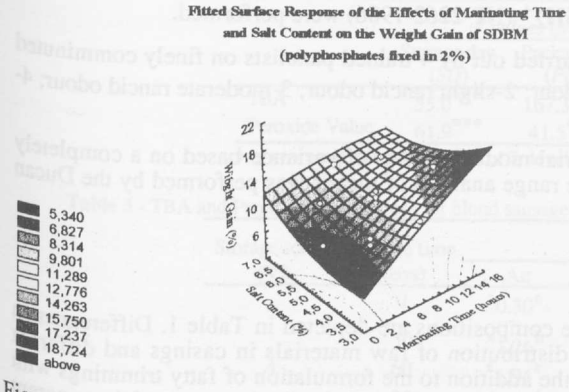

Figure 1: Fitted surface response of the effects of the marinating time and salt content on the weight gain of SDBM.

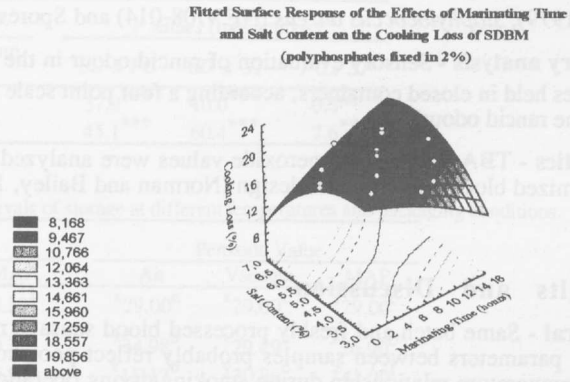

Figure 2: Fitted surface response of the effects of the marinating time and salt content on the cooking loss of SDBM.

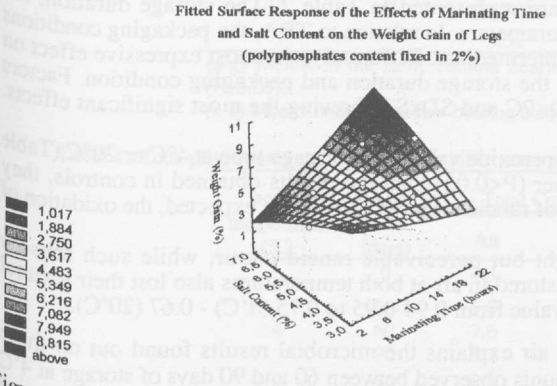

Figure 3: Fitted surface response of the effects of the marinating time and salt content on the weight gain of legs.

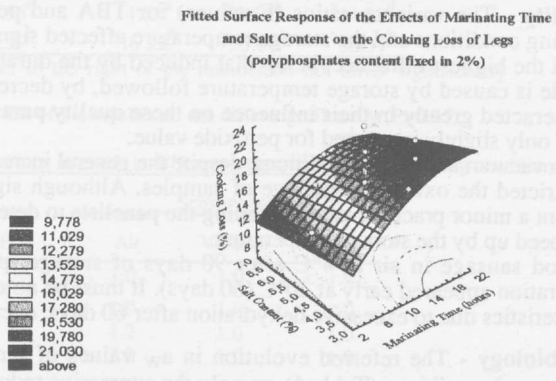

Figure 4: Fitted surface response of the effects of the marinating time and salt content on the cooking loss of legs.