PE8.39 Texture Profile Analysis in Restructured Chicken with transglutaminase and egg white450.00

Carmen J Contreras-Castillo ccastill@esalq.usp.br, Almeida M.A., Miyagusku L.,Andrade J.C. and Godoy, V.A.

Abstract— The importance of the entire poultry productive chain in Brazil is strongly motivated by chicken meat exports. However, cuts exports and the Brazilian consumer's preference for chicken cuts and fillets instead of whole chickens led to the need of finding means for using deboning left-overs (neck and back). The production of mechanically separated meat using these parts has become a viable alternative over the years, for it produces a low-cost raw material. Thus, the development of a cooked-frozen restructured product using breast and drumstick left-overs added to mechanically separated meat is considerably important for both the industry and the consumer. However, the characteristics desired by consumers for this type of product are texture, cohesiveness and juiciness, that is, the very characteristics of whole chicken fillets. In order to obtain the desired characteristics, we can use non-meat ingredients, such as transglutaminase and egg white powder, which were precisely the study object of this research. The texture of restructured products will be evaluated by the texture profile analysis (TPA) and other quality analyses, such as pH and color will be conducted.

Contreras-Castillo C.J. is with the Agroindustry, Food and Nutrition Department of the "Luiz de Queiroz" Higher School of Agricultural Sciences – University of São Paulo, Piracicaba, SP. ZIP 13418-900 Brazil (phone: +55-1934294150; fax:+55-1934294288; e-mail: ccastill@ esalq.usp.br.

Almeida M.A. and Godoy V.A. are with Agroindustry, Food and Nutrition Department of the "Luiz de Queiroz" Higher School of Agricultural Sciences – University of São Paulo, Piracicaba, SP. ZIP 13418-900 Brazil (madalmei@esalq.usp.br)

Miyagusku L., Andrade J.C. are with the Meat Technology and Development Center, Food Technology Institute, Campinas, SP, ZIP 13070 173 Brazil (lucianam@ital.sp.gov.br)

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I. INTRODUCTION

Industrial poultry breeding in Brazil has developed considerably over the last 30 years. With the first chicken meat exports to Japan, the Brazilian consumer discovered a variety of new cuts and chicken-meat-based industrialized products [3]. The production reached 11 million tons in 2008 and chicken exports exceeded three million tons, one third of which was represented by whole chickens and the remaining, by cuts, with a *per capita* consumption of 40kg.

The various cuts and industrialized products, represented by sausages and ready-made meals, are products that promote consumption expansion, forcing the industry to make adaptations for the development of easy-to-prepare products.

In Brazil, molded products – classified by the meat industry as products which are shaped in several ways using available muscles with the objective of adding a higher commercial value, keeping the same characteristics as a whole muscle [4] – are in evidence in the industrialized products market.

Thus, the industry is interested in adding value to its products, using cuts with no commercial value, such as the bird back, which is transformed into mechanically separated meat and added to cooked industrialized products [13].

Since adhesion force is an important characteristic for restructured muscle products, the addition of non-meat proteins, enzymes, such as transglutaminase, and Polysaccharides hydrocolloid is important in several processes [11][7].

The industry is concerned about cost reduction through the use of meat cuts with no commercial value. This study regards the use of binding agents, such as transglutaminase, due to its capacity of improving rheological properties, promoting better adhesion of meat pieces [14], and egg white for its capacity of forming cross-links [6], interfering in the cohesiveness of the final product [12] [2] [1], improving the use of the mechanically separated poultry meat (MSM) with restructured breast and drumstick meat, and resulting in a restructured product with similar texture quality to that of a whole chicken fillet.

II. MATERIALS AND METHODS

Color and pH processing and analyses were performed in the Meat Quality Laboratory (ESALQ/University of Sao Paulo) and the TPA was done in the Meat Research and Development Center (Meat Technology Institute-CTC/ITAL) in Brazil.

The deboned and skinned drumsticks and breasts used were taken from animals slaughtered on the previous day and cooled at 1°C, and separately ground in a Hobart 4b22 meat grinder (Hobart do Brasil Ltd, Sao Paulo, SP, Brazil) with disk nº 12. The frozen back was processed and the MSM was obtained using a deboning machine model HT 1.0 (High Tech Solutions, Chapeco, SC, Brazil) at USP Campus in the city of Pirassununga and transported frozen to the Meat Quality Laboratory. This raw material was ground with the skinned breast in a nº 3 disk at the rate of 1/1. The batches were divided and classified as showed in tables 1 and 2.

Table 1 – Identification of the batches and composition of each batch

Identification of the batches	Composition of each batch
T1T	1% Transglutaminase
T2TCMS	1% Transglutaminase and 30% MSM*
T3A	1% Egg white
T4ACMS	1% Egg white and 30% MSM *
T5TACMS	1% Transglutaminase, 1% Egg white and 30% MSM *

* Ground mechanically separated meat and chicken breast at the rate of 1/1.

Table 2 – Ingredients and batches

	Batches				
Ingredients (%)	B1	B2	B3	B4	B5
Breast	42.7	20.2	42.7	20.2	19.7
Deboned drumsticks	42.7	35.2	42.7	35.2	34.7
MSM[1]	0.0	30.0	0.0	30.0	30.0
Water	10.0	10.0	10.0	10.0	10.0
Transglutaminase	1.0	1.0	0.0	0.0	1.0
Egg white	0.0	0.0	1.0	1.0	1.0
Condiments[2]	3.5	3.5	3.5	3.5	3.5
Total in %	100	100	100	100	100

[1]MSM – Mechanically Separated Meat.
[2]Condiments: Onion powder 0.15%, Garlic powder 0.10%, White pepper 0.03%, Sugar 0.20%, Sodium Lactate 0.80%, Sodium Eritorbate 0.25%, Smoked aroma 0.50%.

The ingredients were mixed, put into nylon/polyethylene trays (dimensions of 120x7mm) in portions of 100 grams, vacuum sealed and cooled for a period of 24 hours. These trays were cooked in steam at a water temperature of 80°C until the internal temperature of the restructured product reached the temperature of 72 °C. Then, they were cooled in running water for 10 minutes and frozen at -25°C. After 48 hours of freezing time, they were thawed out under refrigeration and submitted to instrumental color analysis, determined by four readings of the surfaces of five whole samples using a Minolta Chroma meter – 200b, and readings of L* (lightness), a*(redness) and b* (yellowness) were obtained by the CIELab* system with the following characteristics: measured area of 8mm diameter, observation angle of 10°, illuminant D65 with a specular component. For the obtention of the pH, a glass penetration electrode of an Oakton pH 300 series 35618 potentiometer with automatic temperature compensation was used in 4 different points of the five samples.

Five samples from each batch were taken to the CTC/ITAL for the conduction of the Texture Profile Analysis [5] using an XTPlus texture analyzer Texture Technologies Corp., Scarsdale, NY, USA). The restructured product was cut into squares of 20x20mm by 15 mm height, compressed twice at 40% of its original height by a probe at a constant speed of 60mm/min. The probe used was an aluminum cylinder of 38mm diameter. The TPA parameters obtained were: stiffness, adhesiveness, cohesiveness, elasticity and chewiness.

The results obtained were analyzed statistically using the analysis of variance (ANOVA) and Tukey's test using the Statistic Analysis System (SAS) with a confidence level of 95% (p<0.05).

III. RESULTS AND DISCUSSION

Batch B3 presented a significant difference of parameter L*, having a lighter color compared to the other batches. In accordance to [9], the use of egg whites in restructured chicken causes a change in lightness (table 3). In batches B2, B4 and B5, there was a change in the value of a*, making it redder due to the addition of mechanically separated poultry meat, which contains large amounts of hemoglobin released from the bone marrow during mechanical separation and bone breaking [10].

The use of binding agents, such as transglutaminase, egg white and mechanically separated meat, resulted in a restructured product with no significant difference (p<0.05) in the values of stiffness among the treatments and the same can be observed for elasticity and adhesiveness (Table 4).

Stiffness is defined as the necessary force for the sample to reach a certain compression, that is, the first-bite force and the results obtained of 2.074 to 2.609 N were below the value of 5.330N found by [8] using chicken breasts. However, regarding cohesiveness, the isolated addition of trasnglutaminase (TG) in B1 resulted in significantly higher values (p<0.05) compared to the batches to which the enzyme was not added (B3 and B4), being similar (p<0.05) to batches B2 and B5, which contain TG + MSM, TG + MSM + egg white, respectively. We suppose transglutaminase changes the cohesiveness of restructured products significantly, and, according to Keeton (2000), it can alter the texture and cohesiveness of meat products, being indicated to improve food rheological properties with or without association with other ingredients such as salt, alkaline phosphates and curing salts. In this work, we also observed that the addition of mechanically separated meat in batch B2 did not change the cohesiveness of the restructured product significantly and, batch B5 demonstrated that the combination of TG with egg white and MSM may be used in meat products without altering texture negatively, as suggested by Pietrasik [14].

Table 3 – Results CIELab color and pH analyses

Batch	CIELab color			pH
	L*	a*	b*	
B1	67.0^{b} ±0,84	3.14 ^{b} ±0,32	13.96^{cd} ±0,49	6.41^{a} ±0,03
B2	57.68^{d} ±0,31	7.59 ^{a} ±0,23	16.28^{a} ±0,25	6.46^{a} ±0,01
B3	70.09^{a} ±0,64	3.24 ^{b} ±0,25	13.38^{d} ±0,26	6.33^{b} ±0,01
B4	60.46^{c} ±0,51	6.66 ^{a} ±0,22	15.46^{ab} ±0,24	6.42^{a} ±0,01
B5	57.85^{d} ±0,61	7.20 ^{a} ±0,19	14.97^{bc} ±0,29	6.44^{a} ±0,02

Small case letters in the same column show that the results were statistically different with a confidence level of 95%.

Table 4 – Results of the Texture Profile Analysis Parameters in the five batches

Batch	Texture Profile Analysis Parameters				
	Stiffness (N)	Adhesiveness	Cohesiveness	Elasticity	Chewiness
B1	2.609^{a} ±0.190	-16.911^{a} ±2.905	0.717 ^{a} ±0.003	0.944 ^{a} ±0.010	1754.5^{a} ±119.31
B2	2.524^{a} ±0,126	-15.721^{a} ±4.393	0.709 ^{a} ±0.003	0.936 ^{a} ±0.006	1667.9^{a} ±73.75
B3	2.074^{a} ±0,135	-12.979^{a} ±2.974	0.680 ^{b} ±0.005	0.924 ^{a} ±0.008	1295.8^{b} ±77.08
B4	2.375^{a} ±0,114	-11.888^{a} ±0.941	0.685 ^{b} ±0.005	0.944 ^{a} ±0.005	1526.0^{ab} ±60.59
B5	2.378^{a} ±0,115	-12.055^{a} ±2.417	0.711 ^{a} ±0.004	0.950 ^{a} ±0.007	1602.0^{ab} ±72.61

Small case letters in the same column show that the results were statistically different with a confidence level of 95%.

Among the Texture Profile Analysis parameters showed in Table 4, chewiness, which is the necessary effort to chew a sample till the moment of swallowing, batches B1 and B2 present higher values (p<0,05) than batch B3, regardless the presence of MSM in their composition, indicating the effect of TG in this texture profile. The existence of a similarity among the batches was also true for cohesiveness parameter and the same behavior was observed in both texture parameters. The higher values of cohesiveness and chewiness of B1, B2, and B5, in which one of the ingredients is transglutaminase, caused a strong aggregation of the meat pieces of the restructured product whether combined or not with MSM. The results obtained for B1 in this study (higher value) guarantee more cohesiveness (approximately 37.9% and a chewiness seven times higher than the same texture parameters reported by Li (2006) for chicken breast. The best way to analyze if the cohesiveness and chewiness parameters are what the consumer desires regarding texture is to compare the texture profile analysis to a sensory evaluation, thus, determining the acceptance of this product by the final consumer.

IV. CONCLUSION

The use of binding agents such as transglutaminase, used alone or in combination with mechanically separated poultry meat, produces desirable texture effects of cohesiveness. However, the addition of MSM darkens and increases the redness of the final product.

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