

SENSORY EVALUATION IN THE DEVELOPMENT OF FROZEN COOKED RESTRUCTURED CHICKEN STEAKS

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Abstract—The importance of poultry production in Brazil is strongly motivated by poultry meat exportation of 3.268 million of tons and by per capita consumption of 41.5 kg/head/year. In Brazil, the industries are focused on developing products ready or easy to prepare, according to a consumer profile change due to the need for reduction in time spent preparing meals. This need requires changes in the poultry industry to develop new products. The mechanically separated poultry meat (MSPM) production has been a viable alternative over the years resulting in lower cost of raw material. The transformation of secondary parts of the carcass in formatted products maintains similar characteristics to the whole muscle. The effects of using MSPM (15%) in combination with boneless chicken breast and drumsticks and cohesion coadjuvants (transglutaminase and egg albumin powder) on the sensory characteristics (overall characteristics, flavor, tenderness, juiciness and purchase intent) of five restructured formulations was evaluated. The restructured cooked frozen chicken products showed similar sensory characteristics and were well accepted by consumers of such products. The acceptance rate and purchase intent were used to select three treatments that will be studied to increase the shelf life.

***Index Terms* - poultry meat, restructured products, acceptability, purchase intent, consumer**

I. INTRODUCTION

Brazil is the largest poultry meat exporter and the second consumer market, only behind the United States. The accumulated Brazilian production of poultry meat was eleven million tones and exports exceeded three million tons in 2008, one third represented by whole chicken and the rest by chicken cuts in the same period, the per capita domestic consumption reached 41.5kg (Anualpec, 2009).

Industries in Brazil are focused on developing products ready or easy to prepare, according to a consumer profile changed due to the need for reduction in time spent to preparing meals. This need has required adjustments of the poultry industry to develop new products (Avila 2006). This segment includes products that are shaped in various ways from whole muscle or parts previously grounded with the recovery of parts of available muscles in order to add greater business value. The transformation of secondary parts of the carcass into formatted products maintains similar characteristics to the whole muscle (Avila, 2006).

This study includes the use of cohesion coadjuvants such as transglutaminase (with its ability to improve the rheological properties of food), egg albumin powder (through its gelling property) and a better use of chicken mechanically separated of poultry meat (MSPM) in the formulation and development of restructured cooked and frozen products with sensory qualities similar to that of whole chicken fillet.

II. MATERIALS AND METHODS

Five formulations of restructured cooked and frozen products were processed at the Laboratory of Meat Quality - Escola Superior de Agricultura Luiz de Queiroz – University of São Paulo (USP) and have been evaluated for sensory in the Reference Unit Laboratory of Physical, Sensory and Statistics Reference Laboratory Unit (LAFISE) of the Center for Food Science and Quality (CCQA) - Institute of Food Technology - ITAL.

Frozen back, drumsticks and boneless and skinned chicken breast, cooled at 4°C were obtained, all from animals slaughtered at the previous day in a slaughterhouse showing good manufacturing practices (GMP). The chilled cuts were separately comminuted in grinder (Hobart) with disc 12. The MSPM from the frozen back was processed and shipped frozen to the Laboratory of Meat Quality - USP - Pirassununga. The MSPM was ground at a ratio of 1/1 with skinless chicken breast, disk 3. The treatments were formulated in accordance with Table 1. The ingredients were mixed, added of spices, coadjuvants, with salt and antioxidants being added in the final period of the mixture, packaged

in nylon/polyethylene package (dimensions 120x70mm) in portions of 100 grams and sealed under vacuum and sent for cooling for 24 hours to stabilize the product. These restructured products underwent "cook in" process in a water bath at 85°C and the cooking time was established by applying the curve of thermal destruction for the reference microorganism, *Clostridium botulinum* type E, with parameters D and z defined by Stumbo (1973), for pasteurized product, confirmed by microbiological control (not shown). The restructured products were frozen at a temperature of -18°C and sent for sensory evaluation.

Table 1 - Formulations of the five treatments of chicken meat restructured products.

Ingredients (%)	Treatments				
	T1	T2	T3	T4	T5
Breast	42,74	35,24	42,74	35,24	34,74
Deboned drumsticks	42,74	35,24	42,74	35,24	34,74
MSPM*	-	15,00	-	15,00	15,00
Water	10,00	10,00	10,00	10,00	10,00
Transglutaminase	1,00	1,00	-	-	1,00
Egg albumin powder	-	-	1,00	1,00	1,00
Condiments**	3,53	3,53	3,53	3,53	3,53
Total in %	100	100	100	100	100

*MSPM – Mechanically Separated Poultry Meat; **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% and salt 1.5%.

The restructured products obtained from five formulations were evaluated for sensory acceptability, with the participation of 52 consumers of chicken steak / nugget products (restructured chicken), being 16 male and 36 female and aged between 21 and 60 years without restriction as to gender or social class.

The samples were evaluated for the acceptability of the product in an overall acceptability, regarding colour, odour, flavour, tenderness and juiciness, using a 9-point hedonic scale (9 = like extremely, 5 = neither like or dislike and 1 = extremely dislike), and the color intensity and tenderness of the product by means of the ideal 5-point scale (5 = much more intense / tender than I like, 3 = the way I like and 1 = very less intense / tender than I like), purchase intent on a 5-point scale (5 = would definitely buy 3 = would probably buy, would probably not buy, 1 = would definitely not buy). The samples were evaluated in a monadic sequential way according to a randomized complete block design and presented with codes of three random numbers (Meilgaard et al, 2006). The heating of the frozen restructured product was conducted in electric grill label George Foreman for 5 minutes, cut into 2 x 2 cm pieces and served on white plates.

The test was conducted in individual booths with fluorescent lighting and equipped with computerized system Compusense Five version 4.8 for collecting and analyzing data. Data on scale used were submitted to ANOVA and Tukey test to compare means.

III. RESULTS AND DISCUSSION

Of the 52 consumers taking part in the sensory tests, approximately 58% were between 21 and 30 years old; 13% were between 31 and 40 years old; 21% were between 41 and 50 years old and 8% were between 51 and 60 years old. Finally, 11% of them consumed steak/nuggets with a frequency of 15days, 27% with a frequency a day/week; 35% twice/week and 27% three or more/week.

Regarding the acceptability of attributes: overall acceptability, color, odor, flavor, tenderness and juiciness of restructured products showed no statistical difference ($p > 0.05$) between treatments and the mean scores corresponded to "like", showing that different formulations with the addition of MSPM and cohesion ingredients did not affect the acceptability of restructured products and these were well accepted by consumers (Table 2). Statistical differences ($p \leq 0.05$) were observed in color intensity of treatments T2 and T5, which were ranked from "a little less intense than I like it" to "the way I like it," did not differ, but differed from treatments T1 and T3 in a score between "a little more intense than I like it" to "the way I like it." T4 did not differ to all treatments. In the assessment of tenderness intensity, statistical difference was also observed ($p \leq 0.05$) and T2 was significantly different from T3, both not differing from the other treatments, which received scores between "a little less soft" to "the way I like it". In assessing the purchase intent, samples T2 had lower mean, corresponding to "probably would buy, probably would not buy," differing significantly ($p < 0.05$) from T1, with media evaluation corresponding to "probably would buy".

Table 2 - Results obtained in the test for assessing the acceptability of the product in overall acceptability, colour, odour, flavour, tenderness and juiciness, colour intensity, tenderness and the purchase intent of restructured chicken samples.

Attribute	Treatments				
	T1	T2	T3	T4	T5
Overall acceptability	7.1 ^a	6.7 ^a	6.8 ^a	7.1 ^a	6.7 ^a
Colour	6.4 ^a	5.9 ^a	6.6 ^a	6.4 ^a	6.4 ^a
Colour intensity	3.2 ^a	2.7 ^b	3.2 ^a	3.1 ^{ab}	2.8 ^b
Odour	7.0	6.6 ^a	6.9 ^a	7.0 ^a	7.1 ^a
Flavour	7.1 ^a	6.6 ^a	6.9 ^a	7.1 ^a	7.0 ^a
Tenderness	7.2 ^a	6.7 ^a	7.0 ^a	7.2 ^a	7.1 ^a
Tenderness Intensity	2.9 ^{ab}	2.6 ^b	2.9 ^{ab}	3.0 ^a	2.8 ^{ab}
Juiciness	6.8 ^a	6.6 ^a	6.8 ^a	6.9 ^a	6.7 ^a
Purchase Intent	2.1 ^b	2.6 ^a	2.3 ^{ab}	2.3 ^{ab}	2.3 ^{ab}

Different capital letters in same column mean that the results are statistically different from each other with 95% of confidence interval.

It is observed in Table 3 that treatments with / without MSPM and cohesion coadjuvants showed ideal intensity colour index for 40-50% of consumers, except for T2, with coadjuvants, which showed low ideal colour intensity index (29%). Treatments with MSPM and without / with coadjuvants T2 and T5 showed higher colour intensity indexes of 42% and 33%, respectively. These treatments also showed low ideal tenderness levels: 56% and 63%, compared to the others (75-70%) and were considered softer than the ideal for 38% and 29% of consumers. These tenderness intensity differences can be explained by the combination of MSPM and transglutaminase in T2, probably due to the low amount of myofibrillar proteins in this product. In T5, transglutaminase interacted positively with MSPM and the egg albumin powder due to the ability to form gels (FERNÁNDEZ-LÓPEZ et al. 2006) and transglutaminase for improvement of rheological properties, showing tenderness greater intensity than the others.

Table 3 - Consumers' comments (%) for color intensity and tenderness.

Attributes	Intensity	Treatments				
		T1	T2	T3	T4	T5
Colour intensity	More intense*	17	42	21	29	33
	The way I like	48	29	40	40	50
	Less intense **	35	29	39	31	18
Tenderness intensity	More intense+	15	38	17	13	29
	The way I like	79	56	75	79	63
	Less intense ++	6	6	7	8	8

*Sum of the ideal scale "much more intense and a little more intense"; ** Sum of the ideal scale "much less intense and slightly less intense" + Sum of the ideal scale "much softer and a little softer" ++ Sum of the ideal scale "much less soft and a little less soft."

The acceptance and rejection indexes by consumers for the different treatments are described in Table 4. For the acceptance index of overall acceptability, T1 had the highest index (94%) while T3 had the lowest index (84%) and T2 had a higher rejection index (12%) for this attribute. These acceptance indexes show that all products were well formulated. The lowest rejection index of color attribute for T1 and T3 (13% and 12%) can be explained by the absence of MSPM in the formulation, while the highest rejection index observed in T2 (23%), T5 (25%) and T4 (17%) can be caused by the presence of MSPM, which contains high hemoglobin levels in relation to chicken meat (FRONING, 1981). Probably, the acceptance and rejection indexes of odor and flavor of T2 have been influenced by the presence of MSPM and absence of cohesion coadjuvants, which may have some synergistic effect on the taste of meat. The content of seasoning used was effective for obtaining restructured products in all formulations, with high acceptance indexes of odour and flavour. The substitution of chicken meat by MSPM, as well as the addition of cohesion coadjuvant did not affect the high acceptance indexes of juiciness in the treatments studied (Table 4).

In assessing the purchase intent, treatment T1 had a higher positive purchase intent index (69%), followed by T3, T4 and T5 respectively (Table 5). The use of chicken meat and transglutaminase was the most accepted because non-meat ingredients helped forming the restructured product with desirable characteristics by consumers. The negative purchase intent index was higher for T2 (25%), followed by T3 (19%), which may be explained by the fact that MSPM without transglutaminase/ egg albumin powder and salt (present with the seasoning) (T2), and chicken meat with egg albumin powder (T3) was less effective to retain water (LAWRIE, 2005), verified by the high rejection indexes of these treatments than the others.

Table 4 - Rejection and acceptance frequency by consumers for the different treatments (%)

Attributes	Acceptability	Treatments				
		T1	T2	T3	T4	T5
Overall acceptability	Acceptance	94	86	85	92	92
	Indifference	-	2	8	6	2
	Rejection	6	12	8	2	6
Colour	Acceptance	81	71	83	81	77
	Indifference	6	6	6	2	2
	Rejection	13	23	12	17	21
Odour	Acceptance	90	83	92	94	92
	Indifference	-	8	6	-	6
	Rejection	10	10	2	6	2
Flavour	Acceptance	92	81	85	92	92
	Indifference	2	8	4	6	2
	Rejection	6	12	12	2	6
Tenderness	Acceptance	94	83	90	94	94
	Indifference	6	8	4	2	4
	Rejection	-	10	6	4	2
Juiciness	Acceptance	88	83	88	90	88
	Indifference	6	6	4	4	-
	Rejection	6	12	8	6	12

Table 5 - Purchase intent of the restructured product for the different treatments (in%)

Attributes	Purchase intent	Treatments				
		T1	T2	T3	T4	T5
Purchase intent	Positive intent	69	46	61	58	56
	Neutral	19	29	19	27	35
	Negative intent	12	25	19	15	10

V. CONCLUSION

Restructured products developed with the addition of cohesion coadjuvant such as transglutaminase or a combination of egg albumin powder with MSPM and the combination of both were well accepted by consumers of this product type. Treatments T4 and T5 had higher acceptability in attributes overall acceptability, tenderness and positive or neutral purchase intent.

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