USE OF MICRONIZED SODIUM CHLORIDE AND ITS INFLUENCE ON THE ACCEPTABILITY OF BREAST TURKEY HAM WITH REDUCED SODIUM CONTENT

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Abstract – The impact of Sodium chloride reduction and substitution of micronized salt for sodium chloride on consumer acceptance of breast turkey ham was investigated. Five formulations - F1(control) using 2% NaCl and four tests: F2 and F3 using 1.7% and 1.4% NaCl respectively and F4 and F5 using 1.7% and 1.4% micronized NaCl were evaluated for emulsion stability, proximate composition, sodium chloride and sodium content. The formulations were also evaluated by consumers using a 9 point hedonic scale for overall acceptance and using a CATA (check all that apply) survey with 24 descriptors. Results showed that at the lowest content level (1.4%) the formulation with micronized salt had better emulsion stability than the formulation with normal salt and neither treatment differed from the control, with 2% NaCl. The sodium content was statistically different between formulations with the same sodium content, probably due to differences related to the salt moisture content or hygroscopicity.

Reductions of up to 30% did not affect the overall acceptability by the consumers. However, the consumers recognized the formulations with lower salt content as "less salty and less seasoned than the control".

Key Words – check all that apply (CATA), emulsion stability, salt substitution

I. INTRODUCTION

Sodium consumption, associated mainly with sodium chloride content, has been criticized for impact on human health over the past decades. Meat products are considered to be the one of the main contributors to this high consumption. According to Katz *et al*.[1] about 80% of the sodium consumption comes from processed meat products and only 15-20% comes from other sources.

Sodium reduction in meat products is a complex challenge. It is the most common ingredient used in processing and it has many functions besides flavoring [2]. Sodium chloride is responsible for miofibrillar protein extraction and it increases the ionic force in the meat matrix. Meat´s functional properties such as emulsifying capacity, gel formation, water and fat binding are influenced positively by the sodium chloride in meat batters and cooked products [3].

A lot of studies reported in the literature have investigated sodium reduction in meat products [4,5] and its substitution by other salts such as potassium chloride. In general, there are few reports related to sodium chloride reduction and its impacts on the product´s sensory characteristics and its acceptance [6]. Some recent studies have indicated that a simple size reduction in the sodium chloride structure can be an alternative to sodium reduction. Smaller sodium chloride particles can promote higher perceptions of salt taste because they dissolve faster in the mouth. Kilcast *et al.* [7] evaluated different sizes and formats of sodium crystals in potato chips using a time intensity methodology with trained panels and noted that with smaller sizes the salt perception was noted faster but, the perception intensity was not the same. In the meat area there are no studies that evaluate sodium chloride substitution by micronized salts.

The use of a sensory technique such as a CATA (check all that apply) survey in consumer acceptance studies is relatively new and has been used in jams, powder juice, iced tea and milk desserts [8,9]. There are no previous reports using meat products.

In this context, the present study has as objectives to identify the impact of a simple salt reduction and its substitution by micronized salt on the physico-chemical characteristics and consumer acceptance of breast turkey ham.

II. MATERIALS AND METHODS

Five breast turkey ham formulations were produced using different levels of sodium content: F1(control) using 2.0% NaCl and four tests: F2 and F3 using 1.7% and 1.4% NaCl respectively and F4 and F5 using 1.7% and 1.4% micronized NaCl. The micronized salt was from Romani (5% retention on a mesh 20 sieve). The products were produced using breast turkey meat without skin. After thawing, 90% of the raw material was ground in a 35mm disc and 10% in a 10mm disc. All the others ingredients except the cassava starch and the isolated soy protein were added to 60% of the water to produce the brine. The meat and the brine mixture were homogenized for 20 min under vacuum. After this period, all the other ingredients were added and mixed for 10 minutes. The product was then embedded in a plastic casing of 3 1/2´´ diameter with approximately 0.8kg and cooked in a steam oven up to the internal temperature of 74^{o}C. After cooling in an ice bath the products were stored at 4^{o}C for two weeks before the beginning of the analysis.

Emulsion stability was analyzed according to Horita *et al*.[3]. Proximate composition (moisture, fat, protein and ash) was analyzed in triplicate according to AOAC[11]. Salt and sodium content was carried out according to the methodology proposed by Instituto Adolfo Lutz [12].

The sensory protocol was previously approved by the Ethics in Research Committee by the University of Campinas, SP, Brazil under the number 1128/2011. All the products were submitted to an acceptance test (overall acceptability) according to Stone *et al*. [13] using 77 consumers of sliced meat products and the 9 point hedonic scale (1=disliked extremely; 5=neither liked nor disliked; 9=liked extremely). Between the samples participants were offered water and a cracker. After evaluating each product the consumers were asked to mark, on a list of 24 descriptors, which ones expressed their opinion about the product they had tasted according to Ares *et al.*[9].The terms used to prepare the list were collected in previous studies with consumers and expressed their opinions about this type of product, in their own language.

The proximate composition data were statistically analyzed using a Tukey T test and significance level of 5% in an excel office. The acceptance data was analyzed by using analysis of variance (ANOVA) with significance level of 5% and the data collected by CATA was analyzed by frequency of mentions. To evaluate if the consumers perceived significant differences between the products a k proportion test and Chi-Square Analysis using XLSTAT was used.

III. RESULTS AND DISCUSSION

Data on the emulsion stability of the formulations are presented in Table 1.

Table 1 Emulsion stability (%) of the formulations with sodium reduction and micronized salt

	F1	F2	F3	F4	F5
Released liquid (%)	8.43^{ab}	10.50^{a}	10.22^{a}	8.51^{ab}	7.40^{b}

a, b – means in the same row with the same letters did not differ significantly at 5% level (Tukey´s test)
F1-2% NaCl; F2-1.7% NaCl; F3-1.4% NaCl; F4-1.7% micronized NaCl; F5- 1.4% micronized NaCl

No statistical differences in the emulsion stability were detected between the treatments using refined salt and micronized salt at concentrations of 1.7% although there was a tendency to higher liquid content when the salt content was reduced. At the lowest content level (1.4%) the formulation with micronized salt showed better emulsion stability than the formulation with refined salt and neither formula differed from the control with 2% NaCl.

The proximate composition and salt and sodium content are presented on Table 2.

Table 2 Proximate composition, sodium chloride and sodium content of the formulations with sodium reduction and micronized salt

	F1	F2	F3	F4	F5
Moisture (%)	75.92[a]	75.43[a]	75.63[a]	75.78[a]	75.47[a]
Fat (%)	1.17[a]	1.11[a]	1.15[a]	0.80[b]	0.91[b]
Ash (%)	3.20[a]	2.78[b]	2.47[c]	2.74[bd]	2.35[ce]
Sodium Chloride (%)	1.95[a]	1.58[b]	1.28[c]	1.51[d]	1.14[e]
Sodium (mg/100g)	1048[a]	915[b]	740[c]	879[b]	761[c]

a, b, c, d, e – means in the same row with the same letters did not differ significantly at 5% level (Tukey´s test)
F1-2% NaCl; F2-1.7% NaCl; F3-1.4% NaCl; F4-1.7% micronized NaCl; F5- 1.4% micronized NaCl

Although some statistical differences were found in the proximate composition the values were very similar. There were some differences in the sodium content added and the sodium content analyzed and they were perceived more in the formulations made using micronized salts (F4 and F5). With this, the effective sodium reduction in relation to the control formulation was 19%, 34%, 23% and 42% respectively. As expected, the products´ sodium content decreased significantly when compared to the control. However, there were statistical differences ($p<0,05$) between the formulations with the same sodium content added (F2 x F4) and (F3 x F5) probably due to differences related to the salts´ moisture content or hygroscopicity.

The results from the acceptability test are shown on Table 3.

Table 3 Degree of overall acceptability and standard deviation of the formulations with sodium reduction and micronized salt

	F1	F2	F3	F4	F5
Overall acceptability	7,34[a]	7,23[a]	7,18[a]	7,32[a]	7,04[a]
Standard deviation	1,26	1,56	1,44	1,42	1,46

a, b – means in the same row with the same letters did not differ significantly at 5% level (Tukey´s test)
F1-2% NaCl; F2-1.7% NaCl; F3-1.4% NaCl; F4-1.7% micronized NaCl; F5- 1.4% micronized NaCl

No statistical differences were detected between the products in overall acceptability and the consumers moderately liked all the formulations.

The results from the CATA survey are presented in Table 4. From the 24 descriptors given to the consumers to characterize the formulations only three of them were found to be significantly different between the formulations: without salt, salty and without seasonings.

The frequency of consumer selection of the formulations with 1.4% of NaCl as “without salt” was statistically superior. In relation to the descriptor “salty” both formulations with 1.4% showed frequencies statistically inferior when compared with the control. Formulations with 1.4% and the formulation with 1.7% micronized salt also showed frequencies statistically superior for the descriptor “without seasoning” when compared to the control.

IV. CONCLUSION

Reductions of up to 30% in the sodium content did not influence the meat matrix stability although there was a slight increase in the percentage of the liquid exudate. The use of micronized salt instead of refined salt (substitution by weight) showed levels of salt content slightly lower but, did not promote significant changes in the sodium content.

Salt reductions of up to 30% did not influence the consumers´ acceptability although they recognized the formulations as less salty and less seasoned than the control.

Table 4 Descriptors frequency used to characterize the formulations with sodium reduction and micronized salt

Descriptors	F1	F2	F3	F4	F5
Healthy appearance	49^{a}	47^{a}	46^{a}	52^{a}	41^{a}
Tenderness	45^{a}	41^{a}	42^{a}	43^{a}	41^{a}
Beautiful appearance	42^{a}	40^{a}	42^{a}	49^{a}	36^{a}
Flavor	39^{a}	37^{a}	24^{a}	37^{a}	29^{a}
Bland taste	38^{a}	44^{a}	40^{a}	42^{a}	40^{a}
Seasonings in the right amount	34^{a}	30^{a}	22^{a}	28^{a}	23^{a}
Clear color	32^{a}	37^{a}	36^{a}	41^{a}	42^{a}
Juiciness	32^{a}	30^{a}	29^{a}	32^{a}	20^{a}
Salt in the right amount	29^{a}	24^{a}	19^{a}	27^{a}	20^{a}
Turkey meat taste in the right amount	21^{a}	20^{a}	19^{a}	25^{a}	20^{a}
Easy mastication	14^{a}	20^{a}	23^{a}	21^{a}	21^{a}
Strong turkey meat flavor	12^{a}	8^{a}	9^{a}	7^{a}	9^{a}
Strong overall flavor	12^{a}	4^{a}	4^{a}	3^{a}	3^{a}
Salty	12^{a}	4^{ab}	1^{b}	2^{ab}	1^{b}
Strong seasoning	9^{a}	6^{a}	6^{a}	2^{a}	2^{a}
Weak turkey meat flavor	5^{a}	13^{a}	17^{a}	14^{a}	16^{a}
Weak overall flavor	4^{a}	8^{a}	13^{a}	13^{a}	18^{a}
Dry	4^{a}	4^{a}	8^{a}	10^{a}	14^{a}
Ugly appearance	2^{a}	3^{a}	7^{a}	3^{a}	7^{a}
Hard	2^{a}	2^{a}	2^{a}	4^{a}	2^{a}
Without salt	1^{b}	9^{ab}	14^{a}	12^{ab}	20^{a}
Without seasonings	1^{b}	7^{ab}	15^{a}	9^{a}	17^{a}
Bad flavor	1^{a}	3^{a}	5^{a}	2^{a}	4^{a}
Dark color	1^{a}	1^{a}	0^{a}	2^{a}	0^{a}

a, b, – numbers in the same row with the same letters did not differ significantly at 5% level

F1-2% NaCl; F2-1.7% NaCl; F3-1.4% NaCl; F4-1.7% micronized NaCl; F5- 1.4% micronized NaCl

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