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Original scientific paper

Sodium chloride replacement with other chloride salts in chicken burgers

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A R T I C L E I N F O

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A B S T R A C T

The aim of this paper was to investigate the influence of reducing the sodium chloride content in chicken burgers by partial replacement of the normal level of sodium chloride with potassium chloride or ammonium chloride. The experiment consisted of five groups. In the control group of chicken burgers, only the normal level of sodium chloride was added. One third of sodium chloride was replaced with potassium chloride in group 1; One half of the sodium chloride was replaced with potassium chloride in group 2; One third of the sodium chloride was replaced with ammonium chloride in group 3. In group 4, sodium chloride was reduced by one half and one quarter of ammonium chloride was added in relation to the control group. Burgers in all experimental groups had acceptable sensory attributes. A bitter taste was the most expressed in group 2, in which one half of the added sodium chloride was replaced with potassium chloride. The most expressed saltiness acceptability and taste acceptability were in control and group 1 burgers, without statistically significant differences ($p > 0.05$).

1. Introduction

Nowadays, dietary salt intake is very high, particularly in developed countries, mainly due to consumption of processed foods. Excessive dietary sodium intake is recognised as the main cause of essential hypertension (*Brown et al*., 2009). Studies show that as salt intake increases, body mass, total blood sodium content, extracellular volume, plasma and blood volume increase. At the same time, there is a decrease in the levels of renin, angiotensin and norepinephrine (*Haddy*, 2006).

The World Health Organisation (*WHO*, 2012) recommends a daily intake for adults of less than 5 grams of salt/2,000 mg of sodium, and less than 3,510 mg of potassium. The main source of sodium in food products is derived from sodium chloride, i.e., from table salt. One of the important sources of sodium in human diets are meat products. Products like burgers and kebabs are very popular and are mostly made from beef and pork. However, there is a need to produce these products from chicken meat. Total production and consumer interest in chicken meat are permanently increasing due to this meat's low cost and due to consumers' religious aspects.

One of the methods that can be used to limit the amount of sodium in human diets is reducing the salt content of meat products by partial replacement of sodium chloride with other chloride salts (potassium chloride, KCl; calcium chloride, $CaCl_2$; and magnesium chloride, $MgCl_2$) (*Sofos*, 1983; *Tarell*, 1983). The aim of this study was to investigate the possibility of reducing the sodium content in meat preparations, i.e.,

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Table 1. Composition of chicken burgers (g)

Group	Chicken minced meat	Sodium Chloride	Potassium chloride	Ammonium chloride
Control	589.8	10.2		-
1	589.8	6.79	3.41	-
2	589.8	5.1	5.1	-
3	589.8	6.79		3.41
4	592.35	5.1		

chicken burgers, by partially replacing sodium chloride (NaCl) with KCl or ammonium chloride (NH_4Cl).

2. Materials and methods

Five sample groups of chicken *burgers* were produced from chilled, category I chicken minced meat (drumstick and thigh without skin) with different salt mixtures. The trial design is shown in Table 1.

In the control group (C), only 10.2 g of sodium chloride was added, an amount that is common for this type of product. In group 1, one third of the sodium chloride was replaced with potassium chloride, while in group 2, one half of the sodium chloride was replaced with potassium chloride. In group 3, one third of the sodium chloride was replaced with ammonium chloride. In group 4, sodium chloride was reduced by half in the relation to the control group, and one quarter of ammonium chloride was added.

2.1. Sensory evaluation

After forming, the burgers were grilled and presented to ten trained assessors who evaluated sensory attributes using numeric scales. Colour acceptability, consistency, saltiness acceptability and taste acceptability were evaluated using a 1-5-point scale, where 1 was the least acceptable and 5 was the most acceptable attribute. Saltiness intensity and bitterness intensity were evaluated with a 1-5-point scale, whereby 5 was the most expressed attribute and 1 was the least expressed attribute. Preparation and presentation of the cooked burger samples to the assessors (number, coding and randomization) as well as the fitting out of the serving area (isolation of panellists, lighting conditions) were performed according to standards. The final ranking was done according to the sum of all sensory evaluation results, where the best scored chicken burgers was ranked first and the worst ranked in fifth place.

2.2 Statistical evaluation

The obtained results were statistically evaluated using Microsoft Excel 2010 and are presented as mean±SD. Statistical differences between means of the examined parameters were determined at the levels 0.05 and 0.01 by Student's t-test.

3. Results and discussion

In Table 2, the results of sensory evaluation of the chicken burgers are shown.

Burgers in all experimental groups had acceptable sensory characteristics. Saltiness as a sensory attribute is directly linked to amount of added

Table 2. Sensory evaluation of chicken burgers, Mean±SD, n = 10

	Colour acceptability	Consistency	Saltiness acceptability	Saltiness intensity	Taste acceptability	Bitter taste intensity	Overall acceptability
C	4.70±0.46	4.50±0.55	4.45±0.47^{a}	4.20±0.81^{a}	4.50±0.50^{ax}	1.65±1.14^{a,x}	4.60±0.49$^{a, x}$
1	4.60±0.66	4.15±0.78	4.10±0.86	3.70±0.75	4.05±1.01	2.65±1.10	3.95±0.65
2	4.65±0.55	3.70±0.71	3.60±1.18	2,95±0.79^{b,x}	3.40±0.49^{y}	3.30±1.19^{y}	3.00±1.20^{y}
3	4.55±0.57	3.90±0.66	3.15±1.10^{b}	4.30±0.75^{y}	3.15±0.87^{y}	2,70±1.03	3.30±0.75^{b}
4	4.50±0.81	4.05±0.88	3.40±1.09^{b}	3.15±1.16^{b}	3.30±1.33^{b}	3.20±1.35^{b}	3.05±1.29^{y}

$^{(a,b)}$ Values (m ean±SD) in columns with different superscript letters are significantly different (P≤0.05)

$^{(x,y)}$ Values (mean±SD) in columns with different superscript letters are significantly different (P≤0.01)

C = control

salt (sodium chloride). Only sodium chloride has a clearly salty taste, and adding any other salt instead of sodium chloride to food products degrades the products' saltiness.

The highest saltiness intensities were determined in control and group 3 burgers, which were significantly higher than the saltiness intensities of group 2 and 4 burgers ($p < 0.05$). However, a greater statistical difference in saltiness intensity was determined between group 2 and 3 burgers ($p < 0.01$).

Saltiness acceptability and taste acceptability were both evaluated as the best in the control and group 1 burgers, without any statistically significant difference between these two groups ($p > 0.05$). The lowest evaluations for saltiness acceptability and taste acceptability were given to burgers in groups 3 and 4. Saltiness acceptability scores in these two groups were significantly different from the control group burgers ($p < 0.05$), while group 3 burgers had significantly different taste acceptability from the control group burgers at the level of $p < 0.01$.

In accordance with the taste acceptability, the overall acceptability was evaluated similarly. The most acceptable burger products were the control group, while the group 1 burgers were a little less acceptable overall, but not different to the control. Group 3 burgers were significantly less acceptable than those of the control group ($p > 0.05$), as were burgers in groups 2 and 4 ($p > 0.01$).

Colour and consistency were acceptable in all groups and without statistical differences ($p > 0.05$). A bitter taste was the most expressed in the group 2 burgers in which one half of the normal amount of sodium chloride was replaced with potassium chloride. Adding potassium chloride had a negative influence on both the saltiness and taste acceptability due to the appearance of this bitter taste, particularly in the group 2 burgers. This result is in accordance with results of *De Almeida et al*. (2016) and *Inguglia et al*. (2017).

4. Conclusion

Chicken meat burgers in all experimental groups had acceptable sensory characteristics. Colour and consistency were not affected by the addition of the different salts. Saltiness acceptability and taste acceptability were rated the most highly in the control and group 1 burgers. However, for these two attributes, group 3 and 4 burgers received the lowest ratings, which were significantly lower than the ratings for control group burgers. A bitter taste was the most expressed in group 2 burgers due to this product formulation having the largest amount of added potassium chloride.

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