Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 6 [9] August 2017: 07-10

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.533
Universal Impact Factor 0.9804

ORIGINAL ARTICLE **OPEN ACCESS**

Effect of Potassium Chloride on Functional Chicken Meat Nuggets

[1]R.Jayanthi, [2]V.Appa Rao, [3]Robinson J.J. Abraham, [4]R.Narendra Babu, and [5]S.Ezhilvelan
1-Ph.D Scholar, 2- Professor and Head, 3-Retd. Professor & Head, 4-Professor, 5- Assistant Professor, Department of Livestock Products Technology (Meat Science), Madras Veterinary College, TANUVAS, Chennai-07
[Corresponding author E-mail: jayvet1212@gmail.com]
The work was conducted in Department of Livestock Products Technology (Meat Science), Madras Veterinary College, TANUVAS, Chennai-07

ABSTRACT
A study was carried out to evaluate the effect of replacement of sodium chloride with potassium chloride in chicken meat nuggets. Chicken nuggets with optimum level of guava powder (1.5 %) was used for development of Functional chicken nuggets with low sodium by replacing sodium chloride with potassium chloride at different levels viz.,60:40, 50:50 and 40:60. The results revealed that as the level of potassium chloride replacement increased there was a highly significant (P< 0.01) decrease in emulsion stability, cooking yield, sodium content and sensory scores. There was no significant difference in pH, cholesterol content, energy value, texture profile analysis. Hence chicken nuggets can be prepared by replacing sodium chloride with potassium chloride upto 40 per cent without affecting the palatability.
Key words: Sodium Chloride, Potassium Chloride, Chicken Nuggets

Received 21.04.2017 Revised 16.06.2017 Accepted 03.07.2017

INTRODUCTION

Meat as such is relatively poor in sodium, but the meat products are much higher because of the salt content, which can be as much as 2% in heat-treated products (e.g. sausages) and as much as 6% in uncooked cured products, in drying (loss of moisture) the proportion increases even further. High levels of sodium intake may lead to hypertension, age-related rise in blood pressure and other health issues. Therefore, limitation of dietary sodium intake should be achieved by restricting daily salt (sodium chloride) intake to less than 5 g per day [1]. Total replacement of sodium chloride in processed meats may not be desirable as it affects the flavour as well as lowers the shelf stability of meat products. So potassium chloride can be used in certain proportions during formulation of meat products to reduce sodium content but at the same time maintain the sensory characteristics of the product.

MATERIALS AND METHODS

a. Nuggets preparation: Chicken meat nuggets were prepared by using lean chicken meat along with following levels of other ingredients. Chicken meat was minced and added with the Pre weighed quantities of sodium chloride and potassium chloride combination, sodium nitrite and sodium tripolyphosphate one by one and mixed. Ice flakes and refined vegetable oil were added slowly in between until the complete dispersal. Then Condiment paste, pepper, spice mix and refined flour were added one after the other. Finally, desired consistency of emulsion was achieved. The emulsion was then filled uniformly into aluminium moulds and cooked in steam for 30 minutes until it reaches the internal temperature of 72º C.

b. Determination of pH, Emulsion stability and Cooking yield: For determination of pH 5g of sample was blended with 45 ml of distilled water to get a homogenate and the pH was recorded by using a digital pH meter into liquate of sample. Emulsion stability of the sample was determined by using the method outlined by Baliga and Madaiah [2] and modified by Kondaiah *et al*. [3]. Cooking yield is used to predict the yield of cooked product which was determined as per the method outlined by Verma *et al*. [4].

c. Estimation of Cholesterol and Energy: Cholesterol content of functional chicken meat nuggets were determined using cholesterol test kit (ROBONIK India Pvt Ltd.,). Lipid extract was used instead of blood

serum, as per the method described by Rajkumar *et al.* [5]. The total carbohydrate content in percentage of the functional chicken meat nuggets sample was determined by the method outlined by Bhattacharjee *et al*. [6]. This method involved adding the total values of crude protein, ether extract, crude/dietary fibre, moisture and ash contents of the sample and subtracting it from 100. The value obtained is the percentage carbohydrate constituent of the sample.

Thus:

% carbohydrate = 100 – (% moisture + % crude fibre + % protein + % lipid + % ash)

d. Estimation of sodium and potassium: Estimation of sodium and potassium content of chicken meat nuggets was done by using the method prescribed by AOAC [7]. The energy value or total calorie estimates (Kcal) were determined as per the method outlined by Kumar *et al*. [8].

e. Texture profile analysis: Texture profile analysis was carried out as per the procedure outlined by Bourne [9] by using a Stable Microsystems Texturometer.

h. Statistical analysis: Statistical analysis of the data was done using ANOVA in SPSS (version 20.0) software as per the method described by Snedecor and Cochran [10].

RESULTS AND DISCUSSION

The results of physico-chemical characters are presented in Table 1. The pH of chicken nuggets revealed no significant differences but there was a highly significant (P<0.01) decrease in emulsion stability and cooking yield with the increased level of potassium chloride (Fig.1 and 2). Increasing levels of potassium chloride in the combination deliberately affected the emulsion stability of the product. This may be due to the inability of potassium chloride to retain the water and extract the protein from the muscles. This is due to the different proportions of sodium or potassium bound to chloride. Chloride ions are mainly responsible for activating proteins and potassium chloride demonstrates a non-chloride part of 48% compared with 39% in sodium chloride. As a result, more potassium chloride has to be added to end up with the same concentration of chloride within the meat product [11].

Table- 1. Mean ± SE values of physico-chemical characteristics of chicken nuggets with different combinations of Sodium chloride and Potassium chloride

Parameters	Control	Sodium chloride: Potassium chloride			F value
		60:40	50:50	40:60	
pH	6.60 ± 0.05	6.60 ± 0.03	6.62 ± 0.05	6.63 ± 0.05	0.117^{NS}
Emulsion stability (%)	97.25^{d} ± 0.92	93.88^{c} ± 0.40	90.47^{b} ± 0.32	86.65^{a} ± 0.16	72.83**
Cooking yield (%)	96.73^{d} ± 0.30	93.70^{c} ± 0.25	90.88^{b} ± 0.37	85.52^{a} ± 0.87	87.51**
Cholesterol (mg/dl)	48.00 ± 4.39	46.67 ± 3.63	47.00 ± 3.26	47.33 ±3.70	0.023^{NS}
Sodium (mg/100g)	1939.17^{d} ± 9.52	1367.17^{c} ± 3.88	1213.83^{b} ± 26.97	906.67^{a} ± 18.74	636.92**
Potassium (mg/100g)	866.33^{a} ± 4.67	1508.67^{b} ± 20.10	1906.00^{c} ± 5.52	2280.00^{d} ± 17.29	1936.46**
Energy (Kcal)	492.17 ± 7.02	492.83 ± 7.38	495.67 ± 5.51	500.50 ± 4.06	0.38^{NS}

Means bearing different superscripts (a, b, c and d) within rows differ significantly (P<0.01)

n=6 NS - Not Significant ** - Highly Significant (P<0.01) difference

Table- 2. Mean ± SE values of Texture Profile Analysis of chicken nuggets with different combinations of sodium chloride and potassium chloride

Parameters	Control	Sodium chloride: Potassium chloride			F value
		60:40	50:50	40:60	
Hardness (Kgf)	2804.65 ± 363.40	2162.77 ± 347.22	2726.77 ±384.01	2265.78 ± 165.37	0.975^{NS}
Adhesiveness (Ns)	-0.94 ± 0.67	-5.60 ± 3.06	-4.50 ± 1.80	-2.19 ± 1.44	1.191^{NS}
Springiness (mm)	0.57 ± 0.04	0.55 ± 0.07	0.62 ± 0.03	0.52 ± 0.04	0.703^{NS}
Cohesiveness (A2/A1)	0.52 ± 0.05	0.57 ± 0.07	0.57 ± 0.06	0.56 ± 0.05	0.148^{NS}
Gumminess	1543.03 ± 336.18	1169.00 ± 167.50	1495.78 ±212.40	1284.34 ± 188.41	0.562^{NS}
Chewiness (Kgf.mm)	844.44 ± 166.85	673.25 ± 147.25	909.70 ± 108.61	652.41 ± 70.36	0.971^{NS}
Resilience	0.20 ± 0.03	0.24 ± 0.05	0.22 ± 0.03	0.23 ± 0.03	0.283^{NS}

n=6 NS - Not Significant

Figure- 1. Emulsion stability (%) of chicken nuggets with different combinations of Sodium chloride and Potassium chloride

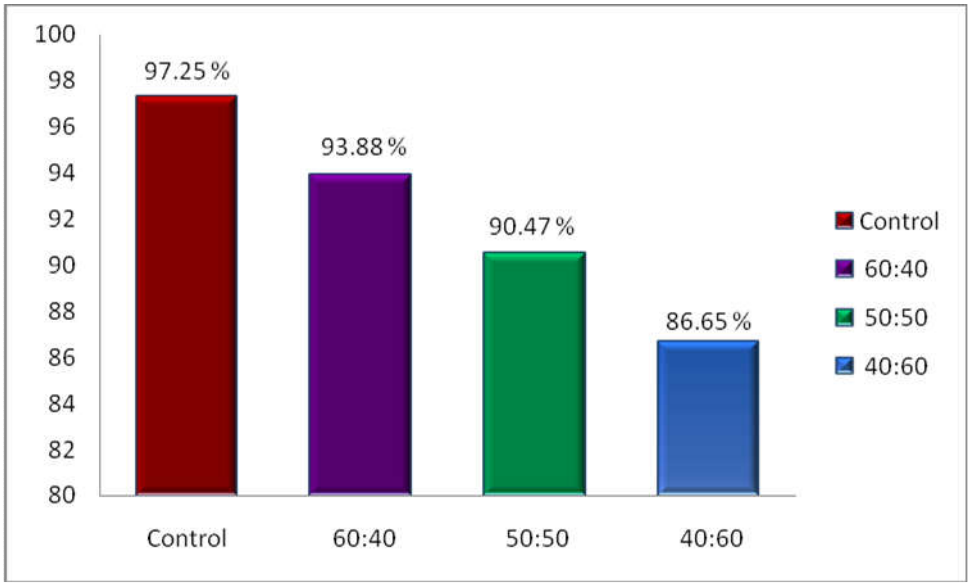
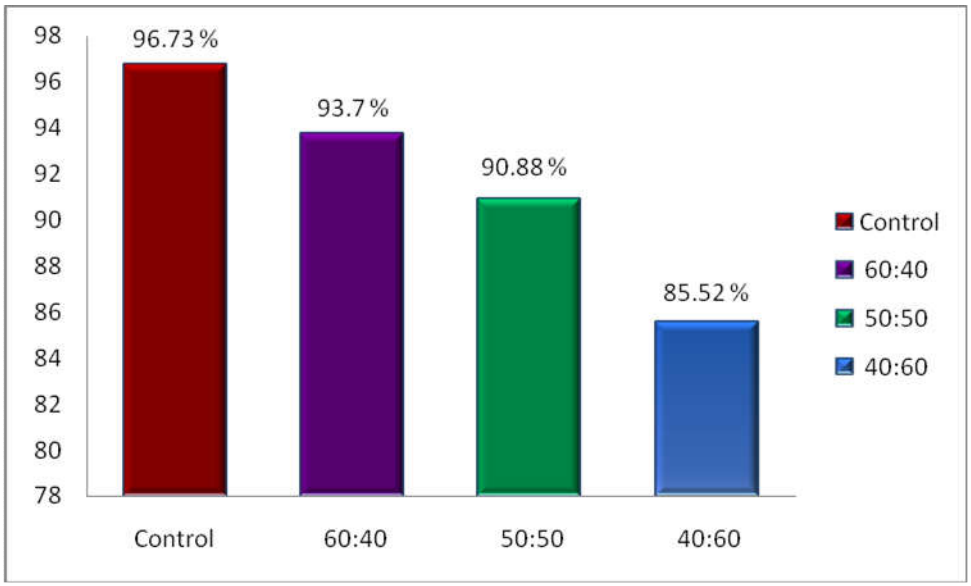


Figure- 2. Cooking yield (%) of chicken nuggets with different combinations of Sodium chloride and Potassium chloride



There was no significant difference in cholesterol content of control and the three combinations of sodium chloride and potassium chloride incorporated chicken nuggets. The mean values of chicken meat nuggets indicated that replacement of sodium chloride with potassium chloride does not have any influence on cholesterol content. A highly significant ($P<0.01$) decrease on sodium content was observed with increase in level of potassium chloride addition. Chicken nuggets incorporated with 40:60 combination of sodium chloride and potassium chloride had lower sodium content compared to other treatments. A highly significant ($P<0.01$) increase on potassium content was observed with increased level of potassium chloride addition. Carraro *et al*. [12] also found similar results in the bologna sausages with the replacement of NaCl with KCl. There was no significant difference in energy values of control and the three combinations of sodium chloride and potassium chloride incorporated chicken nuggets and it indicates that there is no deviation in energy values and may be readily acceptable by the busy urban population [13; 14].

There was no significant difference ($P>0.05$) in over all mean values of texture profile analysis (hardness, adhesiveness, springiness, cohesiveness, gumminess, chewiness and resilience) between control and other treatments (Table 2). This is in agreement with the effect of sodium reduction and the use of herbs

and spices on the quality and safety of bologna sausage [12]. They also found no significant (P>0.05) difference in hardness, springiness, cohesiveness and chewiness in the bologna sausages.

Based on the above findings it has been concluded that the high fiber and low sodium functional chicken meat nuggets prepared with incorporation of 1.5 per cent guava powder and by replacing sodium chloride with potassium chloride upto 40 per cent level can be recommended to people/patients (with hypertension, bowel disorders, Ischemic Heart Diseases, etc.,) without affecting the physico-chemical and sensory characteristics of the product.

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CITATION OF THIS ARTICLE

R.Jayanthi, V.Appa Rao, Robinson J.J. Abraham, R.Narendra Babu, and S.Ezhilvelan. Effect of Potassium Chloride on Functional Chicken Meat Nuggets. Bull. Env. Pharmacol. Life Sci., Vol 6 [9] August 2017: 07-10