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Cured Characteristics, Physicochemical Properties and Sensory Profile of Frankfurters Produced with *Ocimum Gratissimum* Extract Leaf Extracts

Worlah Yawo Akwetey[1*], Frederick Adzitey[2] and Gabriel Ayum Teye[2]

[1]*Department of Animal Science, Faculty of Agriculture, College of Agriculture and Natural Resources, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.*

[2]*Department of Animal Science, Faculty of Agriculture, Food and Consumer Sciences, University for Development Studies, Tamale, Ghana.*

[*]Correspondence:
Worlah Yawo Akwetey, Department of Animal Science, Faculty of Agriculture, College of Agriculture and Natural Resources, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana, Fax: +233 322 060 137; Tel: +233 501 349 018.

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ABSTRACT

Objectives: *To determine cured characteristics, physicochemical properties as well as sensory profiles of frankfurters produced with either nitrite salt or common salt with or without Ocimum gratissimum extract leaf extracts.*

Materials and methods*: Five treatments were formulated to produce 5 kg each of frankfurters from pork and beef with and without nitrite salt, Ocimum gratissimum leaf extract or common salt. Proximate composition, cooking loss, water holding capacity (WHC), cooking yield, pH, water activity (Aw), objective color and residual nitrite and nitrate were determined.*

Results: *No significant differences ($p > 0.05$) were observed for b* (yellowness) of all frankfurters. Frankfurters produced with common salt only recorded significantly higher ($p<0.05$) water activity compared to those with either nitrite salt or common salt-OG combinations. Nitrite salt or OG-common salt as cure ingredients did not significantly ($p>0.05$) influence the water holding capacity of frankfurters. But the use of common salt alone resulted in significantly ($p<0.05$) lower water holding capacities. No significant ($p>0.05$) differences were observed in the pH of meat batters for which reason their cooking loss values were also not significantly ($p>0.05$) different. The proximate compositions as well as sensory profiles of frankfurters were also not different significantly ($p>0.05$).*

Conclusions: *Frankfurters produced with Ocimum gratissimum and common salt resulted in similar cured characteristics and sensory properties of those produced nitrite salt, and these characteristics were better than using common salt only.*

Keywords

Frankfurters, Proximate composition, Cooking loss, Water holding capacity, Residual nitrite, Objective color.

Introduction

The art and science of curing have existed for several years since it was first established to have occurred through the accidental contamination from saltpeter in common salt [1]. Cured meat characteristics include desirable pinkish red color, enhanced flavor and texture, microbial inhibition as well as prevention of rancidity. Cured meat color development results from a reaction between nitrite and the meat pigment myoglobin to form a stable product after heat treatment. These cured meat characteristics of nitrite are desirable by consumers [2]; however, there are increasing concerns about the continued use of synthetic or chemical additives in foods in general and meats in particular. According to Brewer and Prestat [3] these concerns are responsible for the current trends in consumer awareness and preferences for natural foods which in turn has prompted food industries to look for natural alternatives to synthetic food additives. There is therefore, an increasing interest in the search for readily available potent alternatives from natural sources that may have better or comparable meat curing

characteristics to replace the commonly used synthetic nitrite in the food industry.

According to Avato and Rosito (200) [4], spices possess unique aroma and flavor which are capable of attracting benefits and repelling harmful organisms. They also serve as photo-protectants and respond to environmental changes. Numerous classes of phytochemicals including the isoflavones, anthocyanins and flavonoids are found associated with different spices [5]. *Ocimum gratissimum* is one of such common herbs that has several health benefits and is used in most Ghanaian homes as herbal preparation against numerous ailments. There is however paucity of information in the scientific literature concerning the use of *Ocimum gratissimum* in meat and meat products. Akwetey, Yeboah and Adzitey (2020) [6] recently recommended the use of *Ocimum gratissimum* and common salt as cure ingredients in other cured meat products after a preliminary study with bacon. This study was therefore aimed at evaluating the nutritional composition and eating quality of frankfurters produced with and without nitrite curing salt or *Ocimum gratissimum* and common salt. The objectives of this study were to use *Ocimum gratissimum* extract with common salt as cure ingredients in frankfurters and to examine their cured characteristics, physicochemical properties as well as sensory profiles with either nitrite salt or common salt.

Materials and methods

Frankfurter Production

Five (5) treatments were formulated to produce five (5) kg each of frankfurters from pork and beef, purchased from the Kumasi abattoir Company Limited, with and without nitrite salt, *O. gratissimum* leaf extract or common salt. The treatments were respectively labeled as F0, F1, F2, F3 and F4 where F0 represented a control with 12 g/kg nitrite salt and F4 (a second control) with 12g/kg common salt. F1, F2 and F3 respectively were produced with 12g/kg common salt plus 12.5mg, 25mg and 50gm *O. gratissimum*/kg meat respectively. OG (*Ocimum gratisimum*) leaves were harvested from the Forestry Research Institute of Ghana (FORIG) at Kumasi, washed with tap water, rinsed with distilled water, air dried to 10% moisture and ground into powder. OG leaf extract was obtained according to the method described by [7]. Table 1 shows the ingredient formulation used for the different types of frankfurter treatments replicated three times.

Table 1: Ingredients used in frankfurters produced with or without nitrite curing salt, OG and or common salt.

Ingredient (/kg meat)	Type of Frankfurter				
	F0	F1	F2	F3	F4
OG (mg)	0	12.5	25	50	0
Common salt (g)	0	12	12	12	12
Curing salt (g)	12	0	0	0	0
Chilli pepper (g)	3	3	3	3	3
Nutmeg (g)	4	4	4	4	4
Onion (g)	2	2	2	2	2
Phosphate (g)	4	4	4	4	4
Ice (kg)	0.24	0.24	0.24	0.24	0.24
Meat (kg)					
Pork	1.5	1.5	1.5	1.5	1.5
Beef	3.5	3.5	3.5	3.5	3.5

Parameters Measured

Proximate composition, cooking loss and objective color parameters

The procedures recommended by AOAC (2000) [8] were used in the determinations of percentage moisture, fat, protein and ash. Cooking yield (%) was determined by differences in each treatment weight after overnight chilling.

The Hunter color system was used to determine surface color of cooked frankfurters using the Meat Color Measurements Guidelines suggested by [9]. Three (3) measurements were taken from different position of each cooked treatment sample after removal of the casings.

Residual Nitrate and nitrite, pH (acidity), water holding capacity, moisture and fat retentions

Methods suggested by Ahn and Maurer (1987) [10] were used for sample preparation and nitrate determination at the Department of Chemistry, KNUST while residual nitrate was by modification of the procedures of [11]. Briefly, finely ground treatment samples (5g) were used for all residual nitrite assays in triplicate at the same time to minimize variation in analysis due to time. Acidity (pH) of mashed frankfurters in distilled water was determined using a microprocessor pH-meter (Suntex pH Meter, SP-2100PA, Taiwan) while water holding capacity was by the method of [12]. Moisture and fat retentions were evaluated using procedures described by [13].

Sensory profile

Sensory parameters of warmed frankfurter in water bath were determined by 30 consumer panelists as described by Akwetey and Knipe [14] for appearance, flavor, taste, mouth feel, juiciness, texture and acceptability using a 9-point hedonic scale.

Statistical analysis

Data generated were analysed statistically with Minitab version 18.1 software using a 5x3 factorial arrangement in CRD design. Significant differences between means were determined by Tukey's range test of homogeneity at 5%.

Results and Discussion

Objective color of frankfurters

Results obtained for L, a*, b* color coordinates of frankfurters produced with and without nitrite, OG or common salt are shown in Table 2. No significant differences ($p > 0.05$) were observed for b* (yellowness) color coordinates of all frankfurters. Also, there were no significant differences between treatments F0, F1, F2, and F3 for coordinates L (lightness) and a* (redness). However, treatment F4 was significantly different in both lightness (L) and redness (a^*) as compared to treatments F0, F1, F2 and F3; all of which were similar. The levels of L observed in this study ranged from 52.37(F4) to 55.45(F2), a* was between 17.91(F4) and 23.98(F1) while b* was ranged between 18.48(F4) and 21.09(F1). Thus, using *O.gratissimum*-common salt in frankfurters resulted in similar lightness and redness characteristics just as the use of nitrite salt only, and these characteristics were better than using

common salt only. Components of *O.gratissimum* were probably converted by meat microflora and possibly meat enzymes into nitrite to effect better "curing effects" compared to using common salt only in frankfurters. However, according to Sebranek and Bacus (2007) [15] the USDA did not accept such natural sources of nitrite generation as "replacement" for conventional nitrite, but could be used for purposes of the pink color of cured meat products because several vegetables are known to contain natural amounts of nitrate in significant quantities [16].

Table 2: Effect of treatment on internal Color coordinates of frankfurter sausages produced with and without *O. gratissimum*

Treatment type	Color coordinate		
	L	a*	b*
F0	55.41[a]	23.64[a]	19.48
F1	55.51[a]	23.98[a]	21.09
F2	55.45[a]	22.63[a]	19.49
F3	54.33[a]	22.63[a]	18.87
F4	52.37[b]	17.91[b]	18.48
P-value	0	0	0.179

[ab]Means in same column with same superscripts are not significantly different (p>0.05), L (light vs. dark) (0 to 50 indicates dark, 51 to100 indicates Light), a* (±) red vs. green, b* (±) yellow vs. blue. F0 is 12g nitrite salt only, F1, F2, F3 contain 12g common salt+ *O. gratissimum* at 12.5mg, 25mg and 50gm respectively, per kg meat, and F4 is 12g common salt only per kg meat.

Water activity, residual nitrite and nitrates of frankfurter produced with and without O.G *or common salt*

Table 3 shows the results obtained for water activity, residual nitrite and nitrate of frankfurters produced with and without *OG* or common salt. Significant differences (p<0.05) were observed in the values recorded for Aw, residual nitrite and nitrate of all the frankfurters produced. Frankfurters produced with common salt only recorded significantly (p<0.05) higher water activity compared to those produced with either nitrite salt or common salt-OG combinations. However, treatment F4 (common salt) was not different from treatment F1(OG-common salt). The Aw values recorded ranged from 0.952(F3) to 0.971(F4). The significance level of water activity in the shelf stability of food in general cannot be overemphasized since it could help predict which microorganisms will be potential sources of spoilage and infection, and water activity of a food is equally instrumental in maintaining its chemical stability [17]. Foods with relatively lower water activity are generally more shelf stable than those with higher water activity. Hence from the results of this study, we can safely suggest that frankfurters produce with common salt only are more likely to spoil faster under similar storage conditions compared to those with OG-common salt or nitrite curing salt.

Residual nitrites in treatment F0 (nitrite salt-treated) and treatments of *O. gratissimum*-common salt were not different significantly (p>0.05) however, the residual nitrite in treatment F0 was significantly (p<0.05) higher compared to that of treatment F4 (common salt-treated). These observations corroborate result of a recent study by Saputro, Bintoro and Pramono (2016) [18] which reported no significant differences in residual nitrites in naturally cured "dendeng sapi" using various levels of celery leaf compared to controls at similar incubation temperatures. But OG-common salt-treated frankfurters were not statistically different from common salt-treated frankfurters in terms of residual nitrite. These observations were inconsistent with Baseler (2007) (unpublished data), who evaluated cured pork product manufactured with a natural nitrate source (celery powder), with or without 0.28% cherry powder and observed that including the cherry powder reduced residual nitrite by about 50%.

Table 3: Effect of treatment on water activity, residual nitrite and nitrates (ppm) of frankfurter sausages produced with and without *O. gratissimum*

Treatment	Aw	Residual nitrite (ppm)	Residual nitrate
F0	0.956[b]	5.23[a]	4.53[bc]
F1	0.959[ab]	4.66[ab]	6.03[abc]
F2	0.957[b]	9.0[ab]	8.58[a]
F3	0.953[b]	4.11[ab]	7.69[ab]
F4	0.970[a]	2.95[b]	2.49[c]
P-value	0	0.04	0

[ab]Means in same column with same superscripts are not significantly different (p>0.05). F0 is 12g nitrite salt only, F1, F2, F3 contain 12g common salt+ *O. gratissimum* at 12.5mg, 25mg and 50gm respectively, per kg meat, and F4 is 12g common salt only per kg meat.

Table 4: Water holding capacity, pH, cooking loss, moisture and fat retentions of frankfurters produced with and without nitrite salt, *O. gratissimum* or common salt

Treatment	WHC	pH	CL	MR	FR
F0	33.40[ab]	5.63	25.8	31.37[ab]	17.77[a]
F1	33.40[ab]	5.67	25.7	27.23[b]	16.47[ab]
F2	33.67[ab]	5.74	26.43	33.33[ab]	16.07[ab]
F3	34.40[a]	5.66	26	36.53[a]	15.17[b]
F4	32.77[b]	5.73	26.7	27.23[b]	17.70[a]
P-value	0.017	0.813	0.709	0.018	0.023

[ab]Means with same superscript in a column are not significantly different (p<0.05). F0 is 12g nitrite salt only, F1, F2, F3 contain 12g common salt+ *O. gratissimum* at 12.5mg, 25mg and 50gm respectively, per kg meat, and F4 is 12g common salt only per kg meat. WHC= %water holding capacity, CL**:** %cooking loss, MR**:** %water retention, FR**:** %fat retention.

Water holding capacity, pH, cooking loss, moisture and fat retentions of frankfurters produced with and without O. gratissimum

Result obtained for water holding capacity, pH, cooking loss, moisture and fat retentions of frankfurters produced with nitrite curing salt, *O. gratissimum* with or without common salt are shown in Table 4. The water holding capacity of meat is essential in determining cooking loss, which also has crucial effects on economics and eating characteristics. Using nitrite salt or OG plus common salt as cure ingredients did not significantly (p>0.05) influence the WHC of frankfurters in this study. But the use of common salt alone in frankfurter resulted in significantly (p<0.05) lower water holding capacities. Factors affecting water holding capacity of meat include cooking and cooling procedures, especially their heating and cooling rates, cooking temperature and end point temperature. Since all treatments were prepared under

similar cooking and cooling methods, it was not expected to see significant changes in water holding capacities of the finished products. Another parameter which could influence water holding capacity is the ionic strength of meat batters and pH. According to [19], cooking loss reduces with increasing ionic strength and pH, but no significant ($p>0.05$) differences were observed in the pH of frankfurter batters for which reason their cooking loss values were also not significantly ($p>0.05$) different. WHC of frankfurter ranged between 32.77(F4) and 34.40(F3) while pH was from 5.63(F0) to 5.74(F2). Significant differences ($p<0.05$) were however observed in both moisture and fat retentions after cooking the frankfurters. Moisture retention was seen to increase in OG-treatments from 27.23% (F1) to 36% (F3) and the moisture retained in F3 was significantly ($p<0.05$) higher than F4. Conversely, there were reductions in fat retentions in the OG-treated frankfurters compared to both nitrite salt and common salt-treated counterparts which were significantly higher than F3. These observations were attributed to the inverse relationship between fat and moisture contents in foods as suggested by [19].

Proximate composition (%) of frankfurters produced with and without nitrite salt, OG *extract or common salt*

The percentage compositions of moisture, fat, protein and ash as determined for frankfurters in this study were reported in Table 5. No significant differences ($p>0.05$) were observed in all the proximate components of frankfurters produced with or without nitrite curing salt, OG-common salt, or common salt only. Protein contents raged from 54.24% to 55.60%, moisture was from 17.16% to 21.17%, while percentage fat and ash were ranged from 14.43% to 14.63% and 2.66% and 2.99% respectively.

Table 5: Proximate composition (%) of frankfurters produced with *O. gratissimum*

Treatment	Moisture	Fat	Protein	Ash
F0	55.6	20.33	14.63	2.69
F1	54.6	19.46	14.63	2.79
F2	54.24	17.16	14.6	2.81
F3	54.44	16.43	15.54	2.66
F4	54.24	21.17	14.43	2.99
P-value	**0.082**	**0.244**	**0.0468**	**0.928**

[abc]Means with same superscripts in same column are not significantly different ($p>0.05$). F0 is 12g nitrite salt only, F1, F2, F3 contain 12g common salt+ *O. gratissimum* at 12.5mg, 25mg and 50gm respectively, per kg meat, and F4 is 12g common salt only per kg meat.

Sensory profile of frankfurters

Results obtained for sensory properties of the frankfurters are shown in Table 6. The appearance of frankfurter produced with common salt only was scored significantly ($p<0.05$) less by the panel of consumers compared to all other treatments. This observation was attributed to the higher degree of redness colour recoded in Table 2 for frankfurters produced with either nitrite curing salt or OG-common salt combinations compared to using only common salt in frankfurter manufacture. There were however the observed significant differences in flavour, taste, mouth feel, texture and over all acceptance of all the treatments. Juiciness of OG-common salt treatments was observed to increase with increasing levels of OG used, and the value recorded for 50mg/kg OG was significantly higher compared to frankfurters containing 12.5mg/kg OG. The possible explanation to this observation is due to the higher moisture retention values recorded in Table 3 for the frankfurters containing 50mg/kg OG compared to all other treatments, because the level of retained moisture in a product after cooking in addition to saliva in the mouth could positively influence its juiciness characteristic during mastication.

Table 6: Sensory profile of frankfurters produced with and without nitrite salt, OG-common salt or common salt only.

Treatment	Appea	Flav	Tast	Mouth	Juic	Text	Accept
F0	6.40[a]	5.9	6	5.7	5.80[ab]	7.1	7.3
F1	6.30[a]	6.2	5.5	5.3	5.20b	6.9	6.7
F2	6.20[a]	6.1	6	5.9	5.70[ab]	7.2	7.1
F3	6.40[a]	6.3	6	5.6	6.10[a]	7.1	7.2
F4	5.20b	5.8	5.6	5.4	5.40[ab]	6.5	6.7
P-value	**<0.04**	**0.19**	**0.22**	**0.12**	**0.03**	**0.65**	**0.13**

[abc]Means with same superscripts in same column are not significantly different ($p>0.05$). F0 is 12g nitrite salt only, F1, F2, F3 contain 12g common salt+ *O. gratissimum* at 12.5mg, 25mg and 50gm respectively, per kg meat, and F4 is 12g common salt only per kg meat. Appea: Appearance, Flav: Flavour, Tast: Taste, MF: Mouth feel, Juic: Juiciness, Text: Texture, Accept: Acceptance

Conclusions and Recommendation

Using *Ocimum gratissimum* with common salt in frankfurters resulted in similar cured characteristics just as the use of nitrite salt, and these characteristics were better than using common salt only. The use of OG in frankfurter manufacture did not have any noticeable effect on proximate components as well as flavor, mouth feel, texture and sensory acceptance. From the above, we can conclude that *Ocimum gratissimum* with common salt could be used as cure ingredients in Frankfurters. Further study is recommended using OG in other cured meat products, and to make an assessment of their cured characteristic during storage.

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