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EFFECTS OF SWEET BASIL (OCIMUM BASILICUM) LEAF POWDER ON THE SENSORY AND NUTRITIONAL QUALITIES OF BEEF AND FRANKFURTER SAUSAGES

Abu, A., Teye, G. A. and Adzitey, F.
Department of Animal Science, University for Development Studies, Tamale, Ghana

Abstract
The aim of the experiment was to find out the effects of sweet basil leaf powder on the sensory and nutritional qualities of beef and frankfurter sausages. The experiment involved the use of basil leaves powder at 4, 6 and 8g/kg meat in place of adobo®, a commercially formulated spice in both beef and frankfurter sausages. Sensory attributes such as colour, aroma, flavour intensity, flavour liking and texture were evaluated. The addition of basil leaves powder resulted in a significant (P<0.001) effect on the colour of both beef and frankfurter sausages. The control and 4g of the test materials in beef and frankfurter sausages had acceptable sensory attributes as compared to the higher levels (6 and 8g/kg). Sweet basil leaf powder did not have any adverse effect on the sensory characteristics of the products. There was significant difference (P<0.05) among treatment means in terms of fat content of the frankfurter sausages. However, the moisture and crude protein content of both beef and frankfurter sausages were not improved by the addition of basil leaf powder.

Keywords: Sweet Basil, Beef Sausages, Frankfurter, Sensory, Minerals

Introduction

Meat products such as sausages and burgers require the use of spices. Spices are esoteric food adjuncts that are used as flavouring agents and as preservatives in meat products (Srinivisan, 2005). Spices and herbs are valued for their distinctive flavours, colours, and aromas, and are among the most versatile and widely used ingredients in food preparation hence the meat industry cannot be imagined without the utilization of spices (Skrinjar *et al.,* 2012). More than 400 spices have been used in the world (Ceylan & Fung, 2004).

The extensive use of artificial additives and preservatives is receiving lots of mixed feelings from consumers for health reasons, including cancer. Hypertension and obesity are perceived to be associated with these additives (Lawrie & Ledward, 2006).

Alternative and natural or non-artificial spices could be the best approach to dealing with the health challenges posed by artificial spices.

Sweet basil (*Ocimum basilicum*) is a local spice which is commonly cultivated throughout the Mediterranean region (Ganasoundari *et al*., 1997). It is locally known as "Akokobesa'' in "Akan'' in Ghana. It is an aromatic bushy herb and a dicotyledonous plant from the family of *Lamiaceae* (Dokosi, 1998).

A preliminary study on basil leaf paste in burgers showed an increase in crude protein level of beef burgers up to 24.88% when included up to 4g/kg in beef burgers (Teye *et al.,* 2013). However, basil has not been included in beef and frankfurter sausages.

The aim of the experiment was to determine the effect of sweet basil leaf powder on the sensory and nutritional qualities of beef and frankfurter sausages.

Materials and methods

Study area

The products formulations took place at the Meat Processing Unit of University for Development Studie (UDS), proximate analyses were carried out at laboratories of UDS while mineral analyses was carried out at Ghana Atomic Energy (Chemistry Department), Accra.

Processing of basil leaf powder

Fresh basil leaves were harvested from the environs of Aseseeso-Akuapem in the Eastern Region of

Ghana, shade dried for two days and ground into powder using a blender.

Sausage formulations

Frozen muscles from the hindquarters of mature bull and castrate (hog); comprising of *Longissimus dorsi, Semitendinosus, Semimembranosus* and *Quadriceps femoris* were obtained from the UDS Meat Processing Unit, thawed overnight at a temperature of 2°C, cut into smaller sizes and minced using a 5mm-sieve table top mincer (Taller Ramon, Spain). A total of 8 kg of both beef and pork was used for the experiment. Treatment 0 (T0, control) contained no basil, Treatment 1 (T1) contained 4 g of basil, Treatment 2 (T2) contained 6 g of basil and Treatment 3 (T 3) contained 8 g of basil. Each treatment was replicated three (3) times.

Comminution of meat and packaging

The minced meat was comminuted in a bowl chopper (Talleres Ramon, Spain) until a meat butter temperature of 16°C was attained. Crushed ice was added to each set of products during comminution to obtain the desired consistency and temperature of meat butter and to minimise the risk of fat separation from the muscles. The meat butter was immediately stuffed into natural casings, using a hydraulic stuffer (Talleres Rammon, Spain) and manually linked into equal length of about 10 cm. Frankfurter sausages were prepared by a similar method as the beef sausages but the sausage formulation contained 50% beef and 50% pork. The sausages were hanged on smoking racks and smoked for 45 minutes after which they were scalded to a core temperature of 70°C. They were then allowed to cool down with the help of cold water. The water was drained off after cooling and the products vacuum sealed in transparent polythene bag and stored in a refrigerator at -2°C for sensory and chemical analyses.

Sensory evaluation of the products

A total of 15 panelists were selected and trained according to the British Standard Institution guidelines (BSI, 1993). Sensory analysis according to the British Standard Institution (BSI, 1993) was conducted by panelists to determine the colour, aroma, flavour, juiciness and overall acceptability of the sausages. A five-point category scale was used to evaluate the products:

Colour: 1= very pale red; 2 = pale red; 3 = intermediate; 4 = dark red; very dark red

Aroma: 1 = very offensive; 2 = offensive; 3 = intermediate; 4 = pleasant; 5 = very pleasant

Flavour intensity: 1 = very weak; 2 = weak; 3 = intermediate; 4 = strong; 5 = very strong

Flavour liking: 1= dislike very much; 2= dislike; 3= intermediate; 4 = like; 5 = like very much

Texture: 1 = very smooth; 2 = smooth; 3 = intermediate; 4 = rough; 5 = very rough

Overall liking: 1 = dislike very much; 2 = dislike; 3 = intermediate; 4 = like; 5 = like

Sensory evaluation of products

Sensory evaluation was carried out on the first day of sausage production. The stored products were removed from a refrigerator and allowed to thaw for three hours under normal room temperature. They were then grilled in an electric oven (Turbonfan, Blue seal, UK), sliced into 2cm thickness and wrapped with coded aluminium foil. The grilled products were presented to the panelists under conditions of controlled lighting. Panelists were provided with water and pieces of bread to serve as neutralizers in between products.

Proximate analysis

The products were analysed for moisture, crude fat and crude protein contents according to the methods of the AOAC (1999).

Mineral analysis

Procedure:

A total of 2 g of each sausage sample was put into a 100 ml borosilicate beaker and 6 ml of concentrated nitric (HNO_3) acid and 1 ml of hydrogen peroxide (H_2O_2) were added to it in a fume chamber. The beaker was covered with a cling film and placed on a hot plate and digested for 3 hours at a temperature of 45°C. After the acid digestion, the sample was transferred into a 100ml measuring cylinder and was topped with 50ml distilled water. After this, the whole content was transferred into a test tube for Atomic Absorption Spectrometry (AAS) analysis.

The digest was then assayed for Iron (Fe), Copper (Cu), Zinc (Zn), Selenium (Se), Sodium (Na) and Calcium (Ca) using VARIAN AA 240FS Atomic Absorption Spectrometer in an acetylene- air flame. Reference standards (Sigma-Aldrich Chemie GmbH) was used for the elements of interest, blanks and duplicates of samples were digested under the same conditions as the samples. These served as internal positive controls.

Table 1: Mineral composition of sweet basil leaf powder (mg/kg)

Mineral	Sweet basil
Calcium	12,800
Manganese	0.10
Iron	12.40
Zinc	0.20
Selenium	0.01
Potassium	90,600
Copper	0.11

Source: Field data, 2016

Statistical analysis

The data obtained from sensory evaluation were analysed using General Linear Model (GLM) of Analysis of Variance (ANOVA) of GenStat 3rd edition whilst data for proximate and mineral composition of the products were analysed using One-Way Analysis of Variance (One-Way ANOVA) of GenStat 3rd edition. Where significant differences were found, the means were separated using Tukey Pair Wise comparison at 5% level of significance.

Results and discussion

The addition of basil leaves powder had significant ($P<0.001$) effect on the colour of the sausages (Table 2). The dark brown colour of basil leaf powder was imparted to the sausages. This finding disagrees with Teye *et al*. (2013) when basil leaf paste was included up to 4g/kg meat in beef burgers. This could be as a result of the higher inclusion level of basil in the product (up to 8g/kg meat). Colour and product appearance are very important criteria that influences consumer buying decisions, as it indicates the freshness or otherwise of the product (Boles and Pegg, 2010). It was expected that the dark colouration of the basil products would have had a negative effect on the acceptability of the products but that was not the case. This is an indication that the inclusion of basil leaf powder up to 8g/kg would not have any adverse effect on the patronage of the products. There were no significant ($P>0.05$) effect on the aroma, flavour intensity, flavour liking, texture and overall liking of the beef sausages. The use of sweet basil leaves powder up to 8g/kg meat resulted in products with similar characteristics as the control products probably because the levels of inclusion were not high enough to cause its flavour and effects to be felt in the sausages.

Table 2: Sensory characteristics of beef sausages spiced with basil leaf powder

Parameter	T0	T1	T2	T3	S.e.d	Sig
Colour	2.9[b]	3.3[a]	3.3[a]	3.6[a]	0.3	***
Aroma	3.2	3.0	3.2	2.9	0.3	Ns
Flavour intensity	2.7	2.8	3.3	3.0	0.3	Ns
Flavour liking	3.5	3.4	3.2	2.9	0.3	Ns
Texture	2.7	2.8	2.6	3.3	0.5	Ns
Overall liking	3.8	3.5	3.2	3.1	0.3	Ns

Ns = no significant difference S.e.d = standard error of difference of means. Means on the same row with the same superscript are not significantly different, ***=P<0.001.

The addition of basil leaves powder resulted in a significant (P<0.001) effect on the colour of the frankfurter sausages (Table 3).The dark brown colour of basil was imparted to the frankfurter sausage. The flavour intensity of the product was significantly affected (P>0.001) by the basil leaves powder with the basil products having stronger flavour. There were significant differences (P<0.01) among the treatment in terms of flavour liking and overall liking of the products. The control was more accepted by the panelists than the sausages spiced with sweet basil leaf powder (Table 3).

Table 3: Sensory characteristics of frankfurter sausages spiced with basil leaf powder

Parameter	T0	T1	T2	T3	S.e.d	Sig
Colour	1.9[c]	2.8[b]	3.5[a]	3.8[a]	0.4	***
Aroma	3.4	3.6	3.4	3.4	0.3	Ns
Flavour intensity	2.4[c]	3.5[b]	3.6[b]	4.2[a]	0.4	***
Flavour liking	4.4[a]	3.7[b]	3.6[b]	3.4[b]	0.3	**
Texture	2.6	2.6	2.9	2.5	0.3	Ns
Overall liking	4.7[a]	3.8[b]	3.6[b]	3.5[b]	0.4	**

Ns= no significant difference S.e.d = standard error of difference of means. Means on the same row with the same superscript are not significantly different, *=P<0.01, ***=P<0.001

Table 4 shows the proximate composition of beef sausages containing sweet basil. All the parameters measured were not significantly affected (P>0.05) by sweet basil leaves powder.

Table 4: Proximate composition beef sausages spiced with basil leaf powder

Parameter	T0	T1	T2	T3	S.e.d	Sig
Moisture	74.4	76.3	76.3	77.9	1.4	Ns
Protein	18.3	19.9	18.8	18.6	0.5	Ns
Fat	8.5	7.8	7.9	7.9	0.4	Ns

Ns= no significant difference S.e.d = standard error of difference of means.

This indicates that the inclusion of sweet basil leaf powder as a spice in beef sausages would not have any adverse effect on its nutritional qualities.
The inclusion of sweet basil leaf powder in frankfurter sausages had no significant (P>0.05) effect on the moisture and protein content (Table 5). The incorporation of sweet basil leaf powder did not have any impact on the crude protein content of the beef sausages. According to Farrell (1990), sweet basil leaf contains about 14% crude protein. However, the inclusion of basil leaf powder up to 8g/kg in beef sausages did not significantly improve the crude protein content of the products in this study.

The similar difference in moisture indicates that frankfurters prepared with sweet basil leaf powder would equally be juicy as the control.

Table 5: Proximate composition of frankfurter sausages spiced with basil leaf powder

Parameter	T0	T1	T2	T3	S.e.d	Sig
Moisture	74.3	74.3	75.1	75.6	1.0	Ns
Protein	21.70	21.9	20.3	19.3	4.7	Ns
Fat	17.7^{a}	15.2^{b}	14.9^{bc}	13.7^{c}	1.1	*

Ns = no significant difference S.e.d = standard error of difference of means, Means in the same row with the same superscript are not significantly different, *=P<0.05.

However, there was significant difference (P<0.05) in the fat content with the control being significantly higher than the basil products. The difference in fat could be due to the incorporation of sweet basil. Consumers are more cautious with respect to fat consumption as far as their health is concerned. This indicates that basil will not have a detrimental effect on the health of consumers when included in frankfurter sausages.

Mineral composition of the basil beef sausages
Minerals are defined as inorganic substances in all body tissues and fluids for the preservation of specific physiochemical processes essential to life (Erubetine, 2003). The calcium content of the basil products (T2 and T3) was higher than the control. Sweet basil contains minerals such as calcium, iron magnesium, zinc and many more according to Leonard et al. (2003). Also, the data obtained from the field (table 1) showed that basil contains appreciable amount of calcium (12,800 mg/kg). Hence the difference in terms of calcium could be as a result of sweet basil leaf powder incorporation. Calcium is good for the development of strong bones. The products from basil could be beneficial to the health of humans.
The copper content of the basil products was significantly higher (P<0.001) than the control. The inclusion of basil was able to provide up to about 3% of the daily requirement of copper needed by humans. The control products had significantly (P<0.001) higher iron content than the basil products. The basil beef sausages had significantly higher

(P<0.001) zinc content (T3 and T4) as compared to the control. It means that basil products were a better source of zinc compared to their control. Zinc is an essential mineral found in all body fluids, organs and tissues and represents approximately 1.5-3g of adult human weight (Deshpande et al., 2013). This would be an advantage to the health of humans when basil beef sausages are consumed. The selenium content of the basil products was significantly higher (P<0.01) than the control. Selenium works with vitamin E to protect cells from damage that may lead to cancer, heart related diseases and other health problems (Nutrition Reference Guide, 2013). The inclusion of basil increased the selenium content of the beef sausages which is good for consumers. The basil products were significantly higher (P<0.001) in sodium than the control. The high sodium content in the basil leaves (Table 1) contributed to a higher sodium content of the beef sausages. All the products were able to supply in abundance the recommended daily intake of sodium. This means that just a small amount of the beef sausage consumed can supply enough sodium for the body.

Mineral composition of the sausages

Table 6: Mineral composition (mg/kg) of basil beef sausages

Minerals	T0	T1	T2	T3	S.e.d	Sig
Calcium	777.5^{a}	792.50^{a}	369.00^{c}	633.00^{b}	2.40	***
Copper	0.02^{b}	0.02^{b}	0.04^{a}	0.04^{a}	0.00	***
Iron	1.00^{a}	0.77^{c}	0.81^{b}	0.87^{b}	0.00	***
Sodium	63100.00^{c}	70400.00^{b}	77500.00^{a}	78200.00^{a}	1706.00	***
Selenium	0.01^{b}	0.02^{a}	0.01^{b}	0.02^{a}	0.00	**
Zinc	0.24^{b}	0.26^{b}	0.30^{a}	0.32^{a}	0.00	***

Ns = no significant difference Sed = standard error of difference of means. Means on the same row with the same superscript are not significantly different, **=P<0.01, ***=P<0.001.

There were significant differences (P<0.001) in the concentration of calcium among frankfurter sausages (Table 7). The control had a higher (P<0.001) calcium content than the basil sausages. The results from Table 1 indicates that sweet basil leaves are a good source of calcium. This might have imparted the frankfurter sausages. Calcium is good for the development of strong bones. It would therefore be beneficial to the health of humans.

The iron content of the basil product was significantly higher (P<0.001) than the control product with T2 and T3 being the highest. The iron content of the products was significantly improved with the inclusion of basil. Iron serves as a carrier of oxygen to tissues from the lungs by red blood cell haemoglobin, as a transport medium for electrons within cells, and as an integrated part of important enzyme systems in various tissues (Nutrition Reference Guide, 2013). The improvement of the iron content of the products by basil inclusion may help curb anaemic situation among humans. The basil frankfurter sausages had significantly (P<0.001) higher zinc content as compared to the control. It means that basil products were a better source of zinc compared to their control. This would be an advantage to the health of humans when basil beef sausages are consumed. The high sodium content in the basil leaves contributed to a higher sodium content of the beef sausages. All the products were able to supply in abundance the recommended daily intake of sodium. The selenium content of all the products did not differ from each (P>0.05).

Table 7: Mineral composition (mg/kg) of basil frankfurter sausages

Minerals	T0	T1	T2	T3	S.e.d	Sig.
Calcium	797.50[a]	792.50[a]	369.00[c]	633.00[b]	2.40	***
Copper	0.01[b]	0.02[b]	0.03[a]	0.04[a]	0.00	***
Iron	1.60[c]	1.64[c]	1.80[b]	4.21[a]	0.00	***
Sodium	80200.00[d]	83700.00[c]	85200.00[b]	94200.00[a]	291.60	***
Selenium	0.02	0.02	0.02	0.03	0.00	Ns
Zinc	0.50[c]	0.60[b]	0.60[b]	0.70[a]	0.00	***

Ns = no significant difference S.e.d = standard error of difference. Means on the same row

Conclusion

The inclusion of basil leaves powder did not have any adverse effect on the sensory attributes of both beef and frankfurter sausages. The crude protein, crude fat and moisture content of the sausages were not negatively affected by basil. Basil was found to be a rich source of both major and micro minerals.

Recommendations

- Meat processors can produce sausages with basil leaves.
- Basil leaves powder can be used up to 8g/kg of sausage without any adverse effect.
- Proper packaging of sweet basil leaves powders should be introduced on our local markets.

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