AJFAND ONLINE
Volume 9 No. 2 2009
March 2009
ISSN 1684-5374
AFRICAN JOURNAL OF FOOD AGRICULTURE NUTRITION AND DEVELOPMENT

THE EFFECTS OF ALTERNATIVE FUEL TYPES ON THE ORGANOLEPTIC QUALITIES OF SMOKED COARSE PORK SAUSAGES

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Volume 9 No. 2 2009
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ABSTRACT

This study was carried out to assess the effects of alternative smoking fuel types on the organoleptic qualities of coarse pork sausages. The sausages were produced with lean pork (2.5 kg) and pork fat (0.5 kg), minced, mixed with spices and stuffed into natural casings. They were grouped into four and each group was smoked with one of four fuel types: sawdust (control, C), corn cobs (CC), groundnut pods (GP) or soybean residue (SBR) for fifty minutes and stored for assessment in two batches on the day after production and fourteen days later. The attributes assessed were colour, taste, flavour and texture of the smoked sausages. The products were grilled to a core temperature of 70^{o}C, sliced into pieces of 2.0cm in length and served to trained taste panelists in coded aluminum foil for sensory evaluation. A five-point category scale was used for the evaluation. There were no significant differences among the fuel types on the qualities of the smoked pork sausages. The fuel types imparted a desirable brownish colour and a moderate 'smoky' flavour in the sausages resulting in a pleasant taste and these qualities were found to persist after freezing for fourteen days. The alternative fuel exhibited different characteristics during the smoking process. The SBR was found to burn faster than all the other fuels and therefore, would be needed in relatively larger quantities than any of the fuel types for meaningful economic use. The CC had the tendency to flame easily, burn quite fast and requires occasional sprinkling with water to enhance smouldering and smoke production. The moistened GP were observed to produce the best smoke comparable to standard fuels like hardwoods. These alternative fuels therefore, have some potential for use in smoking pork sausages without marked deviations from the conventional products smoked with sawdust. They could, therefore, serve as substitutes or supplementary fuel to the use of sawdust.

Key words: smoking, fuel, organoleptic, pork, sausages

INTRODUCTION

Smoking was originally intended to extend the shelf life of the products and is one of the methods mostly used in the preservation and processing of meat in Ghana and most parts of Africa [1]. Smoking later became a method of producing products with a unique flavour and appearance. A 'smoky' aroma, colour and flavour have become associated with desirable qualities in certain meat products [2]. Apart from the organoleptic benefit, smoke constituents produce bacteriostatic and bactericidal action during treatment such that at the end of the smoking process, the product's microbial population is practically zero [2].

The type of wood undergoing pyrolysis determines the composition of the smoke, its properties and the properties of the smoked product [2, 3]. The combustion of resinous or softwoods generates smoke that consists chiefly of phenols and cresols that impart a rather 'heavy' aroma and bitter flavour to the product whereas smoke obtained from the pyrolysis of wood from deciduous trees consist of compounds that contribute a mildly fragrant aroma in the smoked product [2,3]. The amount of the smoke deposited on the surface of a meat product is affected by the smoke density, the humidity and air movement in the smoker, the amount of tar in the smoke and the surface condition of the product [2, 3]. Sausage is smoked in order to pasteurize it and extend its shelf life as well as to impart a smoky flavour and improve its appearance [4]. Some components of smoke such as formaldehyde and creosote modify the outer surface of the product by tanning it and coagulation the muscle fibers of the meat or natural casing material and therefore have effect on the texture of the smoked product [4]

Meat processing in Ghana provides livestock farmers, especially pig farmers, with a ready market thereby providing the necessary encouragement for improved and increased production [5]. Even though there are religious and social prejudices against fresh pork, there exists greater demand for processed pork such as smoked pork sausages, bacons, and hams [5].

Dried wood is the main raw material for smoking; however, non-woody plant material such as leaves, stems and pods produce smoke upon combustion and could, therefore, be used to smoke meat and meat products [6]. Sawdust, wood shavings and firewood are the most used materials for smoking in Ghana. These materials are, however, not readily available in all parts of the country, especially areas outside the forest zone with minimal lumbering activities.

The aim of this study was to identify alternative smoking fuels that could be readily available as substitutes or supplement to sawdust and their effects on the qualities of smoked coarse pork sausages.

MATERIALS AND METHODS

Sources of fuel

The fuel samples for this experiment were collected from households and farms in Nyankpala, a town where the Faculty of Agriculture of the University for Development Studies is located about twenty kilometers from Tamale. Both groundnut pods (GP) and the corn cobs (CC) were collected from homes after the removal of the main products that is groundnuts and maize, respectively. They were sufficiently sun-dried. The soybean residues (SBR) (vines and pods) were collected from farms where they had been left after harvesting. Only dried samples were collected. The control material sawdust (C), was collected from the only sawmill in the locality.

Manufacture of sausages

Two and a half kg of lean pork was cut into pieces and a half kg of pork fat was added. Both the lean and fat was minced through a 5mm sieve, using a table-top mincer (Talleras Rammon, Spain), Spices such as 16g of curing salt, 10g of mixed spices, 5g of chili pepper and 0.5g of black pepper were added to the minced meat. The minced meat plus spices was thoroughly mixed using a mechanized mixer (Talleras Rammon, Spain). The spiced minced meat was stuffed into natural casings using a hydraulic filler (Talleras Ramman, Spain) and linked manually at regular intervals.

Methods and materials for smoking

The smoke was produced by the slow combustion method of igniting the fuel types SBR, GP, CC and C directly beneath the products. The equipment used was a modified version of the hearth and a flue system. It was a two-door, rectangular walk-in smoking chamber with the width of 1.2m, length 2m and height 2m. It was constructed with wood and covered with galvanized roofing sheet. The various smoking fuels, except the control were moistened to prevent flaming or burning and ignite in the center of the chamber. The sausages were divided into four groups and hung on four racks. Each rack was labeled according to the four fuel types to be used for smoking as follows: SBR, GP, CC and C. Each group of sausages was smoked using the designated fuel for fifty minutes. Each rack with the sausages hanging on it was hung by means of lateral supporting rafts in the smoker directly above the smoke source. The smoking method could be described as the cold smoking. The smoked products were cooled, packaged, labeled and frozen for sensory evaluation at later dates that is the day after production and fourteen days after frozen storage.

Preparation of Products for Sensory Evaluation

The frozen sausages were thawed at 1^{o}C for about six hours to ensure that they were defrozen before smoking. The thawed sausages were grilled to a core temperature of 70^{o}C. The grilled products were sliced into pieces of about 2cm long, wrapped in coded aluminium foil and served to the panelists. The panelists were served four coded products each together with a piece of bread to act as a neutralizer between tests. The panelists were seated such that they did individual assessment of the products and thus could not influence each other.

Sensory evaluation
Fourteen panelists were selected and trained according to the British Standard Institution guidelines to evaluate the products [7]. A five-point category scale was used for the evaluation. The panelists were asked to evaluate each of the four samples on the following parameters:

Colour: yellow-1; yellowish-brown-2; pale-brown-3; reddish-brown-4; dark-brown-5
Smoky flavour: very weak-1; weak-2; moderate-3; strong -4; very strong-5
Taste: acrid-1; pleasant-2; indeterminate -3; bitter-4; sour-5
Texture: very smooth-1; smooth-2; indeterminate-3; coarse-4; crisp-5

Statistical Analysis
Data obtained from the assessment were analysed using a general linear model of analysis of variance of Minitab, version 13.0 (MINITAB, PA, USA).

RESULTS

The results of the sensory evaluation of the products on a day after smoking are presented in Table 1, whilst the results of the sensory evaluation after 14 days of deep freezing are presented in Table 2. In both cases, the panelists detected no significant differences among the fuel types for all the parameters considered.

Colour
The panelists detected no significant differences among the treatments with respect to colour ($P \geq 0.05$) (Table 1). Generally, the panelists described the products smoked with CC as reddish-brown and those smoked with C, SBR and GP as pale brown (Table 2). After freezing the smoked products for 14 days, however, panelists generally described the colour as pale brown, except for those products smoked with soybean residue, which they described as reddish-brown.

Flavour
There were no significant differences among the treatments with respect to their effect on the flavour of the smoked products ($P > 0.05$) (Tables 1 and 2). The panelists judged the strength of the smoky flavour for all the products during the first assessment and after fourteen days of storage as moderate.

Taste
The taste assessment of the smoked products showed no significant differences among the treatments ($P > 0.05$) (Table 1 and 2). The panelists described the taste of the products as pleasant irrespective of the type of fuel used. This description persisted after fourteen days of storage.

Texture
Assessment by panelists showed no significant differences among the various fuels with respect to texture of the smoked sausages ($P \geq 0.05$). The panelists generally could neither describe the texture of the products smoked with CC and C as smooth

nor as coarse but the texture of products smoked with SBR residue and GP were described as coarse though not significant.

Smouldering characteristics of fuel types

During the smoking process, it was observed that the dried CC tended to flame easily and burn quite fast and had to be sprinkled with water occasionally to enhance smouldering and smoke production. The moistened GP was observed to produce thicker or denser smoke, whilst the SBR was found to burn faster than all the other fuels. The control (sawdust) had the least tendency to flame and thus required least attention during smoking.

DISCUSSION

Colour

It was observed that the colours of the smoked products were not deeper than that of the fresh sausages before smoking implying that, the fuels did not appear to have imparted much deeper colour to the smoked products. The depth of the colour obtained from smoking is related to the amount of tar in the smoke [2]. This suggests that the various fuels used in this study did not produce much tar in their smoke, which may be an advantage in reducing the risk of exposing consumers to health problems associated with tar intake.

The typical colouration of smoked products arises from interactions between the carbonyl constituents of the smoke and the amino groups in the meat [8,9]. Smoking usually has a browning effect on the smoked product as a result of the Maillard reaction [8,9]. The depths of the brown colourations obtained in this trial using the various fuels may be considered as desirable as it conforms to description of acceptable colours when other popular materials were used [6].

Flavour

The moderate smoky flavour intensities detected in the smoked products suggests that the fuel types seemingly, produced smoke with similar constituents with reduced phenolic and resin contents [3, 10, 11]. The stable flavour intensity over the fourteen days storage indicates that the phenols content in the various smokes was enough to prevent the fats in the sausage from turning rancid [10].

Taste

The attributes of taste which include; pleasant, acidity, bitterness, sour, saltiness and sweetness are mostly unaffected by processing but are largely determined by the formulation used [12]. A pleasant taste implies that the product is desirable for consumption and is not very acidic, irritating, bitter, sour, salty or sweet. The description of taste of the sausages as pleasant irrespective of the type of fuel used confirms with the effects shrubs and aromatic plants such as dried heather, dried rosemary, laurel, thyme, marjoram and dried Sage have on the organoleptic qualities of smoked products [6].

Texture

Textural evaluation in the mouth relies on the feel of the food in the mouth [13]. The various fuels did not influence the texture of the products and as such, only the original coarse mincing was detected. The fuel types apparently had similar effects on the movement of proteins to the surface of the sausage during smoking [4], hence the mouth feels experience was not influenced.

Smouldering characteristics and smoke density

The burning characteristic of CC which includes; flaming easily, burning very fast and producing very light some conforms to the description of the smoke produced by burning vine pruning [6]. The moistened GP were observed to produce denser smoke characteristic of desirable smoking hardwoods such as the oak hickory trees [3, 6]. The SBR was found to burn faster than all the other fuels and, therefore, would be needed in relatively larger quantities than any of the fuel types for meaningful economic use. The burning behaviour of the CC and SBR can be improved by soaking them in water for several hours or overnight to prevent them from burning quickly and enhance their smoke generation [3].

CONCLUSION

This study had shown that all the fuel types imparted a moderate 'smoky' flavour on the products resulting in a pleasant taste. These qualities were found to persist after freezing the sausages for fourteen days. These alternative fuels (soybean residue, corn cobs and groundnut pods or shells) have the potential for use in smoking coarse pork sausages without any negative effect on products qualities especially the moistened GP. They could therefore serve as substitutes or supplementary fuel to the use of sawdust.

Table 1: Effects of fuel types on the eating qualities of smoked pork sausages

Parameter	C	SBR	CC	GP	sem	P≤ 0.05
COLOUR	3.4	2.9	3.6	3.0	0.2127	0.092
SMOKY FLAVOUR	2.8	3.2	3.2	3.0	0.2649	0.618
TASTE	2.4	1.6	2.2	2.2	0.4375	0.622
TEXTURE	3.4	3.6	3.4	3.8	0.2881	0.732

SEM – standard error of mean, P – Probability (0.05)

Table 2: Effect of Fuel Type on the Eating Quality of Smoked Pork Sausages after fourteen days of Cold Storage

Parameter	C	SBR	CC	GP	sem	P≤0.05
COLOUR	3.2	3.5	3.2	3.0	0.2774	0.650
SMOKY FLAVOUR	2.9	2.8	2.8	2.9	0.2739	0.987
TASTE	1.6	1.7	2.1	2.1	0.4953	0.838
TEXTURE	3.0	3.7	2.7	3.5	0.3193	0.124

SEM – standard error of mean, P – Probability (0.05)

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