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EFFECT OF SMOKE FROM SELECTED FUELWOOD SPECIES ON THE MICROBIOLOGICAL SAFETY AND PROXIMATE COMPOSITION OF BALANGU MEAT

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ABSTRACT

Balangu was produced using wood from four different wood species including Azadirachta indica, Parkia biglobosa, Guiera senegalensis, Vitellaria paradoxa and Oven (control) making five treatments to evaluate their effect on bacteriological load and proximate composition. The bacteria isolated include, E. coli, S. aureus, Salmonella, and S. pyogenes. Results indicated that fuelwood species had significantly affected all the proximate parameters evaluated. Among the treated samples, Vitellaria paradoxa had proven to exert more influence as it engendered higher crude protein than others. Microbiological evaluation showed that the fuelwood species treated samples had low bacterial count than the control samples. The bacterial count ranged between 3.87×10^6 cfu/g in G. senegalensis to 2.60×10^6 cfu/g in V. paradoxa. Vitellaria paradoxa had lower bacterial count. The organisms isolated include, E. coli (41.7%), S. aureus (2.5%), Salmonella (2.5%), and S. pyogenes (8.3%). It was concluded that fuelwood species had effect on proximate composition of balangu with V. pardoxa having better performance since it engendered higher crude protein. Fuelwood species had effect in eliminating bacterial growth and proliferation with V. paradoxa treated samples having lower bacterial count. V. paradoxa wood had better performance and could be useful in the production of balangu since it enhanced high crude protein content and low bacteria count.

Keywords: Fuelwood, Smoke, Microbiological Safety, Proximate Composition, Balangu

INTRODUCTION

Balangu is a Nigerian traditional ready-to-eat meat product that is reported to be popular and highly cherished (Ribah *et al.*, 2013). *Balangu* refers to meat that has been grilled over wood or coal fire. Specifically, no seasoning is applied to bring out the natural flavor of the particular type of meat which may be of goat, sheep or cattle. Salt and spices could be added to taste after preparation (Ribah *et al.*, 2018). Wood has been one of the oldest sources of fuel and the most commonly used source of fuel in the world for centuries, after the discovery of fire itself (Danshehu, 1995; FAO, 2010). In some poor African nations, fuel wood still accounts for more than 90% of national energy consumption (Sambo, 2009). Some wood species are believed to have substances which could have negative effects on consumers of meat smoked with such wood (Adeoti *et al.*, 2010). Also, studies have shown the possibility of synthesizing dangerous molecules like Polycyclic Aromatic Hydrocarbons (PAH) during smoking transformation. Gomez *et al.* (2011) reported that the PAH content in smoked fish is four times high as the one found in the flesh of fresh fish. Although many wood types may be used as fuel for meat smoking, health considerations should be among the many factors influencing the choice of wood, aside its local availability. The fuel wood preferences of most meat smokers are also related to the physical characteristics of the wood and how they affect the smoked product since different fuel woods may affect the quality of the smoked meat differently (Campbell-Platt *et al.*, 1980). According to Etras (2000), smoking is a treatment to some products, to provide special colour and flavor as well as antioxidative and antimicrobial effects for the products. The effect of smoking on the attributes of meat is as a result of the smoke constituents and the reaction products between the smoked meat and the smoke (Hitzel *et al.*, 2013). According to Adeoti *et al.* (2010), smoking involves burning wood to create smoke or its condensates in order to preserve the products by utilizing the antimicrobial and antioxidant properties of the smoke components on the exposed surfaces of the products. In addition to its preservative effect, smoking uniquely modifies the sensory characteristics of poultry meat products. In fact, smoking has been found to induce desirable color and

**NSAP****47th Annual
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PROCEEDINGS**THEME
**SECURING ANIMAL
AGRICULTURE AMIDST
GLOBAL CHALLENGES**

flavor in various poultry products (Oluyemi *et al.*, 2012). Hence, the aim of this research is to evaluate the microbiological safety and proximate composition of *balangu* produced by using different fuel wood species.

MATERIALS AND METHODS

Study Area

The experiment was carried out at Biochemistry laboratory of the Department of Animal Science, Kebbi State University of Science and Technology Aliero. Aliero is town in Kebbi state in northern Nigeria.

Experimental Design

The experiment involved five treatments (oven (control) and four (4) different fuel wood species that are commonly used around the study area, namely: Neem tree (*Azadirachta indica*), Locust tree (*Parkia biglobosa*), Shea tree (*Vitellaria paradoxa*) and Sabara (*Guiera senegalensis*). They were replicated three times in a Completely Randomized Design (CRD).

Preparation of Balangu Samples

Three kilograms (3 kg) of semi membranous muscle of beef was purchased from the market and cleaned of all visible fats and connective tissues and then washed. The washed lean meat was divided into five. One part was used to produce balangu in an oven to serve as control, while the four parts were administered as a treatment each. The fresh meat was placed on a grill over a locally made drum kiln and smoked using the four fuel wood species for 75 minutes according to local production. The smoking process involved placing a piece of cardboard over the meat to cover the meat during the process. The piece of cardboard traps the smoke to enable it act directly on the meat samples. When the smoked balangu production was completed and allowed to cool for 30 minutes, a clean knife was used to cut the meat into pieces of approximately 30g each and stored in a refrigerator at 4°C for further analysis.

Microbiological Analysis

Microbiological analysis was conducted at the Microbiology laboratory, Kebbi State University of Science and Technology, Aliero, using standard procedure on general media. Biochemical tests were conducted to identify isolates according to the procedures of AOAC (AOAC, 2000).

Determination of Proximate Composition

Proximate composition was determined using the procedures of Association of Analytical Chemists (AOAC, 2000).

Data Analysis

Microbiological data was expressed as colony forming units per gram (cfu/g) of balangu. The data on proximate composition was subjected to general linear model analysis of variance (ANOVA) and means were separated using the Tukey test at 5% level of significance.

RESULTS AND DISCUSSION

Proximate composition of balangu produced using different fuel wood species

The result of proximate composition of balangu produced from different fuel wood species is presented in Table 1. There were significant differences ($P < 0.05$) in all parameters evaluated among treatments.

The moisture content of the balangu sample range from lower (47.5%) in *A. indica* to higher (49.0%) in *V. paradoxa*. The reduced moisture content in *A. indica* is desirable as this can affect quality of sample positively in terms of storage. The crude protein of the balangu samples range from 25.0% in *A. indica* to 27.1% in *V. paradoxa*. The range value obtained with regards to the crude protein content which was reported in a similar experiment by Iheagwara and Okonkwo (2016). *V. Paradoxa* and *P. biglobosa* had the higher lipid content (7.5% each) and *A. indica* had the lowest lipid content (4.300%). The Nitrogen content of the balangu sample



range from 4.0% in *A. indica* to 4.4% in the control. The ash content of the balangu samples range from 6.5% in the *V. paradoxa* to 9.5% in *A. indica*.

Table 1: Proximate Composition of balangu produced using difference wood species

FUELWOOD SPECIES	PARAMETERS				
	Moisture Content	Crude Protein	Lipid	Nitrogen	Ash
Control	48.50 ^{ab}	26.3 ^b	5.5 ^{ab}	4.4 ^a	8.5 ^{ab}
<i>A. indica</i>	47.50 ^b	25.0 ^d	4.3 ^c	4.0 ^d	9.5 ^a
<i>P. biglobosa</i>	48.00 ^{ab}	26.2 ^b	7.5 ^a	4.2 ^b	7.6 ^{bc}
<i>G. senegalensis</i>	48.50 ^{ab}	25.7 ^c	5.8 ^b	4.1 ^c	7.5 ^{bc}
<i>V. paradoxa</i>	49.00 ^a	27.1 ^a	7.5 ^a	4.3 ^a	6.5 ^c
SE	0.29	0.07	0.28	0.007	0.33

a,b,c,d: Means with different superscripts along the same column differ significantly (P<0.05).

Bacterial load in balangu

Table 2 shows the result for bacteria load of balangu produced using different wood species. Results indicated that the highest number of bacterial load was observed in balangu samples prepared using oven.

Table 2. Bacterial load of balangu produced using different fuel wood species

Fuel wood species	TVC (CFC/g)
Control	5.27×10 ⁶
<i>Azadirachta Indica</i>	3.20×10 ⁶
<i>Parkia Biglobosa</i>	3.72×10 ⁶
<i>Guiera senegalensis</i>	3.87×10 ⁶
<i>Vitellaria paradoxa</i>	2.60×10 ⁶

The higher number of bacteria colonization (5.27×10⁶ cfu/g) in the control compared to others could be due to the absence of the antimicrobial effect in the oven prepared samples compared to the fuelwood treated samples which was largely reported to possess antimicrobial effects (Oluyemi *et al.*, 2012; Etras, 2000). Also, among the treated samples, *V. paradoxa* had the least bacteria (2.50×10⁶ cfc/g) load indicating that the smoke content of *V. paradoxa* could have a significant lethal effect on the growth of the bacteria species investigated.

Bacteria isolates from balangu produced using different fuel wood species

The result for bacteria isolates from balangu samples is shown in Table 3. Results indicated that four (4) types of bacteria species were isolated from the balagu samples including *E.coli*, *Salamolla*, *S. aureus* and *Strephylococcus pyogenes*.

The species of bacteria isolated from this study were similarly reported in some previous research for the same product, such as the works of Ribah *et al.* (2018); Ogbonna *et al.* (2012) and Edema *et al.* (2008). *Escherichia coli* had shown more incidence in the current study. This however indicated that smoking had little effect in completely eliminating these bacteria species.

Table 3. Distribution of bacteria isolated from balangu produced by using different fuel wood species.

Organisms	Frequency	Percentage (%)
<i>Escherichia coli</i>	5	41.7
<i>Staphylococcus aureus</i>	3	2.5
<i>Salmonella sp</i>	3	2.5

**NSAP****47th Annual Conference**
(JOS 2022)**CONFERENCE PROCEEDINGS**THEME
SECURING ANIMAL
AGRICULTURE AMIDST
GLOBAL CHALLENGES

<i>Streptococcus pyogenes</i>	1	8.3
<i>Total</i>	12	100

Conclusion and Recommendation

It was concluded that *V. paradoxa* had better performance since it engendered higher protein content and *V. paradoxa* treated samples had lower bacterial count than other wood species studied. The microorganisms isolated are of public health significance since their presence in balangu could pose health risks.

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