

**NSAP****47th Annual Conference**
(JOS 2022)**CONFERENCE PROCEEDINGS**THEME
SECURING ANIMAL
AGRICULTURE AMIDST
GLOBAL CHALLENGES**COMPARATIVE EVALUATION OF LIQUID SMOKE MADE FROM *PARKIA BIGLABOSA*, *VITELLERIA PARADOXA* AND *EUCALYPTUS GLOBULUS* ON THE MICROBIAL PROPERTIES OF GRILLED BROILER CHICKEN MEAT****Authors:** *¹Yaqoob, R., ²Yaqoob, U., ¹Ahmad, Y., ¹Muhammad H., ¹Shehu, F. N., ³Adamu, H¹Department of Livestock and Fisheries, National Agricultural Extension and Research Liaison Service, Ahmadu Bello University Zaria, Kaduna State, Nigeria.²Department of Science Laboratory Technology, Waziri Umaru Federal Polytechnic, Birnin-Kebbi.³Department of Food Science and Home Economics, National Agricultural Extension and Research Liaison Service, Ahmadu Bello University Zaria, Kaduna State, Nigeria.***Corresponding Author- Email:** ummnusaybah29@gmail.com; **Phone no:** +234 7033587008.

Abstract: This research compares the antimicrobial properties of liquid smoke made from *Parkia biglabosa*, *Vitellaria paradoxa* and *Eucalyptus globulus* when applied to broiler chicken meat. Completely Randomized Design (CRD) was used for this experiment. The antimicrobial effect of the liquid smokes on grilled broiler chicken were evaluated using the pour plate count method to determine their Total Aerobic Plate Counts (TAPC) and Total Fungal Count (TFC). The result revealed no significant difference ($P > 0.05$) across the treatment for TAPC. However, significant difference ($P < 0.05$) was observed for TFC with the least count recorded for Liquid Smoked Meat *Parkia* (LSMP- 6.3×10^1) and Liquid Smoked Meat *Eucalyptus* (LSME- 3.3×10^1) whose values were statistically similar. During the storage periods, day 3 had the highest microbial count across all the parameters monitored having the highest count of 7.1×10^4 for TAPC. This is followed by day 1 (8.25×10^2) and day 7 (2.17×10^3) whose values were statistically similar. From the result obtained, Liquid Smoke from *Eucalyptus* (LSE) showed the most versatile antimicrobial potential, though all the microbial count obtained from this study fell within the acceptable range (10^6 - 10^7) specified by the International Commission of Microbial Specifications on Foods.

Key words: Liquid Smoke, Microbial Properties, Storage Periods, Grilled Broiler Chicken**1.0 Introduction**

Liquid smoke, also termed as condensed smoke, wood vinegar or pyroligneous acid, is a high browning condensable liquids of pyrolyzed wood chips or sawdust which has the ability to preserve, flavour and impart characteristic smoke colour to food products (Rizal *et al*, 2020). The antimicrobial, colour and flavour properties of wood smoke are due to the presence of phenolic and carbonylic compounds naturally present in wood (Holley and Patel, 2005). The preservative action of the smoking process for foods depends upon factors such as processing temperature and partial dehydration. The chemical composition of liquid smoke depends primarily on the wood type (soft or hard) and moisture content of wood; the latter influences the pyrolysis temperature and duration of smoke generation (Rizal *et al*, 2020).

The choice of wood for this experiment was influenced by its availability. *Parkia biglabosa* (African Locust Bean), *Vitellaria paradoxa* (shea butter) and *Eucalyptus globulus* (*Eucalyptus*) are very common and widely spread in Nigeria, especially in the Northern regions. These woods have been used either singly or in combination for traditional smoking in Nigeria. The pyrolysis of wood produced from *Parkia biglabosa*, *Vitellaria paradoxa* and *Eucalyptus globulus* was reported in previous studies to have yielded 0.09, 3.33; 0, 3.47 and 0.09, 5.28 mg/ml of phenolic compounds and carbonylic compounds respectively. They were all acidic, with a pH ranging from 3.22- 4.20. Liquid smoke from *eucalyptus* had the highest acidity of 3.22 (Yaqoob *et al*, 2021)

Smoke extracts are being used to replace the traditional smoking system in most part of the world in processing varieties of homogenous meat products; one of such product is smoked grilled chicken. Grilled chicken is a popular processed meat product in Nigeria, it is categorized among the RTE (Ready to Eat) food products. Studies have been carried out on the antimicrobial activity (Indiarto *et al.*, 2019), antioxidant effects

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(Soares *et al*, 2016) and influence on organoleptic properties (Yaqoob *et al*, 2021) of smoke flavourings (liquid smoke). However, there is limited information available on the effects of wood varieties like Parkia, Sheabutter and Eucalyptus wood used in making the liquid smoke on the shelf stability when applied to broiler chicken meat, hence, the need for this study. Being an all-natural antimicrobial in food (Lingbeck *et al*, 2014), it may also appeal to many consumers who tends to have concerns on food preserved using synthetic additive. Therefore, this study would be valuable for the industries and research communities in the food science and technology as it would give insights on producing a more uniform shelf stable meat products, thereby reducing the limitations of environmental pollution and the traditional livestock product marketing system.

2. Materials and Methods

2.1 Experimental Materials

The materials used included liquid smoke from *Parkia biglabosa*, *Vitellaria paradoxa* and *Eucalyptus globulus*. Whole breast muscles of broiler chicken, salt (as seasoning), vegetable oil and charcoal grill.

2.2 Meat source and processing of broiler chicken meat

Whole broiler chicken breast meats numbering 15 were obtained from Department of Animal Science, Animal Product Laboratory, Ahmadu Bello University, Zaria. They were scored on the surface so as to allow uniform penetration of the experimental ingredients. The chicken breast meats were shared into three different treatment bowls containing five chicken breasts each. Ten (10) grams of salt and 20 *mls* of the individual wood vinegar (liquid smoke) were rubbed on the chicken per treatment bowl. It was then refrigerated for 30 minutes to allow proper infusion of the ingredients before grilling. The chicken meats were grilled on its crown on a charcoal grill to a core temperature of 75°C. Grilled meat samples from each treatment were wrapped with food grade paper and stored at room temperature. Samples were pulled at days 1, 3 and 7 of storage period for microbial analysis.

2.3 Microbiological analysis

The initial microbial count of the unprocessed fresh chicken meat was evaluated for their TAPC and TFC. Grilled liquid-smoked chicken meat samples were also evaluated at days 1, 3 and 7 of storage periods using the pour plate count method to determine their TAPC and TFC. This was carried out in conformity with the International Commission of Microbiology Specification for Food as outlined by AOAC (2005).

2.4 Data analysis

All data collected was subjected to analysis of variance (ANOVA) using the general linear model of SAS software (SAS, 2005). Significant differences among treatments mean were separated using the Duncan Multiple Range Test in the SAS Package.

3. Results and Discussion

3.1 Effect of Treatment and Storage Period on the Microbial Properties of Grilled Broiler Chicken

The mean counts for the effect of liquid smoke type on the microbial characterization of the broiler meat marinated with the different liquid smoke (Table 1) ranges from 1.4×10^4 - 3.8×10^4 and 3.3×10^1 - 1.6×10^2 for TAPC and TFC respectively. There was no significant difference on the microbial counts for TAPC. However, significant difference was observed in their TFC across the treatment. In general, LSE had least microbial count. This may be because the liquid smoke (LSE) used in the treatment had the highest acidity, titreable acidity and carbonylic compounds of 3.22, 0.46 and 5.28 mg/ml respectively (Yaqoob *et al* 2021). This in turn means that LSE showed the most versatile antimicrobial potential when compared with the other liquid smoke tested. This result validates what was reported by Milly (2003) who reported that the most effective liquid smoke fraction with the highest antimicrobial activity is one with low pH value and high carbonyl compound. The general variations observed in the microbial counts across the treatment could be attributed to the differences in the wood materials used and hence the composition of their liquid smoke, this is in agreement with Toledo (2008) who stated that the microbial inhibitory activity of a liquid smoke varies with different liquid smoke preparations. The microbiological analyses when compared with that of the fresh broiler chicken meat showed that the microbial counts on all the samples decreased with the application of liquid smoke.



Table 1: Main effect of the smoke source on the microbial properties of the grilled broiler chicken meat (cfu/g)

Parameters	Fresh	Liquid smoke type			SEM	LOS
		LSMP	LSMS	LSME		
TAPC	7.0x10 ⁶	2.2x10 ⁴	3.8x10 ⁴	1.4 x10 ⁴	27444.2	NS
TFC	1.3x10 ³	6.3x10 ^{1a}	1.6x10 ^{2ab}	3.3x10 ^{1a}	67.88	*

LSMP- liquid smoked meat from pakia, LSMS-Liquid smoked meat from sheabutter, LSME- Liquid Smoked meat from eucalyptus, TAPC- Total aerobic plate count, TFC- Total Fungal Count, cfu- coliform forming unit, ^{ab} – means within the treatments having different superscript differs significantly (P<0.05), SEM- standard error mean, LOS- levels of significance, NS- not significant, *-significant.

Significant (P<0.05) difference was observed on the effect of the storage periods on the microbial characterization of the grilled broiler chicken meat (Table 2). The microbial count observed in this study rose at day 3 and declined over time to storage day 7. These did not follow the trend reported by Indiarito *et al.* (2019) whose report showed an increase in the microbial counts as the length of storage increased. However, the trend was similar to the result of Ebabhamiegbegbho *et al.* (2011). The reason for the reduction in the microbial count of the liquid smoked chicken at day 7 may have been due to the further reduction in moisture content of the meat product since liquid smoke is known to induce dehydration (Zuraida *et al.*, 2011) which in the long run enhances the shelf life of the product as it become unfavorable for attack, growth and multiplication of spoilage organisms. All the mean values for the microbial counts (TAPC and TFC) of the grilled broiler chicken meat marinated with different liquid smoke though significantly (P<0.05) different, fell within the acceptable range (10⁶ -<10⁷) of the ICMSF (2014).

Table 2: Main effect of storage periods on the microbial characterization of grilled broiler chicken meat(cfu/g)

Parameters	Storage periods			SEM	LOS
	1	3	7		
TAPC	8.25x10 ^{2a}	7.1x10 ^{4b}	2.2x10 ^{3a}	13035.3	*
TFC	8.0x10 ^{1ab}	1.8x10 ^{2b}	0 ^a	56.57	*

TAPC- Total aerobic plate count, TFC- Total Fungal Count, CFU- coliform forming unit, ab – means within the treatments having different superscript differs significantly (P<0.05),SEM- standard error mean, LOS- levels of significance, *-significant.

Significant difference (P<0.05) was also observed in the interaction between the liquid smoke source and the storage periods on the grilled broiler chicken meat (Table 3). The results proved that liquid smoke affect the microbiological properties and the keeping quality of the final product, which is in concurrence with the findings of Toledo (2008); Swastawati (2008); Milly (2003) and Indiarito *et al.* (2020) in their findings on the antimicrobial properties of liquid smoke on different animal protein.

Table 3: Interaction effect of the smoke source and storage periods on the microbial characterization of broiler chicken meat

Param eter	Liquid smoke type and storage periods (day)									SEM	LOS
	LSMP			LSMS			LSME				
	1	3	7	1	3	7	1	3	7		
TAPC	2.0x10 ² a	6.3x10 ^{4e}	2.0x10 ³ b	2.1x10 ³ b	1.1x10 5g	2.5x10 3d	1.2x10 2a	4.0x10 4f	2.0x10 3b	16.7 4	*
TFC	0 ^a	1.9x10 ^{2c}	0 ^a	2.4x10 ² d	2.4x10 2d	0 ^a	0 ^a	1.0x10 2b	0 ^a	3.33	*

Superscript ^{abc...} – means within the treatments having different superscript differs significantly (P<0.05), LSMP- liquid smoked meat from pakia, LSMS-Liquid smoked meat sheabutter, LSME- Liquid Smoked meat eucalyptus, SEM- standard error mean, TAPC- Total aerobic plate count, CFU- coliform forming unit, LOS- levels of significance, *-significant.

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4.0 Conclusion and Recommendation

The foregoing analysis and results obtained has shown that among all the liquid smoke tested, Liquid Smoke Eucalyptus (LSE) performed the best in preserving the grilled broiler chicken meat throughout the 7 days storage period. This was expected since it had the highest acidity, titerable acidity and carbonylic compounds (3.22, 0.46 and 5.28 mg/ml respectively). Further studies should be carried out on the effectiveness of different dilution strength of liquid smoke from LSE. Also liquid smoke from nonconventional wood materials like sugarcane bagasse should be explored.

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