MICROBIAL LOAD AND SENSORY EVALUATION OF BROILER BREAST MEAT PRESERVED BY REFRIGERATION, SUNDRYING AND GROUNDNUT OIL

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Abstract
Many Nigerians are involved in poultry production whether at subsistence or commercial level yet, there is unavailability of quality poultry meat. This has been adduced to unstable power supply for preservation of dressed carcass and inadequate knowledge of alternative processing or preservation techniques. This study aimed at the possibility of immersing broiler meat in groundnut oil as a medium of preservation. Dressed carcasses were processed and preserved by refrigeration (Control: T1), sun-drying (T2) and immersion in groundnut oil (T3). Samples from each of the treatments were processed for microbial load and sensory evaluation using 9-point Hedonic Scale. The data were collected on preservation days 0, 7, 14 and 21. It was shown that *Proteus mirabilis, Bacillus firmus, Staphylococcus aureus, Klebsiella aerugenes* and *Aeromonas hydrophila* were recorded in all the treated samples. The responses of the panellists indicated that the meat samples appearance, was liked extremely (66.7%) and very much (33.3%) in all the treatments except, in T2 where 33.3% disliked the meat samples extremely. Also, it was observed that colour, aroma and texture were best in T3, fairly followed by T2 and T1 in that order. Consequently, broiler breast meat embedded in groundnut oil may be preferred to other form of processing and preservation methods hence, the need to intensify more efforts in improving on this inexpensive technique of broiler meat preservation.

Keywords: Broiler meat, microbial spoilage, processing and preservation,

Introduction

According to FAO (2010), poultry production is gaining popularity in the developing countries, due to its role in bridging the protein malnutrition and economic empowerment of the resources poor segment of the society. Poultry production is practiced in all levels ranging from subsistence to large scale commercial operations. Poultry meat and eggs are the most consumed animal protein unrestricted by any religion or culture in Nigeria. It was recorded that the poultry industry contributed about 25% to the country's Agricultural Gross Domestic Product. Nigeria presently produces above 550,000mt of poultry meat and 700,000mt of eggs per annum. Despite this, Nigeria is far from meeting her domestic demand when compared with developed countries. This situation has been worsened by animal product spoilage hence, the necessity to preserve the little available meat by preventing its contamination and spoilage.

The pathways by which such deterioration and spoilage occur are diverse including microbial, chemical and physical processes (FAO, 1990). Thus, meat preservation necessarily involves the application of measures to delay or prevent certain changes which render meat unsafe for consumption. Common methods of meat preservation include drying, curing, smoking, thermal processing, and refrigeration (chilling and freezing). Smoking is one of the most effective processes of meat preservation in Nigeria because, apart from its consequent flavour and colour attraction, it does not require high costs and electric power supply which is difficult to maintain in developing countries of the world but, it has led to deforestation for search of fire wood. Over the past years, there has been an on-going development of curing processes with natural ingredients designed to meet consumer demands and safety requirements for natural and organic processed meat (Heinz and Hautzinger, 2007). Bio-preservation has gained increasing attention as a means of naturally controlling the shelf-life and safety of meat products (Ogunbanwo and Okanlawon, 2006). The

utilization of spices possessing antimicrobial and antioxidant properties in various forms, like powder and essential oils (especially groundnut oil) have been reported (Shaltout *et al.*, 2016) yet, little is known about the use of groundnut oil as fat embedment in meat preservation. Although, refrigeration and sun-drying are common techniques, a lot is still required in poultry meat preservation particularly, in the rural areas with irregular power supply and inadequate sun-drying platforms. As a result, the present study examined the possibility of using groundnut oil embedment as preservative, compared to the conventional refrigeration and sun-drying techniques.

Materials and methods

The study was conducted at the Federal College of Animal Health and Production Technology Vom, Plateau State on Latitude 9^0 43'N and Longitude 8^0 45'E, altitude of about 4,200 FT (1280m) with average rainfall between 1,300 and 1,500. The average daily maximum temperature is 83.4^0F (28.6^0 C) and minimum of 62.6^0F (17^0C) with mean relative humidity of 14 and 74% (Wikipedia, 2018). Three broiler chickens of Cobb strain weighing 2.9kg, 3.0kg and 3.2kg at 12 weeks of age were procured from a reputable farm in Jos, fasted overnight, slaughtered, bled and scalded at temperature of about 56^0C to ease defeathering. The carcasses were eviscerated and the breast part was deboned and processed for refrigeration (Control: T1), sun-drying (T2) and groundnut oil embedment (T3). In Control, the carcass was placed in a sterile zip-lock bag free of air and refrigerated, the carcass in T2 (sun-drying) was cut into thin filets using knife and sun-dried on a clean sun-drying platform at the Poultry Division, NVRI and in T3 (refrigeration) the carcass was cut into pieces and then submerged in groundnut oil as preservative.

Samples from different areas of the broiler breast meat were cut from each of the treatments, ground and one gram (1g) each was homogenized in 225ml peptone water to form stock solution. In each stock, 1ml was transferred aseptically into 9ml of peptone water for serial dilution as described by Moshood *et al.* (2012). Thereafter, 0.3ml of the serial diluted stock solution was transferred aseptically into a mixture of nutrient agar and Mac Conkey agar. The inoculated culture media were incubated inversely for overnight at 37ºC. The bacteria were identified and the number of bacterial colonies recorded was expressed as colony forming unit per gram (CFU/g) according to the procedure of Bhandari *et al.* (2013). The data were collected on days 0, 7, 14 and 21. Also, samples from each of the treatments were prepared (without seasoning) for sensory evaluation on appearance, colour, aroma and texture (without tasting) based on 9-point Hedonic Scale by 9 semi-trained panellists drawn from within NVRI according to Wichchukit and O'Mahony, (2014). On the first day (day 0) of data collection, samples were taken and prepared for sensory evaluation before processing and preservation. On the last day of data collection (day 21) samples were taken, broiled without seasoning and prepared for sensory evaluation after preservation. In this case, data were collected only on day 0 and 21. All the data collected were analysed using simple descriptive statistics according to Adesoye (2006).

Results and discussion

Table 1 shows microbial load of broiler meat preserved by refrigeration, sun-drying and groundnut oil embedment on preservation days 0, 7, 14 and 21. On day 0, it was observed that the microbial load was very low in all the treatments. The bacteria detected in the broiler breast meat samples on day 0 of preservation were *Bacillus firmus* and *Staphylococcus aureus* (T1), *Proteus mirabilis* (T2) and *Klebsiella aerugenes* in T3. Meanwhile, on days 7, 14 and 21 of preservation, *Proteus mirabilis, Bacillus firmus, Staphylococcus aureus, Klebsiella aerugenes* and *Aeromonas hydrophila* were recorded in all the treatments. This observation was similar to what Suleiman *et al*. (2017) reported when five bacteria genera were isolated in fresh and frozen poultry chicken parts. The microbial load increased tremendously on preservation days 7 (32 CFU/g, 102 CFU/g, 82 CFU/g), 14 (60 CFU/g, 186 CFU/g, 100 CFU/g) and 21 (82 CFU/g, 222 CFU/g, 130 CFU/g) in T1, T2 and T3 in that arrangement even in refrigeration (Control). This probably suggested that the contaminations were from the environment, handlers and the materials used during data collection. In any case, T1 (Control) was comparatively lower throughout the study period corroborating the reports of Perez-Chabela *et al*. (2004) and Rahman (1999) that freezing improved meat quality and shelf life. Unfortunately, the broiler breast meat in T2 (sun-dried) had the highest bacteria load followed by T3. This was probably due to exposure of the meat samples to the ubiquitous microbes in the

environment. This observation suggested that groundnut oil embedment of broiler breast meat may be a suitable method of preservation.

Table 1: Microbial load of broiler meat preserved by different methods

Parameters		Treatments (CFU/g)		
Day	**Bacteria detected**	**T1**	**T2**	**T3**
0	*Proteus mirabilis* (x 10^2)	0	1	0
	Bacillus firmus (x 10^2)	1	0	0
	Staphylococcus aureus (x 10^2)	1	0	0
	Klebsiella aerugenes (x 10^2)	0	0	1
	Aeromonas hydrophila	0	0	0
	Total	**2**	**1**	**1**
7	*Proteus mirabilis* (x 10^3)	0	19	25
	Bacillus firmus (x 10^2)	12	26	21
	Staphylococcus aureus (x 10^4)	5	34	16
	Klebsiella aerugenes (x 10^4)	9	15	12
	Aeromonas hydrophila (x 10^2)	6	8	8
	Total	**32**	**102**	**82**
14	*Proteus mirabilis* (x 10^3)	11	40	23
	Bacillus firmus (x 10^3)	14	48	22
	Staphylococcus aureus (x 10^4)	8	37	30
	Klebsiella aerugenes (x 10^2)	5	32	8
	Aeromonas hydrophila (x 10^2)	22	29	17
	Total	**60**	**186**	**100**
21	*Proteus mirabilis* (x 10^4)	9	52	26
	Bacillus firmus (x 10^4)	11	34	28
	Staphylococcus aureus (x 10^3)	19	57	33
	Klebsiella aerugenes (x 10^2)	23	32	27
	Aeromonas hydrophila (x 10^2)	20	49	16
	Total	**82**	**222**	**130**

Presented in Table 2 is the sensory evaluation of broiler breast meat before refrigerating, sun-drying and embedding in groundnut oil. According to the semi-trained panellists, none of the meat samples in all the treatments was liked extremely except the aroma in T2 where 33.3% was recorded. More so, it was observed that the aroma in T1 and T3 was placed on less than 5 on the Hedonic Scale. The colour of the meat sample in T2 was liked by all the semi-trained panellists (100%).

Table 2: Sensory evaluation of the broiler breast meat before preservation

Hedonic Scale	Treatments (%)											
	T1				T2				T3			
	A	**C**	**AR**	**T**	**A**	**C**	**AR**	**T**	**A**	**C**	**AR**	**T**
9	0	0	0	0	0	0	33.3	0	0	0	0	0
8	33.3	0	0	33.3	66.7	100	33.3	66.7	33.3	0	0	0
7	66.7	66.7	0	0	33.3	0	33.3	0	0	33.3	0	33.3
6	0	0	0	33.3	0	0	0	33.3	0	0	0	0
5	0	0	66.7	0	0	0	0	0	0	0	33.3	0
4	0	33.3	0	33.3	0	0	0	0	33.3	0	33.3	33.3
3	0	0	0	0	0	0	0	0	33.3	66.7	33.3	33.3
2	0	0	33.3	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0

Parameters measured (A: Appearance; C: Colour; AR: Aroma; T: Texture); Hedonic Scale used (9: like extremely; 8: like very much; 7: like moderately; 6: like slightly; 5: neither like nor dislike; 4: dislike slightly: 3: dislike moderately; 2: dislike very much; 1: dislike extremely); T1 (Refrigeration); T2 (Sun-drying); T3 (Fat embedment).

About 33.3% of the semi-trained panellists liked the meat sample texture very much in T1, 66.7 (T2) and 33.3% moderately in T3. Based on the responses of the panellists, T2 meat samples seemed to be more preferred in all the parameters evaluated, followed by T1 and T3 in that order. This probably buttressed the fact that unprocessed broiler meat, might not be palatable hence the need to process, season and preserve prior to cooking and consumption (USDA, 2005).
Sensory evaluation of the preserved broiler breast meat by refrigeration, sun-drying and groundnut oil embedment is given in Table 3. It was shown from the panellists' responses that the meat samples appearance, was liked extremely (66.7%) and very much (33.3%) in all the treatments except, in T2 where 33.3% disliked the meat samples extremely.

Table 3: Sensory evaluation of broiler breast meat preserved by refrigeration, sun-drying and groundnut oil embedment

Hedonic Scale	Treatments (%)											
	T1				T2				T3			
	A	C	AR	T	A	C	AR	T	A	C	AR	T
9	66.7	0	66.7	0	33.3	33.3	66.7	100	66.7	66.7	66.7	33.3
8	33.3	33.3	0	66.7	33.3	33.3	33.3	0	33.3	33.3	33.3	33.3
7	0	33.3	33.3	33.3	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	33.3
5	0	0	0	0	0	0	0	0	0	0	0	0
4	0	33.3	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	33.3	0	0	0	0	0	0
1	0	0	0	0	33.3	0	0	0	0	0	0	0

Parameters measured (A: Appearance; C: Colour; AR: Aroma; T: Texture); Hedonic Scale used (9: like extremely; 8: like very much; 7: like moderately; 6: like slightly; 5: neither like nor dislike; 4: dislike slightly: 3: dislike moderately; 2: dislike very much; 1: dislike extremely); T1 (Refrigeration); T2 (Sun-drying); T3 (Fat embedment)

This observation contradicted the negative responses by the respondents when fish oil and tallow were used in broiler breast meat processing (Hugo *et al*., 2009). It was observed that colour, aroma and texture were best in T3, fairly followed by T2 and T1 in that order. This partly concurred with the report of Shaltout *et al*. (2016). This apparently suggested that broiler breast meat that was broiled and embedded in groundnut oil, may be preferred to other form of processing and preservation methods except, for the microbial load that was seemingly high.

Conclusion

Although, the broiler breast meat immersed in groundnut oil had the highest bacteria load throughout the study period the colour, aroma and texture were seemingly best after broiling and preservation. Apparently, broiler breast meat that was broiled and embedded in groundnut oil may be preferred to other form of processing and preservation methods. Therefore, more research investigations are required in order to improve on this inexpensive technique of broiler meat preservation.

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