QUALITY EVALUATION OF LAMB MEAT SAUSAGE PREPARED WITH DIFFERENT ANITIOXIDANTS

Abstract

The present study was aimed to investigating on fatty acids and microbial load of lamb meat sausage with different natural antioxidants. Lipid oxidation and growth of undesirable microorganisms in food products result in the development of spoilage, off flavor, rancidity and deterioration, rendering such products unacceptable for human consumption. The experiment was carried out at Animal Products and Processing Unit, Ladoke Akintola University of Technology Ogbomoso, Oyo state, Nigeria. The present results showed that the total bacterial count decreased significantly ($P<0.01$) with natural antioxidant included as the average bacterial load of the fresh and frozen samples of camel sausages were (3×10^6 and 2×10^6 CFU/gm) respectively. For bacterial load, it is observed that control (sample without natural antioxidant) had highest load while moringa sausage with the least value greatly reduced the number of load.

Keywords: Lamb meat, **a**nimal Products, antioxidant, Lipid oxidation

Introduction

Sausage is one of the oldest known forms of processed meat products and is very popular in many areas around the world. Sausages were invented as a means of making the most of leftovers of meat and entrails. Sausages can be defined as meat products that are manufactured by selecting, chopping, and mincing lean and fat, with or without offal, adding condiments, spices, additives and starter culture (Leroy, 2006). The ingredients are stuffed into casings, ripened, cured, and in some cases smoked.

Lipid oxidation and growth of undesirable microorganisms in food products result in the development of spoilage, off flavor, rancidity and deterioration, rendering such products unacceptable for human consumption (Bozin *et al*., 2007; Ibrahim *et al.*, 2010), and yielding many compounds that contribute to the pathogenesis of cancer, atherosclerosis, heart and allergic diseases (Mielnik *et al*., 2008). The most efficient and practical way to prevent oxidative and color deterioration of meat products is to incorporate antioxidants into formulations which could be Natural or Artificial (Kong *et al*., 2010). Antioxidants are compounds or substances that can retard lipid oxidation and prolong product shelf life of meat products (Nunez *et al.*, 2008). However, the application of synthetic antioxidants has been recently restricted because there is suspicion that they are carcinogenic. Natural antioxidants are various substances with different chemical characteristics, which are widely present in plants. Antioxidants retard or inhibit oxidation of other substances by inhibiting the initiation or propagation of oxidizing chain reactions (Velioglu *et al*., 1998). Some authors have reported that natural antioxidants have no effect on sensory characteristics of meat. Chaves *et al*., (2008) did not detect any effect of

essential oil compounds added to the diet of growing lambs. Spices and herbs have been added to food since ancient times, not only as flavoring agents, but also as folk medicine and food preservatives (Nakatani, 1994). Meat color has been reported as the most important factor when consumers assess meat quality since they relate color to freshness. However, color does not correspond to differences in eating satisfaction (Carpenter *et al*., 2001). Changes in meat color are due to oxidation of red oxymyoglobin to metmyoglobin (MMG), which give meat an unattractive brown color (Nerín *et al*., 2006). For this reason a growing interest has been paid to the research of natural antioxidants, among which spices occupy an important position (Pokorny *et al*., 2001). This study aimed at investigating on fatty acids and microbial load of lamb meat sausage with different natural antioxidants.

MATERIALS AND METHODS

The experiment was carried out at Animal Products and Processing Unit, Ladoke Akintola University of Technology Ogbomoso, Oyo state, Nigeria. The lamb meat was bought at Teaching and Research slaughter slab, LAUTECH, and other ingredients such as spices, vegetable oil and different natural antioxidants such as Garlic, Tumeric, Honey, Ginger and Moringa were obtained from a local market in Ogbomoso, Oyo state.

Table 1: **Ingredients Composition of Lamb Sausage**

Ingredients	**Control**	**Tumeric**	**Garlic**	**Honey**	**Moringa**	**Ginger**
Lamb meat (mutton)	65	65	65	65	65	65
Binder (wheat flour)	20	20	20	20	20	20
Spices	3	1	1	1	1	1
Vegetable oil	6	6	6	6	6	6
	6	6	6	6	6	6
Natural antioxidants	-	2	2	2	2	2
Total	**100**	**100**	**100**	**100**	**100**	**100**

Organoleptic evaluation

It was conducted using a 10 member trained panelists according to the procedures of AMSA (1995). Meat preparation was done using a wet cooking method. The prepared lamb sausages were served to 10 member taste panels drawn from students in the Faculty of Agricultural science, Ladoke Akintola University of Technology, Ogbomoso. The semi trained panelists evaluated the samples for colour, flavour, juiciness, tenderness and general acceptability. The assessment was based on a 9 point hedonic scale. The score was arranged in a descending order, the maximum score 9 was given to extremely like condition while the lowest score 1 was for the poorest condition.

Chemical properties

Lamb sausage samples were analyzed for proximate composition and fatty acid profile by the procedures of AOAC (2002).

Microbial assay

This was carried out following the procedures of APHA, (1992), Apata (2013) and AOAC, (2000). Colony forming units were counted and were expressed in log10cfu/g of samples for The Total Aerobic Counts (TCC), Total Coliform Counts (TCC) and Total Fungal Counts (TFC) while Gram-staining, motility test, and biochemical test techniques were conducted for clear identification as described by (Cheesebrough, 2000).

Statistical analysis

All data collected from this study were subjected to one way analysis of variance (ANOVA) using the SAS (2000) analytical software.

RESULTS AND DISCUSSION

Table 2 Cooking yield of lamb meat sausage with different natural antioxidants

Samples	Cooking yield (%)
Control	96.36[a]
Turmeric	95.83[a]
Garlic	95.90[a]
Honey	97.35[a]
Moringa	93.73[b]
Ginger	93.25[b]
SEM	2.05

Table 3 **Organoleptic properties of lamb sausage prepared with different antioxidants**

Parameters	Control	Tumeric	Garlic	Honey	Moringa	Ginger	SEM
Colour	4.50[ab]	5.60[a]	5.00[ab]	3.60[b]	4.50[ab]	4.80[ab]	0.24
Flavour	4.40[b]	4.90[ab]	6.30[a]	4.20[b]	4.00[b]	4.30[b]	0.26
Tenderness	4.60	5.00	5.90	5.10	5.60	5.80	0.21
Juiciness	3.30	3.80	4.40	3.40	4.00	4.20	0.25
Texture	4.50	5.20	4.30	4.40	4.80	4.50	0.25
Overall Acceptability	6.20[b]	6.00[a]	4.20[c]	6.90[a]	5.60[a]	6.00[b]	0.21

Parameters	Control	Tumeric	Garlic	Honey	Moringa	Ginger	SEM

Crude protein	36.10[a]	34.72[b]	35.28[b]	35.01[b]	34.41[c]	33.90[d]
Ether extract	9.00	10.00	9.00	8.00	8.00	9.00
Ash	1.40	1.50	1.40	1.70	1.70	1.50
Dry matter	62.30[c]	77.86[a]	73.03[b]	73.08[b]	77.90[a]	61.95[c]
Moisture content	37.70[b]	25.14[c]	26.97[c]	26.92[c]	26.10[c]	40.05[a]
Lipid peroxidation	9.61×10^{-03}	1.28×10^{-03}	1.00×10^{-04}	2.00×10^{-04}	2.00×10^{-04}	3.00×10^{-4}

Table 4 Proximate composition and lipid peroxidation of lamb sausage prepared with different natural antioxidants

Table 5 Fatty acid profile of lamb meat sausage prepared with different antioxidants

Parameters (MEqL)	**Control**	**Tumeric**	**Garlic**	**Honey**	**Moringa**	**Ginger**	**SEM**
C12:0 SFA	4.22	6.11	4.30	2.00	4.34	6.05	
C18:0 SFA	5.69	8.53	5.49	2.84	5.64	8.63	
C16:0 SFA	5.42	7.79	5.16	2.56	5.12	7.69	
C24:0 SFA	7.37	11.25	7.37	3.68	7.57	11.05	
C17:0 SFA	5.45	8.12	5.44	2.70	5.41	8.21	
C 20:4n-6 PUFA	6.48	9.23	6.68	3.04	6.58	9.13	
C18:3n-3 PUFA	5.63	8.45	5.60	2.80	5.66	8.47	
C18:1n-9 MUFA	5.67	8.47	5.65	2.82	5.55	8.47	
Total SFA	15.33	41.80	27.76	13.78	28.08	41.63	
Total PUFA	12.11	17.68	12.28	5.84	12.24	17.60	
Total MUFA	5.63	8.47	5.65	2.82	5.55	8.47	
Total FA	**33.07**	**67.95**	**45.69**	**22.44**	**45.87**	**67.70**	

SFA- Saturated Fatty Acid
PUFA- Poly Unsaturated Fatty Acid
MUFA- Mono Unsaturated Fatty Acid
TFA- Total Fatty Acid

Table 6 Bacteria count of lamb meat sausage with different natural antioxidants

Samples	Total Bacteria Counts (TBC) cfu/g x 10^6	Total Coliform Counts (TCC) cfu/g x 10^4	Total Fungi Counts (TFC) cfu/g x 10^3
Control	5.54^a	6.54a	6.12^a
Turmeric	1.24^c	4.32b	5.32^b
Garlic	1.88^c	3.22^c	5.22^b
Honey	2.92^b	3.65^c	5.64^b
Moringa	1.19c	2.76^d	2.34^c
Ginger	1.76^c	3.54^c	4.78^b
SEM	0.32	0.43	1.12

Table 7 isolated

Samples	Characterized bacterial
Control	*Pseudomonas aeruginosa*
Turmeric	*Pseudomonas aeruginosa*
Garlic	*Pseudomonas aeruginosa*
Honey	*Staphylococcus aureus*
Moringa	*Pseudomonas aeruginosa*
Ginger	*Proteus mirabilis*

RESULTS AND DISCUSSION

Results

Table 2 present the cooking yield of lamb meat sausage prepared with different natural antioxidants. The results revealed the sausage prepared with honey had the highest ($p<0.05$) coking yield (97.35%) while the least ($p<0.05$) value was found in those prepared with ginger (93.25%)

Organoleptic properties of lamb sausage prepared with different natural antioxidants are presented in Table 3. The results showed that tenderness, juiciness and texture were not significantly affected ($p<0.05$) with the different antioxidants samples, while colour, flavour and overall acceptability were significantly affected ($p<0.05$). The panelist rated turmeric, garlic and honey highest ($p<0.05$) for colour, flavour and overall acceptability.

The proximate composition of lamb sausage prepared with different natural antioxidants is presented in Table 4. No significant ($p>0.05$) effects were reported in ether extract and ash while variations ($p<0.05$) were observed in Crude protein, dry matter and moisture contents of the lamb sausage.

Table 5 shows the Fatty acid profiles of lamb meat sausage prepared with different natural antioxidants. The result shows that there were significant difference values in all the fatty acid

analyzed except in few parameters of the samples that have the same values. The highest value ($p<0.05$) was observed in turmeric (11.25) found in ligoceric acid and the lowest ($p<0.01$) was observed honey with (2.00) in lauric acid. Control that has no inclusion of natural antioxidant has close values similar to garlic in all the parameters analyzed. Turmeric and ginger have the same values of (8.47) in oleic acid, also the same values were observed in control and garlic (7.37) in ligoceric acid. Ginger has the highest ($p<0.05$) values in all the parameters except in palmitic acid and ligoceric acid that turmeric values were higher.

Table 6 shows the microbial load of lamb sausage prepared with different natural antioxidant. The results showed significant ($p<0.05$) differences in the microbial load of the lamb sausage samples as highest values ($p<0.05$) were reported in the control for TAC, TCC and TFC compared to those prepared with the antioxidants. However least values ($p<0.05$) were reported in sausage prepared with moringa.

Discussion

In general, lamb meat sausages treated with different antioxidants were rated better in colour, flavor and overall acceptability than the control. These are the criteria the consumers see in a products before buying and consuming the products. The results were in agreement with Mohamed and Monsour (2012) who reported that the flavor score of patties prepared without addition of antioxidants were significantly ($p<0.05$) lower than those of other samples treated with antioxidants and panelist detected a rancid flavor in the patties formulated without the addition of antioxidants.

The lowest values obtained from the sample with honey were in agreement with those reported by Muguerza (2001), Campos (2007), Rubio (2007) and Del (2009). It was observed in the values obtained in honey that its chemical composition has low significant effect on all the parameters of fatty acid analyzed while the sample with ginger suggests its chemical component greatly contributes to the fatty acid analyzed. The sausage products studied have n-6/n-3 ratios higher than those suggested by international health organizations, which is in agreement with Jimenez (2007), who reported that meat products show that n-3 PUFAs is present in very low levels. The polyunsaturated fatty acid (PUFA)/saturated fatty acid (SFA) ratio is one of the major parameters currently used to assess the nutritional quality of the lipid of foods. Fatty acids from each sample (control, turmeric, garlic, honey, moringa and ginger) were affected by inclusion of a specific natural antioxidant. An increase was observed for turmeric and ginger, while honey values decreased. Increases in polyunsaturated fatty acids (PUFAs) after cooking have been observed in other studies. Maranesi *et al.*, (2005) observed an increase in polyunsaturated fatty acid (PUFA) for lamb rib-loins after boiling and microwaving followed by final grilling. Some authors (Gerber *et al.*, 2008 ; Igene *et al.*, 1981 and Rodriguez *et al.*, 1997) have found an increase in polyunsaturated fatty acid (PUFA) levels of meat and meat products after cooking due to the lipid losses, containing mainly triacylglycerols of adipose tissues with relatively more saturated fatty acid (SFA) than polyunsaturated fatty acid (PUFA), as suggested by Ramamurti (1986).

However, PUFA levels were much lower than those found in the sausage of the present study. Sarries *et al.*, (2009) found no changes in the relative distribution of fatty acids upon cooking beef from with diets designed to enhance the concentration of conjugated linoleic acid (CLA) in tissue. This suggests that the oil added during manufacturing might help stabilize the presence of fatty acids during cooking.

The addition of antioxidants is therefore necessary to increase storage stability, sensory quality and nutritional value of animal products as reported by Kazimierczak, (2008) ; Ladikos and Lougovois, (1990). Due to the positive health effects of long chain n-3 polyunsaturated fatty acids (PUFA), there is an increased interest to produce meat products rich in n-3 polyunsaturated fatty acids (Wood, 2003). Increasing the amount of easily oxidized polyunsaturated fatty acid (PUFA) in animal products however will also require a higher content of antioxidants in the end-product to protect the nutritional valuable fatty acids (FA).

The present results showed that the total bacterial count decreased significantly ($P<0.01$) with natural antioxidant included as the average bacterial load of the fresh and frozen samples of camel sausages were (3×10^6 and 2×10^6 CFU/gm) respectively. The sample with moringa has the lowest counts. This result was in agreement with that reported by Abass, (2009). In general, results in this study showed that the total viable count for the sausage ranged between (5.54×10^{18} and 1.88×10^{18}), these results in line with the findings of SSMO, (2008). The present results showed that total bacterial count decreased significantly ($P<0.01$) with natural antioxidant included, this result is matching with that reported by Abass (2009). The contamination that increases the microbes comes from different sources, mainly hides, hoofs, air, water, equipments, intestinal contents and slaughtering floor as reported by Ikeme, (1990). Very few bacterial genera can thrive under freezing conditions Judge *et al*., (1989). Results of the total viable bacterial counts obtained in the present study were in agreement with standards suggested by Oregon Department of Agriculture, (1973).

CONCLUSSION

It is observed from the result of this study that natural antioxidant in lamb meat sausage had varied level of fatty acids. Tumeric sausages had high increased level of fatty acid due to its chemical composition and therefore have noticeable effect on public health improvement.

For bacterial load, it is observed that control (sample without natural antioxidant) had highest load while moringa sausage with the least value greatly reduced the number of load.

RECOMMENDATION

This study therefore stresses the use of natural antioxidant in order to reduce the number of microbes that may likely affect the quality and quantity of the meat product. Natural antioxidant is food additive therefore it should be incorporated in human foods.

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