LIPID OXIDATION AND MICROBIAL LOAD OF SUYA (TSIRE) AS AFFECTED BY *MORINGA OLEIFERA* LEAF POWDER

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ABSTRACT
Lipid oxidation is the primary process responsible for quality deterioration of meat and meat products during storage. This study was carried out to evaluate lipid oxidation and microbial load of Suya (tsire) as affected by *Moringa oleifera* leaf powder (MOLP). Semi membranous muscle from a mature bull excised from the thigh cut was used. It was sliced into thin sheets of 0.15- 0.30mm thickness. Fresh green *Moringa* leaves were harvested, washed with distilled water and oven dried at 50°C for 48 hours to maintain its greenish colour and nutritive value. The leaves were ground and sieved with 0.2mm fine mesh to obtain the *Moringa* leaf powder. The study comprised of five treatments with ten replicates in a completely randomized design. Treatment one was the control (no MOLP) while treatments two, three, four and five were formulated with suya ingredient at 2.5, 5.0, 7.5, and 10% inclusion levels of MOLP respectively. Product was analyzed for lipid oxidation and microbial load at days 0, 3, and 6 kept under refrigeration. The results showed that there weresignificant differences ($P< 0.05$) in lipid oxidation among treatments. On day 0, treatment one had the highest value of 0.13mgMalonaldehyde/kg while the least value of 0.09mgMalonaldehyde/kg was recorded in treatment five. The same trend of significance ($P<0.05$) was observed on day 3 and day 6. On day 0, microbial load was lower in treatment five while treatment one had the highest microbial count, this trend of significance ($P<0.05$) also was observed product on day 3 and day 6. The result of this study shows that the use of MOLP up to 10% reduced the rate of lipid oxidation and microbial load of suya (Tsire).

Keywords: Suya (Tsire), Lipid Oxidation, Microbial load, *Moringa oleifera*

INTRODUCTION

ipid peroxidation has been as one of the primary echanisms of quality deterioration in displayed or stored ods especially muscle food (Asghar *et al.*, 1991). nthetic antioxidants have been used to retard or inimize oxidative deterioration of foods. such as tylated hydroxyanisole (BHA), butylated droxytoluene (BHT), and tertiary butyl hydroquinone - BHQ (Fasseas *et al.*, 2007). Recently, consumers have ected synthetic antioxidants because of their rcinogenicity Altmann *et al.*, (1986) However, the use natural antioxidants to stabilize meat has gained much ntion from consumers because they are considered r than synthetic antioxidants (Jung *et al.*,2010). It has been reported that these natural antioxidants, ecially of plant source, have greater application ntial for consumer's acceptability, palatability, ility and shelf life of meat products (Jung *et al.*, 2010). of such plants with potential to be used as an oxidant is *Moringa oleifera* (Moyoet *al.*, 2011). *inga oleifera* (family: *Moringaceae*) is native to sub-Himalayan regions of North West India. It is commonly known as horse radish tree, drumstick tree and highly recognized for its nutritional and medicinal properties with some useful minerals, vitamins and amino acids. It is the most economically important species of its kind followed by *Moringa stenopetala*. The leaves of the tree have been reported to bear antioxidant activity or contain a higher amount of polyphenols (Sreelatha and Padma 2009; Verma *et al.*, 2009; Qwele *et al.*, 2011). The polyphenolics content of the leaves are high, comparable to vegetables and fruits of strawberries, hot pepper, carrot and soybean which are high in phenolics, ascorbate, carotene and - tocopherol, respectively (Yang *et al.*, 2006). The objective of this study was to evaluate the lipid oxidation and microbial load of suya (tsire) as affected by *Moringa oleifera* leaf powder.

MATERIALS AND METHODS

EXPERIMENTAL SITE

The experiment was carried out at the Meat Science Laboratory of the Department of Animal Science University of Ibadan, Ibadan.

PREPARATION OF MORINGA LEAF POWDER

Fresh green *moringa* leaves were harvested washed with distilled water and oven dried at 50°C for 48 hours to maintain its greenish colour and nutritive value. The dried leaves were shredded and sieved with 0.2mm fine mesh to obtain the *moringa* leaf powder.

MEAT PREPRARATION

Raw beef was purchased from the slaughterhouse of the Department of Animal Science in the University of Ibadan. The cut of beef used in this experiment was taken from a portion of the semi membranous muscle of a mature bull. The meat was trimmed of all visible bones and connective tissue. It was cut into chunk 12cm long and 6mm wide. The chunks were sliced into 0.15 - 0.30mm thickness in the same direction of the muscle fibre using a long knife with a very sharp blade. Weight was taken, recorded and labelled after which the meat was staked on the slender wooden stick. The weighed sheets of meat with sticks were randomly allotted into five treatments with ten replicates each.

PREPARATION OF SUYA INGREDIENTS

Spices were obtained from Bodija market in Ibadan, Oyo State. The spices were mixed together as shown in table 1 below.

Table 1: Composition of Suya Ingredients

Moringa Leaf Powder treatment					
Ingredients	**1**	**2**	**3**	**4**	**5**
Groundnut Cake Powder	52.00	49.50	47.00	44.5	42.00
Moringa Leaf Powder	0.00	2.50	5.00	7.50	10.00
Ginger	5.00	5.00	5.00	5.00	5.00
Galic Powder	5.00	5.00	5.00	5.00	5.00
Red dried Pepper	10.00	10.00	10.00	10.00	10.00
White Pepper	5.00	5.00	5.00	5.00	5.00
Salt	8.50	8.50	8.50	8.50	8.50
Curry	5.00	5.00	5.00	5.00	5.00
Maggi	7.50	7.50	7.50	7.50	7.50
Groundnut oil	2.00	2.00	2.00	2.00	2.00
Total	100	100	100	100	100

Inclusion level of moringa leaf powder: Treatment 1- 0%, Treatment 2- 2.5%, Treatment 3- 5%, Treatment 4- 7.5%, Treatment 5- 10%

PREPARATION OF SUYA:

Meat pieces on sticks were properly coated with the formulated ingredients and each treatment was labelled for easy identification. The labelled sticks of meat were then arranged on a glowing, smokeless fire made from grilling machine that was medium hot (about 65.5°C). The stick meats were allowed to stay on the fire for 20 minutes with regular turning of the product and additional groundnut oil was sprinkled on the meat while roasting continued. Treatment 1, which is the control, had no *Moringa* leaf powder while treatments 2, 3,4 and 5 contained *moringa* leaf powder at 2.5%, 5%, 7.5% and 10% respectively. All necessary hygienic precautions were observed.

THIOBARBITURIC ACID (TBA) VALUE:

Thiobarbituric acid value (TBA) was estimated by modified methods of Buege and Aust (1978).

DETERMINATION OF MICROBIAL LOAD OF SUYA

Suya samples (lg) were aseptically transferred into 9 ml of 0.1% sterile peptone water. Serial dilutions were made. From each dilution, 0.1ml was plated then nutrient agar, MacConkey agar and potato dextrose agar in duplicates using the pour plate method was poured. Nutrient agar and MacConkey agar plates were incubated at 37°C for 24 hrs. while the potato dextrose agar plates were incubated at 25°C for 72 hrs. Developed colonies were counted and were expressed in log CFU/g of samples.

STORAGE OF SUYA

Suya was properly wrapped with foil paper to prevent moisture loss and placed inside the refrigerator for 6 days. Parameters were taken at 0, 3 and 6 days of storage.

STATISTICAL ANALYSIS

Completely randomized design (CRD) was used for this study. Data obtained were analyzed using SAS (2002) while the means were separated using Duncan multiple Range test of the same software.

RESULT AND DISCUSSION

The Thiobarbituric acid (TBARS) value determines the extent of lipid oxidation. On day 0 (Table 2), There were significant differences ($P<0.05$) in TBARS among the treatments with treatment five having the least value of 0.09mgMalonaldehyde/kg, while treatment one had the highest values of 0.13mgMalonaldehyde/kg. On day 3 (Table 2), There was significant difference ($P<0.05$) in

TBARS among the treatments with treatment five having the least value of 0.11mgMalonaldehyde/kg, while treatment one had the highest values of 0.21mgMalonaldehyde/kg. The same trend of significance (P<0.05) was observed on day 6(Table 2). When compared among days. There was significant increase (P<0.05) in TBARS among days in all the treatments. Treatment 5 had the highest inclusion level of MOLP, it also recorded the least value of TBARS. It could be inferred that, the antioxidant in the MOLP for suya in this treatment were preserved by the high inclusion level of the MOLP.

Table 2: Effect of *Moringa oleifera* leaf powder on TBARS (mgMalonaldehyde/kg) of freshly prepared and stored Suya (Tsire)

Days of Storage	Treatments 1	2	3	4	5	SEM
0	0.13^{ak}	0.11^{abk}	0.10^{bj}	0.09^{bj}	0.09^{bk}	0.00
3	0.21^{aj}	0.19^{abj}	0.19^{bi}	0.15^{bi}	0.11^{bj}	0.01
6	0.25^{ai}	0.21^{bi}	0.20^{bi}	0.16^{ci}	0.13^{ci}	0.11
SEM	0.01	0.01	0.01	0.01	0.01	

abcde: Means on the same row with similar superscript are not significantly different (P > 0.05)
ijk: Means on the same column with similar superscript are not significantly different (P > 0.05)
Inclusion level of *Moringa* leaf powder: Treatment 1 = 0%, Treatment 2= 2.5%, Treatment 3= 5%, Treatment 4= 7.5%, Treatment 5=10%

On day 0 (Table3), Total aerobic count (TAC) significantly (P<0.05) differed among the treatments means. Treatment one had the highest value while treatment five had the least. The same trend was observed for TAC on day 3 and 6. Edema *et al.* (2008) recorded similar range of $0.07x10^5$-$2.22x10^5$cfu/g and stated that the values placed the Suya samples consumed in Nigeria within satisfactory limit according to the International Commission of Microbiological Standards for Foods ICMSF, (1978). The result obtained in this study falls within the acceptable range of $2.5x10^5$-$1.0x10^8$cfu/g recorded by Pearson (1968). The result suggest that *moringa* leaf powder significantly (P<0.05) reduced aerobic bacteria load of suva (tsire), it also showed that a high level of hygiene of the meat and ingredient used in preparing the Suya was observed.

The total aerobic count among days showed no significant difference (P>0.05) in all the treatments. It was expected that as the storage days increased, there would be a significant (P<0.05) increase in total aerobic count of suyabut this was not so, this suggests that moringa leaf powder contain antimicrobial properties, which inhibit microbial growth. It could also be due to the lowered storage temperature of the refrigerator, as against the high ambient temperature. Similar trend was obtained in total coliform and fungi count. Bacterial count exceeding 10^5/g or coliform counts higher than 10^2/g in delicatessen food products are indicative of dangerous contamination (Solberg *et al.* 1986). Results obtained in this study revealed that moringa leaf powder contains antimicrobial properties that inhibit microbial growth, suggesting that moringa leaf powder significantly (P<0.05) decreased fungi load of suya (tsire). Edema *et al* (2008) reported similar results.

TABLE 3: Effect of *MoringaOleifera* leaf powder on microbial count (Log_{10}cfu/g) of freshly prepared and stored suya (Tsire)

	Days of Storage	Treatments 1	2	3	4	5	SEM
TAC	0	2.00^{a}	1.30^{b}	1.05^{b}	1.00^{b}	0.90^{b}	0.11
	3	2.15^{a}	1.45^{b}	1.35^{b}	1.30^{b}	0.90^{c}	0.11
	6	2.30^{a}	1.80^{ab}	1.60^{ab}	1.40^{ab}	1.00^{b}	0.12
	SEM	0.09	0.1	0.12	0.11	0.04	
TCC	0	1.00^{a}	0.87^{ab}	0.75^{ab}	0.70^{ab}	0.50^{b}	0.06
	3	1.15^{a}	1.05^{ab}	0.95^{ab}	0.90^{b}	0.45^{c}	0.08
	6	1.25^{a}	1.00^{a}	1.05^{ab}	1.05^{ab}	0.55^{c}	0.07
	SEM	0.05	0.07	0.07	0.07	0.03	
TFC	0	1.00^{a}	0.67^{b}	0.52^{bc}	0.35^{cj}	0.25^{c}	0.08
	3	1.05^{a}	0.75^{ab}	0.72^{ab}	0.50^{bcij}	0.22^{b}	0.09
	6	1.10^{a}	0.77^{ab}	0.75^{ab}	0.72^{abi}	0.35^{b}	0.09
	SEM	0.04	0.04	0.09	0.04	0.03	

abcde: Means on the same row with similar superscript are not significantly different (P > 0.05) ;ijk: Means on the same column with similar superscript are not significantly different (P > 0.05)

TAC= Total aerobic count; TCC= Total coliform count; TFC= Total fungi count

Inclusion level of moringa leaf powder: Treatment 1- 0%, Treatment 2- 2.5%, Treatment 3- 5%, Treatment 4- 7.5%, Treatment 5- 10%

CONCLUSION

The result of this study shows that TBARS and microbial count was reduced as the inclusion level of *Moringa oleifera* leaf powder increased. Therefore, the use of *Moringa oleifera* leaf powder up to 10% reduced the rate of lipid oxidation and microbial load of suya(Tsire).

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