EFFECT OF ONION AND GINGER JUICE EXTRACT ON THE QUALITY OF HOT-SMOKED MEAT

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ABSTRACT

An experiment was conducted to determine the effectiveness of extracts from ginger rhizome and onion bulbs, in retarding lipid oxidation and on the organoleptic quality of smoked meat. Brine solution consisting of potassium sorbate, sodium chloride with or without butylated hydroxy toluene (BHT), onion juice extract and ginger juice extract respectively were used as dips for curing. Samples dipped in 10% brine served as control. Meat samples were trimmed of visible fats, cut into 1kg sizes, pan broiled at 80°C for 30 minutes, and then recut into 100 - 130g pieces. Samples were divided randomly into four batches and dipped for 5 minutes in different solutions, drained, smoked at a temperature of 70 - 80°C for 6 hours and cooled to room temperature. Products were individually packaged in polytene bags, stored at room temperature (25° - 30°C) and used for sensory evaluation, chemical and microbial analysis. Results of chemical, and sensory analyses indicated that lipid oxidation was not a problem in smoked beef. Samples dipped in solution containing ginger juice and BHT were rated better than others. Six per cent potassium sorbate did not offer adequate antimycotic activity. Samples dipped in solution without potassium sorbate were unacceptable by the fourth day of storage as these were covered by visible mouldy mass of mycelia.

Key word: Smoked beef, onion and ginger extract, rancidity quality.

INTRODUCTION

A major cause of muscle food deterioration is oxidative rancidity (Melton, 1983; Love, 1983; Dawson and Gartner, 1983). The development of rancid flavour in processed meat has been reported by many workers (Obanu, 1986; Sato and Hegarty, 1971; Pearson et al. 1977; Sweet, 1973; Caldironi and Bazani, 1982; Deng, 1978; Younathan et al., 1980). An antioxidant is any

substance that is capable of delaying, retarding or preventing the development of rancidity, or other flavour deterioration due to oxidation in food. Antioxidants can be broadly classified into two major groups i.e. synthetic and natural. Synthetic antioxidants are antioxidants which are produced by chemical transformation or synthesis of naturally occurring antioxidants. Natural antioxidants are those compounds extracted naturally from plants, mostly vegetables. Onion, ginger and tomatoes juice extract are natural antioxidants. The effect of a variety of plant and spice extracts on the prevention of rancidity have been investigated by many workers (Watts, 1962; Pratt and Watts, 1964; MacNiel *et al.*, 1973). Ginger and onion extracts have been used as successful control for rancidity in heated mackerel and precooked pork patties respectively (Lee, *et al.*, 1986; Younathan, *et al.*, 1983). Synthetic compounds such as BHT, commonly used antioxidant in the food industry, are not available to the local processor. The purpose of this study was to determine the effectiveness of ginger and onion juice extracts in controlling oxidative rancidity and on the organoleptic quality of smoked beef. Onion and ginger were chosen because they often are used as added ingredients in many Nigerian cooked foods.

MATERIALS AND METHODS

Collection and Treatment of Samples:

Beef muscle, longissimus dorsi, used for this experiment was first trimmed of visible fat and connective tissues, cut fairly into uniform sizes of about 1.5kg, pan boiled for 30 minutes at about 80°C, cooled, recut into final weights of about 120 - 140 g and divided into 4 different batches such that each of the 4 batches would contain at least 12 samples.

Fresh ginger rhizomes and onion bulbs, respectively, were bought and the outer coat scrapped off. They were cleaned, then weighted

TABLE 1: PERCENTAGE CONCENTRATION OF COMPONENTS IN SOLUTION

Components	Solutions (Treatments)			
	1	2	3	4
BHT	0.02 ^a	-	-	-
Potassium Sorbate	6	6	6	-
NaCl	10	10	10	10
Water	83.98	84 ^a	84 ^{**}	90

^a 0.02% BHT (Butylated hydroxytoluene) dissolved in 0.08% ethanol

^{*} 50% of onion bulbs by weight of water in solution

^{**} 50% of ginger rhizome by weight of water in solution.

TABLE 2: SENSORY EVALUATION OF PRODUCT QUALITY SAMPLE SCORE SHEET USED BY TASTE PANEL.

Name: _____ Date: _____

You are given six samples. Use a sample score sheet for each of the parameters based on a 5-point Hedonic scale. Score the samples according to the intensity of appearance, juiciness, saltiness, rancidity, flavour, and general acceptability.

FACTOR	1	2	3	4	5
Appearance	UNACCEPTABLE	FAIR	MEDIUM	GOOD	VERY GOOD
Juiciness	DRY	FAIR	MEDIUM	JUICY	VERY JUICY
Saltiness	TOO SALTY	SLIGHTLY TOO SALTY	ACCEPTABLE	SLIGHTLY SALTY	NO SALT
Rancidity (Off Flavour)	Extremely Rancid	HIGHLY RANCID	MEDIUM RANCID	SLIGHTLY DETECTABLE RANCIDITY	NO DETECTABLE RANCIDITY
Flavour	UNDIESIRABLE	SLIGHTLY UNDESIRABLE	MEDIUM	GOOD	EXCELLENT
General Acceptability	VERY BAD	BAD	MEDIUM	GOOD	EXCELLENT

Comments: _____

to obtain a weight of about 1.5kg, cut into smaller units and fed to the grinder. The crushed marsh was pressed through a filter cloth and the filtrate collected (about 1295mls) and used in preparation of dips, as part of solvent (Table 1).

Curing of Meat Samples:

Meat samples were dipped for 15 minutes in appropriate solutions (Table 1), drained on wire-mesh and then transferred to the smoke house, preheated for 30 minutes. Hardwood and saw dust were used for firing. Initial smoking temperature was low to prevent surface drying of the meat samples. a temperature of about 70 to 80°C was attained and this was maintained by either withdrawing or adding of wood. Samples were removed after 6 hours.

Meat Storage and Sampling:

The various meat samples were packaged differently in polytene bags. The packaged meat

were arranged in cartons and stored at room temperature (28 - 30°C) for 10 weeks. A set of samples dipped in 10% brine was stored in the refrigerator and used for taste panel tests. Samples were subsequently taken bi-weekly for organoleptic, chemical and microbiological evaluation.

Chemical Analysis:

Protein, lipid, moisture contents of smoked products were determined according to (A.O.A.C., 1975) procedures. Peroxide value was determined according to the method of Lee (1971). Thiobarbituric acid (TBA) values, determined according to the method described by Tarladgis et al., (1960). Sodium chloride content was determined using the Volhard method as reported by Pearson (1976) and determination of potassium sorbate level in samples was carried out according to FAO.

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TABLE 3: PROXIMATE COMPOSITION (%) AND NaCl CONTENT OF SMOKED AND RAW MEAT SAMPLES AT FIRST WEEK OF STORAGE

Treatment	Moisture	Fat	Protein	Ash	SodiumChlorideContent
1	35.0	3.2	46.7	7.0	4.9
2	43.5	3.4	45.5	6.0	3.8
3	38.5	3.6	44.5	6.0	4.4
4	44.5	3.0	43.9	8.5	3.3
FRESH MEAT	73.5	2.0	26.0	1.0	-

Formula of solutions are shown in Table 1.

TABLE 4: MOISTURE, PEROXIDE AND TBA VALUES¹ OF SMOKED MEAT AFTER STORAGE FOR 9 WEEKS.

Treatment Solution	Moisture (Per cent)	Peroxide (MEq/Kg)	TBA Mg Malonaldehyde Per Kg.
1	21.7 ^a (16.5-35)*	18.7 (15.60-24.17)	0.09 (0.01-0.19)*
2	35.7 ^b (33.-43.5)*	18.9 (14.00-24.10)*	0.40 (0.61-1.45)*
3	28.2 ^b (15.5 - 38.5)	19.0 - 5.65 (12.57-26.00)*	0.20 (0.03-0.09)*
4R.F.	43.2 ^b (37.0 - 44.5)*	19.0 (14.90-28.01)*	0.20 (0.01-0.20)*

1 Values are means $\pm$ SE for 18 observations

* Range

R.F. Refrigerated control (brined)

^{ab} Values within the same column with same superscript are not significantly different ($P > 0.05$).

procedures (1986).

Microbiological Analysis:

Mould counts were determined according to standard procedures (Speck, 1976). Visual examination of the products was carried out daily. Products with visibly mouldy mass of mycelium were removed on observation to prevent contamination of products.

Panel Evaluation of products Quality:

Subjective evaluation of product quality was carried out by an experienced panel composed of 10 students and staff of our Department of Food Science and Technology. Quality attributes studied include appearance, juiciness, saltiness, rancidity (off flavour), flavour and general acceptability. For evaluation, products were rinsed with water for one minute, covered with aluminium foil, heated in an oven at 250°F for 30 minutes and allowed to cool at room temperature before presentation to the panel. Panel members scored all factors on a 5-point Hedonic scale (Table 2). Refrigerated brined and smoked samples (Treatment 4) served as control.

Statistical Analysis:

Analysis of variance was applied to the treatments values obtained. Duncan's Multiple Range Test (1955) was then used to determine significant differences between means.

RESULTS

Chemical Analysis:

Data in Table 3 shows the proximate composition of smoked meat samples at the first week of storage as compared to fresh meat. Smoking decreased moisture content while concentrating the other nutrients. Moisture contents of smoked samples ranged from 35.0 (Treatment 1) - 45.0 per cent (Treatment 4) and average 40.4% at the first week of storage. Fat contents averaged 3.3%. Significant ($P > 0.05$) differences were not observed with regards to the various nutritional constituents of the smoked

Table 4 is a summary of the effect of different treatment on moisture contents, peroxide and Thiobarbituric Acid (TBA) values of smoked products at the end of a 9-week storage period.

TABLE 5: TREATMENT MEANS¹ AND STANDARD ERRORS (SE): TASTE PANEL RATINGS OF SMOKED MEAT

Treatment Solution ²	Appearance	Juiciness	Saltiness	Rancidity (Off flavour)	Flavour	General Acceptability
1	3.6 ^c	2.28 ^a	3.43	4.88 ^b	3.74 ^c	3.84
2	3.18 ^{ab}	2.84 ^{bc}	3.44	4.30 ^a	3.22 ^a	3.42
3	3.26 ^{bc}	2.42 ^{ab}	3.66	4.56 ^{bc}	3.62 ^{bc}	3.7
4 ^{RF}	2.94 ^a	3.08 ^c	3.42	4.34 ^a	3.12 ^a	3.4

1 Values are Means for fifty observations

2 Composition of solutions are shown in Table 1

abc Values within the same column with same superscript or no superscript are not significantly different ($P > 0.05$)

RF Refrigerated control samples.

There were no differences in TBA and peroxide values of treated samples ($P > 0.05$). TBA and peroxide values for fresh samples averaged 0.75 and 21.7 mg/kg respectively, indicating that the smoking process decreased rancidity levels. This perhaps is as a result of reaction between some of the smoke components (e.g. phenols) - and free radicals making them unavailable. It appears that lipid oxidation is not a problem in smoked beef, as indicated by similar peroxide and TBA values obtained for both control and antioxidant treated samples. Moisture contents values ranged from 15.51 to 44.5 per cent depending on the period of storage. This moisture level is conducive for mould growth.

Sensory Panel Evaluation:

Table 5 is a summary of taste panel ratings of product during a 9-week storage period. Treatment significantly ($P < 0.01$) affected appearance, juiciness, rancidity and flavour of products. With regards to rancidity and flavour, significant differences were not observed ($P > 0.05$) between samples dipped in BHT - potassium sorbate-sodium chloride solution (Treatment 1) and samples dipped in ginger juice-potassium sorbate-sodium chloride solution (Treatment 3). These samples were preferred to samples dipped in onion-juice-potassium sorbate-sodium chloride solution (Treatment 2) or samples dipped in 10% brine (control).

All products were acceptable to members of the last panel scores obtained were above the minimum acceptable in a 5 point hedonic scale.

Microbiological Observation:

Samples dipped in 10% brine (control) stored at room temperature were covered by visibly mouldy mass of mycelium by the fourth day of storage and

were considered unacceptable. Mouldiness was observed on 40.0% of samples dipped in the solutions containing 6% potassium sorbate (Treatment 1, 2, and 3) by the third week of storage. It appears that at the moisture content of products (35.0%) at the first week of storage, 6% potassium sorbate did not offer adequate control against mould growth. Moisture content of the smoked unrefrigerated samples decreased during the 9-week storage period.

DISCUSSION

The warmover flavour in cooked meat was first observed by Tims and Watts (1958) who considered lipid oxidation to be a primary cause of off flavour. Pearson et al (1977); Younathan and Watts (1959); Watts (1962) also have suggested the role of lipids and phospholipid in initiation and development of the reaction.

Results of the present study indicates that rancidity (lipid oxidation) is not a problem in Nigerian hot-smoked beef (Banda). Similar TBA and peroxide values were obtained from control and treated samples. Peroxide and TBA values obtained were within tolerable limits as confirmed by taste panel members, who did not consider the products rancid (Table 5). Watts (1962) reported that TBA numbers above 1.0 generally correspond to detectable off-flavour in meat. TBA values obtained in this study during the 9 - week storage period were below 1.0. A rancid taste often begins to be noticeable when the peroxide value is between 20 and 40 MEq/kg. Working with distillates from beef, Pearson (1968) found a steady increase in the

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TBA number as spoilage progressed for individual meats but found that fresh samples gave rather variable figures. Results of sensory panel evaluation showed that ginger juice flavour was acceptable to panelist. The major problem encountered in the smoked products appears to be that of mould growth. At per cent moisture level (35%) of products used in this study 6% potassium sorbate did not offer effective control against mould growth. Ikeme (1985) had reported that 6% potassium sorbate dip was effective in controlling mould growth in smoked mackerel products with less than twenty-five per cent moisture content.

At moisture levels greater than 35 per cent the use of 10% dips may be preferable. Moreover, residual sorbate levels in smoked samples after 15 minutes dip in solutions containing 6 or 10% potassium sorbate was below the 0.2% level standard (Ikeme, Unpublished).

Nigerians appreciate the benefit of using ginger and onions as spices but their usage in smoked meat may also be effective in retarding the development of off-flavours and odours resulting from growth of moulds.

REFERENCES

- AOAC (1995). Official methods of Analysis, 14th Ed. Association of Analytical Chemists. Washington, D.C.
- CALDIRONI, H.A. and BAZANI, N.Y. (1982). Effect of antioxidant on Malonaldehyde production and fatty acid composition in pieces of bovine muscle and adipose tissue, stored fresh and frozen. *J. Food Sci.* 47: 1329.
- DAWSON, L.E. and GARTNER, R. (1983) Lipid oxidation in mechanically deboned poultry. *Food Technology* 37(7):117
- DENG, J.C. (1978). Effect of iced storage of free fatty acid production and lipid oxidation in mullet muscle. *J. Food Sci.* 43: 337.
- DUNCAN, D.B. (1955). Multiple range and Multiple F-test. *Biometrics*, 11: 1 - 42.
- FAO (1986). Manuals of Food quality control Food Analysis. 7: 60 - 61.
- IKEME, A.I. (1985). Extending the shelf-life of smoked mackerel. FAO Expert Consultation on Fish Technology in Africa, Lusaka, Zambia, 21 - 25 January. FAO Fisheries Report No. 329, Supplement, FAO Rome.
- LEE, A. (1971). Laboratory Handbook of Methods of Food Analysis. Leonard Hill, London.
- LEE, Y.B., KIM, Y.S. and ASHMORE, C.R. (1986). Antioxidant property in Ginger Rhizome and its application to meat products. *J. Food Scis.* 51: 20.
- LOVE, J.D. (1983). The role of heme iron in the oxidation of lipids in red meats. *Food Technol.* 37(7): 105.
- MACNELL, J.A., DIMICK, P.S., and MAST, M.G. (1973). Use of chemical compounds and a rosemary spice extract in quality maintenance of deboned poultry meat. *J. Food Sci.* 38: 1080.
- MELTON, S.L. (1983). Methodology for following lipid oxidation in muscle foods. *Food Technol.* 37(7): 105.
- OBANU, Z. A. (1986). Losses and their control in the meat industry. Paper presented at the National Workshop on "Post-Harvest Food Losses and their Control", held at University of Nigeria, Nsukka, April 14 - 28.
- PEARSON, D. (1968). *Journal of Science of Food Agriculture*, 19: 593.
- PEARSON, D. (1976). *The Chemical Analysis of Foods*, Church-Hill Livingstone, Edingborough, London and New York Publishers, Ltd.
- PEARSON, A. M., LOVE, J.D. and SHORLAND, F.B. (1977). "Warmed over flavour" in meat, poultry and fish. In: "Advances in Food Research", C. O. CHICESTER, E.M. MRAK and G. I. STEWART (Ed.) 23: 39. Academic Press, New York.
- SATO, K. and HAGARTY, G.R. (1971). Warmed-over flavour in cooked meats. *J. Food Sci.* 36: 1098.
- SPEAK, M. L. (1976). *Compendium of methods for the Microbiological examination of food*. Amer. Publ. Health Asso., Washington, D.C.
- SWEET, C. W. (1973). Activity of antioxidants in fresh fish. *J. Food Sci.* 38: 1260.
- TARLADGIS, B.G., WATTS, B.M. and YOUNATHAN, M.T. (1960). A distillation method for quantitative determination of Malonaldehyde in rancid foods. *J. Am. Oil Chemists Soc.* 37: 44 - 48.
- TIMS, M. and WATTS, B.M. (1958). Protection of cooked meats with phosphates. *Food Technol.* 12: 240.
- WATTS, B.M. (1962). Meat Products; In symposium on Foods: Lipids and their oxidation. (Ed.) H. M. SCHULTS, E.A. DAY and R. O. SINNBULER. AVI Publishing Company.
- YOUNATHAN, M.T. and WATTS, B.M. (1959). Relationship of meat pigments to lipid oxidation. *Food Res.* 24: 728.
- YOUNATHAN, M.T., JUAT, K. OON and ROKIAH, M. Y. (1983). Control of heat induced oxidative rancidity in refrigerated shark and mackerel. *J. Food Sci.* 48: 176.
- YOUNATHAN, M.T., MAROFAN, Z. M. and ARSHAD, F.B. (1980). Oxidative rancidity in stored ground turkey and beef. *J. Food Sci.* 45: 274.