COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
INSTITUTE FOR SCIENTIFIC AND TECHNOLOGICAL INFORMATION

P. O. Box M. 32; Accra
or P. O. Box CT 2211,
Cantonments, Accra
Ghana, West - Africa

ALL COMMUNICATIONS SHOULD BE ADDRESSED TO THE DIRECTOR

TEL: 233-0302-778808/780708/9
TEL: 233-0302-764822 Director's Office
FAX: 233-0302-777655
EMAIL:insti@csir.org.gh
WEBSITE: www.csir.org.gh

Our Ref..... CSIR/AGJ/13/14

Date.....18th March 2013

Dear Dr Hodare-Okae,

THE QUALITY OF TRADITIONALLY COOKED COW HIDE AS A SOURCE OF FOOD IN GHANA

I write to inform you that the above-mentioned manuscript had been accepted for publication in **Vol. 46 (2013)** of the *Ghana Journal of Agricultural Science.*

You will be informed as soon as publication of the said issue of the Journal is due.

Yours sincerely,

Ayitey Armah, Jr

(AYITEY ARMAH)
TECHNICAL EDITOR
Ghana Jnl agric. Sci.

Dr M. Hodare-Okae
CSIR-Food Research Institute
P. O. Box M.20
ACCRA

The quality of traditionally cooked cow hide as a source of food in Ghana

E.C-T. TETTEY, A. OSEI-YAW & M. HODARE-OKAE
CSIR-Food Research Institute, Accra, Ghana.

ABSTRACT

The consumption of cooked cow hide as a source of animal protein in Ghana is phenomenal and perhaps forms a substantial part of the total animal protein intake in diet. Cow hide is a rich source of collagen (a fibrous protein), but nutritionally incomplete, lacking in two essential amino acids (tyrosine and tryptophan). It is, however, a rich source of hydroxyproline, proline and glycine. Cow hide processed traditionally with scrap tyres and rubbers and associated with overwhelming emissions of thick black smoke into the environment. It is also well documented that the hydrocarbon fraction of smoke contains polycyclic aromatic hydrocarbons (PAH). PAH have been shown to be potent carcinogens in experimental animals and highly hypothesized to make a significant contribution to cancer in humans. This is the concern of the public against possible harmful effects upon consumption of cow hide singed with scrap tyres and rubbers. The study highlights handling and storage of traditionally processed cow hide at the marketplace and assesses the quality of the product through chemical, microbiological and sensory analyses. Results on chemical analysis indicated high moisture content of the cooked cow hide (65.04 to 78.97 %). Results on microbiological analysis indicated high contamination with micro-organisms ($5.1x10^{11}$ to $3.0x10^{14}$ counts per gram). The presence of coliforms and faecal coliforms together indicate signs of spoilage for the cooked cow hide and contamination of the storage water, product or both with material of faecal origin. Sensory analysis results indicated high off-flavour threshold of cooked cow hide in a traditional Ghanaian light soup, an indication of signs of spoilage. The differences in tenderness and juiciness may be as a result of variability in the source of raw material used and the cooking time given to the cow hide. The overall acceptability of the product was however, fair 3.12±0.32, (62.4%) acceptability. Recommendations for improved processing methods of cow hide, handling and storage of the product in the marketplace are given.

Introduction

The consumption of cooked cow hide as a source of food in Ghana is phenomenal and perhaps forms a substantial part of the total animal protein intake in the diet of Ghanaians. Most of the hide (especially from cattle) obtained daily from slaughter houses and slabs in Ghana are all consumed as cooked cow hide and, therefore, very little finds its way to the few local tanneries for processing into leather. Insignificant quantities of cow hide are sometimes washed, dried and used as praying mats especially by the Muslim community. Hides from small ruminants, especially sheep and goats, are normally left intact on the carcass, however, small quantities are sometimes collected for processing by local tanneries.

Cow hide is a rich source of collagen, a fibrous protein, but is known to be nutritionally incomplete, lacking in two essential amino acids (tyrosine and tryptophan), both of which are vital to the anabolic synthesis of body proteins (Gerrard and Mallion, 1980). Collagen is unique in that it contains 14% hydroxyproline, 16% proline and 26% glycine (Anon, 2000). The ingestion of large quantities of cow hide will still

leave one deficient in protein owing to the lack of some essential amino acids, such as tyrosine and tryptophan, unless cow hide is supplemented with other proteins rich in those essential amino acids. The assurance of complete freedom from parasites, chemical contamination caused by substances used on the cow's skin for veterinary purposes must be approved by public health inspections as a priority before cow hide may be used as a source of food (Anon, 2010).

The concern of the public against locally processed cow hides stem from the possible harmful effects upon consumption of cooked cow hide singed with scrap tyres and rubbers, associated with overwhelming amount of thick black smoke emitted into the atmosphere when these materials are burnt. This presents environmental hazard and pollution. The burning of these scrap rubber materials constitute incomplete combustion and associated with the evolution of toxic gases such as carbon monoxide, sulfur dioxide and possibly their acid derivatives and a whole chain of other hydrocarbon compounds (Personal communication). It is also well documented that the hydrocarbon fraction of wood smoke contains some components best known as polycyclic aromatic hydrocarbons (PAH), which have been the source of much concern because of their toxicity potential. Several compounds of this group have been shown to be potent carcinogens in experimental animals and are highly hypothesized to make a significant contribution to cancer in humans (I.A.R.C., 1983; 1987; Phillips, 1999; Chichester *et al.*, 1969; FAO, 1992; Lawrie, 1985; Kramlich *et al.*, 1973; Bartoszaek, 2002; Varlet *et al.*, 2007).

The raw material for the production of cooked cow hide is fresh cow hide obtained from daily slaughtering of cattle in slaughter houses and slabs. Sun-dried or fire-dried cow hides, usually imported from the Sahelian countries of Africa, can also be used as a raw material provided the hides are reconstituted in water to assume the fresh soft state. The cow hide is first cut into portions about 30mm in length and rolled (hair side out). The rolled ends are tied up with scrap wire obtained after burning scrap tyres. The fire place for singeing is constructed with car tyre reams or block of stones arranged in two parallel lines separated by a distance of about one meter. On top and across these supports are placed two parallel cylindrical metal rails on which the hides are singed by fire made below this arrangement from scrap tyres. The singed hide is carried away by middlemen who unroll the hide and thoroughly wash with sponge and water. The washed hide is cut into smaller pieces and boiled in water in large aluminium pots for about six hours or more until the hide becomes moderately tender. After the cooking process the hide is soaked in water overnight; a process believed to leach out bitter taste from the cooked hide probably imparted to it through the singeing process. The hide is then rinsed in clean water and ready for the market. The period of holding by the market women while the cooked hide is offered for sale is variable depending on quantity and sales. The hide is kept in water in plastic containers during the holding period. The traditional practice of singeing cow hide with scrap tyres and rubber-based materials may be viewed to be a possible health risk from the standpoint of environmental pollution and contamination of the hide with possible toxic materials from fires and smoke produced by the tyres and rubber-based materials.

The objective of the study was to assess the quality of traditionally processed cow hide through market sampling, chemical, microbiological and sensory analysis and to recommend possible ways of processing cow hide, handling and storing of the product while on sale to minimize health risks.

Materials and methods

Materials

To identify the variability in quality of traditionally processed cooked cow hide on the open market, five sample lots of the product were collected from five sellers of the product at random and from five different markets in the Accra metropolis (Nima,

Mallam Atta, Kaneshie, Makola and Agbogbloshie markets). This gave a total of twenty-five sample lots from twenty-five different sellers randomly selected from the five different markets

Each sample lot comprising 10 cooked cow hide pieces (average weight 1kg) was cut into smaller pieces and all five sample lots mixed together and subdivided into three parts and used for the following analyses: chemical, microbiological and sensory respectively.

Chemical analysis

Samples for chemical analysis were kept frozen (average temperature -18°C) during four weeks period of analysis. The following chemical analyses were carried out on cooked cow hide according to A.O.A.C. (1990) procedures: moisture content, crude protein, total ash, total fat, and pH. Salt content was analysed by the Mohr method (Pearson *et al., 1981*).

Microbiological analysis

Microbiological analysis was carried out within twenty-four hours of sample preparation, while the sample was kept refrigerated. The following microbiological analyses were carried out according to Thatcher and Clark (1974) procedures: total aerobic counts, mould and yeast counts, culture micro-organisms, coliforms and faecal coliforms.

Sensory analysis

Samples for sensory analysis were kept frozen (average temperature -18°C) during four weeks period of analysis. Sensory analysis on cooked cow hide was carried out with 12 trained panelists. Cooked cow hide was used to prepare a Ghanaian light soup, coded samples rated on a 5-point hedonic scale, following the procedures as described by Tettey *et al.,* (1997).

Results and discussion

Chemical Analysis

The mean moisture content of cooked cow hide was 70.39±5.19% over a range of 65.04 to 78.97 % (Table 1). The high moisture content was expected since after long periods of cooking cow hide, the product is again stored in water during the holding period for sale in the market. Anon (1975), reported the moisture content of raw beef at 69.9% and cooked cow hide at 77.7%. These values are similar to values obtained in the study (Table 1). Mean crude protein content was 25.18 ±3.87% over a range of 19.96 to 30.48%. Comparative values reported by Anon (1975) for raw beef and cooked cow hide were 18.8% and 21.7%) respectively. Crude protein values were higher for cooked cow hide in the study even at the respective moisture contents compared. It is however, understood that the higher protein content of cooked cow hide is nutritionally incomplete when compared with raw beef due to lack of some essential amino acids (Gerrard and Mallion, 1980). The mean total ash content was 0.68 ±0.17% over a range of 0.46 to 0.89 %. Values obtained may reflect natural levels, assuming the absence of contaminants such as hair and sand particles. Anon (1975) reported total ash values 1.0% and 0.2% for raw beef and cooked cow hide respectively. Low salt content values, mean 0.12 ±0.10% and range 0.02 to 0.29% may also reflect natural levels in cooked cow hide since it is not salted during processing or at the point of sale on the market. Mean total fat value was 0.36 ±0.10% over a range of 0.28 to

TABLE 1

Results of Chemical Analysis of Cooked Cow Hide

Quality Parameter	*Mean Score (%)*	*Standard Deviation (%)*	*Range of Scores (%)*
1. Moisture content	70.39	5.19	65.04 to 78.97
2. Crude protein	25.18	3.87	19.96 to 30.48
3. Ash	0.68	0.17	0.46 to 0.89
4. Salt	0.12	0.10	0.02 to 0.29
5. Total fat	0.36	0.10	0.28 to 0.52
6. *p*H	6.06	0.74	5.40 to 7.15

Results are means of two determinations.

0.52%. Comparative values for raw beef and cooked cow hide (Anon, 1975) were 10.3% and 0.7%, respectively, an indication of naturally low fat content of cow hide. Mean pH value of cooked cow hide was 6.06 ±0.74 over a range of 5.40 to 7.15. The higher pH range may indicate deteriorative pattern by micro-organisms as indicated by high microbiological counts (Table 2). The pH for optimal growth of most bacteria is reported to be between 6.8 to 7.2 (Thatcher and Clark, 1974), and between pH 6.5 to 7.5 (Riemann *et al.*, 1972).

Microbiological Analysis

Physical examination of the cooked cow hide showed soft and wet feel. The colour ranged from brown to dark brown with a slight meat off-odour. Mould and yeast counts on the samples showed low levels, (range $2.1x10^2$ to $5.0x10^2$ counts per gram), however, total viable counts on samples indicated high contamination levels with a range of $5.1x10^{11}$ to $3.0x10^{14}$ counts per gram, (Table 2). This result may be due to the high moisture content of the product (Table 1), and its storage in water during the holding period for sale in the market. Cooked cow hide is displayed on open trays for sale and unsold product, at the end of the day, is stored in water in plastic containers. This practice may expose the product to external contamination including daily handling of the product with contaminated hands. The presence of coliforms and faecal coliforms also indicate poor sanitary conditions during handling of the product. The product, it's storage water or both may have been contaminated with material of faecal origin. Kayode and Kolawole (2008), reported the frequency of occurrence of pathogenic bacteria and faecal indicator (*E.coli*) from smoked bush meat isolates to indicate gross contamination of the samples either during processing with faecal contaminated water or handling by the sellers.

Sensory Analysis

The mean overall acceptability score for cooked cow hide in a Ghanaian light soup was 3.12 ±0.32, 62.4%, over a range of 2.8 to 3.6 scores, 56.0 to 72.0%, indicating a fair acceptability of the product, as scored by panelists. Cooked cow hide is a popular and highly cherished meat product in Ghana. Off-flavour threshold in the sample was high as shown by their mean scores 3.70 ±0.38, 74.0%, probably an indication of signs of spoilage shown by high total viable counts (Table 2) and long storage of cow hides in water. Slightly higher tenderness mean score, 3.50 ±0.95, 70.0%, over juiciness mean score, 3.18 ± 0.67, 63.6%, may indicate variabilities in the samples analysed as a result of factors such as differences in stage of maturity of animals slaughtered for their hides, differences in cooking time of cow hides and differences in the source of raw materials used (fresh cow hide or sun/flame-dried cow hides). Samples were collected at random from five different markets. Mean score for odour 3.40 ±0.46, 68.0%, indicates a fair acceptance of the meat odour of cooked cow hide.

TABLE 2

Results of Microbiological Analysis of Cooked Cow Hide

Sample Description	*Range of total viable counts per gram*	*Range of mould and yeast counts per gram*	*Culture micro-organisms*	*Coliforms (in 0.10 gram sample)*	*Faecal coliforms*
Soft, brown to dark brown in colour	$5.1x10^{11}$ to $3.0x10^{14}$	$2.1x10^2$ to $5.0x10^2$	Bacillus, Penicillium, Mucor, species	Present	Present

Results are means of two determinations.

TABLE 3

Results of Sensory Scores of Cooked Cow Hide in a Ghanaian Light Soup

Quality Parameter	*Mean Score*	*Standard Deviation*	*Range of Scores*
1. Odour	3.40	0.46	2.7 to 3.8
2. Tenderness	3.50	0.95	2.2 to 4.7
3. Flavour	2.86	0.20	2.5 to 3.0
4. Juiciness	3.18	0.67	2.2 to 4.0
5. Off flavour	3.70	0.38	3.1 to 4.1
6. Overall Acceptability	3.12	0.32	2.8 to 3.6

Number of panelists = 12
Quality parameter scores ranged from 5 (desirable attribute) to 1 (undesirable attribute).

Conclusion

Results of the study indicate high moisture content of cooked cow hide obtained in the marketplace. The storage of cooked cow hide in water in plastic containers under ambient conditions prior to display for sale predisposes the product to contamination from the external environment and through unhygienic handling by sellers and buyers alike. This is indicated by the presence of high total viable counts. The presence of coliforms and faecal coliforms in cooked cow hide is an indication of contamination of the storage water, the product or both with material of faecal origin. The high off-flavour threshold of cooked cow hide in a Ghanaian light soup may indicate signs of spoilage for the product. The overall acceptability of the product (62.4%) was however fair indicating the popularity of cooked cow hide as an important animal protein source in the diet of Ghanaians. Cooked cow hide is a rich source of collagen and can be consumed as an animal protein source provided it is supplemented with other animal protein rich sources to compensate for it's lack of the two essential amino acids (tyrosine and tryptophan). However, there may be possible health risks associated with the consumption of locally produced cooked cow hide, regarding poor storage and handling practices that occur in the marketplace, and possible contamination of the hide with parasites or veterinary drugs used for treatment. With proper inspection at the slaughter house by public health inspectors and improved processing, storage and handling practices as recommended in this study, cooked cow hide may be consumed with minimal health risks.

Recommendations

Fresh cow hides may be singed with a gas torch fuelled by domestic liquefied petroleum gas (LPG) which happens to be cheaper than fuel wood and electric power usage. This practice will prevent contamination of the singed cow hide with any toxic components that may be imparted through the use of scrap tyres and rubber-based products as fuel materials for singeing and also assure the consuming public of a safer and wholesome cow hide as a source of food.

The cooked cow hide may be packaged and sealed aerobically in plain polyethylene bags and stored under refrigeration (0°C to +8°C) for short-term storage (about two weeks), or frozen (about -18°C) for long-term storage (about two months), during the holding period and sales in the marketplace. This practice can extend the shelf-life, minimize contamination of cooked cow hide and retain its freshness during the holding period in the marketplace.

REFERENCES

Anon (2000): Cole, C.G.B., Gelatin Frederick, J.F. editors: Encyclopedia of Fd. Sci. and Technol., (2nd Edn.) vol. 4, N.Y. John Wiley and Sons, 1183-1188.

Anon (2010): Oxtail, Tripe and Cow Foot – Nutritious or Delicious? Jamaica Gleaner News. http://www.jamaica-gleaner.com

Anon,(1975): Composition of Foods Commonly Used in Ghana. CSIR/UNDP/FAO Reasearch Project. Food Research and Development Unit.

A.O.A.C. (1990): Association of Official Analytical Chemists, 5th Edn. Vol. 11.

Bartoszek, A. (2002): Mutagenic, carcinogenic and chemo-preventive compounds in foods. In (Z.E. Sikoiski (Edn.) Chemical and functional properties of food components (2nd Edn.), Boca Paton: CRC

Press, 307-336).

Chichester, C.O., Aryee, J.C., Goldblith, S.A., Maynard, J.A., Milner, R.T., Powers, J.J. and **Schweigert, B.S.** (1969): 101 Problems in Food Science and Technology, Section 5, 89.

FAO (1992): Food and Agriculture Organization of the United Nations. Food and Nutrition Paper No. 53, Chpt. 3, 51.

Gerrard, F. and **Mallion, F. J.** (1980): The Complete Book of Meat, 2nd. Edn., Trinity Press, Worcester, U.K.

I.A.R.C. (1983): International Agency for Research on Cancer. Polynuclear aromatic compounds. Part I. Chemicals, environment and experimental data vol. 32. Monographs on the evaluation of the carcinogenic risk of chemicals to humans. IARC, Lyon, France. J. of Fd. Prot., 66(6), 2003, 1095-1099.

I.A.R.C. (1987): International Agency for Research on Cancer. Overall evaluation of carcinogenicity: an updating of IARC monographs volumes 1 to 42, supplement 7. Monographs on the evaluation of the carcinogenic risk of chemicals to humans. IARC, Lyon, France. J. of Fd. Prot., 66(6), 2003, 1095-1099.

Kayode, R.M.O. and **Kolawole, O.M.** (2008): Studies on the b-lactamase production of bacterial isolates from smoked bushmeats. J. Appl. Sci. Environ. Manage. 12(2), 89-92.

Kramlich, W.E., Pearson, A.M. and **Tauber, F.W.** (1973): Processed meats: Westport, Conn. The AVI Publishing Co. Inc. Chpt. 4, 61-77.

Lawrie, R.A. (1985): Meat Science. 4th Edn. Permagon Int. Library of Sci., Tech., Eng. and Social Studies, ISBN 0080307892, 155-156.

Pearson, D., Egan, H., Kirk, R.S. and **Sawyerr, R.** (1981): Chemical Analysis of Foods. 8th Edn.

Philips, D.H. (1999): Polycyclic aromatic hydrocarbons in the diet. Mutat. Res., 443, 139-147. J. of Fd. Prot., 66(6), 2-3, 1095-1099.

Reimann, H., Lee, W.H. and **Genigeorgis, A.** (1972): Control of Clostridium botulinum and Staphylococcus aureus in semi-preserved meat products. J. of Milk and Fd. Technol., 35, 514-523.

Tettey, E.C.T., Osei-Yaw, A. and **Hodari-Okae, M.** (1997): Studies on the quality of traditionally smoked-dry snail meat (Achaina achatina) in Ghana. Ghana J. of Agric. Sci., 30, 145-150.

Thatcher, F.S. and **Clark, D.S.** (1974): Micro-organisms in Foods (II). International Commission on Microbiological Specifications for Foods (ICMSF). Univ. of Toronto Press, Toronto.

Varlet, V., Serot, T., Knockart, C., Cornet, J., Cardinal, M., Monteau, F., Bizec, B.L. and **Prost, C.** (2007): Organoleptic characterization and PAH content of Salmon (Salmo salar) fillets smoked according to four industrial smoking techniques. J. of Sci. Fd. And Agric. 87(5), 847-854.

Mordecai, Akwafo. Personal Communication: Chemistry Department, University of Ghana, Legon.