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Original Article

Chemical and Nutrient Composition of Cattle Hide ("Welle") Using Different Processing Methods

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Abstract

This study investigated the concentrations of Fe, Mn, Cu, Zn, Pb and Cd in cattle hides ("welle") processed using either fermentation or singeing with wood, discarded motorbike tyre or liquefied petroleum gas (LPG). Crude protein, ether extract and ash contents of "welle" were also determined. Heavy metal levels in fermented and singed samples ranged from 73.13 to 264.14 mg Fe/kg; 5.84 to 40.04 mg Mn/kg; 0.19 to 20.31 mg Cu/kg and 3.29 to 35.31 mg Zn/kg respectively. The contents of Pb and Cd in the hides were below detectable limits. Fermented treatments recorded significantly higher ($p<0.05$) metals compared to singed treatments. Percentage CP, EE and ash values for both un-singed and singed hides ranged from 85.60 to 93.60, 4.0 to 11.67, and 0.83 to 1.67 respectively. Suggestions were made about how to produce "welle" in an environmentally friendly manner.

Keywords: Metal content, cattle hide, fermentation, singeing; atomic absorption spectrophotometry.

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Introduction

Cattle hide, popularly known as "ponmo" in South-Western Nigeria, and "welle" in Southern Ghana is a delicacy in several parts of Africa (Obiri-Danso, Horgah, & Antwi-Agyie, 2008). Removal of hair from cattle hide in Nigeria is traditionally done by tenderization in hot water followed by scraping to obtain "ponmo" (Okiel, Ogunlesi, Alabi, Osiughwu & Sojinrin, 2009). In Ghana, and other African countries, singeing is preferred because it maintains the carcass hide for consumption and evokes meat flavors that are highly acceptable (FAO, 1985). Traditionally, singeing is done in open fire using firewood as fuel. However, the relative scarcity of firewood in recent times has resulted in the use of discarded tyres (Obiri-Danso, Horgah, & Antwi-Agyie, 2008), spent engine oil, plastics mixed with refuse or tyres (Okiel, Ogunlesi, Alabi, Osiughwu & Sojinrin, 2009) for singeing cattle hides. These fuel sources may contain potentially toxic substances like furans and benzene which could contaminate the hides and render them unfit for human consumption (USFA, 1999; Obiri-Danso, Horgah, & Antwi-Agyie, 2008). Among other environmental pollutants, tyres also contain several metals such as lead, mercury, cadmium, chromium, zinc and arsenic which could contaminate hides when these were used as sources of fuel for singeing (Pechan, 1997; IAFC, 2000; OECD, 2004). The consumption of such potentially contaminated meat products can be a great source of health risk (Leita, Enne, Nobili & Sequi, 1991; Jayasekara, Samarajeewa & Jayakody, 1992; Costa, 2000) to the ultimate consumers. It was against this background that this study sought to investigate the levels of heavy metals in "welle" processed through different methods. The percentage crude protein, ether extract and ash of the processed cattle hides were also determined. Thus the specific objectives of this study were to determine the effect of different processing methods on the levels of:

- Fe, Mn, Zn, Cu, Pb and Cd
- CP, EE and Ash in "welle".

Materials and Method

Raw materials and processing methods

A total of thirty (30) fresh cattle hides were obtained from the Buipe slaughter house over a period of three months and used in this study. Each fresh hide was initially divided into four-quarters and four (4) 6cm^2 pieces of hide each were randomly cut from each quarter to obtain 120 pieces of hide. Each piece of hide from the four quarters were randomly allocated to four treatments for processing using either fermentation (F) or singeing with wood (W), tyre (T) or gas (G). 500g of processed hide was taken from each treatment, scrapped, washed in excess distilled water and oven dried to a constant weight at 106°C for 24 hr. The dried samples were milled and used for the chemical and nutrient analysis. All treatments were stored in a freezer at -18°C prior to sample analysis.

Chemical and nutrient analysis

The milled samples were analyzed for Fe, Mn, Zn, Cu, Pb and Cd using atomic absorption spectrophotometer in acetylene-air (Varian Australia Pty Ltd., 1997). The nutrient compositions of the processed hides were determined according to AOAC (1990) procedures.

Statistical Analysis

The experimental design used in this study was 4 × 4 factorial design in completely randomized design (CRD) and a two-way analysis of variance (ANOVA) was employed using GenStat Discovery Edition 3, (2008) statistical software. Significant differences ($p < 0.05$) between treatment means were determined using Duncan's Multiple Test (Steel and Torrie, 1984).

Results and Discussion

The effects of the different processing methods on the metal contents in cattle hides are presented in Table 1. With respect to Fe, Mn, Cu and Zn fermentation recorded the highest values of 210.11mg/kg, 27.86mg/kg, 9.66mg/kg and 26.60mg/kg respectively. The tyre-treated cattle hides recorded significantly lower ($p<0.05$) concentrations of all the metals in exception of Zn, which was least (5.65mg/kg) in the wood-treated hides. Cd and Pb were however not detected in all the processing methods used.

Table 1: Effects of processing methods on metal contents of cattle hide (“welle”) Processing method.

Chemical (mg/kg)	Fermentation	Gas	Tyre	Wood	LSD
Fe	210.11[a]	127.00[c]	117.67[d]	148.11[b]	0.080
Mn	27.86[a]	9.58[c]	7.77[d]	9.17[b]	0.060
Cu	9.66[a]	4.91[b]	1.13[c]	5.16[c]	0.060
Zn	26.60[a]	9.77[b]	5.73[c]	5.65[d]	0.070
Pb	ND	ND	ND	ND	-
Cd	ND	ND	ND	ND	-

[abcd]Means in a row with different superscripts are significantly different ($p<0.05$); ND = Not detected.

Generally, the observed metal levels in all the processed cattle hides were far below the maximum permissible levels (MPLs) in meats. The (USDA, 2006) reported the maximum MPLs of Cu, Zn, Cd and Pb in meat as 20mg/kg, 50mg/kg, 0.05mg/kg and 0.1mg/kg respectively. With regards to the observed levels of Fe and Mn however, it was not clear whether the recorded values in this study constituted significant health implications for consumers because no MPLs have been assigned to Fe and MN in meat (MFPO, 1973). In fact the levels of heavy metals reported in all the processed hides were generally quite low when compared to some reported cases of heavy metal concentrations in other meat products (Obiri-Danso, Horgah, & Antwi-Agyie, 2008; Santhi, Balakrishnan, Kalaikannan & Radhakrishnan, 2008; Okiel, Ogunlesi, Alabi, Osiughwu & Sojinrin, 2009). It has also been established that there was a close relationship between heavy metal concentration in cattle tissues with their concentrations in the soil, feed and sources of drinking water (Voegborloh & Chirgawi, 2007; Cai, Long, Lui, Zhu, Zhou, Deng, Li & Tain, 2008). Thus, these results to some extent support some previous assertions that partially attributed heavy metals in cattle hide to other environmental conditions rather than the processing methods used (Obiri-Danso, Horgah, & Antwi-Agyie, 2008; Okiel, Ogunlesi, Alabi, Osiughwu & Sojinrin, 2009). The results of the nutritional analyses of the cattle hides are shown in Table 2. Very high CP with moderate values of EE and ash were obtained. The CP values for fermented, gas, tyre and wood treatments were 93.6, 85.60, 92.03 and 90.37 respectively. There were no significant differences ($p>0.05$) between the fermented, tyre and wood-treated cattle hides but the gas-treated samples were significantly lower in CP compared to all the other treatments. The observed differences in CP were attributed to differential heat intensities from the different fuels used in singeing the cattle hides. According to Girard (1992) the heat intensity from singeing materials resulted in degradation of essential amino acids of proteins. It was thus suggested that the heat generated from fermentation and singeing using tyre and wood as fuels in this study probably degraded less amino acid components of proteins in the processed cattle hides compared to using gas as fuel.

Table 2: Effects of processing method on nutrient compositions of cattle hide (“welle”).

Nutrient (%)	Processing method				
	Fermentation	Gas	Tyre	Wood	LSD
Crude protein	93.60[a]	85.60[c]	92.03[a]	90.37[ab]	2.200
Ether extract	4.00[d]	11.67[a]	4.67[c]	7.17[b]	0.580
Ash	1.67[a]	1.17[ab]	1.50[a]	0.83[c]	0.470

[abcd]Means in a row with different superscripts are significantly different ($p<0.05$).

Generally the crude protein values obtained in this current study did not compared favorably with those reported Ofori (2001), who obtained CP values (dry matter basis) in the range of 56.46 to

69.19. The seemingly higher CP value of 93.6% reported in this current study during fermentation was possibly due to the activities and multiplication of anaerobic bacteria which possibly added to the total protein content of the fermented hides. The significantly lower ($p<0.05$) CP in gas-singed treatments reflected in a significantly ($p<0.05$) higher ether extract compared to fermented, tyre and wood-treated cattle hides because fat and protein contents of food materials are inversely related (Lawrie, 1991). The percentage ether extract (EE) values for fermented, gas, tyre and wood treatments were 4.00, 11.67, 4.67 and 7.67 respectively (Table 2). There were significant differences ($p<0.05$) among the observed treatment means. The relatively lower EE values recorded was attributed to the fact that the procedure followed in the extraction of EE did not remove all fats especially, phospho-lipids or fats bound to proteins (McDonald *et al*., 1987). Ash values for fermented, gas, tyre, and wood treated samples were 1.67%, 1.17%, 1.50% and 0.83% respectively (Table 2). There were no significant differences ($p>0.05$) between fermented and tyre treatments and the observed differences between the ash contents of gas and tyre-singed “welle” were statistically not different ($p>0.05$). Similarly the differences observed between the ash contents of gas and wood treatments were also statistically not significant ($p>0.05$). These results compared favorably with those reported by Ofori, (2001). The significant ($p<0.05$) differences between the ash contents of fermented, gas and wood-singed “welle” were probably due to differences in the heat intensities generated from the different fuels used in the singed treatments.

Conclusion

Singeing cattle hides with gas, tyres or wood reduced heavy and essential metal concentrations compared with fermentation, and the extent of the reductions observed were dependent on the type of fuel used for the singeing processes. However, processing the cattle hides through fermentation resulted in reduced fat with higher protein and ash contents. The fermentation method of “welle” production should be encouraged because it is environmentally friendly and its products had higher protein and ash contents. We recommend that the amino acid profile of processed cattle hides should be considered and their bioavailability and nutritional benefits in human diets examined in future studies.

References

AOAC (1990). Official Methods of Analysis of the Official Analytical Chemists, (15th ed.) Arlington, VA: Association of Analytical Chemists.

Cai Q, Long M, Lui J, Zhu M, Zhou Q, Deng Y, Li Y, Tain Y (2008). Correlation between heavy metal concentration in cattle tissues and rearing environment. Chinese J. of Ecol., 27 (02) 202-207.

Costa M (2002). Trace Elements: aluminum, arsenic, cadmium and nickel. In Morton Lippmann (ed) Environmental Toxicants: Human Exposures and their Health Effects. John Wiley and Sons Inc. pp. 811-850.

FAO (1995). Manual of the slaughter of small ruminants in developing countries; section on slaughtering practices and techniques. Animal production and health paper No. 49, pp. 51-55.

GenStat (2008). Discovery Edition 3, Release 7. 22 DE, VSN International Ltd., UK.

Girard JP (1992). Smoking Technology of Meat and Meat Products. Ellis Horwood Ltd. Chinchester, England.

IAFC (2000). Environmental Concerns. In: The Prevention and Management of Scrap Tyre Fires Scrap Tyre Management Council (STMC) and National Fire Protection Association (NFPA). Pp. 31-34.

Jayasekara S, Samarajeewa U, Jayakody AN (1992). Trace metals in foods of animal origin in Srilanka. ASEAN Food Journal, **7**, 105 – 107.

Lawrie RA (1991). Meat Science (5th Ed) Pergamon Press oxford, New York, Pp. 225 – 232.

Leita L, Enne G, De Nobili M, Sequi P (1991). Heavy metal bioaccumulation in lamb and sheep bred in smelting and mining areas of South Western Sardinia, Italy. Food Science and Technology, **24**:125-127.

McDonald P, Edwards RA, Greenhalgh IFD (1987). Animal Nutrition. 4th Edition. Longman Group UK Ltd, England. Pp.

MFPO (Meat Food Products Order). (1973). Food Safety and Standards Authority of India. Available at: http://www.fssai.gov.in/AboutFssai/Introduction.aspx?RequestID=4MSeee0EuiuUkeE8iuM_doAction=True (20/12/2012).

Obiri-Danso K, Hogarh JN, Antwi-Agyei P (2008).Assessment of contamination of singed hides from cattle and goats by heavy metals in Ghana. African Journal of Environmental Science and Technology. Vol. 2 (8) pp 217-221.

OECD (2004). Emission Scenario Documents: Additives in the Rubber Industry, Federal Environmental Agency,

Berlin, Germany.
Ofori SK (2001). Effects of processing methods and storage conditions on the microflora and chemical content of cattle skin. MSc. Dissertation School of Graduate Studies, KNUST, Kumasi, Ghana.
Okiel W, Ogunlesi M, Alabi F, Osiughwu B, Sojinrin A (2009). Determination of toxic metal concentrations in flame treated meat products, *ponmo*. African Journal of Biochemistry Research Vol.3 (10) Pp. 332-339.
Pechan EH (1997). Air Emission from scrap Tyre Combustion. A report prepared for the United States Environmental Protection Agency, Pechan Associates Inc., USA.
Santhi D, Balakrishnan V, Kalaikannan A, Radhakrishnan KT (2008). Presence of heavy metals in pork products in Chennai (India). American Journal of Food Technology, 3, (3): 192-199.
Steel RGD, Torrie JH (1984). Principles and Procedures of Statistics, McGraw Hill Book Co. Inc. NY, USA.
USFA (1999). Report on tyre fires-Submitted to Committee on Commerce, Science and Transportation, United States senate and Committee Science, United States House of Representative, pp.12-14.
USDA (2006). Specific maximum levels of contaminants in foods. (Jim Butterworth and Wu Bugang). Foreign Agric services GAIN Report, Global GAIN Report No. CH6064.
Varian Australia Pty Ltd (1997). "Introducing Atomic Absorption Analysis. Publication No. 8510084800, Australia.
Voegborloh RB, Chirgawi MB (2007). Heavy metal accumulation in roadside soil and vegetation along a major highway in Libya. Journal of Science and Technology, 27 (3): 86-97.