International Journal of Nutrition and Food Sciences
2017; 6(4): 172-174
http://www.sciencepublishinggroup.com/j/ijnfs
doi: 10.11648/j.ijnfs.20170604.14
ISSN: 2327-2694 (Print); ISSN: 2327-2716 (Online)

An Evaluation of Nutritional Quality of Traditionally Processed Camel Meat (Nyirinyiri): Value Chain Assessment and Recommendations

Stephen W. Kisembe[1, *], Patrick S. Muliro[1], Joseph W. Matofari[1], Bockline O. Bebe[2]

[1]Department of Dairy and Food Science and Technology, Egerton University, Njoro, Kenya
[2]Department of Animal Sciences, Egerton University, Njoro, Kenya

Email address:
stevewakoli@gmail.com (S. W. Kisembe)

To cite this article:
Stephen W. Kisembe, Patrick S. Muliro, Joseph W. Matofari, Bockline O. Bebe. An Evaluation of Nutritional Quality of Traditionally Processed Camel Meat (Nyirinyiri): Value Chain Assessment and Recommendations. *International Journal of Nutrition and Food Sciences*. Vol. 6, No. 4, 2017, pp. 172-174. doi: 10.11648/j.ijnfs.20170604.14

Received: April 22, 2015; **Accepted**: January 19, 2017; **Published**: June 29, 2017

Abstract: *Nyirinyiri* is a ready to eat meat product prepared from dehydrated camel meat that is deep fried in fat. This study was conducted to determine the effect of processing and storage on the nutritional properties of camel *Nyirinyiri* in a total of 35 samples represented by fresh camel meat and *Nyirinyiri* collected at different nodes along the value chain. The results showed that traditional processing of camel meat had a significant effect on the nutritional composition. The mean values for crude protein, crude lipids and free fatty acid at the different nodes of the value chain were significantly different at P<0.05% level. The crude protein increased significantly (P<0.05) from 25.26% at production to 49.68% and 48.07% at processing and marketing respectively. There was a significant increase in crude lipids between production (1.18%) and processing (22.04%) nodes of the value chain. However, the increase at marketing (24.01%) was not significant. There was a significant increase (P<0.05) in free fatty acid (FFA) level from 0.2% at production to 0.73% at processing relative to 0.98% at marketing node of the value chain. Processing of camel meat into *Nyirinyiri* improves the nutrient composition especially, the protein and fat thus making it nutrient dense. The study revealed that camel *Nyirinyiri* is of high nutritional quality and therefore could be of great relevance to food security and income for the pastoral processors.

Keywords: *Nyirinyiri*, Camel, Value Chain, Molds

1. Background of the Study

Kenya has about 70% arid and semi-arid lands (ASALs). These areas are sparsely populated mainly by different nomadic pastoral people who depend largely on livestock and their products for a living (Bruntse, 2003).Of all the animals kept in northern Kenya, camels are most adapted to the prevailing harsh environmental conditions in ASALs (Rutagwenda *et al.,* 1989; Schwartz, 1992; Guliye *et al.,* 2007). Camels play multiple roles central to the livelihoods and culture of nomadic pastoralists in northern Kenya (Guliye *et al.*, 2007), notably provision of milk and meat, a means of transport, and sources of income from sale of live camels and camel products. Thus, camels play an important part in the food security of communities in the ASALs of Kenya. Pastoral women process camel meat into Nyirinyiri product using traditional low cost technology. *Nyirinyiri* is an indigenous, ready to eat dehydrated meat product that is preserved in fat. It is prepared by cutting camel meat into thin strips then sun drying the meat for 1 hour. The sun dried meat is then comminuted into small cubes and deep fried in commercial vegetable fat. It is stored in the same fat and consumed little by little as required. The challenges that impede women group *Nyirinyiri* processors which make them lose in quality, safety and price as well as accessing market opportunities vary in their number and significance. In northern Kenya, the harsh climate and poor infrastructure create insurmountable barriers, thus the product often varies widely in the degree of processing and this results in poor microbiological stability and difficulty in achieving consistent quality. Previous studies on *Nyirinyiri* from northern Kenya concentrated on meat from sheep and goat (Mathenge 2005) and there is little or no available information on camel *Nyirinyiri* meat value chain from Isiolo County. The objective of the present study therefore, was to analyze the nutritional quality of *Nyirinyiri* along the camel meat value chain in Isiolo County, in order to enhance food safety, quality and market acceptability of camel *Nyirinyiri* for consumers and for income security of the pastoral processors.

2. Methodology

2.1. Study site

The topography of Isiolo county is generally arid and semi-arid low lying plains on most parts of the region. Ewaso Nyiro is one of the main sources of water for both domestic and agricultural purposes. The average altitude of Isiolo County is between 200-300m above sea level and it receives very low precipitation. There are two rainy seasons in most years (April-June and October-December) and annual rainfall ranges from 150 to 650mm. Day time temperatures vary from 12°C -28°C. The most predominant type of vegetation is shrubs and acacia plant species that are well adapted to the high temperatures. Camels are the most abundant livestock species in this area, with camel milk and meat marketing being an important income earning opportunity for the pastoral households.

2.2. Sampling

The sampling of camel *Nyirinyiri* was conducted along the value chain mapped from Isiolo County where camels are produced and *Nyirnyiri* processed to urban markets in Nairobi (Eastleigh) where the product is sold to urban consumers. A total of thirty five samples (eight fresh camel meat samples and twenty seven *Nyirinyiri* samples) were collected at different nodes along the value chain by simple random sampling.

2.3. Compositional Analyses

2.3.1. Crude Protein (AOAC 2000)

Crude protein was determined by the micro-kjeldhal method using 0.1 grams of the sample, concentrated sulphuric acid and selenium tablets (catalyst) for digestion at 430°C for 3 hours in a digester. The digest was cooled to room temperature and distilled into 20ml of 0.1N HCl containing a mixed indicator of 0.1% methyl red and 0.5% phenolphthalein. The resultant distillate was titrated against 0.1N NaOH solution. The titre obtained was used to calculate percent crude protein content using the following formula;

$$\% P = V \times N \times 14 \times C \times 100/ 1000 \times S$$

Where: P is the % protein by weight.

V = Number of ml of hydrochloric acid solution used in titration (titre).

N = Normality of the hydrochloric acid solution.

C = Conversion factor (6.25 for meat).

S = Weight in grams of the sample.

2.3.2. Crude Fat Content (AOAC 2000)

Fat content was determined by the Soxhlet method using petroleum ether as the solvent. A weighed sample of 10 grams was placed in an extraction thimble in triplicate and closed with fat free cotton- wool. The fat was extracted for 8 hours on a heating mantle. The solvent was then evaporated and the fat dried in an oven set at 80°C for 30 minutes. It was cooled in a desiccator and weighed. The crude fat content was calculated by the formula:

$$\% \text{ Crude lipids} = \text{Weight of residue/Original weight of sample} \times 100$$

2.3.3. Free Fatty Acids (AACC 2004)

Acid value was determined by mixing together 50ml ether and 50ml alcohol (95%). An indicator, 1 ml phenolphthalein solution was added and neutralized with 0.1N Sodium Hydroxide solution. To this neutral solvent, 7g of *Nyirinyiri* was added and titrated with aqueous Sodium Hydroxide while shaking constantly until a pink color persisted for 15 seconds. Acid value was calculated using the following formula:

$$\% \text{ Free fatty acid} = ml \times N \times F \times 100/ \text{Sample weight} \times 1000$$

Where ml = Volume of Sodium Hydroxide solution required.

N = Normality of Sodium Hydroxide solution.

F = Equivalent weight of free fatty acid in which results are to be expressed (usually expressed as % oleic acid and equivalent weight is 282)

2.4. Statistical Analysis

All determinations were done in duplicate and the data collected were subjected to analysis of variance (ANOVA) using SAS program version 9.1. The least significant difference (LSD) was used for mean separation.

3. Results and Discussion

Table 1 shows that the mean values for crude protein, crude lipids and free fatty acids at the different nodes of the value chain were significantly different at P<0.05% level. The crude protein increased significantly (P<0.05) from 25.26% at production to 49.68% and 48.07% at processing and marketing respectively. There was a significant increase in crude lipids between production (1.18%) and processing (22.04%) nodes of the value chain. However, the increase at marketing (24.01%) was not significant. There was a significant increase (P<0.05) in free fatty acid (FFA) level from 0.2% at production to 0.73% at processing relative to 0.98% at marketing nodes of the value chain.

Table 1. *Variations in nutritional composition of camel Nyirinyiri along the value chain.*

	Nodes of the value chain		
Property	**Production**	**Processing**	**Marketing**
	(N=8)	(N=18)	(N=9)
Crude protein (%)	25.26 ± 0.71a	49.68 ± 1.91b	48.07 ± 0.94c
Crude lipids (%)	1.18 ± 0.05a	22.04 ± 4.74b	24.01 ± 0.99b
Free Fatty Acid (as % oleic acid)	0.2 ± 0a	0.73 ± 0.11b	0.98 ± 0.12c

Means in the same row followed by the same superscript are not significantly different (p< 0.05)

The crude protein increases along the value chain and this can be attributed to the heat processing using cooking oil that is employed during *Nyirinyiri* preparation. The protein percentage increases in cooked meat than raw, because of reduced weight (Casey, 1992).This indicates that processing camel meat into *Nyirinyiri* improves the percentage protein of the product thus increasing nutrient density. Heat – induced changes in protein solubility relate to changes in water-holding capacity of the meat (Morphy and Marks, 1999). The water content within the meat myofibrils in the narrow channels between the filaments changes as the meat shrinks within the tissue matrix. Cookout due to moisture loss from a cut serves to increase the protein fraction (Casey, 1992). *Nyirinyiri* is thus a protein dense food.

There was a significant increase (P<0.05) in crude lipids between production and processing nodes of the value chain (table 1). *Nyirinyiri* is prepared by deep frying in oil and when frying food, the hot frying fat that has penetrated into it, replaces part of the water it contains (Varela *et al.,* 1988). When fat penetrates a food, it may selectively modify the composition of the food. The uptake of absorbed oil in food ranges in percentage from 4 – 14% of the total weight, depending on the food and the type of the frying medium (Andrikopoulos *et al*., 2003). At marketing these values were also expected since *Nyirinyiri* is a meat product preserved in fat.

Table 1 indicates that there was a significant increase (P<0.05) in free fatty acid (FFA) level from 0.2% at production to 0.73% at processing relative to 0.98% at marketing nodes of the value chain. Fats undergo changes resulting in the production of off-odors and taste, loss of nutritive value, and perhaps the production of toxic substances. Free fatty acid test was done to monitor the extent of hydrolysis of camel *Nyirinyiri* lipids. Free fatty acid (FFA) value in *Nyirinyiri* gradually increased with storage time. There was a significant increase in FFA level between each node of the value chain. The reference value for fresh camel meat (at production) is 0.23% Oleic acid (Muhammad, et al., 2011). At the processing node, the result was expected since the water present in the meat interacted with the oleic acid causing hydrolytic reactions which resulted in larger amounts of free fatty acids such as diacylglycerol, monacylglycerol and glycerol. However, FFA value did not exceed the 1.2- 2.1% limit which was reported by Pearson (1968a) to be the minimum limit for odor to be acceptable. There was no off-odor perceived in the product.

4. Conclusion and Recommendation

Processing camel meat into *Nyirinyiri* has a significant effect on the nutritional value. It improves the nutrient composition especially, the protein and fat thus making it palatable and nutrient dense. Cooking influences the content of several nutrients in meat depending on the cut and the cooking process (time, medium and temperature).The study showed that camel *Nyirinyiri* as a dried meat product is of high nutritional quality and therefore has a promising future if policies can be developed and adopted to guide this informal meat value chain as well as marketing the product to enlighten the general public of its health benefits. The product could also be of great relevance towards addressing food security and income for the pastoral processors. We recommend educational programs and training to support *Nyirinyiri* women processors in terms of hygiene, packaging and storage for better market access and also in collaboration with the Kenya Bureau of Standards, analyze and develop standards for the product as a way of quality control.

Acknowledgements

My sincere gratitude goes to RUFORUM for funding this research and Egerton University for facilitating the work to completion.

References

[1] Andrikopoulos, N. K., Boskou, G., Dedoussis, G. V. Z., Chiou, A., Tzamtzis, V. A., Papathanasiou, A. 2003. Quality assessment of frying oils and fats from 63 Restaurants in Athens, Greece, Food Service Technology 3: 49 – 59.

[2] AOAC. 1990. Association of Official Analytical Chemists. Official Methods of Analysis, 15th Ed. Washington, D.C. pp

[3] Bruntse, A., Lemunyete, L. 1. 2003. Partnership for milk / meat preservation technologies development.

[4] Casey, N. H. 1992. Goat Meat in Human Nutrition, International Conference on Goats Pre-conference Proceedings Vol. II: Invited papers, Indian Council of Agriculture Research New Delhi, India.

[5] Guliye, A. Y., Noor, I. M., Bebe, B. O., Koskey, I. S. 2007. Role of camels (*Camelusdromedarius*) in the traditional lifestyle of Somali pastoralists in northern Kenya. Outlook on Agriculture, 36(1), 29-34.

[6] Mathenge, M. W. 2005. Physico-chemical and Microbiological properties of sheep and goat meat preserved by deep-fat frying (Samburu*Nyirinyiri*). MSc. Thesis Egerton University

[7] Morphy, R. Y., Marks, B. P. 1999. Effects of meat temperature on proteins, texture and cook loss for ground chicken breast patties. pdf

[8] Muhammad, B. F., Abubakar, F. M. 2011. Chemical Composition of Raw and Cooked Camel (*Camelusdromedarius*) Meat Cuts. Volume 6(2).

[9] Pearson, D. 1968a. Application of Chemical Methods for the assessment of beef quality part I. General considerations, sampling and the determination of basic components. J. Sci. Food Agric., 19: 364-366.

[10] Rutagwenda, T., Kaske, M., Engelhardt, W. Y., Lechner-doll M., Schultka, W., Schwartz, H. J. 1989. Adaptation strategies of camels on a thornbush savannah pasture: comparison with other domestic animals. Options Méditerranéennes - SérieSéminaires, 2, 69-73.

[11] Schwartz, H.J. 1992. Productive performance and productivity of dromedaries (*Camelusdromedarius*). Journal of Animal Research and Development, 35, 86-98.