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Utilization of Beef Slaughter By-Products among the Kenyan Pastoral Communities

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Abstract
Slaughter of animals (cattle, goats, sheep and camels) is very common in the pastoral areas to satisfy the high local demand for meat. Most of this slaughter is informal. Slaughter is aimed at producing meat but at the same time many by-products are produced. However information on the traditional use of slaughter by-products is scanty, in spite of their high potential for commercial utilization. This study therefore was designed to establish how beef by-products are utilized and assess their potential for utilization in commercial processed products.The counties of Turkana, Garissa, Kajiado and Marsabit were purposively selected because they are the largest livestock producers among the pastoral counties. They are inhabited by Turkana (Turkana), Somali (Garissa), Maasai (Kajiado), and Borana, Rendile and Orma(Marsabit) communities. Data was collected using key informant interviews and focus group discussions. Visual observations in selected slaughterhouses were also employed.Results showed that the by-products could be divided into wastes (hooves and sometimes horns), commercial (hides, sometimes horns and bones) and food (blood, glands and organs and meat on bones). The by-products that were used for food were prepared for consumption in different ways by the different communities. The study established that the by-products were not effectively utilized leading to high post slaughter wastage. The inedible by-products such as the hides were sold to tanneries, the horns were used for ornamentals, skins as dry-skin containers and hooves were just cast away
Keywords: Beef slaughter, by-products, utilization, pastoral communities, Kenya.

1.0 Introduction`

In a meat slaughtering operation, by-products are those parts of the animal that are removed to dress the carcass. There are two categories of by-products .The common edible by products are including liver, heart, tongue, tripe brains, oxtail, trimmings, intestines, testicles, blood and spleen, and the inedible by-products which include bones, hooves and hides and skins. High losses of by-products are experienced post slaughter because they are not handled with as much care as the main carcass. Their utilization is also not very well organized and due to the high temperature prevailing in the pastoral areas, deterioration can be rapid. According to FAO (2011), 29.7% of meat products are lost post slaughter in East Africa. Reducing Post harvest losses will effectively and sustainably increase the volume of available food, without encountering the adverse effects on the regional ecological and economic situation (Hensel 2011). The inedible by-products can be channelled to commercial uses. Hides and skins can be sold to the tanneries, horns used for ornamentals and extraction of glue, bones for animal feed and hooves for production of glue. However, most often, the bones and hooves are thrown away. Today in the pastoral areas the cost of live animal often exceeds the selling price of its carcass. The preparation of saleable part of the carcass can be greatly increased by utilizing the by-products commercially to make the slaughter most cost effective. According to Bowater and Gustafson, 1988, 15% of slaughterhouse income could come from by-products if they are handled properly. However in the last several years, the economic value of animal by- products has declined (Hedrick et al., 1994) because of technological advancement in producing competitive substitutes from non-animal sources.

Improper disposal of animal slaughter by-products may create major aesthetic and health problems (Jayathilakan *et al.,* 2012). By-products disposal and waste management in food processing industry can pose problems in the areas of environmental protection and sustainability (Russ and Pittroff 2004). The edible slaughter by-products have the potential to be incorporated into the commercial products in the modern processing plants to increase their value without necessarily jeopardising the acceptability of the products. This is an area that needs to be explored because it will boost the economic value of the by-products

This study therefore was designed to identify methods and extent of utilization of by-products in the pastoral areas with the view to evaluating the potential of the by-products for mainstreaming them into the modern commercial meat processing industry.

2. Methodology

2.1 The study setting

The study was conducted in four pastoral counties namely Turkana, Marsabit, Garrisa and Kajiado. These counties are shown in figure 1. The counties were purposively selected because they are the leading cattle producing areas.

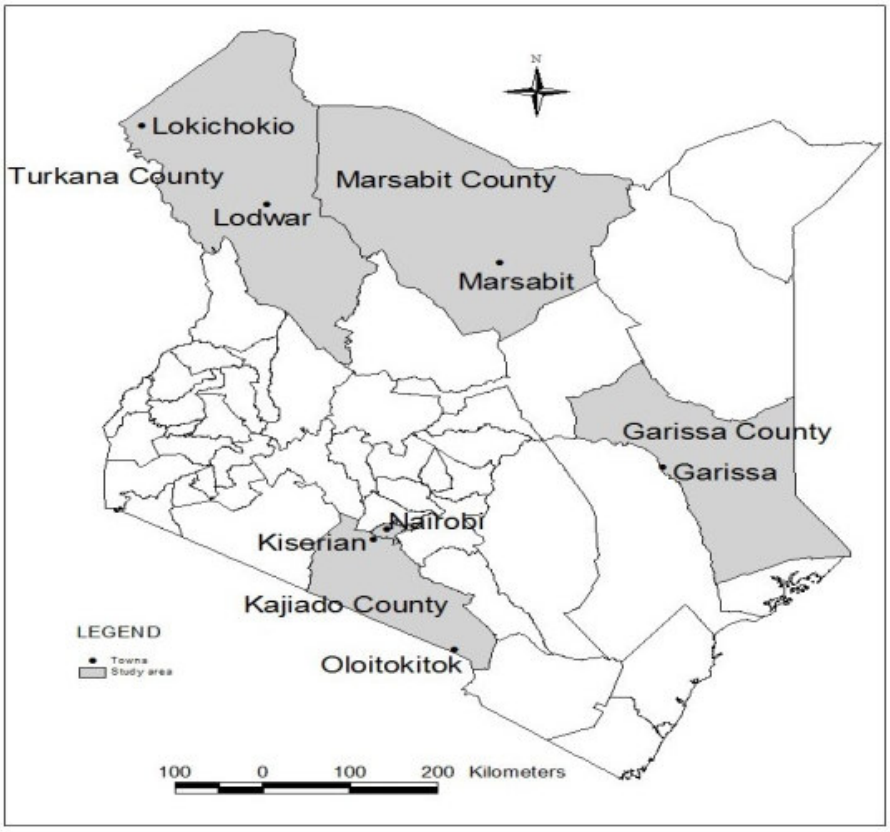

Figure 1 Study areas

Turkana and Marsabit are the largest arid and semi-arid land counties in Kenya therefore constitute an important area of cover; moreover, they fall under the pastoral regions of Kenya. Garissa is one of the largest Counties in the arid and semi-arid land and also the leading livestock market in East Africa moving over 30,000 cattle a week and 500 shoats daily, according to the Department of Veterinary Services. Kajiado County is important as the biggest livestock producer in Kenya.

2.2 Study design

The study was cross sectional in design. The residents of the four counties have different socio-cultural backgrounds. A semi structured questionnaire was used to guide the interviews .The persons therefore were therefore assembled, one from each county. The focus groups interviewed were key informants who were selected from each county as government veterinary officers, mainly meat inspectors and regularly interact with the local residents at the slaughterhouses and households. Focus groups members were drawn from the local communities within the county with the help of the local government officers. The focus groups consisted of members of the communities who were best knowledgeable on the animal slaughter and products utilization. The two research tools were combined with personal visits and observations of at least two slaughterhouses in each county

2.3 Method of data collection

Key informant interviews were conducted and focus group discussions held to gather information about the current slaughter by-products utilization. Government meat inspectors and knowledgeable people provided the information. A previously pretested semi-structured questionnaire was used as a guide to gather information on various utilization ways. Meat inspectors interact with the slaughter operators at slaughterhouse levels. The knowledgeable people supplied the cultural details and aspects regarding the by-products utilisation by local communities. Further, knowledgeable people from the various communities in each county were involved so that they give the cultural aspect of the by-products utilisation. .

The number of informants varied from county to county depending on the expansiveness as well as the cultural variance of the areas. In total, 22 informants were interviewed. Turkana(6),Garissa (5), Kajiado (7) and Masrsabit(4). The focus group discussion membership constituted six to ten participants with attempts to balance gender of group members. The ages of the group members ranged from 42 to 74 years. These age groups of people were deemed to have the relevant knowledge about the by-products in their respective localities. The languages used were English and Swahili. Where necessary, some terms or questions were interpreted with the help of native field assistants. The interviews of the key informants were conducted individually, to avoid influences from other

informants.

3. Results and discussion

The four counties reported varied ways of by-product utilization. Ethnic traditions and cultures influenced the way by-products are utilized. Traditions, culture and religion are often important when a meat by-product is being utilized for food (Jayathilakan *et al.,* 2012). So diverse are food preparation methods that the same products are cooked differently for consumption by different communities. These results are shown in Table 3 and the specific narratives are as shown in the following:

3.1 Blood utilization

The average percentage of blood that can be recovered from cattle is 3.0–4.0 % (Jayathilakan *et al*., 2012). There was a very high amount of blood produced in the slaughterhouses. Most of the blood was left to waste with very little being consumed by humans. That which was consumed was incorporated in the traditional sausage (*mutura*) as stuffing or fed to the pets especially dogs. Ethnic Somalis in Garissa County do not consume blood due to cultural and religious convictions. Other communities of the county however, consume in various food formulations. Among all the study areas, Garrisa reported most blood wastage because of the high proportion of the inhabitants of the county being Somalis. Maasais in Kajiado consume blood and it is accepted as food in the homesteads. During grazing especially far away from home, young maasai men (*morans*) pierced the cattle's jugular vein, bled and collected the blood which was mixed with raw milk and consumed. In the commercial slaughterhouses in Kajiado, most of the blood was left to waste again although some was used in sausage stuffing. In one of the slaughterhouses the blood was directed together with other ingesta matters into a biogas digester plant. There was very little utilization of blood in Turkana and Marsabit. It was merely left to waste. Similar to other counties, any used blood was mainly for traditional sausage stuffing. The rest of the blood was merely dumped in lagoons. One of the major challenges reported was the maintenance of hygiene in the collection and handling of the edible by-products to maintain safety in consumption. This inhibited utilization of the products for food because the methods of preparation for consumption at the domestic level could not necessarily guarantee safety.

Blood is usually sterile in a healthy animal. It has high protein content, 17%, with a reasonably good balance of amino acids (Jayathilakan *et al*., 2012) and a high level of heme iron, (Wan *et al.,* 2002). It can therefore be used as protein and iron supplement. There is a huge potential in blood utilization as ingredient in processing of human and animal food, but also as farm inputs. In Europe, animal blood has long been used to make blood sausages, blood pudding, biscuits and bread. In Asia, it is used in blood curd, blood cake and blood pudding (Ghost 2001). Blood is also used for non-food items such as fertilizer, feedstuffs and binder for sausages. Blood is used in food as emulsifier, stabilizer, clarifier,colour additive, and as nutritional suppliment (Silva and Silvestre 2003).Blood plasma has ability to form a gel, because it contains 60.0% albumin (Silva and Silvestre 2003) and has excellent foaming capacity (Del *et al*., 2008).

Table 1 Edible by- products utilization in the pastoral areas

	County and dominant community			
	Garissa *(Somali)*	**Kajiado** *(Maasai,kikuyu)*	**Marsabit** *(Borana,Rendile,Orma)*	**Turkana** *(Turkana)*
By-product	**Method(s) of utilization**			
Blood	Human food	Human food. Animal food	Human food	Human food
Liver	Human food	Human food	Human food	Human food
Heart	Human food	Human food	Human food	Human food
Kidney	Human food	Human food	Human food	Human food
Tongue	Human food	Human food	Human food	Human food
Brain	Human food	Human food	Human food	Human food
Tripe	Human food	Human food	Human food	Human food
Oxtail	Soup making	Soup making	Soup making	Soup making
Testicles	Human food pet food	Human food	Human food	Human food
Pancreas	Human food pet food	Human food	Human food	Human food
Sinews	Meat on bones Human food	Meat on bones Human food	Meat on bones Human food	Meat on bones Human food
Trotters	For making soup	For making soup	For making soup	For making soup
Bones with meat	For stock making	For stock making	For stock making	For stock making

Table 2 Some uses of the inedible by-products in the counties

County	Garissa	Kajiado	Marsabit	Turkana
Product		**Some uses**		
Horns	-	Ornamental fabrication	Musical instruments fabrication	Ornamental Musical instruments
Hides/skin	Sold to tanneries.	Sold to tanneries	Sold to tanneries, packaging	Sold to tanneries, construction of meat package*(enyas)*

3.2 Utilization of glands and organs.

Glands and organs form a very important food in many parts of the world. The study showed that these products are very important food items in the pastoral regions.They include the brain, heart, kidneys, liver, lungs and spleen. Others are the tongue, the pancreas and udder, the rumen, reticulum, omasum, abomasum the testes and thymus (Liu 2002). Glands and organs were cooked for consumption in almost the same way in all counties. However whereas in other counties the kidneys were roasted, stewed or boiled before consumption, the maasai morans(worriors) in Kajiado county ate them raw. Other communities within the County cooked kidneys mainly by boiling in water before eating. Liver was cooked and eaten by all communities. Liver is commercially processed into products such as sausage and liver paste (Devatkal *et al.* 2004). Urban hotels commonly fry liver as part of their daily menu. Lungs were cooked together with other meat trimmings. However, some lungs and trimming were used as pet food. It has been reported in USA and Europe that calf and lamb lungs are mainly used to make stuffing for some types of sausages and processed meats (Darine *et al.,* 2010).

Brain and tongue were not removed from the head and were therefore sold together and cooked together for consumption, mainly by boiling after scalding the adhering fur on the head. Elsewhere, the cholesterol in the brain has been used as an emulsifier in cosmetics (Ejike and Emmanuel 2009). The intestines and tripe in general were utilised as local delicacies by all the communities in the study regions. They were either cooked by boiling and /or roasting or used as a local sausage casing. Before cooking they were cleaned of the residual excreta. World over, the intestines constitute an important use as a sausage casing (Bhaskar *et al*., 2007). Sinews and tendons were not separated from the main carcass and therefore were sold as meat on bones. The fats were also not separated from the main carcass meat. This made the meat fattier in the pastoral areas than in other urban areas where high end butcheries usually trim the fat and hard tendons from the main carcass. Majority of people in the pastoral areas preferred their meat fresh and fatty since they perceived such meat as the most delicious and juicy. They argued that meat which has been stored overnight is not sweet on consumption. Testicles and udders were used as food for human. They were mostly boiled or roasted and eaten immediately after slaughter. Similar by- products showed similarities in the way they were prepared in different areas.

Table 3 Common methods of storage and preparation of slaughter by-products for consumption in the pastoral areas.

By product	State of its preparation	Method of preparation
Blood	Fresh but coagulated	Sausage stuffing, cooked for pet food
Liver	Fresh , refrigerated	Boiled, fried, stewed
Heart	Whole ,fresh ,refrigerated	Fried, boiled, roasted
Kidney	Whole, fresh, refrigerated	Boiled, Roasted, stewed
Tongue	Whole, fresh	Boiled, roasted, stewed
Brain	Whole within the head	Boiled
Tripe	Whole	Boiled, stewed, roasted, sausage
Oxtail	Fresh, frozen ,refrigerated	Boiled, cooked into broth
Testicles	Whole ,sliced, fresh	Roasted, boiled(fur scalded first)
Pancreas	Whole, fresh	Boiled, Fried, sausages stuffing
Sinews	In meat cuts, trotters	Cooked as meat on bones
Trotters	Fresh	Boiled, roasted

3.3 Utilization of hides and skins.

The hides represent a remarkable portion of the weight of the live animal, from 4% to as much as 11% e.g. cattle: 5.1–8.5%, average: 7.0% (Jayathilakan *et al*., 2012). Hides and skins were not utilised as food according to the study. The hides and skins were sprayed with salt on the whole surface and partially dried in air, then sold to intermediaries who sold them to tannerries as shown in table 2. Hides and skins from animals slaughtered at homes were usually left to waste since most of the collection centres were far away from households. In a few cases, communities in Kajiado dried them and used them for preparation of meat storage containers, for making

traditional ornaments and clothing. Wooden containers were wrapped by a dried softened skin and used to package traditional meat products. These containers were for example the one used to store *Enyas*, a traditional Turkana meat product. Other products from the hides of cattle include leather shoes and bags, rawhide, athletic equipment, reformed sausage casing and cosmetic products, sausage skins, edible gelatine and glue (Benjakul*et al.* 2009). Figure 2 shows the turkana traditional meat product, *enyas* packed in gourd wrapped in a skin.

Figure 2 A skin wrapped gourd for storage of enyas

In more advanced cases, the hides have been used for extraction of gelatin through hydrolysis of collagen. Gelatin has many applications including use in food (Choa *et al*. 2005). Gelatin is also the major ingredient in jellies (Jamilah and Harvinder 2002).

3.4 Utilization of hooves and horns.

Hooves and horns are not used for food by the pastoral communities in all the counties studied. Hooves were sold to glue manufacturers. Horns were locally utilised in various ways depending on the cultural practices of the community. Most of the communities used the horns for preparation of music instruments and making ornamentals, by chopping and shaping to desired shapes and sizes. Kajiado County had the most diverse ways of utilizing horns. This probably owed to the fact that people living there were of more diverse cultural backgrounds. Besides being used for ornamental and music instrument, horns were prepared into containers for drinking local brew by the kikuyu community living in Kajiado. It should be realized that only a small proportion of selected horns were used for manufacture of the items indicated. The larger proportion of horns plus the hooves were discarded or sold to the glue manufacturers. If hooves and horns are controllably collected and sold to glue manufacturers, then this can help to increase the profitability of animal slaughter.

3.5 Utilization of bones.

The study showed that most of the bones had adhering meat and were sold as meat on bones. Very few slaughterhouses deboned their meat. The few ones who deboned their carcass sold the bones to people who made clear soups/stock in hotels, restaurants and households. Trotters contributed the largest proportion of bones since many people perceived them to be inferior food. Soup from trotters was prepared in most slaughterhouses. To make soup from trotters, they are first flamed to burn off the hairs, and then brushed and washed-off the soot. They are cut into chunks then boiled until soft. Bone soup was reported to be very popular among people living in the study areas. Since the trotters were the most affordable and available source of bones, majority of soup makers preferred them to the carcass bones. Competition for main carcass bones with pet keepers also contributed to the trotters being more preferred soup making ingredient than main carcass bones. People however seemed to dislike the tendons/sinews and cartilages on the trotters since they were arguably tough to chew. This perception led to some soup makers requiring that the tough tendons be removed before boiling for soup. The sinews were thereafter used for pet food.

The carcass consists of 15% bones with the figures being higher if the meat chips clinging on the bones are included. The marrow in the bones which account for 4.0-6.0% of the carcass weight (West and Shaw1975), is also used as food. In some more developed countries in Europe, the bones are used for meat bone meal manufacture. Kenya meat commission (KMC) in Kenya also utilises their bones for bone meal processing and sinews as part of the binders for corned beef.

4.0 Conclusion

By products utilization in the pastoral areas is not well organised and wastage is rampant. However, most of the by-products with the exception of solid bones, hides and skins and hooves are considered as food. Their incorporation into commercially processed products for a wider market will therefore be considered acceptable. There also exist market for inedible by-products like hooves, horns and solid bones. If the marketing of the edible

and inedible slaughter by-products is well organized, then this should increase profitability of slaughter.

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