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Utilisation of High Acid Milk at Rural and Peri-Urban Milk Value Chain Systems in Nakuru County, Kenya

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Abstract

Developed acidity in milk, a major proportion of post-harvest losses in smallholder delivered milk at collection centres, results from microbial activity as it is being transported or stored under uncontrolled temperature. The resulting high acid milk is considered of low quality and rejected based on failed alcohol test. The contribution of rejected milk to post-harvest losses is documented however its utilisation is not. This study therefore determined this milk's utilisation. Using a semi-structured researcher administered questionnaire, Focus Group Discussions, observation checklist and Key Informant Interviews, data was collected. Results reveal insufficiency of milk quality control at the collection centres. Several volumes of milk failed quality control tests per month resulting to milk post-harvest losses. Frequency of milk rejection was higher during rainy season compared to the dry. Naturally fermented milk was the most common product developed from rejected high acid milk. Other farmers mentioned the disposal of this milk while others fed it to animals and/or sold it to neighbours. The study concludes that once safety and physico-chemical quality of high acid milk is determined, appropriate technologies for processing can be used to develop milk products.

Key words: Milk post-harvest losses, High acid milk, Milk collection centres

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Introduction

More than 80% of the total milk produced in Kenya is handled by processors. Farmers' organizations such as cooperative societies and farmers' groups handle only about 40% of marketed milk production and about 20% of total milk (Muriuki, 2003). These organizations are formed to enable farmers market their milk more efficiently by pooling their resources and the quantities of milk each of them produces (Kurwijila, 2006). This results in the collection and bulking of milk.

Farmer groups and operators of milk collection centres have systems of quality control for the milk they receive from individual farmers, therefore segregating poor quality milk. Simple platform tests are carried out to enable the centres ensure that only good quality milk is accepted for onward transportation to milk processing factories, milk bars or retailers of raw milk in urban centres. These centres therefore play an important role between the dairy farms and the dairy industry in terms of supplying high-quality, safe and adequate raw milk (Demirbas *et al.,* 2009).

The tests that are carried out include: organoleptic test, alcohol test and lactometer test. The alcohol test, which is the most common quality control test carried out, analyses milk on the basis of stability of milk casein micelles. Development of acidity in milk causes disintegration of these micelles (FAO, 2011).

Acid development in milk results from microbial activity as it is being transported from farms or stored under uncontrolled temperature. The long hours taken for milk transportation under uncontrolled temperatures provides favourable environment for microorganisms in milk, principally the lactic acid bacteria to ferment the milk. These microorganisms sour the milk by converting the milk sugar, lactose to lactic acid (IDF, 1992 a, b). At low levels of pH, casein is destabilized (Walstra *et al.,* 1999). The destabilization of casein is detected upon subjecting milk to the alcohol test. The milk is rejected upon failing this test.

Milk rejection contributes to post-harvest losses at farm level which can be more than 6% of total production (Muriuki, 2003). The contribution of rejected milk to post-harvest losses is documented however its utilisation is not. This study therefore determined the utilisation of coagulated or high acid milk that is rejected at collection centres.

Alcohol test

Coagulated milk indicating failed alcohol test

Material and Methods

Study area

The study was conducted in Dundori (peri-urban area) and Olenguruone (rural area) Divisions found within Nakuru County in the Rift Valley region, Kenya.

Study design

The study regions were selected purposively based on two dairy farming systems, that is, peri-urban and rural systems. Milk collection centres were then selected purposively based on the study region. Three collection centres were picked, two in Olenguruone and one in Dundori. These included: Wanyororo dairy cooperative society collection centre in Dundori and Olenguruone Dairy Cooperative Society collection centres, Olenguruone and Kaplamai branches. Information on utilisation and processing of high acid milk at household level was then collected. This information was obtained from collection centres, farmers and extension officers. Individuals in the collection centres provided information on quality control tests performed at the centres, amount of milk that fails either of the tests performed, frequency of milk rejection and the farmers whose milk fail the tests. Since the study sought interventions for high acid milk, only farmers whose milk failed the alcohol test were followed up. These farmers formed the sample size of those who responded to questions in the structured questionnaire. Any current products developed from the high acid milk were documented.

Results and Discussion

Collection and bulking of raw milk

Collection and bulking in the two study areas depended mainly on intermediaries (traders) and the road network. Some farmers reported that the road network and further to this the cost of transporting milk were the main reasons why they never took their milk to the collection centre. This would result into selling the milk to neighbours or to intermediaries who took milk to the centres or sold it to other outlets including shops and hotels. Poor roads contributed to delay in delivering milk at collection centres. During rainy season the situation was worse which made it impossible for some farmers to get their milk to the centres. Those who manage to deliver their milk to the centres during this season, mainly using transporters on motorbikes and donkeys reported many cases of milk rejection. Majority of farmers however took their milk to the collection centres despite of all these factors. All these farmers were members of cooperative societies that owned the collection and bulking centres in the study region. By virtue of being members and the centres being a source of good market price for milk, the collection and bulking of milk is important in these study regions. Wanyororo dairy cooperative society collection centre collected about 800liters/day. The transporters taking their milk to this centre reported an average of 3 to 4 hours taken to get milk there. The same was reported during the farmers' interviews as they estimated milking time, time the milk is picked at their gates by transporters and estimated time these transporters take to deliver the milk at the centres (based on their knowledge about distance between their homes and the collection centres). Operators of the collection centres reported similar time for arrival of transporters. As for Olenguruone Dairy Cooperative Society collection centres, Olenguruone branch collected about 6000liters/day. The Kaplamai branch on the other hand collected about 1100liters/day. The transporters taking milk to both centres reported an average of 3 to 5 hours taken to deliver milk at the centres.

Safety and quality of raw milk at milk collection centres

Most of the commonly performed quality control tests were the alcohol test and lactometer test. It was reported during the interviews that these two tests were effective, rapid, that is, not time consuming and required minimal resources to carry out. Milk rejection was based on failure of these tests. Failure of the alcohol test indicated developed acidity in milk whereas milk that failed the lactometer test indicated milk adulteration using water or solids. This milk was not considered for further processing. Poor hygiene of milk containers also contributes to many cases of milk rejection. This may explain the higher cases of milk rejection in Olenguruone region during the dry season compared to the rainy season. The availability of water during the rainy season may lead to better hygiene of milk containers therefore lesser microbial contamination. The high environmental temperatures during dry season may also contribute to developed acidity in milk hence rejection.

Physico-chemical composition and chemical safety of both accepted and rejected milk were not determined. The stability of milk components is not understood therefore leading to disposal of high acid milk or adulterated milk that may be processed into other dairy/milk products.

Significant milk losses were noted as a result of milk rejection. Wanyororo dairy cooperative society collection centre in Dundori reported 50-100 liters of milk failing quality control tests per month during the rainy season and 10-20 liters during the dry season. This was translated into about 0.2%-0.4% milk losses as a result of milk rejection during the rainy season and about 0.04%-0.08% during the dry. Olenguruone Dairy Cooperative Society collection centres, Olenguruone and Kaplamai branches reported 100-150 liters of milk failing quality control tests per month during the rainy season and 200 liters/month during the dry season and 5 liters/month during the rainy season and 10 liters/month during the dry season respectively. This was translated into about 1.67%-2.5% and 0.45% milk losses as a result of milk rejection during the rainy season and about 3.33% and 0.90% during the dry for the centres at Olenguruone and Kaplamai branches respectively.

Utilisation of rejected high acid milk

The rejected milk was returned to individual farmers or transporters. Most of this milk was fermented naturally, that is, stored in containers and left to ferment for 2 to 3 days, to make traditional fermented milk. Other farmers reported disposal of the milk, fed it to animals and/or sold it to neighbours. Besides tea and raw milk, traditional fermented milk was a preferred form of milk consumption. The availability of milk for the preparation of milk products however, depends on many factors including: the total amount of milk produced, quantity of the milk dispatched to industrial dairy factories and quantity retained by the milk producer for the direct use of the household, for the preparation of milk products for local sale, or for use in calf rearing. Regions that have highest quantities of milk being used for preparation of dairy products on the producer's farm or household, or local small processing units usually have a dairy industry which is less developed (Kurwijila, 2006). In addition to this, it is only good quality milk that is highly preferred for product development. Any milk that is considered of low quality is least preferred but may not be completely left out for preparation of dairy products particularly traditional fermented milk. The preference of milk consumption in the form of home-made fermented milk is also reported by Ouma *et al.,* (2000). The condition of roads between the milk-producing areas and the urban areas was also important in determining how milk is utilised. Poor access roads and impassable ones during the rainy season leads to rejection of milk at collection centres due to deteriorated quality as a result of poor handling and the time taken to reach markets (FAO, 2011). The rejected milk is not considered for processing. Despite the milk being considered not suitable for processing, farmers channel it to other uses that may not earn them any economic value but some functional value is achieved. The extension workers reported offering safety and quality training as far as hygienic raw milk production and storage is concerned. Training to the persons who prepare milk products, mostly the fermented milk, is minimal.

Conclusions and Outlook

Collection and bulking of milk in the study regions is faced with challenges in terms of time taken to transport milk from the farms and the insufficiency of quality control tests carried out. The milk mostly fails the alcohol test which is the most common quality control test carried out. The physico-chemical composition and chemical safety of the milk that fails the alcohol test is however not understood since no analysis is done with this respect. This may lead to disposing off milk that may be further processed into other milk products. The study therefore concludes that once safety and physico-chemical quality of high acid milk is determined, appropriate technologies for processing can be used to develop milk products. Minimal industrial (processing) infrastructure that can be accessed by small-scale processors can be used. This would ensure appropriate processing of rejected milk and production of safe products unlike the traditional fermented milk that is commonly produced without standard procedures and safety of the raw material and final product is not ascertained.

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