

Milk Retailing Innovation in Kenya and Consumers Perceptions of Safety

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Background

Recent economic surveys in Kenya show a steady growth in sales of processed milk and dairy products (KNBS, 2016). The demand is likely greater among urban consumers, given their higher incomes and changing dietary habits with trend towards more milk and meat. Coupled with this increase are innovative businesses that have emerged to deliver affordable pasteurized milk to consumers through dispensing machines, popularly known as 'milk ATMs' in Kenya. An ATM is an automated facility that dispenses chilled, pasteurized, ready-to-drink milk that is sold unpackaged. The ATM offers several advantages. For the business, they eliminate packaging and processing which lower retail prices, and automated business transactions ease monitoring of sales turnover. Consumers expect ATM milk to enhance hygiene and offer affordable milk of any desired volume, matching their variable purchasing capacities.

ATMs are now widespread and are located in various strategic outlets: retail shops, farms, cooperatives, supermarkets and milk bars (Kosgey et al., 2018). As part of the growing Kenyan dairy industry, the ATM enterprises are expanding, even as safety of fluid milk remains a highly debated issue of public concern. Operating an ATM requires reliable power and a clean water supply to ensure milk quality is not compromised. Regulations require that the ATM is cleaned once every 24 hours to assure high quality of milk and to minimize loss from spoilage (KDB, 2015).

Though is an emerging innovation in milk retailing, information about the ATM as a retailing enterprise and their value offer for quality milk is scanty. This brief summarises findings of a recent market and consumer study that assessed the quality of milk sold through ATMs and other milk retailing practices, to understand the business proposition of this enterprise. The study also assessed consumer perceptions of risks of ATM milk compared with packaged and raw milk.

The study was carried out in four towns—Nairobi, Nakuru, Eldoret and Kisumu—but during the consumer survey, Kisumu was replaced with Kakamega. These towns represent a high concentration of the growing milk demand in Kenya.

Findings and Implications for the Sector

Milk ATMs as an enterprise

Different types of milk ATM models are in the market; some are imported from China, Italy and The Netherlands. They vary in capacity and price, ranging from KES 150,000 to 700,000 (USD 1,500–7,000). Their average annual operational costs, based on information collected from sampled operators, amount to KES 123,200 (USD 1,232). Almost 60% of these operational costs are spent on servicing the ATM equipment and another quarter (24%) in paying licensing fees (Figure 1).

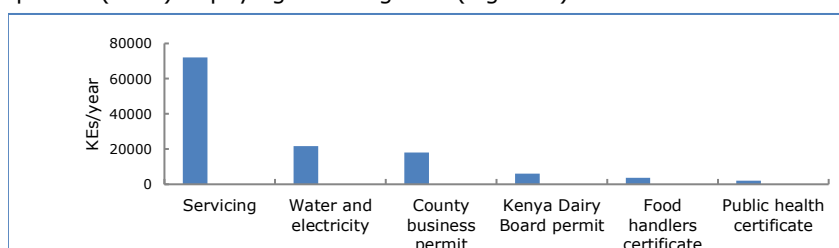


Figure 1: Cost categories of operating a milk ATM business in Kenya

Key messages

- Milk vending machines ("ATMs") are a growing retail business innovation that seek to offer competitive price and safety advantages to consumers of pasteurized milk
- As a business, sales margins per litre of milk are up to USD 0.1 (KES 10) positive, but operational costs are high: servicing (58.4%) and paying license fee (24.0%)
- The general consumer perception is that milk sold at ATMs is safer than raw milk and is as safe as packaged milk
- Field observations show evidence of intentional non-compliant behaviour that exposes consumers to serious health hazards.
- Field observations show that ATM milk retailing do not guarantee quality and safety to consumers
- Severe limitations exist in surveillance and quality control of ATMs

Policy recommendations

- The Kenya Dairy Industry Regulations 2017 should include a framework for regulating the practices of milk ATM vendors to ensure compliance with the standards
- Scale up the implementation of stipulated action towards non-compliant traders through periodic safety control management training for ATM operators linked to trade licensing and permits.
- Establish and strengthen public-private partnerships to support the development of standards for local milk dispenser models.

The annual turnover from daily sales of between 200 and 1500 litres is worth between USD 3,650 and 54,750, depending on volumes of milk sold and on the selling location. ATM milk is sold at about half the price (KES 60–70, USD 0.60–0.70) of packaged pasteurized fluid milk per litre (KES 120, USD 1.2). This pricing offers consumers an economic incentive to purchase ATM milk. Overall, sales margins per litre of milk are up to USD 0.1 (KES 10) positive, thus, for operators with large sales volumes the ATM business is lucrative, hence the reason it has attracted many entrepreneurs. However, some business operators might skip servicing the equipment because of its high costs, which may compromise the quality of milk.

Comparing ATM milk quality with other retail practices

The study assessed how milk from ATMs compares with packaged milk and milk from plastic containers on several quality and safety indicators. These included milk density, solids not fat (SNF), total viable counts (TVC), total coliform counts (TCC) and aflatoxin AFM1.



Milk reception at a cooperative platform

Compositional quality of milk

Regulations require that milk sold in ATMs be pasteurized. Milk samples analysed show that some ATMs dispensed raw milk. The study could not assess the prevalence of this practice, but the sale of raw milk in ATMs should concern consumers and regulators. This breach of regulations is a health hazard to consumers who buy ready-to-drink milk and do not boil it as they do with milk obtained directly from the farms.

While the average milk density (1.027 g/ml) passes for the national standards (KEBS), the density would fail in case of export trade to other East African countries where the standards prescribe milk density of between 1.028 and 1.036 g/ml. This implies that pasteurised milk from Kenya would not enter into the regional market on suspicion of milk adulteration. Intentional adulteration may be with water to increase volume of milk to earn more revenues. Sometimes, low milk density may be due to mastitis infection. While intentional adulteration with water can be deterred with penalties whenever is detected, mastitis infections can be managed with improved hygienic practices.

The Kenyan standards prescribes solids not fat of at least 8.5 percent. Table 1 results shows that packaged milk meets this standard requirement but not milk from ATM and from plastic containers. Of the milk samples not meeting the standards, more are from plastic containers

(59.1%) and from ATM (55.3%) than the samples of packaged milk (43.8%).

Low solids not fat content of milk can be attributed to many factors including the dominance of dairy Friesian cattle breeds and their crossbreeds and inadequate feeding (Radenaker et al., 2017; Ndungu et al., 2016; Kashongwe et al., 2017).

As already explained in another practice brief, solids not fat is not a quality criteria in Kenyan dairy industry yet is an essential component for cheese yields, dry milk powder yields and quality of ice cream. In addition, solids not fat in milk confer to consumers the milk nutritional value and has a growing commercial demand in food and pharmaceutical industries (Costa et al, 2019).

Table 1: Quality and safety levels of milk samples from ATM and plastic containers and packaged milk

| Quality indicator | Milk retailing | Sample (n) | Mean & SD | Samples non-compliant (%) |
|----------------------------------------------------|----------------|------------|---------------------------|---------------------------|
| Solids not fat (%) | ATM | 38 | 8.45±0.37 ^b | 55.3 |
| | Packaged | 32 | 8.51±0.27 ^a | 43.8 |
| | Plastic | 22 | 8.36±0.37 ^b | 59.1 |
| Total Viable Counts (TVC) (log 10 cfu/ml) | ATM | 38 | 1.60±2.46 ^a | 18.4 |
| | Packaged | 32 | 1.50±1.64 ^a | 0.0 |
| | Plastic | 22 | 4.62±2.81 ^b | 68.2 |
| Total Coliform Counts (TCC) (log 10 cfu/ml) | ATM | 38 | 1.19±2.15 ^a | 23.7 |
| | Packaged | 32 | 1.01±1.37 ^a | 28.1 |
| | Plastic | 22 | 3.84±2.47 ^b | 77.3 |
| Aflatoxin AFM1 (ppt)* | ATM | 14 | 88.79±84.91 ^b | 0 |
| | Packaged | 9 | 101.99±60.41 ^b | 0 |
| | Plastic | 7 | 51.59±72.86 ^a | 0 |

Means for a quality indicator with different letter superscript differ at $p < 0.05$

*Aflatoxin results are reported on a subset sample that could be analysed

*Codex maximum tolerable AFM1 concentration of 500ppt standards apply

Bacterial quality of milk

In milk retailing, milk from ATM and packaged milk are pasteurized milk while milk from plastic is raw milk. Kenyan milk quality standards prescribes total viable counts of less than \log_{10} 6cfu/ml in raw milk and less than \log_{10} 4.47 cfu/ml in pasteurized milk. The corresponding standards for total coliform counts is counts less than \log_{10} 4.69 cfu/ml in raw milk and counts less than \log_{10} 1.00 cfu/ml in pasteurised milk.

Applying these national standards, pasteurized milk from ATM and packaged milk were higher in the average total coliform counts (Table 1). This is not the case for the raw milk from plastic containers: both average total viable counts and coliform counts are below the set maximum load counts. For proportion of milk samples exceeding the maximum set load counts, milk from ATM had lower prevalence in both total viable counts and coliform counts (<24%) and packaged milk (29%) in coliform counts than milk from plastic containers (68%).

High bacterial load counts in pasteurised milk points to challenges of keeping high standards of hygienic milk handling practices in the milk ATM operations. These challenges stem from poor access to quality water, interruptions in the supply of power and water, poor sanitation during milking, or wet bedding in cow housing units. The incidences of poor microbial milk quality are source of post-harvest losses from milk going off-flavour, reduced quality and/or reduced shelf-life.

Therefore the risk of microbial contamination remains



Milk ATM entrepreneur

high even in ATM and packaged milk. This provide evidence that ATM and packaged milk were not distinctly different in guaranteeing allowable maximum microbial load counts for safety of consumers and quality requirements by processors.

Aflatoxin, antibiotics and hydrogen peroxide contamination of milk

The maximum safe limits for aflatoxin AFM1 concentration in milk applicable in Kenya is 500 ppt recommended by Codex standards. In the absence of own prescribed standards, the country subscribes to Codex recommendations. By Codex standards, milk samples from ATM, plastic containers and packaged milk were all safe from AFM1 concentration (Table 1).

However, the Codex standards serve as advisory and not mandatory and so are less stringent (500 ppt) than the European Union (EU) standards (50 ppt) for maximum safe limits of AFM1 concentration allowable in milk. Benchmarking to the EU standards, the unsafe levels of AFM1 are less prevalent in milk from plastic containers (29%) than in milk from ATM (50 %) and packaged milk (78 %). This marked discrepancy between the Codex and EU standards for AFM1 in milk necessitates the need to align food standards with the local socio-economic conditions including food security and consumption patterns.

Figure 1 demonstrates that milk samples testing positive for presence of hydrogen peroxide and antibiotics are more prevalent in ATM milk (8 percent) and packaged milk (6 percent) than in raw milk in plastic containers (4 percent). These are evidence of an intentional breach of compliance because presence of hydrogen peroxide and

antibiotics in traded milk are prohibited in Kenya and internationally.

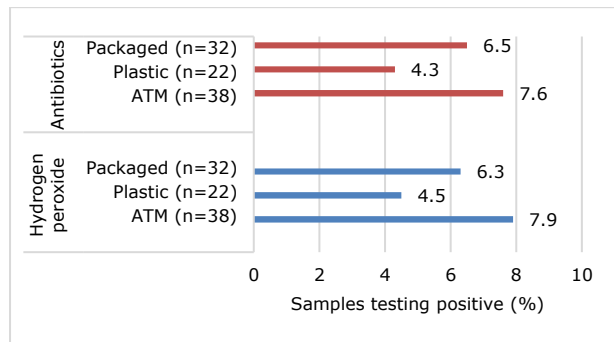


Figure 1: Proportion (%) of milk samples testing positive for presence of hydrogen peroxides or antibiotics

Consumer Perceptions of Milk Quality

What are consumers’ perceptions of milk sold in ATMs compared with other retail options?

Most consumers perceive ATM milk as safer and of better quality than raw milk (Figure 2). Almost 61 percent of consumers’ associate raw milk sold in plastics with a high risk of adulteration, while fewer (<16 percent) consider that ATM milk is adulterated.

Fewer consumers perceive milk sold in ATMs and packaged as likely to be adulterated or exposed to bacterial contamination, while more consumers think that packaged milk is more likely to contain preservatives than milk from ATM.

In addition, fewer consumers perceive the risk of antibiotic presence lower in milk from ATM compared with raw milk from plastic containers but higher than in packaged milk (Figure 2).

A deeper examination of consumer preference revealed that consumers prefer milk from ATM over packaged milk for several attributes. Price was the most outstanding. Other reasons for consumers preferring milk from ATM over packaged milk included consistency in availability, organoleptic attributes, hygiene in the premises, traceability and safety from chemical and biological hazards but not safety from adulteration and shelf-life.

It was also clear from this study that consumers express low confidence in milk retailed from plastic containers as compared to milk retailed from ATM or packaged milk. However, use of plastic containers in milk retailing remains widespread in the market outlets.



Consumers purchasing milk from an ATM

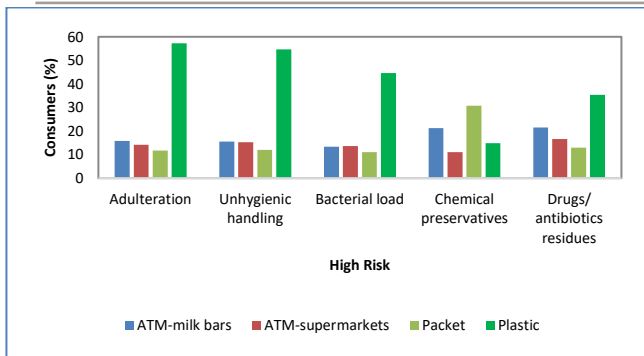


Figure 2. Consumer perceptions of milk quality retained in ATMs, packaged or plastic containers.

Which Way Forward?

The growing milk ATMs retail innovation offers good business opportunities and is attracting consumers because of the competitively priced milk they offer. While consumers perceive raw milk in plastic containers as less safe than pasteurized ATM and packaged milk, this study established that ATM milk is not safer than raw and packaged milk.

The slightly higher levels of hydrogen peroxide in ATM and packaged milk show non-compliance by processors and vendors, exposing consumers to health risks. This reveals a gap in enforcing standards. Specifically, the presence of raw milk in ATMs violates the Consumer Protection Act of 2012 that, in line with the constitution,

grants consumers access to safe, quality food. The Act, outlines penalties for businesses that knowingly sell sub-standard goods, should be enforced.

Under the Kenya Dairy Industry Regulations, 2017, which stakeholders are currently reviewing, the national regulator should include a framework for regulating the practices of milk ATM vendors, to ensure compliance. Due to the high noncompliance of ATMs in milk bacterial load standards, consumers should be advised to boil the milk before consuming it. However, this will likely reduce their confidence in ATM milk as a ready-to-drink product.

The high cost of maintaining milk ATMs potentially results in vendors not adhering to the servicing schedule to increase their profit margins, compromising the quality and safety of traded milk. This further validates the importance of having a strong surveillance system to monitor the operations of milk ATM businesses.

The exponential growth in milk retailing through ATMs is indicative of its potential to expand the country's level of milk processing. While this expansion could reduce the challenges of the dominant raw milk market, a controlled approach to expanding ATM retailing is needed to guarantee consumers that the milk is pasteurised as expected. This would not only secure the value proposition of this growing business venture by emphasising the quality of their product but also protect consumers from exposure to health hazards and risks associated with poor quality and unsafe milk.

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The brief is a summary of a more comprehensive research report available at <http://www.3r-kenya.org/>

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