Milk safety at the vendor and household level: Evidence from peri-urban Kisumu

POLICY BRIEF | FEBRUARY 2020

Key Findings

We tested samples of milk used to prepare infant food, both at the time they were purchased and prior to infant feeding, for microbial contamination.

- Pathogen contamination at purchase (found in 9% of samples overall) was highest in unpackaged milk, but also found in packaged samples
- Pathogen contamination in pasteurized and especially "long life" milk increased dramatically after purchase

Recommendations

Ensuring compliance

Samples of packaged milk tested breached EAC standards for microbiological limits in 6% of cases, and 9% contained a dangerous pathogen. Regulators need to work with milk processors and vendors to improve compliance with standards and ensure food safety.

Continued failure to comply with standards should lead to revocation of Kenya Bureau of Standards approval or the business license of retailers.

A substantial share of purchased milk in the study was imported long-life milk. The Department of Food Safety & Quality should ensure that imported milk is test at the same rate as local processors and that imported products at the retail level are tested as often as local products.

Vendor requirements

Vendors should not accept deliveries of fresh milk that are not cold upon receipt. Fresh milk products are refrigerated. Refrigerated vehicles should be required for long distance transport.

Consumer information

Information campaigns should emphasize the following recommendations:

- Milk should always be boiled prior to consumption, regardless of source
- "Long-life" milk should not be stored for long periods after opening
- All milk should be stored in a clean covered container in a cool area

Background

Illness and death among children under 5 years of age accounts for 40% of the total global health impact of foodborne illness.[a] In Kenya, 5 of every 1,000 children die of diarrheal disease before the age of 5.[b] Studies uniformly find higher levels of bacterial contamination in weaning foods than drinking water.[c] Cow's milk is an important weaning food in Kenya, and is more likely to be contaminated than other weaning foods.[d] An important question is the source: does contamination occur before entering the household, or within the household?

Previous quantitative work[e] may understate the risk of disease transmission through milk in Kenya:

- Processed milk may contain dangerous levels of pathogens if improperly stored or transported post-pasteurization.
- High rates of survey respondents reporting boiling milk prior to consumption may be overstated
- Re-contamination of boiled milk within households may occur via hands or utensils, and worsen over time in unrefrigerated milk

The aim of this study is to understand the food safety risks of purchased milk given to infants at 8 months of age. We conduct an analysis of linked samples of milk conducted at point of purchase and infant food prepared using the same milk within the household.

Data & Methodology

Our data is taken from an ongoing study in peri-urban Kisumu which aims to evaluate the effectiveness of a food hygiene intervention targeting early childhood exposure to enteric pathogens.[f] The research team contacted participants in advance of a household visit. If a participant planned to feed their infant food prepared with milk the next day, a team member arranged to accompany the participant to procure the milk. The study team obtained a sample of milk from the vendor, as well as a sample of food prepared by the caregiver for their child using that milk.

Samples were immediately analyzed for contamination with two pathogens (*Salmonella enterica* and *Shigella sonnei*) and *Klebsiella aerogenes* which is not a pathogen but indicates contamination with fecal matter.

Statistical comparisons of the results were carried out to test for differences in contamination at purchase vs. infant feeding, and by the type of milk used (unpackaged, fresh packaged or long-life).

Results

Of the 396 samples of milk obtained by caregivers to feed their infant children, the vast majority were purchased from small shops known as dukas (Table 1). The most common types of milk purchased was long-life (UHT) milk (68% of purchases) and fresh packaged milk (23%) however 9% of study caregivers purchased unpackaged milk, predominantly from milk bars or roadside vendors.

Table 1 - Type of milk provided to infants

	% of all purchases	N	Main vendor type	% of milk type from vendor type
Packaged long-life milk	68.0	278	duka	99.6
Packaged fresh milk	22.8	83	duka	98.8
Unpackaged cow's milk	8.9	34	milk bar	61.8
Baby formula	0.3	1	duka	100

Laboratory analysis found that *K. aerogenes* was present in 12.1% of all purchased samples: 7.5% of packaged samples and 55.9% of unpackaged samples. Overall, at least 5.6% of vendor samples failed to meet the EAC standard for coliform contamination. Some samples of all milk types tested positive for the presence of two pathogens, *S. enterica* (5.3% of samples) and *S. sonnei* (6.3%). The levels of these pathogens detected are considered unsafe for consumption by infants.

Table 2 - Microbial contamination at purchase, by liquid milk type

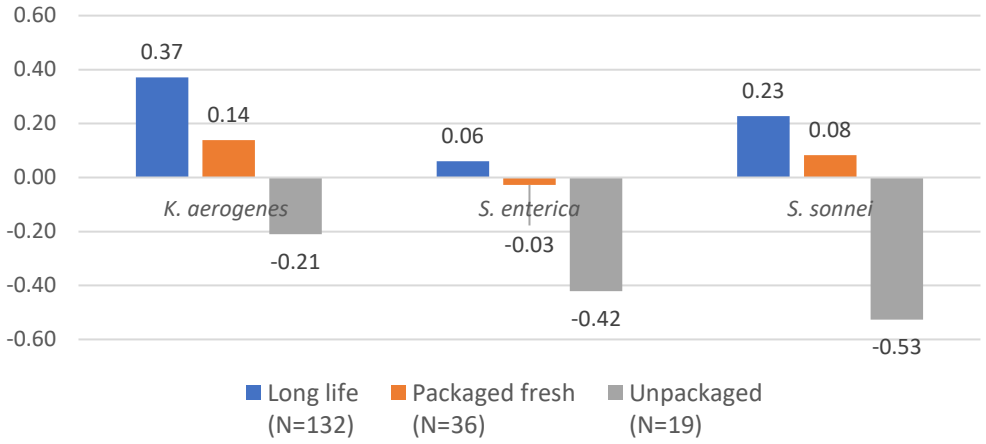
	Overall	Packaged long-life	Packaged fresh	Un-packaged	Probability contamination differs (p-value)		
	(1)	(2)	(3)	(4)	(2) vs. (3)	(2) vs. (4)	(3) vs. (4)
K. aerogenes (% positive)	12.1	5.4	16.9	55.9	**0.000**	**0. 000**	**0. 000**
Range of cfu/mL if positive	(2-199k)	(4-199k)	(2-2.48k)	(52-199k)			
K. aerogenes (% > standard)*	5.6	2.5	14.5	8.8	**0.000**	**0. 049**	0.408
Range of cfu/mL if > standard	(10-199k)	(4-199k)	(2-2.48k)	(52-199k)			
S. enterica (% positive)	5.3	1.8	2.4	41.2	0.723	**0.000**	**0.000**
Range of cfu/mL if positive	(4-199k)	(4-56)	(66-68)	(14-199k)			
S. sonnei (% positive)	6.3	0.7	3.6	58.8	**0.048**	**0.000**	**0.000**
Range of cfu/mL if positive	(2-199k)	(4-20)	(2-18)	(4-199k)			
Observations	396	278	83	34			

* Colony-forming units of *K. aerogenes* are compared against the EAC standard for coliform contamination. *K. aerogenes* is one coliform among many, so the level of non-compliance based on this organism alone represents a lower bound of actual non-compliance. *Notes:* P-values for each comparison indicate the probability that contamination rates are statistically identical across milk types. P-values < 0.05 are shown in bold type

We see differences in the influence of the household environment and practices on microbial contamination of milk. For all three of the pathogens analyzed,

contamination increases greatly between the time long-life milk is purchased and the time it is consumed by infants. On the other hand, the proportion of raw milk samples contaminated with bacteria decreases between purchase and consumption, due to the widespread practice of boiling raw milk.

Figure 1- Difference in proportion of contaminated samples between vendor and infant food, by type of milk



By the time infants consume milk, there is no detectable difference between raw and packaged milk. Our results suggest that households are aware of the risks associated with raw milk, but may not be aware of the risks of contamination being present in packaged milk or occurring as a result of practices within the home. Anecdotal evidence from the field team suggests that caregivers may have a mistaken belief that 'long life' milk remains fresh for extended periods after opening.

Study authors: Vivian Hoffmann (International Food Policy Research Institute), Sheillah Simiyu (African Population & Health Research Center), Jane Mumma (Great Lakes University of Kisumu), Oliver Cumming (London School of Hygiene & Tropical Medicine), Kevin Tsai and Kelly K. Baker (University of Iowa)

References

[a] World Health Organization. 2015. *WHO estimates of the global burden of foodborne diseases.* WHO: Geneva
[b] UNICEF. Retrieved from: https://data.unicef.org/topic/child-health/diarrhoeal-disease/
[c] Lanata, C. F. (2003). Studies of food hygiene and diarrhoeal disease. International Journal of Environmental Health Research, 13(sup1), S175-S183.
[d] Tsai, K., Simiyu, S., Mumma, J., Aseyo, R. E., Cumming, O., Dreibelbis, R., & Baker, K. K. (2019). Enteric Pathogen Diversity in Infant Foods in Low-Income Neighborhoods of Kisumu, Kenya. International journal of environmental research and public health, 16(3), 506.
[e] Grace, D., Omore, A., Randolph, T., KanG'Ethe, E., Nasinyama, G.W. and Mohammed, H.O., 2008. Risk assessment for Escherichia coli O157: H7 in marketed unpasteurized milk in selected East African countries. Journal of Food Protection, 71(2), pp.257-263.
[f] Cumming, O. and Mumma, J. 2018. The Safe Start Trial - Kisumu, Kenya. ClinicalTrials.gov Identifier: NCT03468114. Retrieved from: https://clinicaltrials.gov/ct2/show/record/NCT03468114