ASSURANCE OF MARKETED MILK QUALITY IN KENYA

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Abstract

Food safety standards require the implementation of specific standards from production-to-consumption. The Hazard Analysis Critical Control Points (HACCP) is now a widely accepted methodology in risk analysis for industrially processed foods. The application of HACCP is a bigger challenge in developing countries where food market channels are less formal.. This study adapted a HACCP methodology to assess health risks at different points in the informal milk marketing network. Key critical control points identified for high total bacterial counts were channels with multiple transaction points which took considerable time from the farm without refrigeration facilities. High coliform counts were associated with the use of plastic versus metal containers. Approximately 13% of samples were adulterated with added water. Recommendations for procedures to improve milk quality and how these can be communicated to farmers, market agents and consumers are proposed and discussed.

Introduction

Milk safety has been debated in Kenya but without much quantitative information for over a decade. This has been especially so since milk market liberalisation in 1992 which was followed by a dramatic increase in raw milk sales in urban areas. As with all food safety standards worldwide, milk safety requires monitoring from production-to-consumption. The Hazard Analysis Critical Control Points (HACCP) process, recommended by FAO/WHO (1998), is now a widely accepted methodology in risk analysis for industrially processed foods. HACCP identifies the points in a process that are hazardous, their risk factors and potential level of risk so that “critical control points" for remedial action can be implemented. Controls are specific actions taken to prevent health risks. The application of HACCP is a major challenge in developing countries where food markets are mostly informal. Market channels for milk range from direct sales of liquid milk or processed dairy products from producers to consumers, to a long chain involving combinations of private traders on bicycle, public or private transport, milk bars and kiosks, dairy farmer groups, small-scale and industrial processors. About 88% of marketed milk in Kenya is sold unprocessed, outside regulated channels. This paper attempts to adapt a HACCP methodology to assess health risks at different points in the informal dairy marketing network in Kenya.

Materials and Methods

Between March and May 1999, 162 raw milk traders of various cadres were identified and their milk handling practises studied. Traders were selected in a random sample, stratified on proximity to consumers (Nairobi) and producers (Kiambu). Milk handling practices for each trader were both observed and recorded on a questionnaire. Questions included milk procurement (source, time of collection, distance travelled, quality control procedures, type of handling vessels, bulking (mixing of milk from different sources), mode of transport and prices paid); milk handling (time to re-sale, storage, method of cleaning, water source); milk sale (type of buyers, quantities sold, packaging, prices received); and hygiene of premises and personnel. In addition, variable and fixed costs were estimated. One or more milk samples were collected at retail points in sterile tubes from each market agent and total and coliform bacteria in the milk counted using the Standard Plate Count method. Boiling and adulteration of sampled milk were also investigated by the peroxidase test and lactometer, respectively. Bacterial counts were estimated for 80 pasteurised milk samples, purchased from retail shops and tested on the last day of expiry.

Two strategies were used to identify critical points (CPs) that were associated with high total and coliform counts in raw milk. The first was descriptive, to define dummy variables for all potential CPs (combinations of sources of milk and agent) and estimate statistics for each CP or group of CPs. These included the calculation of proportions with counts above national standards and the plotting of bacterial counts versus time since collection for each CP to visually assess trends. The second strategy was to include all potential CPs and milk procurement, handling and sale variables in stepwise regression models of the logarithm of total and coliform bacterial counts as dependent variables in the Proc REG procedure ($p<0.05$ for entry and retention) in SAS. Time since collection of milk was forced into all final models.

Results

About 75% of milk samples were collected within two hours of their receipt by traders. Market points with one or more intermediate steps comprised 41% of samples collected. Direct sales occurred between producers and dairy co-ops (20%), hawkers (15%), milk-/snack-bar (13%) and kiosks/shops (12%). Bacterial counts were high (Table 1). At this early point in the retail chain, 58% and 82% of raw milk samples did not meet national standards for coliform and total bacterial counts, respectively (Figure 1). Interestingly, 70% of pasteurised samples did not meet national standards for bacterial counts. Approx. 13% of samples were adulterated with water.

Complete data for the regression analysis were obtained for 103 samples. Two market channel types (retail agents other than dairy co-ops and multiple selling steps) and three risk factors: scooping of milk, higher milk temperature and piped water were associated with higher coliform counts (the three risk factors were also associated with higher total bacterial counts) (Table 2). Using both complete and incomplete data records (154 samples), high coliform counts were also associated with the use of plastic versus metal containers ($p=0.03$). Time in the market chain and distance to retail points showed no significant association with bacterial counts ($p>0.05$).

Table 1. Descriptive statistics of milk bacterial counts and some continuous variables during the first seasonal survey of market agents in Kiambu and Nairobi

Variable	Number of obs.	Range	Median	% with counts above national standards [a]
Total bacterial counts (x 10^6/ml)	179	0.25 - 25,100	1,490	82 (70)[b]
Coliform counts (x 10^3/ml)	178	0.10 - 1,540	149	58 (73)[b]
Time since collection of milk (hrs)	159	0.03 - 7	1	-
Milk temperature (^{o}C)	171	11 - 31	21	-
Distance travelled (Km)	140	0 - 200	15	-

[a] Kenyan national standards (maximum bacterial counts/ml) for 'good' milk are: 2,000,000 and 50,000 for total and coliform counts, respectively, for raw milk; and, 50,000 and 10 for total and coliform counts, respectively, for

pasteurised milk. [b] Figures in parentheses are proportions of pasteurised milk samples with counts above acceptable limits for ‘good’ milk.

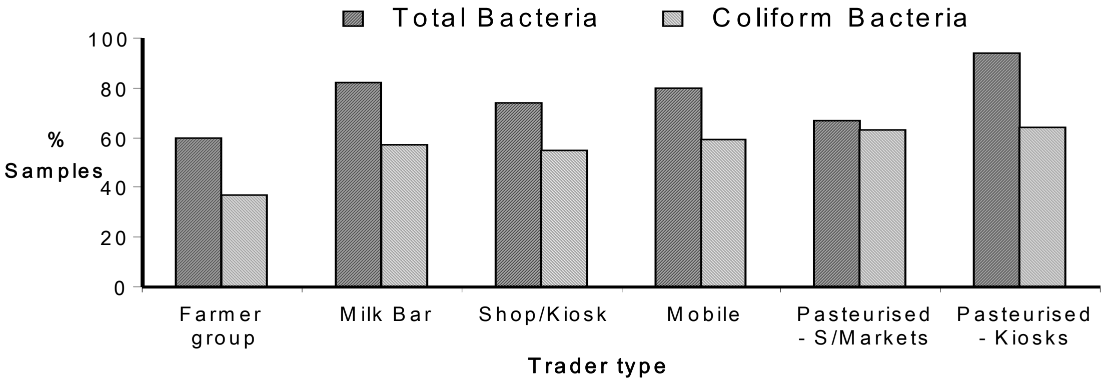

Figure 1. Proportion of milk samples with bacterial counts (cfu/ml) above KBS standards for ‘good milk’ (Raw: Total Bact. = 2M; Colif. Bact=50,000. Pasteurised: Total Bact= 50,000; Colif. Bact.=10)

Table 2. Regression models for $\log_{10}$ of total and coliform bacterial counts in milk collected from market agents during the first season in Kiambu and Nairobi

Parameter	Estimate	s.e.	*p*-value
a) Regression model for $\log_{10}$ total counts (unit)			
Intercept	2.74		
Time since milk collection (hrs)	0.14	0.14	0.33
Milk temperature (^{O}C)	0.20	0.05	<0.01
Method of dispensing milk (scooping vs. pouring)	0.90	0.38	0.02
Water source (Piped vs. river, well or roof catchment)	1.43	0.39	<0.01
b) Regression model for $\log_{10}$ coliform counts (unit)			
Intercept	-0.25		
Time since milk collection (hrs)	0.09	0.11	0.38
Milk temperature (^{O}C)	0.13	0.04	<0.01
Method of dispensing milk (scooping vs. pouring)	1.02	0.29	<0.01
Water source (Piped vs. river, well or roof catchment)	1.18	0.34	<0.01
CPs without intermediaries selling milk to bars/shops/kiosks/hawkers *vs*. points selling milk to dairy co-ops	1.13	0.38	<0.01
CPs with >1 intermediary *vs*. points selling milk to dairy co-ops	0.79	0.37	0.04

Discussion

The generally high bacterial counts and lack of association with time suggest that most bacterial growth occurred before the first transaction. Given a previous finding that milk sampled fromfarms had low bacterial counts (Ombui et al., 1994), we hypothesize the existence of one (or more) CP(s) between farm and milk market agent. There are numerous possibilities (e.g. time held on farm, bulking), which deserve further investigation. Association of piped water source with higher counts was unexpected and may reflect a relative shortage of water from piped sources. Better milk quality from dairy co-ops is likely due to higher hygiene standards (mainly testing for adulteration, use of aluminium containers and chilling equipment). Otherwise, most milk samples were not chilled and the high bacterial counts (both raw and pasteurised) can be partly attributed to the general lack of a cold chain. One option is the adoption of the lacto-peroxidase system (LPS) for milk preservation (see FAO Internet Home Page). However, the widespread adoption of LPS will require its widespread acceptance by national policy makers. The majority of milk that currently reaches consumers, both from informal and formal agents, is below Kenyan national standards. Thus, the boiling of milk, now done by virtually all consumers of marketed milk, should continue to be encouraged. This study shows that some practices of informal market agents, such as scooping of milk and use of plastic containers, could be improved by extension and training. Since bacterial counts were already high on reaching the informal market agents, we will focus on studies to investigate potential CPs on-farm and between farm and market agent. Given the low common practice of boiling, the public health risks from informally marketed milk appear low when compared to the substantial socio-economic benefits obtained from this system.

References

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