The suitability of locally produced milk for human consumption: Investigations into quantity, composition and quality profiles of milk at Njoro, Kenya

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Abstract

The basic premise of this paper is that the supply of milk and milk products from the Guildford Dairy Institute (GDI) at Egerton University (EU) in Kenya decreased drastically over the recent past as a result of a nearly six-fold increase in the human population in the area. A drop of 40 % of milk production from the university farms also added more impetus to the study. These developments resulted in a significant shortfall of milk to the GDI factory for processing and for sale to the university and surrounding communities. The results of the study carried out at some randomly selected neighbouring farms as possible source of additional milk to GDI factory showed 3.8 ± 0.5 % BF, 12.6 ± 0.8 % TS, 0.16 ± 0.02 LA, 1.029 ± 0.003 Sp Gr; - 0.55 ± 0.02 Fr Pt; 0.03 ± 0.004 Fg Pb and 0.04 ± 0.003 ppm Hg and sensory results indicated 'Liked Moderately' for all samples, which were within the Kenya Bureau of Standards (KBS) guidelines. Milk was available but the logistics to collect and pay for the milk need to be put in place.

Introduction

Human population at Egerton University and neighbouring villages in 1986 was such that milk supply from the university farms was higher than the actual demand. This forced the EU farms to deliver the surplus milk to Kenya Co-operative Creamery (KCC) factory, about 60 km return to Nakuru. The population was then about 4500, and ten years later (1996), the population rose to about 28000 people (Aiyabei, 1996). This rapid growth in population was attributed to the up-grading of the Egerton College to University Status in 1986. A big portion of the university Tatton farmland was taken up by building structures and play grounds while Ngongogeri, another university farm replaced almost a third of its dairy farmland with wheat farming. This led to the reduction in the number of milking cows both at Tatton and Ngongogeri farms (Kuto and Ndinye, 1996).

For these reasons, milk supply from the university farms became insufficient to sustain the growing population, resulting in the dairy factory facing milk shortage. This created long queues of frustrated customers who on many occasions went away without obtaining any milk products. Consequently, a study was formulated with the objectives to investigate the causes of milk shortage at EU farms and GDI factory and propose remedial solutions for the Njoro community. Secondly to investigate the physico-chemical and microbiological quality of milk produced from the neighbouring farms as possible source of milk for GDI factory, and finally to survey the possible quantities of milk produced at these farms for inclusion into GDI factory milk collection and processing.

Materials

Study sites

These included two university farms namely Tatton and Ngongogeri which are located close to Egerton University in Njoro area. Others were ten randomly selected neighbouring farms which are also located close to EU within a radius of about 10 km. Most of these farms keep Friesian, Aryshire and Guernsey breeds of cattle except Tatton farm which keeps Jerseys.

Data collection

Statistics about the farms were obtained from the farm records, interviews and from the questionnaires developed at the Department of Dairy and Food Science and Technology at Egerton University, Njoro Kenya.

Milk samples

Milk samples were collected directly from milking stations at GDI farms and ten randomly selected neighbouring farms. Both morning and evening raw milk were sampled randomly for 15 days from the stations. Evening milk in labeled bottles was preserved in the refrigerator at 5 - 7 0 C and mixed with the morning milk before analyses were carried out.

Equipment

Laboratory equipment, apparatus, chemicals and reagents were obtained from GDI factory and laboratory.

Methods

Milk samples in triplicate were analyzed for butter fat, total solids, specific gravity, freezing point, acidity and for heavy metals (Lead and Mercury), using simple and routine dairy factory procedures and AOAC standard methods. Milk samples were also subjected to sensory evaluation for flavour and smell.

Butter fat was determined by the method described by Gerber (Martin, 1979), total solids were calculated using Richmonds formula (David, and MacDonald, 1953) and freezing point was determined by Hortvert Cryoscope described by Martin (1979). Acidity was determined by titration method described by Davis and MacDonald,(1953) and sensory evaluation by Official methods of Analysis (AOAC, 1990) and by Davis and Hanson (1954) in order to ascertain milk freshness, quality attributes and conditions in which milk was harvested. Heavy metals were determined at the Goverment laboratory using AOAC Official Methods for lead and mercury respectively (Conniff, 1995). Sensory evaluation on smell and taste were carried out by fourth year dairy and food science students and lecturers on Hedonic scale and results were tested statistically.

Heavy metals were determined for the reasons that in Njoro area, cattle are grazed along the highways with exhaust emissions containing lead and animals are fed on grains (concentrates) preserved with fungicides containing mercury.

Statistical analysis

The results obtained were subjected to statistical analysis of variance (ANOVA).

Results and Discussions

The means for milk yields from EU farms for 1986 and 1996 describing compositional quality, level of contaminating heavy metals and land utilization for dairy production are in **Tables 1, 2 and 3**.

In total, milk production at the farms dropped by 40 % over the last ten years (3200-4000 litres/day to 1200-1800 litres/day in 1996) Milk yield per cow also dropped from an average of 12 ±2.0 litres/day to 8 ±1.5 litres/day (**Table 1**).

Escalating prices of feeds and drugs, shortages of water for livestock and difficulty in obtaining funds from the EU finance office to curb some of the problems were the reasons given for low milk yields at the EU farms. The practice is that revenues from factory products are collected by the finance department of the EU and reallocated to the farms and factory according to their budget, if and when available (Kuto, and Ndinye, 1996).

Dairy farmland was reduced by about 34 % (from 2690 ha to 1772 ha) through land reallocation to building constructions, playing fields and wheat farming (**Table 2**). As a result, the number of dairy cows

Table 1. Mean results for milk yield in Kg (1986 and 1996) - Egerton farms

Farm	Production per day		Milking cows		Production per cow	
	1986	1996	1986	1996	1986	1996
Ngongogeri	3200 ± 20	1323 ± 15	270 ±15	165 ± 10	12 ± 2	8 ± 1.5
Tatton	800 ± 15	263± 10	66 ± 5	38 ± 3	12 ± 1.5	7 ± 1.0
Totals	4000 ± 18	1586 ± 13	336 ± 10	203 ±7	12 ± 1.7	7.5 ± 1.3

Source: Farm records/Questionnaires

Table 2. Land utilization in hectares - EU farms 1986 and 1996

Farm	1986 Dairy	1996 Dairy	Other Uses	%	Other Uses
Ngongogeri	2400	1610	790	33	Mostly Wheat
Tatton	290	162	128	44	Constructions/play grounds
Totals	2690	1772	918	34	Other uses

Source: Farm records/Questionnaire

Table 3. Mean results for physico-chemical quality - EU farms 1986 and 1996

Farm	BF %	TS %	Sp Gr	LA %	Fr.Pt	Pb Hg	Hg ppm
Ngongogeri	3.4±0.4	11.9 ±03	28 ±2	0.16±0.02	-0.50±0.04	0.03±0.004	0.04 ± 0.003
Tatton	3.6 ±0.3	12.4±0.5	29 ±3	0.15±0.02	-0.54 ±0.02	0.03 ± 0.003	0.04 ± 0.004
Average	3.5±0.3	12.2±0.05	28.5±3	0.15± 0.02	-0.52 ± 0.03	0.03 ± 0.004	0.04 ± 0.004

Source: Sample analysis results
Note: BF = Butter fat, TS = Total solids, Sp Gr = Specific gravity, LA = Lactic acid, Fr.Pt = Freezing point, Pb = Lead and Hg = Mercury.

Table 4. Mean daily milk yield per herd and per cow in Kg - 1996

Farm	Size (h)	Yield/day	Yield/cow
Kibe	12.0	75 ± 4	8.0 ± 2
Koech	6.0	25 ± 2	8.0 ± 2
Irangi	1000.0	200 ± 5	9.0 ± 3
Kabuba	31.0	25 ± 2	8.0 ± 2
Abma	150.0	300 ± 6	7.5 ± 1.5
Kihumba	5.5	21 ± 1	8.0 ± 2
Gathoga	5.5	25 ± 2	7.0 ± 1
Kibungi	5.0	150 ± 4	8.0 ± 2
Nightingale	900.0	800 ± 5	12.0 ± 3
Montello	5.5	12 ± 2	9.0 ± 3
Totals	-	1636 ± 15 kg/day	8.5 ± 3 kg/cow

Source: Questionnaires/ Interviews,
: All was sold to KCC factory

Table 5. Mean physico-chemical results of milk from selected farms - 1996.

Farm	BF %	TS %	LA %	Sp Gr	Fr Pt	Pb Hg	Hg ppm
Kibe	4.2 ± 0.5	13.4 ± 0.3	0.16 ± 0.01	29.0 ± 3	-0.55 ± 0.02	0.03 ± 0.004	0.04 ± 0.003
Koech	3.6 ± 0.4	12.5 ± 0.3	0.14 ± 0.02	29.5 ± 2	-0.55 ± 0.02	0.03 ± 0.004	0.04 ± 0.003
Irangi	3.6 ± 0.3	12.0 ± 0.4	0.15 ± 0.02	28.5 ± 3	-0.55 ± 0.02	0.03 ± 0.004	0.04 ± 0.003
Kabuba	3.4 ± 0.2	12.0 ± 0.4	0.18* ± 0.01	29.5 ± 1	-0.55 ± 0.02	0.03 ± 0.003	0.04 ± 0.003
Abma	4.2 ± 0.2	13.0 ± 0.4	0.16 ± 0.01	28.5 ± 2	-0.55 ± 0.02	0.03 ± 0.003	0.04 ± 0.003
Kihumba	4.0 ± 0.2	12.9 ± 0.3	0.15 ± 0.02	29.0 ± 3	-0.55 ± 0.02	0.03 ± 0.003	0.04 ± 0.004
Gathoga	4.0 ± 0.2	12.9 ± 0.3	0.15 ± 0.02	29.0 ± 3	-0.55 ± 0.02	0.03 ± 0.003	0.04 ± 0.004
Kibingi	3.8 ± 0.4	12.6 ± 0.4	0.15 ± 0.02	29.0 ± 2	-0.55 ± 0.03	0.03 ± 0.004	0.04 ± 0.003
Nightingale	3.8 ± 0.2	12.7 ± 0.3	0.14 ± 0.02	29.5 ± 2	-0.56 ± 0.01	0.03 ± 0.003	0.04 ± 0.004
Montello	4.1± 0.3	13.0 ± 0.2	0.16 ± 0.01	29.0 ± 3	-0.55 ± 0.02	0.03 ± 0.003	0.04 ± 0.003

Source: Sample results
:*Slightly higher acidity

was reduced by 40 % (from 336 to 203 cows) which adversely affected the total milk delivery to the GDI factory for processing (**Table 1**).

Table 3 describes the mean results for physico-chemical quality of milk from EU farms in 1996. The results were 3.8 ± 0.5 % fat, 12.6 ± 0.8 % total solids, 0.16 ± 0.02 % lactic acid, 1.029 ± 0.003 specific gravity, -0.55 ± 0.02 0 C freezing point, 0.03 ± 0.004 Fg Pb and 0.04 ± 0.003 ppm Hg; which are all within the KBS acceptable standards. High levels of heavy metals can be detrimental to the health of the milk consumers as are poisonous.

Tables 4 and 5 show milk yields and results of milk analyses from the neighbouring selected farms. The quantities from the farms were low (**Table 4**). However, the results from the questionnaires indicated a high possibility of adding more farms to the list so as to add and utilize the GDI factory capacity to the full in order to curb the shortages experienced.

Physico-chemical results of milk analyses from the neighbouring farms are presented in **Table 5** and are similar to those from EU farms. The quality of milk from these farms fell within KBS standards and other International standards (Davis, MacDonald, 1953; Martin, 1979; Webb, 1965 and KBS, 1976) though in some cases the acidity was high and needed improvement on hygiene. Sensory evaluation statistical tests showed no significant difference (liked moderately) and were acceptable for processing and consumption.

Conclusion

The findings from the EU farms and GDI factory show that the problem of milk shortage can be overcome simply by accepting changes and challenges and by accepting milk supply from other sources to meet the demand and to curb shortages experienced in order to fully utilize the 4500 kg/day capacity of the GDI factory. However, in order to do this efficiently and effectively the EU administration need to solicit funds to purchase extra facilities such as a vehicle for milk collection and distribution, more aluminium cans and additional manpower to absorb extra activities. Most importantly the EU factory requires revolving funds for prompt payment of milk collected from the farms and for repairs of processing equipments, otherwise the project will not work. There is a need for the factory to work as a business entity for the good of the community. The EU farms also require money for animal feeds and drugs and for improvement of water supply for livestock

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