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Factors Influencing the Somatic Cell Counts in Goat Milk in Kenya

R. S. Shivairo[1], J. Matofari[2], C. I. Muleke[3], P. K. Migwi[4], E. Lugairi[5]
1. Department of Clinical Studies, P.O. Box 536, Egerton, Kenya.
2. Department of Dairy & Food Technology, P.O. Box 536, Egerton, Kenya.
3. Department of Clinical Studies, P.O. Box 536, Egerton, Kenya.
4. Department of Animal Science, P.O. Box 536, Egerton, Kenya.
5. Department of Geography, P.O. Box 536, Egerton, Kenya.
*E-mail of the corresponding author shivairo2000@yahoo.com

ABSTRACT
The dairy goat sector in Kenya is young and rapidly growing. There are many breeds being introduced e.g. the Saanen, Toggenburg and Alpine, in varying agro-climatic zones, ranging from Coast, Rift Valley and Western Kenya. The objective of this study was to look at the impact of breed, location, parity and lactation length on Somatic Cell Counts (SCC) considering the fact that SCC thresholds are often used as parameters to determine quality standards of milk. This study demonstrated significant SCC variations amongst breeds, especially Toggenburg / Saanen, Toggenburg X Alpine / Saanen, and Saanen / Alpine. The SCC also varied significantly amongst various study sites. This study also established an increasing SCC with parity and lactation length. In developing SCC as milk quality standard for Kenya Dairy Board these factors will have to be considered.
Key words: Somatic cell counts, goat breeds, location, parity, lactation length.

1.0 INTRODUCTION

Normal goat milk has a higher somatic cell count (SCC) than normal milk from cows. The higher cell count is in part caused by an increase in the rate of sloughing of epithelial cells and the presence of cytoplasmic masses which occur as a consequence of apocrine secretory process of goat milk gland cells. A part from the above nucleated cytoplasmic particles, SCC in goats are known to be affected by breed, stage of lactation, parity, ostrus hygiene and environmental / climatic factors. (Haskell, S. R., 2005; Escobar E. N., 2007).
The impact of these factors has been a subject of research. As a result no reliable threshold values could yet be defined for SCC in goat milk, with some researchers viewing SCC as unsuitable for monitoring caprine mastitis (Vihan, 1989). In the EU the SCC threshold for cow milk is set at 400 x 10^3 cells per ml (EC, 2004), but so far no limit values for goat milk exists (Paape *et al.*, 2007). Only in the USA the SCC in bulk goat milk is not allowed to exceed 1 million cells per ml. (US Public Health Service, 2003).
The dairy goat sector in Kenya is young and growing rapidly, involving a number of different breeds like Toggenburg, Saanen and Alpine, and varying agro-climatic zones, ranging from Coastal region, Rift Valley, Central Kenya and Western Kenya. It is therefore necessary that research to document the factors that impact on productivity, like mastitis and the monitoring parameters like SCC be carried out.

2.0 MATERIALS AND METHODS

A cross-sectional survey was carried out in key dairy goat keeping regions namely; Coast (Kwale county) lower ecological zone 2, 3; Nyanza (Homabay, Migori, Siaya), low medium potential, and Rift Valley (Bomet, Nakuru), lower ecological zone 2 – 3 (Jaetzold and Schmidt, 1983).
The study focused on the breeds in these regions, including the Toggenburg, Saanen, Alpine and their crosses.
A total of 239 milk samples were collected from lactating does. In the laboratory a SCC was conducted using the Improved Neubauer Chamber (AO, American Optical, USA).
A structured questionnaire was also administered with questions focusing on breed, kidding records, lactation length, parity and mastitis treatment records.

2.1 Breed distribution

In Figure 2, the overall distribution of the breeds shows that 54% of the goats on the farms were Saenen, imported from South Africa, German Alpine constituted 17%, Toggenburg were 10%, with 3% Anglo-Nubian. The 16% crosses represented undefined crosses.

3.0 RESULTS

3.1 Somatic Cell Counts (SCC)

A total of 239 milk samples were analyzed for SCC. Table 1 summarizes the SCC in actual counts, and the corresponding $\log^6$. The lowest SCC was 248,371 (248 x 10^6) the highest was 1,693,440 (1693 x 10^6), with a mean count of 869,522.87 (86592 x 10^6).

3.2 SCC and location

Table 2 shows descriptive statistics of SCC across locations. In order to find out if these mean SCC were significantly different across locations ANOVA was used.

Table 3 shows ANOVA comparisons of SCC across locations, p value 0.000 < 0.05. Post HOC multiple comparisons using Least Squares Difference (LSD) was used to establish differences between specific locations. Table 4 shows statistically significant differences.

3.3 SCC and breed

Table 5 shows descriptive statistics of SCC across breeds.

ANOVA was used to establish if the above differences are significant or not, as shown in

Table 6. SCC across breed types was significant (P value, 0.000 < 0.050).

Post HOC Multiple Comparison using Least Squares Differences (LSD) test was used to establish the SCC against specific types of breeds, as in Table 7. The LSD tests shows significant differences in SCC between some breed type, while others are not significantly different.

3.4 SCC and parity

The study sought to establish a relationship between parity and SCC. Table 8 shows the Correlation Coefficient between the two, which shows r = 0.145, P(0.380) > 0.05, a positive but not statistically significant.

3.5 SCC and lactation length

The study sought to establish the relationship between SCC and Lactation length using Pearson's Correlation Coefficient. Table 9 shows the relationship, r – 0.0880 P(0.617) > 0.05, a positive but not statistically significant.

4.0 DISCUSSION

Among the factors documented to influence SCC in goat milk is breed. In this study ANOVA comparing SCC between various breeds demonstrated statistically significant variations. Studies in USA and European countries have documented significant breed variations in SCC, especially the Nubian breed (Mannasmith, 1981; Haskell, 2005; Stuhr & Aulrich, 2010). A study of French Alpine & Saanen goat breed established a heritability factor of SCC of 0.20 (Rupp *et al.,* 2012). The major goat breeds in Kenya have been introduced by various NGO projects.

Heifer Project International (HPI) biggest, has concentrated on the Saanen replacing the Alpine breed imported from South Africa. Farming Systems Kenya (FSK) a Catholic Church project introduced the Toggenburg.

This is the first such a study in Kenya documenting significant breed variations in SCC. It pauses a challenge in setting thresholds for use of SCC in mastitis diagnosis in Kenya, considering that the Dairy Board of Kenya has not established quality standards for goat milk, just as is the case in many other countries.

The SCC variations amongst the study regions could be explained partly by the breed-clustering in the various sites, i.e. each study site consisted of specific / homogenous breeds, e.g. Njoro, Kasambara and Elburgon has a concentration of Toggenburg supplied by the FSK, while the sites in Nyanza and Coast regions, mostly under the Heifer Project consists mostly of Saanen and Alpine. However, the possibility of climatic variations across the study sites, and their impact on diet and oestrus cycles needs to be documented in a study. In a study on effect of oestrus on SCC, it was indicated that in Southern Europe region / climatic variations had impact on SCC (Moroni *et al.,* 2007). Stuhr & Aulrich (2010) in their review concluded that factors affecting estrus are bound to affect the SCC, climate would be one such factor.

Parity (number of kiddings) and lactation length are among the factors documented to affect SCC in goat milk by many researchers (Mannasmith, 1981; Haskell, 2005; Stuhr & Aulrich, 2010). In this study SCC generally increased with parity and lactation length, even though not statistically significant. These results therefore generally research concur with findings elsewhere on the effect of these two factors on SCC. However, the real significance of physiological factors like lactation and parity need to be elucidated in a longitudinal study, taking into consideration breed and agroclimatic zones in Kenya.

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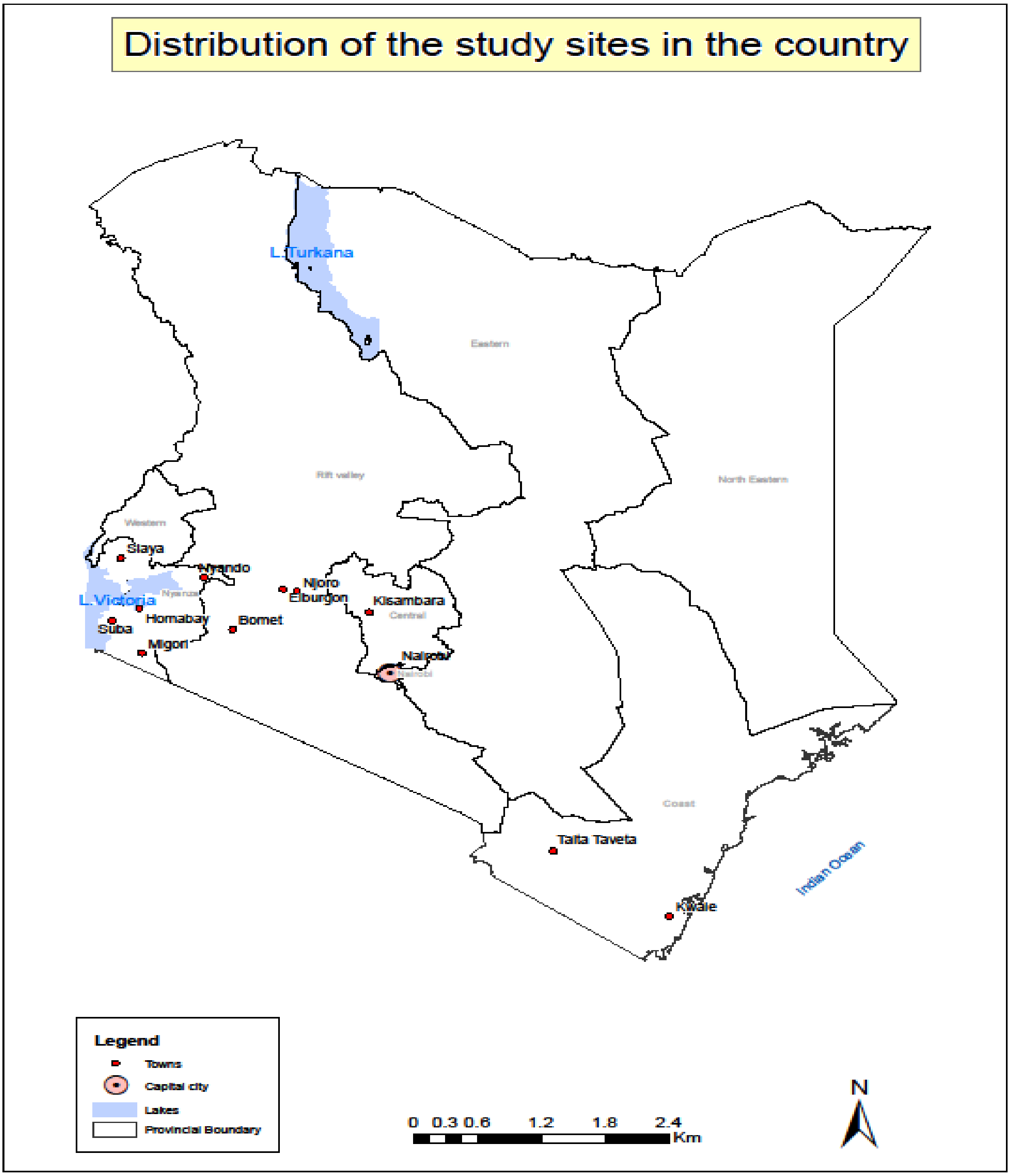

Figure 1: Distribution of the study sites in the country

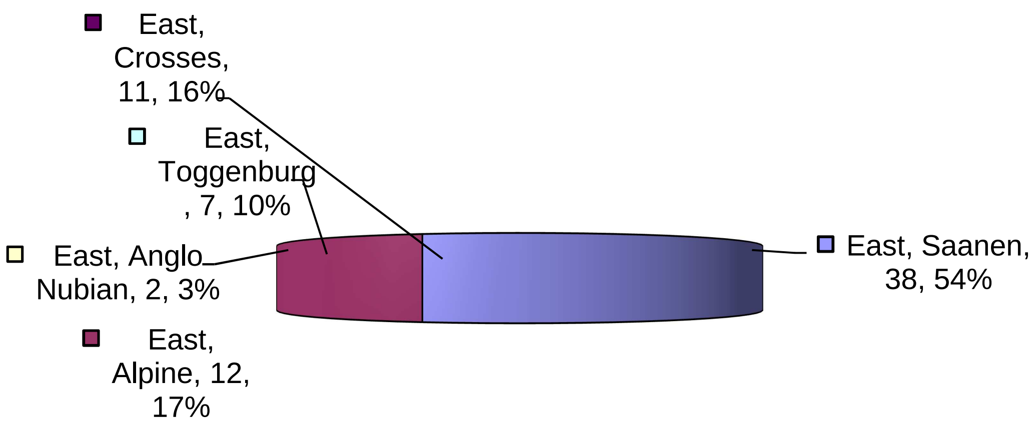

Figure 2: Goat breed distribution in SHD goat farming areas in Kenya

Table 1: Somatic Cell Counts (SCC)

	SCC	SCC log 6
N	239	239
Mean	869,522.87	.86,952 x 10^6
Standard deviation	206,609.32	.206,609 x 10^6
Range	1,445,069	1.455 x 10^6
Minimum	248,371	.248 x 10^6
Maximum	1,693,440	1.693 x 10^6

Table 2: Descriptive Statistics of SCC scores across location

Location	N	Mean	St. Deviation	St. Error	Minimum	Maximum
Njoro	51	0.91645	0.20675	0.028951	0.531	1.693
Kasambara	31	0.90161	0.135596	0.024354	0.621	1.106
Elburgon	38	0.99259	0.169991	0.027576	0.576	1.332
Kwale	33	0.76222	0.162853	0.028335	0.463	1.185
Homabay	16	0.69572	0.172986	0.043247	0.248	1.039
Siaya	29	0.75485	0.205346	0.038132	0.485	1.287
Nyando	30	0.90016	0.221507	0.040441	0.598	1.343
Bomet	11	0.92985	0.216294	0.065215	0.644	1.242
Total	**239**	**0.86952**	**0.206609**	**0.013364**	**0.248**	**1.693**

Table 3: ANOVA Comparing SCC mean scores across location

	Sum of squares	df	Mean square	F	Sig.
Between groups	2.033	7	0.29	8.254	0
Within groups	8.127	231	0.035		
Total	**10.16**	**238**			

Means significant at α = 0.05 significant level ($p < 0.05$)

Table 4: LSD Test Comparison SCC Mean scores across location

(I) Location	(J) Location	Mean Difference (I-J)	Std. Error	Sig.
Njoro	Kwale	.154230*	0.041904	0
	Homabay	.220731*	0.053747	0
	Siaya	.161607*	0.043623	0
Kasambara	Elburgon	-.090986*	0.045395	0.046
	Kwale	.139385*	0.046915	0.003
	Homabay	.205886*	0.057739	0
	Siaya	.146761*	0.048457	0.003
Elburgon	Kwale	.230371*	0.044631	0
	Homabay	.296872*	0.055899	0
	Siaya	.237748*	0.046249	0
	Nyando	.092436*	0.04581	0.045
Kwale	Nyando	-.137935*	0.047316	0.004
	Bomet	-.167630*	0.065303	0.011
Homabay	Nyando	-.204436*	0.058065	0.001
	Bomet	-.234131*	0.073466	0.002
Siaya	Nyando	-.145311*	0.048846	0.003
	Bomet	-.175006*	0.066419	0.009

Table 5: Descriptive Statistics of SCC Scores across Types of Breeds

Types	N	Mean	Std. Dev.	Std. Error	Minimum	Maximum
Toggenburg	29	0.97474	0.162282	0.14379	0.621	1.253
Toggenburg Alpine Cross	77	0.91972	0.1911	0.10368	0.531	1.693
Saanen	123	0.80266	0.205719	0.08830	0.248	1.343
Alpine	10	1.00026	0.166876	0.25150	0.768	1.31
Total	**239**	**0.86952**	**0.206609**	**0.06367**	**0.248**	**1.693**

Table 6: ANOVA Comparing SCC Mean Scores across Type of Breed

	Sum of Squares	df	Mean square	F	Sig.
Between groups	1.236	3	0.412	10.848	0
Within groups	8.924	235	0.038		
Total	**10.16**	**238**			

Means significant at α = 0.05 significant level ($p < 0.05$)

Table 7: LSD test comparing SCC mean scores across types of breeds

(I) Breeds	(J) Breeds	Mean Difference (I-J)	Std. Error	Sig.
Toggenburg	Toggenburg Alpine Cross	0.055026	0.042457	0.196
	Saanen	.172079*	0.040226	0
	Alpine	-.025516	0.071462	0.721
Toggenburg Alpine Cross	Toggenburg	-.055026	0.042457	0.196
	Saanen	.117053*	0.028318	0
	Alpine	-.080542	0.065502	0.22
Saanen	Toggenburg	-.172079*	0.040226	0
	Toggenburg Alpine Cross	-.117053*	0.028318	0
	Alpine	-.197595*	0.064079	0.002
Alpine	Toggenburg	.025516	0.071462	0.721
	Toggenburg Alpine Cross	.080542	0.065502	0.22
	Saanen	.197595	0.064079	0.002

*The mean difference is significant at the 0.05 level.

Table 8: Correlation of Parity with SCC

		Parity	Somatic Cell Count (log6)
Parity	Pearson Correlation	1	-.145
	Sig. (2 - tailed)		.380
	N	45	39
Somatic Cell Count (log6)	Pearson Correlation	-.145	1
	Sig. (2 - tailed)	.380	
	N	39	239

Table 9: Correlation of Lactation with SCC

		Somatic Cell Count (SCC)	**Lactation**
Somatic Cell Count (SCC)	Pearson Correlation	1	.088
	Sig. (2 - tailed)		.617
	N	239	35
Lactation	Pearson Correlation	.088	1
	Sig. (2 - tailed)	.617	
	N	35	40