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Occurrences of Goat Mastitis and Milking Management in the Oodi Agricultural Region, Botswana

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Authors' Contribution
WM conducted the field and laboratory work and wrote the manuscript. GSM procured funding. JK, SJN and W Mahabile conceived and designed the study. KD assisted in data collection and AAS desingned the experiments and supervised the research.

Key words
Flock size, Goat, Milk, Mastitis, Oodi.

ABSTRACT

Goat milk production contributes less to Botswana's dairy sectors with a low annual production of 4 tonnes per year. The objectives of the study were to evaluate goat milk production practices and attributes of goat farmers in the Oodi agricultural region, Botswana. Ninety-one farmers were purposively selected based on milk production potential from a list of 170 farmers officially registered with the Oodi agriculture station. Farmers were visited to conduct face to face interviews and administer a questionnaire. The results showed that farmers milking average three goats constituted the highest (47%) share, and the majority (46%) of them had a daily yield of 1-2 L/day followed by those yielding <1L/day (40%). A significantly ($P<0.05$) high (62%) proportion of farmers adopted a 3-4 months lactation period while longer lactation periods (>4 months) were the least adopted at 4%. A significantly ($P<0.05$) high proportion (58%) of the farmers were not informed on mastitis nor its management. From the 38 farmers informed on the diseases only, 76% were able to diagnose the disease. Most diagnosis was based on clinical observations (68) with the low utility of California Mastitis Test (CMT) (3%). Milk production was at subsistence scale and a secondary product from meat type breeds. With a commercial mindset, improved goat management and cooperative pooling and marketing of milk the current farming setup of using meat breed for milk could prove beneficial to both the meat and dairy sectors.

INTRODUCTION

Botswana is among the countries with the highest per capita consumption (88.89 kg/capita/year) of milk in sub-Saharan Africa (FAOSTATS, 2014). In the year 2015/16, a total of 4,137,701 litres of milk was produced locally compared to 2,202,062 liters in 2014/15 litres thus supplying only 6% of the domestic demand of 64 million litres/annum (MoA, 2016). Despite the continues policy interventions by government to improve the dairy sector such policies have proven a failure on their part leading to the continuous dependency on imports for milk and dairy feed. Feeding costs significantly increased by more than 50% during year 2015/2016, leading to an increase in the price of raw milk produced locally (MoA, 2014). Meanwhile, the deficit of 60 million litres was covered by continuous milk imports from South Africa at a tune of BWP 212.9 million. According to Ndambi *et al*. (2007) traditional milk production systems in sub-Saharan Africa account for the highest share (75-90%) in milk supply. Despite the case, goat milk production contributes less to Botswana's formal dairy sectors with a low annual production estimate of 3934 tonnes per year (FAOSTATS, 2014). Despite the limited contribution of goats to the dairy industry, their role in household food security, nutrition, employment generation and capital accumulation remain significant (Pannin and Mahabile, 1997). The goat population in Botswana has significantly increased over the years to approximately 2.4 million. Dipheko *et al*. (2016) reported a total of twelve farmers keeping a total of 100 dairy goats of different breeds in the Central, Kgatleng and Kweneng districts of Botswana. To date research on goat milk is inadequate despite the ever-growing number of farmers willing to venture into goat milk production enterprises (MoA, 2014, 2016). There are efforts to improve goat milk production systems for smallholder farmers, but this has been limited by the scarcity of information on traits of economic importance such as milk yield and failure to account for the constraints posed by the production systems and environmental constraints

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(Mpapho, 2011). The limitation is evident in the paucity of information in the national inventories as such there are no comprehensive records on goat milk supply, demand, acceptability, rejection and the level of contribute to household food security. It without a doubt that Botswana is challenged to develop goat dairy systems tailor-made to take advantage of existing and locally available resources to increase the participation of local goat farmers into dairy value chains. For this to be realized emphasis should be placed on understanding and documenting current milk production practices, traditions, the trend of consumption and available resources to guide decision-making. To bridge the information gap, this study was designed to evaluate goat milk production practices and attributes by farmers Oodi agricultural region, Botswana.

METHODOLOGY

The study was conducted in the Oodi agricultural region of Botswana in September 2013 to February 2014. The area covers tribal villages of Oodi, Matelebelng, Ruretse, Mokatse, and Modipane. The farmers interviewed in the study were selected with the help of small stock extension offices and Animal Health Production staff stationed at Oodi. The farmers were selected from a list of 170 farmers officially registered with the Oodi station. The A total 91 goat farmers were purposely selected from the pool based on milk production potential and involvement in milking activities. Since most of the farms were clustered around the arable areas surrounding the villages and as well as next to the main road where accessibility was relatively easy we visited the farmers to conduct face to face interviews and administered questionnaires. The questionnaires and interviews entailed questions on flock sizes, milking management practices and milk production. Milk yield was estimated at the peak of lactation because farmers did not regularly measure milk yield throughout the whole lactation. Instead, they depended on the highest milk production estimates of each goat which probably is at peak lactation. Mastitis management aspects were only targeted to farmers knowledgeable and informed about the diseases. Therefore, the sample size for this element was narrowed to 38 farmers. The estimates on the occurrences for mastitis and udder infections was based on clinical observations by the farmers, reported in the current 2013/2014 lactation. The collected survey data were coded and analyzed using Statistical Package for Social Sciences (SPSS version 17.0 for windows) (SPSS, 2008).

Table I.- The effects of milk production factors on farm milk yields.

Factors	Categories	Farm yield per day (L/day)					Freq (N)	Freq (%)	χ2	P value
		< 1	1-2	2-5	5-10	>10				
Milking pattern	Daily	11	11	13	8	12	55	60		
	Frequently	3	6	10	0	0	19	21		
	Periodically	4	5	4	0	1	14	15		
	Rarely	0	2	1	0	0	3	3		
	Total	18	24	28	8	13	91	100	19.60	0.08^{NS}
Lactation length	3 months	7	12	7	2	3	31	34		
	3-4 months	11	11	21	5	8	56	62		
	>4 months	0	1	0	1	2	4	4		
	Total	18	24	28	8	13	91	100	11.82	0.16^{NS}
Flock size	>5	3	0	0	0	0	3	3		
	6-10	6	2	0	1	0	9	10		
	11-20	7	9	11	0	1	28	31		
	21-30	0	9	8	1	0	18	20		
	<30	3	3	9	5	13	33	36		
	Total	19	23	28	7	14	91	100	62.62	$<.0001^{**}$
No. of milking goats	less 5	19	20	4	0	0	43	47		
	6-10	0	3	19	2	0	24	26		
	11-15	0	0	5	4	4	13	14		
	> 15	0	0	0	1	10	11	12		
	Total	19	23	28	7	14	91	100	120.44	$<.0001^{**}$

Freq, frequency; L, liters; P-Values with ** were highly significant at (P<0.001); NS, not significant.

Descriptive statistics such as χ^2-test, mean, frequencies and percentages were used to analyze the production parameter against the milk yields/day. Probabilities of $P<0.05$ were considered as statistically significant.

Table II.- Average flock sizes and farm yield /day.

Factors	Categories	No. farmers	Total goats	Mean	S.D.
Flock size	>5	3	11	4	0.58
	6-10	9	75	8	1.58
	11-20	26	371	14	2.74
	21-30	19	474	25	3.15
	<30	34	2034	60	29.57
No. of milking goats	less 5	43	135	3	1.06
	6-10	24	176	7	1.61
	11-15	13	157	12	0.76
	> 15	11	248	23	4.06
Farm yield / day	< 1	12	6.55	0.55	0.19
	1-2	23	48	1.67	0.44
	2-5	28	99	3.41	0.87
	5-10	7	65	7.22	1.39
	>10	14	240.5	20.04	14.6

RESULTS

Effects of flock sizes and goat milking numbers on farm yield

Flock sizes and milking flock sizes significantly ($P<0.05$) influenced the farm yield /day reported in the present study (Table I). Most farmers (36%) had flocks of more than 30 animal followed by those with 11-20 animals at 31%. The farmer (37%) owning more than 30 goats had an average flock size of 60 goats while those keeping less 1-30 goats had an average flock of 22 goats (Tables I and II). Farmers milking less than five goats/day (an average of three goats) constituted the highest (47%) share, and the majority (46%) of them had a daily yield of 1-2 L/ day followed by those yielding <1L/day (40%). Farmer milking > 15 goats/day (average 23 goats) were the least (12%), and 91% of them yielded above 10L/day (Table II).

Effects of milking pattern and lactation length of farm yield

Milking patterns and lactation length did not significantly ($P>0.05$) influence farm yields/day (Table I). Daily milking of goats was highly (60%) practiced whereas few farmer rarely milked their goats (3%). Daily milkers yielded mostly >10L/Day (24%) followed by farmers yielding 1-2L (18%). A significantly ($P<0.05$) high (62%) proportion of farmers adopted a 3-4 months lactation period while more extended lactation periods (>4 months) were the least adopted at 4% (Table I). Most farmers (38%) following a 3-4 months lactation length were yielding 2-5L/day followed by those producing <1 and 1-2L /day.

Effects of breeds and yield/goat on farm yield

According to Table III, the present study demonstrated a significantly ($P<0.05$) high use of the Tswana breed (71%) as compared to the other breeds. The Saanen breed constituted the least significant share (1%). The majority of farmers (29%) utilizing the Tswana breed produced on average 1-2 L/day followed by those who had a yield of less than 1L/day at 28 %. The highest milk yield (>10L/ Day) was achieved by farmers keeping the Tswana* Boer crosses. The Saanen breed exhibited a significantly higher average milk yield of around 1.5 L /day as compared to the other breed. As shown in Table III, 77% of the farmers kept goats yielded on average 0.25-0.5 L/ day moreover, the same category of goats attained the highest farm yield/ day (>10L/Day). On the other hand, the category of goats yielding more than 1.5 L/day constituting the least share of 1%. The trade, processing, and utility significantly ($P<0.05$) influenced the farm yield /day (Table III). In the current study, 82.5% of farmers were subsistence producers who consumed all milk produced, while 17.6% we partially involved in the trade of milk. The majority of farmers (56%) involved in the trade were yielding >10L/ Day followed by those yielding 5-10L/day (25%). Sixty-two percent of the farmers used milk for multiple purposes while 38% used it solely for brewing tea ($P<0.05$).The majority of the farmers (73%) employed boiled the milk for use as fresh milk while 24% of the farmers were involved in fermenting milk for use as sour milk.

Mastitis and udder health management

A significantly ($P<0.05$) high proportion of the farmers (58%) were not informed on Mastitis nor it management (Table IV). From the 38 farmers informed on the diseases only, 76% were able to diagnose the disease. The most diagnosis was based on clinical observations (68) with the low utility of California Mastitis Test (CMT) (3%). A significantly ($P<0.05$) high (76%) proportion of farmers had encountered at least a case of mastitis or udder infection in the current lactation. The majority of the farmers (50%) did not treat mastitis but allowed the does to heal naturally. Indigenous methods of treatment were highly (34%) employed compared to antibiotic treatments (16%) (Table IV). Culling of mastitis-infected animals was adopted by 26 % of the respondents.

Table III.- The effects of milk production factors on farm milk yields.

Factors	Categories	Farm yield per day (L/day)					Freq (N)	Freq (%)	χ2	P value
		< 1	1-2	2-5	5-10	>10				
Breed	Tswana	17	20	19	6	3	65	71		
	Saanen	0	0	0	0	1	1	1		
	T*B	1	4	7	2	7	21	23		
	T*B + S*B	0	0	2	0	2	4	4		
	Total	19	23	27	7	14	91	100	26.59	0.01*
Yield per goat (L)	0.25	8	0	0	0	0	8	9		
	0.25- 05	10	22	25	6	7	70	77		
	0.5 -1	0	1	3	2	4	10	11		
	1-1.5	0	1	0	0	1	2	2		
	>1.5	0	0	0	0	1	1	1		
	Total	18	24	28	8	13	91	100	54.10	<.0001**
Milk utility	Tea	14	10	6	3	2	35	38		
	Multi utility	4	14	22	5	11	56	62		
	Total	18	24	28	8	13	91	100	18.22	0.001**
Process milk	Boiling	18	21	24	1	2	66	73		
	Fermentation	0	0	0	0	1	1	1		
	None	0	0	1	0	0	1	1		
	Boiling & fermentation	0	3	2	7	10	22	24		
	Total	18	24	27	8	13	91	100	58.21	<.0001**

Freq, frequency; L, liters; T*B, Tswana * Boer crosses; S*B, Saanen *Boer crosses; P-Values with * were significant at (P<0.05), ** were highly significant at (P<0.001).

Table IV.- Mastitis and udder health management.

Variables	Mastitis prevalence			X^2	P-value
	Category	Freq No.	Freq %		
Knowledge of mastitis	Yes	38	42		
	No	53	58		
	Total	91	100	36.86	0.001**
Diagnosis mastitis	Yes	29	76		
	No	9	24		
	Total	38	100	39.05	0.001**
Method of diagnosis	CMT+ Clinical	3	8		
	Clinical exam	26	68		
	No diagnosis	9	24		
	Total	38	100	39.84	0.001**
Cull infected animals	Yes	10	26		
	No	28	74		
	Total	38	100	39.05	0.001**
Treat mastitis cases	Yes	18	47		
	No	20	53		
	Total	38	100	34.53	0.001**
Treatment method	Antibiotics	6	16		
	Indigenous meds	13	34		
	Natural healing	19	50		
	Total	38	100	27.71	0.001**

Freq, frequency; ** were highly significant at (P<0.001).

DISCUSSION

In the current study, 54% of the 170 goat farmers registered with the Oodi extension office were involved in the milking of goats meanwhile 32% and 5% milking was reported in the Kgatleng and Kweneng districts, respectively (Aganga and Moganetsi, 1998; Aganga *et al*., 2005). The average flock size for the region was 33 goats. The observations of this study were in close consent with findings by Aganga and Moganetsi (1998) who reported an average herd size 18 and the milking flock size of 4 in Kgatleng and Kweneng districts. Dipheko *et al*. (2016) reported milking flock size of 2-10 goats for smallholder dairy farmers in Central, Kgatleng and Kweneng districts. Ahuya *et al*. (2003) and Helene *et al*. (2012) reported an average milking flock size of 3-4 does in Kenya and Tanzania, respectively. The small milking flock sizes in the current study could be attributed to uncontrolled breeding which results in most kidding to occurs in the winter/dry season (July to September) when the nutritional quality of range forages is low. Aganga *et al*. (2005) indicated that farmers in the Kgatleng and Kweneng regions of Botswana adopted a buck to doe ratio of 1:60 which tend to affect the breeding season and flock management.

With regards to the daily milk yield /breed, the observed results (Table III) were comparable to findings by Aganga

and Moganetsi (1998) who observed daily milk yields of 0.35 litres and 0.56 litres, respectively for Tswana does feed different levels of energy content. Furthermore, Kibuuka (2011) and Mpapho (2011) reported daily milk yields of 1.61 and 2.80 litres/day, respectively for Saanen does. The adoption of the Tswana breed as the breed of choice for the most farmer was mainly due to it acclimatization to local climate and communal system. It was evident that dairy type breeds were still in demand while out of reach for most of the farmers a similar phenomenon was reported in Kenya by Ahuya *et al*. (2003). According to Dipheko *et al*. (2016), the 70% of, the 12 dairy goat farms in Central, Kgatleng and Kweneng districts belonged to government institutions while only 30% were in the hands of private farms. This demonstrates the level of scarcity of dairy breeding and production stock. The observed results (Table I) regarding the average farm yield/day (1.18 L/day) were closer to findings by Aganga and Moganetsi (1998) who reported an average production per farm of 0.94 litres in the Kgatleng and Kweneng districts of Botswana. The low daily yield/goat and low daily milk yield per farm in the current study could be attributed to the predominant use of meat goats, especially the indigenous breed. Rege (1993) reported that the low genetic potential in indigenous tropics breeds as a major constraint to milk production since they are not selected for milking traits. Respondents in the current study also attributed the low milk potential to the limited and unaffordable genetic material for dairy selected breeds. Similarly, Kenya is faced with challenges of insufficient genetic material for dairy goats hence leading to risks of inbreeding and drop in milk productivity (Ahuya *et al*., 2003). The lactation lengths observed in the current study (Table I) were comparable to those reported in Borana pastoral areas of Ethiopia (3 months) and Babati and Kongwa districts of Tanzania (5.4 months) (CARE, 2009; Jackson *et al*., 2014). Meanwhile, an average lactation period of 10 months was reported for goat milking households in Brazil (Vieira *et al*., 2009). These short lactation periods in current study influenced milk production to be seasonal than annual. Thus, milk was produced mainly from October-April then declining during the dry season (May-September). The adoption of short lactation periods (>4 months) is likely to be influenced by the communal system that is by fluctuations in feeding resources and uncontrolled breeding. No significant ($P<0.05$) difference was reported for milking patterns, but it was evident that most farmers (60%) milked their goats daily for home consumption purposes. Daily milking and consumption were linked to the use of goat milk as part of the diets mainly because some households had goats in proximity to residential areas in the village and arable areas.

Subsistence household consumption of goat milk has been widely reported in Botswana, by previous studies (Aganga and Moganetsi, 1998; Dipheko *et al*., 2016; Moreki *et al*., 2011) but reports on goat milk trading and marketing do not exist. In the current study, 82.5% of farmers were subsistence producers who consumed all milk produced, while 17.6% were partially involved in the trade of surplus milk (Table III). Accordingly, the milk was sold to neighbours and other consumers in the locality. The groups of farmers producing >10L/Day (56%) and 5-10L/day (25%) were able to trade milk as well as make sour milk since they milked on average 20 and seven goats/day, respectively (Table II). Studies by Mpapho (2012) highlighted the commercial acceptance of goat milk in the form of sour milk in communities around Gaborone. Thus the limited diversity of goat milk products could significantly affect the acceptability, utility, and marketing. These trends suggest the need for investment in goat milk processing and diversification. Goat milk pooling by farmer cooperative has been widely practiced in Kenya and Tanzania to address goat milk marketing constraints (Helene *et al*., 2012; Rege, 1993). BIDPA (2001) cited the lack of supply linkages and market-oriented production as key factors influencing the subsistence nature of goat milk in Botswana. Similarly, Ogola *et al.* (2010) reported difficulties in marketing as a reason for the large home consumption of goat milk in Kenya.

The results obtained in the present study could not be used to estimate the prevalence rate in the region, but Mugabe *et al*. (2017) reported the prevalence of mastitis in the Oodi region at 17.8%, with, a significantly ($P<0.05$) higher prevalence rate for sub-clinical (13.5%) as compared clinical mastitis (4.29%). The result of the present study regarding the low adoption of sub-clinical detection methods (Table IV) was comparable to that archived by Husein *et al*. (1993) and Kivaria *et al*. (2004) who indicated that subclinical mastitis receives little attention among smallholder milk producers in Ethiopia and Tanzania since the effort was concentrated on the treatment of clinical cases. Similarly, the lack of diagnosis was reported as a key factor in the increase in other dairy diseases including tuberculosis and tuberculosis (Batool *et al.*, 2017). Amin *et al*. (2013) suggested that farmers tend to neglect the sub-clinical forms of mastitis mainly due to lack of awareness. Since milk production was not a major objective to most of the farmers, goats diagnosed with mastitis were discontinued from milking activities (culled) but kept in the same flock. According to Amin *et al*. (2013) infected animals serve as reservoirs for further infection within the flocks, and may shed organisms intermittently in the environment. Furthermore, Contreras *et al*. (2005) reported that *Staphylococcus aureus*

provoked mastitis may be transmitted from infected does to the rest of the lactating females, by suckling kids that cross suckle from other does. Therefore lack of culling and isolation of infected does may aggravate the prevalence of mastitis cases, especially in large flocks. Min *et al*. (2007) suggested that most instances a spontaneous cure of the intra-mammary infection occurs but at the expense of reduced milk production and possibly permanent damage to milk secretory tissue.

CONCLUSION

Milk production was at subsistence scale and mostly a secondary product from meat-type breeds. The study has shown that farmers have the fair number of stock but the productivity of the stock regarding genetic milking potential, milk yield and lactation length did not warrant a profitable adventure. With a commercial mindset, improved goat management and cooperative pooling and marketing of milk the current farming setup of using meat breed for milk could prove beneficial to both the meat and dairy sectors. The Tswana breed has proven to be a widely available breed. Therefore, research should focus on designing production systems that can derive a dual benefit from them.

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Statement of conflict of interest

Authors have declared no conflict of interest.

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