Comparative milk production and prevalence study of parasites and sub clinical mastitis on indigenous lactating cows under different feeding regimes in central highlands of Ethiopia

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Abstract

Comparative study on prevalence of gastrointestinal parasites, ticks and subclinical mastitis as well as milk yield was conducted on local zebu lactating dairy cows exposed to different feeding regimes in dry seasons at Sululta and Mukaturi districts of North Shewa zone, central Ethiopia. A total of 15 households at each district having at least two lactating local zebu dairy cows were selected; 15 cows of one group at each district were maintained as farmers own feeding practice (control diet, T_0), and the others 15 at each district were supplemented (intervention diet, $T_{1)}$. Prior to the experiment, all animals were checked for any gastrointestinal parasite infection, tick infestation and mastitis, through clinical and laboratory diagnosis. All animals with positive results were effectively treated and rechecked before the commencement of the study and those with negative results were followed until the end. The study showed that there was no statistical significant difference ($p>0.05$) in the prevalence rate of gastrointestinal parasites, external parasites (ticks) and sub clinical mastitis among the treatment and control groups at each district and among districts where the overall prevalence rate was (63.3%, 60% and 33.3%, respectively) for Sululta district and (80%, 56.7% and 40% respectively) for Mukaturi district. The prevalence rate of gastrointestinal parasites, external parasites (ticks) and sub clinical mastitis were 60%, 46.7% and 33.3%, respectively for the treatment group and 66.7%, 73.3% and 33.3%, respectively for the control group at Sululta district, while prevalence of 87.5%, 56.3% and 43.8%, respectively for the treatment group and 71.4%, 57.1% and 35.7%, respectively for the control was observed at Mukaturi district. Also, no statistical significant difference ($p>0.05$) was found in the mean EPG value among the two districts. The main tick genera encountered were *Boophilus, Amblyomma, Rhipicephalus* and a mixed infestation by two or more than two of these ticks in both districts. Furthermore, the possible observational limiting factors encountered in the study were those related with general management and lack in utilization of different disease prevention and control options. The study also showed that cows maintained on

the intervention diet at both districts produced considerably higher (P<0.05) milk per day compared to those cows which were receiving the control diet. Moreover the financial returns in terms of net profits gained per cow per day were observed to be higher for experimental cows receiving the intervention diets at both districts

Keywords: dairy cattle, feeding, season, mastitis, prevalence, parasites, milk yield

Introduction

Among parasites on domestic cattle, external parasites are the most serious threat since they feed on body tissues such as blood, skin and hair. In Ethiopia ticks are the most important ones and the economic loss incurred when they infest livestock particularly, cattle are enormous (Feseha Gebreab, 1983). On the other hand gastrointestinal parasite infections causing enormous economic loss have been considered to be also world-wide problem for both small- and large-scale farmers where their impact is considered greater in Ethiopia due to the availability of a wide range of agro-ecological factors suitable for diversified hosts and parasite species. Economic losses are caused by gastrointestinal parasites through lowered fertility, reduced work capacity, involuntary culling, a reduction in food intake and lower weight gains, lower milk production, treatment costs and mortality in heavily parasitized animals (Lebbie, *et al*.; 1994). Mastitis is also one of the most prevalent diseases worlds wide. The disease, which is common in dairy cows, causes significant losses to the dairy industry and affects milk hygienic and sanitary features (Cullor, *et al*.; 1990; Singh, *et al*.; 1994; Harmon, *et al*.; 1994). The disease is usually classified as sub-clinical, acute, sub acute, chronic and gangrenous based on aetio-pathological findings and observations. Like much of the places, in Ethiopia, it is usually difficult to get enough quality feed for cattle during the dry season in the study areas. One way of improving the performance of grazing cattle during periods of scarcity of feed would be to use basal feed and concentrate supplementation while the animals are back at home after day time grazing. The positive effect of supplementation on milk production has been widely reported (Dhiman *et al*.; 1997; Granzin *et al.;* 1998; Wohlt *et al*., 1998).

Information is scanty on the prevalence of parasites and mastitis in relation with milk yield on small holder dairy cattle under different feeding regime in these districts. Therefore, the objective of the study was to assess the prevalence rates of gastrointestinal parasites, ticks and sub-clinical mastitis as well

as milk yield performance of lactating local cows maintained on a *teff* straw basal diet supplemented with a concentrate mix and Multinutrient block (MNB).

Materials and Methods

Selection of dairy farmers and experimental sites

The study was conducted for six consecutive months in 2011 in a selected PA's of Sululta and Mukaturi Woredas. Site and farmers selection was based on farmers willingness, and own at least two lactating cows that receive intervention diets and the other that will be kept as a control, *teff* straw that would be suffice to feed the animals for over six month, separate housing and feeding structures for indoor feeding, previous experience in dairying and access to marketing. Farmers selected for the study and enumerators were trained on-station before the actual start of the study.

Feeding and animal management

A total of fifteen farmers per each district having, at least, a pair of cows in their early lactation (15±10 days) period were selected. The selected cows were similar for their initial live weight (170±20Kg), range of daily milk production capacity and parity (1to 4). The calves were allowed to suckle their dams for 5-10 minutes depending farmers own practice. Both the treatment and control cow were allowed to graze for 8hrs during the day time. Control cows were managed according to farmers own practice (grazing for 8h and group feeding of small amount of *teff* straw blended with some but occasionally provided with concentrate mix (*atella*, noug cake, pulse huls and oat grain supplements). Those cows receiving intervention diet were supplemented with a *teff* straw basal diet during the night at the rate of 50% of the total dry matter intake (TDMI) assuming daily TDMI of the cow to be 3%. A dairy concentrate mix composed of wheat bran, noug seed cake and common salt was formulated in the ration of 65:34:1 to be offered at the rate of 0.5kg/lt of milk for experimental animals managed under the 2nd set of experiment. For animals under the 1st set of experiment Multi-Nutrient Block was prepared from Molasses, noug seed cake, wheat bran, urea, cement, and salt in the proportion of 37%,15%, 25%, 10%, 10%, and 3%, respectively. The blocks after one week of adaptation were available free of choice during the whole night. Moreover, additional concentrate mix was offered at the rate of 0.3kg/lt of milk production. Watering of animals followed normal practice of the farmers. Individual milk yield, supplemental concentrate and basal feed (*teff* straw) were among data's considered to

be recorded daily. Experimental cows with in each district were randomly arranged in a paired T-test model to receive the under looked dietary treatments.

A. The first set of experiment (Sululta district)
   1. Local farmers practice (control)
   2. Grazing + MNB + Concentrate @ 0.3kg/lt milk production + *teff* straw allowance @ 50% TDMI
B. The second set of Experiment (Mukaturi Woreda)
   1. Local farmers practice (control)
   2. Grazing + Concentrate mix @ 0.5kg/lt of milk production + *teff* straw offered @ 50% TDMI

Data analysis

Milk yield and feed intake (*teff* straw, concentrate and MNB) were subjected to analysis of variance using SAS 2002 and the model for an independent T-test given below was used.

$Yij = \mu + Ti + e_{ij}$, Where Y is the dependant variable, μ = Over all mean, Ti = Treatment effect, e_{ij} = Random error.

Study design for the prevalence

Longitudinal study design was implemented for general clinical, laboratory and observational studies. Accordingly, data were gathered regarding the management, disease control and prevention strategies through questionnaire and data collection formats. Moreover, physical examination of the animals was performed through veterinary clinical examination tools and procedures by veterinarian researchers and field veterinarian and prevalence was determined using descriptive statistics according to SAS (2002) soft ware

Field and laboratory works

Tick collection and identification

The entire body surfaces of the cattle were examined every day and the ticks were collected by hand picking (Urquhart, 1998). Then they were carried in a clean glass test tube plugged with cotton wool and brought to the veterinary parasitology laboratory, Holeta Agricultural Research Center (HARC) for

identification and further studies. Identification of ticks was made according to taxonomic keys of Robinson (1926) and Walker *et al*.; (2003).

Fecal sample collection

Fecal samples for parasitological examination were collected from the rectum of the animal on monthly bases. Each sample was clearly labeled and was packed and dispatched in a cool box to parasitology laboratory of Holeta Agricultural Research Center and the sample were put in the refrigerator (4^0C) until processing. Qualitative and quantitative techniques were employed. Simple test tube floatation and sedimentation technique were used for separating, concentrating and demonstrating eggs, oocysts and larvae in faecal samples while McMaster technique was employed to determine the number of eggs per gram of faeces. The procedures followed for the above three methods and the identification keys used were according to Urquhart, *et al*., (1998).

Milk sampling and california mastitis test

Milk sample from all animals were collected monthly bases. Prior to quarter sampling, the teat ends were cleaned and rubbed with cotton moistened in 70 % alcohol, initial streams of milk were discarded and approximately 5 ml of foremilk collected into 10-ml polythene tubes kept on ice. A portion of each quarter milk sample was inspected for clots, discoloration or wateriness before adding the california mastitis test (CMT) reagent. The CMT reagent (DeLaval, Wroclaw, Poland) method was used alongside the physical examinations and the test was carried out as described by Schalm, (1957). Reactions were graded according to Klastrup, 1975). The procedures and the interpretations were done according to Quinn *et al.;* (1999). Samples with a CMT score of 0 or 1 considered negative, while those with CMT scores above of 1 were considered positive (Miller and Keans, 1967).

Results and discussions

Disease prevalence

The study indicated that there is no significant difference b/n districts ($p>0.05$) in the overall prevalence of gastrointestinal parasites, external parasites (ticks) and sub clinical mastitis which was (63.3%, 60% and 33.3% respectively) for Sululta and (80%, 56.7% and 40% respectively) for Mukaturi district. In this study it has been observed also that the prevalence of these threats among

the treatment and control groups within each district did not shown significant difference (p>0.05) (Table 1) which were (60%, 46.7%, 33.3% for the treatment group) and (66.7%, 73.3%, 33.3% for the control group) at Sululta district and (87.5%, 56.3%, 43.8% for the treatment group) and (71.4%, 57.1%, 35.7% for the control group) at Mukaturi district.

Table 1. Prevalence rate of different gastrointestinal parasites and ticks at Sululta and Mukaturi districts

District	Animal group Total examined	Prevalence of GIT parasites (%)	P-Value	P-value of overall prevalence	Prevalence of Ticks (%)	P-Value	P-value of overall prevalence	Prevalence Subclinical Mastitis (%)	P-value	P-value of overall prevalence
Sululta	Treatment 15	60	0.5		46.7	0.123		33.3	0.65	
	Control 15	66.7		0.126	73.3		0.500	33.3		0.450
Overall prevalence	30	63.3		60				33.3		
Mukaturi	Treatment15	87.5	0.26		56.3	0.62		43.8	0.47	
	Control 15	74.4			57.1			35.7		
Overall prevalence	30	80 (n=24)			56.7(n=17)			40(n=12)		

n= number of positive animals

The main gastrointestinal parasites genus encountered in the study were *Coccidia, Ascaris, Paramphystomum, Fasciola,* and mixed infection by two and more than two of these parasites; which accounted an overall prevalence of (13.3%, 10%, 0%, 26.7% and 3.3% respectively) for Sululta district and (6.7%, 26.7%, 10%, 6.7%, 26.7% and 0% respectively) for Mukaturi district. The result indicated also that the tick genera encountered were *Boophilus, Amblyomma, Rhipicephalus* and mixed infestation by two or more than two of these parasites which accounted an overall prevalence of (33.3%, 23.3%, 30% and 13.3% respectively) for Sululta district and (26.7%, 20%, 53.3% and 100% respectively) for Mukaturi district (Table 2).

Table 2. Prevalence of ticks and gastrointestinal parasites at Sululta and Mukaturi districts

District	Experiment type	Prevalence of tick genera					Prevalence of GIT parasites genera						
		Boophilus	Amblyomma	Rhipicephalus	Mixed infestation	P-value	Coccidia	Paramphystomum	Ascaris	Fasciola	Mix of two parasites	Mix of more than two parasites	P- value
Sululta	Treatment	26.7	20	46.7	6.7	0.229	26.7	6.7	0	6.7	13.3	6.7	0.176
	Control	40	26.7	13.3	20		0	13.3	0	13.3	40	0	
	Overall prevalence	33.3	23.3	30	13.3		13.3	10	0	10	26.7	3.3	
Mukaturi	Treatment	0	18.3	12.5	68.8	0.192	0	31.3	12.5	6.3	31.3	0	0.305
	Control	0	35.7	28.6	35.7		14.3	21.4	7.1	7.1	14.3	0	
	Overall Prevalence	26.7	20	53.3	100		6.7	26.7	10	6.7	26.7	0	

GIT= Gastrointestinal

There was no statistical significant difference ($p>0.05$) in the overall mean EPG of the two districts being (4.27± 3.648) for Sululta district and (4.35± 3.115) for Mukaturi district and it has indicated low infection rate in both cases according to the standards of Jorgen, *et al*.; (1994) (Table 3).

Table 3. Mean Egg per gram of feces (EPG) at Sululta and Mukaturi district

District	Mean EPG	N	Std. Deviation	Std. Error of Mean
Sululta	4.27	30	3.648	.666
Mukaturi	4.43	30	3.115	.569
Total	4.35	60	3.364	.434

EPG= egg per gram of feces

In the study, all respondents didn't have a proper disease prevention and control strategies including health records. From a total of 60 respondents 60 (100%) answered that they do not use disinfectants, routine vaccination, routine deworming, chemoprophylactic drugs and use of acaricides to prevent and control diseases where no significant statistical difference ($P>0.05$) was observed among the two district (Table 4).

Table 4. General observations on prophylactic activities at farms of Sululta and Mukaturi districts

No.	General question to the respondents	Total number of respondents		Proportion of response type by district						P-value
		Sululta	Mukaturi	Sululta			Mukaturi			
				Yes	No	%	Yes	No	%	P>0.05
1	Use of health record	15	15	0	15	100	0	15	100	
2	Use of disinfectants	15	15	0	15	100	0	15	100	
3	Routine vaccination	15	15	0	15	100	0	15	100	
4	Routine deworming	15	15	0	15	100	0	15	100	
5	Use of chemoprophylactic drugs	15	15	0	15	100	0	15	100	
6	Routine use of acaricide	15	15	0	15	100	0	15	100	

In the study all observed farms lack proper hygienic and sanitation conditions based on the check list prepared for the purpose. Fifty three point three percent and 46.7% of the farms at Sululta district had medium and poor hygienic condition respectively while at Mukaturi district it was (46.7% and 53.3% respectively). Statistical significant difference (P=0.033) was observed among the treatment and control group at Sululta district while no statistical significant difference (p=0.225) was found at Mukaturi district (Table 5).

Table 5. General hygiene and sanitation aspects of the farms at Sululta and Mukaturi districts

District	Experiment type	Hygiene and sanitation aspect of the farms			p-Value
		Good (%)	Medium (%)	Poor (%)	
Sululta	Treatment	0	73.3	26.7	0.033
	Control	0	33.3	66.7	
	Overall	0	53.3	46.7	
Mukaturi	Treatment	0	56.3	43.8	0.225
	Control	0	35.7	64.3	
	Overall	0	46.7	53.3	

Daily feed intake and milk yield performance of experimental cows

Result showing the daily feed intake and milk production performance of cows fed the intervention and control diet for the two districts is shown in table 6 below. Supplementation of local lactating indigenous dairy cows with urea-molasses multi-nutrient block leak in the Sululta district improved daily intake

for *teff* straw, dairy concentrate mix and total dry matter by 19.5%, 68% and 43.4% , respectively over the control cows managed according to farmers own practice. Similarly, compared to cows in the control group the mean daily milk was significantly improved by 44% when urea molasses multinutrient block UMMB was additionally supplemented to cows receiving the intervention diet. Moreover, the boost in feed and daily milk yield compared to the control group resulted to a net return per cow per day of 4 ETB (US$ 0.2129). Moreover, in Mukaturi district, supplementation with a dairy concentrate mix without UMMB have been observed to significantly improve daily *teff* straw intake, concentrate mix and total dry matter intake by 30.7%, 94.7% and 48.2%, respectively over the cows receiving the control diet. Daily Milk yield for cows managed under the intervention diet was also increased by 87.5% compared cows in the control group.

The increase in the daily feed intake and milk yield in the district due to intervention diet lead to substantial financial gain (Table 6) over cows managed according to farmers own feeding practice i.e., compared to the control group the net profit obtained per cow/day was 8 ETB (US$ 0.4258).

Table 6. The effect of intervention and control diet on feed intake and milk yield (Kg/cow/d)

Response variable	Sululta district				Mukaturi District			
	Intervention diet	Farmers diet	Mean ±SEM	%CV	Intervention diet	Farmers diet	Mean ±SEM	%CV
Teff straw intake	3.06[a]	2.56[b]	2.81±0.61	23.92	3.49[a]	2.67[b]	3.08±0.44	17.97
Concentrate intake	1.27[a]	0.756[b]	1.01±0.35	29.58	1.85[a]	0.95[b]	1.4±0.28	33.47
MNB intake	0.431	NA	NA	41.01	NA	NA	NA	NA
TDM intake	4.76[a]	3.32[b]	4.04±0.65	22.56	5.32[a]	3.59[b]	4.45±0.55	16.14
Milk yield	3.73[a]	2.59[b]	3.16±0.48	28. 6	3.9[a]	2.08[b]	2.99±0.34	23.41
Gross return/ Cow/d	33.01	23.57			29.55	16.31		
Net return/ cow/d	19.42	14.86			13.99	5.66		
Net return over control/ cow/d	4.56				8.33			

a,b= letters with different superscripts in same row are significantly different at P=0.05; SEM; Standard Error of the mean;Treatment 1=Intervention diet; Treatment 2=Control (farmers diet); MNB=Multi-nutrient block leak; TDM=Total Drymatter; NA=Not applicable; 1ETB = 0.0532$

Moreover, when comparative advantages between the two types of intervention diet were assessed slight betterments of concentrate supplementation in a straw based basal diet was observed assuming, in fact, pasture condition and intake from the grazing pasture is constant over the two locations. It can be computed from Table 1 above that cows that have been supplemented with a dairy concentrate mix alone in the Mukaturi district consumed daily an extra 0.43kg *teff* straw and 0.56kg total dry matter over and above than cows supplemented with UMMB + dairy concentrate in the Sululta district. Milk production followed same trend as for the feed in that cows receiving the intervention diet in the Mukaturi produced an extra daily milk yield of 0.18kg over cows in the Sululta district. The limited effect of the supplementation compared to lactating crossbred cows in the districts (avg. 8-10 lt/day) may be due in part to local cows partitioning less of their energy for milk production. The fact that supplemented cows receiving the intervention diet produced significantly ($P<0.05$) more milk than cows in the control group suggests the need for improved feeding of local lactating cows in the area during the dry months. In this experiment, local cows supplemented with 1.3 kg/day and 1.9 kg/day of a concentrate in Sululta and Mukaturi districts could generate about ETB 3495.6 and 2518.2 (US$ 186.03 and US$ 134. 02) net profit per cow, from milk every year respectively, if a 180-day milking period is assumed. The effect of dairying on the local economy could, therefore, be enormous if all cows in the districts were properly fed and milked. A greater part of the potential revenue from milk is lost to the economy because many local farmers are not interested in milk production for their main interest is to obtain replacement stocks for traction purposes. In an experiment carried out to assess the economics of dry season feed supplementation in an emerging peri-urban dairy production system in the Kumasi district of Ghana same finding that support the result from the current trial was reported. According to this report by Karikari *et al*.; (2008) local Sanga breed produced 53% more milk and 16.6% more milk revenue than the control cows clearly implying the potential of indigenous lactating dairy breeds to respond to better feeding managements.

The prevalence rates for gastrointestinal parasites, ticks and subclinical mastitis seem to be high and may indicate the strong relation sheep between the hosts, the environment and the agents. In our study the information gathered regarding the different disease prevention and control options as well as the management system, hygiene and sanitation aspects might have been possible favorable conditions (Tables 4 and 5). Both the control and treatment group animals in each district graze in communal grazing land and they had

the same watering points. The treatment and control group animals in each farm at each districts share the same housing, hygiene and sanitation conditions and all farms at each district do not have proper disease prevention and control strategies. Bliss, *et al.*; (1982) indicated that, changes in weather, nutrition, management, immune status of the animals and the amount of exposure each animal has within parasite contaminated area affects the type of parasites present. This contamination will determine the numbers and type of parasite present and the numbers of parasites that are picked up by animals and develop within such animal. Each type or species of parasite is different in terms of where it lives within the animal and how it survives during the part of its life cycle that is spent outside the animals. In this study, the overall GIT parasites prevalence rate (63.3%) (n=19) encountered at Sululta district is similar with that of indicated by Joost, *et al.*; (2000) who in their study conducted on adult dairy cattle, have encountered a prevalence rate of 64%; Nevertheless, the treatment (60%) (n=9) and control (66.7%) (n=10) groups in the same district showed less and greater rates respectively as compared with the same authors result. No statistical significant difference ($p>0.05$) was observed among the districts and the treatment and control groups within the district. This might be explained by the similarity of the agro ecology and the health and management practices existing in both districts. In the study the main gastrointestinal parasites genera encountered were C*occidia, Paramphystomum, Asacaris* and *Fasciola* and the mean EPG value which was (4.27 ± 3.648) for Sululta and (4.35 ± 3.115) for Mukaturi indicated low degree of infection according to Jorgen, *et al.;* (1994) and no statistical significant difference ($p>0.05$) was observed among the two districts.

The overall prevalence rate (60%) (n=18) of ticks encountered at Sululta district and the prevalence rate (46.7%) (n=7) and (73.3%) (n=11) encountered in the treatment and control group respectively were higher than that of the finding of Abdul Manan *et al.*; (2007) who in their study found 20.4% of prevalence of ticks on cattle. This study revealed also *Boophilus, Amblyomma* and *Rhipicephalus* were the main prevalent tick genus encountered in both districts. In study conducted by Abdul Manan *et al.*; (2007) the most commonly prevalent ticks encountered were those belonging to genus *Boophilus* followed by *Hyalomma*, *Rhipicephalus* and *Amblyomma* which is similar with our result on both control and treatment groups of the two districts. Our result also coincides with Sileshi Mekonnen, *et al.*; (2001) who indicated that different species of ticks belonging to the genus *Amblyomma, Boophilus Haemaphysalis, Hyalomma* are present in the administrative zones of central Ethiopia.

In our study the overall prevalence rate of subclinical mastitis (33.3%) (n=10) encountered at Sululta district and the prevalence rate (33.3) (n=5) and (33.3) (n=5) for the treatment and control group respectively and the overall prevalence of subclinical mastitis (40%) (n=12) encountered at Mukaturi district and the prevalence rate (43.8) (n=7) and (35.7) (n=5) for the treatment and control groups respectively were similar with that of Hafiz *et al*.; (2005) who obtained prevalence of sub clinical mastitis 33.33% , 56%, 46.67% and 40% in different studied districts.. The positive effect of supplementation on milk production has also been widely reported (Little *et al*., 1994; Dhiman *et al*., 1997; Granzin *et al.;* 1998; Wohlt *et al.;* 1998). It is concluded that with proper feeding of indigenous lactating cows, smallholder dairying could be a significant component of the agricultural economy of both districts located in the central highlands of Ethiopia.

Conclusions and Recommendation

The prevalence of gastrointestinal parasites, ticks and mastitis in the treatment and control groups at both districts did not shown significant difference. Limitations on disease control and prevention approaches were observed in all farms of both districts. Both types of intervention feeding packages resulted to a considerable biological and economic advantages over farmers own feeding practice. Moreover, combined analysis for the two intervention diets indicated slight betterment of concentrate supplementation in a straw based basal diet assuming pasture condition and intake from the grazing pasture is constant over the two locations. Proper management, disease control and prevention approaches should be extended through health extension system and veterinary service delivery bodies at each district. To introduce the interventions in a sustainable way, it will be necessary to improve farmer training, access to information and strengthen linkages with stakeholders.

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