Ethiop. J. Agric. Sci. 28(2) 53-63 (2018)

Effect of Cattle Breed on Milk Composition in the same Management Conditions

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አህፅሮት

ይህ ጥናት ትኩረት ያደረገው በተመሳሳይ አያያዝ ሁኔታ ውስጥ የወተት ከብቶች ዝርያ በወተት ምርት ውህደት ወይም ንጥረ ነገር ላይ የሚያስከትለውን ውጤት ለማየት ነው:: ለዚህ ጥናት 32 የተለያዩ ዝርያ ያላቸው የወተት ከብቶች ሲሆኑ እነሱም ሆልስቲን ፍርዥያን፣ ጀርሲ፣ የኢትዮጵያን ኦጋዴን እና የሆሮ የድብልቅ ዝርያዎች ከእያንዳንዳቸው 8 ከብቶች በመጀመሪያ የእልበት እና በተመሳሳይ የውልጃ ደረጃ ያሉ ሆን ተብሎ ከተመረጡ በኋላ ለ60 ተከታታይ ቀናት የክትትል ስራ ተደርጓል:: በዚህ ጥናት ውስጥ ከእያንዳንዱ ከተመረጡ ከብቶች 100 ሚሊ የወተት ናሙና ለ3 ጊዜ በ 20 ቀን ልዩነት ተወስዶ በቤተሙከራ ውስጥ የወተቱን ቅባትነት፣ ገንቢ ንጥረ ነገር፣ ማዕድን፣ የውሃ መጠን፣ ቅባት የሌለው ንጥረ ነገር፣ አጠቃላይ ደረቅ ንጥረ ነገር፣ የስኳር እና የወተት ዩሪያ ናይትሮጂን ይዘት በጥልቀት ተመርምሯል:: የእነዚህ ከብቶች ዝርያ የወተት ንጥረ ነገር ከዚህ በፊት ሌሎች ተመራማሪዎች ሰርተው ባስቀመጡት እርከን መጠን ውስጥ መሆኑን ለማረጋገጥ ተችሏል:: በአጠቃላይ የዚህ ጥናት ግኝት ውጤት የሆልስቲን ፍሪዥያን ከብቶች 50 ፐርሰንት የደም እርከን ከ25 ሆሮና ከ25 ጀርሲ ጋር ተዳቅሎ ከኢትዮጵያው ኦጋዴን 50 ፐርሰንት ጀርሲና ሆሮ ሲዳቀል ውጤቱ ተመጣጣኝ ነው:: ስለዚህ የኢትዮጵያ ዝርያ ያላቸው ከብቶች ከውጭ ዝርያ ካላቸው ከብቶች ጋር በተለያየ የደም እርከን ሲዳቀሉ የውጭ ከብቶች የወተት ስኳር እና ቅባት የሌለው ንጥረ ነገር በስተቀር ሌሎች የወተት ንጥር ነገሮች መጠናቸው ጨምሯል:: በመጨረሻ ይህ ጥናት ኦጋዴን እና ሆሮ ዝርያ ያላቸው የኢትዮጵያ ከብቶችን ብቻ ላይ የተደረገ በመሆኑ ወደፊት ሌሎች የተዳቀሉ አገር በቀል የኢትዮጵያ ዝርያ ያላቸው ከብቶች ላይ ሰፋ ያለ ጥናት እንዲደረግ እጠቁማለሁ::

Abstract

This study evaluated the effect of bovine breed on milk composition under the same environmental conditions. Thirty two dairy cattle breeds of Holstein Friesian, Ethiopian Ogaden cattle, Jersey x Horro crosses, and Holstein Friesian x Jersey x Horro crosses were used in the study. Eight cows in early lactation stage and with the same parity were purposively selected from each breed and monitored for 60 days. Animals were maintained under intensive systems and all consumed on the same diet. 100ml milk samples collected three times every twenty days from each milking cows and separate analysis were done for each breed in duplicate using a MilkoScan™ FTl to determine fat, protein, ash, water, SNF), TS, lactose, and MUN. The major content of milk for breed in this study is within the range for the milk composition standard requirement for bovine. The breed had a significant effect on water ($p \leq 0.0001$), Protein ($p \leq 0.05$), TS ($p \leq 0.05$), fat ($p \leq 0.05$), MUN ($p \leq 0.001$) and ash ($p \leq 0.0001$) content of milk. The study finding revealed that the milk content of Holstein Frisian at 50 percent blood level cross with 25 percent Horro and 25 percent Jersey cattle was comparable to the milk content of Ethiopian indigenous pure Ogaden cattle and Jersey and Horro crosses at 50 percent blood levels. This study suggesting that crossbreeding schemes of indigenous Horro cattle breeds with Holstein and Jersey cows at different blood level had a significant effect on milk content of bovine except lactose, FFA and SNF. Further studies are needed to better understand of genetic aspects of other cross breed Ethiopian indigenous cattle on milk composition.

Introduction

Milk from different cattle breeds holds distinct composition profiles because of genetic background (Poulsen *et al.,* 2012). The chemical composition of bovine milk and the protein to fat ratio are constantly being modified in order to meet consumer preferences (Boichard *et al.,* 2012). The optimal protein to fat ratio in cow's milk should be 1:1. Such a value could be achieved by decreasing the fat content or increasing protein content, which is not an easy task since milk fat and protein concentrations are determined by genetic factors and environmental conditions as well as cow's age and lactation stage (Litwińczuk *et al.,* 2000). One of the primary goals of the dairy industry has always been to improve the technological properties of milk, including its chemical composition (Boichard *et al.,* 2012). The quality of milk intended for consumption and processing varies subject to cattle breed (Barłowska *et al.,* 2009). Increased milk production is one of the main dairy breeding goals worldwide dominating selections the last decades (Meredith *et al.,* 2012). However, new breeding goals have recently been identified, especially on milk composition, following the demands of a healthier human diet (Boichard *et al.,* 2012).

The chemical composition of milk can be influenced by several factors such as animal species and genetics, environmental conditions, lactation stage, and animal nutritional status (Kalac and Samkova, 2010). Generally milk is composed of 87.7 % water, 3.3% protein, 3.4% fats, 4.9% lactose and 0.7% mineral (Haug *et al.,* 2007; Poulsen *et al.,* 2012). Fat, protein and casein content are important traits for the milk and cheese industry while the fraction of milk used for cheese making is growing worldwide (International Dairy Federation, 2012). For example, increased casein content is favorable for cheese production (Wedholm *et al.,* 2006), a low beta-lactoglobulin concentration reduces the fouling rate of heating equipment (Elofsson *et al.,* 1996) and increased proportions of long chain fatty acids improve the spread-ability of butter. The main driving forces for manipulating the milk composition in dairy cows are aimed at improving the manufacturing and processing of milk and dairy products, changing the nutritional value of milk to conform to the dietary guidelines, and using milk as a delivery nutraceuticals with known benefits to human health (Haug *et al.,* 2007). Modifying composition might be possible through selective breeding (Bovenhuis *et al.,* 2013).

Exotic breeds mainly Holstein Friesian and Jersey are imported to Ethiopia and crossed with the indigenous cattle breeds to improving the yields of milk volume (Tegegne *et al.,* 2010) and bring the highest economic returns under poor feeding conditions (Tadesse and Dessie, 2003). Crossbreds have increased lactation lengths, shorter calving intervals and calve at a younger age than the indigenous stock (Galukande, 2010). This has encouraged farmers to use crossbreeding systems to increase farm profit only through focusing on the yields of milk volume (Lopez-Villalobos, 1998). Although, several authors have reported the increased milk yields of crossbred indigenous cattle in Ethiopia, yet, there is complaining on the milk composition characteristics of cows crossed with exotic breeds and this discourage farmers who want to increase farm profit through focusing on the milk quality. Moreover, the milk-pricing system has shifted from ordinary quantity to its composition, affecting the farm income directly (Krovvidi Sudhakar *et al.,* 2013). Many consumers have complaints regarding quality of milk and addressing this issue needs research. Development of breeding programs for changing the composition of milk requires knowledge of the relative influence of genetic and environmental factors affecting milk constituents (Lindmark-Mansson *et al.,* 2000). Augmenting lactation milk yield has been emphasized for increasing the productivity of dairy animals; however, milk constituents such as fat, protein, SNF, lactose, and lactose percentages have so far received little attention in Ethiopia. The detailed information about the milk composition is generally not included in breeding goals for dairy cattle production in Ethiopia and the evidence for a cross breed effect on milk composition traits is currently scanty. It might be of interest to select for breeds that produce milk with a specific composition, which will add value for the dairy farmers and industry. Therefore, the objective of this study was to determine the effect of bovine breed on milk composition under the same environmental conditions.

Material and Methods

Description of the study area

The study was conducted in Eastern Ethiopia at Haramaya university dairy farm which is located 5 km from Haramaya town, about 527km east of Addis Ababa, 17 kilometers from the city of Harar and 40 kilometers from the Dire Dawa city. The elevation of the area is about 2000m above sea level and geographically it located 041°59′58′′ latitude and 09°24′10′′longitudes. The district receives an average annual rainfall approximately 900mm. There two ecological zones in the district of which 66.5% are midland and 33.5% is lowland. The district has about 63,723 cattle, 13,612 sheep, 20,350 goats, 15,975 donkeys, 530 camels, and 42,035 chickens.

Sampling method

The study was conducted on thirty two dairy cattle breeds such as Holstein Friesian (pure), Ogaden (pure indigenous Ethiopian Cattle); 50% Jersey and 50% Horro crosses, and 50% Holstein Friesian, 25% Jersey and 25% Horro crosses, which were reared at the Haramaya University dairy farm under the same environmental conditions. Eight cows in early lactation stage and with same parity were purposively selected from each breed and monitored for 60 days.

Herd management

Animals were maintained under intensive systems and all cows consumed on the same diet. The feeds used were basically mixed on the farm using a mixer (Table 1) with no supplementary limestone and Premix. Animals were individually stall-fed on the same mixed concentrates three times every eight hours interval. Following concentrate fed, immediately corn silage individually fed in cubicles starting at 8:00am, but they fed hay in groups in the afternoon starting at 1:00pm as *ad libitum*. Mineral lick was also supplemented as *ad libitum*. Tap water was available as *ad libitum*. Animals milked twice a day by milking machine at 12 hours interval moving 35m away from their stall barn.

Table 1. The proportion of ingredients (%) used in formulating the experimental rations during the monitoring periods and its nutrition value

Ingredient	Percentage	Kg/ton	Average Nutritional Value (%)						
			DM	CP	NDF	ADF	ADL	EE	Ash
Ground corn	56.1	561	89	7.1	27.9	3.9	0.6	5.3	2.3
Wheat bran	20.6	206	93.1	15.3	43.1	9.5	4.2	4.8	3.9
Soybean meal	5.2	52	93.2	38.5	-	-	-	8.9	8.0
Peanut meal	14.9	149	94.7	37.3	34.7	13.8	6.3	9.6	6.2
Hay	-	-	91.2	8.4	79.7	52.1	8.8	3.9	12.1
Corn silage	-	-	90.4	7.3	73.1	42.7	4.1	2.8	8.5
Salt	0.7	7	-	-	-	-	-	-	-

DM = Dry Matter; CP = Crude Protein; EE = Ether Extract; NDF = Neutral Detergent Fiber; ADF=Acid Detergent Fiber; ADL= Acid Detergent Lignin,-=Not evaluated

Sample collection and analysis

100 ml milk samples collected three times every twenty days from each milking cows and pooled separately for each breed. A separate analysis were done for morning and afternoon samples in duplicate using a MilkoScan™ FTI (FOSS, Hillerød, Denmark) in Haramaya University Dairy Technology laboratory to determine fat, protein, ash, water, solid not-fat (SNF), total solids (TS), lactose, density and milk urea nitrogen (MUN). Beakers and borosilicate glass washed by tap water then 80 ml of milk sample filled to a beaker in a duplicate and attached to the milkoscan. Clearing agents (25 gram powder detergents dissolved in 0.5 liter of deionized water) used to rinse the milko scan probe which suck milk in between analyses.

Statistical analysis

One-way analysis of Variance (ANOVA) was carried out using the PROC General linear model (GLM) procedure in Statistical Analysis System (SAS) version 9.1 to determine the significant ($P<0.05$) effect of treatment. Least square means of significantly ($P<0.05$) different treatments were compared using Duncan's multiple range test.

Results and Discussion

All the differences for milk composition traits among the breeds were statistically not significant (P>0.05). However, the test day yields of fat, protein, TS, casein and MUN differed significantly (P<0.05) among the breeds (Table 2).

Table 2: Effect of breeds on daily milk composition (mean + SE)

Variable	Treatment				P-value	SL
	HF	JR50*HO50	HF50*JR25*HR25	Ogaden		
Water	87.84±0.63[a]	86.76±0.23[b]	86.32±0.10[c]	85.97±0.98[d]	<0.0001	***
Fat	3.7±0.03[b]	3.98±0.40[ab]	4.70±0.08[a]	4.69±0.01[a]	0.0489	*
Protein	3.14±0.06[b]	3.8±0.18[a]	3.54±0.09[ab]	3.9±0.14[a]	0.0415	*
SNF	8.48±0.10	9.29±0.23	8.98±0.09	9.28±0.50	0.2797	NS
TS	12.16±0.14[b]	13.24±0.23[a]	13.68±0.02[a]	14.03±0.39[a]	0.0184	*
Lactose	4.64±0.04	4.67±0.023	4.71±0.04	4.57±0.19	0.7645	NS
Casein	2.34±0.04[b]	2.74±0.10[a]	2.55±0.01[ab]	2.8±0.11[a]	0.0371	*
FFA	0.46±0.01	0.34±0.11	0.49±0.07	0.40±0.14	0.7264	NS
MUN mg/dl	22.65±0.70[b]	23.78±0.39[b]	24.25±1.31[b]	47.66±2.69[a]	0.0009	**
Ash	0.70±0.13[d]	0.82±0.54[a]	0.73±0.31[c]	0.81±0.69[a]	<0.0001	***

HF -Holstein Frisian, JR50-Jerry 50%,Ho50-Horro 50%, HF50- Holstein Frisian 50%, JR25-Jerrsey-25%,HR25-Horro 25%. SL-Significance levels

Milk Fat (MF)

The fat content of milk for breed in this study (Table 2) is within the range for the milk composition standard requirement for cows of 3.5 - 5.0% (Anantakrishnan *et al.,* 1993). Fat content on the daily basis of milk was significantly higher in cattle synthetic breeds (composite from 50% HF*25%Jersey*25% Horro) and lowest in Holstein Frisian breed at P<0.05 (Table 2). This finding is similar to earlier study reported by Belewu (2006) on variation in fat content among cow breeds. The fat content in this finding for all the study breed ranges from 3.7-4.7% ,which is higher than the result reported by Myburgh *et al.* (2012) that was 2.6, 4.18, 2.01, 3.79, 3.76 and 3.63 for Boran, Nguni, Tuli, Afrikane, Bonsmara, Drakensberger, respectively. Many scholars reported extensively varied milk fat among the breeds (Adesina, 2012; Myburgh *et al.,* 2012). Whereas, studies conducted in six breed groups, milk revealed non-significant differences in its fat (Talukder *et al.,* 2013). Herrinton (2000) described that the percentage of fat (3.65-3.90%) in milk shows more variation than a percentage of the other major constituents. Farrington and Woll (2010) stated that the cow's milk generally contains between 3 and 6 percent fat. Nevens (2010) found that the fat percentage of five dairy breeds (Ayrshire, Brown Swiss, Guersey, Holstein and Jersey) were ranged from 3.41% to 5.06%. Banerjee (2009) described that the fat percent of Indian dairy cattle ranged from 3.5 to 5.5%. The standard adopted by US government for fat in milk is 3.25 percent. The variation in the fat content may be attributed to different genetics and physiological status of the cow breeds (Frank, 1988). According to Belewu, (2006), variations in fat content between breeds of cow is an inherited character which implies that breeds with higher fat content produce less milk quantity than those with low fat content. According to Barłowska *et al.* (2006), the average fat content of cow's milk oscillates around 3.7%, but it may vary widely (2.8% – 8.1%) depending on cattle breed, nutritional regime and lactation stage. The lower fat composition for Holstein Frisian in this finding is not unlikely, which is within the range of 3.2 to 3.8% reported by Shahrooz Bassiri1 *et al.* (2012) for the same breed. This study result proved a breed effect on fat composition of milk similar to numerous author study reports (Barłowska *et al.*, 2009). This study finding indicated that the fat content of milk from 50 percent blood level of Holstein Frisian crossed with 25 percent Jersey and 25 percent Horro cattle was comparable to fat content of Ethiopian indigenous pure Ogaden cattle and Jersey and Horro crosses at 50 percent blood levels.

Milk Protein (MP)

The test daily milk protein and casein components of each of the breed groups are shown in Table 2. The significant differences for protein among the breed is contradicted to Adesina (2012) who reported no significant differences in the values recorded for the protein compositions at $P<0.05$ in the cow milk of the three breeds of White Fulani, Red Bororo and Muturu. Besides, Myburgh *et al.* (2012) analyzed milk from African cattle breeds such as Boran, Nguni, Tuli, Afrikaner, Bonsmara, Drakensberger and reported non-significant difference among the breeds in protein content ($P>0.05$).This variation in the protein content may be attributed to different genetics and physiological status of the cow. However, in line to the current finding several authors were reported a significant effect of breed on milk protein composition (Back and Lopez-Villalobos, 2007). Increased protein and casein content is favorable for cheese production (Wedholm *et al.,* 2006).Therefore, this study result found higher milk protein content in milk of Ogaden breed and these would contribute to Ogaden milk generating higher cheese yields than other breeds. The study finding also revealed that the protein content of milk from 50 percent blood level of Holstein Frisian crossed with 50 percent Horro cattle is comparable to the protein content of Ethiopian indigenous pure Ogaden cattle. This confirmed crossing Holstein Frisian with Ethiopian indigenous cattle improved milk protein trait of Holstein Frisian for which the consumers and cheese producers complaining the breed.

Solid Not Fat (SNF)

The non-significant difference for SNF among the study breed is in agreement with what has been reported in earlier studies (Krovvidi Sudhakar *et al.,* 2013). A study conducted on six breed groups revealed similar effect on solid not fat (Talukder *et al.,* 2013). The contrary results reported in Jersey crossbreds compared to the Friesian crossbred (Kalac and Samkova, 2010). The study conducted in six breed groups reported by Talukder *et al.* (2013) for solid not fat (9.02 - 9.40%) was higher than the result of the present finding (8.47-9.29%). SNF for Holstein Frisian was lower than the recommended value of 8.5 - 9.5% (Anantakrishnan *et al.,* 1993) which might be due to lower protein content than other study breeds (Table 2). However, this study finding indicated crossing Holstein Frisian and Jersey breeds with Ethiopian indigenous cattle is not significantly improved SNF content.

Total Solid (TS)

The significant differences for TS among the study breed is in contradict to Talukder *et al.* (2013) who found significant differences among six breed groups and reported 13.01 - 13.81% for TS. In this study TS content for Holstein Frisian (12.16%) do not meet the milk composition standard requirement for cows of 12.8 - 14.5% (Anantakrishnan *et al.,* 1993). Nevens (2010) described higher TS percentage (12.27 to 14.54%) for Ayrshire, Brown Swiss, Guersey, Holstein and Jersey. The Indian dairy cattle, milk TS percent ranged from 12.20 to 15.0% as described by Banerjee (2009). According to this study finding, the TS content of milk from 50 percent blood level of Holstein Frisian crossed with 50 percent Horro cattle was comparable in fat content of Ethiopian indigenous pure Ogaden cattle.

Milk Lactose (ML)

The study revealed non-significant difference of breed on milk lactose content ($P>0.05$) which is corresponding to Adesina (2012) who found similar results among three cattle breeds such as White Fulani, Red Bororo and Muturu. In contradict, Myburgh *et al.* (2012) analyzed milk from African cattle breeds such as Boran, Nguni, Tuli, Afrikaner, Bonsmara, Drakensberger and reported significant differences among the breeds in lactose ($P<0.001$) content. The lactose content in this finding for all the study breed rangse from 4.57-4.71%, which result is lower than reported by Myburgh *et al.* (2012) that was 5.16, 6.59, 6.74, 5.64, 5.47 and 5.43 for Boran, Nguni, Tuli, Afrikane, Bonsmara, Drakensberger, respectively. Holstein cows normally have 4.8% lactose (Shahrooz Bassiri1 *et al.,* 2012). Beata Kuczyńska *et al.* (2012) reported higher (4.9 %) lactose for Montbeliarde and 4.8 % for Polish Holstein-Friesian. However, this study revealed that cross breeding program at different blood level had no significant effect on the lactose content of bovine milk.

Water

The breed influences water composition (Table 2). The mean 85.97-87.84% water content observed in the milk of the present study met the milk composition standard requirement for cows (84 to 88%) (Anantakrishnan *et al.,* 1993). Herrinton (2000) described that the percentage of water content of milk ranged from 87.20 to 87.90%. Farrington and Woll (2010) stated that the water content of normal American cow's milk ranged from 82 to 90%, although, Nevens (2010) found that the water percentage of five dairy breeds (Ayrshire, Brown Swiss, Guersey, Holstein, and Jersey) ranged from 85.37 to 87.73%. The difference in water composition in this study is contradicted to Talukder *et al. (*2013) who reported non-significant difference in water content between six breed groups. This study revealed lower water content for Ogaden cattle, which imply the better nutritive composition of milk than other breed in the study. This study finding revealed that the water content for Holstein Frisian breed reduced by crossing with indigenous cattle breeds.

Mineral

This observation is revealed the high significant difference in milk ash among the study breeds (Table 2) which is in disagreement with Adesina (2012) who found non-significant difference in the ash composition of the milk among White Fulani, Red Bororo and Muturu cattle breeds. However, similar to this study, many scholars confirmed the effect of breed on milk ash content (Mariani *et al.,* 2002; Summer *et al.,* 2004). Mariani *et al.,* (2002) reported that milk mineral content varies among breeds, for instance, the mineral content of Holstein-Friesian cow milk was lower than mineral contents of milk from Brown Swiss, Reggiana and Modenese breeds. The differences in terms of milk mineral composition between Holstein-Friesian and Brown Swiss were confirmed by Summer *et al.* (2004). However, from this result, the milk samples of the four breeds are varying in mineral composition, which may be attributed to different genetics, and physiological status of the cow since the environment is controlled. Wiesław *et al.,* (2014) reported lower (0.59, 0.52, and 0.54) ash content for HF, Jersey and HF-Jersey crosses, respectively. This study favors Ogaden breed and crosses of Jersey in mineral composition.

Free fatty acids

The means of free fatty acid composition as affected by different breeds of dairy cows is presented in Table 2. The morning FFA content of milk was significant ($P < 0.01$). FFA in this study was lower than the usual FFA content in milk which is between 0.5 and 1.2 mmol/100 g (Deeth, 2006). Deeth (2006) reported the highest values (0.97-0.98 mmol/100 g) and the lowest (0.71- 0.72 mmol/100 g) with an average of 0.82 mmol/100 g for raw cow milk in the Czech Republic. Free fatty acids have strong sensory properties and are important compounds in the flavour and aroma of many dairy products, especially cheese and fermented dairy products (Collins *et al.,* 2003). An increased FFA causes deterioration of technological milk properties (Vyletělová *et al.,* 2000a, b), but mainly deterioration of milk sensory properties, taste and odour. The consequence is a slightly bitter smack that can impair the dairy product quality. The elevated levels of FFA are also develops a rancid flavour due to the liberation of short chain free fatty acids (SCFA), especially butyric acid, and generally becomes unacceptable (Deeth 2006). The increased FFA content also reduces or even inhibits the milk fermentation progress in soured product production (Peterková, 2002). Free fatty acids also contribute to texture and functionality, as they affect surface tension and foaming capacity of milk (Kamath *et al.,* 2008).

The monitoring of FFA levels in milk production is important from a health and safety point of view, as bad hygiene practices can lead to the growth of psychotropic bacteria, which in turn increases lipolysis (Antonelli *et al.,* 2002). FFA particularly, butyric acid and conjugated linoleic acid, have also been shown to have beneficial health and nutritional effects, such as anticarcinogenic properties (Parodi, 1999), and can act as bioactive compounds in vivo (Parodi, 1999; Nielsen *et al.,* 2015). There is also some evidence to suggest that they may help to reduce body fat (Wahle *et al.,* 2004). The FFA content of dairy products is an important indicator of lipolysis in ripened and fermented products and is a useful marker when establishing and defining process conditions (David and Kieran, 2015). The FFA content increase implies negative impacts of lipolysis type or defective fat globule generation, usually for the reason of dairy cow metabolic problems. However, this study result confirmed as a cross breed program not improved milk FFA trait.

Milk Urea Nitrogen (MUN)

Statistically highly significant differences ($P \leq 0.001$) were shown in the morning, afternoon, and daily MUN composition in relation to the breed (Table 2). This is corresponding to Myburgh *et al.* (2012) who analyzed milk from African cattle breeds such as Boran, Nguni, Tuli, Afrikaner, Bonsmara and Drakensberger and reported highly significant difference among the breeds in MUN content ($P<0.001$). The MUN concentrations investigated for the study breeds are very high compared with those data obtained from dairy herds in USA which are about 12 to 14 mg/dl (Jonker *et al.* 2002), in Sweden about 11 to 15 mg/dl (Carlsson and Pehrson, 1994) and in Korean dairy cows are 16.68 ± 5.87 mg/dl (Yoon *et al.,* 2004). MUN averaged 19.09, 21.03, 19.81, and 20.95 mg/dl for Holstein-Friesian, Brown Swiss, Simmental, and Alpine Grey, respectively (Gottardo *et al.,* 2017) which was significant among study breeds and lower than current finding. Excessive protein intake is a common nutritional factor for elevated MUN (Jonker *et al.,* 1998). The results of MUN measurement can be a valuable indicator of nutritional status and health of a cow (Rajala-Schultz, 2001). MUN can also be used as a useful monitor of protein efficiency in dairy cows to help optimize dietary protein utilization efficiency (Schepers and Meijer, 1998). Nutritional studies in Canada (Eicher *et al.,* 1999), the U.S. (Wattiaux and Karg, 2004), Germany (Richardt *et al.,* 2002), Scandinavia (Nousiainen *et al.,* 2004), and other parts of the world have shown that milk urea nitrogen (MUN) reflects the efficiency of utilization of dietary protein. If dietary intake is low in energy or high in protein to energy ratio, rumen bacteria will have reduced efficiency in utilizing free ammonia to synthesize protein, which can result in increased blood urea nitrogen (BUN) or MUN (Rajala-Schultz and Saville, 2003). Similarly, cows under negative energy balance tend to have a slightly higher urea concentration in milk, which could be associated with the increase of body protein mobilization (Schepers and Meijer, 1998). Although all breeds in the study fed on the same diet, this finding suggests the breeds in the study are fed diets either high in protein or insufficient in energy. As there is no evidence of differences in efficiency of utilization of metabolizable protein for maintenance or milk (protein) production (NRC, 2001), true genetic differences are not likely to contribute to the large differences observed here among breeds. Yet, genetic differences should not be completely disregarded as MUN heritabilities greater than 0.4 have been reported in Holstein Frisian (Wood *et al.* 2003). The highest test-day MUN was recorded for Ogaden breeds (Table 2). Therefore, the breed has a significant impact on MUN and this will improved by cross-bred programs.

Acknowledgments

The author was highly acknowledged Haramaya University and EIAR for covering all costs to undertake this piece of work. The author is also very thankful to Haramaya University dairy farm and Animal Nutrition and Dairy technology Laboratory staffs for the support and cooperation in providing dairy farm facilities and undertaking laboratory analysis.

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