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Original Article

Feed Intake, Milk Yield and Milk Composition of Fogera Cows Supplemented with Different Feeds

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ABSTRACT

An experiment was conducted at Andassa Livestock Research Center in Amhara National Regional State (ANRS), Ethiopia, to evaluate the effect of different feed supplements on feed intake, milk yield and milk composition of Fogera cows. Twenty second parity Fogera cows with similar stage of lactation, mean initial body weight of 258 kg and an average initial milk yield of 0.86 kg cow^{-1} day^{-1} were selected from the herd of the research center. The experiment had four treatments with five replications each using a randomized complete block design to which initial body weight was used for blocking. The treatments were; 1. Animals fed on only hay harvested from natural pasture (Control), 2. Hay plus grass pea bran; 3. Hay plus wheat bran and 4. Hay plus commercial concentrate mix (maize grain + Noug seed cake + wheat bran + fish meal + salt). There were significant ($P<0.01$) differences in total dry matter, crude protein, neutral detergent fiber, acid detergent fiber and ash intakes among treatment groups. The overall milk yield (kg/cow/day) was 1.44; while fat, protein, total solid, solid-not-fat, and Ash composition of milk (%) were, 5.01, 3.07, 14.23, 9.22, 0.70, respectively. Milk yield was significantly different ($P<0.01$) between treatment groups. Except ash content all the milk compositions analysed were significantly different ($P<0.01$) among treatment groups. Supplementation of Fogera cows maintained on natural grass pasture with different feeds has an effect on feed intake, milk yield and milk composition.

KEY WORDS: Grass Pea Bran, Nutrient Intake, Total Solid Content

INTRODUCTION

Feed in terms of both availability and nutritional value is the most important constraint affecting the production and productivity of livestock in Ethiopia (Azage and Alemu, 1998). The availability of common feed sources is seasonal and what is available is mostly of poor quality to support livestock to produce to their biological potential.

Fogera cattle are among the indigenous cattle breeds of Ethiopia which are found in Amhara National Regional State. The breed is well adapted to the marsh areas of the region and it is believed to be triple use: as a source of draught power, meat and milk (Addisu *et al.*, 2010). The production and productivity of the breed has been severely declining due to production constraints such as lack of production inputs and lack of information on dairy and beef production. Fogera cows provide on average 2 liter of milk per cow per day at Andassa Livestock Research Center under extensive management system. The milk yield and milk composition performance of the breed under intensive management system is not yet evaluated. The most important supplements for intensive cattle production in areas where Fogera cattle are dominant are grass pea bran, wheat bran, oil seed cakes and mixed ration. Therefore, the present study was intended to evaluate the feed intake, milk yield and milk composition performances of Fogera cows fed with different locally available and commercial feed supplements.

MATERIALS AND METHODS

Description of the study area

The study was conducted at Andassa Livestock Research Center (ALRC), located in Amhara National Regional State (ANRS), Ethiopia. It is situated about 587 km north-west of Addis Ababa, the capital of Ethiopia and 22 km south-east of Bahir Dar, the capital of ANRS. The center is situated at an altitude of 1730 m above sea level. The mean annual

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rainfall is 1434 mm and the mean maximum and minimum temperature ranged from 27.9 to 13.1^{O}C and humidity ranged from 95% throughout the rainy season to 35% during the dry season. The topography of the area varies from river valley plain to gentle slope grassland. In general, the area is characterized by dark clay soil, which is seasonally water logged (Yihalem, 2004).

Experimental animals and management

The experiment was carried out using Fogera cows kept in ALRC for the purpose of breed conservation and improvement. Twenty lactating cows were selected from the station's herd. The selected cows were second parity and at early stage of lactation (2-5 months after calving). Weight of cows was taken using heart girth meter early in the morning before feed offer. Average body weight of the selected cows was 258 kg (215 - 340 kg), with an average initial milk yield of 0.86 kg cow^{-1} day^{-1}.

Cows were tested for incidence of mastitis using a standard California Mastitis Test and treated with Penstrip (Malty inject) before the commencement of the experiment. In addition, animals were de-wormed for internal parasites with Zanisol and teraclozan (malty inject). The experimental cows were kept in individual pens.

All the cows were hand milked twice a day (in the morning at 7:00 am and in the evening at 5:00 pm). Milk yield measurements were taken using graduated bottles during the entire study period.

Experimental feeds and feeding

The treatment feeds used are presented in Table 1. Hay was harvested from the natural grazing pasture in the research center. The dominant grasses in the center include *Cynodon*, *Hyperhenia*, *Andropogon*, *Paspalum*, *Cetaria*, *Elusin*, *Eragrostis*, *Sporobulus* and *Trifolium* species (Yihalem, 2004). Grass pea bran was purchased from the surrounding grain mills; wheat bran from Guder Agro- Industry in Bahir Dar city and concentrate mix was purchased from Wongele animal feed retail shop.

The treatment feeds were formulated based on the nutrient requirements of lactating dairy cows in the tropics which are 75% TDN and 17% CP on the average. Supplementation level for the treatment groups was based on milk yield performance of experimental cows. About 0.25 kg supplement was given kg^{-1} milk yield cow^{-1} day^{-1} (Holleta Research Center, 2004 cited by BoFED, 2006).

Experimental cows were fed with hay harvested from the natural grazing pasture. Treatment feeds were offered by dividing in to two equal portions two times a day at 7:00 and 16:00 hours. The experimental animals were given water two times a day. Basal diet (hay) was offered *ad libitum* adjusted daily by allowing 20% of refusal from previous day's intake. However, periodic adjustment of treatment feed offer was made for each cow as per the average milk produced per week. Body weight change was recorded fortnightly for each treatment to monitor body weight changes across the experimental period for each dietary treatment.

Table 1. Treatment feeds

Treatment	Basal Diet	Supplement
1	Natural pasture hay (control)	-
2	Natural pasture hay	Wheat bran
3	Natural pasture hay	Grass pea bran
4	Natural pasture hay	Concentrate mix*

*Composed of wheat bran, noug seed cake, fish meal and maize grain – the percentages were not provided for commercial reason.

Experimental design

A Randomized Complete Block Design (RCBD) was used to carry out the experiment. Initial body weight of the cows was used for blocking. The experiment had four treatments with five animals in each treatment. The experiment was conducted for 45 with an adaptation period of 15 days.

Feed analysis

Samples from treatment feeds, both offer and refusal, were taken and analyzed for DM, N (Kjeldahl-N), Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) by the method of Van Soest and Robertson (1985). The chemical composition of treatment feeds is presented in Table 2. The CP, NDF and ADF composition of native hay at ALRC were 4.33%, 79.11% and 50.80%, respectively (Yihalem, 2004).

Table 2. Chemical composition of treatment feeds

Variables (%)	Hay	Grass pea bran	Wheat bran	Concentrate mix*
Dry Matter	93.06	93.48	91.50	91.04
Organic Matter	84.35	96.10	91.25	89.56
Ash	15.65	3.90	8.75	10.44
Crude Protein	4.33	16.55	14.48	20.76
NDF	79.11	64.37	41.79	41.20
ADF	50.80	43.93	10.87	17.77
Hemicelluloses	28.31	20.44	30.92	23.43

NDF = neutral detergent fiber; ADF = acid detergent fiber; Hemicelluloses = % NDF - % ADF; *Composed of wheat bran, noug seed cake, fish meal and maize grain. (Source: Yihalem, 2004).

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Milk composition analysis

Milk samples were taken at different stages of the experiment using graduated bottle every day throughout the study period. A composite of 100 ml of morning and afternoon milk samples were collected from each experimental cow at the start of the experiment and every fifteen days interval then after. The milk samples were kept in an ice box and delivered to Holleta Agricultural Research Center. Milk composition analysis was determined following standard methods (Marth, 1978).

Total solids and ash contents were determined following the procedures of Richardson (1985). Solid-not-fat composition was determined by subtracting the percent fat from total solids (O'Mahony, 1988).

Statistical analysis

Feed and nutrient intakes, milk yield and milk composition were subjected to ANOVA using the General Linear Model (GLM) procedure of Statistical Analysis System (SAS, 2003). Least significant difference (LSD) was used to determine any significant difference between means.

The model used for data analysis was:

$Yij = \mu + T_i + B_j + e_{ij}$

Where;

Y = the observation on feed intake, milk yield or milk composition

μ = the overall mean

T_i = effect of i^{th} treatment

B_j = effect of the j^{th} block

e_{ij} = random error

RESULTS AND DISCUSSION

Feed and nutrient intake

The overall mean feed and nutrient intakes of cows are presented in Table 3. Dry matter intake significantly ($p<0.01$) varied between treatments. Treatment groups supplemented with concentrate mix and wheat bran had greater DM intake than those fed on hay alone (control) or with grass pea bran. This might be because of the differences in the crude protein content of the supplemental feeds (Table 2) which was positively correlated (Table 5). In general, animals on feeds with better protein content have better intake than those on grass diets (Steinshamn, 2010). The low DM intake recorded in cows supplemented with grass pea bran, which had relatively higher crude protein content, than those supplemented with wheat bran might be attributed to the higher NDF content of the former. Neutral detergent fibre content is negatively correlated with intake (Arelovich *et al.*, 2008).

Crude protein intake was statistically different ($p<0.01$) that concentrate supplemented cows had better intake followed by those fed on hay plus wheat bran. This might be attributed to both the total feed intake and CP content of the respective feeds.

Neutral detergent fiber and ADF intakes were also significantly different ($P<0.01$) among treatment groups. Cows fed on only hay had the lowest NDF intake which was obviously attributed to the low total DMI (Table 3), which in turn is associated with the high NDF content of natural pasture hay (Table 2).

Table 3. Least squares mean of dry matter and nutrient intakes (kg DM/day) of Fogera cows fed on different treatment feeds

Variable	DMI	CPI	NDFI	ADFI	ASHI
Overall mean	5.34	0.27	4.14	2.66	0.81
Treatment	**	**	**	**	**
Control (Natural grass hay)	4.90^{a}	0.21^{a}	3.88^{a}	2.49^{a}	0.76^{a}
Hay + Grass pea bran	5.06^{a}	0.25^{a}	3.96^{b}	2.55^{b}	0.76^{a}
Hay + Wheat bran	5.63^{b}	0.28^{b}	4.32^{c}	2.71^{c}	0.85^{b}
Hay + Concentrate mix*	5.76^{b}	0.32^{c}	4.39^{c}	2.90^{d}	0.88^{b}
SE	0.10	0.01	0.08	0.08	0.02
CV, %	4.26	5.01	11.1	11.34	0.20

[abc]Means with different superscripts with in columns are significantly different ($P<0.01$); ** = significant at $P<0.01$; DMI = dry matter intake; CPI = crude protein intake; NDFI = neutral detergent fiber intake; ADFI = acid detergent fiber intake; ASHI = ash intake

Milk yield

The overall least square mean milk yield and composition in the current study is presented in Table 4. The overall mean milk yield (1.44 ± 0.43 kg day^{-1}) obtained in the current study is lower than reported for Fogera cows (1.74 kg/day) (Goshu, 1981; cited by Adebabay *et al.*, 2009) and even from the cows from the same herd in the center (Addisu *et al.*, 2010). This might be related to the stress due to confinement of the animals during the experiment period.

Mean milk yield was significantly different ($P<0.05$) between treatment groups. Milk yield from cows supplemented with concentrate mix or wheat bran was relatively greater than ($P<0.05$) their counterparts supplemented with grass pea bran. The difference in milk yield between treatment groups could be attributed, among other factors, to the differences in crude protein and energy contents in the feeds (Steinshamn, 2010) which are positively correlated with

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the variable (Table 5). The results of the present study are in agreement with that reported by Adebabay *et al.* (2009) who indicated that supplemented cows produced significantly more milk than those grazed on natural pasture alone. Similar results were also reported by Getu (2008) who indicated that crossbred cows fed urea treated wheat straw supplemented diet has significantly higher milk yield than for non-supplemented animals of cross bred cows.

Milk composition

The overall mean fat, protein, total solids, solid-no-fat and ash contents is presented in Table 4. Except ash content all the milk compositions analysed were significantly different ($p<0.05$) among treatment groups. The overall mean fat content (5.01±0.33%) was higher ($p<0.05$) for cows fed on natural pasture hay alone (control) and those supplemented with wheat bran.

Breeds and individuality of the cow show obvious differences in their milk composition and yield. Differences among individuals are often greater than differences within breeds (O'Connor, 1994). Such differences are due to partly genetic and partly to environmental factors. For instance, Jersey and Guernsey breed gives milk with about 5% while the milk of Friesian contains about 3.5% fat, Zebu cows can give milk containing up to 7% fat (O'Mahony, 1988). The milk from indigenous cows contains 6.1% fat, 3.3% protein, 4.5% lactose and 0.7% ash (Alganesh, 2002). In line with this study, Adebabay *et al.* (2009) reported the lowest fat composition of milk samples from treatment groups fed on noug seed cake and concentrate (comprising of 74% maize grain, 25% noug seed cake and 1% salt). This agrees with the generally accepted literature that cows fed low roughage rations yield milk of lower fat content compared to cows fed higher proportion of roughage diets.

Milk from wheat bran supplemented cows had the lowest ($p<0.05$) protein content than milk from cows fed on other treatment feeds.

Table 4. Least squares mean milk yield (kg/day) and milk composition (%) of Fogera cows fed on different treatment feeds

Treatment	Milk yield (kg/day)	Milk composition (%)				
		Fat	Protein	TS	SNF	Ash
Over all mean	1.44	5.01	3.07	14.23	9.22	0.70
Treatment	*	*	*	*	*	NS
Control (Natural grass hay)	1.05[b]	5.81[a]	3.09[a]	14.61[a]	8.79[b]	0.72
Hay + Grass pea bran	1.20[b]	4.30[b]	3.15[a]	13.43[b]	9.12[a]	0.67
Hay + Wheat bran	1.62[a]	5.02[a]	2.89[b]	14.54[a]	9.52[a]	0.70
Hay + Concentrate mix*	1.85[a]	4.90[b]	3.15[a]	14.36[a]	9.46[a]	0.70
SE	0.43	0.33	0.13	0.48	0.28	0.03
CV	14.52	14.65	9.36	7.65	8.74	6.83

[a,b]Means within the same column with different superscripts are significantly different (*P<0.05); NS = not significant; TS total solid; SNF solid-not-fat; *Concentrate mix (wheat bran, noug-cake, fish meal and maize grain)

The total solid content of milk from cows fed on hay plus grass pea bran was significantly lower ($p<0.05$) than milk from cows on other treatment feeds. Solid-not-fat content showed significant difference among treatments groups to which supplemented treatment groups had higher ($p<0.05$) contents than the control group. It is believed that the SNF content can fall if the cow is fed a low energy diet, but it is not greatly influenced by protein deficiency, unless the deficiency is acute (O'Connor, 1994).

Table 5. Correlations among dry matter intake and nutrient intake, milk yield and milk composition

	DMI	OMI	CPI	Milk yield	Protein	Fat	TS	Ash	SNF
DMI	1								
OMI	1.00**	1							
CPI	0.92**	0.92**	1						
Milk yield	0.77**	0.77**	0.86**	1					
Protein	-0.03	-0.02	0.12	0.19	1				
Fat	-0.20	-0.23	-0.34	-0.20	-0.04	1			
TS	-0.01	-0.02	-0.06	0.03	0.14	0.82**	1		
Ash	-0.19	-0.20	-0.18	-0.07	0.17	0.82**	0.91**	1	
SNF	0.24	0.25	0.35	0.31	0.28	0.11	0.66**	0.51*	1

*Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed); DMI Dry matter Intake; OMI Organic matter Intake; CPI Crude protein Intake; TS Total solid; SNF Solid-not-fat

CONCLUSION AND RECOMMENDATION

Supplementation of Fogera cows maintained on natural grass pasture with different feeds has an effect on feed intake, milk yield and milk composition. Because the experiment was conducted indoor, using animals that were grazing

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during the day, the expected result was not achieved. This might be because of the time needed by animals to adapt the environment. Therefore, the trial should be conducted with grazing animals and under farmers management system for a recommendable result.

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