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Chemical Compositions of Dairy Feed Resources at Haramaya University

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Abstract

The aim of this study was to identify major feed resources and analyzing chemical composition of major feeds. A total of 7 feed samples (partially mixed ration, grass hay, corn silage, and peanut meal wheat bran and maize and soybean meal) were collected from the farm. Data were analysed using one-way ANOVA using SAS version 20 software. The results of laboratory analysis of chemical composition showed that the DM content of grass hay was highest (92.35%) of all others. the DM of R1 rations was highest (89.38.) among rations. The ash content of these ingredients was 8.84 highest in grass hay. The highest crude protein content obtained in peanut meal (48.6%) and the lowest (8.12%) was in corn silage while that of R1, R2 and R3 were 20.49, 20.36 and 19.92%. The organic matter of grass hay, peanut meal, soybean meal, maize grain and wheat bran and corn silage were 95.22, 93.60, 93.36, 94.54, 93.79 and 94.71% respectively and for R1, R2 and R3: 84.19, 86.28, and 89.22. The results of NDF contents of grass hay (67.98) were highest of all. The ether extract content was highest in peanut meal (6.40%) followed by Soybean meal (4.28) and lowest in grass hay (0.09%).Generally feeds originated from legumes have highest protein and fat (ether extract) than other feed sources originated from either cereals or roughages like grass hay.

Keywords: Chemical; Compositions; Dairy; Feed; Haramaya; Resources

Introduction

The agricultural sector contributes 52% to the Gross Domestic Product (GDP) and 90% to the foreign exchange earnings [1]. The livestock subsector contributes about 16.5% of the GDP and 36% of the agricultural GDP and the subsector currently support and sustain livelihoods for 80% of all rural population [2]. It also contributes 15% of export earnings and 30% of agricultural employment.

Ethiopians have long history that constantly relied on livestock in order to survive. Livestock in Ethiopia are extremely important as they serve a wide variety of functions in society from social to subsistence purposes [3]. Despite relatively low notice they are afforded, livestock are estimated to contribute to the livelihoods of 60 - 70% of the Ethiopian population [4]. An estimate of [5] indicates that the country is home to about 59.5million heads of cattle, 30.7 million sheep, 30.2 million goats, 2.1million horses, 8.44 million donkeys, 0.41millions mules, 1.21 million camels, 56.53 million poultries and 5.92 million beehives found in the country. Despite high livestock population and existing favourable environmental conditions, the current livestock contribution is below its potential due to various reasons associated with a number of complex and inter-related factors such as feed shortage and disease [6, 7], less efforts in introducing the appropriate package of improved livestock technologies of cross breeding, improved feed management practices and adequate healthcare services which enhance the current livestock production and productivity [8] and inadequate feed, water scarcity, poor health management, low productivity of local breeding stock.

Livestock plays vital role in supporting livelihood, nutrition and development of Ethiopian agriculture. Livestock contribution especially dairy sector to agricultural and national GDP is inevitable in the country. Livestock production contributes 30 to 35% of the GDP and more than 85% of farm cash income. In this respect, milk production is playing a vital role in the livelihoods of the people of Ethiopia. Dairy cows (and all other ruminants) have the capacity to convert roughages and other by- products from the human food industry, otherwise useless waste products, into valuable products like milk and meat [9]. Even though the sector is worthy to the livelihood and economic development, there are many more problems that hinders the sector. Feed quantity and quality are the major factors contributing to efficient and profitable dairy farming, of either commercial or smallholder farms.

Shortage of livestock feed resources in general and dairy feed resources and feeding system is the main problem in Ethiopia in general and in Haramaya university dairy farm too in specific. This problem is due to the day to day skyrocketing feed cost and less attention paid to locally available feed sources. Dairy cows (and all other ruminants) have the capacity to convert roughages and other by- products from the human food industry, otherwise useless waste products, into valuable products like milk and meat. In order to exploit the production capacity, the exotic breed requires not only more feed, but also feeds of better quality. If these facts are not taken into consideration properly, they will suffer from under feeding and they will also produce below their capacity [9].

Ethiopia has an enormous potential for increasing livestock production, both for local use and for export purposes [10]. Stated that there were so many problems and limitations of feed supply and poor quality of the available feeds are the major constraints for optimal livestock productivity in tropical and sub-tropical countries. One of the most devastating constraints is that these regions are characterized by irregular rainfall and thus livestock have to survive on persistent shortage of feed resources of low nutritional value for most part of the year [11]. During the dry periods, poor quality feeds and inadequate nutrition has been reported to be one of the most important constraints for livestock production Ethiopia across all ecological zones. According to [11] degradation of lands due to abandoned and excessive use of

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communal grazing lands of hoven topography in the highlands and erratic rainfall in semi-arid areas has further reduced the availability of feed resources.

Preston and Leng [12] concluded that Seasonal inadequacy of the quantity and quality of available feeds are the major problems facing dairy cattle production in the developing countries. Furthermore the efficiency with which the available feed is utilized is constrained by failure to use recommended management practices that could improve livestock output. A variety of feed resources for ruminant livestock are unused, undeveloped and poorly utilized due to, among other reasons, lack of technical know-how, resulting in decreased livestock output [13]. For instance, feeds such as stovers, straws and haulms (i.e. plant material left after harvesting from soybean and peanut meal if better utilized could make a substantial contribution to the basal feeds available to the dairy animals [14].

In this university dairy production constraints and nutrient requirement of lactating cows" needs have not yet been fully studied. Improvement in dairy productivity can be achieved through identification of production constraints and introduction of technologies which have capability of improving the existed production bottlenecks and compatible with the system of production. Therefore, it is important to assess the quantity and quality of the available feed resources in relation to the requirements of dairy cows on annual basis in a given area. Hence, this study was conducted in Haramaya University with the following specific objectives:

Objectives

General objectives

To identify available livestock feed resources and determine chemical compositions of the major feeds in Haramaya University, and to assess dairy feed balance in Haramaya University.

Specific objectives

To formulate rations from partially mixed ingredients and test their chemical compositions.

Materials and Methods

Description of study area

The study was conducted at Haramaya University Dairy Farm, which is located in Haramaya district in the eastern Hararghe Zone of Oromia Regional State, Ethiopia, 500 km east of Addis Ababa, the capital city of the country [15]. Astronomically the University is located at 9o 26' N latitude and 42o 3'E longitude with altitude about 2000 meters above sea level. The mean annual rainfall of the study area is about 870 mm, which ranges 560-1260 mm, and the mean maximum and minimum temperatures are 23.4oC and 8.25oC, respectively (Haramaya University Meteorological Station unpublished summary report, 2012). The area receives bimodal distribution rainfall pattern, peaking in mid-April and mid-August. There are four seasons, as a short rainy season (mid-March to mid-May), a short dry season (end of May to end of June), a long wet season (early July to mid-October) and long dry season (end of October to end of February). Main pasture production obtained after the short rainy season, continuing until the end of the long wet season (National Metrological sciences agency, 2007).

Data collection

Only Primary data used. Ata were directly collected from the farm feed storing barn and analysed for chemical composition. Feed sampling and laboratory analysis were the methods employed.

Analysis of chemical composition of feeds resources

Chemical analysis of the samples of feed ingredients and rations was performed at Animal Nutrition Laboratory of Haramaya University. The representative samples of major feed resources from the study area collected, bulked, dried, sub-sampled and ground to pass through pass a 2-mm screen using a Wiley mill for determination of Dry Matter (DM), ash, Nitrogen (N), Neutral Detergent Fiber (NDF), acid detergent fiber (ADF) and Acid Detergent Lignin (ADL). The samples were pre-dried at 135°C for two hours in an oven dry to remove the moisture content in the feed before chemical analysis and analyzed for DM, OM, CP and ash contents following the methods described by [15]. Chemical analyses were done in duplicate for each sample. Dry Matter (DM) and ash contents of feed samples were determined by oven drying at 105°C overnight and by igniting in a muffle furnace at 500°C for 6 hours, respectively [15]. Nitrogen content was determined by the Kjeldahl method and Crude Protein (CP) was calculated as N*6.25 according to [16] Dry matter, CP, NDF, and ADF were determined for each sample. The amount of crude protein in each sample was determined using the Kjeldahl method [17]. NDF and ADF for all samples were determined sequentially using the Van Soest method [18].

Statistical analysis of data

For statistical analysis the data which concerned with chemical composition of experimental feed and ingredients were analyzed. Data were analyzed using analysed using one-way ANOVA using SAS version 20 software. Least significant difference used to separate means at $p<0.05$.

Results and Discussion

Chemical composition of feeds feed resources

The result of analysis of chemical composition of ingredients used in the experiment was given. The result revealed the presence of significant differences ($P<0.01$) in almost all components of the ingredients used in the experiment except ADF which is different at $P<0.05$. The highest DM (92.35%) was found in grass hay and the lowest DM (34.9%) was in corn silage. The CP content of the currently used hay (9.41%) was within the range of 7.5 -15.45% reported for natural pasture hay [6]. The CP content of peanut meal used in this study was not significantly different ($P<0.05$) from CP content of soybean meal. The CP content of peanut meal (48.07%) obtained from the current study was higher than the value (45.6%) reported by Batal and Cafe (2005) and lower than the CP value (50.7%) reported by NRC (1994) and CP of (50-55%) reported by [19].The difference in crude protein may attribute to the different method used to extract the oil and due to differences in the raw material [18]. Demonstrated that overheating of peanut meal reduces amino acid availability [20]. The ash content of peanut meal was similar with the work finding of which was 6.3% [21]. The fat content of the peanut meal (7.02) was found to be in a range of 1-7% and similar with the report of [22]. When compared to other ingredient there were highly significant differences ($P<0.05$) among the chemical composition of ingredients. This is may be due to their nature as peanut meal and soybean meal are leguminoseae family they are higher in protein content. The result also shows that the Protein content of maize was 8.41%, Ash content was found to be 5.46% and crude fat was 4.02%which agree with the finding of [23]. The DM, Ash and CP contents at dry matter basis of corn silage obtained in the current study agrees with the work of who concluded 35.1%

Table 1: Chemical composition of feed resources used at Haramaya dairy farm.

	Chemical components							
Feeds	**DM**	**Ash**	**OM**	**CP**	**EE**	**NDF**	**ADF**	**ADL**
GH	92.35a	8.84a	95.22a	9.41c	0.09c	67.98a	44.72a	5.57b
PM	90.51b	6.4c	93.6e	48.07a	6.4ba	30.99d	9.93d	2.32e
SB	90.43b	6.64b	93.36f	46.97a	4.28ab	30.54e	10.25d	5.093c
MG	90.00c	5.46d	94.54c	8.41c	4.02ab	9.39f	22.97c	6.03a
WB	89.88c	6.21c	93.79d	13.14b	4.24ab	46.45b	26.62bc	5.09c
CS	34.9d	4.78e	94.71b	8.12c	2.68b	44.76c	32.4b	3.23d
Significance	**	**	**	**	*	**	**	*
SE ±	9.29	0.56	0.29	8	0.96	8.03	5.68	0.59
CV (%)	0.25	1.98	0.046	7.43	3.91	0.117	9.43	0.97

Means with different superscript letters in the same column are statistically different. * = significant at P<0.05, ** = highly significant at p< 0.01, ns= non-significant (p > 0.05). Where: ADF=acid detergent fiber, ADL=acid detergent lignin; CP = crude protein; CS= corn silage; DM = dry mater; EE =ether extract; kg = kilogram; GH= grass hay MG=maize grain; NDF=neutral detergent fiber, OM= organic matter, PM=peanut meal: SBM= soybean meal; WB= wheat bran

Table 2: Mean values of the chemical composition of the partially mixed ration formulated differently.

Rations	**R1**	**R2**	**R3**			
Components	**25%PM,25%M, 25%W,25%WB**	**50%SBM 50%PM**	**50%SBM,25%W 25%M**	**LS**	**SE(±)**	**CV (%)**
DM	89.38a	88.53a	83.2b	**	0.64	0.72
OM	84.19c	86.28b	89.22a	**	0.072	0.03
Ash	15.81a	13.72b	10.78c	**	0.072	0.53
CP	20.49a	20.36b	19.92c	**	0.003	0.27
EE	8.12a	5.99b	2.24c	**	0.029	0.53
NDF	39.82c	47.32a	44.24b	**	0.034	0.08
ADL	2.92b	3.69a	1.41c	**	0.03	1.12
ADF	7.02a	6.65b	5.50c	**	0.17	2.70

Means with different superscript letters in the same row are statistically different at P<0.01.Where: ADF=acid detergent fiber, ADL=acid detergent fiber; CP = crude protein; DM = dry mater; EE =ether extract; NDF: neutral detergent fiber; OM= organic matter; PM=Peanut meal, SBM=soybean meal, sig. = significance, R1: Ration one, R2: Ration two; R3: Ration three.

DM, 3.64% ash and 7.6 %CP content in his experiment which is lower than 8.12%CP found in the corn silage used in the current study. This difference may attribute to the maturity stages, season of preparation, variety of the plant and stage of harvesting of the raw material used for the preparation of silage (Table 1).

Chemical compositions of formulated rations

The results of chemical compositions of Rations which were formulated for dairy cows from partially mixed rations were presented. Accordingly there were highly significant differences (P<0.01) among the rations in all components except DM content of the ration (between R1 and R2) but the lowest DM% was found in r3. The highest organic matter (89.22%) was scored inR3 and the lowest (84.19%) was in R1 [24]. The ash content was highest (15.81%) in R1 and lowest (10.78) in R3. The CP of R1 (20.49%) was higher than the CP content of ration two (20.36) and ration three (19.92). This difference could be attributed the variation in the protein content of raw materials included in the rations; it means that the peanut meal in ration one has higher crude protein than the soybean meal found in ration three [25]. The EE of R1 (8.12) was higher than that of R2 and R3 having the mean of 5.99 and 2.11% on feed basis, respectively and this indicate that ration one may provide more energy than the remaining two rations. There was highly significant difference (p<0.01) in NDF among rations. R2 showed highest NDF (47.32%) and the lowest (39.82%) scored in R1.The highest ADF content (7.02%) was found in R1 the acid detergent fiber content of ration three was lower. Generally, though the chemical compositions of the rations were statistically different, it can match with the nutrient requirement of lactating dairy animals (Table 2).

Conclusion and Recommendations

Conclusion

The study was conducted at Haramaya university dairy farm to identify major feed resources and analyzing their chemical composition. There was inadequacy of feed resources, erratic distribution of factory by products from processing manufacturers, and inappropriate feeds and feed resources handling and storages. Especially there is high scarcity of grass hay in the study area due to that it is bought traveling very long distance (700Kilometer) which is very costive. Corn silage is prepared by cultivating maize on their own farm land. The chemical compositions of the feed resources which are an indicator of the quality of feed were quite low.

Recommendations

Despite high dairy cows' population and existing favourable environmental conditions at Haramaya University, the current dairy contribution is below its potential due to various reasons associated with a number of complex and inter-related factors such as feed shortage, improved feed management practices, inadequate feed and absence of improved forage production.

- Hence the farm should use its own improved forage and pasture production
- Should improve the feed storing barns
- There should be training for the workers to update the on feed resource handling.

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