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On farm evaluation and demonstration of substitution of poultry litter to concentrate in diet of growing F1 heifers in the low lands areas of mid rift valley of Ethiopia

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Abstract

An on farm experiment was conducted to evaluate the effect of partial substitution of poultry litter for concentrate in the diet of growing F1 cross bred heifers to evaluate the economic advantage of substitution of poultry litter for concentrate and to understand farmers perception. Ten growing cross bred heifers estimated age of 1.5 yrs with initial body weight of 197.2±12.62kg (M±S.E) were used to investigate the effect of poultry litter substitution for concentrate at a rate 30%. Using completely randomized design. The experiment lasted for 105 days of which 15days adaptation period and the 90 days was experimental period. The result indicated that there was no significant difference ($P<0.05$) in feed intake and weight gain between the treatments. Economic advantage of using poultry litter as a substitute of concentrate was indicated with greater net income. Moreover farmers perception over using poultry litter as ruminant feed showed tremendous improvement over the experimental period. . It can be concluded that substitution of poultry litter for concentrate in the diet of growing F1 heifer calves will be economical without affecting the biological response.

Keywords: feed intake, supplement, profitable, concentrate

Introduction

When the rains cease the quantity and quality of grazing falls rapidly, so that dry grazing is fibrous and low in crude protein (CP.; around two per cent). As the grazing fails, accepted practice is to redress the deficit with crop residues. Efficient use of these resources demands supplementation and, or, modification of them. This is especially true where production targets (growth; reproduction; lactation; draught) have to be met. Under-supply of nutrients is often a combination of lack of feed coupled with an imbalanced diet (Bensalem and Smith, 2008).

Poor quality pastures and cereal crop residues, the main feed resources in East Africa, cannot sustain effective animal production or even maintenance when fed alone, particularly during the dry season. Thus, provision of appropriate supplementary feedstuffs would be an important step to enhance the productivity livestock under smallholder and pastoral production systems of East Africa (Adugna et.al.2000). Two possible inexpensive means of utilizing cereal crop residues to rear growing ruminants are ammonization and supplementation with available by products such as broiler litter (Anmute etal., 2002). The high content of protein, energy and minerals in poultry waste indicates its importance as a partial substitute for concentrates and high protein feeds like fish meal (Salama et al.2002). Poultry litter can be successfully included in the diet of ruminants as a protein supplement and it is also rich in minerals.

Optimum supplement levels for dairy cows are 1 to 2 kg daily. The ensiling of the poultry litter is a simple and appropriate method of conservation which effectively destroys harmful micro-organisms possibly present in poultry litter (LSU Ag Center, 2007).

The alternative feeds available chicken litter has also the greatest value for its cost. It is best if used in dry season feeding programs. It is an economical and safe source of protein, minerals and energy for beef cattle. Litter also makes an economical substitute for hay especially during the drought years when hay is in short supply (Carter and Poore. 1995). Furthermore, Layer chicken litter could be used as a supplement by farmers to avoid cases of Mg deficiency that can lead to decreased productivity and economic losses to the livestock industry (Hurley et al., 1990). However, farmers should vaccinate their animals for botulism before feeding layer chicken litter.

Use of by products can decrease production costs and increase total production. So far, there are very few work done on evaluation of poultry litter to the dairy cattle in Ethiopia. In a research conducted at on-station conditions at Adami Tulu agricultural research center Estefanos et,al 2016 found out that substituting poultry litter at 30% rate for growing F1 heifer did not show significant difference in growth rate when compared with conventional concentrate. However, the cost of using the substituted poultry litter was less than using conventional concentrate with a 0.91 marginal rate of return. Based on this on-station result an on farm evaluation and demonstration was conducted in 2016/17 with an objective to see the supplemental value of poultry litter as a substitution of concentrate in the diet of F1 growing heifer at on farm conditions.

Materials and Methods

Description of the study area

The experiment was conducted in Adami Tulu Jiddo Kombolcha district of Oromia regional state, Ethiopia. Two Peri urban sites namely Adami Tulu and Bulbula areas were selected purposively taking into consideration the accessibility and availability of F1 cross breed heifers.

Animal management and treatment diets

Ten growing heifers were allocated to each treatment, and the animal's allocation to treatments was based on age and weight.

Table.1. Treatment diets

Feed ingredients proportion	Treatment1	Treatment2
Noug cake %age	36	25
Wheat bran %age	62	43
Poultry litter %age	0	30
Salt %age	2	2
Total	100	100

T1= Noug cake 40% and wheat bran 58% + 2% salt
T2= substitution poultry litter for concentrate at the rate of 30%

Data collected

Fortnight body weight, feed delivered, left over, price of feed, all cost incurred for each treatment and knowledge level and before and after trial of the participating farmers was collected

Partial budget Analysis

The partial budget analysis was calculated to determine the profitability of the supplemental feeds fed to growing F1 heifers calves under on farm management conditions. According to (Ehui et al. 1992) Net income (NI) was calculated as the amount of money left when total variable cost (TVC) was subtracted from total returns (TR). In this experiment the variable costs included estimated purchase price of the hiefers before entering the feeding trial, purchase of supplemental feed cost, labour cost for preparation of the supplemental feed and cost for medicaments of treatments. While total return (TR) was estimated by the selling price of the F1 heifers. Therefore a formula of **NI= TR- TVC** was used for the calculation of profitability.

Feed sample Analysis

The chemical composition of the basal and supplemental diet for each treatment was collected and analyzed at Holeta Agricultural research center. Representative sample, 100g of the ingredients was collected each time when feed was mixed once in two weeks. For the individual feed components before mixing for the treatment sample from the upper, middle and bottom part of the container was used to make it representative. The feed samples 250gm from each ingredients and treatments were partially dried at 65^{o}c for 48 hrs and grounded by 1mm sieve in the laboratory. Crude fiber, Dry matter, Nutrient free extract, Ether extract and Ash were determined using proximate procedures (Van Soest and Robertson 1985). Nitrogen was determined according to Kjeldhal procedure and crude protein calculated as N x 6.25. In vitro dry matter digestibility was determined by two stage method developed by Tilly and Terry (1963). Rumen fluid was collected from three rumen fistulated steers before morning feeding. The steers were fed on natural pasture hay ad libitum and two kg concentrate per day.

Data analysis

In the feeding trial two treatments were replicated to 10 animals per treatment in Completely Randomized Design. The growth rate of the heifers was analyzed using GLM procedure of SAS version 9 (SAS 2004). Means were separated using Tukey test and were considered significant at P<0.05.

Results

Composition of experimental Feed

The dry matter (DM), Ash, organic matter (OM), Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF), Lignin, Crude Protein (CP) Digestible Organic Matter Digestibility (DOMD) of all the feed ingredients used in the feeding trial was presented in (Table).

Table.2. Feed composition of the basal and supplemental feed used in the experiment

Feed Sample	DM%	Ash	OM	NDF	ADF	Lignin	CP
	% DM						
Poultry litter	90.18	15.45	84.55	58.09	20.83	6.15	27.47
Noug cake	91.98	12.51	87.49	39.64	31.56	9.16	29.16
Wheat bran	90.56	4.58	95.45	36.44	9.78	2.74	14.39
T1	91.28	6.94	93.06	44.26	22.06	5.25	19.71
T2	91.28	11.33	88.67	47	17.2	4.47	19.67

DM= dry matter, OM= organic matter, NDF = neutral detergent fibre, ADF= Acid detergent fibre, CP= crude protein.

Table .3. Body weight change of the F1 heifer during the 105 days of experimental period

Parameters	Treatments diets		N	SEM	P-value
	Treatment1	Treatment2			
Initial weight (kg± SEM)	197.2±12.62^{a}	193.1±12.9^{a}	10	12.78	0.82
Final weight (kg± SEM)	267.5±9.67^{a}	262.8±13.25^{a}	10	11.59	0.78
Body weight change (kg)	70.3	69.7	10	11.62	0.79
Average daily weight gain (kg/day)	0.6695	0.6638			
Feed intake (kg/day)	2.92 ± 0.047	2.81 ± 0.06	105	0.81	0.16

Parameters with in the column with different letter shows significant difference at p< 0.05 level of significance.

Fig 1. Wither height change of the heifers over the experimental period

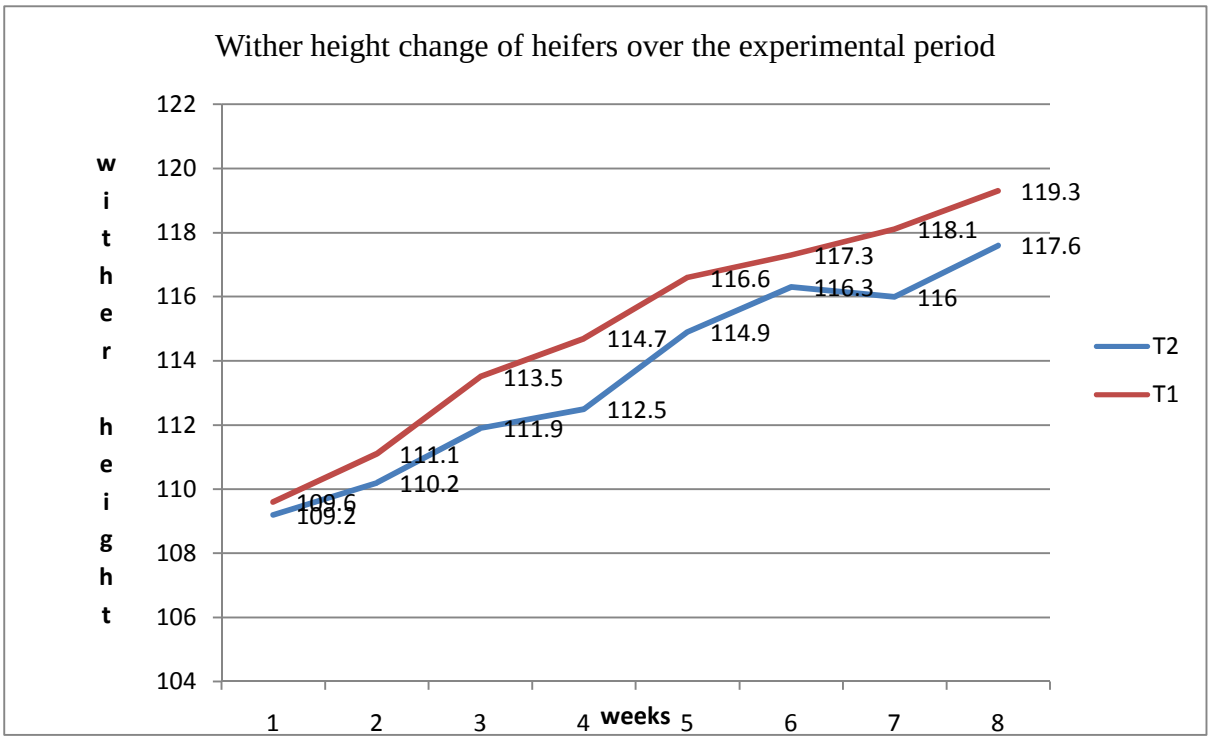

Fig 2. Heap height change of the F1 heifers over the experimental period

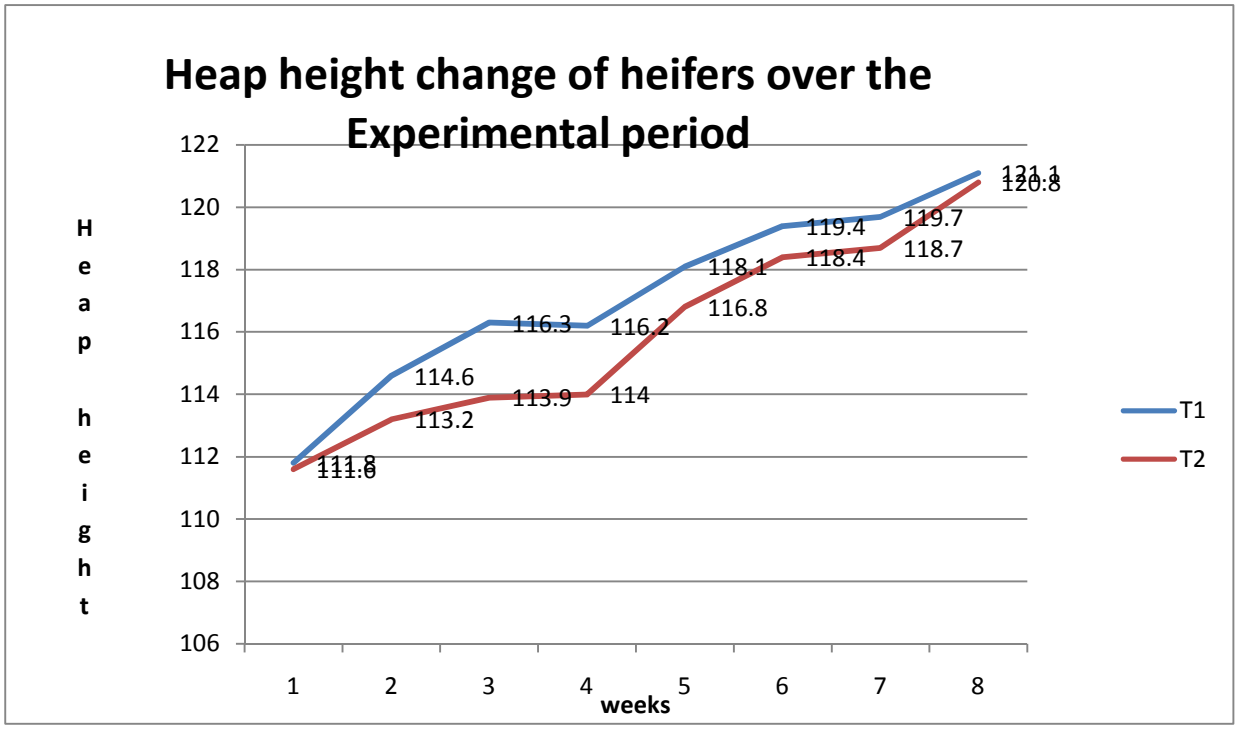

Table 4. Partial budget analysis

Particulars	Treatment diets	
	Treatment1	Treatment2
Supplemental feed cost	1912.05	1069.875
Labour cost	1000	1000
Medicaments	100	100
Total Input cost	3012.05	2169.88
Average cost of the calves if purchased	4050	4050
Total variable cost	7062.05	6219.88
TR	10000	10000
NI	2937.95	3780.13

TR= total revenue, NI=net income

Farmers' feedback and knowledge level before and after the trial period

A simple yes or no question was designed and asked to rate the knowledge level of the participant farmers before and after the trial period involving a total of 30 farmers. The data was collected during training period before starting the trial and during seminar conducted after the trial to share the outputs of the experiment to the participating farmers. According to the findings, before intervention only 4.4 % of the farmers had information about what poultry litter is, it's nutritional and economic value and had interest in using poultry litter as their cattle feed. However after intervention all the participant farmers have responded as they have understood what poultry litter is and are interested in feeding their cattle with poultry litter (Table 5).

Table 5. Farmer's knowledge before and after trial

Question	Before trial		After trial	
	Yes (%)	No (%)	Yes (%)	No (%)
Had information about poultry litter	1 (4.4)	29 (96.6)	30 (100)	0 (0)
Understand the nutritional and economic value of poultry litter	1 (4.4)	29 (96.6)	30 (100)	0 (0)
Interested in feeding poultry litter to my cattle	1 (4.4)	29 (96.6)	30 (100)	0 (0)
Know how to mix poultry litter with the conventional concentrates	0 (0)	30 (100)	30 (100)	0 (0)

Discussion

Broiler litter is high in CP, typically ranging between 15 and 35%, Levels of NDF are usually between 30 and 60%.(Owen et.al.2008; Daniel and Oleson, 2005: Saleh et.al. 2003) and the present finding (Table 2) has lower CP and ADF but higher NDF than the report of Abdul et al. (2008) which indicated 28.2%, 30.29 and 38.62 and slightly higher CP than the finding of Yosef and Mengistu (2013) which indicated 25%. Dry matter intake of the supplemental feed was not significantly affected by substitution with poultry litter (Table 3). Mixing the poultry litter with the concentrate did not have significant effect on the intake of poultry litter by the ruminants. The mixing action also delivered adequate amount of energy and protein for the microbes in the rumen to utilize the non-protein nitrogenous substance in the poultry litter. The present result is in agreement with the result of Hopkins and Poore (2001), which indicated similar feed intake observed with substitution of soya bean meal substitution with deep stacked poultry litter. The current weight gain result (Table 3) is slightly higher than the finding of Rossi et al. (1997) which indicated that 0.47-0.57 kg daily weight gain per cow per day with poultry litter substitution of concentrate diet for beef cow. And the results are greater than the result 0.37-0.44 kg daily weight gain per day per gestating beef heifer reported by Rossi and Leorech (1999) and the report of Mubi et al. (2008) which indicated average daily weight gain of 69.7 gram for growing heifer fed on alkali treated sorghum plus 0.5kg poultry litter/day/head in the north eastern Nigeria.

More over the result is in agreement with the finding of Yosef and Mengistu (2013) supplementing dairy cows with concentrate mix at 22% poultry litter as a replacement of ground nut cake increased total dry matter intake and did not depress the body weight and reproductive performance of a cow as compared to cow fed supplementation only on ground nut cake in experiment conducted in Haramaya University.

Conclusion and Recommendation

Inclusion of poultry litter at the rate of 30% (T2) for substitution of concentrate in the diet F1 growing heifers conducted on farm indicated that biologically similar and economically feasible result was obtained as compared to conventional supplement used (T1) so further training and awareness creation has to be given for the farmers in the study area so that they could practice the inclusion of 30% of the poultry litter in the diet of the growing F1 heifers.

Further studies required to identify the optimum level of inclusion poultry litter in the diet of growing F1 heifers for the locality since the feed cost is lower for poultry litter as compared to the conventional concentrate and the dairy farmers in the area will be more beneficiary.

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