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Inclusion of Pulse Hulls in Concentrate Mixture and their Effect on Nutrient Intake, Digestibility and Milk Yield of Dairy Cows

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Abstract

The present study was undertaken to assess the effect of feeding field pea (*Pisum sativum* L.) and grass pea *(Lathyrus sativa* L.) hulls at different levels of inclusion in concentrate mixture on nutrient intake, digestibility and milk yield of dairy cows. Thirty lactating Jersey cows with similar range of body weight, body condition and first stage of lactation were selected from the herd maintained at Adaberga Research Station, West Shoa Administrative Zone, Oromia Regional State, Ethiopia. Animals were blocked based on parity and milk yield under Complete Randomized Block Design (CRBD) and were assigned to each treatment randomly. Five dietary treatments were: T_1 (control), maintained on native hay + concentrate mixture formulated with only conventional feed ingredients (0% pulse hulls); T_2, T_3, T_4 and T_5 were maintained on native hay + concentrate mixtures formulated with inclusive of 35% field pea hull, 50% field pea hull, 35% grass pea hull and 50% grass pea hull, respectively. Animals were fed native hay *ad lib* while concentrate mixtures were fed @ 2kg for maintenance requirement and 1kg for each 2.5 kg of milk yield individually both in the morning and afternoon for a period of 180 days. Data were analysed using SAS software packages and Turkey's HSD multiple comparison technique was used for means separation. Results of the study revealed that the average DM, OM and CP intake during the whole experimental period (kg/h/d) were higher ($P<0.01$) as a result of feeding 35 and 50% field pea hulls and 35% grass pea hulls in concentrate mixtures (T_2, T_3 and T_4, respectively) as compared to the control while feeding of 50% grass pea hull in concentrate mixture (T_5) had no effect on DM, OM and CP intake. The NDF and ADF intake (kg/h/d) were higher ($P< 0.001$) in all treatment groups which were fed field pea and grass pea hulls at different levels of inclusion in concentrate mixture as compared to the control group. Digested DM was higher ($P<0.01$) in feeding of 35% field pea hull (T_2) and digested CP was higher ($P<0.01$) as a result of feeding 35 % field pea and grass pea hulls in concentrate mixture (T_2 and T_4) than the control. Digested NDF and ADF intake were also higher ($P<0.01$) in T_2, T_3 and T_4 than the control. Digestibility of CP was significantly higher ($P< 0.01$) in T_2, T_3 and T_4 than the control while digestibility of NDF was higher ($P< 0.01$) in T_2 than the control. Milk production was higher ($P<0.01$) as a result of feeding 35% field pea and grass pea hulls in concentrate mixture (T_2 and T_4) than the control. Therefore, it is concluded that alternative concentrate mixtures could be formulated by inclusion of 35% field pea and grass pea hulls in the ration of dairy cows.

Key words: Dairy cows, Digestibility, Field pea (*Pisum sativum* L.) hulls and Grass pea (*Lathyrus sativus* L.,) hulls, Milk yield and Nutrient intake.

Introduction

Milk production is largely depend on the appropriate feeding of dairy animals based on their requirement. In Ethiopia, as is true in most other countries of the world, the major sources of feed for cattle are generated mainly from natural pasture and crop residues; which these feed resources are deficient in protein and fermentable energy (Adugna and Sundstol, 2000). Therefore, concentrate mixture should be supplemented to dairy animals to fulfil the deficiency of nutrients and there by boost milk production. Tadesse *et al. (*2002) reported that supplementation of concentrate mixture @ 5-6 kg/head/day to dairy animals has shown to increase efficiency in milk production. In Ethiopia, the commonly used conventional feed ingredients to prepare concentrate mixtures include Niger seed (*Guizatia abyssinica*) cake, wheat bran, wheat middling etc. However, the prices of these conventional feed ingredients and the formulated concentrate mixtures are increasing at an alarming rate from time to time. As a result, dairy farmers are facing critical problem of feeding costly conventional feed ingredients/ formulated concentrate mixtures to their dairy animals. In this regard, feeding of pulse hulls such as field pea (*Pisum sativum L.*), grass pea (*Lathyrus sativus* L.), lentil (*Lens culinaris*), faba bean (*Vicia faba*) hulls etc. at different levels of inclusions in concentrate mixtures to dairy cows could be promising alternative feed resources, which are economical and available in the vicinity of dairy farmers. Besides, the protein content of pulse hulls is promising, where most of the pulse hulls have CP content of 14 to 16%.

Pulse hulls are by-products obtained during the processing of pulse seeds to get pure cracked pulses for human consumption. Different pulse hulls are abundantly produced in most secondary towns of Oromia Regional State, Ethiopia (such as Addis Alem, Holetta, Ginch, Sendafa, Nazerit etc.) as different pulse grains are continuously purchased and processed in large amount by merchants of secondary towns to get pure cracked pulses to use for human consumption and the by-products of pulse hulls. Therefore, the different pulse hulls produced as a by-product during the processing of pulse grains are found in bulk in the hands of local merchants of secondary towns since only few farmers utilize pulse hulls for fattening of sheep and feeding of dairy animals. So, pulse hulls are underutilized, but possess good potential non-conventional feed resources which could be used as feed ingredients in formulation of economical concentrate mixture for dairy animals. Yoseph *et al*. (2003) stated that pulse grains are commonly used nation-wide for making human food, their use being highest during fasting periods, when the Orthodox Christians refrain from consuming animal products. Consequently,

enormous quantities of pulse hulls are being produced annually in Ethiopia. Sisay (1995) also described that as most concentrate feeds are expensive and not readily available; they are unlikely to be used by the smallholder farmers. So, pulse hulls could be used for fattening lambs and dairy animals as they have high protein content. A report by David *et al*. (1994) on chemical composition of some protein feed stuffs revealed that the crude protein contents of faba bean, field pea and grass pea hulls were 16%, 15.5% and 15%, respectively while that of Niger seed cake was 32%.

Although pulse hulls are available in large quantities and are good potential non-conventional feed resources, only certain research works have been undertaken on feeding of pulse hulls to small ruminants while information about feeding of pulse hulls to dairy animals are scanty. Therefore, the present research work was undertaken to investigate the effect of feeding field pea (*Pisum sativum* L.) and grass pea *(Lathyrus sativus* L.) hulls at different level of inclusion in the concentrate mixture on nutrient intake, digestibility of nutrients and milk yield of dairy cows.

Materials and Methods

Descriptions of the study area

The study was conducted at Adaberga Research Station under Holeta Agriculture Research Centre), which is located 75 km west of Addis Ababa (capital city of Ethiopia) and 30 km from Holeta Agriculture Research Centre in Adaberga district, West Shoa Administrative Zone, Oromia Regional State, Ethiopia. It lies within an altitude that ranges from 2,400-2,800m above sea level and the temperature varies from 10^0C to 25^0C, the average being 22^0C. The rain fall amount ranges between 900 to 1,200mm (Adaberga Research Station, 2010).

Experimental design and dietary treatments

Thirty Jersey lactating dairy cows with similar body weight, body condition and first stage of lactation were selected from the herd maintained at Adaberga Research Station, West Shoa Administrative Zone, Oromia Regional State, Ethiopia and blocked based on parity and milk yield under complete randomized block design. Based on this grouping, there were a total of 6 blocks having 5 animals in each group. The five treatments were then randomly distributed to animals in each block using random numbers and animals taking the same treatment were picked up from each block and form one treatment group. By this method there were 5 dietary treatment groups having 6 replications in each. The 5 dietary treatments were: T_1 (control), animals in this group were used as control group and fed natural hay *ad lib* + conventional concentrate mixture (0% pulse hulls); T_2, T_3, T_4 and T_5 were fed native hay *ad lib* + concentrate mixtures formulated by inclusion of

35% field pea hull, 50% field pea hull, 35% grass pea hull and 50% grass pea hull, respectively. For conducting the digestibility trial, four cows having better body weight and conditions were selected from each treatment group and were fed similar diets as the previous and digestibility trial was conducted for seven days, 15 days before the end of the experimental period.

Formulation of concentrate mixtures

Five types of concentrate mixtures were formulated based on NRC (1989) requirements as shown in Table 1. These concentrate mixtures were formulated in such a way so as to have isonitrogenous and isocaloric ration and had CP content of 20 to 21% and TDN content of 71 to 72.8%.

Table 1. The proportion (%) of feed ingredients used in formulation of different concentrate mixtures

Ingredients	**Treatments**				
	T_1	**T_2**	**T_3**	**T_4**	**T_5**
Wheat short	32	28	15	28	15
Wheat bran	31	-	-	-	-
Niger seed cake	34	34	32	34	32
Field pea hull	-	35	50	-	-
Grass pea hull	-	-	-	35	50
Mineral mixture	2	2	2	2	2
Salt	1	1	1	1	1
Total (%)	100	100	100	100	100

Housing and feeding management

All the experimental animals were kept individually in a conventional well-ventilated partition barn tied by the neck chain in all the time except for some hours where they were kept free in the paddock every morning and after-noon after milking for exercise, drinking water and detection of heat. Animals were fed native hay *ad lib* by adjusting hay offered based on refusals and providing enough amounts frequently both in the morning and afternoon. Concentrate mixtures were fed 2kg for maintenance requirement and 1kg for each 2.5 kg of milk yield individually both in the morning and afternoon during milking for a period of 180 days.

Data recording and chemical analysis

Hay and concentrate mixtures offered for each animal were recorded daily and then refusals were weighed and recorded every morning in the next day before feed offered, there by feed intake of each animal was calculated and recorded daily by deducting the amount of feed refused from offered. All cows were hand milked twice per day both in the morning and afternoon and milk yield for each animal was recorded daily for a period of 180 days. Digestibility trial was also conducted and data on feed offered, refusal and total faeces

voided were collected for a period of 7 days after adaptation period.

Representative samples from each feed offered and refusals were collected separately for each treatment group at the beginning of the experimental period and at fortnightly interval for two consecutive days. Besides, during the period of digestibility trial, samples from each feed offered, left over feed and faeces voided were collected separately for each treatment group for a period of seven days. The collected samples from each treatment group were pooled and representative samples were subjected to proximate analysis for determination of dry matter, organic matter, crude protein and total ash as per AOAC (2005). Fiber constituents (neutral detergent fiber (NDF), acid detergent fibre (ADF) and lignin) were determined as per the methods described by Goering and Van Soest (1970). Besides, total tannin content of different concentrate mixtures, field pea and grass pea hulls were determined according to Makkar *et al*., (1993). Samples of 100 ml of milk were also collected both in the morning and afternoon from each cow at fortnightly interval and fat content of milk was analyzed as per the procedure of O'Connor (1995).

Data analysis

Data were analysed using least square analysis in SAS software packages (SAS, 1989) for Complete Randomized Block Design (CRBD). Means were separated using Tukey's HSD multiple comparison technique whenever ANOVA showed significant variation.

Results and Discussion

Chemical composition of feeds

Organic matter and CP contents of concentrate mixtures ranged from 91.24 to 94.3% and 20 to 21.03%, respectively which were in the acceptable range. The NDF and ADF contents remained higher in concentrate mixtures formulated by inclusion of 50% field pea and grass pea hulls than concentrate mixtures formulated by inclusion of 35% field pea and grass pea hulls; which was due to high level of inclusion of field pea and grass pea hulls. The lignin content was slightly higher in concentrate mixtures formulated with inclusive of 50% grass pea hulls (7.13%) and was lowest in control concentrate mixture (2.70%). Other concentrate mixtures had lignin contents between 5.26 and 5.60% which were closer to reported values by Berman and Rai (2008) who reported the lignin contents were 5.13 and 5.28% in concentrate mixtures formulated by inclusion of 20 and 40% babul pods, respectively. The tannin content in concentrate mixtures was between 0.04% and 1.86%. Field pea hull had slightly higher OM and lower contents of ash, NDF, ADF and lignin than grass pea hull (Table 2).

Table 2. Chemical composition (% DM) of different concentrate mixtures, hay and field pea and grass pea hulls

S. N0.	Type of Con. Mix./ Feeds	DM	OM	CP	Ash	NDF	ADF	Lignin	Tannin
1	**I**	91.01	94.3	20.99	5.74	32.89	14.57	2.70	0.04
2	**II**	91.04	93.19	21.03	6.81	45.93	24.17	5.26	0.88
3	**III**	91.3	92.51	20.73	7.49	48.29	33.56	5.60	0.57
4	**IV**	91.64	92.5	20.0	7.49	39.15	26.36	5.33	0.73
5	**V**	92.31	91.24	20.2	8.76	49.45	31.9	7.13	1.86
6	Natural Hay	93.11	90.6	5.75	9.39	77.85	42.47	6.04	-
7	Field pea hull	92.65	95.7	16.52	4.33	58.98	43.54	5.02	6.16
8	Grass pea hull	93.45	91.93	15.15	8.07	61.68	47.01	10.85	5.99

Note: DM = Dry Matter, OM = Organic Matter, CP = Crude Protein, NDF = Neutral Detergent Fibre and ADF = Acid Detergent Fibre, Con. Mix= Concentrate mixture

I = Control Con. Mix which was formulated from only conventional feed ingredients with out pulse hull; II= 35% field pea hull inclusion in Con. Mix; III= 50% field pea hull in Con. Mix; IV= 35% grass pea hull in Con. Mix and V= 50% grass pea hull in Con. Mix.

Effect of feeding different diets on nutrient intake

The average total dry matter, organic matter and crude protein intake during the whole experimental period (kg/h/d) were higher ($P<0.01$) as a result of feeding 35 and 50% field pea hull and 35% grass pea hull in concentrate mixtures (T_2, T_3 and T_4) as compared to the control. However, feeding of 50% grass pea hull in concentrate mixture had no significant effect on DM, OM and CP intake of the animals. The higher ($P<0.01$) average total OM and CP intake in T_2, T_3 and T_4 were due to significantly higher ($P<0.01$) total DM intake in these treatment groups. Nutrient utilization was improved due to the presence of tannin in field pea and grass pea hulls based rations which facilitated bypass of rumen degradability.

Available evidence suggests that the tannin content in the feeds serves as bypass protein source so that highly degradable protein feeds are effectively utilized in the lower digestive tract thereby improve the performance of the animals. Barman and Rai (2006) reported that tannin content up to 4% in the feeds serves as bypass protein by binding with macro molecules such as protein in the rumen and thereby protects highly rumen degradable dietary proteins from rumen degradation and increases the proportion of proteins reaching the lower digestive tract where amino acids are effectively utilized. Dubey (2007) also reported that feeding of 33% Acacia pods (4% tannin) in concentrate mixture to crossbred dairy cows resulted in significantly higher milk yield for treatment group (12.75 lt.) than the control group (11.16 lt.). As the milk yield increased both nutrients and dry matter intake increased. Significantly higher ($P<0.01$) DMI of concentrate mixtures in T_2, T_3 and T_4 than the control group (Table 3) was as a result of allocation of higher concentrate mixtures due to higher milk

production in these treatment groups. Hay dry matter intake was similar among the treatment groups. On the other hand, T_2 had significantly higher hay DM intake than the control group. The present findings of higher (P<0.01) total DM, OM and CP intake in T_2, T_3 and T_4 is in agreement with the findings of Yoseph *et al*. (2002) who reported the feeding of pulse hulls (lentil, grass pea and field pea hull) to sheep improved total DMI, OMI and nitrogen intakes than the control group. Habte (2010) also revealed that supplementation of different level of lentil hull to lambs resulted in higher DMI, OMI and CPI than the control group.

The NDF and ADF intake (kg/h/d) were higher (P<0.01) in all treatment groups, which were fed field pea and grass pea hulls at different level of inclusion in concentrate mixture than the control group. Higher intake of NDF and ADF in this study are in agreement with the findings of Yoseph *et al*. (2002) who reported that the feeding of pulse hulls improved NDF intake over the control. Habte (2010) also reported that supplementation of lentil hull at the rate of 350g/head significantly improved NDF and ADF intake over the control.

Table 3. Effect of inclusion of different levels of field pea and grass pea hulls in concentrate mixture on dry matter and nutrients intake (kg/h/d) of Jersey cows during experimental period

Attributes	T1	T2	T3	T4		
Hay DMI	6.41^{b} ± 0.07	6.65^{a} ± 0.06	6.50^{ab} ± 0.05	6.52^{ab} ± 0.05	6.51^{ab} ± 0.05	*
Con. Mix DMI	4.40^{b} ± 0.05	4.69^{a} ± 0.06	4.71^{a} ± 0.07	4.75^{a} ± 0.08	4.43^{b} ± 0.05	**
Total DMI	**10.81^{c} ± 0.09**	**11.34^{a} ± 0.08**	**11.21^{ab} ± 0.08**	**11.27^{a} ± 0.11**	**10.94^{bc} ± 0.08**	**
Hay OMI	5.81^{b} ± 0.06	6.02^{a} ± 0.05	5.89^{ab} ± 0.04	5.91^{ab} ± 0.05	5.89^{ab} ± 0.04	*
Con. Mix OMI	4.15^{b} ± 0.05	4.37^{a} ± 0.05	4.36^{a} ± 0.06	4.39^{a} ± 0.08	4.04^{b} ± 0.04	**
Total OMI	**9.96^{b} ± 0.09**	**10.40^{a} ± 0.08**	**10.24^{a} ± 0.07**	**10.30^{a} ± 0.10**	**9.94^{b} ± 0.07**	**
Hay CPI	0.369^{b} ± 0.004	0.382^{a} ± .003	0.374^{ab} ± 0.003	0.375^{ab} ± 0.003	0.374^{ab} ± 0.003	*
Con. Mix CPI	0.92^{bc} ± 0.01	0.99^{a} ± 0.01	0.98^{a} ± 0.01	0.96^{ab} ± 0.02	0.89^{c} ± 0.01	**
Total CPI	**1.29^{c} ± 0.011**	**1.37^{a} ± 0.012**	**1.35^{ab} ± 0.014**	**1.34^{ab} ± 0.018**	**1.27^{cd} ± 0.011**	**
Hay NDFI	4.99^{b} ± 0.05	5.18^{a} ± 0.04	5.06^{ab} ± 0.04	5.08^{ab} ± 0.04	5.06^{ab} ± 0.04	*
Con. Mix NDFI	1.45^{d} ± 0.02	2.15^{b} ± 0.03	2.27^{a} ± 0.03	1.86^{c} ± 0.03	2.19^{b} ± 0.02	**
Total NDFI	**6.44^{c} ± 0.06**	**7.33^{a} ± 0.05**	**7.33^{a} ± 0.05**	**6.94^{b} ±0.06**	**7.26^{a} ±0.05**	**
Hay ADFI	2.72^{b} ± 0.03	2.82^{a} ± 0.02	2.76^{ab} ± 0.02	2.77^{ab} ± 0.02	2.76^{ab} ± 0.02	*
Con. Mix ADFI	0.64^{e} ± 0.01	1.13^{d} ± 0.01	1.58^{b} ± 0.02	1.73^{a} ± 0.03	1.41^{c} ± 0.02	**
Total ADFI	**3.36^{e} ± 0.03**	**3.96^{d} ± 0.03**	**4.34^{b} ± 0.03**	**4.50^{a} ± 0.04**	**4.18^{c} ± 0.03**	**

Note: *Significant at (P < 0. 05) and ** Significant at (P<0.01, DMI= Dry Matter Intake, OMI = Organic Matter Intake, CPI= Crude Protein intake, NDFI= Neutral Detergent Fiber, A DFI= Acid Detergent Fibre, Con. Mix = concentrate Mixture

Digested nutrient intake and digestibility of nutrients

Digested dry matter intake (DDMI) and organic matter intake (DOMI) were significantly higher (P<0.01) in T_2 than the control. DOMI was also higher (P<0.01) in T_3 than the control. Digested crude protein intake (DCPI) was higher (P<0.01) in T_2 and T_4 than the control while T_3 and T_5 had no effect on DCP intake. Digested neutral detergent fiber intake (DNDFI) and digested acid detergent fiber intake (DADFI) were higher (P<0.01) in T_2, T_3 and T_4 as compared to the control. However, feeding of 50% grass pea

hull in concentrate mixture had no effect on DNDFI and DADFI per animal (Table 4).

Digestibility of CP was higher (P< 0.01) as a result of feeding 35 and 50% field pea hulls and 35% grass pea hull in concentrate mixture (T_2, T_3 and T_4) as compared to the control while feeding of 50% grass pea hull in concentrate mixture had no effect on digestibility of CP. Digestibility of NDF was higher (P< 0.01) as a result of feeding 35% field pea hull in concentrate mixture than the control while the treatment groups T_3, T_4 and T_5 had no effect on digestibility of NDF. On the other hand, digestibility of dry matter and acid detergent fiber were not affected by feeding field pea and grass pea hulls at all level of inclusion (35% and 50%) in concentrate mixtures (Table 5).

The present finding of higher digestibility of CP in feeding of 35% and 50% field pea hull and 35% grass pea hull in concentrate mixture is in agreement with the findings of Merga (2006) who reported that nutrient digestibility of CP was higher for those goats which were fed Acacia pods with tannin content of 4% than the control group. On the contrary, Barman and Rai (2008) reported that feeding of Acacia pods at the inclusion level of 31% in concentrate mixture, equivalent to 4% tannins to crossbred cattle did not affect digestibility of DM, CP and OM.

Table 4. Least squares means and ± SE of digested nutrients intake per animal (kg/d) of Jersey cows in different treatment groups

Nutrients	**T1**	**T2**	**T3**	**T4**	**T5**	Level of Significance
Digested DMI	5.97^{b} ±0.19	7.28^{a} ±0.14	6.45^{b} ±0.15	6.452^{b} ±0.16	6.32^{b} ±0.09	**
Digested OMI	5.84^{cd} ± 0.17	7.08^{a} ±0.12	6.31^{b} ±0.14	6.28^{bc} ±0.14	5.77^{d} ± 0.11	**
Digested CPI	0.72^{c} ± 0.02	0.95^{a} ± 0.01	0.77^{c} ± 0.02	0.85^{b} ± 0.02	0.74^{c} ±0.01	**
Digested NDFI	3.78^{d} ± 0.12	4.81^{a} ± 0.10	4.57^{ab} ± 0.11	4.33^{bc} ± 0.10	4.09^{cd} ± 0.08	**
Digested ADFI	1.53^{c} ± 0.07	1.78^{ab} ± 0.06	1.94^{a} ± 0.06	1.81^{ab} ± 0.07	1.68^{bc} ± 0.05	**

** In a row having different superscripts are statistically different at P < 0.01

Table 5: Least squares means and ± SE of digestibility of nutrients (%) of Jersey cows indifferent treatment groups

Nutrients	T1	T2	T3	T4	T5	Level of Significance
Dry Matter	63.99 ± 1.34	67.44 ± 1.30	65.26 ± 0.92	65.27 ±1.19	64.18 ±0.80	NS
Organic Matter	67.19^{ab} ± 1.23	70.26^{a} ±1.20	68.35^{ab} ± 0.84	68.13^{ab} ±1.10	65.59^{b} ±0.82	**
Crude Protein	71.04^{c} ± 1.10	79.51^{a} ± 1.23	75.20^{b} ±0.70	76.35^{ab} ±1.11	73.02^{bc} ± 0.43	**
Neutral Detergent Fibre	62.55^{b} ± 1.41	66.98^{a} ±1.33	66.18^{ab} ± 0.91	65.05^{ab} ±1.23	62.86^{b} ± 0.91	**
Acid Detergent Fibre	50.00 ± 1.98	53.09 ± 1.81	55.00 ± 1.23	54.12 ± 1.70	50.73 ± 1.21	NS

Milk and fat corrected milk (4% FCM) yield

The average milk yield (kg/h/d) was higher (P<0.01) as a result of feeding 35% field pea and grass pea hulls in concentrate mixture (T_2 and T_4) than the control and T_5. There was an increment of milk yield by 11.61% and 11.76% in T_2 and T_4, respectively than

the control. The treatment group T_3 had also higher milk yield ($P<0.01$) than T_5 (Table 6). However, there was no significant variation ($P>0.05$) between T_3 and T_1 and T_5 and T_1. The milk yield trend indicated that T_2 and T_4 had average milk yield above fortnightly mean in all fortnights while T_5 and the control group had milk yield below fortnightly mean in all fortnights (Fig 1).

An increased in milk yield as a result of feeding 35 and 50% field pea hull and 35% grass pea hull in concentrate mixture might be due to optimum tannin facilitates the protein bypass by binding with macro molecules such as protein in the rumen thereby amino acids are more effectively utilized in the lower digestive tract. On the other hand, the higher tannin content in concentrate mixture formulated by inclusion of 50% grass pea hull (T_5) had lower milk yield; which might be due to slightly higher lignin content of concentrate mixture of this group. The higher ($P<0.01$) digested CP intake in feeding of 35% field pea and grass pea hulls and higher digestibility of CP in feeding of 35% and 50% field pea hull and 35% grass pea hull in concentrate mixtures than the control might also indicate that the tannin helps to bypass protein to lower digestive tract, where amino acids are effectively utilized.

The present finding of significantly higher milk yield in feeding of 35% field pea and grass pea hull in concentrate mixture than the control is in agreement with the finding of Rai and Shukla (1979) who reported that milk production was significantly increased in those lactating cows which were fed 10 percent salseed meal (11% tannic acid) in concentrate mixture than the control group. Similarly Dubey (2007) reported that feeding of 33% Acacia pods (4% tannin) in concentrate mixture to crossbred dairy cows resulted in significantly higher milk yield (12.75 liters) than the control group (11.16 liters) due to effective utilization of protein feeds.

Milk yield comparison based on the average 4% FCM yield revealed that there was no significant difference between the treatment groups and the control group on average 4% FCM yield. However, the treatment groups of T_2 and T_4 had 5.48 and 2.10%, respectively more 4% FCM yield than the control although these did not differ significantly. T_2 and T_4 also had higher ($P<0.01$) 4% FCM yield than the treatment group T_5 (Table 6). The present findings of non-significant differences in 4% FCM yield of the treatment groups is in contrary to the findings of Barman (2004) who reported that feeding of 20 and 40 per cent Acacia pods in concentrate mixtures to crossbred cows resulted in reduction ($P<0.01$) of 4% FCM yield at both the 20 and 40% inclusion levels.

Table 6. Least square means (±SE) of milk and 4% fat corrected milk (FCM) yield (kg/h/d) of Jersey cows in different treatment groups

Attributes	T1	T2	T3	T4	T5	Level of Signi.
Milk Yield	6.72^{bc} ± 0.15	7.50^{a} ± 0.14	7.24^{ab} ± 0.19	7.51^{a} ± 0.23	6.59^{c} ± 0.15	**
4% FCM Yield	8.21^{ab} ± 0.19	8.66^{a} ± 0.19	8.22^{ab} ± 0.22	8.38^{a} ± 0.23	7.67^{b} ± 0.22	**
Milk yield over the control (%)	-	11.61	7.74	11.76	-1.9	
4% FCM yield over the control (%)	-	5.48	0.12	2.10	-6.58	

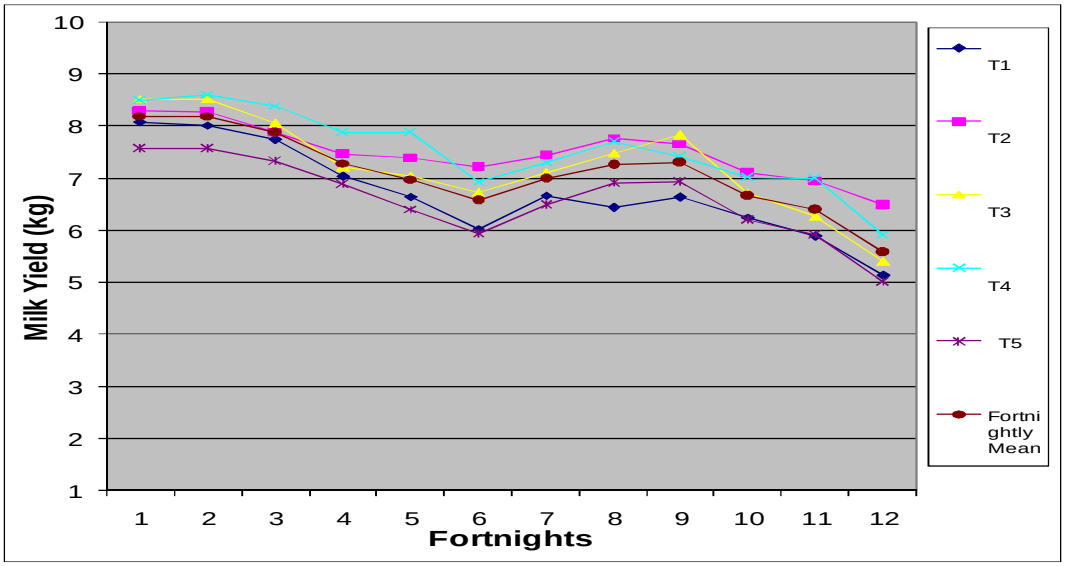

Figure 1. Fortnightly average milk yield of Jersey cows in different treatment groups

Conclusion

Based on the present findings, it is concluded that alternative economical concentrate mixtures could be formulated by inclusion of 35% field pea and grass pea hulls in concentrate mixtures for dairy cows as they increased nutrients intake, improved digestibility of CP and milk yield of dairy cows.

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