

Original Research Article

<https://doi.org/10.20546/ijcmas.2018.703.220>

Effect of Feeding Dried Distiller's Grains Plus Solubles on Milk Yield and its Composition in Dairy Cattle

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ABSTRACT

Sixteen crossbred lactating cattle of average 411.75 ± 14.23 kg body weight, 14.01 ± 1.38 milk yield and 30.87 ± 6.10 DIM were divided into four treatment groups of four animals each on the basis of milk yield and parity following completely randomized design. All the experimental animals were fed weighed quantities of wheat straw, green fodder and concentrate mixture to meet out the requirements as per feeding standards (NRC, 2001). The concentrate mixture of lactating cattle of treatment groups T₂, T₃ and T₄, the CP of GNC of control group was replaced with CP of DDGS @ 50, 75, and 100 %, respectively. For cattle fed 50 and 100% DDGS in place of groundnut cake CP intake increased ($P < 0.05$) as compared to the cattle fed control diets containing no DDGS. No significant difference among control and treatment groups revealed that concentrate mixtures having either groundnut cake or DDGS were equally accepted by the experimental cattle. Nutrient digestibility and dry matter, DCP & TDN intake in lactating cattle are not affected by replacing 50% groundnut cake with DDGS in their concentrate mixture. Nutritive value in terms of DCP & TDN percent of the ration fed to cattle and feed efficiency & feed conversion ratio are not affected at 50% substitution level. Milk yield, its composition and energy value of milk in crossbred cattle are not impacted due to substituting 50 % ground nut cake with distiller's dried grains with soluble as primary protein source in their concentrate mixture, however, 4% FCM yield augmented. There was net saving of Rs. 1.32 for feed cost per kg FCM production in cattle by feeding 50% DDGS, as protein source in place of ground nut cake.

Keywords

DDGS, Cross bread Cattle, Milk yield, Composition

Article Info

Accepted:

16 February 2018

Available Online:

10 March 2018

Introduction

In developing countries like India, the increasing cost and decreasing supply of traditional feedstuffs are expected to constrain the future expansion of livestock production. Feed prices have increased sharply due to increase in the feed ingredient prices. The

availability of low-priced, high-quality feeds is critical for the expansion of the dairy industry. DDGS is one of residual co-produced from the production of ethanol from grain after fermentation of the starch (Youssef *et al.*, 2013). The non-fermentable components of this process which are rich in essential nutrients such as protein, fat, fiber,

vitamins and minerals are recovered in a highly concentrated form (approximately 3 fold) as distillers dried grains with solubles (NRC, 1994; Weigel *et al.*, 1997; AAFCO 2002). DDGS from alcohol industry is a valuable source of energy, protein, water soluble vitamins and minerals for dairy animals. Feed prices have increased sharply due to increase in the feed ingredient prices. DDGS supply energy, protein (amino acids), linolic acid and phosphorus in poultry diet often at a competition price and may lower feed cost (Youssef *et al.*, 2013). Hoffman and Baker (2010) showed that DDGS prices relative to alternate feed ingredients have declined in to a favorable feeding range for many different types of livestock and poultry. Wet and dry distiller's grains are excellent feed ingredients for use in lactating dairy cow rations. Distiller's grains can replace more expensive sources of protein, energy, and minerals in dairy cow diets. Feeding of DDGS to lactating dairy cows has been shown previously to increase the concentration of unsaturated fatty acids in milk fat. Kleinschmit *et al.*, (2006) evaluated the effects of feeding total mixed diets containing 20% DDGS and found that the DDGS sources used in this study did not affect lactation performance. Anderson *et al.*, (2006) determined the effects of feeding 10% or 20% dried or wet distiller's grains with soluble and reported improved feed efficiency and energy-corrected milk/kg of DMI by increasing yield of milk, protein, and fat while dry matter intake tended to decrease. Kleinschmit *et al.*, (2007) observed that replacing corn silage with alfalfa hay in diets containing 15% DDGS increased milk yield, and tended to linearly increase milk protein yield in cows during late lactation. Janicek *et al.*, (2008) suggested that lactating dairy cow rations can contain as much as 30% DDGS and support satisfactory lactation performance and milk composition. Kalscheur and Garcia (2004) reported that DDGS can be added to growing

heifer rations at levels up to 40% of dry matter intake to achieve excellent growth rate and feed conversion.

Due to increased interest and availability of this feed stuff, the present study has been planned to conduct to evaluate the effect of feeding dried distiller's grains plus solubles on milk yield and its composition in dairy cattle.

Materials and Methods

The study was conducted at the Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India. Sixteen crossbred lactating cattle of average 411.75 ± 14.23 kg body weight, 14.01 ± 1.38 milk yield and 30.87 ± 6.10 DIM were divided into four treatment groups viz. T₁, T₂, T₃ and T₄, of four animals each on the basis of milk yield and parity following completely randomized design (CRD). All the experimental cattle were tied with rope in well ventilated feeding stall having arrangement for individual feeding. Before commencement of actual trial animals were acclimatized with experimental feeds for 10 days followed by 115 days of experimental feeding and five days of digestion trial. All the experimental animals were fed weighed quantities of wheat straw, green fodder and concentrate mixture to meet out the requirements as per feeding standards (NRC, 2001). The concentrate mixture of control group (T₁) was comprised of Maize grain (37), GNC (35), rice polish (25), mineral mixture (2) and common salt (1 part), while, in the concentrate mixture of lactating cattle of treatment groups T₂, T₃ and T₄, the CP of GNC of control group was replaced with CP of DDGS @ 50, 75, and 100 %, respectively. Ingredient and chemical composition of different concentrate mixtures fed to experimental animals is given in Table 1. The feed intake was recorded at fortnightly intervals on two consecutive days, the average of two days intake was used for daily dry

matter and crude protein intake. Daily milk yield of morning and evening of individual animal was recorded using digital balance. The milk was sampled at interval of fifteen days for each animal in separate bottles of both morning and evening and mixed before proceeding for estimation of major constituents of milk. Fat and protein percentage were estimated with the help of milk analyzer. Total solids in milk were estimated by Gravimetric method. Fat corrected milk and energy value of milk were calculated by the method of Tyrrel and Reid (1965) by the following formulae:

$$4\% \text{ FCM (Kg)} = 0.4 \times \text{total milk (kg)} + 15 \times \text{total fat}$$

$$\text{EVM (Mcal/kg)} = 0.0929 \times \text{fat\%} + 0.0547 \times \text{CP\%} + 0.192$$

Economics of feeding distiller's dried grains plus soluble as substitute of groundnut cake protein in concentrate mixture of crossbred lactating cattle was calculated. At the end of experimental period a digestion trial of five days was conducted by manual quantitative collection of total faeces from individual animal offered weighed quantity of test diet and recording its refusal. The samples of feed offered, refusals and faeces were analyzed for proximate principles (AOAC, 2005) and fiber fractions (Van Soest *et al.*, 1991).

Results and Discussion

The chemical analysis of the concentrate mixture revealed that ether extract decreases, while NDF and ADF increases as the level of DDGS increased in the concentrate mixture. The average value of dry matter intake (DMI) per day during the 105 day experimental period was not affected significantly by replacing different levels of groundnut cake with DDGS as primary source of protein in

concentrate mixture of lactating cattle. Crude protein intake was increased by the addition of distiller's grains in dairy cow diets. For cattle fed 50 and 100% DDGS in place of groundnut cake CP intake increased ($P < 0.05$) as compared to the cattle fed control diets containing no DDGS (Table 3). Dry matter intake of experimental lactating cattle in terms of percent body weight and per kg metabolic body size ($W^{0.75}$ kg) did not differ significantly among different dietary treatment groups.

No significant difference among control and treatment groups revealed that concentrate mixtures having either groundnut cake or DDGS were equally accepted by the experimental cattle. It was also observed that all the experimental animals were in positive body weight balance and body weight gain of lactating cattle during experimental did not differ significantly due to different replacement levels of GNC with DDGS in their concentrate mixtures (Table 2).

The digestibility of dry matter, crude fibre and NFE, were comparable in all four treatment groups, however, crude protein, ether extract and organic matter digestibility values were significantly ($P < 0.05$) less in cattle of treatment groups T_3 (75% DDGS) and T_4 (100% DDGS) as compared to T_1 (0% DDGS), but these value did not differ significantly among T_1 and T_2 . The results of study revealed that nutrients digestibility were not affected due to 50% replacement of ground nut cake with DDGS in concentrate mixture of cattle. The daily digestible crude protein intake and DCP percent value of ration did not differ significantly between treatment groups $T_{1(0\%DDGS)}$ and $T_{2(50\%DDGS)}$, but was significantly ($P < 0.05$) less when groundnut cake was replaced at 75 and 100% level with Dried Distiller's Grain with soluble in concentrate mixture of lactating cattle.

Table.1 Feed ingredient and chemical composition (%DM basis) of different concentrate mixtures

Feed ingredient	Concentrate mixture				
	T ₁ (0%DDGS)	T ₂ (50%DDGS)	T ₃ (75%DDGS)	T ₄ (100%DDGS)	
Maize	37.00	37.00	37.00	37.00	
GNC	35.00	17.50	08.75	Nil	
DDGS	----	17.50	26.25	35.00	
Rice Polish	25.00	25.00	25.00	25.00	
Mineral Mix.	02.00	02.00	02.00	02.00	
CS	01.00	01.00	01.00	01.00	
Total	100.00	100.00	100.00	100.00	
Cost Rs/Kg	21.16	19.82	19.16	18.50	
Chemical Composition (% DM Basis)					
Attributes	T ₁ (0%DDGS)	T ₂ (50%DDGS)	T ₃ (75%DDGS)	T ₄ (100%DDGS)	DDGS
DM	92.14	91.62	91.28	91.08	91.43
OM	93.12	93.31	93.35	93.48	94.82
CP	20.26	20.97	21.23	21.35	39.48
EE	07.59	06.77	06.36	05.94	03.62
CF	07.16	06.98	06.66	06.41	04.01
NFE	58.11	58.59	59.10	59.78	47.71
Ash	06.88	06.69	06.65	06.52	05.18
NDF	12.03	18.19	21.28	24.36	49.24
ADF	04.76	07.63	09.05	10.49	22.37

Table.2 Effect of different levels of DDGS on nutrients digestibility and intake in experimental lactating cattle fed different levels of DDGS

Attribute	Dietary treatment				CD
	T ₁ (0%DDGS)	T ₂ (50%DDGS)	T ₃ (75%DDGS)	T ₄ (100%DDGS)	
Body wt. changes (kg)	20.25±2.25	19.5±3.20	19.00±4.02	19.75±3.25	NS
DMI(kg)/100Kg body wt	2.53±0.07	2.53±0.02	2.60±0.05	2.57±0.12	NS
DMI (g)/kg W ^{0.75}	115.29±2.04	118.48±1.68	118.31±1.59	116.63±4.16	NS
Nutrients Digestibility (%)					
DM	65.95±0.42	65.69±0.31	65.22±0.63	64.37±0.27	NS
OM	68.62 ^a ±0.23	67.82 ^{ab} ±0.16	67.26 ^b ±0.62	67.00 ^b ±0.22	1.12
CP	69.31 ^a ±0.53	68.67 ^a ±0.25	65.41 ^b ±0.32	64.44 ^b ±0.29	1.14
CF	52.65±0.51	51.42±0.63	50.62±0.64	50.56±1.01	NS
EE	70.94 ^a ±0.23	68.84 ^b ±0.41	68.25 ^b ±0.13	66.59 ^c ±0.26	0.87
NFE	73.26±0.31	72.86±0.31	72.06±0.57	72.47±0.14	NS
Nutrients Intake					
DCPI (g/d)	969.31 ^a ±10.76	984.69 ^a ±3.15	936.64 ^b ±4.73	922.33 ^b ±5.27	20.66
TDNI (kg/d)	7.47 ^a ±0.08	7.51 ^a ±0.06	7.30 ^{ab} ±0.10	7.22 ^b ±0.04	0.23
Nutritive value					
DCP%	8.86 ^a ±0.11	8.77 ^a ±0.05	8.51 ^{ab} ±0.04	8.45 ^b ±0.07	0.22
TDN%	68.35 ^a ±0.31	67.88 ^a ±0.12	66.39 ^b ±0.57	66.13 ^b ±0.31	1.13

Mean values with different superscripts in a row differ significantly (P<0.05).

Table.3 Dry matter intake, milk yield, milk composition and feed efficiency in dairy cattle fed different levels of dried distillers grains with solubles

Attribute	Dietary treatment				CD
	T ₁ (0%DDGS)	T ₂ (50%DDGS)	T ₃ (75%DDGS)	T ₄ (100%DDGS)	
Intake					
DM, kg/d	10.93±0.14	11.14±0.18	10.86±0.20	10.55±0.16	NS
CP, kg/d	1.51 ^a ±0.01	1.55 ^b ±0.01	1.53 ^{ab} ±0.01	1.54 ^b ±0.01	0.02
Production					
Milk, kg/d	14.03 ^{ab} ±0.65	15.44 ^a ±0.87	13.11 ^{bc} ±0.40	12.65 ^c ±0.63	2.05
FCM, kg/d	15.11 ^a ±0.29	16.50 ^b ±0.29	13.78 ^c ±0.56	13.21 ^c ±0.31	1.18
Efficiency					
Feed efficiency	1.39 ^a ±0.02	1.48 ^a ±0.03	1.27 ^b ±0.06	1.26 ^b ±0.02	0.11
N efficiency %	30.73 ^{ab} ±1.19	32.21 ^a ±1.50	28.62 ^{bc} ±1.41	26.74 ^c ±0.95	3.04
Milk composition					
Fat %	4.56 ^a ±0.03	4.47 ^{ab} ±0.04	4.36 ^{bc} ±0.07	4.31 ^c ±0.02	0.13
Protein %	3.35 ±0.07	3.28 ±0.07	3.34 ±0.03	3.31 ±0.06	NS
Total solid%	12.64 ^a ±0.06	12.45 ^{ab} ±0.06	12.34 ^b ±0.08	12.27 ^b ±0.04	0.19
EVM kcal/kg milk	798.82 ^a ±2.79	786.82 ^{ab} ±4.69	780.12 ^b ±7.31	772.90 ^b ±3.65	15.31
Feed conversion ratio					
DMI, g/kg milk	782.28 ±30.41	727.54 ±33.93	857.64 ±44.00	864.47 ±34.06	NS
DMI, g/kg FCM	726.03 ^a ±23.74	680.05 ^a ±28.70	811.66 ^b ±37.85	827.07 ^b ±23.48	90.45
Cost Rs./Kg FCM	11.31	9.99	11.89	12.12	

Mean values with different superscripts in a row differ significantly (P<0.05).

Feed efficiency = FCM/DMI; Nitrogen efficiency = milk N/ N intake.

Similarly, daily TDN intake of experimental cattle and TDN percent in ration were not affected up to 50% replacement level, however, decreased significantly (P<0.05) at higher level of substitution of GNC with DDGS (Table 2).

Milk production was not impacted by 50% substitution of groundnut cake with distiller's grains, but there was a curvilinear response to increasing distiller's grains in crossbred dairy cattle diets (Table 3). Cattle fed diets containing 100% dried distiller's grains plus soluble in place of GNC, milk yield tended to decrease. These cattle produced 1.38 kg/d less milk than cattle fed no distiller's grains. The experimental cattle fed 50% DDGS substituting GNC as protein source produced higher (P<0.05) amount of 4% fat corrected

milk(FCM), approximately 1.39 kg/d more, than cows fed diets containing no distiller's grains. When cattle were fed the higher dietary inclusion rate (75 & 100% replacement levels) of distiller's grains had decreased fat corrected milk production.

The average milk fat percentage was higher (P<0.05) in T₁ (4.56±0.03) than T₃ (4.36±0.07) and T₄ (4.31±0.02), however, did not differ significantly with T₂ (4.47 ±0.04), similar trends were observed in total solid contents of milk. The results of the study revealed that milk fat and total solids contents are not affected by 50% replacement of groundnut cake with DDG in concentrate mixture of cattle, however, crude protein contents of milk were not influenced even at 100% substitution. Milk energy value

(kcal/kg) did not differ among cattle fed diets GNC based concentrate mixture or containing 50% DDGS in place of GNC. However, energy value of milk decreased ($P < 0.05$) by 18 and 26 kcal units per kg milk when distiller's grains was included at 75 and 100% as alternate protein source of groundnut cake. Similarly Nitrogen efficiency (milk N/N intake) percent value was higher in cattle fed 50% GNC and 50% DDGS (T_2) followed by control group (T_1) but did not differ significantly among each other, however, cattle fed 100 % DDGS had significantly ($P < 0.05$) less nitrogen efficiency as compared to fed no DDGS.

The feed efficiency and feed conversion ratio in terms of feed intake per kg 4% FCM production were not affected at 50% replacement of groundnut cake with DDGS as protein source in concentrate mixture of lactating cattle. However, at 75 and 100 % substitution levels feed efficiency decreased ($P < 0.05$) and FCR reduced. There was net saving of Rs. 1.32 feed cost per kg 4% FCM production in cattle by replacing GNC with DDGS at 50 % level.

With no negative effects on the animals among control and treatment groups revealed that concentrate mixtures having either groundnut cake or DDGS were equally accepted by the dairy cattle with more economic returns in the DDGS fed animals.

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How to cite this article:

Sajjan Sihag, Zile Singh Sihag, Sushil Kumar and Narender Singh. 2018. Effect of Feeding Dried Distiller's Grains Plus Solubles on Milk Yield and Its Composition in Dairy Cattle. *Int.J.Curr.Microbiol.App.Sci.* 7(03): 1861-1867. doi: <https://doi.org/10.20546/ijcmas.2018.703.220>