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Effect of Conjugated Linoleic Acid (CLA) Supplementation during Transition Period on the Nutrient Intake, Milk Production and Milk Efficiency in Crossbred Cows

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ABSTRACT

Background: Conjugated linoleic acid (CLA) has been shown to influence a range of biological processes. The current study was aimed to evaluate the effect of CLA supplementation during prepartum on nutrient intake, milk production and milk production efficiency in crossbred cows during postpartum.

Methods: Multiparous crossbred cows (n=30) were allotted to three treatment groups: Control group (CG) was supplemented 50 g bypass fat top dressed on basal diet; CLA-25 group was supplemented with 25g CLA and 25 g bypass fat top dressed on basal diet; CLA-50 group was supplemented with 50g CLA top dressed on basal diet. Supplementation started -21d from calving and continued till 60 days in milk (DIM). The feed and residue samples were analysed for its chemical composition. Milk samples were analysed on weekly basis for its composition.

Result: Positive effect of CLA supplementation on milk parameters was observed where CLA supplemented cows had higher milk yield, protein yield, SNF yield and total milk solid yield. Milk fat depression (MFD) was observed in CLA supplemented cows. Milk production efficiency was higher in CLA supplemented cows.

Key words: Conjugated linoleic acid, Crossbred cows**,** Milk fat depression, Milk production, Milk production efficiency.

INTRODUCTION

Transition period is a vulnerable period encountered by dairy cow that extends from three weeks before and after calving (Grummer, 1995). The metabolic changes that are necessary to prepare dairy cow for parturition and milk production occurs during the transition period. Cows experience about one-third reduction in feed intake during the last three weeks prior to calving, with significant reduction in final week (Hayirli *et al.* 2002). This is mainly due to less capacity for rumen to expand because of increased foetus size. The resultant decreased dry matter intake (DMI) and inability of cow to cope with the increasing energy demands of lactation during the first phase of lactation lead to negative energy balance (NEB).

The resultant NEB results economic losses through decreased milk production, decreased reproductive performance and increased risk of disease incidence. CLA supplementation has been examined as a tool to reduce negative energy balance and improve milk yield and fertility in dairy cattle (Bernal-Santos *et al.* 2003). Approximately 50% of the energy required for milk production is used for milk fat synthesis (Tyrrell and Reid, 1965), so milk fat depression caused by CLA supplementation has an energy sparing effect, the energy used for milk fat synthesis is being spared and diverted towards increasing milk production and other body functions during transition period. Most of the research studies related to CLA had been done in Holstein cows, but there are only few on crossbred cows. So with an objective to evaluate the effect of CLA on nutrient intake, milk production and milk efficiency in crossbred cows during transition period, this study was conducted.

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MATERIALS AND METHODS

Animals, management and treatments

The study was carried out at Department of Animal Nutrition, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, India (30056′N, 75052′E, 247 m above sea level) in 2019-20. Thirty healthy cross bred cows (n = 30) with -30 to -35d prepartum with 2 to 5 parity were selected and randomly distributed into three groups (control, CLA-25 and CLA-50) of ten animals each, on the basis of their body weight and previous milk yield. All the animals were fed as per NRC (2001) feeding standards. After 10-12 days of adaptation period, feeding trial was started at -21 days prepartum and continued till 60 days postpartum. The animals in control group (CG) were fed basal diet composing of wheat straw, concentrate and corn silage and 50g bypass fat supplement top dressed on basal diet. The animals in

CLA-25 group were fed the same basal diet but 25g CLA (Rumen protected CLA Lutrell Pure, BASF) + 25 g bypass fat was top dressed on basal diet. The animals in CLA-50 group were fed the same basal diet as control but 50 g CLA (Rumen protected CLA Lutrell Pure, BASF) was top dressed on basal diet. Chemical composition of basal diet is given in Table 1. The level of CLA supplementation was decided on the basis of study of previous trials conducted by several researchers. All the animals were tethered individually using cotton rope and housed in a well-ventilated shed. The animals were provided with *ad lib* clean drinking water along with feed as per the requirement during an experiment. The animals were kept healthy and disease-free by regular vaccination and deworming as per schedule. The animals and shed were cleaned regularly and thoroughly washed with water to maintain hygiene.

Proximate analysis

The daily record of feed intake and residue was maintained. The feed and residue samples were analysed for dry matter, crude protein, total ash (AOAC 2007) and cell wall constituents NDF, ADF, ADL (Van Soest *et al.* 1991) and nutrient intake was calculated.

In vitro gas production and ME intake

ME intake was calculated based on *In vitro* gas production technique (Menke and Steingass, 1988). The ME value of the sole ingredient and of TMR was calculated by using the following equation developed by Menke *et al.* (1979).

ME (MJ/kg DM) =
1.24 + 0.146 G (ml/200 mg DM) + 0.007 CP + 0.0244 EE

Where,
ME = Metabolisable energy.
G = Net gas production, ml/200mg DM.
CP = Crude protein of sample, g/kg DM.
EE = Ether extract of sample, g/kg DM.

Body weight

The bodyweight of the animals was recorded fortnightly. Weight of animals was taken in the morning hours before feeding and watering on error-free weighing balance.

Milk production and composition

Cows were milked twice daily and yields were recorded at each milking till 60 DIM. Milk samples were taken weekly for analysis of milk composition. Milk was analysed for milk fat, milk protein, SNF and total milk solids. Milk samples were collected in clean polypropylene bottles, morning and evening milk samples were pooled and analysed for milk components by using pre-calibrated automatic milk analyzer 'Lactoscan SA Standard' (Milktronic LTD, Bulgaria). The total solids were estimated by taking summation of SNF and milk fat.

Table 1: Chemical composition of basal diet.

Nutrient	Silage	Concentrate	Wheat straw
CP (%)	8.37	23.50	5.16
ASH (%)	6.95	9.08	9.30
NDF (%)	48.92	22.12	77.2
ADF (%)	25.2	9.15	51.93
ADL (%)	2.38	2.56	6.95
EE (%)	3.11	5.68	1.38
OM (%)	93.05	90.92	90.70
DM (%)	40.14	90.18	89.82

Statistical analysis

Data was analysed by one-way ANOVA, as described by Snedecor and Cochran (1994), by using SPSS (2012) version 21. The differences in means were tested by Duncan's multiple range test (Duncan, 1955) at 5 % level of significance ($P \leq 0.05$).

RESULTS AND DISCUSSION

DMI, Body weight, nutrient intake and energy intake

Dry matter intake, nutrient intake, ME intake and body weight data is presented in Table 2. Dry matter intake and ME intake did not differ among dietary groups. DMI started decreasing as the calving period approached. After calving, DMI increased to cope with the nutritional demand of lactation. ME intake was decreased as the calving approached because diminished DMI, however after calving, ME intake was also improved due to increased DMI with onset of lactation. CLA supplementation had no effect on DMI which is in agreement with previous studies (Bernal-Santos *et al*. 2003; Castañeda-Gutiérrez *et al.* 2007; Kay *et al.* 2006; Medeiros *et al.* 2010; Odens *et al*. 2007; Perfield II *et al.* 2002). CLA supplementation had no effect on ME intake and in agreement with Odens *et al*. (2007).

CLA supplementation also had no influence on the nutrient intake and body weight. Nutrient intake was similar in all the groups during prepartum but increased in postpartum to cope with the increasing nutritional demands of lactation. Decline in body weight was observed on the day of calving due to parturition but after calving period, animals continued to gain weight throughout the period of the study. Loss of body weight was similar in all the groups. Lack of effect of CLA supplementation on body weight was in agreement with previous studies on CLA supplementation (Castañeda-Gutiérrez *et al.* 2007; Kay *et al.* 2006; Medeiros *et al.* 2010; Perfield II *et al.* 2002).

Milk production and composition

Milk production and composition data is presented in Table 3. Significant effect ($P<0.05$) of CLA supplementation on milk yield was observed with higher milk production in CLA supplemented cows than CG. Milk yield in CG, CLA-25 and CLA-50 was 21.50 kg/d, 24.98 kg/d and 22.98 kg/d, respectively. Other workers also reported increased milk yield with CLA supplementation to lactating cows (Bernal Santos *et al.* 2003; Chandler *et al.* 2017; Medeiros *et al.* 2010; Mackle *et al.* 2003; Piamphon *et al.* 2009).

Milk fat depression (MFD) was observed in CLA supplemented cows. Milk fat and yield in CLA-25 and CLA-

Table 2: Effect of CLA supplementation on DMI, nutrient intake, ME intake and BW.

Parameters	Control (50g BY pass fat)	CLA-25 (25g CLA+25g Bypass fat)	CLA-50 (50g CLA)
DMI (kg/d)	13.29±0.33	13.25±0.31	13.18±0.33
ME intake (MJ/d)	129.35±3.42	128.73±3.32	129.10±3.42
BW (kg)	526.92±7.09	538.81±13.79	531.13±9.41
Nutrient intake			
CPI (kg/d)	1.69±0.07	1.67±0.07	1.67±0.07
OMI (kg/d)	12.20±0.29	12.27±0.29	12.09±0.29
NDFI (kg/d)	5.81±0.14	5.79±0.13	5.76±0.14
ADFI (kg/d)	3.10±0.08	3.07±0.07	3.06±0.08

*The varying superscripts in a row vary significantly (P<0.05).

Table 3: Effect of CLA supplementation on milk production and composition.

Parameters	Control (50g BY pass fat)	CLA-25 (25g CLA+25g Bypass fat)	CLA-50 (50g CLA)
Milk yield (Kg/D)	21.50 ± 0.17^{a}	24.98 ± 0.26^{c}	22.98 ± 0.28^{b}
Milk fat yield (Kg/D)	1.19 ± 0.01^{b}	1.04 ± 0.02^{a}	1.04 ± 0.01^{a}
	($5.60\%\pm0.05^{c}$)	($4.16\%\pm0.08^{a}$)	($4.64\%\pm0.05^{b}$)
Milk protein yield (G/D)	699.70 ± 5.95^{a}	808.27 ± 8.48^{c}	741.31 ± 9.21^{b}
	(3.24%±0.01)	(3.22%±0.01)	(3.23%±0.01)
Snf yield (Kg/D)	1.89 ± 0.01^{a}	2.13 ± 0.02^{c}	1.96 ± 0.02^{b}
	($8.21\%\pm0.12^{b}$)	($7.66\%\pm0.21^{a}$)	($8.29\%\pm0.09^{b}$)
Total milk solid yield (Kg/D)	2.92 ± 0.04^{a}	3.17 ± 0.03^{b}	2.99 ± 0.03^{a}
Milk per Kg Dmi (Kg)	1.38 ± 0.01^{a}	1.65 ± 0.02^{c}	1.50 ± 0.02^{b}
Milk per 100 Kg Bw (Kg)	4.06 ± 0.03^{a}	4.34 ± 0.05^{b}	4.32 ± 0.06^{b}
Me intake per Kg of pilk (Mj)	6.58 ± 0.14^{b}	5.18 ± 0.12^{a}	6.23 ± 0.10^{b}

*The varying superscripts in a row vary significantly (P<0.05).

50 cows was significantly (P<0.05) lesser than CG. Inverse relationship between CLA supplementation and milk fat was reported in previous studies (Bernal Santos *et al.* 2003; Chandler *et al.* 2017; Medeiros *et al.* 2010; Mackle *et al.* 2003; Piamphon *et al.* 2009) that investigated the effect of CLA supplementation on milk fat content and milk fat yield.

Milk protein% was not affected by the supplementation of CLA however, its yield was significantly higher in CLA group than CG which was in agreement with Medeiros *et al.* (2010) and Oliveira *et al.* (2018). The increase in milk protein yield was due to increased milk yield resulted from shift in nutritional partitioning, where energy spared from the reduction in milk fat was utilized to increase milk synthesis (Bernal Santos *et al.* 2003).

Significant effect (P<0.05) of CLA was observed on Milk SNF% being lowest in CLA-25 group but comparable between CG and CLA-50 cows. Giesy *et al.* (2002) also reported significant effect of CLA supplementation on milk SNF (P<0.05). Contrarily, Piamphon *et al.* (2009) reported decrease in SNF content of milk with increase in dose of CLA supplementation to lactating cows.

CLA supplemented cows yielded significantly (P<0.05) more total milk solids in compare to cows in CG which was contrary to the observations of Piamphon *et al.* (2009) and Mackle *et al.* (2003).

Milk production efficiency

Effect of CLA supplementation on milk efficiency is given in Table 3. Significant effect (P<0.05) of CLA supplementation was observed on milk per kg DMI, milk per 100 kg body weight and ME intake per kg of milk produced. CLA supplemented cows tended to have higher milk per kg DMI, milk per 100 kg body weight and lower ME intake per kg of milk produced as compared to animals in CG. CLA supplementation improved ME utilization for milk synthesis compared to CG.

CONCLUSION

CLA supplementation had no effect on nutrient intake. Supplementation with CLA during transition period in crossbred cows resulted in higher milk production efficiency, milk yield, milk protein yield, SNF yield and total milk solid yield but, depressed milk fat. CLA supplementation positively affects the milk production and milk production efficiency in crossbred cows. 25g CLA plus 25g bypass fat is recommended as CLA-25 group had higher milk production efficiency, milk yield, milk protein yield, SNF yield and total milk solid yield.

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