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# Effect of Cotton Seed Cake on Cattle Milk Yield and Composition at Livestock Research and Development Station Surezai, Peshawar, Pakistan

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**Abstract:** The present study was conducted at Livestock Research and Development Station Surezai, Peshawar during June to August 2011. The objectives of this study were to determine the effect of Cotton Seed Cake (CSC) on milk yield, milk composition, feed intake, Body Condition Score (BCS) and live weight of Holstein Friesian (HF) crossbred cows. A total of nine mid-lactation crossbred cows were randomly distributed to three groups and allocated to diets containing zero (control), 20 and 35 percent CSC. All the three rations were Isocaloric and Isonitrogeniuos. Each cow was given a daily feed ration according to NRC standards. Mean daily milk yield differed (P<0.05) among all treatment groups. However, highest milk yield 5.68±0.096 kg/day was recorded for cows feed 35% CSC while the control group (0% CSC) produced the least yield 4.473±0.184 kg/day. Cows on 35% CSC produced higher milk fat 4.46±0.22 percent and have significant (P<0.05) effect on milk fat content while the control group produced the least 3.35±0.22 percent fat. CSC had no significant (P>0.05) effect on protein content in milk as cows on 35% CSC diet produced the least 2.7±0.09 percent protein, while the control group produce the highest 3.00±0.09 percent. The concentration of Lactose and total milk solid not fat (SNF) content was higher (P>0.05) for control group than the cows fed on other diet. There was significant (P<0.05) difference in daily feed intake as the cows on 35% CSC diet had the highest daily feed intake of 32.478±0.31kg/day while the control group had the least intake 29.138±0.31kg/day. Experimental rations had no significant (P>0.05) effect on mean changes in BCS. The Live weight was not effected significantly (P>0.05) by rations, However highest mean change in weight gain of 7.66±4.95kg/45day was recorded for cows fed ration having 35% CSC while least 5.00 ±7.90 kg/45day was recorded for cows fed zero% CSC in the ration. Economically ration having 35% CSC had the lowest cost of milk production (Rs: 17.14/kg) as compared to ration having 20% (Rs.19.68/kg) and Zero% CSC (Rs.21.6/kg). These results concluded that milk yield; milk fat and feed intake was increased with supplementation of high level of cotton seed cake in the dairy cattle ration. Higher proportion of CSC (35%) has shown the best efficiency of production as compare to other rations.

**Key words:** Cotton seed cake, milk yield, body condition scores, crossbred cattle

## INTRODUCTION

Livestock sector is considered as important sub-sector of the Agriculture in Pakistan. Its contribution to the GDP is 11.4 percent and 53.2% of agriculture value added; alone livestock sector provide employment to 30-35 million people. Livestock census 2006 revealed that huge livestock population exists in Pakistan.

Milk is the main product of livestock farming placing the country at 3rd number in global ranking (International Dairy Federation, 2008). The cattle herds include a variety of purebred animals such as Sahiwal, Red Sindhi, Achai and majority of crossbred animals. But due to improper management and poor quality nutrients deficient in fodder, the average milk production is very low as compared to other countries e.g., a cow in New Zealand can produces as much milk as three dairy animals in Pakistan, while one American cow produces as much as seven cows in Pakistan (Garcia *et al*., 2003).

Milk composition and quality are important characteristics that determine the nutritive value and consumer acceptability. In Pakistan a lot of research and development is required in milk production, processing and marketing to satisfy consumer's demand as still they are in primitive stage. The available milk comes from various dairy animals, in different physiological states and on various nutritional plans (Bath *et al*., 1985).

In Pakistan, Cotton Seed Cakes (CSC) are being traditionally used in the feed of dairy animals, however

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inadequate supply and seasonal availability of CSC result in high price. One of the major constraints in the development of dairy industry in Pakistan is inadequate availability of nutrients (Sarwar *et al*., 2002). Cotton is primarily grown for the fiber but "CSC" and its meal secured in the production of oil from the seed are the most important feed for livestock. CSC is very palatable and good source of protein therefore being used traditionally in the feed of livestock. "CSC" as cattle feed is of great economic importance. Because of its exceptionally high protein content, it is of particular value in the dairy industry as an accessory in the fodder rations, as it has been found to stimulate the production of milk besides improving the cattle through supplying them with nourishing feed.

The ruminants can make efficient use of mill by-products, crop residues and other non-conventional feed sources. Variation in the nutritive values of different feedstuffs affects the Feed intake, palatability and digestibility of feed. Moreover these feed also effect the milk yield and milk Composition. Keeping in view the present study was, planed to find out the effect of CSC on Milk yield, feed intake, BCS and L wt of Cattle.

## MATERIALS AND METHODS

Present study was executed at Livestock Research and Development Station (LR and DS) Surezai, Peshawar. The study was conducted during summer (July, 2011). During the research phase there were no green fodders due to scarcity of water in the station. As Livestock Research and Development Station Surezai is located in semi-arid zone and the normal range of temperature during experimental phase was 40-48°C at LR and DS Surezai. The main source of water for irrigation is tube well but due to excessive load shedding of electricity at the station, there is scarcity of water which results in green fodder deficiency particularly in hot summer season.

**Selection of animals:** At the time of selection/execution of the experiment the selected animals were of live weight ranged 322kg to 385 kg and BCS 3.5 to 4.2. Animal were of the aged group ranged 5 to 5.5 year and most of the animals were in mid-lactation stage. Nine Non pregnant lactating HF crossbred cows were selected on the basis of nearly the same lactation stage, age and live weight. The experimental animals were divided into 3 groups A, B and C and were fed individually on wheat straw as a basal diet along with specially formulated different concentrate ration having cotton seed cake at zero, 20 and 35% level. These entire rations were made Iso- caloric and iso-Nitrogenic. Before feeding trail, each experimental animal (HF crossbred cow) was treated for ecto and endo parasite through the use of endectin (Ivermectine) injection.

Adaptation period of Fifteen day was given, before the start of, the experimental feed was gradually increased and the usual feed was decreased until the cattle were shifted completely to experimental rations. Adaptation was followed by 45 days experimental period.

The effectiveness of each ration was tested in term of feed intake, feed refused weight gain, Body Condition Score (BCS), milk yield and on milk composition.

**Feed intake:** Desired concentrate rations were prepared and fed to each experimental animal as per his maintenance and production requirement twice daily. Required quantity of concentrate rations and wheat straw were weighed separately for each animal on digital weighing balance and offered to the animals. The data for feed intake was recorded on daily basis on separate profarma.

**Feed refused:** Feed refused was calculated by weighing the feed wasted/refused in the manger next morning. Fresh drinking water was available to cows throughout the day:

Feed refused = Feed offered-Feed intake

**Milk yield:** Lactating cows of each group were hand milked twice a day as a routine milk practices at about 11AM and 9 PM by different milk men and the Author himself recorded the daily morning and evening milking on daily basis. Hand milking operation performed on standard procedures. Calves were not allowed to suckle the milk. Neither oxytocine was used for milk let down. The experimental animals were fed concentrate ration to make them busy during milking time.

Individual cow milk was weighed separately for morning and evening and recorded on the milk sheet.

**Milk composition analysis:** For milk analysis special plastic bottle were used for sample collection, these plastic bottles were first clean with detergents and then air/sun dried. Milk samples were collected from each experimental animal in the plastic bottle. They were labeled and analyzed in the Dairy Technology lab for Fat, Solid Not Fat (SNF) it include all solid content of milk except fat such as carbohydrate, mineral, cholesterol, protein and Lactose by using milk analyzer (lacto scan) Machine.

**Weighing of experimental animals:** All the experimental lactating animals were weighted empty stomach at the start of the experiment. Live weight was recorded fortnightly for each experimental animal, for weight recording Dovl balance was used. Weighing of all experimental animals was recorded early in morning prior to feeding.

**Body condition score data:** All experimental cows, BCS were recorded by Author and counter checked by Khan R.W (Co-supervisor) by using the method of (Peter and Ball, 1987). According to this method the thickness of fat over the lumber and tail head area was estimated and was assigned a score from 0 (very weak) to 5 (very fat). Data on BCS was measured on weekly basis and entered in excel sheet for determining the changes in the body condition of cows in different plow of nutrition.

**Statistical analysis of data:** The data was statistically analyzed in M State C, for the effect of cotton seed cake on milk yield, Milk composition, weight gain, feed intake and BCS by using Analysis of variance (ANOVA).

## RESULTS AND DISCUSSION

**Feed Intake (FI):** Cotton seed cake have significant ($P<0.05$) effect on feed intake (Table 2). Mean value showed that maximum Total Mix Ration (TMR) intake (32.478kg/day) was recorded for group fed on ration having CSC 35%, while minimum (29.138 kg/day) was recorded for control group. Substitution of mustard seed cake with cotton seed cake affected the feed intake in present study. There was a linear increase in the intake with increasing CSC level in the ration. The increased in feed intake might be due to high palatability of CSC. These result were in line with the work done by James *et al.* (2010) who fed CSC based diet to Guernsey cow in Zimbabwe and find out that feed intake was significantly ($P<0.05$) increased (30±0.34kg/day) i.e., 57.93% more than Baobab Seed Cake (BSC) with supplementation of CSC in the ration.

Yasmeen *et al.* (2007) reported that higher intake of the total dry matter of the basal diet supplemented with cottonseed cake may be due to its palatability and may be a good appetizer. Morgan (1977) observed in sheep that finely ground cottonseed meal provide animals with by-pass protein resulting in increased total feed intake and found by other (Tong and Preston, 1983).

The lower intake for the control group animals might be due to bitter taste and less palatability of mustard seed cake due to the presence of tannin. Voluntary feed intake is negatively affected by high concentration of tannin in the diet by three main mechanisms: A reduction in palatability of the feed, by slowing the digestion and the development of conditioned aversion. A reduction in palatability may be due to the reaction between tannin and salivary mucoprotein, or directly react with taste receptors, by provoking an astringent sensation (McLeod, 1974).

The present finding that mustards seed cake supplementation (control group) depress feed intake support the result of Bell (1993). Who reported that lower intake of diet supplemented with Mustard seed cake may be due to the presence of glucosinolates an Anti-nutritional Factor (ANF) which is toxic especially to non-ruminants, having bitter taste and will also reduce the palatability of the meal. McDonald *et al.* (2002); Molle *et al.* (2009) reported that lower intake for mustard seed cake may be due to the presence of high concentration of tannin (ANF), that react with the outer cellular layer of the gut there by giving a signal in the ruminant for

Table 1: Composition of experimental rations

| Ingredient | CSC 0% | CSC 20% | CSC 35% |
|---|---|---|---|
| CSC | 0 | 20 | 35 |
| Mustard seed cake | 40 | 18 | 0 |
| Maize oil cake | 15 | 15 | 15 |
| Wheat bran | 10 | 10 | 5 |
| (20%) corn gluten | 6 | 6 | 6 |
| (30%) corn gluten | 6 | 6 | 6 |
| Molasses | 10 | 10 | 10 |
| Wheat grain | 6 | 6 | 6 |
| Salt Powder | 1 | 1 | 1 |
| D.C.P | 1 | 1 | 1 |
| Rice Polish | 5 | 5 | 15 |
| Total | 100 | 100 | 100 |
| Crude protein (Percent) | 16.4 | 16.5 | 16.3 |
| ME (MCal/kg) | 2.97 | 2.86 | 2.81 |

Table 2: Effect of CSC on Total Mixed ration intake (kg/day) of dairy cattle

| Ration type | Mean±SE | P-value |
|---|---|---|
| 0% CSC | 29.138±0.31 | <0.05 |
| 20% CSC | 31.207±0.31 | |
| 35% CSC | 32.478±0.31 | |

Table 3: Effect of CSC on Mean changes in BCS of dairy cattle

| Ration type | Average initial BCS | Average final BCS | Mean change in BCS | P-value |
|---|---|---|---|---|
| 1. (0% CSC) | 4.26±0.14 | 4.36±0.11 | 0.1±0.07 | 0.08 |
| 2. (20% CSC) | 3.66±0.16 | 3.83±0.14 | 0.16±0.08 | |
| 3. (35% CSC) | 3.53±0.06 | 3.8±0.11 | 0.26±0.09 | |

Table 4: Effect of CSC on Mean changes in live body weight of dairy cows

| Ration type | Mean initial weight (kg) | Mean final weight (Kg) | Mean change in weight (kg) | P-Value |
|---|---|---|---|---|
| 0%CSC | 377.66±15 | 382.66±6.6 | 5.00±7.90 | 0.065 |
| 20%CSC | 330.33±15.9 | 336.66±20.2 | 6.33±5.36 | |
| 35%CSC | 358±7 | 365.66±10.5 | 7.66±4.95 | |

controlling voluntary feed intake. Ondiek *et al.* (2000) and Preston and Leng (1984) suggested that Nitrogen, Digestible nutrient and mineral are usually low in straw based basal diet. So when a good quality concentrate is supplemented it not only compensates their nutrient deficiency but also boost up the intake of basal diet as happen in the present experiment.

This results is also supported by Chowdhery (2001) (8.32 kg DMI/day) i.e., 10.93% more feed intake than control group (Capper *et al.*, 1989; Yahaya *et al.*, 1998) (2.4kg DMI/day), Morgan (1977) and Wegad *et al.* (1987) (4.72kg DMI/day) i.e., 11.8% more intake than control diet, they narrated that supplementation of CSC in the ration has significant effect on feed intake of the animals.

**Body Condition Score (BCS):** Table 3 shows that CSC had no significant effect on BCS. Mean changes in BCS showed that all rations have positive effect on BCS, being highest for group fed on 35% CSC ration. Cows have physiological ability to lose their body tissue by losing "Body condition" for about 40-100 days after calving by providing nutritional substances from their body for milk production and afterward they restore again the lost body reserve (Koenen *et al.*, 2001). Body condition score correlates with the milk production of cows and body condition scoring is widely recommended method to evaluate the nutritional management of a dairy cows. When the cows is at peak milk production and its energy requirements exceed its intake, than they go into negative energy balance, mobilizing their lipid reserves, become thinner and lose their body condition score (Aeberhard *et al.*, 2001a).

Present study suggested that increasing the concentration of CSC in ration improved the changes at high rate in BCS of lactating cows. This is in line with the work done by Yoseph *et al.* (2011) who study the effect of strategic supplementation with different proportion of agro-industrial by-products and grass hay on live weight changes in Ogaden bulls (*Bos indicus*) grazing native pasture in Ethopia. Who randomly assigned to one of the three treatments (T). (T1; Control) constituted of only grazing in pasture, while T 2 and T3 constituted of grazing and supplementation of agro industrial by-products and hay at a ratio of 25:75 and 50:50 respectively and find out that bull had better body condition score than the preceding periods. T3 and T2 had improved ($P<0.05$) L wt and body condition score compared to T1.

Positive effect in BCS for all groups' animals might be due to the fact that all the cows were in mid lactation period beyond 100 days of parturition, during which the lactating animals restore their body reserves (Koenen *et al.*, 2001).

**Live weight (L wt):** Live weight was not significantly affected by CSC in the ration (Table 4). Mean changes in L wt during 45 day experimental period recorded for group A, B and C were 5.00±7.9, 6.33±5.3 and 7.66±4.9 kg, respectively. Present study is supported by Jabbar *et al.* (2008) who study the Effect of Replacing CSC with Sunflower meal in the ration of lactating crossbred Cows and find out significant ($P<0.05$) difference in live weight gain, being highest (29.5) kg for the group fed ration having 48% CSC, while minimum (11.5) kg was recorded for the group fed on ration having 0% CSC through out 90 day experimental period.

The result is in line with the work done by Jabbar (2009), Jabbar *et al.* (2006), Chowdhery (2001), Spiekers (1991) reported that supplementation of CSC in the ration has positively effect the live weight of lactating crossbred animals.

Positive effect in live body weight gain in all groups may be due to the high energy density of cotton as well as mustard seed cake due to their higher Ether Extract content and positive nitrogen balance and they did not lose their body weight.

**Milk Yield (MY):** Table 5 showed significant changes in MY of HF Crossbred dairy cattle fed with ration having different level of CSC. Mean value revealed that highest MY (5.689±0.096 kg/day) was recorded for group C (35% CSC) while minimum milk yield (4.473±0.184 kg/day) was recorded for Control group. Constitution of diet effect the fermentation pattern in the rumen; among the metabolites produced, volatile fatty acid content and proportion of propionate is related positively with milk

Table 5: Effect of CSC on MY (kg/day) of Crossbred dairy cows

| Ration type | Mean±S.E | P-value |
|---|---|---|
| 0%CSC | 4.473±0.184 | <0.001 |
| 20%CSC | 4.967±0.144 | |
| 35%CSC | 5.689±0.096 | |

Table 6: Effect of ration having different level of CSC on milk profile of dairy cows (Mean±S.E)

| Milk composition (Percent) | Ration type: 0% CSC (Control group) | 20% CSC group | 35% CSC group | P-value |
|---|---|---|---|---|
| Fat | 3.35±0.22 | 3.38±0.22 | 4.46±0.22 | 0.0007 |
| Protein | 3.00±0.09 | 2.76±0.09 | 2.77±0.09 | 0.136 |
| Lactose | 4.24±0.13 | 3.92±0.13 | 3.92±0.13 | 0.144 |
| SNF | 7.68±0.19 | 7.41±0.19 | 7.45±0.19 | 0.571 |

yield, Volatile fatty acid content in rumen is affected by the proportion and source of roughage, kind of concentrate supplement, source and level of starch in the ration within normal dietary protein limit (Sawal and Kurar, 1998). Increasing the CSC level in the ration favor higher milk production, with 35% CSC substitution improved the milk yield by 21.3%. Toolsee (2001) studied support our finding that CSC supplementation increased milk production by 11-30 percent in crossbred cows. Feed had significant effect on overall milk yield, when feeding allowances are above or best matched with the requirement of the animals, this result confirms to the result narrated by Jabbar (2009), Mushtaq (2009). Miller and Wise (2004), Belibasakis and Tsirgogianni (1995), Chaturvedi (1992), Grings *et al.* (1991) and Sawal *et al.* (1991). James *et al.* (2010) who narrated that milk yield was significantly ($P<0.05$) increased with ration having high level of CSC. The findings were in line with the result of Bade *et al.* (2008) who study the effect of replacement of cottonseed cake with sunflower extraction on lactation performance of cows and find out that highest daily milk yield was produce for the group fed with ration having 50 Percent CSC.

The higher milk yield for group C (35%CSC) might be due to high level of rumen by pass protein of the diet; this finding is in line with the result of Kunju *et al.* (1992) who fed formulated bypass protein feed to crossbred cows on straw based ration and find out that milk production was increased accordance with the level of bypass protein feed intake.

The lower milk production for the control group (0%CSC) might be due to high level of Tannin (ANF) in the diet. High tannin level in the diet could reduce cellulose degradation leading to low concentration of volatile fatty acids such as propionic acid which is required for milk synthesis (Chiqutte *et al.*, 1998; Molle *et al.*, 2009). Tannins reduce cell wall digestibility by inactivating cellulase enzyme and also preventing adhesion of rumen microbes on the cellulose fiber (Waghorn, 2008). In General, productivity is negatively affected by high tannin intake; the availability of the nutrient is reduced due to the formation of complex between tannin and several types of macromolecules. Due to the effect of tannin, voluntary feed intake and digestibility is reduced, leads to impaired animal digestive physiology and mucosal perturbation (Frutos *et al.*, 2004). The most significant effect of tannin is reduction in the ruminal protein degradation (McLeod, 1974). Tannin has great affinity for these molecules and the formation of tannin-protein complex is favor by the pH of ruminal media. As a result of reduction in protein degradation there is lower production of ammonia nitrogen and greater flow of non-ammonia nitrogen to small intestine (Waghorn, 1996). The Mechanisms of ruminal degradation of different dietary fiber by tannin are not totally clear, several authors have reported that the attachment of rumen microorganisms to plant cell walls is prevented by tannins and it is well known that for degradation such attachment is essential to occur (Chiquette *et al.*, 1988). Tannins are also a chelating agent and the availability of certain metallic ions necessary for the metabolism of rumen microorganisms is reduced (Scalbert, 1991). Apart from that tannin has also enzyme inhibiting effect, it react with microbial (both bacterial and fungal) enzymes and inhibiting their activity (Makkar *et al.*, 1988).

**Milk composition:** Table 6 shows the effect of cotton seed cake on milk profile. Among the treatment, control group had average milk Fat 3.35±0.22%, 20% CSC group had average milk fat 3.38±0.22% while 35% CSC group animals had average milk fat 4.46±0.22%. Cows fed on ration having 35% CSC produced 33% higher milk fat content from the control and 20% CSC group cows. Feeding cotton seed cake at higher proportion to the dairy cows is preferred by the local farmers, as local farmers are more interested in higher quantity of butter fat. James *et al.* (2010) had also concluded from their study that supplementation of CSC has significantly ($P<0.05$) increased the milk fat content. However the protein and SNF content was recorded the least in the milk of cows fed with CSC supplementation, while they have no effect on milk lactose content. Coppock *et al.* (1987), Sawal *et al.* (1998), Perry and McLeod (1968), Smith *et al.* (1981) and Gring *et al.* (1991) also narrated that supplementation of CSC in the ration has significantly increased the milk fat content.

The result is in line with the findings of (Miller and Wise, 2004; Nawaz and Yaqoob, 1996 and Chaturvedi, 1992). They find out that high level of CSC in the ration has significantly increased milk fat content. The decline in milk fat content of the control group (0% CSC) might be due to high Ether Extract (fat) content of the diet. The ratio of Acetate to propionate in the rumen is specifically dependent on the number and activity of cellulytic microorganisms that is essential for fiber fermentation (Brand *et al.*, 1997). The number of cellulytic bacteria decrease with high level of dietary fat as it has toxic effect on the microbes, hence lowering ruminal fiber digestion (Vafa *et al.*, 2010) and reducing the acetate to propionate ratio leading to a low fat content in the milk.

The CSC supplementation in the ration has no significant effect on milk protein, Lactose and SNF content. The result confirm to the results derived by Shah (2012), James *et al.* (2010), Cezayry *et al.* (2005) and Tashev and Todorov (1981).

The lower percentage of milk protein for the ration having 20 and 35% CSC can be attributed to the high total mix ration intake or may be due to usual inverse relationship

between milk yield and the content of milk solid components (Olafadehan, 2008). According to Klusmeyer *et al*. (1990) that milk protein content depress with increased in forage intake.

**Conclusions and recommendations:** The present study has confirmed that milk yield was increased with increasing CSC level in feed up to 35%. Feed intake of total mixed ration was increased with increasing concentration of CSC in the ration. Live weight gain was increased with high level of CSC. Nutritive value of cottonseed cake is very good and one of the supplementary source of protein for livestock, especially for ruminants. Production performances of ruminant's animals in terms of milk production and L wt gain were improved by supplementing CSC in ruminants' diets.

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