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## Effects of feeding Distillers Dried Grains with Solubles (DDGS) on blood metabolites of crossbred cows

**Dr. MP Madhavatar, Dr. SV Shah, Dr. KN Wadhvani, Dr. PM Lunagariya, Dr. RJ Modi and Dr. AC Patel**

### Abstract

Present experiment was conducted at Livestock Research Station, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Anand, Gujarat to study the performance of feeding Distillers Dried Grains with Solubles (DDGS) on milk production on 18 HF×Kankrej (75:25) advance pregnant crossbred heifers which were distributed into three treatment groups comprising of 6 animals each. Animals were offered three different types total mix rations containing 20, 10 and 0% Soy DOC and 0, 10 and 20% rice DDGS (RDDGS) in T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups, respectively. Average total WBC, Lymphocytes and Monocytes (103/ $\mu$ L) was non-significantly higher in T<sub>3</sub> (10.02 $\pm$ 0.35, 5.59 $\pm$ 0.24 & 0.35 $\pm$ 0.03) as compared to T<sub>1</sub> (9.68 $\pm$ 0.30, 5.48 $\pm$ 0.21 & 0.32 $\pm$ 0.03) and T<sub>2</sub> (9.26 $\pm$ 0.32, 5.27 $\pm$ 0.20 & 0.32 $\pm$ 0.03) groups, respectively. RBC count (106/ $\mu$ L) and Hb (g/dL) of T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> group cows were (7.59 $\pm$ 0.19, 7.34 $\pm$ 0.17 & 7.11 $\pm$ 0.16) and (9.93 $\pm$ 0.20, 9.80 $\pm$ 0.26 & 9.84 $\pm$ 0.23), respectively. Serum glucose (mg/dL), Protein (g/dL), Creatinine (mg/dL) and Urea (mg/dL) in T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> group cows were (47.73 $\pm$ 1.29, 53.25 $\pm$ 1.66 & 57.28 $\pm$ 2.07), (6.85 $\pm$ 0.05, 7.03 $\pm$ 0.05 & 7.34 $\pm$ 0.04), (1.14 $\pm$ 0.05, 1.00 $\pm$ 0.04 & 0.94 $\pm$ 0.02) and (40.75 $\pm$ 0.43, 35.86 $\pm$ 0.65 & 29.75 $\pm$ 0.42), respectively. Average serum SGPT and SGOT of crossbred heifers that received 20% Soy DOC (T<sub>1</sub>), 10% Soy DOC + 10% DDGS (T<sub>2</sub>) and 20% RDDGS (T<sub>3</sub>) was found to be (31.13 $\pm$ 1.18, 28.28 $\pm$ 1.38 & 30.83 $\pm$ 1.19) and (33.05 $\pm$ 1.08, 33.92 $\pm$ 0.90 and 35.39 $\pm$ 1.18) U/L, respectively, which similar among the treatment groups. Average serum calcium and phosphorus (mg/dL) was higher in T<sub>2</sub> (10.41 $\pm$ 0.12 & 5.12 $\pm$ 0.08) and T<sub>3</sub> (10.40 $\pm$ 0.12 & 5.11 $\pm$ 0.07) as compared to T<sub>1</sub> (10.05 $\pm$ 2.76 & 4.94 $\pm$ 1.40), respectively, which did not differ among the treatment groups. Hematological parameters were within normal range. Likewise, biochemical parameters viz. serum glucose and protein were within normal physiological values suggesting RDDGS as well as Soy DOC fed cows were normal and healthy.

**Keywords:** Distillers dried grains with solubles, soy doc, blood metabolites, crossbred cows

### 1. Introduction

Animal husbandry plays significant role in the welfare of India's rural economy. In developing country like India, about 70% of cost of milk production is the feed cost (Singh *et al.*, 2003) [26]. Higher feeding cost and less supply of conventional feeds and fodders are major constraints in future expansion of dairying. In developing country higher cost and less supply of conventional feedstuffs has increased the demand of alternative feed ingredients. In this condition scientist are forced to find new and other feed resources to fulfill the gap of demand and supply. Use of unconventional feed resource instead of traditional feed stuffs lowers the cost of production. Various types of cereals are in use and millions of tons of fermentation residues are available from ethanol industry which can be feed of animal. Distilleries dried grains with soluble (DDGS) is one by-product from the production of ethanol from grain after fermentation of the starch (Youssef *et al.*, 2013) [31] and they can be used as alternative high protein feed source for livestock feed especially for dairy cows.

Distillers dried grains with solubles (DDGS) has become a common feed ingredient in lactating dairy cow diets over the past decade. Recent studies have shown that DDGS can replace corn and soybean feeds in lactating dairy cow diets up to 22% of the diet (on a DM basis), while maintaining (Mjoun *et al.*, 2010; Ranathunga *et al.*, 2018) [17, 21] or increasing (Anderson *et al.*, 2006; Kleinschmit *et al.*, 2006) [1, 13] milk output constraints in future expansion of dairying.

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Distillers dried grains with solubles (DDGS) has become a common feed ingredient in lactating dairy cow diets over the past decade. Recent studies have shown that DDGS can replace corn and soybean feeds in lactating dairy cow diets up to 22% of the diet (on a DM basis), while maintaining (Mjoun *et al.*, 2010; Ranathunga *et al.*, 2018)<sup>[17, 21]</sup> or increasing (Anderson *et al.*, 2006; Kleinschmit *et al.*, 2006)<sup>[1, 13]</sup> milk output. If diets contain at least 50% forage, it has been suggested that DDGS could be included at 20% of the diet's dry matter (DM) to get the best performance from nursing dairy cows (Schingoethe *et al.*, 2009)<sup>[23]</sup>. According to research by Ranathunga *et al.* (2018)<sup>[21]</sup>, feeding DDGS up to 21% of diet dry matter (DM) may be cost-effective when grains and soy-based protein supplements are at high commodity costs for feeds. Nevertheless, Janicek *et al.* (2008)<sup>[12]</sup> found that supplementing 30% of DDGS in place of pasture, cottonseed, and soybean feeds resulted in highest milk output.

## 2. Materials and Methods

The proposed work was carried out at Livestock Research Station, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Anand, Gujarat. Eighteen advanced pregnant crossbred heifers were selected for the study and divided into three treatment groups based on dam's first standard lactation milk yield (kg; 300 days), body weight of heifers and heifers' dam's parity. The experiment was conducted from 60 days pre-partum (advance pregnancy) to 150 days postpartum. There were three treatment groups with six animals in each group. Animals were offered three different types of concentrates containing 0, 10 and 20% rice DDGS (RDDGS). Concentrate and roughage were given to the experimental animals in the form of total mixed ration (TMR). *viz.* T<sub>1</sub>: 10 kg green fodder + TMR (compound concentrate mixture + *ad libitum* wheat straw + *ad libitum* groundnut/mung gotar + 20% soy Doc + 1% mineral mixture + 1% salt, T<sub>2</sub>: 10 kg green fodder + TMR (compound concentrate mixture) + *ad libitum* wheat straw + *ad libitum* groundnut/mung gotar + 10% soy Doc + 10% DDGS + 1% mineral mixture + 1% salt, T<sub>3</sub>: 10 kg green fodder + TMR (compound concentrate mixture) + *ad libitum* wheat straw + *ad libitum* groundnut/mung gotar + 20% DDGS + 1% mineral mixture + 1% salt. The protein requirement of the cows under different treatment was met as per the ICAR (2013) feeding standard.

Throughout the experimental period half of the measured quantity of total mixed ration was offered to animals during morning and another half at afternoon after tying animals at appropriate places as per experimental schedule. Green fodder @ 10 kg/animal/day was offered during morning hours. Clean wholesome drinking water was offered to animals 3 times in winter & monsoon and 4 times in summer season in 24 h on

*ad libitum* basis. During the post-partum period 50 g of bypass fat was offered to all experimental animals from calving to 60 days post-partum.

Considering the gestation period and the day of calving as day zero in crossbred cattle maintained at Livestock Research Station, the following pattern was followed for blood collection-60, +1, +60, +120 +150 days.

Five ml of blood samples were collected from jugular vein from each experimental animal in sterilized vacutainer tubes (with and without anticoagulant). Vacutainer tube (with anti-coagulant) was used for haematological examination immediately after collection. Other tubes (without anticoagulant) was allowed to clot at room temperature and serum was separated by centrifugation at 3000 rpm for 15 minutes and stored at -20 °C till analysis of various biochemical estimation.

The recorded data during the experiment were statistically analyzed by completely randomized design (CRD) and one-way ANOVA using SPSS software, as per statistical method described by Snedecor and Cochran (2002)<sup>[27]</sup>.

### 2.1 Results and Discussion Haematological Parameters

The overall average total WBC ( $10^3/\mu\text{L}$ ), lymphocyte ( $10^3/\mu\text{L}$ ), monocyte ( $10^3/\mu\text{L}$ ) neutrophil ( $10^3/\mu\text{L}$ ), RBC ( $10^6/\mu\text{L}$ ) and HB value (g/dL) count regardless of treatments and periods was found to be  $9.65\pm 0.19$ ,  $5.44\pm 0.12$ ,  $0.33\pm 0.02$ ,  $3.56\pm 0.20$ ,  $7.35\pm 0.10$  and  $9.86\pm 0.13$  respectively during the experiment.

Total WBC count irrespective of treatments and periods was within the normal range of 4 to 11. Irrespective of periods, the average total WBC count ( $10^3/\mu\text{L}$ ) was non-significantly higher in T<sub>3</sub> ( $10.02\pm 0.35$ ) as compared to T<sub>1</sub> ( $9.68\pm 0.30$ ) and T<sub>2</sub> ( $9.26\pm 0.32$ ). Total lymphocyte values irrespective of treatments and periods were within the normal range of 2.5 to 7  $10^3/\mu\text{L}$ . The average total lymphocyte ( $10^3/\mu\text{L}$ ) was maximum in T<sub>3</sub> ( $5.59\pm 0.24$ ), followed by T<sub>1</sub> ( $5.48\pm 0.21$ ) and T<sub>2</sub> ( $5.27\pm 0.20$ ) but there was no significant difference among the treatment groups. Monocyte values irrespective of treatments and periods were within the normal range of 0.02 to 0.8  $10^3/\mu\text{L}$ . Monocytes was non-significantly higher in T<sub>3</sub> ( $0.35\pm 0.03$ ) and equivalent in T<sub>1</sub> & T<sub>2</sub> ( $0.32\pm 0.03$ ). There was no significant difference among periods of experiment irrespective of treatments. Neutrophil values ( $10^3/\mu\text{L}$ ) irrespective of treatments and periods were within the normal range of 0.60 to 4.2. Average neutrophils were higher in T<sub>3</sub> ( $3.78\pm 0.38$ ) as compared to T<sub>2</sub> ( $3.57\pm 0.38$ ) and T<sub>1</sub> ( $3.34\pm 0.26$ ) groups. There was no significant difference among periods of experiment irrespective of treatments. Total RBC count ( $10^6/\mu\text{L}$ ) irrespective of treatments and periods was within the normal range of 5 to 9.5. Overall total RBC ( $10^6/\mu\text{L}$ ) was higher in T<sub>3</sub> ( $7.59\pm 0.19$ ) as compared to T<sub>2</sub> ( $7.34\pm 0.17$ ) and T<sub>1</sub> ( $7.11\pm 0.16$ ) groups. Total Hb values irrespective of treatments and periods were within the normal range of 8 to 14 g/dL. Ignoring periods, the average of total Hb (g/dL) was non-significantly higher in T<sub>1</sub> ( $9.93\pm 0.20$ ) as compared to T<sub>3</sub> ( $9.84\pm 0.23$ ) and T<sub>2</sub> ( $9.80\pm 0.26$ ) groups.

Results of WBC count in the present experiment are in agreement with the study of Tanaka (2008) who observed that mean values of WBC count in the DDGS group ( $108.3\pm 25.7\times 10^2$  cells/mL) showed higher WBC counts than those of the control group ( $94.3\pm 35.7\times 10^2$  cells/mL) before and after the commencement of DDGS feeding, although the difference was statistically not significant. Also, Ate *et al.* (2009)<sup>[2]</sup> observed that mean values of WBC during the third trimester of pregnancy and early lactation were non-

significantly different. In the present study also difference in WBC count during the pre-partum and post-partum periods was found non-significant.

The concentration of Haemoglobin (g/dL) in the control group vs DDGS containing diet the concentration was  $7.55 \pm 3.05$  vs  $12.5 \pm 2.10$ , respectively, which agreements with the present study (Coroian *et al.*, 2017) [5]. Also, Dinani *et al.* (2018) [8] found that the different level of rDDGS (rice-based distillers dried grains with solubles) and RGM (rice gluten meal) combinations does not affect the concentration of Lymphocyte, Monocyte, Haemoglobin (Hb) which also corroborated with present study.

The present finding was dis-agreed with Sattar and Mirza (2009) who found the pregnant heifers had the highest Hb concentration ( $11.32 \pm 32$  gm/dl), while the pregnant lactating cows had the lowest levels ( $9.24 \pm 35$  gm/dl, the difference was statistically significant ( $p < 0.05$ ). Youssef *et al.* (2013) [31] found that the Haemoglobin concentration significantly increased by using DDGS, which is opposed to the present study.

## 2.2 Blood Biochemical Profile

### 1. Serum glucose

The overall average serum glucose values of crossbred cows irrespective of treatments and periods, over the entire experimental period were found to be  $52.75 \pm 1.06$  mg/dL within the normal range of 35 to 80 mg/dL. Irrespective of periods, serum glucose concentration was  $47.73 \pm 1.29$ ,  $53.25 \pm 1.66$ , and  $57.28 \pm 2.07$  mg/dL, respectively in T<sub>1</sub>, T<sub>2</sub>, and T<sub>3</sub> groups which differ significantly ( $p < 0.05$ ) among each other. Vazquez-Anon *et al.* (1994) found that during the first week of lactation, serum glucose concentration decreased 25%, but by the 2<sup>nd</sup> week of lactation, started to increase which reflected the recovery of feed intake and improving energy status of the cow. Similar results were obtained in the present study where serum glucose decreased by 13-14% during the 60<sup>th</sup> d of lactation being maximum in T<sub>2</sub> (17.54%) followed by T<sub>3</sub> (15.76%) and T<sub>1</sub> (5.57%) and then started to increase. Contradictory to the present study Pandey *et al.* (2021) [19] observed that serum glucose level ( $47.89 \pm 0.56$  mg/d) was not affected by DDGS feeding. Likewise, Islam *et al.* (2022) [11] found that the average plasma glucose did not differ significantly from each other ( $58.60 \pm 0.39$  mg/dL).

### 2. Serum protein

The overall average serum total protein values in crossbred cows irrespective of treatments and periods, over the entire experimental period was found to be  $7.07 \pm 0.03$  g/dL, were the normal range which is 6 to 8 g/dL. Overlooking periods, average serum protein (g/dL) was significantly ( $p < 0.05$ ) higher in T<sub>3</sub> ( $7.34 \pm 0.04$ ) and T<sub>2</sub> ( $7.03 \pm 0.05$ ) as compared to T<sub>1</sub> ( $6.85 \pm 0.05$ ) groups. The present study was supported by Pandey *et al.* (2021) [19] observed that serum protein ( $6.05 \pm 0.03$  mg/d) increased significantly ( $p < 0.05$ ) when soya DOC was replaced with DDGS, although the increase was non-linear. Opposing to present study, Desai (2020) [6] found statistically similar serum total protein ( $6.43 \pm 0.07$  vs.  $6.55 \pm 0.08$ ) between crossbred calves that received either jowar hay or a mixture of 50% soybean straw and 50% wheat straw.

### 3. Serum creatinine

The overall average serum creatinine values of crossbred cows irrespective of treatments and periods, over the entire experiment was found to be  $1.03 \pm 0.02$  mg/dL, which, within

the normal range of 0.5 to 2.2 mg/dL. Serum creatinine of experimental cows was within normal reference interval as mentioned in Merck's Veterinary Manual in cows (0.5-2.2 mg/dL). However, a higher normal reference range is depicted in Clinical Biochemistry of Domestic Animals i.e. 1.2-1.9 mg/dL. Mili *et al.* (2020) [16] in Manipuri cattle ( $0.49 \pm 0.11$  mg/dL) observed a lower value for serum creatinine than the present study. While, Chandrashekhar *et al.* (2017) [4] in Deoni crossbred cows observed higher serum creatinine (mg/dL) at  $1.52 \pm 0.81$ ,  $1.82 \pm 0.08$  and  $1.64 \pm 0.08$  during winter, spring, and summer, respectively.

### 4. Serum urea

The overall average serum urea values of crossbred cows irrespective of treatments and periods, over the entire experiment were found to be  $35.46 \pm 0.56$  mg/dL, which, is within the normal range of 20 to 42 mg/dL. Overlooking periods, average serum urea (mg/dL) was significantly ( $p < 0.05$ ) higher in T<sub>1</sub> ( $40.75 \pm 0.43$ ) and T<sub>2</sub> ( $35.86 \pm 0.65$ ) as compared to T<sub>3</sub> ( $29.75 \pm 0.42$ ), which differ significantly ( $p < 0.05$ ) among the treatment groups. Dey *et al.* (2019) [7] in crossbred calves ( $20.29 \pm 2.41$  vs.  $18.38 \pm 3.35$  mg/dl) found a numerical decrease in blood urea on feeding RDDGS against soybean meal. Reduction in blood urea nitrogen was significant in dairy cows (5.4 vs. 5.2 vs. 5.0 vs. 4.8 mmol/L) when wDDGS was included at the rate of more than 160 g/kg diet DM (Garnsworthy *et al.*, 2021) [9]. A parallel finding was reported by Shelke *et al.* (2015) [25], they observed significantly higher blood urea (29.65 vs. 35.67 mg/dL) in soybean fed group over the fed group. Likewise, Pandey *et al.* (2021) [19] found that the serum urea level reduced significantly ( $p < 0.05$ ) and linearly on replacing Soy DOC with RDDGS.

### 5. Serum glutamic-pyruvic transaminase (SGPT)

The overall average serum glutamic-pyruvic transaminase (SGPT) values of crossbred cows irrespective of treatments and periods, over the entire experiment was found to be  $30.08 \pm 0.73$  U/L which, is within the normal range which is up to 40 U/L. Average serum SGPT of crossbred heifers that received 20% Soy DOC (T<sub>1</sub>), 10% Soy DOC + 10% DDGS (T<sub>2</sub>) and 20% RDDGS (T<sub>3</sub>) was found to be  $31.13 \pm 1.18$ ,  $28.28 \pm 1.38$  and  $30.83 \pm 1.19$  U/L, respectively. Pandey *et al.* (2021) [19] reported that the serum SGPT (U/L) was statistically similar between the soy DOC fed group and the fed group of cows. Lower serum SGPT (U/L) than the present study, by Dey *et al.* (2019) [7] in crossbred calves ( $12.65$  vs.  $11.04 \pm 1.9$  U/L) on feeding RDDGS in place of soybean meal.

### 6. Serum glutamic-oxaloacetic transaminase (SGOT)

Irrespective of treatments and periods, the overall Serum glutamic-oxaloacetic transaminase (SGOT) of experimental cows was found to be  $34.12 \pm 0.61$  U/L, which was the normal range which is up to 40 U/L. Average serum SGOT (U/L) of crossbred heifers that received 20% Soy DOC (T<sub>1</sub>), 10% Soy DOC + 10% DDGS (T<sub>2</sub>) and 20% RDDGS (T<sub>3</sub>) was found to be  $33.05 \pm 1.08$ ,  $33.92 \pm 0.90$  and  $35.39 \pm 1.18$ , respectively. Dey *et al.* (2019) [7] in crossbred calves ( $34.61 \pm 2.1$  vs.  $37.64 \pm 2.5$ ) reported similar plasma SGOT (U/L). While, Mahima *et al.* (2013) [14] in Haryana heifers ( $66.63 \pm 2.38$ ), Mayengbam (2014) [15] in Frieswal heifers during summer (94.93) and winter (84.91), Giri *et al.* (2017) [10] in Jersey cow during summer ( $93.39 \pm 3.01$ ) & winter ( $73.56 \pm 1.89$ ) and Mili *et al.* (2020) [16] in Manipuri cattle ( $71.39 \pm 4.19$ ) found higher SGOT values than present investigation.

## 2.3 Mineral Profile

### 1. Serum calcium

The overall average serum calcium values of crossbred cows irrespective of treatments and periods, over the entire experiment was found to be  $10.29 \pm 0.92$  mg/dL which, within the normal range is 8.7 to 12 mg/dL. Overlooking periods, average serum calcium (mg/dL) was higher in T<sub>2</sub> ( $10.41 \pm 0.12$ ) and T<sub>3</sub> ( $10.40 \pm 0.12$ ) as compared to T<sub>1</sub> ( $10.05 \pm 2.76$ ). Serum calcium level did not change on feeding RDDGS, a similar finding was reported by Stewart *et al.* (2017) in heifers. Also, Pandey *et al.* (2021)<sup>[19]</sup> concluded that the serum calcium remained statistically similar among soy-DOC and RDDGS fed group heifers. Average serum calcium in crossbred heifers was similar to serum calcium level (10.59 mg/dL) in calves as reported by Patil (2005)<sup>[20]</sup>. In contradiction to the present finding, Desai (2020)<sup>[6]</sup> found significantly higher serum calcium in crossbred calves that received a mixture of leguminous and non-leguminous straw.

### 2. Serum phosphorus

The overall average serum phosphorus values of crossbred cows irrespective of treatments and periods, over the entire experiment was found to be  $5.06 \pm 0.46$  mg/dL which, within the normal range is 4.0 to 6.5 mg/dL. Regardless of the periods, average serum phosphorus (mg/dL) was higher in T<sub>2</sub> ( $5.12 \pm 0.08$ ) and T<sub>3</sub> ( $5.11 \pm 0.07$ ) as compared to T<sub>1</sub> ( $4.94 \pm 1.40$ ). Similar to present findings, higher serum phosphorus in growing cattle was reported by Palmer (1930)<sup>[18]</sup>, Bide, and Tumbleson (1976)<sup>[3]</sup> as well as Shah (1990)<sup>[24]</sup> in crossbred heifers ( $8.424 \pm 0.20$  mg/mL).

### 3. Conclusions

It may be concluded from the present study that blood serum parameters *viz.* WBC, RBC, Hb, neutrophils, monocytes and lymphocytes were within normal range. Likewise, biochemical parameters *viz.* serum glucose and protein were within normal physiological values suggesting RDDGS as well as Soy DOC fed cows were normal and healthy. Serum urea reduced significantly ( $p < 0.05$ ) on feeding RDDGS in place of soy DOC indicating RDDGS as a good source of rumen undegradable protein. Serum creatinine, SGOT and SGPT were within normal limit indicating no harmful effect of feeding RDDGS and Soy DOC on kidney and liver functioning.

**Conflict of Interest:** Not available

**Financial Support:** Not available

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