The Pharma Innovation Journal 2023; 12(2): 1200-1204

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(2): 1200-1204

www.thepharmajournal.com
Received: 12-11-2022
Accepted: 13-12-2022

Biochemical changes in postpartum Bidri goats supplemented with maize alone or with safflower oil and estrus synchronised using CIDR based Protocol

Prashantkumar, Bijurkar RG, Venkanagouda D, Tandle MK, Suranagi MD and Shrikant Kulkarni

Prashantkumar
Ph.D Scholar, Department of Veterinary Gynaecology and Obstetrics, Veterinary College, KVAFSU, Bidar, Karnataka, India

Bijurkar RG
Professor and Head, Department of Veterinary Gynaecology and Obstetrics, Veterinary College, KVAFSU, Bidar, Karnataka, India

Venkanagouda D
Assistant Professor, Department of Veterinary Clinical Complex, Veterinary College, KVAFSU, Bidar, Karnatak, India

Tandle MK
Professor and Director of Instruction (PGS), KVAFSU, Bidar, Karnataka, India

Suranagi MD
Professor and Head, Department of Animal Genetics and Breeding, Veterinary College, KVAFSU, Bidar, Karnataka, India

Shrikant Kulkarni
Professor and Head, Department of Veterinary Physiology and Biochemistry, Veterinary College, KVAFSU, Bidar, Karnataka, India

Corresponding Author:
Prashantkumar
PhD Scholar, Department of Veterinary Gynaecology and Obstetrics, Veterinary College, KVAFSU, Bidar, Karnataka, India

Abstract
This study was conducted to find out the effect of supplementation of maize and safflower oil combined with CIDR estrus synchronization protocol on some biochemical parameters during major and minor breeding seasons. Seventy-five postpartum Bidri goats were selected from the day of kidding and divided into 5 groups (n=15). i. control, ii. maize, iii. maize and CIDR, iv. maize and safflower oil and v. maize, safflower oil and CIDR. The blood samples were collected on 0 (on the day of parturition), 15, 22, 30, estrus day and 30 days post mating. Samples were analysed for serum parameters *viz*., glucose, cholesterol, total protein and albumin. The serum glucose and cholesterol levels showed increasing trend following parturition and reaching high values on d-30 post mating and day of estrus, respectively. The supplementation of only maize or along with safflower oil with or without estrus induction using CDR did not had any impact. Further, the total protein and albumin did not showed any specific trend or impact of any treatment or supplementation.

Keywords: Bidri goats, biochemical parameters, CIDR, estrus synchronization, postpartum period

1. Introduction

Goats, the "Poor man's cow" are known for low cost of rearing and meagre management requirements. They have served the mankind especially the rural poor farmers since prehistoric times. The versatile properties of its various products like milk, meat, hair and skin makes it a reliable and potential source of income. Among the numerous breeds, Bidri goat is mostly reared in the Bidar and Kalaburagi districts of Northern Karnataka region of South India. It is one of the best dual-purpose breed with better milk yield and twinning ability making it as a breed of choice among the farmers. Reproduction is an important phenomenon that determines the income of the livestock farmers and is affected by various factors. Earlier studies have suggested that postpartum constituents of blood are important indicators of biochemical and physiological changes taking place during this critical period (Manat *et al*., 2016) [8]. The biochemical changes are related to the stress condition in animals and are related to the productivity and management practice of the animals (Manat *et al*., 2016; Soares *et al*., 2018; Zamunar *et al*., 2020) [8, 11, 17].

Estrus synchronization is among the most important reproductive management strategy to augment fertility (Stevenson and Britt, 2017) [13]. The controlled internal drug release (CIDR) devices containing 0.3 gm of progesterone are currently the preferred method of progesterone administration in goats (Wheaton *et al*., 1993) [15]. The Bidri goats are reared mostly under traditional method and their commercialization is the need of the time. The reproductive performance and estrus synchronisation studies on this breed are scanty. The present study therefore aimed to evaluate biochemical parameters in postpartum does to improve fertility by energy supplementation and estrus synchronization.

2. Material and Method

2.1 Ethical approval

The study was conducted duly following approved guidelines from the Institutional Animal Ethics Committee.

2.2 Location of the study

The study was conducted in and around Bidar city and lies between 17º35' and 18º29' North latitude and 76º41’ to 77º39’ East longitude. The coldest months are December and January, the temperature begins to rise towards the end of February till May which is the hottest month of the year. The temperature varies in between 20ºC and 42ºC. The year may be divided into summer season from March to May, southwest monsoon season from June to September, post-monsoon season from October to November and winter season from December to February (CGWB, 2008). The complete study was carried out from October 2021 to November 2022. The phase one of the study was conducted between October 2021 to April 2022 and phase two was between May-2022 to November-2022.

2.3 Selection of animals
The experimental animals were selected from the flocks of Bidri goats maintained by local farmers (private farms), in and around Bidar district. For the study, seventy-five healthy, post-partum Bidri goats between 1-4 parity were selected and randomly divided into 5 groups of 15 goats each. The goats were reared under a semi-intensive housing system with free grazing for 4-6 hrs daily with *ad libitum* drinking water and routine deworming and vaccinations on regular basis.

2.4 Estrus synchronization protocols
The following treatment protocols were repeated for two sequential kidding`s on the same goats.

2.4.1 Group 1 (T_0) - Control
This group was considered as control, the goats in this group were not provided with any additional feed other than grazing.

2.4.2 Group 2 (T_1) – Maize Feeding
Each animal in this group along with grazing, additionally fed with 250 g of maize grains daily (morning) for 30 days from the day of parturition.

2.4.3 Group 3 (T_2) – Maize + CIDR
Each animal in this group along with grazing, additionally fed with 250 g of maize grains daily (morning) for 30 days from the day of parturition. On 16^{th} day postpartum, Controlled Internal Drug Release (CIDR= 0.3gm of progesterone) devices were inserted into the vagina aseptically with the help of an applicator and left in-situ for 14 days. Then, implants were withdrawn and an intramuscular injection of a synthetic prostaglandin, PGF2α (Cloprostenol Sodium) @ 125 µg/doe was administered.

2.4.4 Group 4 (T_3) – Maize + Safflower Oil Feeding
Each animal in this group were fed 250 g of maize grains daily (morning) along with 50 g of Safflower oil for 30 days from the day of parturition.

2.4.5 Group 5 (T_4) – Maize + Safflower Oil Feeding + CIDR
Each animal in this group were fed 250 g of maize grains daily (morning) along with 50 g of Safflower oil for 30 days from the day of parturition. On the 16^{th} day Controlled Internal Drug Release (CIDR= 0.3gm of progesterone) devices were inserted into the vagina aseptically with the help of an applicator and left inside the vagina for 14 days. Then, implants were withdrawn and an intramuscular injection of a synthetic prostaglandin, PGF2α (Cloprostenol Sodium) @ 125 µg/doe was given.

2.5. Estrus detection and Mating
The does were observed for estrus signs twice daily at 12-hour interval. The does in estrus were allowed to mate with bucks for naturally.

2.6 Blood Collection
Blood samples, collected by jugular vein puncture in the morning hour before feeding, from all the groups on day 0 (day of kidding), 15, 22, 30, on the day of estrus and 30 days post mating. The serum samples were harvested by centrifugation at 3000 rpm for 10 minutes and samples were made into two aliquot and stored at -20˚C until analysis.

2.7 Serum biochemical analysis
Serum biochemical analysis for glucose (mg/dL), cholesterol (mg/dL), total protein (g/dL) and albumin (g/dL) were performed as per assay procedures mentioned in the kits of Transasia Bio-Medicals Ltd. duly following the procedures as directed by the supplier with semi-automatic biochemical analyser (Microlab-300, Elite Tech Ltd.).

2.8 Statistical Analysis
The data obtained was analysed and compared using SAS 9.3 software.

3. Results and Discussion
The mean ± SE values of serum biochemical parameters for different groups at different reproductive stages in Bidri goats are presented in Tables 1 to 8.

Serum glucose
In the first kidding (Phase-I), the serum glucose showed varying levels but was significantly high only on 30 days post-mating compared to parturition day in all the groups, but not in the second kidding. When compared between the groups in both the kidding’s, except on the day of estrus and 30-days post-mating, the serum glucose was higher in all treatment groups either significantly ($p<0.05$, d-22 and d-30) or non-significantly ($p>0.05$, d-0 and d-15).

The glucose levels are reported to decrease up to day fourteen post-partum and then onwards an increase up to d-45 post-partum (Manat *et al.,* 2016) [8], which was similar to the present study except the decrease in glucose up to 14 day was noted here. Glucose is the primary source of energy for the regulation of multiple reproductive process and reduced blood levels of glucose can affect the follicular growth, ovulation, estrus response (Dupont *et al*. 2014; Sosa *et al*. 2009) [4, 12]. Previously, it has been reported that P4 treatment enhances the glucose level (Samad and Ford 1981) [10]; however, no variation was observed in the present study. All the glucose values were within physiologically normal range as reported for goats (Kaneko *et al*., 2008) [2].

Serum Cholesterol
In both the sequential kidding’s (phase I & phase II), the serum cholesterol did not vary significantly ($p>0.05$) either between the groups or between the days except for between the days in phase II. In both the phases, the cholesterol levels showed sequential increase with advancement of post-partum period which was only significant ($p<0.05$) in all treatment groups on the day of estrus in phase II when compared to day 0. The cholesterol levels were within the normal range which concurs with the findings of 65-136 mg/dl (Mohammed *et al*.,

2016 and Daramola *et al*., 2005) [9, 3] and an increasing trend up to the day of estrus was in agreement with Krajnicakova *et al*. (2003) [7] and Witte and Schafer (2007) [16] in the puerperal period of goats. In addition, Witte and Schafer (2007) [16] stated that cholesterol was precursor for steroid hormones, is needed for early resumption of postpartum ovarian activity and cyclicity. High level of cholesterol during estrus was supported by Ishwar and Pandey (1994) [6], who stated that estrogen influences lipid metabolism through liponeogenesis which in turn causes increased production of cholesterol in endocrine gland tissue from acetate during estrus.

Serum Total Protein

In both the sequential kidding's (phase I & phase II), the proteins levels did not follow a trend except for significantly high level on the day of estrus when compared day-0 in phase I.

The total protein concentration during postpartum period was reported to show slight increase from the day 7th up to 21st day postpartum but the differences were non-significant (Bhoite *et al*., 2019) which was not observed in the present study. Few researchers reported that highest level of serum total protein on day 45th postpartum in Surti goat (Manat *et al*., 2016) [8] and on day 40th postpartum in goat (Krajnicakova *et al*, 2003) [7], which are closer to our findings on 30 days post mating. Moreover, the physiological stage also influenced the total protein concentration in different species. The lactation period did not influence total protein in Sahel goat (Waziri *et al*., 2010) [14], which is in agreement with our study findings.

Serum Albumin

In both the sequential kidding's (phase I & phase II), the serum albumin did not vary significantly (p>0.05) either between the groups or between the days except for treatment group 4 where it showed significantly high levels on day-22 when compared to day 0.

The albumin levels are reported to increase up to 14 days postpartum (Manat *et al*., 2016) [8], which is evident with present study findings and increase in albumin in 1st week followed by decrease in 2nd week and 3rd week after parturition (Iriadam, 2007) [5], which is contrary to present study findings could be because of breed, season and managemental variations. All the albumin values were within the physiologically normal range for goats (Kaneko *et al*., 2008) [2].

4. Conclusion

To conclude, the serum glucose and cholesterol levels have increasing trend following parturition and reaching high values on d-30 post mating and day of estrus, respectively. The supplementation of only maize or along with safflower oil with or without estrus induction using CDR did not had any impact. Further, the total protein and albumin also did not showed any specific trend or impact of any treatment or supplementation.

Table 1: Mean ± SE values of serum glucose (mg/dL) in different groups at different intervals (Phase 1)

Groups \ Days	0th Day	15th Day	22nd Day	30th Day	Estrus Day	P.D. Day
Control (T_0)	47.40±2.02^{aA}	55.80±1.65^{aA}	53.60±1.97^{aA}	56.20±1.60^{aA}	52.27±1.47^{aA}	67.07±2.58^{bA}
Maize (T_1)	53.60±1.60^{acA}	61.53±1.11^{abA}	57.13±0.70^{adeAB}	64.07±1.39^{bdAB}	49.53±1.60^{ceA}	64.53±2.32^{bdA}
Maize + CIDR (T_2)	50.60±2.41^{aA}	60.53±0.90^{bA}	61.47±0.80^{bAB}	57.40±1.66^{abA}	50.53±1.70^{aA}	65.40±1.94^{bA}
Maize + SFO (T_3)	52.00±1.96^{aA}	62.53±1.49^{bA}	61.80±0.80^{bAB}	66.47±0.98^{bB}	50.07±1.39^{aA}	64.87±2.64^{bA}
Maize + SFO + CIDR (T_4)	51.40±2.37^{aA}	58.53±1.02^{abA}	65.73±1.48^{bB}	64.93±1.13^{bAB}	49.73±1.56^{aA}	66.13±2.44^{bA}

Table 2: Mean ± SE values of serum glucose (mg/dL) in different groups at different intervals (Phase 2)

Groups \ Days	0th Day	15th Day	22nd Day	30th Day	Estrus Day	P.D. Day
Control (T_0)	52.67±1.74^{aA}	53.40±1.46^{aA}	52.47±1.96^{aA}	53.53±2.37^{aA}	49.73±0.79^{aA}	57.40±2.52^{aA}
Maize (T_1)	51.93±2.83^{aA}	61.67±2.16^{abA}	68.07±2.55^{bB}	65.93±2.68^{bcB}	53.93±1.30^{acdA}	62.33±2.70^{abA}
Maize + CIDR (T_2)	53.47±2.79^{aeA}	62.27±2.00^{abeA}	71.33±2.32^{bcdB}	65.40±2.66^{acAB}	52.93±1.20^{eA}	62.47±2.27^{adeA}
Maize + SFO (T_3)	52.60±2.82^{aA}	59.93±1.74^{abA}	66.07±2.20^{bB}	70.47±3.11^{bB}	53.07±1.16^{aA}	60.13±2.70^{abA}
Maize + SFO + CIDR (T_4)	53.13±2.86^{aA}	60.13±2.25^{aA}	65.07±3.08^{abB}	68.67±2.38^{bB}	53.40±1.14^{aA}	61.53±2.42^{abA}

Means with different superscripts differ significantly at $P<0.05$

abcdefg Superscripts indicate the statistical difference in serum glucose values on different time interval within groups.

ABC Superscripts indicate the statistical difference in serum glucose values between groups on different time interval.

Table 3: Mean ± SE values of serum cholesterol (mg/dL) in different groups at different intervals (Phase 1)

Groups \ Days	0th Day	15th Day	22nd Day	30th Day	Estrus Day	P.D. Day
Group 1 (T_0)	71.40±7.17^{aA}	72.87±8.34^{aA}	84.47±7.20^{aA}	73.73±7.90^{aA}	93.87±6.66^{aA}	104.27±4.48^{aA}
Group 2 (T_1)	73.87±5.88^{aA}	74.13±6.89^{aA}	83.27±7.75^{aA}	76.33±6.91^{aA}	95.87±5.18^{aA}	103.40±4.44^{aA}
Group 3 (T_2)	73.80±7.19^{aA}	72.20±6.16^{aA}	85.80±5.47^{aA}	94.80±15.07^{aA}	105.67±8.48^{aA}	108.93±5.24^{aA}
Group 4 (T_3)	72.27±6.69^{aA}	74.53±5.40^{aA}	86.07±11.16^{aA}	81.53±10.28^{aA}	91.67±6.50^{aA}	106.93±4.63^{aA}
Group 5 (T_4)	72.80±8.04^{aA}	73.53±5.77^{aA}	83.47±8.91^{aA}	83.60±7.32^{aA}	92.67±7.62^{aA}	108.33±4.82^{aA}

Table 4: Mean ± SE values of serum cholesterol (mg/dL) in different groups at different intervals (Phase 2)

Groups \ Days	0th Day	15th Day	22nd Day	30th Day	Estrus Day	P.D. Day
Group 1 (T_0)	71.53±3.48 aA	73.33±4.58 aA	77.53±3.53 aA	80.53±4.21 aA	90.07±3.34 aA	86.27±3.89 aA
Group 2 (T_1)	71.20±2.79 aA	75.13±4.14 abA	79.73±4.70 abA	81.27±3.64 abA	93.27±2.60 bA	87.93±2.50 abA
Group 3 (T_2)	72.47±2.60 aA	75.40±4.56 aA	79.20±3.78 abA	82.00±4.35 abA	96.00±3.40 bA	90.93±2.89 abA
Group 4 (T_3)	72.13±3.63 aA	78.80±3.99 aA	80.13±4.04 acA	83.13±4.16 acA	105.73±2.64 bA	98.73±2.08 bcA
Group 5 (T_4)	72.87±3.93 aA	80.67±4.00 aA	83.40±3.70 aA	86.47±2.60 acA	118.53±2.71 bA	103.60±3.58 bcA

Means with different superscripts differ significantly at P<0.05
abcdefg Superscripts indicate the statistical difference in serum cholesterol values on different time interval within groups.
ABC Superscripts indicate the statistical difference in serum cholesterol values between groups on different time interval.

Table 5: Mean ± SE values of serum total protein (g/dL) in different groups at different intervals (Phase 1).

Groups \ Days	0th Day	15th Day	22nd Day	30th Day	Estrus Day	P.D. Day
Group 1 (T_0)	7.01±0.44 aA	6.78±0.36 aA	6.69±0.35 aA	7.44±0.36 aA	10.29±0.78 bA	7.89±0.42 abA
Group 2 (T_1)	6.17±0.43 aA	7.11±0.37 aA	6.68±0.39 aA	7.33±0.36 aA	10.49±0.73 bA	8.45±0.38 abA
Group 3 (T_2)	7.45±0.30 abA	6.21±0.43 aA	5.95±0.39 aA	7.07±0.35 abA	8.98±0.64 bA	8.43±0.36 abA
Group 4 (T_3)	6.59±0.56 aA	7.31±0.42 aA	6.13±0.40 aA	7.07±0.30 aA	10.07±0.77 bA	8.37±0.43 abA
Group 5 (T_4)	7.85±0.36 aA	7.27±0.43 aA	6.46±0.52 aA	7.75±0.36 aA	10.59±0.66 bA	8.31±0.44 abA

Table 6: Mean ± SE values of serum total protein (g/dL) in different groups at different intervals (Phase 2).

Groups \ Days	0th Day	15th Day	22nd Day	30th Day	Estrus Day	P.D. Day
Group 1 (T_0)	6.27±0.21 abA	5.76±0.20 aA	7.42±0.36 bA	5.67±0.20 aA	6.62±0.27 abA	6.88±0.15 abA
Group 2 (T_1)	6.25±0.17 aA	5.83±0.17 aA	7.90±0.30 bA	5.93±0.23 aA	7.02±0.24 aA	6.93±0.18 abA
Group 3 (T_2)	6.22±0.24 aeA	5.72±0.26 aA	7.89±0.41 bcA	5.21±0.19 aA	7.32±0.25 ceA	7.08±0.19 bdeA
Group 4 (T_3)	5.92±0.27 adeA	5.79±0.17 adA	7.78±0.23 bfeA	5.43±0.35 aA	6.85±0.23 cdefA	7.20±0.25 eA
Group 5 (T_4)	6.58±0.22 acdA	5.61±0.27 aA	8.47±0.32 beA	6.05±0.21 afA	7.43±0.19 cegA	7.11±0.25 dfgA

Means with different superscripts differ significantly at P<0.05
abcdefg Superscripts indicate the statistical difference in serum total protein values on different time interval within groups.
ABC Superscripts indicate the statistical difference in serum total protein between groups on different time interval.

Table 7: Mean ± SE values of serum albumin (g/dL) in different groups at different intervals (Phase 1).

Groups \ Days	0th Day	15th Day	22nd Day	30th Day	Estrus Day	P.D. Day
Group 1 (T_0)	2.73±0.32 aA	3.05±0.22 aA	3.61±0.32 aA	3.69±0.44 aA	3.44±0.21 aA	2.65±0.42 aA
Group 2 (T_1)	2.67±0.26 aA	2.87±0.15 aA	3.72±0.44 aA	3.45±0.41 aA	3.47±0.25 aA	2.71±0.41 aA
Group 3 (T_2)	2.93±0.24 aA	2.88±0.14 aA	3.20±0.21 aA	3.37±0.45 aA	3.05±0.20 aA	2.58±0.20 aA
Group 4 (T_3)	2.81±0.26 aA	3.35±0.17 aA	3.71±0.51 aA	3.38±0.46 aA	3.03±0.13 aA	2.58±0.42 aA
Group 5 (T_4)	2.57±0.24 aA	2.76±0.11 aA	3.23±0.20 aA	3.48±0.17 aA	3.20±0.18 aA	2.43±0.18 aA

Table 8: Mean ± SE values of serum albumin (g/dL) in different groups at different intervals (Phase 2)

Groups \ Days	0th Day	15th Day	22nd Day	30th Day	Estrus Day	P.D. Day
Group 1 (T_0)	2.41±0.11 aA	3.11±0.35 aA	2.75±0.11 aA	2.84±0.34 aA	2.77±0.14 aA	2.59±0.12 aA
Group 2 (T_1)	2.47±0.11 aA	3.04±0.36 aA	3.01±0.16 aA	2.53±0.19 aA	2.94±0.18 aA	2.89±0.13 aA
Group 3 (T_2)	2.43±0.12 aA	3.05±0.24 aA	2.78±0.30 aA	3.29±0.53 aA	3.06±0.18 aA	2.84±0.11 aA
Group 4 (T_3)	2.42±0.11 aA	3.11±0.16 aA	3.11±0.39 aA	2.48±0.20 aA	2.62±0.17 aA	2.67±0.14 aA
Group 5 (T_4)	2.43±0.08 aA	3.20±0.17 abA	3.89±0.57 bA	2.73±0.19 abA	3.13±0.20 abA	2.91±0.11 abA

Means with different superscripts differ significantly at P<0.05
abcdefg Superscripts indicate the statistical difference in serum albumin values on different time interval within groups.
ABC Superscripts indicate the statistical difference in serum albumin values between groups on different time interval.

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