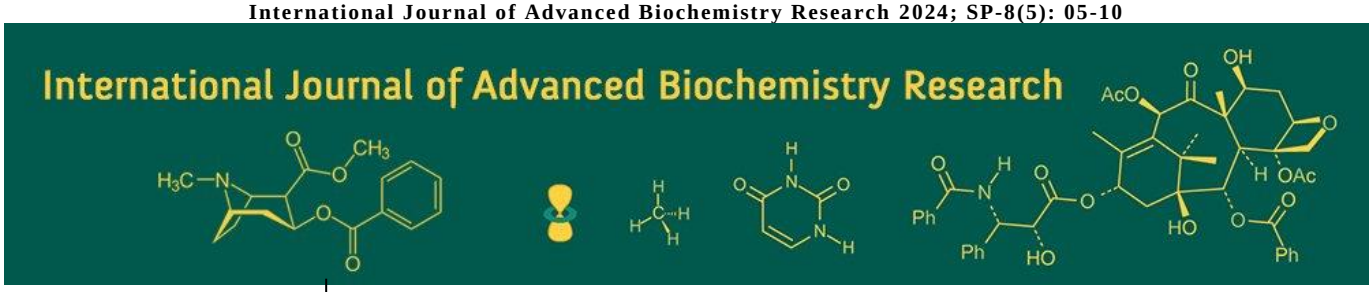

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; SP-8(5): 05-10
www.biochemjournal.com
Received: 05-02-2024
Accepted: 12-03-2024

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Comparative study on serum biochemical profiles during different states of reproduction in Jersey crossbred cows

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DOI: https://doi.org/10.33545/26174693.2024.v8.i5Sa.1084

Abstract
A comparative study on serum biochemical constituents was carried out in pregnant, estrus, anestrus and regular cyclic Jersey crossbred cattle. A total of 48 healthy Jersey crossbred cattle (n=48), aged 3-6 years with body condition score of 5-6 were selected and they were divided into four groups, each group comprised of twelve (n=12) animals (Group I: Pregnant, Group II: Estrus, Group III: Anestrus and Group IV: Regular cyclic). Experimental cows were properly vaccinated and dewormed as per the schedule of the farm. In morning, prior to concentrate feeding, the blood samples were collected in heparinized vacutainer and immediately transported to the laboratory. The blood samples were centrifuged at 3000 × g for 15 min. Serum samples were separated and kept at -20 °C until estimation of biochemical profiles. Concentration of serum total protein, albumin, globulin, glucose, total cholesterol was significantly (p<0.05) higher in pregnant as compared to anestrus animals which was recorded as the lowest among the four groups. Regular cyclic cows had non-significantly higher concentration of serum protein, glucose, total cholesterol and creatine as compared to anestrus cows. Similarly, concentration of serum blood urea nitrogen (BUN), creatinine and liver functional enzymes (aspartate aminotransferase; AST, alanine aminotransferase; ALT and alkaline phosphatase; ALP) was higher in pregnant as compared to anestrus cows. However, anestrus animals were had non-significantly higher concentration of BUN and liver enzymes as compared to regular cyclic cows. Therefore, these findings implied that day 45–60 postpartum, blood glucose, total protein and BUN and total cholesterol have significant impact on the cyclicity of Jersey crossbred cows. Further research on mechanism of these metabolites on cyclicity of postpartum cow is required to confirm these findings.

Keywords: Biochemical analytes, Pregnant, Anestrus, Regular cyclic, Jersey Cows

Introduction
Twentieth livestock census of India revealed that 21% of India's total cattle population (192.49 million) is made up of exotic and crossbred animals. The exotic/crossbred and indigenous/non-descript cattle population in the country is 50.42 million and 142.11 million, respectively. The population of the total exotic/crossbred cattle has increased by 26.9% in 2019 as compared to earlier census. Dairy enterprise is the chief allied agricultural sector in Tamil Nadu, India. Landless labours and small and marginal farmers rely on the dairy industry for their livelihood in rural sector of Tamil Nadu. The state relies on crossbred cattle to produce milk and more than 65% of the cattle population was made up of crossbreds (NDDB, 2014) [1]. Holstein and Friesian crossbred cattle in mountainous regions and Jersey crossbred cattle plain and coastal regions of Tamil Nadu are reared.

Reference values for serum biochemistry and haematology are used to determine normalcy, to diagnose the illness, and to identify the physiological changes. Longer calving interval, lower calf crop, shorter productive life and anestrus result in significant economic loss to the farmers. There have been reports of anestrus incidences ranging from 5.40% to 65.00% (Butani *et al*., 2008) [2]. Researcher agree that the anestrus period following calving in dairy cows should not last longer than 60 days. This complicates the process of inferring results for animals that live in tropical countries like India by using reference intervals from other nations. In order to compare the serum biochemical profiles of pregnant, estrus, and anestrus cows with those of normal cyclic cows, the current study was carried out.

Materials and Methods

Experimental animals

The present investigation was carried out at the Department of Veterinary Physiology and Biochemistry, TANUVAS-Veterinary College and Research Institute, Orathanadu, Thanjavur, Tamil Nadu, India. The institute is located 30 meters above mean sea level (MSL) with a latitude of 10.6°N and 79.3°W. Experimental animals were selected from an organised farm from Thanjavur district, Tamil Nadu, India. A total of 48 healthy Jersey crossbred cattle, aged about 3-6 years and each group was consisted of twelve (n=12) animals *viz.*, Group I: Pregnant (P), Group II: Estrus (E), Group III: Anestrus (A) and Group IV: Regular cyclic (R) crossbred Jersey cows. Herein after, groups will be mentioned G I: (P), G II: (E), G III: (A) and G IV: (R) Jersey crossbred cows.

Managemental practices

Experimental Jersey crossbreed cows were housed under identical setting with comparable managerial techniques under intensive system of management. Experimental animals were received 20-30 kg of green, 5-7 kg of dry fodder and 2 kg of concentrate feed for maintenance, and 400 grams of additional feed were given for each kilogram of milk produced. Milking was done twice a day, separated by twelve hours. Animals were properly vaccinated and dewormed as per farm schedule. The feed received by the Jersey crossbred cows during the study period was a mixture of roughage and concentrate and water supplied as *ad libitum*.

Blood collection

Blood samples were collected in a heparinized vacutainer in morning prior to concentrate feeding and immediately transported to the laboratory. The blood samples were centrifuged at 3000 × g for 15 min. Serum was separated and stored at -20 ºC until further use. Serum biochemical parameters such as total protein (TP; g/dL), albumin (g/dL), globulin (g/dL), glucose (mg/dL), total cholesterol (mg/dL), creatinine (mg/dL), AST (U/L), ALT (U/L) and ALP (U/L). These parameters were investigated with Span Diagnostic kits as per the standard biochemical procedures and using UV spectrophotometer.

Results

The Mean serum biochemical constituents at various stages of Jersey Crossbred cattle G I: (P), G II: (E), G III: (A) and G IV: (R) are presented in Table 1.

Total protein (g/dL)

The total protein concentration was significantly higher (p<0.01) in pregnant G I (P) (7.46 ± 0.56), followed by estrus G II (E) 6.92 ± 0.24 and regular cyclic animals G IV (R) 6.62 ± 0.44. Among the four groups, G III (A) anestrus group has recorded the lowest values (6.16 ± 0.38). In this study, G II (E) estrus (6.92 ± 0.13) non-significantly (p<0.01) higher than G IV (R) cyclic animals (6.62 ± 0.44). In this study, higher serum protein concentrations in pregnant (7.46 ± 0.56) and estrus (6.92 ± 0.24) animals might have been associated with body metabolic needs.

Albumin (g/dL)

The mean albumin levels recorded lowest in G III (A) (2.54 ± 0.42) and significantly (p<0.01) higher (in G I (P) groups (3.92 ± 0.26). As compared to the other groups, G III (A) had significantly (p<0.01) lower mean albumin level. The mean albumin level in G II (E) 3.46 ± 0.64 and regular cyclic animals G IV (R) 2.86 ± 0.24

Table 1: Mean serum biochemical constituents at various stages of reproduction in Jersey Crossbred cattle

Parameter	Group-I Pregnant	Group- II Estrus	Group –III Anestrus	Group –IV Regular cyclic
Total protein (g/dL)	7.46 ± 0.56^{b}	6.92 ± 0.24^{a}	6.16 ± 0.38^{a}	6.62 ± 0.44^{a}
Albumin (g/dL)	3.92 ± 0.26^{c}	3.46 ± 0.64^{b}	2.54 ± 0.42^{a}	2.86 ± 0.24^{a}
Globulin (g/dL)	3.24 ± 0.48^{c}	2.82 ± 0.38^{b}	1.98 ± 0.42^{a}	3.04 ± 0.34^{b}
A/G ratio	1:1.21	1:1.23	1:1.28	1:0.94
Glucose(mg/dL)	58.48 ± 0.64^{a}	56.52±0.72^{a}	46.86±0.64^{b}	53.46±0.69^{a}
Total cholesterol (mg/dL)	160.86 ± 8.26^{c}	146.57± 7.64^{b}	126.42 ± 8.42^{a}	144.26 ± 5.28^{b}
BUN (mg/dL)	38.64 ± 0.52^{c}	34.56 ± 0.62^{b}	30.46 ± 0.84^{b}	24.28 ± 0.72^{a}
Creatinine (mg/dL)	1.86 ± 0.24^{b}	0.92 ± 0.48^{a}	0.84 ± 0.16^{a}	0.88 ± 0.36^{a}
AST (IU/L)	180.24±2.68^{c}	140.62±4.96^{b}	98.46±5.34^{a}	128.36±6.28^{b}
ALT (IU/L)	80.34±2.46^{c}	52.42±1.62^{b}	36.68±1.46^{a}	44.42±1.38^{a}
ALP (IU/L)	32.46±1.14^{c}	26.82±1.84^{b}	23.38±1.32^{a}	24.34±1.56^{b}

Means within the same row bearing different superscripts differ significantly (p<0.01)

Glucose (mg/dL): The blood glucose was significantly (p<0.01) higher in pregnant (58.48 ± 0.64) G I (P), G II (E) estrus (56.52±0.72) and G IV (R) regular cyclic (53.46±0.69) as compared to anestrus (46.86±0.64) G III (A) group. In pregnant animals, glucose levels were non-significantly higher than cyclic animals.

Cholesterol (mg/dL): The serum cholesterol was significantly (p<0.01) higher in G I (P) pregnant (160.86 ± 8.26), G II (E) 146.57± 7.64, and G IV (R) (144.26 ± 5.28) as compared to anestrus G III (A) (126.42 ± 8.42).

Blood Urea Nitrogen (mg/dL)

BUN (mg/dL) concentration levels found in G I (P) (38.64 ± 0.52), G II (E) (34.56 ± 0.62), G III (A) (30.46 ± 0.84) and G IV (R) (24.28 ±0.72) respectively. The mean value of BUN (mg/ dl) was significantly (p<0.01) higher in anestrus G III (A) as compared to G IV (R).

Creatinine (mg/dL)

Serum creatinine (mg/dL) concentration was found in G I (P) pregnant (1.86 ± 0.24), G II (E) (0.92 ± 0.48), anestrus G III (A) (0.84 ± 0.16) and G IV (R) (0.88 ± 0.36) respectively. The serum creatinine was significantly (p<0.01) higher in G I (P) as compared to other G II (E) and G IV (R); G III (A). Nonetheless, G IV (R) had a non-significantly (p<0.01) higher mean creatinine value than G III (A). Serum creatinine in G I (P) pregnant animals was significantly (p<0.01) higher than in the other groups.

AST (U/L)
The AST level was significantly higher in Group I (P) (180.24±2.68), Group II (E) (140.62±4.96), and Group IV (R) (128.36±6.28) as compared to anestrus G III (A) (98.46±5.34).

ALT
In comparison to anestrus G III (A) (36.68±1.46), the ALT level was significantly higher in Groups I (P) (80.34±2.46), II (E) (52.42±1.62), and IV (R) (44.42±1.38).

Alkaline phosphatase
Serum ALP (IU/L) concentration was found in G I (P) pregnant (32.46±1.14), G II (E) (26.82±1.84), anestrus G III (A) (23.38±1.32) and G IV (R) (24.34±1.56) respectively. However, there was no obvious difference in the serum ALP between G III (A) anestrus Vs G IV (R) normal cycling cattle. Compared to normal cyclic cows, the anestrus group's serum alkaline phosphatase levels were significantly lower.

Discussion

Total protein (g/dL)
Total protein content is typically used to evaluate an animal's nutritional status by taking into account its food intake and metabolism. The total protein concentration was significantly higher (p<0.01) in pregnant followed by estrus and regular cyclic animals. Among the four groups, anestrus group has recorded the lowest values. This might be due to an animal with a low protein intake has a negative nitrogen balance. The results were in agreement with the results of Kumar *et al*. (2022) [b] [3], Virmani *et al*. (2011) [4] in cattle and Yotov *et al* (2013) [5] in buffaloes. Kumar *et al*. (2022) [b] [3], reported a higher total protein level in cyclic (8.53 ± 0.02) cows as compared to anestrus (6.72 ± 0.12) cows. Similarly, Virmani *et al*. (2011) [4] reported a lower protein level in anestrus (6.52±0.57) cows than those in induced oestrus (8.61 ± 0.64 g/dl). Nevertheless, compared to induced estrus (6.36 ± 0.48), anestrus cows had higher serum total protein (7.29 ± 0.31) observed by Mahour *et al*. (2011) [6]. In this study, estrus cows had (6.92 ± 0.13) non-significantly (p<0.01) higher TP than cyclic animals. Similarly, in comparison to anestrus cows, the concentration of serum total proteins in oestrus cows was significantly higher (Tandle *et al*., 1996) [7]. In this study, higher serum protein concentrations in pregnant and estrus animals might have been associated with body metabolic needs. To agree with this, Yotov *et al* (2013) [5] reported total protein level (g/l) was non-significantly higher in pregnant buffaloes (73.1±4.1) than non-pregnant (71.9±7.8). Increased nutrient demand during pregnancy, estrus, and regular cyclic groups may be the cause of this increase in total protein concentration. All the groups fall, nevertheless, within Kaneko's (2008) [8] normal reference level of cow (6.74 - 7.46).

Albumin (g/dL)
The mean albumin levels recorded lowest in G III and significantly (p<0.01) higher in G I groups. As compared to the other groups, G III had significantly (p<0.01) lower mean albumin level, which was consistent with the findings of Arosh *et al*. (1998) [9], Virmani *et al*. (2011) [4], and Yotov *et al*. (2013) [5]. Arosh *et al*. (1998) [9], reported that the normal cyclical cows had significantly higher level of total protein, albumin and globulins than that of anestrus cows. Similarly, Virmani *et al*. (2011) [4] reported a lower albumin level in anestrus (3.25 ± 0.26) cows than those in induced oestrus (4.37 ± 0.36 g/dl). Furthermore, Mahour *et al*. (2011) [6]. Compared to cows in induced estrus, anestrus cows had significantly higher serum albumin levels (3.25±0.12 gm/dl vs. 2.61±0.18 gm/dl). A deficiency in specific amino acids may result in a reduction in plasma protein, which in turn obstructs the biosynthesis of gonadotropin and gonadal hormones. Hormonal imbalances related to reproduction result in inactive ovaries.

Glucose (mg/dL)
Blood glucose levels are thought to be one measure of ruminants' energy status. Changes in blood glucose were directly related to fertility and cyclicity, as well. The blood glucose was significantly (p<0.01) higher in pregnant, estrus and regular cyclic as compared to anestrus group. These values suggested a low energy state that was likely influencing the development of the follicles, leading to follicular atresia and anestrus (Dhoble *et al*., 2004) [10]. Similar results were obtained by Uddin *et al*. (2019) [11], Agrawal *et al*. (2015) [12] and Qureshi *et al*. (2016) [13] in cattle. In line with the findings, Uddin *et al*. (2019) [11] found that postpartum anestrus cows' serum glucose levels were significantly lower than those of regular cyclic cows. Comparably, Agrawal *et al*. (2015) [12] found that post-partum anestrus cows had significantly lower mean serum glucose levels (42.58 ± 6.73 g/dl vs. 73.7 ± 10.69 g/dl) than cyclic cows. Similar to the present study, Qureshi *et al*. (2016) [13] reported that in Jersey breed, blood glucose levels remained lowest in anestrus animals (44.16 ± 4.28 mg/dl), increased to (57.12 ± 5.14 mg/dl) one month prior to the occurrence of estrus, and then increased to 61.5 ± 3.57 mg/dl. In pregnant animals, glucose levels were non-significantly higher than cyclic animals. It could be the result of glucose storage during the later stages of pregnancy, with the level remaining stable at the time of delivery (Dhoble *et al*., 2004) [10]. Glucose appears to be centrally involved in the release of LH, which presumably reflects its role in modulating GnRH release. It may also be a metabolic signal that provides information for control of GnRH secretion. The effect of hypoglycemia on the release of gonadotrophins from the hypothalamus is the cause of the reduction in ovarian activity in hypoglycemic animals.

Cholesterol (mg/dL)
Cholesterol levels vary in cows depending on physiological states (e.g. pregnancy and lactation) and low cholesterol may have an effect on reproductive performance (Guedon, 1999) [14]. The serum cholesterol was significantly higher in pregnant, estrus and regular cyclic cows as compared to anestrus cows. Results were in agreement with the results of Dhoble *et al*. (2004) [10], Anushma *et al*. (2021) [15] in cows and Chaudhari *et al*. (2019) [16] in buffaloes. According to Dhoble *et al*. (2004) [10], non-cycling heifers aged 2-3 years had significantly lower serum cholesterol concentrations than pregnant and estrus cows and heifers. The bioclimatic conditions, management techniques, and female steroidal sex hormones could all contribute to this variation in postpartum levels (Dhoble *et al*., 2004) [10]. Similarly, Chaudhari *et al*. (2019) [16] reported that normal cyclic buffaloes had serum total cholesterol levels that were noticeably higher than those of anestrus buffaloes. On the other hand, Virmani *et al*. (2011) [4] and Bhoraniya *et al*.

(2012) [17] and Patel *et al*. (2019) [18] noted that non-cyclic cows had greater cholesterol levels than cyclic ones. One of the building blocks for the production of steroid hormones like progesterone, estrogen, and androstenodione is cholesterol (Arosh *et al*., 1998) [9]. Reduced steroid synthesis in the ovaries was suggested by the anestrus cows' declining cholesterol levels.

Blood Urea Nitrogen (mg/dL)

BUN is a major end product of the urea cycle in ruminants, which occurs in the serum or plasma fractions of the blood (Butler, 2005) [19]. Blood plasma urea is one of the indicators used to assess the metabolism of nitrogen in the rumen. In the present study, BUN was significantly (p<0.01) higher in anestrus as compared to regular cyclic animals. The results were in accordance with the outcomes of Hedaoo *et al*. (2008) [20]., Virmani *et al*. (2011) [4] and Barson *et al*. (2019) [21]. According to Barson *et al*. (2019) [21], repeat breeding cows had a mean BUN of 25.05 mg/dL, which was significantly higher than the mean BUN of normally cyclic cows (22.71 mg/dL). In another study, Virmani *et al*. (2011) [4] found that anestrus cows had higher serum urea levels (32.67 mg/dL) as compared to cyclic animals (27.83 mg/dL). Hedaoo *et al*. (2008) [20] reported that a significantly higher level of BUN in non-cycling buffaloes as compared to cycling buffaloes while Balamurugan *et al*. (2015) [22] reported a significantly higher mean serum values of BUN in regular cyclic buffaloes as compared to anestrus buffaloes. Higher BUN concentration is linked to problems with reproduction; they also lower energy levels, which results in financial loss (Setiadi *et al*., 2003) [23]. Ahmad *et al*. (2004) [24] found that there was no significant difference in the mean serum urea concentrations between cyclic cattle (30.88 ± 2.42 mg/dL) and non-cyclic cattle (33.80 ± 3.45 mg/dL). However, in pregnant cows, serum BUN values were higher which was in accordance with the results of Hill *et al*. (2018) [25] reported that the serum BUN concentration in beef cows, anestrus (25.0 ± 1.1), estrus (25.3 ± 0.9), Pregnant (25.4 ± 1.6). In our study, significantly (p<0.01) higher BUN concentration in pregnant animals might be due to either increased deamination or increased protein intake may be the cause of the elevated BUN levels in dry pregnant cows in the latter stages of pregnancy (Mulei and Daniel, 1989) [26].

Creatinine (mg/dL)

Serum creatinine was significantly (p<0.01) higher in pregnant as compared to other groups. Similar outcomes were seen in cattle by Agrawal *et al*. (2015), Dhoble *et al*. (2004) and in buffaloes by Jayachandran *et al*. (2013) [27]. and Kumar *et al.* (2022)b [28]. Nonetheless, regular cyclic animals had a non-significantly (p<0.01) higher mean creatinine value than anestrus cows. In a similar vein, Balamurugan *et al*. (2015) [22] found that the mean creatinine value in regular cyclic buffaloes was non-significantly higher at 0.84±0.67 mg/dl than in anestrus Murrah buffaloes (0.80±0.32 mg/dl). Comparably, Chaudhari *et al*. (2009) [29] found that there is a strong correlation between the mean serum creatinine levels (1.5) cycling buffaloes and non-cycling buffaloes (1.4). Furthermore, Ghuman *et al*. (2011) [30] provides strong support for the current findings of a non-significant difference in mean serum creatinine level between non-cycling and cycling buffaloes. Serum creatinine in pregnant animals was significantly higher than in the other groups. Srinivasan and Sathyamooorthy (2021) [31] observed in Pulikulam cattle that the mean serum creatinine (mg/dL) values of during early, mid, and late lactation were 2.03±0.03, 2.0±0.16, and 2.3±0.05, respectively. During pregnancy, the higher muscular work required for the dam's movements while carrying the developing fetus may be the cause of the elevated plasma creatinine level during late gestation (Abeni *et al*., 2004) [32].

AST (U/L)

The AST enzyme, which is extensively present in animal tissues, catalyzes the transition of an amino acid's α-amino group to a keto acid. According to Kaneko *et al*. (2008) [8], the mean serum level of AST in all the groups fell within the reference range of 78–132 U/L in cows. The AST level was significantly higher in pregnant, estrus and regular cyclic cows as compared to anestrus animals. Virmani *et al*. (2011) [4], Kalsotra *et al*. (2016) [33], were found similar outcomes in cattle. In a similar vein, Kalsotra *et al*. (2016) [33] reported that anestrus (125.69±3.14) and estrus (131.21±4.66) cows. Virmani *et al*. (2011) [4] reported that AST were found (U/l) in anestrus (97.83±2.75) cows at 0 day, at the time of AI (128.33±8.01) and after 21 days of AI (127.83±6.06). According to Sharma *et al*. (2022) [34], in the Himachal Pradesh hills, anestrus cows had an overall concentration of AST of 81.41±3.70 (14.30–155.90) U/L. Chaurasia *et al*. (2016) [35] reported that serum AST values in normal cyclic groups (85.093 U/L), repeat breeder (104.435 U/L), and anestrus (69.124 U/L) were recorded. Serum AST levels in repeat breeders were significantly (p<0.01) higher than those in the normal cyclic group and lower in the anestrus group. Das *et al*. (2005) [36] reported similar outcomes in heifers. According to Das *et al*. (2005) [36], the mean AST concentration increased significantly on the day of estrus and was lower on the day of estrus induction treatment. In contrast, Kumar *et al*. (2015) [37] found that the serum levels of AST in anestrus buffaloes (127.09±6.72) were significantly higher than those in estrus buffaloes (77.35±13.35). Changes in the various serum enzymatic activities, which are a sign of the physiological activity of the tissues, could be the cause of this. Higher AST levels were discovered in pregnant animals, which was in consistent with the findings of Yotov *et al*. (2013) [5] and Balamurugan *et al*. (2015) [22].

ALT

In comparison to anestrus, ALT level was significantly higher in pregnant, estrus and regular cyclic animals. In cattle, Virmani *et al*. (2011) [4] and Kalsotra *et al*. (2016) [33] obtained similar results. Similarly, Kalsotra *et al*. (2016) [33] reported that serum ALT concentration in anestrus (54.73±4.58), estrus (59.29±4.99) buffaloes. Das *et al*. (2005) [36] found similar outcomes in heifers. After treatment, the mean SGOT concentration rose dramatically on the day of estrus, but it was lower in anestrus animals. In contrast, Kumar *et al*. (2015) [37] found that the serum levels of ALT in anestrus buffaloes (89.43±7.71) were significantly higher than those in estrus buffaloes (75.78±8.5). According to Kumar *et al*. (2015) [37], animals in anestrus have a higher body metabolic load than those in estrus due to higher concentrations of AST and ALT. According to Das *et al*. (2005) [36], changes in the various serum enzymatic activities are a sign of physiological activity in the tissues. It is also possible that this is because

anestrus heifers have lower physiological activity in their reproductive organs. This result was consistent with those of Yotov *et al*. (2013) [5], who found that pregnant buffaloes had 138.7 21 and 112.7 days postpartum, respectively.

Alkaline phosphatase

Kaneko *et al*. (2008) [8] reported that the mean serum level of ALP in all the groups fell within the reference range (0 - 488 U/L) of cows. These serum ALP concentrations were within the limits as reported by Sharma *et al*. (2016) [38]. Similarly, Lalita Sharma *et al*. (2016) [38] observed that serum ALP concentration in healthy cows was 49.60±1.00 as compared to healthy buffaloes 51.12±0.80. To accord with present results, Kadhim and Ali (2019) [39] reported that serum ALP concentration was significantly higher in pregnant (212.15 ± 4.02; 145.21 - 307.08) Vs non-pregnant dairy cows (183.42 ± 2.99; 107.5 – 346.04). The presence of the corpus luteum, which is in charge of producing the progesterone needed to establish and maintain pregnancy, may be the cause of the excessive ALP activity seen in the pregnant cows (Tsiligianni *et al*., 2009) [40]. Furthermore, an increase in ALP activity may be caused by the high metabolic rate or increased bone metabolism brought on by the lack of mineral feed additives in dairy herd feeds (Soch *et al*., 2016) [41]. However, there was no obvious difference in the serum ALP between anestrus Vs normal cycling cattle. Compared to normal cyclic and repeat breeders, the anestrus group's serum alkaline phosphatase levels were significantly lower.

Conclusion

Concentration of serum total protein, albumin, globulin, glucose and total cholesterol was significantly higher in pregnant as compared to anestrus group. Regular cyclic cows had non-significantly higher concentration of serum protein, glucose, total cholesterol and creatine as compared to anestrus cows. Similarly, concentration of serum blood urea nitrogen (BUN), creatinine and liver functional enzymes (aspartate aminotransferase; AST, alanine aminotransferase; ALT and alkaline phosphatase; ALP) was higher in pregnant as compared to anestrus cows. However, anestrus animals were had non-significantly higher concentration of BUN and liver enzymes as compared to regular cyclic cows. Therefore, these findings implied that day 45–60 postpartum, blood glucose, total protein and BUN and total cholesterol have significant impact on the cyclicity of Jersey crossbred cows. Further research on mechanism of these metabolites on cyclicity of postpartum cow is required to confirm these findings.

Acknowledgments

Authors are thankful to Dean, Veterinary College and Research Institute, Orathanadu, Thanjavur for providing necessary facility for conducting present project work.

References

1. NDDB. Dairying in Tamil Nadu - A Statistical Profile. National Dairy Development Board, Anand, Gujarat, 2014.
2. Butani MG, Kumar R, Dhami AJ, Kavani FS, Killedar A. Incidence of major infertility problems in crossbred cows and buffaloes under field conditions. Indian J. Field Vet. 2008;4(2):1-4.
3. Kumar J, Srivastava S, Kumar R, Mohan G, Chaudhiry V. Effect of Janova, Sepia and Ovsynch Protocol on Blood Biochemical Profile and Fertility in Postpartum Anestrus Cows. Indian J Anim. Res. 2022b;56(9):1077-1083. DOI: 10.18805/IJAR.B-4225.
4. Virmani M, Malik RK, Singh P, Dalal SS. Studies on blood biochemical and mineral profiles with the treatment of acyclicity in postpartum anestrus sahiwal cows. Haryana Vet. 2011;50:77-79.
5. Yotov SA, Atanasov AS, Ilieva YY. Relationship of Some Blood Serum Parameters with Reproductive Performance of Bulgarian Jersey cattle After Hormonal Treatment During The Early Postpartum (Preliminary Study) J Vet Adv. 2013;3(5):160-164.
6. Mahour SS, Nema SP, Shukla SP, Shrivastava N, Mehta HK. Biochemical profile of postpartum anestrus and induced estrus crossbred cows. Indian J Field Vet. 2011;6(3):53-55.
7. Tandle MK, Mohd. Amanullah, Honnappagol SS, Kartikesh SM, Jagjiwanram SD. Sonwane Serum Cholesterol, Total Proteins, Phosphorus and Calcium levels in Oestrus and Anestrus Non-Descript Cows Indian J Anim. Res. 1997;18(1):44-45
8. Kaneko JJ, Harvey JW, Bruss ML. Clinical biochemistry of the domestic animals. Amsterdam: Elsevier, 2008.
9. Arosh AJ, Kathiresan D, Devanathan TG, Rajasundaram RC, Rajasekaran J. Blood biochemical profile in normal cyclical and anestrus cows. Indian J Anim. Sci. 1998;68(11):154-1156.
10. Dhoble RB, Sharma NC. Serum phosphatase and transference enzymes in normal cycling and repeat breeder cattle. Indian J Anim. Reprod. 2000;21:16-18.
11. Uddin AHMM, Atikuzzaman M, Islam MS, Hossain MK. Postpartum cyclicity of Holstein-Friesian crossbred cows shows relation with serum biochemical profiles during 45-60 days postpartum. Pak Vet J. 2020;40(2):257-260.
12. Agrawal J, Saxena A, Singh V. Study on metabolic profile of repeat breeder, postpartum anestrus and normal cyclic Sahiwal cows. Indian J Ani. Rep. 2015;36(1):53-55.
13. Qureshi MU, Qureshi MS, Rajwali K, Abdur Rahman, Sohail SM, Ijaz A, *et al.* Relationship of blood metabolites with reproductive cyclicity in dairy cows Indian J Anim. Res. 2016;50(3):338-348.
14. Guedon L, Saumande J, Dupron F, Couquent C, Desbals B. Serum cholesterol and triglycerides in postpartum beef cows and their relationship to the resumption of ovulation. Theriogenology. 1999;51(7):1405-15.
15. Anushma, Pravesh Kumar, Madhumeet Singh, Akshay Sharma. Hematobiochemical and Mineral Profile Evaluation in Post-partum Anestrus cows Intas Polivet. 2021;(II):374-376.
16. Chaudhari NF, Khasatiya CT, Modi LC, Chaudhari CF, Sharma HC, Patel JM. Comparative studies on certain hormonal and biochemical profiles of normal cyclic and anestrus surti buffaloes Haryana Vet. 2019;58:43-45.
17. Bhoraniya HL, Dhami AJ, Naikoo M, Parmar BC, Sarvaiya NP. Effect of estrus synchronization protocols on plasma progesterone profile and fertility in postpartum anestrous Kankrej cows. Tropical Ani. Health Prod. 2012;44(3):1191-1197.

18. Patel CI, Dhami AJ, Panchal MT, Sarvaiya NP, Shah SV. Blood Biochemical, Hormonal and Mineral Status of Cyclic, Acyclic, Endometriotic and Pregnant Crossbred Cows. Ind J of Vet Sci and Biotech. 2019;14(4):1-4.
19. Butler WR. Nutrition, negative energy balance and fertility in the postpartum dairy cow. Cattle Pract. 2005;13:13-18.
20. Hedaoo MK, Khllare KP, Meshram MD, Sahatpure SK, Patil MG. Comparative studies of certain biochemical constituents of normal cyclic and anestrus Surti buffaloes. Vet. Wld. 2008;1(4):105-106.
21. Barson RK, Padder S, Sayam ASM, Rahman MM, Bhuiyan MMU, Bhattacharjee J. Comparison of serum glucose, urea nitrogen, cholesterol, and total proteins in crossbred repeat breeder and normally cyclic cows. J Adv Vet Anim Res. 2019;6(1):82-85.
22. Balamurugan TC, Krupakaran RP, Pandiyan GDV, Arunkumar S, Perumal P. Comparative studies on serum biochemical profiling at various stages of reproduction in Murrah buffaloes. J Cell Tissue Res. 2015;15(1):4823-4826.
23. Setiadi A, Widyobroto BP, Rustamaji DB. Blood plasma glucose and blood plasma urea concentration on Friesian Holstein crossbred cows were given by diets of rumen's undegradable protein level. J Indonesian Trop Anim Agri. 2003;28(4):211-7.
24. Ahmed I, Lodhi LA, Quershi ZI, Younis M. Studies on blood glucose, total proteins, urea and cholesterol levels in cyclic, noncyclic and endometritic cross bred cows. Pakistan Vet. J. 2004;24:92-94.
25. Hill SL, Olson KC, Jaeger JR, Stevenson JS. Serum and plasma metabolites associated with postpartum ovulation and pregnancy risks in suckled beef cows subjected to artificial insemination. J Anim Sci. 2018;96(1):258-272.
26. Mulei CM, Daniel RCW. Effect of herd on changes in blood composition on dairy cows in late pregnancy and early lactation. Indian J Anim. Sci. 1989;19:137-141.
27. Jayachandran S, Nanjappan K, Muralidharan J, Selvaraj P, Manoharan A. Blood biochemical and mineral status in cyclic and postpartum anestrus buffaloes. Int. J Food, Agric. Vet. Sci. 2013;3(1):93-97.
28. Kumar P, Singh MM, Sharma A, Kumar V, Ravindra Kumar, Sharma P. Comparative studies on blood biochemical profile of cyclic, pregnant and infertile cows. Rum. Sci. 2022a;11(1):123-28.
29. Chaudhari NF, Khasatiya CT, Modi LC, Chaudhari CF, Sharma HC, Patel JM. Comparative Studies on Certain Hormonal and Biochemical Profiles of Normal Cyclic And Anoestrus Surti Buffaloes Haryana Vet. 2019;58:43-45.
30. Ghuman SPS, Singh J, Honparkhe M, Ahuja CS, Dhami DS, Nazir G, *et al*. Differential fertility in dairy buffalo: role of thyroid and blood plasma biochemical milieu. Iranian J Appl. Anim. Sci. 2011;1(2):105-109.
31. Srinivasan, Sathyamooorthy. Study on hematological and serum biochemical parameters of Pulikulam cattle in a nucleus herd. Indian J Anim Health. 2021;60(1):40-48.
32. Abeni F, Bergoglio G, Masoero G, Terzano GM, Allegrini S. Plasma hormones and metabolites in Piedmontese cows during late pregnancy: Relationships with calf birth weight J Anim. Sci. 2004;82:438-444.
33. Kalsotra R, Utsav Sharma, Sudhir Kumar, Sharad Kumar, Kafil Hussain. Studies on changes in hemato-biochemical and enzymatic profile in Postpartum anestrus Murrah buffaloes with hormonal protocols Buffalo Bulletin. 2016;35(4):723-729.
34. Sharma A, Singh M, Kumar P. Blood Plasma Minerals and Biochemical Profile of Anestrus and Endometritic Cows Reared in Tribal Areas of Himachal Pradesh, India. The Indian J Anim. Rep. 2022;43(2):50-53.
35. Chaurasia R, Kushwaha HS, Chaurasia D, Gendley MK, Kiran Kumari, Santra AK, *et al*. Comparative studies of certain enzyme assay during various reproductive states in buffaloes Buffalo Bulletin. 2016;35(1):33-38.
36. Das S, Mishra SK, Swain RK, Mohanty DN, Mishra SR. Comparative study of certain serum biochemical parameters in anestrus and repeat breeding cows of bhadrak district of Orissa. Indian J Field Vet. 2012;(7)4:71-74.
37. Kumar S, Balhara AK, Kumar R, Kumar N, Buragohain L, Baro D, *et al*. Hemato-biochemical and hormonal profiles in post-partum water buffaloes (Bubalus bubalis), Vet. Wld. 2015;8(4):512-517.
38. Lalita Sharma, Amit Kumar Verma, Anu Rahal, Amit Kumar, Rajesh Nigam. Relationship between serum biomarkers and oxidative stress in dairy cattle and buffaloes with clinical and sub-clinical mastitis. Biotechnology. 2016;15:96-100.
39. Kadhim, Ali. Levels of some biochemical markers in sera of pregnant and non-pregnant lactating dairy cows in Baghdad, Iraq. Iraqi Journal of Veterinary Sciences. 2019;33(2):353-358.
40. Tsiligianni T, Karagiannidis A, Saratsis P, Brikas P. Enzyme activity in bovine cervical mucus during spontaneous and induced estrus. Canadian J Vet Res. 2003;67(3):189-193.
41. Soch M, Pisek L, Kroupova P, Silhava M, Stastna J. Activity of alkaline phosphatase in cattle blood plasma according to stage of pregnancy. Slovak J Anim Sci. 2008;41(1):39-41. 1335-3686.