

**STUDY ON METABOLIC PROFILE OF DEONI
COWS IN TRANSITION PERIOD**

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JULY, 2016**

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COWS IN TRANSITION PERIOD**

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in

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By

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CERTIFICATE

This is to certify that the thesis entitled “*STUDY ON METABOLIC PROFILE OF DEONI COWS IN TRANSITION PERIOD*” submitted by **Mr. SATEESH ASHOK GOLASANGI, I.D. No. MVNK-1410**, in partial fulfillment of the requirements for the award of **MASTER OF VETERINARY SCIENCE in VETERINARY MEDICINE** of the Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar is a record of bonafide research work carried out by him during the period of his study in this University under my guidance and supervision, and the thesis has not previously formed the basis for the award of any degree, diploma, associationship, fellowship or other similar titles.

**BIDAR
JULY, 2016**

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Affectionately Dedicated

To

My Beloved Parents

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CONTENTS

Sl. No.	TITLE	PAGE No.
I	INTRODUCTION	1-4
II	REVIEW OF LITERATURE	5-30
III	MATERIALS AND METHODS	31-37
IV	RESULTS	38-64
V	DISCUSSION	65-70
VI	SUMMARY	71-73
VII	BIBLIOGRAPHY	74-87
	ABSTRACT	88

LIST OF TABLES

Table No.	Title	Page No.
1	Haematological parameters in individual animal of the control group	46
2	Haematological parameters in individual animal of the group I	47
3	Haematological parameters in individual animal of the group II	48
4	Haematological parameters in individual animal of the group III	49
5	Biochemical parameters in individual animal of the control group	50
6	Biochemical parameters in individual animal of the in group I	51
7	Biochemical parameters in individual animal of the group II	52
8	Biochemical parameters in individual animal of the group III	53
9	Comparison of Mean \pm SE values of haematological parameters in transition period in comparison with healthy control group	54
10	Comparison of Mean \pm SE values of biochemical parameters in transition period in comparison with healthy control group	55

LIST OF FIGURES

Figure No.	Title	Page No.
1	Mean total erythrocyte count ($10^6/\mu\text{L}$) in the transition period in comparison with healthy control group	56
2	Mean haemoglobin concentration (g/dL) in transition period in comparison with healthy control group	56
3	Mean total leukocyte count ($10^3/\mu\text{L}$) in transition period in comparison with healthy control group	57
4	Mean packed cell volume (%) in transition period in comparison with healthy control group	57
5	Mean platelet count ($10^3/\mu\text{L}$) in transition period in comparison with healthy control group	58
6	Mean corpuscular volume (fL) in transition period in comparison with healthy control group	58
7	Mean corpuscular haemoglobin (pg) levels in transition period in comparison with healthy control group	59
8	Mean corpuscular haemoglobin concentration (g/dL) in transition period in comparison with healthy control group	59
9	Mean serum calcium (mg/dL) levels in transition period in comparison with healthy control group	60
10	Mean serum magnesium (mg/dL) levels in transition period in comparison with healthy control group	60
11	Mean serum phosphorus (mg/dL) levels in transition period in comparison with healthy control group	61
12	Mean SGOT/AST (U/L) levels in transition period in comparison with healthy control group	61
13	Mean serum glucose (mg/dL) levels in transition period in comparison with healthy control group	62
14	Mean serum total protein (g/dL) levels in transition period in comparison with healthy control group	62
15	Mean serum albumin (g/dL) levels in transition period in comparison with healthy control group	63
16	Mean blood urea nitrogen (mg/dL) levels in transition period in comparison with healthy control group	63
17	Mean serum triglycerides (mg/dL) levels in transition period in comparison with healthy control group	64

LIST OF PLATES

Plate No.	Title	Page No.
1	Deoni cow with two days old calf (Group II)	32
2	8 month pregnant Deoni cow (Group I)	33
3	Deoni cows housed (head to head system) in LRIC farm, Bidar	33

LIST OF ABBREVIATIONS

%	Per cent
μmol/L	Micro moles per litre
SGOT	Serum glutamic oxaloacetic transaminase
AST	Aspartate amino transferase
BUN	Blood urea nitrogen
dL	decilitre
g/dL	grams per decilitre
U/L	Units per litre
Kg	Kilogram(s)
L	Litre(s)
mcg	Microgram(s)
mg	milligram(s)
mg/dL	milligram(s) per decilitre
ml	millilitre(s)
mmol	mille moles
MCV	Mean Corpuscular Volume
MCH	Mean Corpuscular Haemoglobin
MCHC	Mean corpuscular Concentration
No.	Number
p	Level of significance
S.E.	Standard error
U	Units
viz.,	Namely
TEC	Total erythrocyte count
TLC	Total leukocyte count
et al	Co workers
>	More than
<	Less than
GGT	Gamma glutaryl transferase
LDH	Lactate dehydrogenase
ESR	Erythrocyte sedimentation reta
RBC	Red blood cell
μL	Micro litre
fL	Femto litre
pg	Pico gram
Hb	Haemoglobin
EDTA	Ethylene diamine tetra-acetic acid
PCV	Packed cell volume
ANOVA	Analysis of variance

Introduction



I. INTRODUCTION

India has a diverse population of livestock and ranks first in the milk production in the world. The livestock sector alone contributes nearly 25.6 per cent of value of output at current prices in agriculture, fishing and forestry sector. The overall contribution of livestock sector in total GDP (Gross domestic product) is nearly 4.11 per cent at current scenario. Livestock sector is registering higher growth compared to other subsectors of agriculture and also provides sustenance against natural calamities like drought. The total Bovine population is 299.9 million and numbers of milch animals are 118.59 million in India. The total number of indigenous population in Karnataka is 11.88 million. Though major milk production is contributed by non organised dairy sector with a total milk yield in Karnataka to the tune of 5.9 million tonnes of which 1.43 million tonnes is produced by indigenous cows.

There are thirty seven recognized breeds of cattle in India, in addition to large number of non-descript cattle. The exotic and crossbred cows are not only vulnerable to exotic diseases however other challenges like shortage of feed and fodder, sustainability to the drought condition. Government of India has taken steps to conserve the native breed in order to maintain the balance in the livestock (National Livestock policy, 2013). In addition, existence of superior indigenous breeds can provide valuable research inputs for developing superior breeds. It is therefore important that Indigenous breeds of cattle are conserved, developed and proliferated. The local breeds have many merits over exotic breeds of cattle.

Deoni is a dual purpose animal. The total number of Deoni population is 3, 51, 600 (Deoni pure and Deoni graded) of which pure Deoni cattle are 1, 51, 236 in India distributed in marathwada region of maharashtra, Telengana and adjoining parts of Karnataka. Cows of this breed are moderately good milkers, yielding about 1535 kg in a lactation period of 300 days (Salunke, 2007). Deoni bullocks are best known for their draught abilities for agricultural operations.

High producing dairy cows have been described as "metabolic athletes". The production diseases include all of the diseases which are attributable to an imbalance between the rates of input of dietary inputs and the outputs according to Radostits *et al.* (2009). Production diseases are the manifestation of the cow's inability to cope up with metabolic demands of high production because of continuous drain of nutrients and minerals in the milk. Usually sub-clinical form of these diseases goes unnoticed. A reliable test for early diagnosis of nutritional deficiency or production diseases would be the major step forward in attempting to optimize the production and obtain maximum yield at minimum costs. Therefore the metabolic profile test plays an integral entity to find out the sub clinical diseases in the animals in which we can maximize the production. Metabolic profile test is a pre-symptomatic diagnostic aid in which haematological and biochemical parameters are analysed to determine various factors which cause the production diseases.

The transition period, the period from 3 weeks prior to calving to 3 weeks after calving, is the most stressful period experienced during the cow's lactation. According to LeBlanc *et al.* (2006) estimates that 75 per cent of all disease occurs during this period.

So, it is necessary to carry out the metabolic profile testing in transition period. Essentially all transition dairy cattle experience: reduced feed intake, negative energy balance, lipolysis, and weight loss in early lactation; hypocalcemia in the days after calving. The dramatic changes in circulating progesterone, estrogen, and cortisol concentrations contribute to a substantial reduction of immune function, in particular of neutrophils, at transition period (Kehrli *et al.*, 1989 and Goff *et al.*, 1997). Dairy cattle have been selected to re-partition nutrients in support of milk production, a process described as homeorhesis (Bauman, 2000) in which homeostatic mechanisms are least altered. Increased understanding the biology of the transition period can decrease health problems and increase the profitability of dairy cows (Drackley, 1999). The basic managing of transition cows includes adequate nutrition, management and environmental conditions.

The first metabolic test was conducted in 1960s in Britain. Later the Compton Metabolic Profile Test was designed by Payne *et al.* (1970) to monitor the metabolic health of the herd. The Compton metabolic profile test is based on the concept that laboratory measurement of certain components of the blood will reflect the nutritional status of the animal, with or without presence of clinical abnormalities. The metabolic profile even depends on many factors like origin, climate, management practice, geographical distribution and stage of animals. So, it is necessary to have the documentation of metabolic profile for each breed of the cattle in India. Metabolic profile test will help to predict the production diseases, to access the nutritional status of the animal, to know the health status of the animal and help in the selection superior individuals.

Keeping this in view the present study was undertaken with the following objectives,

- 1) To study the changes in serum metabolic profile in transition period of Deoni cows.
- 2) To study the haematological and erythrocytic indices in transition period.
- 3) To document the metabolic shifts in metabolic profile of Deoni cows during the transition period to suggest remedial treatment.

Review of Literature

A decorative frame consisting of a horizontal line at the bottom, a vertical line on the right, and a small dot at the top left, all in a light gray color.

II. REVIEW OF LITERATURE

Metabolic diseases in the transition period have great economic importance in the dairy industry, as it causes great impact on the milk production and the reproductive life of the animal. Therefore early detection of sub-clinical metabolic disease in the animal will be useful in order to take remedial measures. The literature concerning different parameters in the metabolic profile has been reviewed under following headings:

2.1 Biochemical observations:

2.1.1 Serum calcium

Payne and Leech (1964) reported that plasma calcium level in non pregnant cows and cows at different stages of pregnancy had no significant difference in between groups.

Acharya *et al.* (1968) stated that serum calcium levels of different Indian breeds of cattle during pregnancy had no significant variations.

Lane *et al.* (1968) observed that increased levels of calcium with the advancement in pregnancy in ruminants.

Manston and Allen (1981) observed low concentrations of calcium were observed at calving in dairy cows.

Kulkarni *et al.* (1983) recorded biochemical values in Gir and crossbred Jersey lactating cows. They did not observe significant difference in mean values of calcium and phosphorus.

Curtis *et al.* (1985) observed that low levels of plasma calcium coincided with large number of mastitis cases.

Sivaiah *et al.* (1986) investigated serum calcium levels in crossbred cows in various physiological conditions like during early pregnancy, nearing parturition, recently parturated animals and found significant difference in the levels of calcium among different groups. The serum calcium levels ranged from 7.04 ± 2.07 to 8.15 ± 2.46 mg/dL.

Dhiman and Sasidharan (1999) stated that serum calcium levels were significantly low at post partum period in HF dairy cows.

Ottol *et al.* (2000) reported significant differences in the values of calcium between pregnant, non pregnant and lactating cows with calcium being highest in the non-pregnant cows.

Rakesh Kumar *et al.* (2000) observed that there was a increasing trend in the levels of calcium in the sera samples of the post parturient cows and buffaloes in comparison to the advanced pregnant animals.

Rossato *et al.* (2001) found out that there was significant difference in level of calcium in 1st to 2nd lactation and 3rd to 4th lactation post calving in HF cows.

Jacob *et al.* (2002) showed an increasing tendency of the calcium level attained by the ninth month of pregnancy and decreased significantly at early lactation in crossbred heifers.

Seifi *et al.* (2007) found that calcium levels decreased significantly from 8 days before calving to 8 days after calving in HF dairy cows.

Gerardo *et al.* (2009) stated that the calcium concentrations differed significantly in the pre-calving period when compared to post-calving in HF cows.

Hagawane *et al.* (2009) studied haematological and blood biochemical profile in lactating buffaloes and reported a drop in calcium level during early stage of lactation (8.19 ± 0.83 mg/dL) compared to normal healthy buffaloes (11.21 ± 0.19 mg/dL).

Dodamani *et al.* (2009) observed gradual non significant decrease in the serum calcium from early gestation (10.91 ± 0.46) to mid gestation (10.64 ± 0.48) and then to late gestation (10.28 ± 0.33) in Deoni cows.

Kalaitzakis *et al.* (2010) reported that the downer cows had significantly lower median serum calcium concentration compared with the reference and healthy fresh cows.

Burke *et al.* (2010) reported that plasma calcium level was lower 4th, 7th, 14th and 28th days in post partum period in dairy cows.

Ambica and Rao (2012) reported that decrease in serum calcium concentration below 7.5 mg/dL was considered as subclinical form of hypocalcaemia. The mean serum calcium level at post partum period in control group was 11.17 ± 0.27 . Group I (treated with Calup gel) calcium values were 7.35 ± 0.92 (before treatment) v/s 10.09 ± 0.29

(after treatment) mg/dL and in group II (treated with Intacal 25%) 7.26 ± 0.95 (before treatment) v/s 12.39 ± 0.61 (after treatment) in 280 crossbred cows.

Roberts *et al.* (2012) observed that serum calcium level of 2.3 mmol/L in prepartum and 2.2mmol/L one week after parturition indicated the risk of hypocalcaemia.

Padodara *et al.* (2012) observed increase in serum calcium level during the early stage of pregnancy however the calcium, level declined significantly at advanced pregnancy in 24 triple crossbred cows.

Hussain *et al.* (2013) reported that during fresh (1week after parturition) lactation periods, pooled serum calcium profiles were significantly lower in herds with a history of milk fever than the herds without problems or those experiencing clinical ketosis.

Pal and Acharya (2013) found that lower value of calcium (6.42 ± 0.40) levels during last trimester of pregnancy were susceptible for subclinical form of metabolic diseases in HF cattle.

Pal and Bhatta (2013) reported significantly lower values of calcium during last trimester of pregnancy when compared to the values of normal healthy dairy cattle.

Mane *et al.* (2014) observed significant differences in serum calcium levels 7 days before and after parturition.

Mujeeb (2014) observed significant difference between zero day of parturition and at 30 day pre-partum, on 30th, 60th and 90th day (post-partum) in peri-parturient buffaloes

Kayanu and Kida (2015) found decreased calcium levels by 3 per cent in a study conducted in 1700 dairy farms consisting of 46,000 HF cows.

Piao *et al.* (2015) observed in a study that low variability of the calcium when compared among early pregnant, mid pregnant and late pregnant groups and they were not statistically significant.

Enrico *et al.* (2015) observed significantly lower levels of calcium in post partum period than in pre partum period in 42 HF dairy cows from two different farms.

Yousuf *et al.* (2016) observed significantly higher level of Ca during 7-8 months pregnancy when compared to post-partum period in peri-parturient cows.

Lukasz *et al.* (2016) stated that physiological hypocalcaemia occurred at the beginning of lactation when compared to post-partum period in 60 HF cows.

Calamari *et al.* (2016) observed in 35 dairy cows that plasma calcium was characterized by low variability in transition period.

2.1.2 Serum magnesium

Lane *et al.* (1968) observed that there was increase in the levels of magnesium with the advancement in pregnancy.

Martens and Rayssiguier (1980) reported that hypocalcaemia was associated with hypomagnesaemia.

Sansom *et al.* (1983) reported that magnesium concentration was commonly increased slightly in cows with milk fever.

Bigras-Poulin and Tremblay (1998) reported that serum magnesium level was lower after a week of parturition than on the first day.

Kume *et al.* (1998) observed that restricted feed intake accelerated the reduction in plasma magnesium during hot weather.

Rakesh Kumar *et al.* (2000) observed that there was an increasing trend in the levels of magnesium in the serum samples of the post parturient cows and buffaloes in comparison to the advanced pregnant animals.

Seifi *et al.* (2007) found that magnesium levels were decreased significantly at day 8 and increased slightly at day 21 post partum.

Wadhwa and Prasad (2007) reported that the concentrations of magnesium in plasma, whole blood and erythrocyte were significantly higher in downer cows than the respective control values.

Dodamani *et al.* (2009) found non significant decrease in the serum magnesium levels with progressing gestation period in Deoni cows.

Hagawane *et al.* (2009) studied haematological and biochemical profile in lactating buffaloes and did not find significant differences in serum magnesium concentration in various groups.

Burke *et al.* (2010) reported that plasma magnesium level was lower on 4th, 7th, 14th and 28th days in post partum period in dairy cows.

Kronqvist *et al.* (2011) observed that Plasma magnesium concentration was lower on 2nd, 4th and 7th day after calving in cows fed with the highest level of calcium in 29 Swedish red breed cows.

Ambica and Rao (2012) stated that the mean serum magnesium levels were significantly increased in hypocalcaemic cows. The mean serum magnesium level at post partum period in control group was 2.69 ± 0.08 . Group I (treated with Calup gel) magnesium values were 2.89 ± 0.05 (before treatment) v/s 2.12 ± 0.03 (after treatment) mg/dL and in group II (treated with Intacal 25%) 3.09 ± 0.04 (before treatment) v/s 2.83 ± 0.05 (after treatment) in 280 crossbred cows.

Ahmed *et al.* (2012) reported that serum magnesium level was significantly higher during winter in empty and early pregnancy stages.

Kayanu and Kida (2015) found that there was decrease in magnesium levels by 5 per cent in a study conducted in 1700 dairy farms consisting of 46,000 HF cows.

Piao *et al.* (2015) observed in a study that low variability of the magnesium when compared among early pregnant, mid pregnant and late pregnant groups and they were not statistically significant.

Yousuf *et al.* (2016) observed that significantly higher level of Mg were present during 7-8 months pregnancy in peri-parturient cows.

Calamari *et al.* (2016) stated that greater variability was found for plasma magnesium (9.8%) in 35 dairy cows.

Łukasz *et al.* (2016) reported that a statistically significant increase in serum magnesium concentrations were observed in the groups of cows with milk fever and control animals in HF cows.

2.1.3 Serum phosphorus

Payne and Leech (1964) reported that there was no significant difference in the level of inorganic phosphorus between non pregnant and different pregnancy stages.

Acharya *et al.* (1968) stated that inorganic phosphorus levels in different Indian breeds of cattle during pregnancy had no significant variations.

Lane *et al.* (1968) observed that there was increasing levels of inorganic phosphorus and magnesium with the advancement in pregnancy.

Murtuza *et al.* (1979) observed no significant difference in the levels of inorganic phosphorus at different physiological stages in Haryana cattle.

Manston and Allen (1981) observed low concentrations of phosphorus at calving and if severe, milk fever was likely to occur.

Kulkarni *et al.* (1983) recorded biochemical values in Gir and Jersey lactating cows and observed that non significant variations in mean values of phosphorus.

Sahukar *et al.* (1984) observed significant decrease in the serum phosphorus from first trimester to the advanced pregnancy in Red Sindhi crossbred cows.

Caple (1986) reported that phosphorus deficiency was associated with recumbancy in cows in periparturient period.

Goff *et al.* (1986) observed increased urinary excretion of phosphorus when the animal was treated with Vitamin D.

Sivaiah *et al.* (1986) investigated serum calcium and inorganic phosphorus level in crossbred cows in various physiological stages like during early pregnancy, nearing parturition, recently parturated animals and found significant difference in the levels of inorganic phosphorus among different groups. The serum inorganic phosphorus ranged from 5.73 ± 0.92 to 7.18 ± 0.90 mg/dL.

Sharma *et al.* (1991) reported that inorganic phosphorus (mg /100ml) was estimated as 5.86 ± 0.22 in control group, 4.03 ± 0.33 in cows with retained placenta after birth cows and 5.08 ± 0.20 in cows with dystocia and 6.98 ± 0.08 in the early lactating cows. Estimated values in cows with dystocia were significantly lower as compared to the control group.

Rajora and Pachauri (1994) observed that serum albumin, calcium and phosphorus ratio did not differ significantly in preparturient and post parturient cows and in milk fever cases. The blood glucose and albumin: globulin ratio decreased and serum globulin, calcium increased in post parturient cows compared to preparturient cows.

Gonzalez *et al.* (1996) reported that the low phosphorus level in the winter and at peak lactation.

Bigrass-poulin and Tremblay (1998) reported that serum phosphorus level was lower on the first day of parturition than a week later.

Ottol *et al.* (2000) reported inorganic phosphorus differed significantly between pregnant, non pregnant and lactating cows with inorganic phosphorus values being highest in the non-pregnant cows.

Rakesh Kumar *et al.* (2000) observed that there was a increasing trend in the levels of phosphorus in the sera samples of the post parturient cows and buffaloes in comparison to the advanced pregnant animals.

Ski and Chudoba-Drozdowska (2001) observed that serum inorganic phosphorus concentration reached minimum on seventh day of parturition.

Hussain *et al.* (2001) observed that the mean concentration of phosphorus was in prepartum stage i.e., at 8th month of pregnancy, which was 6.98 ± 0.12 mg/dL. The lowest mean value of phosphorus was observed at parturition, which was 3.77 ± 0.08 mg/dL. Whereas, the mean values of phosphorus at 8th month after parturition and at 2nd month after parturition differ non significantly from each other and also from the mean values of phosphorus at 9th month of pregnancy, at parturition and 1st month after parturition.

Rossato *et al.* (2001) found that there was significant difference in level of phosphorus (1.4 ± 0.4 to 1.7 ± 0.5 mmol/L) in 1st to 2nd lactation and 3rd to 4th lactation post calving in HF cows.

Patel and Jadhav (2003) reported that inorganic phosphorus value was significantly low in the animals with low incidence of post parturient hypocalcemia compared to animals of high incidence with post parturient hypocalcaemia.

Richard *et al.* (2005) stated that phosphorus concentrations were not statistically significant between third trimester of gestation and early lactation in Murrah buffaloes.

Grunberg (2005) stated that the decreased serum inorganic phosphorous in post parturient animals could be attributed to release in colostrum, milk at the onset of lactation, decreased feed intake and possible compromised hepatic functions in dairy cows.

Wadhwa and Prasad (2007) observed significantly lower inorganic phosphorus concentration in downer cow and also recorded that about 32 per cent downer cows had phosphorus concentration below 4mg/dL.

Seifi *et al.* (2007) stated that phosphorus levels decreased significantly at day 8 and increased slightly at day 21 post partum in dairy cows.

Grunberg *et al.* (2009) reported that level of phosphorus was decreased significantly from pre partum to post partum in 6 HF cows.

Hagawane *et al.* (2009) studied haematological and blood biochemical profile in lactating buffaloes and reported that serum phosphorus level in early stage of lactation (4.64 ± 0.53 mg/dl) was significantly lower than the buffaloes of normal healthy control.

Dodamani *et al.* (2009) observed that serum phosphorus level was significantly declined during different stages of gestation in Deoni cows.

Lager *et al.* (2011) reported that phosphorus level at 3 days before precalving and 3 days post calving differed significantly.

Padodara *et al.* (2012) opined that the stage of gestation had a significant ($P < 0.01$) effect on the levels of phosphorous in both the heifer and cow groups and the combined values.

Singh *et al.* (2012) reported that the serum phosphorus level in cattle and buffaloes was found above the critical level. The data revealed that there was no significant variation among the different physiological states of cattle and buffaloes.

Ahmed *et al.* (2012) reported that serum phosphorus level was significantly lower in winter season for non pregnant, early pregnancy, late pregnancy and mid-pregnancy states. The phosphorus level was significantly lower in mid and late pregnancy during summer.

Ambica and Rao (2012) reported that mean serum phosphorous levels decreased significantly in hypocalcaemic cows. The mean serum phosphorus level at post partum period in control group was 6.27 ± 0.22 . Group I (treated with Calup gel) phosphorus

values were 4.46 ± 0.13 (before treatment) v/s 5.21 ± 0.12 (after treatment) mg/dL and in group II (treated with Intacal 25%) 4.67 ± 0.15 (before treatment) v/s 5.50 ± 0.08 (after treatment) in 280 crossbred cows.

Pal and Bhatta (2013) reported lower value of phosphorus level during last trimester of pregnancy in HF crossbred cows. The serum phosphorus level at last trimester of pregnancy was recorded as 4.03 ± 0.18 mg/dL which was significantly lower than the values of normal healthy dairy cattle.

Hussein *et al.* (2013) observed that during fresh lactation period, pooled serum inorganic phosphorous profile was lower in herds experiencing milk fever than herds without any problems.

Mahmood *et al.* (2013) reported significantly decreased serum inorganic phosphorus in haemoglobinuric buffaloes.

Pal and Acharya (2013) observed significantly lower phosphorus levels (3.23 ± 0.13) in post parturient period in HF cows.

Mane *et al.* (2014) found significant difference in serum phosphorus levels at 7 days before and after parturition in marathwadi buffaloes.

Kayanu and Kida (2015) found that decreased inorganic phosphorus by 10 per cent in a study conducted in 1700 dairy farms consisting of 46,000 HF cows.

Piao *et al.* (2015) observed in a study that low variability of the phosphorus when compared among early pregnant, mid pregnant and late pregnant groups and they were not statistically significant.

Łukasz *et al.* (2016) reported that a statistically significant decrease in phosphorus concentrations were also observed in cows with milk fever and control group in HF cows.

Yousuf *et al.* (2016) A significantly higher level of phosphorus were present during 7-8 months pregnancy in peri-parturient cows.

Calamari *et al.* (2016) stated that greater variability was found for inorganic phosphorus (19.34 %) in 35 dairy cows.

Van Saun (2016) observed that phosphorus level differed significantly among the groups in transition period in dairy cows.

2.1.4 Total protein

Mehta *et al.* (1989) reported increase in the level of total serum protein from estrous to third trimester of gestation, followed by a significant decrease just prior to parturition and further dropped during post partum stage in dairy cows.

Kuleta *et al.* (1990) observed that serum protein content was one of the indices of nitrogen metabolism.

Rakesh Kumar *et al.* (2001) reported that the total plasma protein of advanced pregnant animals were higher in comparison to the postpartum animals. However, the

total plasma protein got reduced in anorexic and sub-clinical ketotic animals, particularly, during 2 months of lactation.

Ambica and Rao (2012) stated that mean serum total protein levels were significantly lower in peri-parturient period in 288 crossbred cows.

Prodanović *et al.* (2012) observed that average concentrations of total proteins during the dry period and on day 60 of lactation were significantly higher in comparison with the values obtained during early parturition in HF cows.

Oliveira *et al.* (2014) reported that total protein level was significantly lower pre partum (5.85 ± 0.56) increased slowly 48 days post partum (6.95 ± 0.61) in HF cows.

Piao *et al.* (2015) reported that total protein were significantly increased from the early pregnancy period to mid pregnancy period suggesting that there was an increased intake of dietary proteins in Korean Hanwoo cows.

Yousuf *et al.* (2016) reported that higher levels of total protein were found during peak lactation period when compared to the 7 to 8 month pregnant animals and post-partum period.

2.1.5 Albumin

Whitaker *et al.* (1999) conducted study on the effectiveness of the technique for identifying constraints on productivity in small herds in tropical and sub-tropical countries has been examined and found that globulin levels were high in more than 17 per cent of cows.

Van-Saun (2004) reported that post calving albumin ($P < 0.02$) concentrations differ significantly.

Mir *et al.* (2008) observed albumin and globulin levels were increased from early to late gestation.

Seifi *et al.* (2007) observed lowest albumin levels at day 8 post partum. There were lower concentrations of serum albumin shortly after calving than at any other stage of the lactational cycle.

Burke *et al.* (2010) observed lower albumin concentrations throughout the calving transition period in a study consisting of 389 dairy cows.

Ambica and Rao (2012) the mean serum albumin levels were significantly lower in periparturient period when compared to control group in crossbred cows.

Jonsson *et al.* (2013) observed that total protein concentration was significantly lower in heifers.

Oliveira *et al.* (2014) stated that concentration of albumin was lower pre partum (2.82 ± 0.29) and slight increase post partum (3.12 ± 0.22) in HF cows.

Piao *et al.* (2015) reported that albumin level were significantly increased from the early pregnancy to late pregnancy periods, suggesting that there was an increased intake of dietary proteins in Korean Hanwoo cows.

Yousuf *et al.* (2016) reported that albumin levels differed significantly among different stages in the dairy cows. Albumin was found to be the highest in cows immediately after parturition.

Van Saun (2016) reported that albumin ($P < 0.05$) differ significantly in non pregnant group than pre-partum and post-partum groups in the transition dairy cows.

2.1.6 Glucose

Blum *et al.* (1983) observed that plasma glucose was relatively low during the initial twenty days post-partum and in the period of peak lactation in dairy cows.

Singh and Kasaralika (1990) reported that there was a marked hypoglycemia (48.03 ± 0.69 mg %) and ketonemia (15.53 ± 0.64 mg %) in recently parturated ketotic buffaloes as compared to healthy buffaloes (61.97 ± 0.55 and 2.00 ± 0.1 mg% respectively).

Haloi *et al.*, (1997) recorded lower values of serum glucose (42.93 ± 3.52 mg/dl) in cows with post parturient indigestion as compared to healthy cases (56.82 ± 0.89 mg/dl).

Richard *et al.* (2005) observed that blood glucose level was significantly higher during third trimester of gestation than during early lactation.

Macrae *et al.* (2006) stated that glucose level decreased in 70.4 per cent of the cows in early lactation (10 to 20 days calved), 57.1 per cent of the cows in mid-lactation (51 to 120 days calved) and 57.7 per cent of the dry cows within 10 days of their predicted calving date in a study consisted of 35,506 dairy cattle.

Rendina *et al.* (2007) reported that the lower availability of energy in low dietary groups was responsible for low level of glucose.

Seifi *et al.* (2007) observed that serum glucose concentrations had reached the lowest level on day 8 post partum. The average minimum value was 2.66 mmol/L and tended to rise up slightly at day 21 post partum in 60 HF cows.

Gerardo *et al.* (2009) stated that the glucose concentrations were significantly higher in the precalving period than in post calving period in dairy cattle.

Magnus and Lali (2009) reported low levels of serum glucose and calcium in animals with metritis whereas, serum urea nitrogen and total protein values did not show any alteration.

Burke *et al.* (2010) observed that there was significant difference in the concentrations of glucose and NEFA after analysing blood samples collected on day -14 (pre-partum), 0 (day of calving), 4, 7, 14, 28, and 42 day post-partum.

Khan *et al.* (2011) reported that the concentration of plasma glucose did not differ significantly among the summer and winter seasons during both pre- and post-partum period.

Padmaja and Rao (2012) observed that low glucose concentration in post-parturient indigestion buffaloes due to hepatic insufficiency.

Ambica and Rao (2012) the mean serum glucose post-partum period was significantly lower when compared to control group. The mean serum glucose level at

post partum period in control group was 58.10 ± 2.96 . Group I (treated with Calup gel) phosphorus values were 64.81 ± 0.89 (before treatment) v/s 58.20 ± 0.78 (after treatment) mg/dL and in group II (treated with Intacal 25%) 72.37 ± 0.73 (before treatment) v/s 55.20 ± 1.14 (after treatment) in 280 crossbred cows.

Jonsson *et al.* (2013) conducted a study on 22 HF cows in periparturient period and observed significantly lower glucose concentration in dairy cows in pre calving period.

Moreira *et al.* (2015) found that the plasma glucose concentration in summer and winter seasons was lower in postpartum period when compared to prepartum and at calving.

Enrico *et al.* (2015) recorded that serum glucose ($P < 0.05$) concentration was significantly lower in post partum than in pre partum in a study conducted on 42 HF dairy cows.

Piao *et al.* (2015) did not find significant changes in serum glucose concentration in 2205 Korean Hanwoo cows.

Chen *et al.* (2015) observed that post-calving, cows with a 0th day dry period had greater plasma glucose when compared to cows with a 30th or 60th day dry period indicating good metabolic condition on 0th dry period in 167 HF cows.

Van Saun (2016) observed that glucose ($P < 0.05$) level differed significantly among the groups in peri-parturient dairy cows.

Calamari *et al.* (2016) observed that CV of glucose was not high (16.7 %), but the range was very wide (range of 4.54 mmol L⁻¹).

Maurya *et al.* (2016) reported that the overall mean of plasma glucose was found to be significantly higher in treatment (α -tocopherol acetate) group as compared to control group (62.39 ± 1.23 vs. 57.44 ± 1.59 mg/dl) in 16 pregnant Karan Fries cows around parturition.

Yousuf *et al.* (2016) observed that there was an increasing trend of glucose level evidenced during 7 to 8 month pregnancy in 24 randomly selected dairy cows.

2.1.6 Triglycerides

Bertics *et al.* (1992) observed that liver triglycerides level increased by 22 per cent 17 days prior to the parturition in control group and Increased by 75 per cent in force fed dairy cows.

Acorda *et al.* (1994) suggested that biochemical estimation of hepatic triglyceride content or stereological assessment of fractional volume of fat in hepatocytes were found to be reliable in assessing fatty infiltration of liver in dairy cows.

Van-Saun (2004) conducted study on 111 dairy cows divided in to 3 groups (early dry period, close-up dry and post calving) and stated that triglycerides differ significantly among the three groups.

Turk *et al.* (2005) found that the serum triglyceride concentration in pregnant lactating cows was significantly lower compared to dry ones.

Rabelo *et al.* (2005) reported that plasma concentrations of β -hydroxybutyrate (BHBA) and liver triglycerides content on day 21 post partum were 46 per cent and 30 per cent lower respectively, for cows fed high energy diet compared with cows fed low energy diet in periparturient cows.

Seifi *et al.* (2007) observed that triglyceride concentrations were significantly higher during dry periods than post parturition period in 60 HF cows.

Irena *et al.* (2010) conducted research on HF dairy cows from 2nd to 7th lactation and found increased amount of triacylglycerols in post partum period.

Khan *et al.* (2011) reported that the plasma NEFA showed an increasing trend in winter season calvers whereas, it was decreased up to day 30 pre-partum, then increased up to 30 day post-partum and slightly decreased thereafter in summer season calvers. The values obtained were significant on day 60 post-partum and highly significant on day 30 pre-partum.

Moreira *et al.* (2015) conducted study on 31 crossbred dairy cows and found that the serum triglyceride concentration declined until calving and remained at the same level throughout the postpartum period in summer and winter seasons.

Karimian *et al.* (2015) observed that prepartal diet had no significant effect on postpartal plasma triglyceride concentration however, the postpartal high fat diet increased triglyceride and low-density lipoprotein concentrations compared with the postpartal low fat diet in 24 HF cows.

Newman *et al.* (2016) reported that serum total cholesterol and triglyceride levels declined just prior to parturition in all high-density lipoprotein and low-density lipoprotein fed groups.

Yousuf *et al.* (2016) observed that a significantly increased cholesterol, triglycerides, and HDL were found after parturition (stage-2 and 3) than before parturition (stage-1) in peri-parturient cows.

2.1.7 Blood urea nitrogen

Tainturier *et al.* (1984) reported that serum urea concentration remained nearly constant during pregnancy. However, after calving it increased significantly in the first month and returned almost to its earlier value in the second month.

Mulei and Daniel (1989) studied on HF and Jersey cows from two herds. They observed higher mean albumin and blood urea nitrogen level in herd I (24 cows) than herd II (62 cows) during prepartum. In both herds prepartum total protein, globulin and blood urea nitrogen had significant slope.

Ottol *et al.* (2000) reported lower blood urea nitrogen level in young animal groups than in the mature animal group.

Rossato *et al.* (2001) found that urea levels did not show significant differences between groups of 19 HF cows.

Seifi *et al.* (2003) reported that the peak of urea nitrogen concentration was higher in pre-partum period and it decreased postpartum.

Macrae *et al.* (2006) reported that 16 per cent of the cows in early lactation, 5.6 per cent of those in mid-lactation and 20.5 per cent of the dry cows within 10 days of their predicted calving date had a low plasma urea nitrogen concentration in a study on dairy cows.

Seifi *et al.* (2007) stated that BUN was highest at day 21 after parturition in a study consisting of HF cows in different lactation stage.

Gerardo *et al.* (2009) reported that urea was significantly lower in cows in first lactation compared with cows in second lactation as well as compared with cows in third lactation in both pre- and post-calving groups. Urea precalving versus (P = 0.12), and urea postcalving versus (P = 0.42).

Burke *et al.* (2010) observed significant difference in the concentration of urea in blood samples collected on day -14 (pre-partum), 0 (day of calving), 4, 7, 14, 28, and 42 (days of post-partum).

Khan *et al.* (2011) reported that the plasma urea values were lower in the prepartum than post-partum period for summer and winter seasons. Plasma urea decreased during the pre-partum period and increased during the post-partum period in winter season calvers whereas it followed an increasing trend except on day 30 post partum in summer season calvers.

Piao *et al.* (2015) reported that the urea nitrogen levels were significantly increased from the early pregnancy to late pregnancy periods suggesting that there was an increased intake of dietary proteins in Korean Hanwoo cows.

2.1.8 Serum glutamic oxaloacetic transaminase (AST/SGOT) (U/L)

Haloi *et al.* (1997) reported elevated serum AST (89.50 ± 8.33 U/ml) in animals with post parturient indigestion as compared to healthy animals (41.92 ± 0.79 U/ml).

Rossato *et al.* (2001) conducted study on activity of the enzyme aspartate transaminase (AST) to evaluate liver function. There was neither increase nor difference between 1st to 2nd lactation and 3rd to 4th lactation groups.

Van Saun (2004) conducted study on 111 dairy cows divided in to 3 groups (early dry period, close-up dry and post calving) and stated that GGT ($P < 0.02$) and AST ($P < 0.04$) differ significantly.

Richard *et al.* (2005) observed that blood glucose level was significantly higher during third trimester of gestation than during early lactation. Calcium, phosphorus, total protein, cholesterol and SGOT concentrations were not statistically significant.

Seifi *et al.* (2007) found that AST level was the lowest at day 22 before calving and highest at day 21 post partum in HF dairy cows.

Balusami *et al.* (2008) shown that stages of lactation had significant effect on the level of SGOT which was higher during early lactation and declines as the lactation advanced.

Burke *et al.* (2010) stated that the levels aspartate aminotransferase were higher, in high polymorphonuclear(H-PMN) group cows during early lactation compared with low polymorphonuclear(L-PMN) group cows.

Prodanović *et al.* (2012) did not observe significant difference in the values of the concentrations of urea and glucose between the examined periods in HF cows.

Ambica and Rao (2012) observed that the mean serum AST levels increased in post-partum period when compared to control animals in crossbred cows

Hussein *et al.* (2013) reported that AST and creatinine-phosphokinase were significantly increased in herds having history of milk fever in 21 herds with HF cows.

Moreira *et al.* (2015) found that the GGT activity in the summer and activities of LDH and AST increased postpartum.

Enrico *et al.* (2015) stated that the increase in AST concentrations during the post-partum period ($P < 0.05$) was considered as suitable indicator of hepatic disorders.

Piao *et al.* (2015) stated that mean level of AST was higher in pregnant cows than in non pregnant Hanwoo cows.

Kayano and kida (2015) conducted study on 1700 dairy herds of HF cows and observed that the level of AST increased by 23 per cent in all the stages of lactation.

Van Saun (2016) stated that the level of AST immediately after calving were significantly higher than pre-partum period and post-partum period in transition cows.

2.2 Haematological observations

Ottol *et al.* (2000) reported that pregnant cows showed the highest haematocrit in comparison to non pregnant cows.

Seifi *et al.* (2003) reported that serum total protein and PCV values were lowest at preparturition sampling.

Mir *et al.* (2008) observed that all hematological indices associated with RBC differed significantly within the respective means except ESR and MCH where no specific trend was observed. Mean haemoglobin (g/dL) values were 09.21 ± 0.30 , 10.01 ± 0.22 and 09.21 ± 0.28 respectively, in early and late stages differed significantly with mid stage of pregnancy. PCV (%) values recorded were 29.04 ± 0.89 , 31.82 ± 1.06 , and 28.50 ± 1.06 for early, mid and late stages of pregnancy, respectively. The MCV values clearly indicated that the means reported in mid pregnancy were significantly lower when compared with the values reported in early and late stage of pregnancy. The mean MCH values did not differ significantly and were much higher than the values reported in cattle. In contrast to MCH, the mean values of MCHC in mid stage differed significantly with values observed in early and late stage of pregnancy. Higher MCV signifies the increase in the size of RBC in advanced pregnancy.

Puri *et al.* (2010) observed haemoglobin as 7gm/dL and PCV as 21 per cent in clinical case of alkaline indigestion in cow.

Sawalkar *et al.* (2011) observed that low haemoglobin levels were recorded during postpartum period in hypocalcaemic cows.

Ambika and Rao (2012) mean haemogram and leucogram concentrations in postpartum period were significantly when compared to control group in crossbred hypocalcaemic cows.

Materials and Methods

III. MATERIALS AND METHODS

The present study “Metabolic profile of Deoni cows in transition period” was undertaken to determine the haematological and biochemical parameters of Deoni cows in the transition period. The study was conducted based on grouping as follows:

Group I: Pre-partum (8 months and above)

Group II: Early parturition (within 24 hrs after parturition)

Group III: Post-partum (3 to 4 weeks of post partum)

3.1 Selection of animal

The study was undertaken on 30 multiparous pure Deoni animals which were maintained at the Livestock Research and Information Centre (LRIC) Deoni farm, Hallikhed, Bidar. The animals included in the study were 8 months and above pregnant (Plate 2). The animals selected in the study were apparently healthy and devoid of any clinical symptoms in animals. The animals aged between 8 to 12 years old and average milk production of the cows was 3 to 4 litres per day. The signalment data of the animals were recorded daily in the farm, such as milk production, parity and health status. The expected date of calving was determined by the date of natural service and further by per rectal examination

The study also included control group consisting of 10 Deoni animals selected from LRIC Deoni farm. The selected animals were non pregnant and dry animals in order to find out the normal reference values. The other three groups were compared with control group to find out the degree of variance.



Plate 1: Deoni cow with two days old calf (Group II)



Plate 2: 8 month pregnant Deoni cow (Group I)



Plate 3: Deoni cows housed (head to head system) in LRIC farm, Bidar

3.2 Feeding and management

Animals in the farm are let loose for grazing on bund grass in the morning from 9 to 11 AM. At 11:30 AM stall fed with the roughage (green grass, multi-cut jower, hybrid sweet sorghum and hybrid Napier along with dry fodder) of quantity 2-3Kg per animal and concentrate feed of 1 kg per animal. The concentrate feed usually given to the animals during milking and supplied by the Karnataka milk federation in the pelleted form to increase the palatability. Mineral mixture supplementation per animal in the farm was up to 25-30g per animal. Same quantity of roughage feed was given again at 3 PM.

Animals were housed in an ideal shed (head to head system) with proper ventilation and flooring arrangement (Plate 3). Animals were regularly dewormed and vaccinated for various infectious diseases. The periodic examination for other susceptible diseases was done in farm.

3.3 Haematological examination

Blood samples (2 ml) were collected by jugular venipuncture of the selected animals in to the sterile vials containing disodium salts of EDTA as anticoagulant under aseptic conditions, for the estimation of haematological parameters. The blood samples were labelled properly according to groups (three weeks before parturition, with in 24 hrs after parturition and three weeks after parturition) and brought to laboratory for further investigation. The haematological parameters *viz.* Haemogram (haemoglobin, total erythrocyte count and packed cell volume), Leucogram (total leukocyte count), Platelet count, Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) were carried out on fully

automated haematology cell counter- Automatic Blood Cell Counter, Model PCE 210, Manufactured by ERMA Inc., Tokyo, Japan.

3.4 Serum biochemical examinations

For biochemical estimations 10 ml blood was collected in vials coated with clot activators and blood was allowed to coagulate. Serum was separated by centrifugation at 2500 rpm for 10 minutes and serum was collected in eppendorf tubes, labelled accordingly and maintained at -20°C until analysis.

Biochemical Parameters *viz.* serum glucose, serum triglycerides, serum calcium, serum inorganic phosphorus, serum magnesium, total protein, serum albumin, serum glutamic oxaloacetate transaminase (SGOT) and blood urea nitrogen were analysed by ARTOS[®] semi automatic biochemical analyser.

3.4.1 Serum calcium (mg/dL)

The serum calcium was estimated by O-Cresolphathalein Complexone method as described by Gitelam, (1967). The results obtained were expressed in mg/dL

3.4.2 Serum phosphorus (mg/dL)

Serum phosphorus estimation was carried out by UV-Molybdate method as described by Munoz (1983). The values obtained were expressed in mg/dL

3.4.3 Serum glutamic oxaloacetate transaminase SGOT (U/L)

SGOT level was estimated by modified IFCC method as described by Reitman and Frankel (1957) and values obtained were recorded as U/L

3.4.4 Serum magnesium (mg/dL)

Serum magnesium estimation was carried out by Xylidol Blue method. The values obtained were expressed in mg/dL

3.4.5 Serum total protein (g/dL)

Serum total proteins in serum were estimated by Biuret method as described by Vatzidis (1977). The results obtained were expressed in g/dL

3.4.6 Serum albumin (g/dL)

Serum albumin estimation was carried out by Bromocresol green dye method as described by Doumas and Watson (1971). The results obtained were expressed in g/dL.

3.4.6 Serum triglyceride (mg/dL)

GPO-PAP method was used for *in-vitro* estimation of triglycerides as described by Bucolo and David (1973). The results obtained were expressed in mg/dL

3.4.7 Serum glucose (mg/dL)

Serum glucose was estimated by Glucose oxidase-peroxidase (GOD POD) method as described by Henry (1963). The results obtained were expressed in mg/dL

3.4.8 Blood urea nitrogen (mg/dL)

Serum urea nitrogen was estimated by Diacetyl monoxime (DAM) method as described by Berthelot (1859) and values obtained were expressed as mg/dL

3.5 Feed mineral estimation

In order to assess the dietary status of the macro-minerals of the Deoni cows in the LRIC farm and to formulate proper mineral mixture for the animals, the feed samples were subjected for the estimation of macro-minerals. The feed Samples collected (200gms) were subjected for estimation of calcium, phosphorus and magnesium (IPC-OES) as per National Institute of Animal Nutrition and Physiology (NIANP) protocol.

3.6 Statistical analysis

The haematological and biochemical values obtained on three weeks prepartum, on the day of parturition and three weeks post partum samples were subjected to statistical analysis by one way ANOVA using Statistical Package for Social Sciences (SPSS) version 20. Differences between means were tested using Duncan's multiple comparison test and significance was set at 5 per cent ($p < 0.05$) and also at 1 per cent ($p < 0.01$).

Results



IV. RESULTS

The study was carried out in 30 multiparous pure Deoni animals in Livestock Research Information Centre (Deoni farm), KVAFSU, Bidar. Metabolic profile was assessed in these animals in the transition period and grouped as Group I (pre-partum period), Group II (early parturition) and Group III (post-partum period) consisting 10 animals in each group.

4.1 Haematological parameters

The haematological parameters of individual animal were tabulated in the table (1), table (2), table (3) and table (4). The comparative analyses of the mean values of haematological parameters were tabulated in the table (9).

4.1.1 Total erythrocyte count ($10^6/\mu\text{L}$)

The Mean \pm SE value of Total erythrocyte count was 7.25 ± 0.32 in healthy control group whereas, Mean \pm SE values were 6.13 ± 0.39 , 6.62 ± 0.39 and 6.99 ± 0.21 in group I (pre-partum), group II (at parturition) and group III (post-partum) respectively.

The Mean \pm SE TEC values were significantly ($P < 0.05$) lower in the groups of the transition period when compared to mean values in healthy control group. However, decrease in values was apparently found to be within normal physiological limits.

4.1.2 Haemoglobin (Hb) (g/dL)

The Mean \pm SE values of haemoglobin in control group, group I (pre-partum), group II (at parturition) and group III (post-partum) were 11.27 ± 0.25 , 8.79 ± 0.19 , 8.11 ± 0.29 and 11.06 ± 0.43 respectively.

The Mean \pm SE values of haemoglobin were significantly ($P < 0.05$) lower in group I (pre-partum) and group II (at parturition) when compared to healthy control group. However, there was no statistically significant difference in the Mean \pm SE values of group III (post-partum) with healthy control group.

4.1.3 Total leukocyte count ($10^3/\mu\text{L}$)

The Mean \pm SE values of total leukocyte count were 11.02 ± 0.58 in control group and 8.34 ± 0.18 , 7.01 ± 0.22 and 10.58 ± 0.43 in group I (pre-partum), group II (at parturition) and group III (post-partum) respectively.

The Mean \pm SE values of TLC were significantly ($P < 0.01$) lower in group I (pre-partum) and group II (at parturition) when compared to healthy control group. However, there was no significant difference in Mean \pm SE values of group III (post-partum) with control group. The values in group III (post-partum) differed significantly ($P < 0.05$) when compared to group I (pre-partum) and group II (at parturition).

4.1.4 Packed cell volume (%)

The Mean \pm SE value of packed cell volume was 34.17 ± 0.68 in healthy control group whereas, Mean \pm SE values were 30.30 ± 1.24 , 31.98 ± 1.77 and 34.53 ± 0.92 in group I (pre-partum), group II (at parturition) and group III (post-partum) respectively..

The Mean \pm SE values in group I (pre-partum) were significantly ($P < 0.05$) lower when compared to healthy control group and group III (post-partum) whereas no significant difference found in group II (at parturition) when compared with group I (pre-partum). There was no significant difference between group III (post-partum) and healthy

control group. The values were found to be within normal physiological limits in all the groups.

4.1.5 Mean corpuscular volume (fL)

The Mean \pm SE values of mean corpuscular volume in control group, group I (pre-partum), group II (at parturition) and group III (post-partum) were 47.93 ± 2.27 , 48.37 ± 1.45 , 48.58 ± 1.48 and 49.56 ± 1.29 respectively..

There was no significant difference in the Mean \pm SE values of mean corpuscular volume between control group and study group though the values were in normal physiological limits

4.1.6 Mean corpuscular haemoglobin (pg)

The Mean \pm SE value of Mean corpuscular haemoglobin in control group was 15.69 ± 0.41 whereas the mean values in study groups were 13.71 ± 0.48 , 12.6 ± 0.81 and 15.91 ± 0.70 of group I (pre-partum), group II (at parturition) and group III (post-partum) respectively..

The Mean \pm SE values of MCH were significantly ($P < 0.01$) lower in the group I (pre-partum) and group II (at parturition) when compared to healthy control group. However, there was no significant difference in the Mean \pm SE values of group III (post-partum) with control group. The values in group III (post-partum) were significantly ($P < 0.05$) higher when compared to group I (pre-partum) and group II (at parturition).

4.1.7 Mean corpuscular haemoglobin concentration (g/dL)

The Mean \pm SE values of mean corpuscular haemoglobin concentration in control group, group I (pre-partum), group II (at parturition) and group III (post-partum) were 33.09 ± 1.06 , 28.51 ± 1.12 , 26.05 ± 1.70 and 32.13 ± 1.23 respectively..

The Mean \pm SE values of MCHC in group I (pre-partum) and group II (at parturition) were significantly ($P < 0.01$) lower when compared to control group whereas there was no significant difference between group III (post-partum) and control group. However, there was significant ($P < 0.01$) difference between group II (at parturition) and group III (post-partum) in the transition period.

4.1.8 Platelet count ($10^3/\mu\text{L}$)

The Mean \pm SE values of platelet count in control group, group I (pre-partum), group II (at parturition) and group III (post-partum) were 129.2 ± 5.17 , 146.2 ± 9.81 , 152 ± 8.27 and 146.7 ± 9.86 respectively..

There was no significant difference between the study groups and with the control group however, the values in all the groups were within normal physiological limits.

4.2 Biochemical parameters

The biochemical parameters of individual animal were tabulated in the table (5), table (6), table (7) and table (8). The comparative analyses of the mean values of biochemical parameters were tabulated in the table (10).

4.2.1 Serum calcium (mg/dL)

The Mean \pm SE value of serum calcium in control group was 9.98 ± 0.33 and mean values of study groups were 8.92 ± 0.24 , 7.51 ± 0.28 and 7.63 ± 0.42 in group I (pre-partum), group II (at parturition) and group III (post-partum) respectively.

The Mean \pm SE values of calcium were significantly ($P < 0.05$) lower in all the three groups in transition period when compared to healthy control group. The values in group I (pre-partum) were significantly ($P < 0.01$) higher when compared to group II (at parturition) and group III (post-partum) whereas no significant difference was found between group II (at parturition) and group III (post-partum).

4.2.2 Serum magnesium (mg/dL)

The Mean \pm SE values of serum magnesium in control group, group I (pre-partum), group II (at parturition) and group III (post-partum) were 3.31 ± 0.14 , 3.13 ± 0.08 , 1.99 ± 0.06 and 2.56 ± 0.04 respectively.

The Mean \pm SE values of serum magnesium in group II (at parturition) and group III (post-partum) were significantly ($P < 0.01$) lower when compared to control group. However, there was no significant difference between group I (pre-partum) and healthy control group. The values in group I (pre-partum) were significantly ($P < 0.05$) higher when compared to group II (at parturition) and group III (post-partum).

4.2.3 Serum phosphorus (mg/dL)

The Mean \pm SE value of serum phosphorus in healthy control group was 5.12 ± 0.22 whereas in group I (pre-partum), group II (at parturition) and group III (post-partum) were 3.80 ± 0.29 , 3.10 ± 0.22 and 3.37 ± 0.35 respectively.

The Mean \pm SE values in group I (pre-partum), group II (at parturition) and group III (post-partum) were significantly ($P < 0.01$) lower when compared to control group. There was no significant difference between the study groups.

4.2.4 Serum total protein (g/dL)

The Mean \pm SE values of serum total protein in control group, group I (pre-partum), group II (at parturition) and group III (post-partum) were 7.01 ± 0.14 , 6.58 ± 0.22 , 6.75 ± 0.29 and 7.35 ± 0.29 respectively.

The Mean \pm SE values of serum total protein in group I (pre-partum) were significantly ($P < 0.05$) lower when compared to group III (post-partum) whereas there was no significant difference between group I (pre-partum) and group II (at parturition). However, there was no significant difference found between study groups and healthy control group.

4.2.5 Serum albumin (g/dL)

The Mean \pm SE value of serum albumin in healthy control group was 3.81 ± 0.12 whereas group I (pre-partum), group II (at parturition) and group III (post-partum) values were 3.14 ± 0.15 , 3.27 ± 0.19 and 3.36 ± 0.1 respectively.

The Mean \pm SE values of serum albumin were significantly ($P < 0.05$) lower in transition period when compared with healthy control group.

4.2.6 Serum SGOT (U/L)

The Mean \pm SE values of serum aspartate aminotransferase in control group, group I (pre-partum), group II (at parturition) and group III (post-partum) were 58.88 ± 2.99 , 50.61 ± 3.41 , 55.37 ± 2.54 and 64.49 ± 3.68 respectively.

The Mean \pm SE values of serum aspartate aminotransferase in group III (post-partum) differed significantly with group I (pre-partum) and group II (at parturition). However, there was no significant difference between group I (pre-partum) and group II (at parturition). There was no significant difference between the study groups and healthy control group. However, the values were within normal physiological limits.

4.2.7 Serum glucose (mg/dL)

The Mean \pm SE values of serum glucose in control group was 53.84 ± 1.6 whereas the values in group I (pre-partum), group II (at parturition) and group III (post-partum) were, 36.67 ± 2.47 , 30.41 ± 2.06 and 30.30 ± 1.61 respectively.

The Mean \pm SE values of serum glucose in group II (at parturition) and group III (post-partum) were significantly ($P < 0.05$) lower when compared to group I (pre-partum). However there was no significant difference found between group II (at parturition) and group III (post-partum). The values in control group were significantly ($P < 0.01$) higher when compared to group I (pre-partum), group II (at parturition) and group III (post-partum).

4.2.8 Serum triglycerides (mg/dL)

The Mean \pm SE values of serum triglycerides in control group, group I (pre-partum), group II (at parturition) and group III (post-partum) were 47.80 ± 2.24 , 32.79 ± 2.28 , 41.96 ± 6.09 and 50.23 ± 3.63 respectively.

The Mean \pm SE values of triglycerides in group I (pre-partum) differed significantly ($P < 0.01$) when compared to group III (post-partum) whereas no significant difference was found with group II (at parturition). The control group differed significantly ($P < 0.01$) when compared to group I (pre-partum) however, no significant difference was observed with group II (at parturition) and group III (post-partum).

4.2.9 Blood urea nitrogen (mg/dL)

The Mean \pm SE values of blood urea nitrogen in control group, group I (pre-partum), group II (at parturition) and group III (post-partum) were 19.81 ± 0.43 , 16.84 ± 0.81 , 19.29 ± 0.63 and 17.13 ± 1.15 respectively.

The Mean \pm SE values of blood urea nitrogen in group I (pre-partum) and group III (post-partum) differed significantly ($P < 0.05$) when compared to healthy control group. However, there was no significant difference between group II (at parturition) and control group. The values in group I (pre-partum) were significantly ($P < 0.05$) lower when compared to group II (at parturition) in transition period.

Table 1: Haematological parameters in individual animal of the control group

Parameter	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	MEAN±SE
TEC	6.61	6.68	7.15	9.54	6.33	6.67	7.02	8.16	6.45	7.89	7.25±0.32
Hb	10.70	11.30	12.40	12.60	10.10	10.80	11.20	11.30	10.50	11.80	11.27±0.25
TLC	11.40	9.40	12.40	10.40	11.60	14.90	8.40	9.80	10.20	11.70	11.02±0.58
PCV	35.80	37.20	36.70	34.50	33.80	31.50	32.70	33.10	35.50	30.90	34.17±0,68
MCV	54.16	55.69	51.33	36.16	53.40	47.23	46.58	40.56	55.04	39.16	47.93±2.27
MCH	16.19	16.92	17.34	13.21	15.96	16.19	15.95	13.85	16.28	14.96	15.69±0.41
MCHC	29.89	30.38	33.79	36.52	29.88	34.29	34.25	34.14	29.58	38.19	33.09±0.96
PLT	124.00	104.00	112.00	118.00	129.00	146.00	157.00	134.00	124.00	144.00	129.20±5.17

Table 2: Haematological parameters in individual animal of the group I (pre-partum)

Parameter	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	MEAN±SE
TEC	6.30	5.56	2.96	6.47	6.13	6.77	6.82	6.90	7.40	6.03	6.13±0.39
Hb	9.62	8.80	8.50	8.40	9.70	9.20	8.60	7.83	9.02	8.19	8.79±0.19
TLC	8.70	7.80	8.20	7.30	8.50	9.20	9.10	8.40	8.30	7.90	8.34±0.18
PCV	32.10	25.90	23.70	27.00	32.30	30.50	29.30	37.00	33.19	32.00	30.29±1.24
MCV	50.95	46.58	52.20	41.73	52.69	45.05	42.96	53.62	44.85	53.07	48.37±1.15
MCH	15.27	15.83	13.87	12.98	15.82	13.59	12.61	11.35	12.19	13.58	13.71±0.48
MCHC	29.97	33.98	26.56	31.11	30.03	30.16	29.35	21.16	27.18	25.59	28.51±1.12
PLT	144.00	139.00	153.00	132.00	196.00	198.00	109.00	112.00	156.00	123.00	146.2±9.81

Table 3: Haematological parameters in individual animal of the group II (at parturition)

Parameter	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	MEAN±SE
TEC	6.10	5.83	5.16	8.48	5.16	7.71	8.37	7.02	6.52	5.87	6.62±0.39
Hb	7.20	7.50	7.30	9.20	8.50	8.40	7.10	8.60	7.50	9.80	8.11±0.29
TLC	6.10	6.60	7.10	6.90	6.20	7.40	7.90	6.90	6.70	8.30	7.01±0.22
PCV	33.90	25.70	26.10	35.40	26.10	42.70	37.00	32.40	32.60	27.90	31.98±1.77
MCV	55.57	44.08	50.58	41.75	50.58	55.38	44.21	46.15	50.00	47.53	48.58±1.48
MCH	11.80	12.86	14.15	10.85	16.47	10.89	8.48	12.25	11.50	16.70	12.60±0.81
MCHC	21.24	29.18	27.97	25.99	32.57	19.67	19.19	26.54	23.01	35.13	26.05±1.70
PLT	162.00	190.00	172.00	147.00	178.00	142.00	158.00	149.00	113.00	109.00	152±8.27

Table 4: Haematological parameters in individual animal of the group III (post-partum)

Parameter	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	MEAN±SE
TEC	7.87	6.32	7.25	6.32	6.45	6.69	7.84	7.87	6.34	6.98	6.99±0.21
Hb	12.90	9.50	12.30	11.70	9.80	10.10	9.30	11.80	12.60	10.60	11.06±0.43
TLC	13.90	10.20	9.50	10.70	11.30	10.10	9.90	11.00	8.80	10.40	10.58±0.43
PCV	36.60	32.00	33.80	32.00	29.20	37.60	34.40	38.80	34.90	36.00	34.53±0.92
MCV	46.51	50.63	46.62	50.63	45.27	56.20	43.88	49.30	55.05	51.58	49.57±1.2
MCH	16.39	15.03	16.97	18.51	15.19	15.10	11.86	14.99	19.87	15.19	15.91±0.70
MCHC	35.25	29.69	36.39	36.56	33.56	26.86	27.03	30.41	36.10	29.44	32.13±1.23
PLT	179.00	204.00	133.00	127.00	167.00	117.00	165.00	138.00	135.00	102.00	146.7±9.86

Table 5: Biochemical parameters in individual animals of control group

Parameter	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	MEAN±SE
Ca	8.91	10.79	8.67	9.08	9.63	9.40	10.36	11.27	11.83	9.90	9.98±0.33
Mg	3.90	3.83	3.66	2.89	2.94	3.57	3.13	2.87	3.51	2.80	3.31±0.14
P	5.04	5.25	4.97	4.63	5.02	4.20	4.68	6.14	4.82	6.45	5.12±0.22
Total Protein	6.96	7.37	7.01	6.54	6.49	6.90	7.18	7.43	7.82	6.39	7.01±0.14
Albumin	3.55	3.77	4.43	4.39	3.59	3.80	3.24	3.61	4.04	3.73	3.82±0.12
SGOT	54.26	59.19	63.55	44.22	52.84	57.55	67.94	59.49	68.03	61.68	58.88±2.29
Glucose	50.33	58.16	55.84	57.51	60.41	59.18	51.94	49.23	45.22	50.58	53.84±1.60
Triglycerides	38.35	41.35	45.86	43.61	61.65	57.14	44.62	51.05	47.83	46.58	47.80±2.24
BUN	17.70	21.30	19.40	18.10	20.60	20.10	21.70	19.90	18.60	20.70	19.81±0.43

Table 6: Biochemical parameters in individual animals of group I (pre-partum)

Parameter	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	MEAN±SE
Ca	9.40	8.70	8.40	9.10	7.75	9.21	9.80	8.10	10.20	8.50	8.92±0.24
Mg	3.20	3.01	2.90	3.50	3.13	2.90	2.86	3.30	3.01	3.49	3.13±0.08
P	5.01	5.14	4.71	3.22	3.66	4.09	2.42	3.58	3.47	2.73	3.80±0.29
Total protein	6.80	7.01	7.59	5.07	7.22	6.67	6.37	6.23	6.26	6.59	6.58±0.22
Albumin	3.32	2.86	3.26	2.01	3.60	3.65	3.42	2.98	3.17	3.15	3.14±0.15
SGOT	61.97	55.61	41.87	53.40	38.34	45.68	70.64	43.96	56.43	38.17	50.61±3.14
Glucose	28.17	39.18	40.41	21.09	34.74	32.85	38.20	43.05	48.22	40.80	36.67±2.47
Triglycerides	30.08	32.33	42.86	33.48	21.05	21.97	40.32	39.44	32.76	33.61	32.79±2.28
BUN	17.19	17.33	20.12	16.98	12.39	16.43	17.59	18.55	19.26	12.58	16.84±0.81

Table 7: Biochemical parameters in individual animals of group II (at parturition)

Parameter	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	MEAN±SE
Ca	8.97	8.23	6.71	6.90	6.74	8.41	7.98	7.95	6.35	6.84	7.51±0.28
Mg	2.30	2.10	2.13	1.93	1.90	1.96	1.70	1.78	2.10	2.02	1.99±0.06
P	2.82	4.42	2.13	3.62	3.26	2.36	3.22	3.11	2.36	3.67	3.10±0.22
Total protein	7.73	6.87	7.08	7.34	6.83	5.13	5.07	6.97	7.24	7.19	6.75±0.29
Albumin	3.46	2.92	3.28	4.50	3.09	3.04	2.67	2.75	2.75	4.20	3.27±0.20
SGOT	69.02	62.13	56.39	46.11	48.96	48.32	66.97	52.35	51.36	52.06	55.33±2.54
Glucose	37.96	22.18	25.71	37.14	27.73	37.21	25.12	22.16	36.28	32.65	30.41±2.06
Triglycerides	29.32	32.16	26.32	89.30	49.62	40.00	34.84	50.28	21.94	45.86	41.96±6.09
BUN	19.22	21.58	16.98	21.13	17.39	18.42	18.56	23.15	17.89	18.56	19.29±0.63

Table 8: Biochemical parameters in individual animals of group III (post-partum)

Parameter	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	MEAN±SE
Ca	5.12	7.62	9.16	7.85	8.12	6.49	6.65	9.75	7.56	8.02	7.63±0.42
Mg	2.70	2.60	2.40	2.80	2.45	2.48	2.40	2.50	2.65	2.57	2.56±0.04
P	3.27	2.67	2.01	2.97	3.08	5.41	4.91	3.08	4.09	2.16	3.37±0.35
Total protein	6.80	8.34	8.51	6.23	7.99	8.05	6.03	7.99	6.67	6.89	7.35±0.29
Albumin	3.71	3.41	3.41	3.16	3.61	2.75	3.43	3.61	2.98	3.51	3.36±0.10
SGOT	71.19	66.63	64.01	88.75	64.96	59.17	67.69	57.38	62.71	42.37	64.49±3.68
Glucose	28.57	27.35	24.76	36.33	22.08	38.20	29.78	34.41	32.42	29.08	30.30±1.61
Triglycerides	67.20	36.75	43.37	39.05	63.23	50.91	52.12	63.23	36.12	50.30	50.23±3.63
BUN	20.64	19.14	17.05	22.63	19.35	12.62	17.68	10.45	15.79	16.02	17.14±1.15

Table 9: Comparison of Mean \pm SE values of haematological parameters in transition period in comparison with healthy control group

Parameter	Control Group	Group I (pre-partum)	Group II (at parturition)	Group III (post-partum)
TEC	7.25 \pm 0.32 ^a	6.13 \pm 0.39 ^b	6.62 \pm 0.39 ^{ab}	6.99 \pm 0.21 ^{ab}
Hb	11.27 \pm 0.25 ^a	8.79 \pm 0.19 ^b	8.11 \pm 0.29 ^b	11.06 \pm 0.43 ^a
TLC	11.02 \pm 0.58 ^c	8.34 \pm 0.18 ^b	7.01 \pm 0.22 ^a	10.58 \pm 0.43 ^c
PCV	34.17 \pm 0.68 ^a	30.30 \pm 1.24 ^b	31.98 \pm 1.77 ^{ab}	34.53 \pm 0.92 ^a
MCV	47.93 \pm 2.27	48.37 \pm 1.45	48.58 \pm 1.48	49.56 \pm 1.29
MCH	15.69 \pm 0.41 ^a	13.71 \pm 0.48 ^b	12.6 \pm 0.81 ^b	15.91 \pm 0.70 ^a
MCHC	33.09 \pm 1.06 ^a	28.51 \pm 1.12 ^{bc}	26.05 \pm 1.70 ^c	32.13 \pm 1.23 ^{ab}
PLT	129.20 \pm 5.17	146.20 \pm 9.81	152.00 \pm 8.27	146.70 \pm 9.86

Means with dissimilar superscripts differ significantly

Table 10: Comparison of Mean \pm SE values of biochemical parameters in transition period in comparison with healthy control group

Parameter	Control Group	Group I (pre-partum)	Group II (at parturition)	Group III (post-partum)
Ca	9.98 \pm 0.33 ^a	8.92 \pm 0.24 ^b	7.51 \pm 0.28 ^c	7.63 \pm 0.42 ^c
Mg	3.31 \pm 0.14 ^a	3.13 \pm 0.08 ^a	1.99 \pm 0.06 ^c	2.56 \pm 0.04 ^b
P	5.12 \pm 0.22 ^a	3.80 \pm 0.29 ^b	3.10 \pm 0.22 ^b	3.37 \pm 0.35 ^b
Total Protein	7.01 \pm 0.14 ^{ab}	6.58 \pm 0.22 ^a	6.75 \pm 0.29 ^{ab}	7.35 \pm 0.29 ^a
Albumin	3.81 \pm 0.12 ^a	3.14 \pm 0.15 ^b	3.27 \pm 0.19 ^b	3.36 \pm 0.10 ^b
SGOT	58.88 \pm 2.29 ^{ab}	50.61 \pm 3.41 ^b	55.37 \pm 2.54 ^{ab}	64.49 \pm 3.68 ^c
Glucose	53.84 \pm 1.6 ^a	36.67 \pm 2.47 ^b	30.41 \pm 2.06 ^c	30.30 \pm 1.61 ^c
Triglycerides	47.80 \pm 2.24 ^a	32.79 \pm 2.28 ^b	41.96 \pm 6.09 ^{ab}	50.23 \pm 3.63 ^a
BUN	19.81 \pm .43 ^a	16.84 \pm 0.81 ^c	19.29 \pm 0.63 ^{ab}	17.13 \pm 1.15 ^{bc}

Means with dissimilar superscripts differ significantly

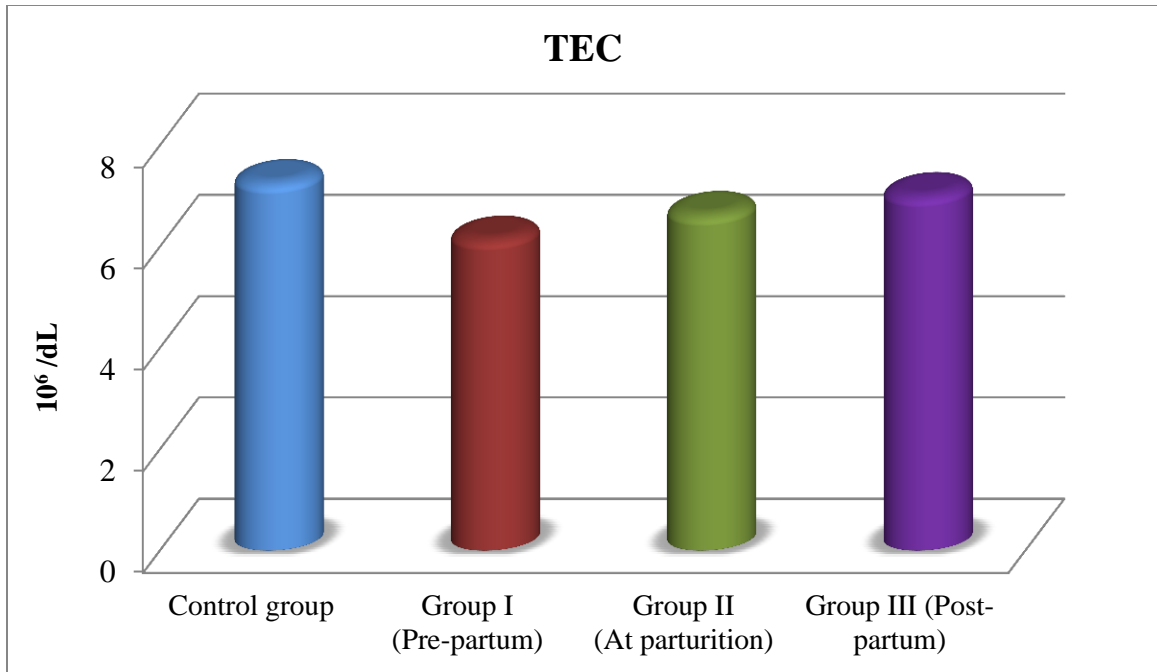


Fig. 1: Mean total erythrocyte count ($10^6/\mu\text{L}$) in the transition period in comparison with healthy control group

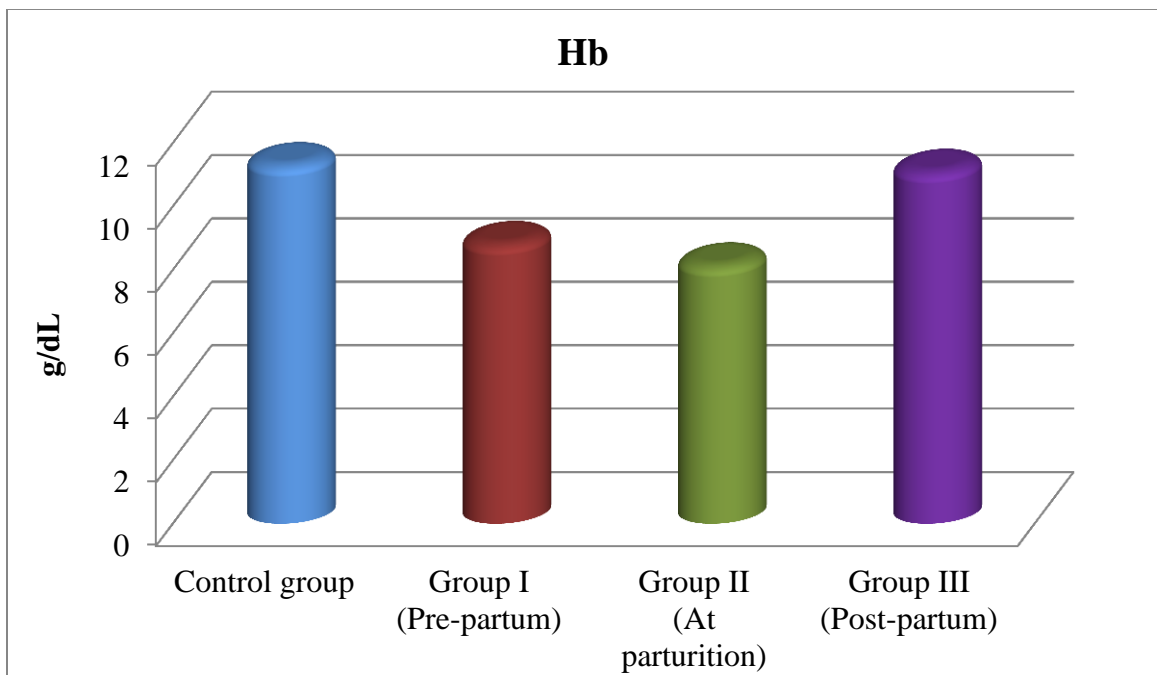


Fig. 2: Mean haemoglobin concentration (g/dL) in transition period in comparison with healthy control group

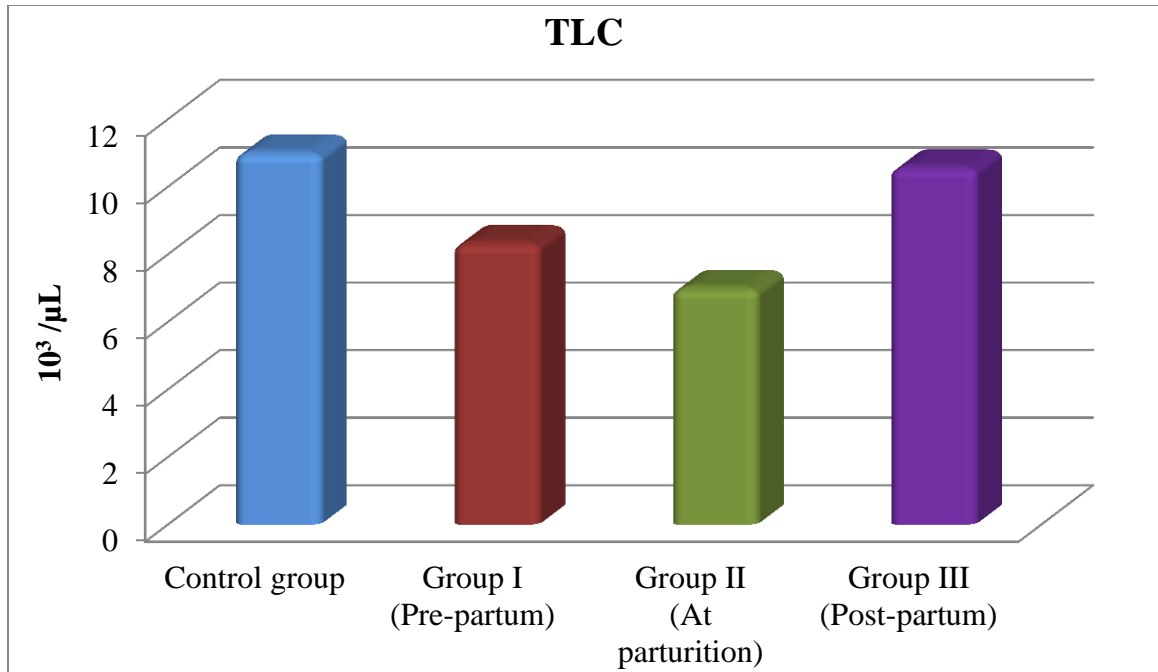


Fig. 3: Mean total leukocyte count ($10^3/\mu\text{L}$) in the transition period in comparison with healthy control group

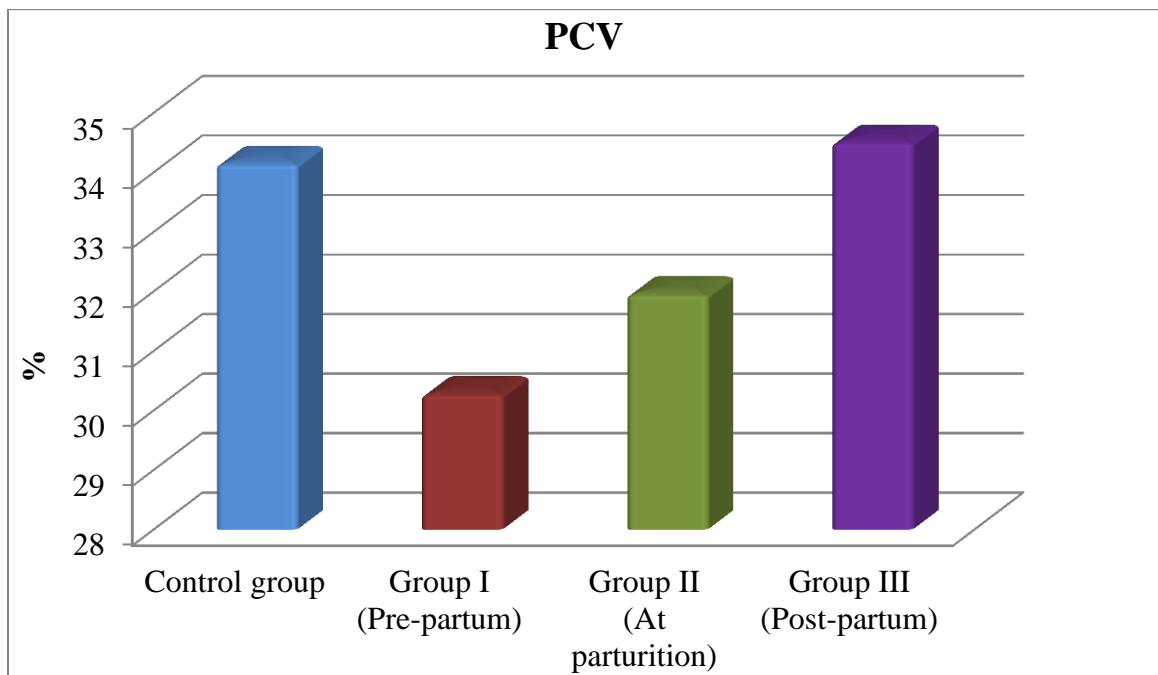


Fig. 4: Mean packed cell volume (%) in transition period in comparison with healthy control group

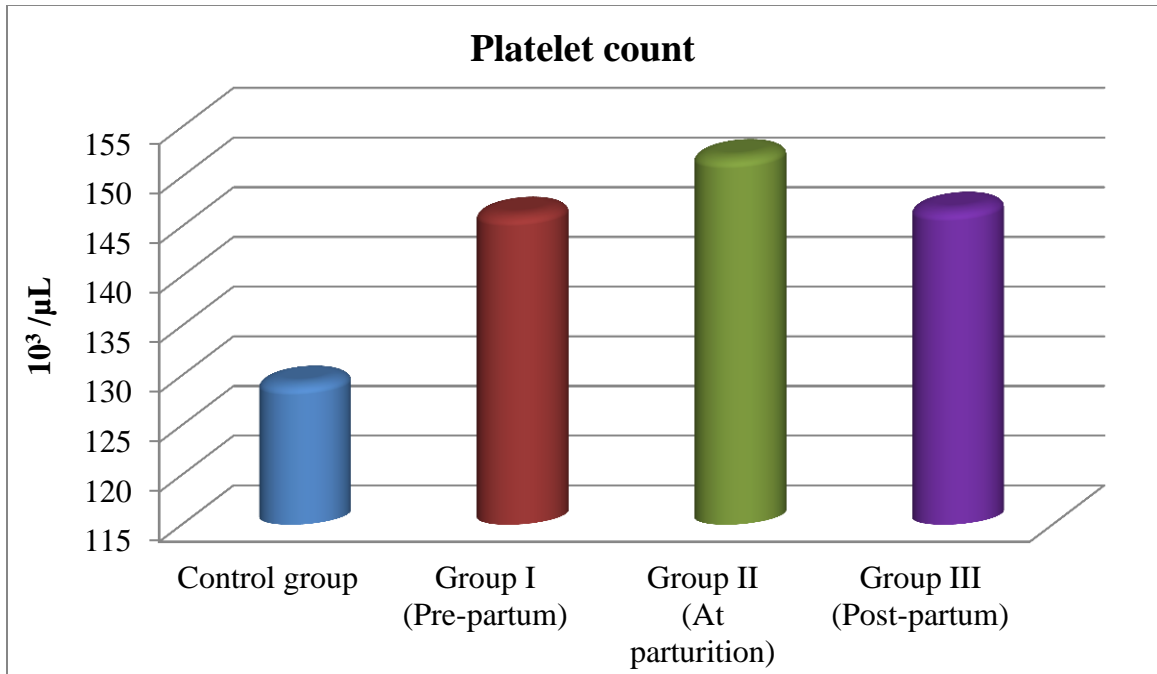


Fig. 5: Mean platelet count ($10^3/\mu\text{L}$) in the transition period in comparison with healthy control group

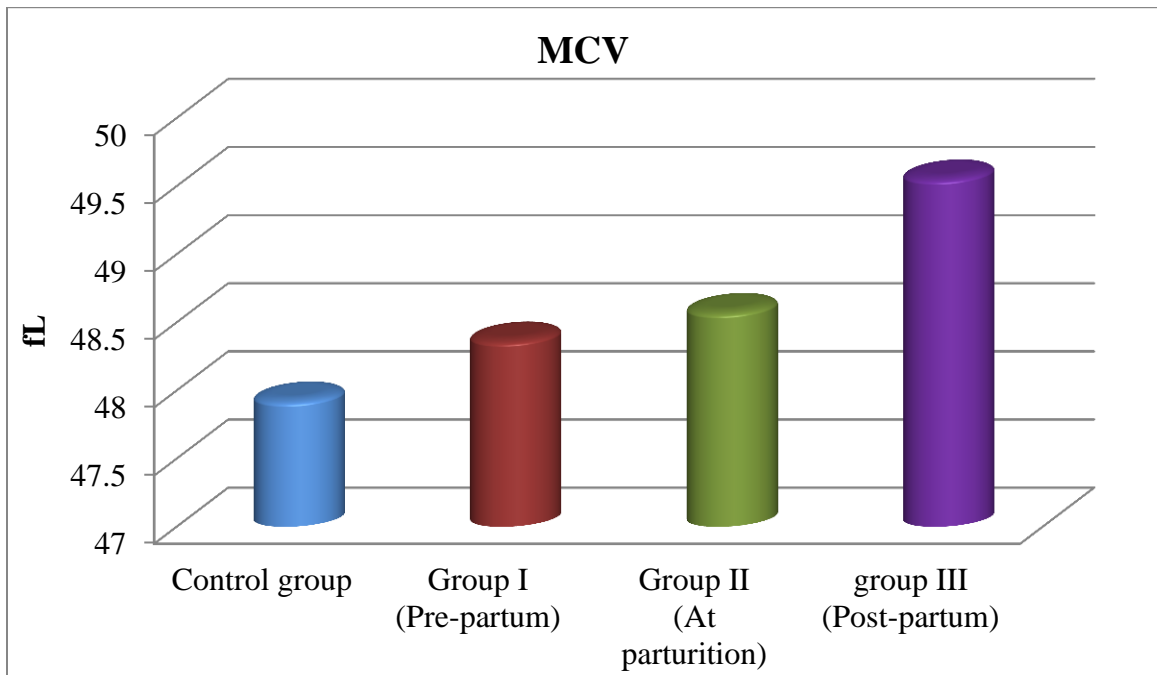


Fig. 6: Mean corpuscular volume (fL) in transition period in comparison with healthy control group

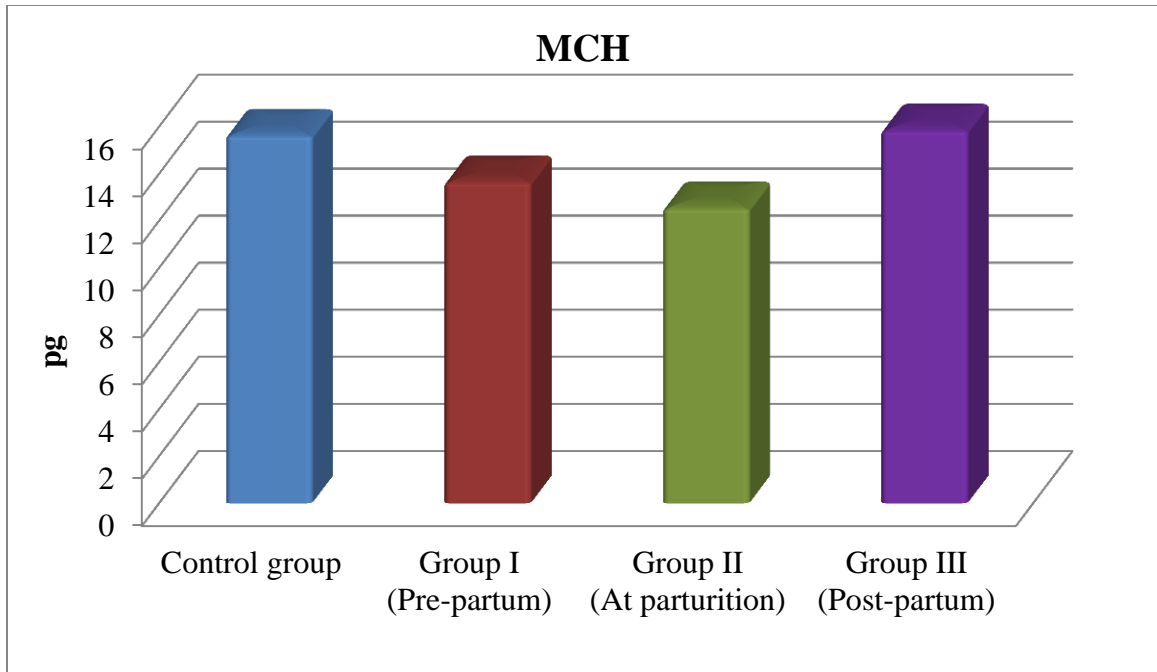


Fig. 7: Mean corpuscular haemoglobin (pg) levels in transition period in comparison with healthy control group

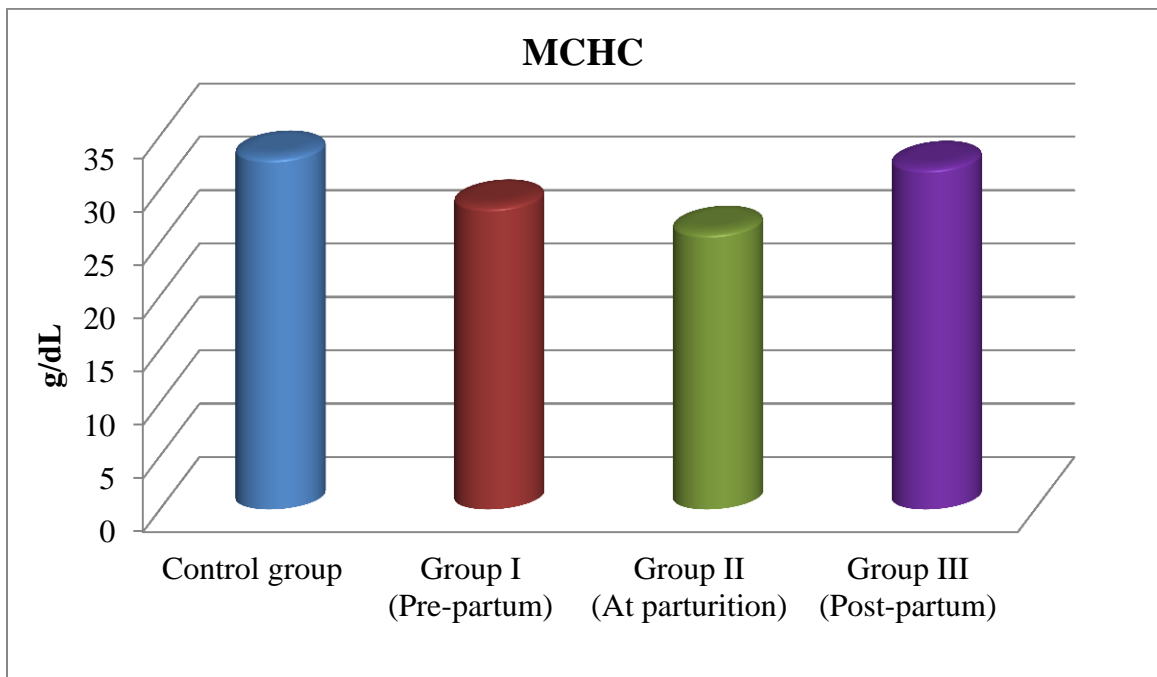


Fig. 8: Mean corpuscular haemoglobin concentration (g/dL) in transition period in comparison with healthy control group

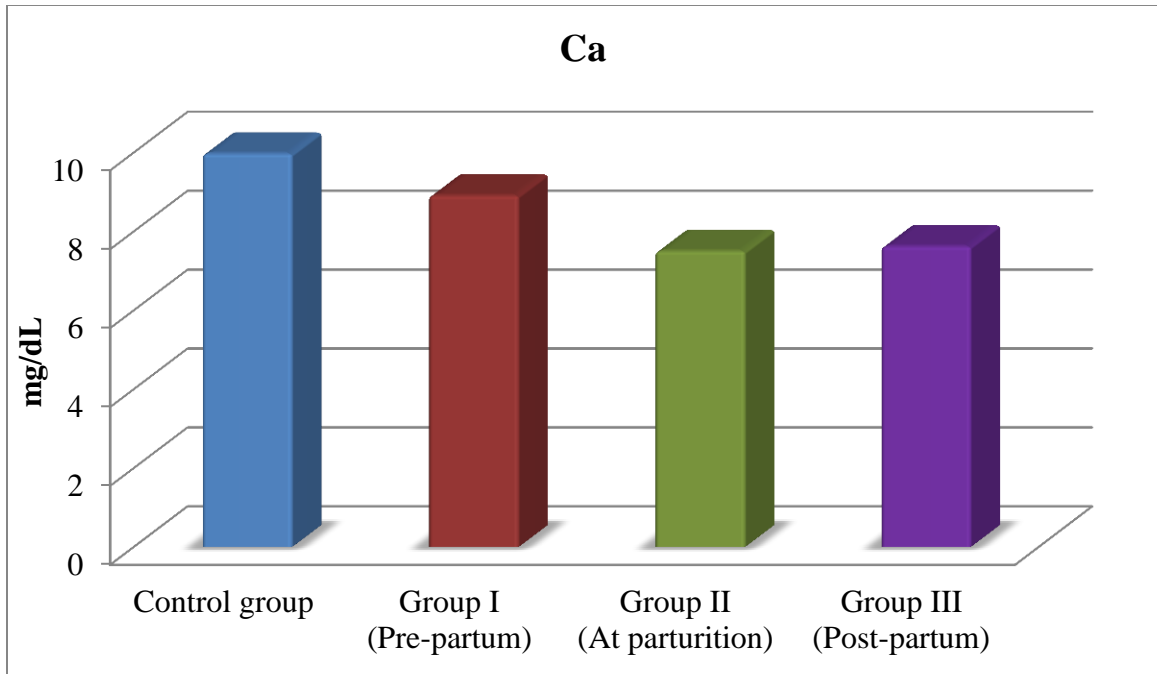


Fig. 9: Mean serum calcium (mg/dL) levels in transition period in comparison with healthy control group

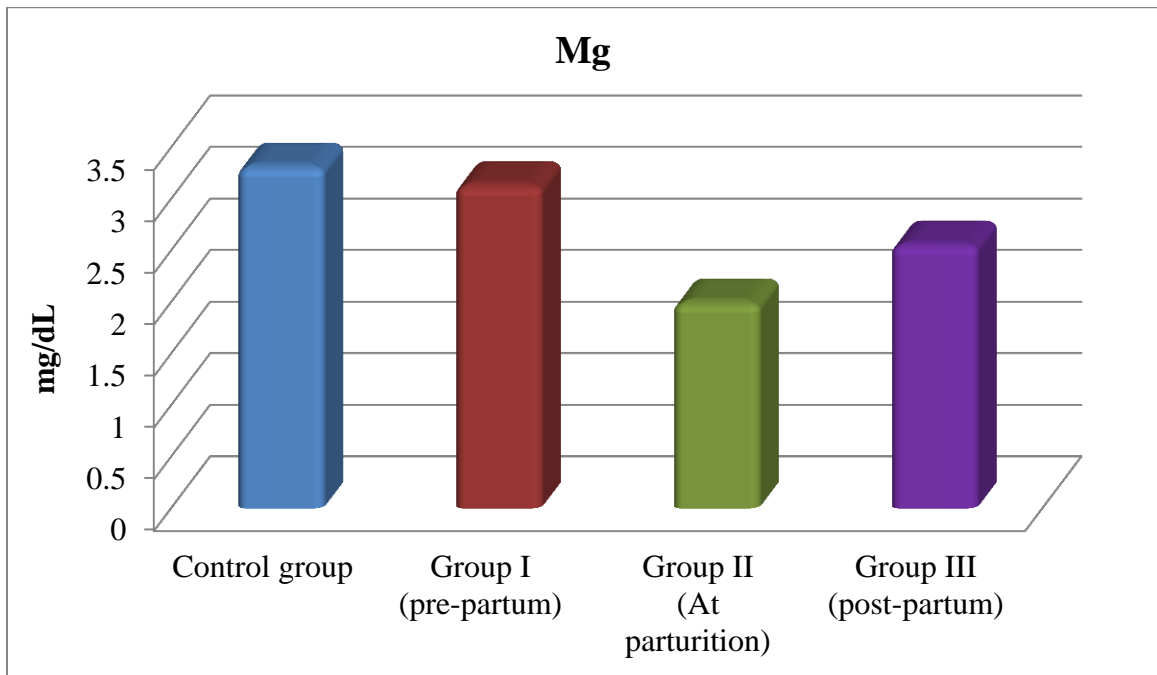


Fig. 10: Mean serum magnesium (mg/dL) levels in transition period in comparison with healthy control group

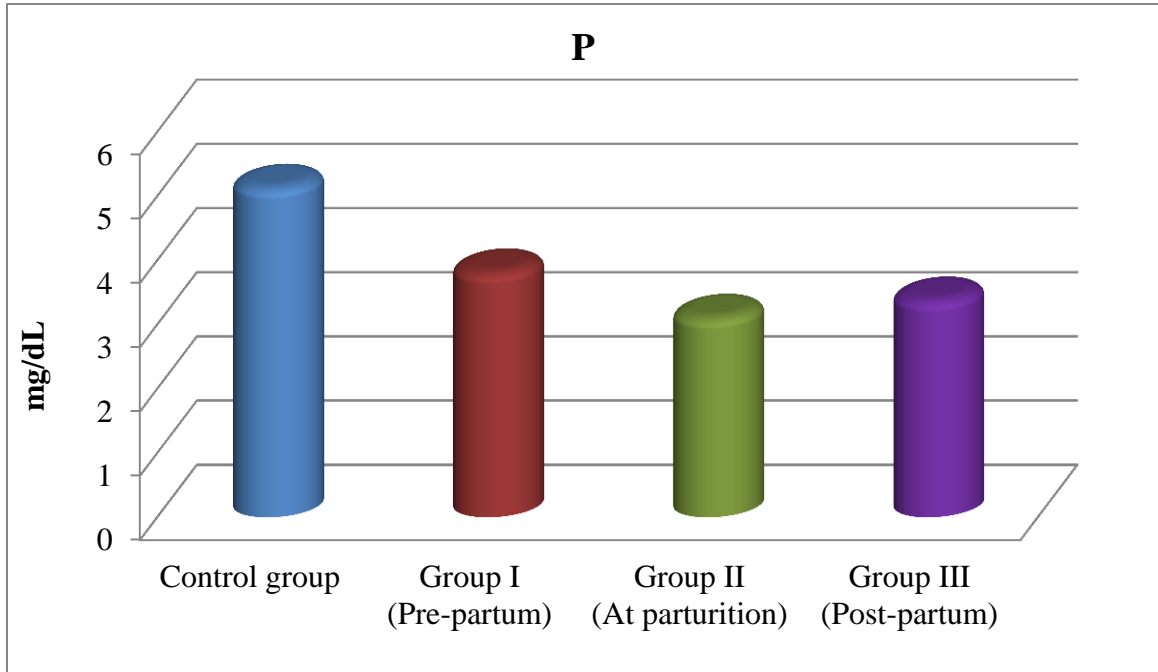


Fig. 11: Mean serum phosphorus (mg/dL) levels in transition period in comparison with healthy control group

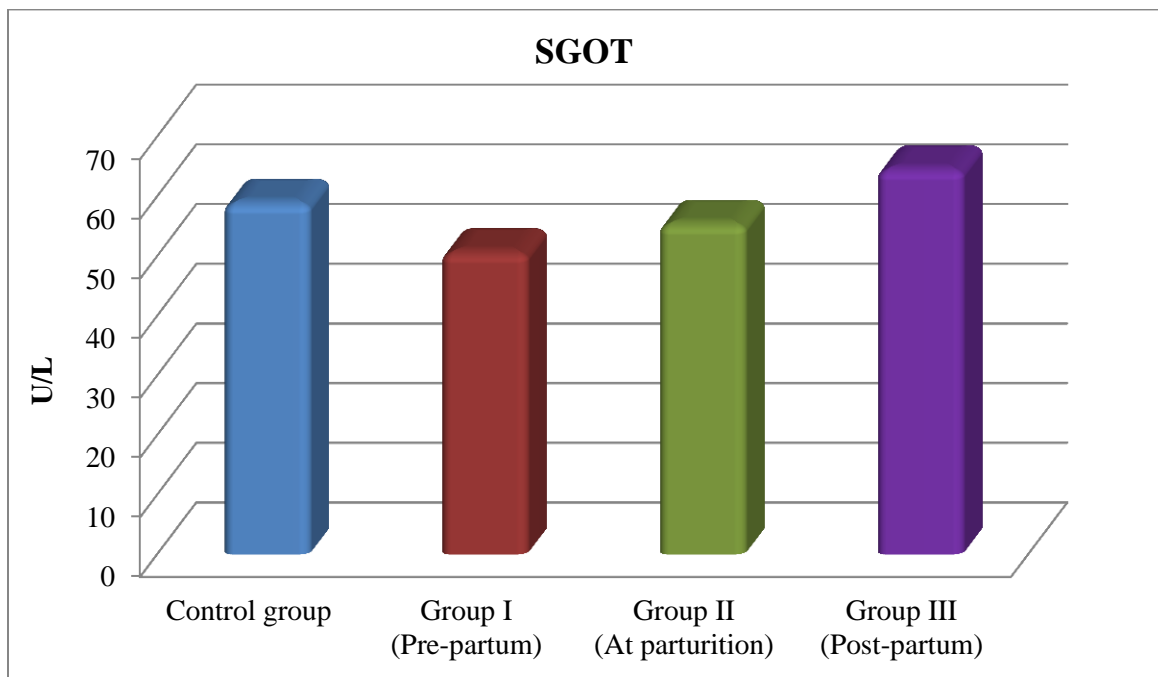


Fig. 12: Mean SGOT/AST (U/L) levels in transition period in comparison with healthy control group

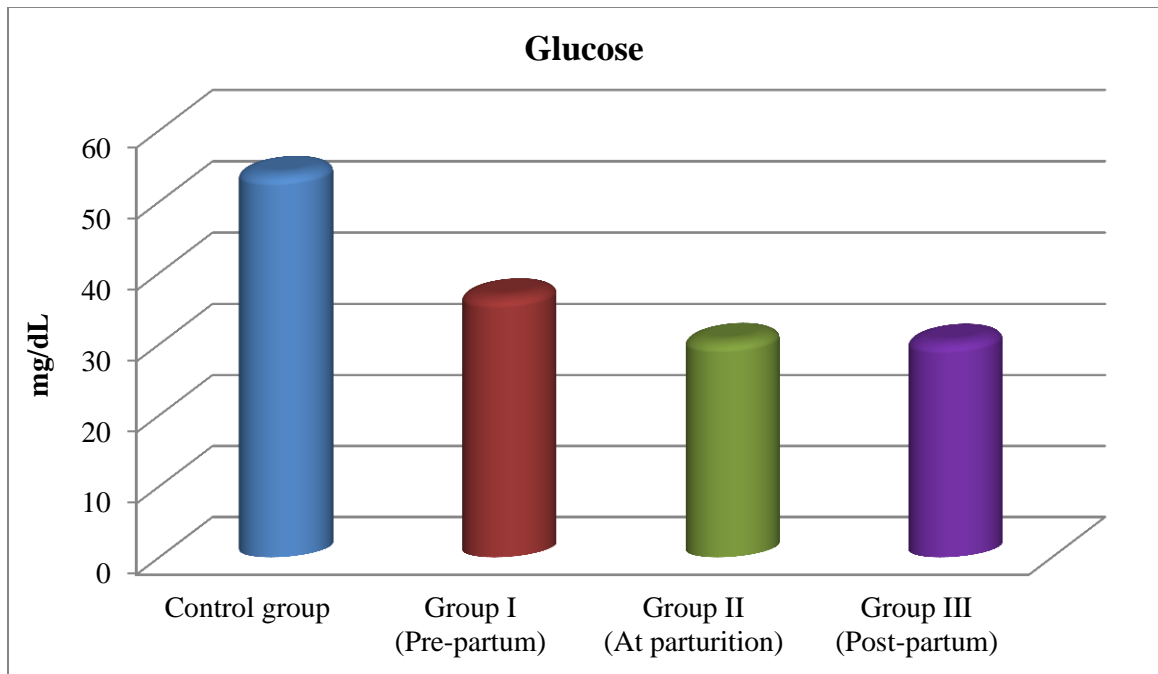


Fig. 13: Mean serum glucose (mg/dL) levels in the transition period in comparison with healthy control group

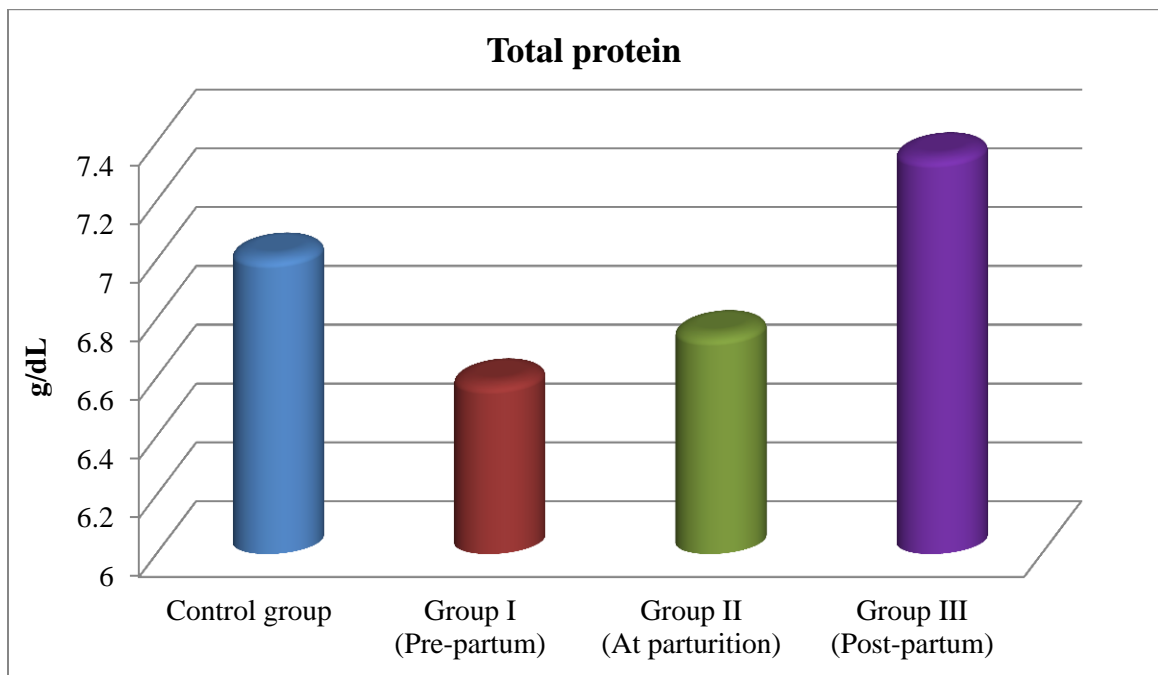


Fig. 14: Mean serum total protein (g/dL) levels in transition period in comparison with healthy control group

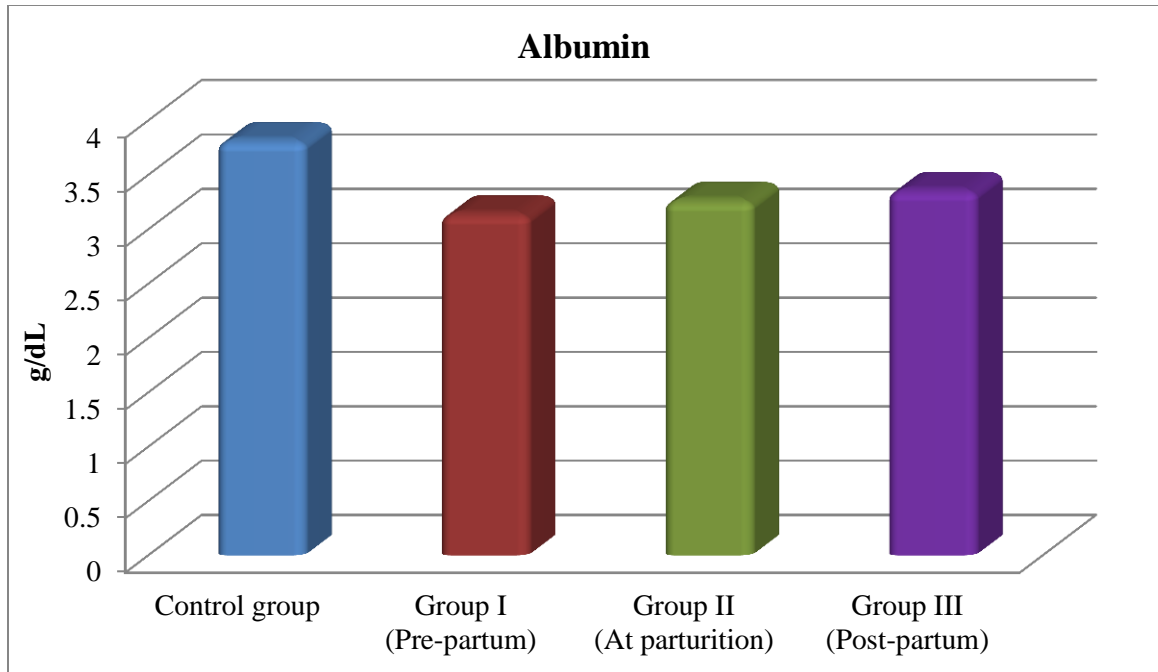


Fig. 15: Mean serum albumin (g/dL) levels in transition period in comparison with healthy control group

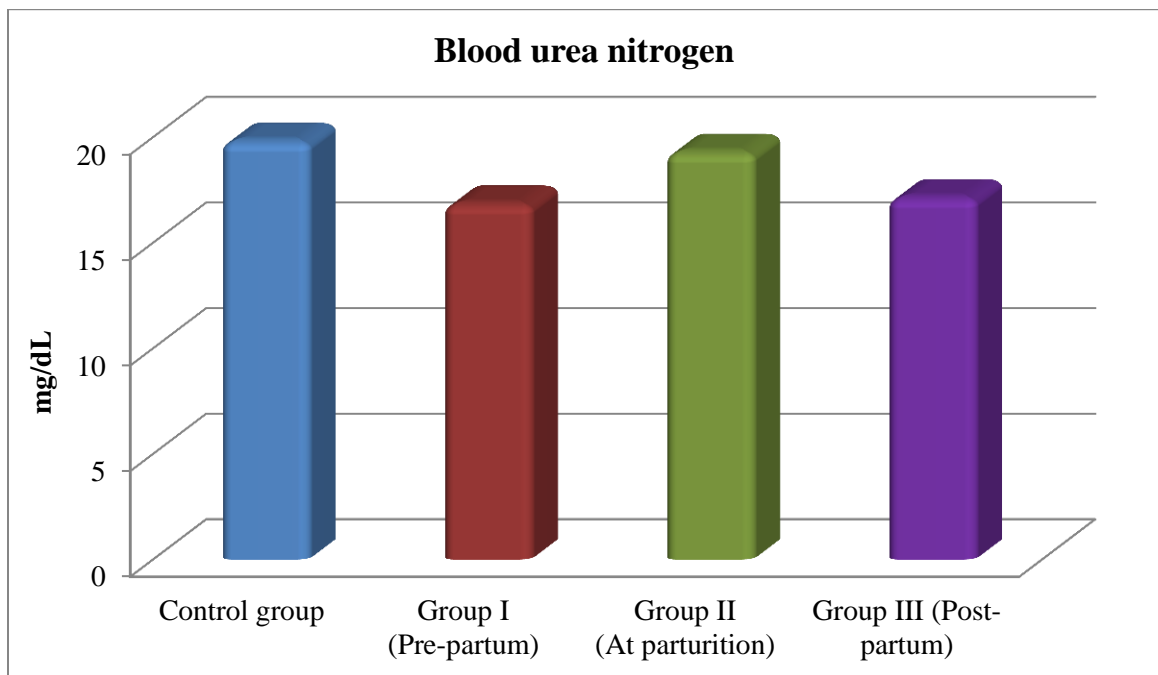


Fig. 16: Mean blood urea nitrogen (mg/dL) levels in transition period in comparison with healthy control group

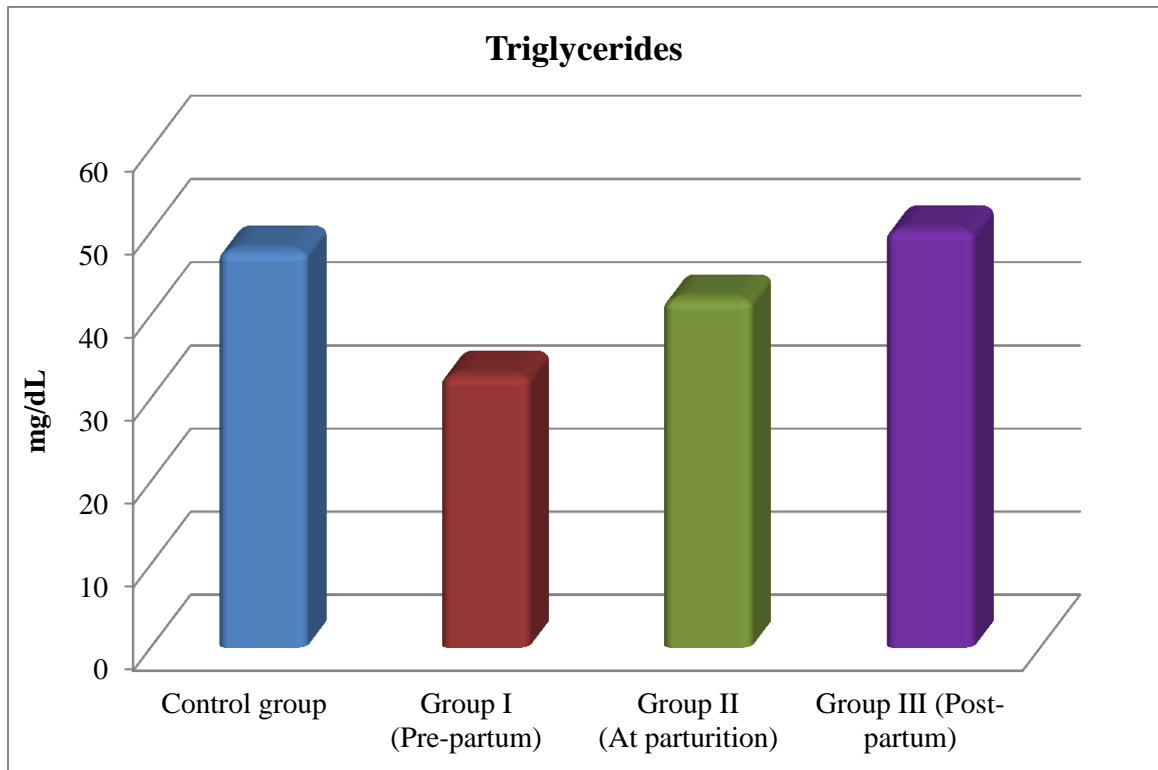


Fig. 17: Mean serum triglycerides (mg/dL) levels in transition period in comparison with healthy control group



Discussion

V. DISCUSSION

The results of present study are discussed in this chapter under following headings: haematological observations and biochemical observations during transition period of Deoni cows.

5.1 Haematological observations

5.1.1 Haemogram

The Mean \pm SE values of TEC in the study groups were significantly ($P < 0.05$) lower when compared to control group. However, there was no significant difference in the values of TEC between the study groups. Reduced values of TEC prior to parturition and at the time of parturition in the transition period were in accordance with Ambica and Rao (2012) observed in crossbred cows. Similarly Mean \pm SE values of haemoglobin in pre-partum period and at the time of parturition were significantly ($P < 0.05$) lower when compared to healthy control group. The present observations of the study were in accordance with Sawalkar *et al.* (2011) in crossbred cows and Ambica and Rao (2012) in crossbred cows. Diminished haemoglobin values were more significantly observed in pre-partum (group I) and at the time of parturition (group II). Whereas, it did not vary significantly in group III (post-partum). The haematocrit values in pre-partum period were significantly ($P < 0.05$) lower when compared to healthy control group and post-partum period. Similar results were found by Seifi *et al.* (2003) in HF cows and Mir *et al.* (2008) in crossbred cows. Low haematocrit values in the transition period had been attributed to diminished immunological status there by suppression of erythropoiesis from bone marrow (Dettileux *et al.*, 2004) in HF cows. Hypoproteinaemia and protein

deficiency has also been linked with low haemoglobin production (Coles, 1986) which was also observed in the present investigation.

5.1.2 Luecogram

In the present study, Mean \pm SE values of TLC in pre-partum period and at the time of parturition were significantly ($P < 0.01$) lower when compared to control group. The reduction in TLC was more prominent in pre-partum and at the time of parturition when compared to post partum group. The results of the present study were in accordance with Mallard *et al.* (1998) in dairy cows and Ambica and Rao (2012) in crossbred cows. Low luecogram at the time of parturition is possibly attributed to increased glucocorticoids, known immunosuppressants (Roth and Kaeberle, 1982), were elevated at parturition, and have therefore been postulated to play a role in periparturient immunosuppression. More over cows during transition period undergo a period of reduced immunological capacity which is multifactorial (Mallard *et al.*, 1998) and could substantiate the low TLC values observed in pre-partum cows in present investigation.

5.1.3 Erythrocytic indices like Mean Corpuscular Volume (fl), Mean Corpuscular Haemoglobin (pg) and Mean Corpuscular Haemoglobin Concentration (gm/dl)

As the erythrocytic indices are arithmetic representatives of haemogram, corresponding decrease has been observed in MCH and MCHC. Mean MCH and MCHC values in pre-partum period and at the time of parturition were significantly lower when compared to healthy control group. Similar results were found by Wadhwa and Prasad in

cows (2007) and Mir *et al.* (2008) in crossbred cows and could be attributed to diminished immunogenic status (Detilleux *et al.*, 2004) in periparturient animals.

5.2 Biochemical observations

5.2.1 Serum calcium

The serum calcium values at the time of parturition and in post-partum period were significantly ($P < 0.01$) lower compared to healthy control group and was suggestive of hypocalcaemia. This decline was more pronounced at the time of parturition (Group II) and post partum period (Group III) The results of the present study were in close confirmation with the earlier reports of Ottol *et al.*, (2000) in Angoni cattle; Doddamani *et al.*, (2009) in Deoni cows ; Pal and Acharya. (2013) in HF cattle and Lukasz *et al.* (2016) in HF cows.

The decrease in the level of calcium might be due the drain of calcium in the colostrum and milk after parturition in post-partum period (Gupta *et al.*, 1995). Disturbance in homeostatic mechanism of calcium has been attributed to physiological hypocalcaemia (Sreedhar *et al.*, 2013). Transient hypocalcaemia in the pre-partum cows (group I) could be attributed to impaired absorption of calcium and overload through the supplement for foetus in pre partum period (Pal and Acharya., 2013).

5.2.2 Serum magnesium

The Mean \pm SE values of serum magnesium were within the normal physiological limits though serum magnesium showed significant difference in transition period when compared to healthy control group. However, contrary to the present investigation there

was significant decrease in the level of magnesium on 7th day post-partum as reported by Yousuf *et al.* (2016) in crossbred cows which could be due to more production stress of high milk yield.

5.2.3 Serum phosphorus

In the present study, the Mean \pm SE values of phosphorus in all the groups of present study were significantly ($P < 0.01$) lower when compared to control group. Similar decrease in the level of phosphorus in transition period has been quoted in earlier reports by Sahukar *et al.* (1984) in crossbred cows; Pal and Bhatta (2013) in HF cows and Van saun (2016) in transition cows. The reduced values of phosphorus at the time of parturition might be due to utilization of phosphorus at this stage with enhanced carbohydrate metabolism (Sahukar *et al.*, 1984) and also required for the foetal growth (Jacob *et al.*, 2002) as observed in pre-partum cows (group I) in present investigation. In post-partum period, decrease in the level of phosphorus might be attributed to increased excretion of phosphorus in colostrum and milk (Rook and Thomus, 1983) and increased activity of parathyroid hormone (PTH) (Ambica and Rao 2012) to compensate hypocalcaemia.

5.2.4 Serum total protein

In the present study, the Mean \pm SE values of total protein in pre-partum period (group I) and at the time of parturition (group II) were significantly ($P < 0.05$) lower when compared to control group. The sharp drop in total protein level on the day or two day before and after parturition has been attributed to drain of immune fraction (globulins) in the formation of colostrum (Mehta *et al.*, 1989) in crossbred dairy cows. Similarly

transient hypoproteinemia observed in the pre-partum group (group-I) could be attributed to requirement protein for foetal growth (Jacob *et al.*, 2002).

5.2.5 Serum albumin

In the present study, there were significant ($P < 0.05$) decrease in the level of albumin in pre-partum period and at the time of parturition when compared to control group and similar results were drawn by Burke *et al.* (2010) who stated that the albumin concentrations were reduced at calving in dairy cows. Decreased albumin level has been attributed to lactation stress at the time of parturition (Ambica and Rao 2012) in crossbred cows. Compromised liver function observed in cows immediately after parturition due to hepatic lipidosis (Radostits *et al.*, 2008) has been documented and could justify the low levels observed in Deoni cows at the time of parturition in present investigation.

5.2.6 Serum glutamic oxaloacetic transaminase (SGOT)

As the SGOT values remained within physiological limits though these values showed difference within the transition period. However, contradictory to the present investigation, Seifi *et al.* (2007) reported that elevated SGOT values in transition period of dairy HF cows.

5.2.7 Serum glucose

In the present study, the values of glucose were significantly lower in all the groups of present study when compared to control group. Hypoglycaemia was more prominent at the time of parturition and during post-partum when compared to pre-

partum period. These findings were concurred with the Blum *et al.* (1983), Seifi *et al.* (2007) and Yousuf *et al.* (2016) in crossbred cows.

Hypoglycaemia in transition period might be attributed to several hormonal changes, primarily to regulate parturition and initiate lactation, and secondly to adapt metabolism to those events (Ingvarsen 2006). These mechanisms produce a hypoglycaemic state after parturition (Butler 2005) in dairy cows. Glucose is also the primary metabolic fuel and required for the vital organs functions, foetal growth and milk production (LeBanc *et al.*, 2006).

5.2.8 Serum triglycerides

As the triglycerides values remained within physiological limits though these values showed difference within the transition period. However, contradictory to the present study, Yousuf *et al.* (2016) reported that increased triglycerides in stage II (7 days after parturition) and III (2 months after parturition) than in stage I (2 months before parturition) in crossbred cows. The marked increase in the values of triglycerides were reported in the high yielding crossbred cows whereas present study was conducted on Deoni cows which were low to moderate milking animals and therefore showed minor fluctuations in triglycerides values.

5.2.9 Blood urea nitrogen

In the study conducted, the serum urea nitrogen levels were within normal physiological limits though there was significant difference between the study groups of the transition period. On the contrary, increased BUN at 21st day post-partum was reported by Seifi *et al.* (2007) in dairy cows.

Summary



VI. SUMMARY

The present study was undertaken to evaluate the metabolic profiles in transition period in Deoni cows. Thirty Deoni cows of third to fifth lactation with an average milk production up to 4 litres per day were selected for the study from LRIC, Deoni farm. The animals were grouped as pre-partum period (group I), at the time of parturition (group II) and post-partum period (group III) consisting of 10 animals in each group and values were compared with healthy control group of 10 animals. Feeding and management were kept same for all the animals in the study. The blood samples were collected from these selected animals through jugular vanipuncture at three weeks prior to parturition, within 24 hours after parturition and three weeks after parturition. All these blood samples were analysed for the various haemato-biochemical parameters. The haematological parameters like haemoglobin, PCV, Total Erythrocyte Count (TEC), Total Leukocyte Count (TLC), platelet count and erythrocytic indices like MCV, MCH and MCHC were estimated. The biochemical parameters *viz.*, serum calcium, serum inorganic phosphorus, serum magnesium, total protein, albumin and blood urea nitrogen. The energy metabolites like triglycerides and glucose and enzymes like SGOT/AST were estimated.

In the haemogram, the values of TEC were significantly ($P < 0.05$) lower in the groups of the transition period when compared to healthy control group. Whereas haemoglobin values were significantly ($P < 0.05$) lower in pre-partum period (group I) and at the time of parturition (group II) when compared to healthy control group. However, the haematocrit values showed significant decrease in pre-partum period (group I) when compared to healthy control group and post-partum period (group III). The values of

erythrocytic indices like MCH and MCHC in pre-partum period (group I) and at the time of parturition (group II) were significantly lower ($P < 0.05$) when compared to healthy control group. In the leucogram, total leukocyte count in pre-partum period (group I) and at the time of parturition (group II) were significantly ($P < 0.01$) lower when compared to post-partum period (group III).

The biochemical analytes revealed that serum calcium values at the time of parturition (group II) and in post-partum period (group III) were significantly ($P < 0.01$) lower when compared to pre-partum period (group I). The magnesium values did not show significant difference in the transition period compared to healthy control group. Serum phosphorus values were significantly lower in the transition period when compared to healthy control group. The mean values of total protein in pre-partum period (group I) and at the time of parturition (group II) were significantly ($P < 0.05$) lower when compared to post-partum period (group III). However, serum albumin were significantly ($P < 0.05$) lower in transition period when compared to healthy control group.

The energy metabolites like glucose and triglycerides were estimated in which hypoglycaemia was noticed at the time of parturition (group II) and post-partum period (group III). Serum triglycerides were within normal physiological limits though there was significant difference found between groups of transition period. Blood urea nitrogen and SGOT values were within normal physiological limits.

Conclusion:

1. Low haemogram with corresponding decrease in MCH, MCHC and low leucogram was more pronounced during pre-partum and at the time of parturition when compared to post-partum period.
2. Marginal hypocalcaemia, hypophosphatemia and hypoglycaemia were observed at the time of parturition and post-partum period than pre-partum period suggestive of lactation stress.
3. Though Deoni cows are low to medium milk yielders, the haemato-biochemical changes observed during transient period in the present investigation warranted necessary dietary incorporation of quality mineral mixture to avoid occurrence of metabolic disorder.



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VII. BIBLIOGRAPHY

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Abstract



STUDY ON METABOLIC PROFILE OF DEONI COWS IN TRANSITION PERIOD

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ABSTRACT

The present study was undertaken to evaluate the metabolic shifts during the transition period in Deoni cows. Thirty Deoni cows were selected for the study maintained at Livestock Research and Information Centre (Deoni) with similar feeding habits and management which were equally divided in to group I (pre-partum), group II (at the time of parturition) and group III (post-partum 3-4 weeks). Haematological parameters such as haemogram, leucogram and erythrocyte indices and biochemical parameters such as calcium, phosphorus, magnesium, SGOT, triglycerides, total proteins, albumin, blood urea nitrogen and glucose were estimated and compared with healthy control. Haemogram reduced significantly in pre-partum period and at the time of parturition compared to healthy control group with corresponding decrease in MCH and MCHC suggestive of marginal anaemia. The TLC values were significantly lower at the time of parturition when compared to healthy control group. There was marginal hypocalcaemia, hypophosphataemia and hypoglycaemia observed at the time of parturition and in post-partum period when compared with healthy control group. Marginal decrease in total protein and albumin at the time of calving and post-partum period was indicative of requirement of necessary incorporation of protein in diet. SGOT, BUN and Mg values were within normal physiological limits. The results indicated that there was metabolic shift in haemato-biochemical parameters in the transient period of Deoni cows and hence incorporation of quality mineral mixture in the diet of cows at the time of parturition till 3-4 weeks post-partum is recommended.