*Indian J. Anim. Nutr.* 2025. 42 (1): 94-103
doi: 10.56093/IJAN.v42i1.14

Indian Journal of Animal Nutrition



# Effect of Transition Period Nutrition on Lactation Performance, Metabolic Profiles and Reproductive Efficiency in Indigenous Dairy Cattle

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## ABSTRACT

A study was conducted to evaluate the effect of Bypass Fat and Vitamin E supplementation on milk production, composition, plasma metabolites, and reproductive performance in postpartum cows during the periparturient period. Twenty-one transition indigenous cows were divided into three groups: T1 (control, n=6), T2 (BF, n=8) and T3 (BF+Vit E, n=7). The Control group received a basal ration as per ICAR (2013) guidelines, while T1 was additionally supplemented with Bypass Fat @ 50 g/animal/day and T2 with Bypass Fat@50 g+Vitamin E @ 3000 IU/animal/day, from 21 days prepartum to 21 days postpartum. Blood samples were collected on days -21, -14, -7, 0, 7, 14, and 21, and milk yield and composition were recorded during the first 21 days of lactation. Uterine involution and ovarian activity were assessed via ultrasonography on days 15, 25, 35, and 45 postpartum, with pregnancy confirmation on days 28-30 and 50 post-AI. Plasma glucose and cholesterol levels were significantly higher ($P<0.05$), and NEFA concentrations were significantly lower ($P<0.05$) in both treatment groups compared to the Control. No significant differences ($P>0.05$) were observed in dry matter intake (DMI), body weight (BW), milk yield, and milk composition, except for a significant reduction ($P<0.05$) in somatic cell count (SCC) in the T2 group. Uterine horn diameter was significantly larger ($P<0.01$) in the Control group on day 45 postpartum. No significant differences ($P>0.05$) were found in the total number and size of antral follicles, calving to first estrus interval, calving to conception interval, or number of services per conception. Pregnancy rates were 50% in the Control group and 66.66% in both T1 and T2 groups. It can be concluded that Bypass Fat supplementation, alone or with Vitamin E, improved energy balance, uterine involution, and conception rates, but did not significantly affect milk yield and composition, except for a reduction in SCC in the T2 group.

**KEYWORDS:** Bypass fat, Lactation performance**,** Reproductive efficiency, Vitamin E

Article received: 30 January 2025; Article accepted: 04 April 2025

## INTRODUCTION

Transition period in dairy cows, encompassing the final weeks of gestation through calving and into early lactation, represents a critical phase characterized by profound physiological adaptations. During this period, dairy cows undergo substantial metabolic, hormonal, and cellular shifts to meet the escalating demands of fetal development, the process of parturition, and the subsequent initiation and maintenance of lactation. These adaptive processes are essential for successful transition. However, the complexity and magnitude of these changes pose significant challenges to the cow's ability to maintain metabolic and physiological homeostasis, thereby predisposing them to various disorders. One of the most critical challenges is the occurrence of negative energy balance (NEB), which results from the increased energy demands of lactation surpassing the intake. NEB leads to extensive mobilization of body fat reserves, contributing to elevated levels of non-esterified fatty acids (NEFAs) and ketone bodies. This metabolic shift increases the risk of various metabolic disorders which can negatively impact milk production, fertility and overall health (Balamurugan et al., 2018). Furthermore, the transition period is frequently associated with

delayed uterine involution and other reproductive complications. Studies have shown that Vitamin E, a key antioxidant, declines significantly around calving (Goff et al., 2002). This reduction in antioxidant capacity diminishes the cow's ability to counteract oxidative stress, leading to impaired immune function and an increased susceptibility to intramammary infections. It also exerts positive effects in body metabolism and fertility (Hosnedlova et al.,2017). Various nutrients are utilized in periparturient period to improve NEB. Among these, dietary supplementation of Rumen protected fat serves as a dense energy source, helping to alleviate NEB and support lactation demands, and imparting better fertility by reducing excessive body condition loss and improving hormonal balance while Vitamin E supplementation improves the immune function, reducing the incidence of metabolic and infectious disorders and improve milk quality.Considering these facts, the present study was designed to investigate the effect of Bypass fat and Vitamin E supplementation on milk production, composition, plasma metabolites, and reproductive performance in postpartum cows during the periparturient period.

## MATERIAL AND METHODS

### Experimental animals, Treatments and management

For this study, Twenty one advanced (8 months) pregnant and healthy cattle in their first to third lactation were selected from the herd maintained at Livestock Farm Complex, DUVASU, Mathura (India). Selected cows were randomly divided into three treatment groups, viz., T1 (control, n=6), T2 (BF, n=8) and T3 (BF+Vit E, n=7) based on their parity, body weight and previous lactation yield. In T1 (control) group, cows were fed with basal diet composed of concentrate mixture, wheat straw and maize green fodder to meet their nutrient requirement as per ICAR (2013) feeding standards followed on the farm. The cows in T2 group received additional dietary supplementation of bypass fat (BF) @ 50 g/d (S.A. Pharmachem Pvt Ltd. Innofeed Rumen Bypass fat supplement (Calcium salt of Long chain fatty acids)) and in T3 group BF along with vitamin E (BF @ 50 gm + Vitamin E @ 3000 IU per animal per day (Microvit E Promix 50, Vitamin E (D-alpha tocopherol acetate)). The treatment began 21 days before expected date of calving and continued for 21 days postpartum. The ingredient composition of concentrate mixture consisted of 20 parts maize grain, 20 parts barley grains, 9 parts oat grain, 10 parts wheat bran, 10-parts gram chunni, 28 parts mustard oil cake and 3 parts mineral mixture. The chemical composition of experimental feed is presented in Table1. Vitamin E powder and bypass fat were premixed with concentrate and was offered prior to providing the ration to ensure its intake.

Table 1. Chemical composition of feed offered (%DM basis)

| Parameters | Concentrate | Green fodder | Wheat straw |
|---|---|---|---|
| DM | 91.3 | 17.72 | 90.4 |
| OM | 91.2 | 89.9 | 88.5 |
| CP | 18.2 | 9.28 | 3.21 |
| EE | 3.12 | 2.42 | 1.01 |
| CF | 8.12 | 53.4 | 34.9 |
| Total Ash | 8.75 | 10.07 | 11.4 |

The animals were kept in separate calving pen one week prior to the expected calving date. After parturition; the cows were subsequently shifted to well-ventilated hygienic concrete milking shed. The cows were fed individually and clean, fresh drinking water was available *ad lib*. Daily dry matter intake was recorded for each cow.

### Observations recorded

### Blood examination

Peripheral blood samples were collected from jugular vein in heparinised vacutainers on days -21, -14, -7, 0, 7, 14 and 21 in relation to the expected date of calving. The samples were brought to the laboratory in ice boxes soon after collection and centrifuged at 1200 g at 4 °C for 20 min to separate

the plasma for the analysis. Plasma concentrations of Glucose, total cholesterol, triacylglycerides (TAG) and VLDL were analyzed by using standard kits (Span Diagnostic Ltd, Surat, Gujarat, India) with fully automatic biochemistry analyzer (BS-120 Chemistry analyzer, Shenzhen Mindray Biochemical Electronics Co. Ltd.) Plasma Non-esterified fatty acids (NEFA) and beta-hydroxy butyric acid (BHBA) were estimated using commercially available ELISA kits (Bioassay Technologies, China).

**Milk yield and composition**

Animals were hand milked twice daily and milk production was recorded at each milking during the first 21 days of lactation using electronic weighing balance. Milk samples from each animal, pooled from two consecutive milkings were collected on days 7, 14 and 21 of lactation. Representative sample of each animal was treated with sodium azide, preservative and stored at 5°C until analysis for milk fat, protein, lactose, solids-not fat (SNF), total solids and SCC by using precalibrated milk analyzer (Lactoscan).The 4% fat corrected milk (FCM) was calculated using formula:

4% FCM = milk yield (kg) X 0.4 + fat yield (kg) X 15

**Reproductive parameters**

During the postpartum period, uterine involution and ovarian activities were monitored using ultrasonographic (USG) examinations at 15, 25, 35, and 45 d postpartum. These evaluations assessed the diameter of the uterine horn cranial to the body and recorded ovarian parameters such as antral follicle counts and the size of the largest follicle, following standard procedures. Routine management practices included monitoring cows for estrus by observing vaginal discharges and behavioural signs, with estrus confirmation conducted through gynaecological examinations of the genitalia. Cows detected in estrus were inseminated using frozen-thawed semen. Pregnancy confirmation was carried out for cows that did not return to estrus, with initial checks performed between days 28 and 30 post-insemination, followed by a second confirmation on day 50 post-artificial insemination (AI). Reproductive metrics, including the date of treatment completion, the first observed estrus or AI dates, subsequent estrus or AI occurrences, pregnancy dates, the total number of services, and the number of services per conception, were recorded.

**Statistical analysis**

All the experimental data obtained were statistically analyzed by using ANOVA procedures of statistical software SPSS software version 20.0 (Snedecor and Cochran 1994). Significant differences between means of treatments were assessed by the Duncan's test, and the differences among treatments were declared significant at $P<0.05$.

**RESULTS AND DISCUSSION**

**Effect on Plasma metabolites**

**Glucose and Cholesterol**

The mean values of biochemical profile in control and treatment groups of periparturient cattle are presented in Table 3. Supplementation of bypass fat alone or in combination with Vitamin E significantly ($P<0.05$) increased plasma glucose concentration (mg/dL) as compared to the control. Overall values were found to be within the normal range of 45-75 mg/dl in all groups and periods. Blood glucose levels were significantly higher on the day of parturition compared to the peripartum periods across all groups, peaking at calving and declining during prepartum and postpartum periods. This peak is attributed to glucocorticoid release before calving, which stimulates glycogenolysis and gluconeogenesis (Hayirli et al., 2002). Consistent with these findings, prior studies reported no significant effect of bypass fat supplementation on blood glucose levels in periparturient cows (Tyagi et al., 2010; Chavda et al., 2022). Plasma cholesterol levels were significantly higher ($P<0.05$) in the treatment group compared to the control group, attributed to enhanced uptake of dietary fatty acids (Kumar et al., 2007). Cholesterol concentrations were lowest at calving but increased significantly postpartum in the treatment group. Elevated cholesterol levels in periparturient cattle supplemented with bypass fat have been reported (Nirwan et al., 2019) though some studies found no significant changes (Tyagi et al., 2010).

**Triglycerides and VLDL**

Plasma TAG and VLDL concentrations were significantly higher during the prepartum period compared to postpartum, with the lowest levels observed on days 7 and 14 postpartum, followed by an increase on day 21 (Fig. 1 and 2). No treatment significantly affected overall mean plasma TAG and VLDL concentrations in periparturient cows. Similar

findings of non-significant effects of BF supplementation on TAG and VLDL were reported by Chavda et al. (2022).

**NEFA and BHBA**

NEFA concentration in blood reflects energy balance and body fat mobilization in lactating animals. In this study, mean plasma NEFA levels were significantly ($P<0.05$) lower in treatment groups compared to controls, with significant variation on the day of calving and days 7, 14, and 21 postpartum. NEFA levels peaked near calving in all groups, indicating increased energy demands and reduced intake. Vitamin E supplementation (T2 vs. T3) had no significant effect on NEFA concentrations. Elevated NEFA levels around parturition reflect negative energy balance (NEB) and mobilization of body reserves (Duffield and Leblanc, 2009). Fat supplementation increases NEFA through hydrolysis by lipoprotein lipase, insulin resistance, reduced lipogenesis, and increased lipolysis (Theodore et al., 2017).Plasma BHBA concentrations did not differ significantly ($P>0.05$) between treatment and control group, remaining consistent with findings by Singh et al. (2014). However, Dhami et al. (2022) found that Se+Vit E supplementation significantly ($P<0.05$) reduced BHBA levels from day 15 to 60 postpartum, likely due to improved hepatic oxidative status.

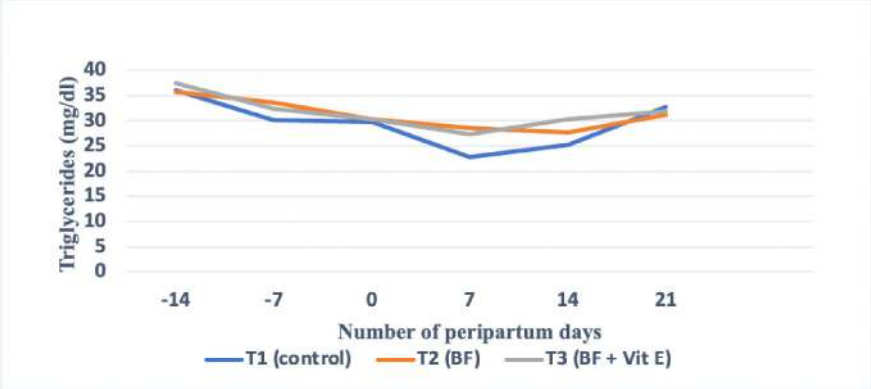


Fig. 1: Effect of supplemental Bypass fat and Vitamin E on plasma Triglycerides concentration of indigenous cows.

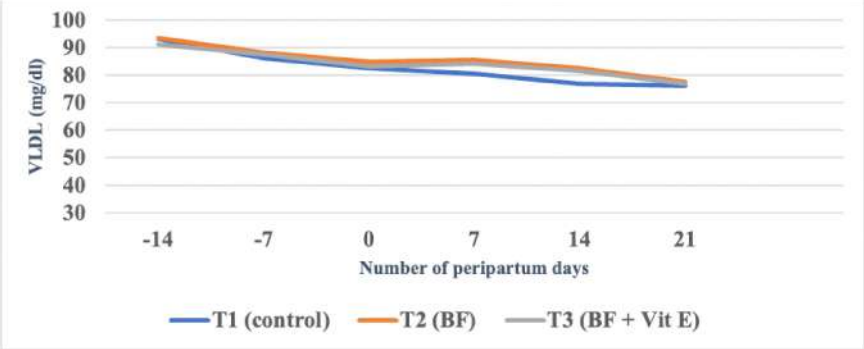


Fig. 2: Effect of supplemental Bypass fat and Vitamin E on plasma VLDL concentration of indigenous cows.

Table 2. Effect of supplemental Bypass fat and Vitamin E on plasma metabolites of transition dairy cows

| Days pre-and postpartum | T1 (control) | T2 (BF) | T3 (BF + Vit E) | Overall |
|---|---|---|---|---|
| Plasma Glucose (mg/dl) | | | | |
| -21 | 56.74±1.06$^{bB}$ | 55.57±0.88$^{abB}$ | 57.87±0.76$^{bB}$ | 56.73$^{B}$ |
| -14 | 52.89±1.23$^{bB}$ | 50.81±1.33$^{aA}$ | 52.64±1.05$^{bA}$ | 52.11$^{A}$ |
| -7 | 53.19±1.66$^{aB}$ | 56.42±1.65$^{bB}$ | 57.04±1.41$^{bB}$ | 55.55$^{B}$ |
| 0 | 61.76±2.02$^{aC}$ | 65.86±1.67$^{bD}$ | 64.75±1.53$^{bD}$ | 64.12$^{C}$ |
| 7 | 56.45±1.56$^{aB}$ | 60.18± 0.89$^{bBC}$ | 59.61±1.10$^{bC}$ | 58.75$^{B}$ |
| 14 | 45.08±1.38$^{aA}$ | 57.62±1.14$^{bB}$ | 56.34±1.42$^{bB}$ | 53.01$^{A}$ |
| 21 | 46.06± 2.05$^{aA}$ | 58.47±1.65$^{bBC}$ | 55.23±1.39$^{bAB}$ | 53.25$^{A}$ |
| Overall | 53.17±2.11$^{a}$ | 57.85±1.54$^{b}$ | 57.64±1.38$^{b}$ | |
| Plasma Cholesterol(mg/dL) | | | | |
| -21 | 133.63±2.34$^{B}$ | 136.26± 1.98$^{B}$ | 140.94±2.24$^{B}$ | 136.94$^{B}$ |
| -14 | 136.27±1.46 $^{B}$ | 140.35± 1.87$^{C}$ | 136.99± 1.55$^{B}$ | 137.87$^{B}$ |
| -7 | 141.27±1.68$^{C}$ | 146.02± 2.02$^{C}$ | 147.42± 1.74$^{C}$ | 144.90$^{B}$ |
| 0 | 118.90± 1.49$^{A}$ | 124.02±2.23$^{A}$ | 122.07± 1.98$^{A}$ | 121.66$^{A}$ |
| 7 | 135.29± 1.56$^{aB}$ | 143.65± 1.89$^{bC}$ | 142.51±1.04$^{bC}$ | 140.48$^{B}$ |
| 14 | 137.17± 1.42$^{aB}$ | 150.32±2.11$^{bD}$ | 154.18±2.42$^{bD}$ | 147.22$^{C}$ |
| 21 | 136.74± 2.31$^{aB}$ | 143.64±1.79 $^{bC}$ | 151.21±1.96$^{bD}$ | 143.86$^{B}$ |
| Overall | 134.18±1.35$^{a}$ | 140.61±2.04$^{b}$ | 142.19±1.76$^{b}$ | |
| NEFA (µmol/L) | | | | |
| -21 | 295±2.34$^{A}$ | 293±2.53$^{A}$ | 292±1.95$^{A}$ | 293±2.13$^{A}$ |
| -14 | 271±3.12A$^{B}$ | 288±2.14$^{AB}$ | 293±2.85$^{A}$ | 284±2.25$^{A}$ |
| -7 | 313±3.67$^{C}$ | 308±1.78$^{B}$ | 305±1.34$^{AB}$ | 308.66±2.03$^{B}$ |
| 0 | 381±2.46$^{bF}$ | 367±2.22$^{aF}$ | 364±3.68$^{aE}$ | 370.66±2.87$^{E}$ |
| 7 | 361±2.23$^{bE}$ | 345±2.54$^{aE}$ | 351±3.01$^{aD}$ | 352±2.77$^{D}$ |
| 14 | 348±1.98$^{bD}$ | 326±1.68$^{aD}$ | 332±2.11$^{aC}$ | 335.33±1.77$^{C}$ |
| 21 | 331±2.06$^{bB}$ | 318±1.79$^{aB}$ | 313±1.76$^{aB}$ | 320.66±1.97$^{B}$ |
| Overall | 328±2.02$^{b}$ | 320±1.98$^{a}$ | 321±2.31$^{a}$ | |
| BHBA (µmol/L) | | | | |
| -21 | 455.25±2.31$^{A}$ | 466.54±1.47$^{A}$ | 458.66±1.56$^{A}$ | 458.82±2.76$^{A}$ |
| -14 | 468.47±2.03$^{A}$ | 473.87±2.34$^{B}$ | 470.32±2.12$^{B}$ | 470.55±3.15$^{B}$ |
| -7 | 511.45±1.87$^{B}$ | 515.43±2.16$^{C}$ | 517.86±2.67$^{C}$ | 512.91±3.04$^{C}$ |
| 0 | 517.22±1.68$^{B}$ | 522.31±2.04$^{C}$ | 526.13±1.98$^{C}$ | 521.89±2.87$^{CD}$ |
| 7 | 543.94±2.05$^{C}$ | 542.06±1.87$^{D}$ | 546.13±1.77$^{D}$ | 542.71±2.77$^{E}$ |
| 14 | 544.44±1.98$^{C}$ | 545.38±1.66$^{D}$ | 548.33±2.31$^{D}$ | 545.05±3.17$^{E}$ |
| 21 | 541.12±1.65$^{C}$ | 542.78±1.75$^{D}$ | 545.56±2.54$^{D}$ | 542.82±2.97$^{E}$ |
| Overall | 511.70±2.02 | 515.14±1.98 | 516.14±2.31 | |

Means having different superscripts abc within a row differ significantly (P< 0.05). Means having superscripts ABC within a column differ significantly (P<0.05).

Table 3- Effect of supplemental Bypass fat and Vitamin E on dry matter intake (DMI), body weight (BW), milk yield and composition of transition dairy cows

| Parameters | T1 (control) | T2 (BF) | T3 (BF+Vit E) | SEM | P value |
|---|---|---|---|---|---|
| Prepartum | | | | | |
| DMI 21d period before calving | 9.24 | 9.32 | 9.36 | 0.431 | 0.691 |
| Mean BW (kg) | 412 | 423 | 421 | 10.23 | 0.643 |
| Post partum | | | | | |
| DMI from d 1-21 of lactation (kg/d) | 10.9 | 11.2 | 11.2 | 0.372 | 0.788 |
| Mean BW (kg) | 376 | 397 | 392 | 11.76 | 0.322 |
| Yield (kg/d) | | | | | |
| Milk | 7.96 | 8.14 | 8.21 | 0.162 | 0.915 |
| 4 % FCM | 8.03 | 8.26 | 8.38 | 0.456 | 0.953 |
| ECM | 8.73 | 9.03 | 9.13 | 0.550 | 0.999 |
| Fat | 0.323 | 0.334 | 0.340 | 0.765 | 0.882 |
| SNF | 0.650 | 0.669 | 0.680 | 0.112 | 0.901 |
| Total solids | 0.974 | 1.001 | 1.021 | 0.043 | 0.999 |
| Protein | 0.258 | 0.271 | 0.272 | 0.021 | 0.671 |
| Lactose | 0.390 | 0.402 | 0.401 | 0.102 | 0.778 |
| Milk composition (%) | | | | | |
| Fat % | 4.07 | 4.11 | 4.15 | 0.045 | 0.878 |
| Protein % | 3.25 | 3.34 | 3.32 | 0.064 | 0.861 |
| Lactose | 4.91 | 4.94 | 4.89 | 0.076 | 0.853 |
| SNF % | 8.17 | 8.23 | 8.29 | 0.124 | 0.775 |
| Total solids | 12.24 | 12.3 | 12.4 | 0.342 | 0.661 |
| SCC (X $10^5$ cells/ml) | $2.13^b$ | $2.16^b$ | $1.98^a$ | 0.145 | 0.006 |

Note: FCM- Fat Corrected Milk, ECM- Energy Corrected Milk, SNF- Solid not Fat SCC- Somatic Cell Count

**Effect on DMI, milk yield and composition**

The mean values for DMI, body weight (BW), milk yield, and composition are shown in Table 3. No significant differences (P>0.05) were found between the control and treatment groups for DMI, BW, or milk yield during the transition period. These findings are consistent with those of Singh et al. (2014) and Ramteke et al. (2014) who observed increased milk yield on feeding bypass fat to buffaloes during early lactation. Tyagi et al. (2009) also reported similar DMI values in control and treated cows during the transition period. Also, Bypass fat supplementation at 2.5% of DMI did not affect DMI during early lactation (Tyagi et al., 2010). The variation in DMI among animals fed bypass fat is influenced by factors such as the level of fat inclusion, palatability, and the lactation status of the animals (Naik et al., 2009).

During the first 21 days in milk, postpartum diets did not significantly affect (P>0.05) milk or FCM yield. In contrast, Wadhwa et al. (2012) reported a 1.13 kg/d increase in average daily milk yield in the bypass fat supplemented group compared to the control. Bypass fat supplementation has been shown to increase milk production in dairy cattle (Sirohi et al., 2010). The benefits of bypass nutrient supplementation are more pronounced in medium- and high-producing animals. Supplementation with bypass fat (BF) and Vitamin E did not significantly (P>0.05) affect milk fat percentage, SNF, total solids, protein, or lactose yield compared to the control. This lack of effect on milk fat aligns with studies by Sharma et al. (2016) and Ranjan et al. (2012), who also found no significant impact of bypass fat supplementation on milk fat. However, these findings are in contrast with those of Savsani et al. (2015)

who reported changes in milk composition due to bypass fat supplementation. Similarly, no significant differences were observed in milk protein, lactose, or their respective daily yields between treatments, consistent with studies by Shelke et al. (2012). Moreover, significant (P<0.05) difference in SCC values was observed between the control and treatment groups. The group supplemented with bypass fat and vitamin E showed significantly (P<0.05) lower SCC compared to the group supplemented with bypass fat alone or the control group.

**Effect on postpartum fertility and reproductive indices**

**Uterine involution, Follicular size and count**

Significant (P<0.05) difference in uterine horn diameter (uterine involution) was observed between the control and treatment groups at days 15, 25, 35, and 45 postpartum. On day 45, the mean uterine horn diameter in the control group was significantly (P<0.05) larger than in the treatment groups (Table 4). However, no significant (P>0.05) difference was noted between the treatment groups. Uterine horn diameter decreases as part of uterine involution, the process by which the uterus returns to its non-pregnant size after parturition.. These findings are consistent with Tyagi et al. (2010), who reported a significant (P<0.05) reduction in the days required for uterine involution in cows supplemented with bypass fat. However, Nirwan et al. (2019) found no significant difference in the number of days required for uterine involution. No significant (P>0.05) differences were observed in the total number of antral follicles and size of the largest follicle in both ovaries between the control and treatment groups.

**Postpartum estrus, service period and conception rate**

The mean number of days to the first postpartum estrus did not differ (P>0.05) between control and treatment groups. Similarly, no significant (P>0.05) differences were observed for the calving-to-conception interval or the number of services per conception between the control and treatment groups. However, pregnancy rates were higher in the treatment groups, with 50% (3/6) in the control group, and 66.66% (4/6) in both T1 and T2 groups. Previous studies have reported significant positive effects of bypass fat supplementation (Khalil et al., 2012) and Vitamin E and Se supplementation (Hosnedlova et al., 2017) on uterine involution, the onset of postpartum estrus, reduced service period, and improved conception rates. Vaswani et al. (2023) reported increased conception in the groups supplemented with bypass nutrients, with highest conception in group supplemented with bypass fat and proteins than the control. Fat supplementation enhances the energy status of the animals, increasing the precursors for reproductive hormone synthesis, such as steroids and prostaglandins, which positively affects reproduction by modulating ovarian follicle and corpus luteum function (Rahbar et al., 2014).

Table 4. Effect of supplemental Bypass fat and vitamin E on postpartum fertility and reproductive indices of transition dairy cows

| Reproductive Attributes | T1 (control) | T2 (BF) | T3 (BF + Vit E) | P value |
|---|---|---|---|---|
| Uterine horn diameter | 25.87±1.28$^{b}$ | 18.94±1.16$^{a}$ | 18.85±1.20$^{a}$ | <0.01 |
| Antral follicle number on day 45 postpartum | | | | |
| Right ovary | 4.17±0.48 | 3.88±0.44 | 3.50±0.40 | 0.99 |
| Left Ovary | 4.83±0.31 | 4.25±0.67 | 3.86±0.26 | 0.87 |
| Antral follicle size (mm) on day 45 postpartum | | | | |
| Right ovary | 10.80±1.50 | 10.30±0.65 | 8.58±1.13 | 0.90 |
| Left Ovary | 16.60 | 9.55±1.48 | 8.03±1.08 | 0.76 |
| Service / Conception | 1.67±0.58 | 2.00±0.71 | 2.00±0.71 | 0.86 |
| Number of animals inseminated | 6 | 6 | 6 | - |
| Pregnancy | 3 (50%) | 4 (66.66%) | 4(66.66%) | - |

## CONCLUSION

Bypass fat supplementation, either alone or in combination with vitamin E, improved energy balance in the treatment groups, as evidenced by significantly lower serum NEFA, higher glucose levels, and increased total cholesterol. Additionally, it enhanced postpartum fertility by reducing uterine involution time. However, no significant effects on milk yield or composition were observed, except for a reduction in somatic cell count (SCC) in cows supplemented with vitamin E.

## ACKNOWLEDGEMENTS

The authors gratefully acknowledge the financial support provided by ICAR, New Delhi, to DUVASU, Mathura, under the project "AICRP on Nutritional and Physiological Interventions for Enhancing Reproductive Performance of Animals."

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