



Bypass Fat with Hormonal Protocol for Reproductive Disorders

Sethy et al.

## Combined Effect of Bypass Fat and Hormonal Protocol on the Performance of Reproductive Disorder Crossbred Cattle.

K. Sethy<sup>1\*</sup>, S. Tripathy<sup>1</sup>, R.K. Swain<sup>1</sup>, S.K. Mishra<sup>1</sup>, N. Panda<sup>1</sup>, K. Behera<sup>2</sup>, S.K. Panda<sup>3</sup>, G.P. Sabat<sup>2</sup> and U. Mishra<sup>1</sup>

<sup>1</sup>Department of Animal Nutrition, C.V.Sc. & A.H., OUAT, Bhubaneswar, India

<sup>2</sup>Department of Livestock Production and Management, C.V.Sc. & A.H., OUAT, Bhubaneswar, India

<sup>3</sup>Department of Veterinary Clinical Medicine, Ethics and Jurisprudence, C.V.Sc. & A.H., OUAT, Bhubaneswar, India

\*Correspondence: babuivri@gmail.com

### ABSTRACT

Bypass fat is the calcium salt of fatty acid used as a major source of energy for production and reproduction in high yielding cattle. Hormonal protocols may not be effective for treating reproductive problems in energy deficient animals. Henceforth, the current study was undertaken to evaluate the effect of hormonal protocol in reproductive disorder crossbred Jersey cattle supplemented with bypass fat. A 60 days study was conducted in eighty reproductive disordered Jersey cattle consisting of 48 cows and 32 heifers divided into four groups having 20 animals each (containing both anoestrus (12) and repeat breeder (8)). Group T0 was control (normal feeding practices of farmer consisting of straw-based diet and locally available concentrate like wheat bran and mung chunies), T1 group: T0+ Bypass fat @ 100g/day/animal), T2 group: T1+ hormone (Double synch) and T3 group: T1+ hormone (Estra-double synch). The growth rate, blood haematological, serum biochemicals and reproductive status of the animals were assessed. Significant improvement in average daily gain and reproductive performances was observed in treated animals as compared to control. Maximum conception was achieved in group T3 (70%) followed by group T2 (60 %) and T1 (40 %). So, it was found that bypass fat along with estra double synch protocol is most suitable in field condition for preventing reproductive disorder in cross bred cattle.

**KEYWORDS:** Bypass fat, crossbred cattle, Double synch, Estra- double synch, Reproduction

Article received :30 June 2022; Article accepted: 02 September 2022

### INTRODUCTION

Bypass fat or rumen protected fat is an energy supplement recommended for high yielding dairy cows including in their transition phase (Naik, 2013). It helps for the release of luteinizing hormone (LH), growth of follicles and ovulation in animals (Imakawa et al., 1987). It provides the fatty acids which act as a precursor of progesterone essential for better reproductive performances (Staples et al., 1998). Addition of protected fat causes higher conception rate, increased pregnancy rate and reduced service period (Moriel et al., 2009). Hormonal treatments with gonadotropin releasing hormone (GnRH) and prostaglandin (PGF<sub>2a</sub>) synchronise estrus, enhances ovulation and

maximizes the proportion of cow's inseminated (Barros et al., 1999). Administration of two doses of PGF<sub>2a</sub> at 14 days apart brings estrus in animals (Stevenson et al., 2000). Hormonal protocols like double synch and estra double synch enhanced the reproductive performance of cross bred animals in field condition (Sahoo et al., 2017). Treatment of hormones along with energy supplement may be a potential mean to enhance the performance of reproductive disorder animals. Keeping this in view with the paucity of work done, an attempt has been made to assess the combined effects of bypass fat and hormonal protocol on the performance of anestrus and repeat breeding animals in Nimapara block of Puri district, Odisha.

## MATERIALS AND METHODS

An on-farm trial was carried out in Nimapara block (20.07° N latitude and 86.02° E longitudes at an altitude of 19.3 meters) of Puri district, Odisha, India, which lies in east and south eastern coastal plain agroclimatic zone. The average rainfall of the

zone is about 1449.68 mm. A survey work was conducted for obtaining general information from the dairy farmers *viz.*, breed, age of animals, details of estrus, age at first calving, calving number, services per conception, date of last calving, anoestrus, post-partum anoestrus, repeat breeding and feeding practices of the animals (Table 1).

Table 1. Incidence of reproductive disorder of surveyed and experimental crossbred jersey cattle

Attributes	Numbers
Number of cows surveyed	165
Number of cows with reproductive disorder	92
Percentage of cows with reproductive disorder	55.76
Number of heifers surveyed	196
No. of heifers with reproductive disorder	75
Percentage of heifers with reproductive disorder	38.26
Total crossbred animal with reproductive disorder (%)	46.26
Total No. of crossbred animals selected for experiment	80
Age at first estrus (days)	541.8±12.50
Age at first calving(days)	1110.5±25.50
Calving interval(days)	568.7±10.90
First post-partum estrus observation (days)	175.2±8.40

Further, the reproductive statuses of the cross bred animals were assessed by per-rectal examination of individual animal. Each animal was examined per rectally to know the status of reproductive organs like cervix, uterus and ovary etc. On the basis of breeding history and per-rectal findings, eighty reproductive disordered crossbred animals with no physiological and anatomical abnormality were selected and dewormed with Fenbendazole @ 10 mg/kg body weight to rule out the possible effect of worms on reproduction of the animals.

Four kg rice bran oil was heated in an aluminium pan followed by addition of 120 ml of concentrated sulphuric acid and 500 ml of water. In a separate container 1.6 kg calcium oxide was mixed thoroughly in 10 liters of water and this mixture was added to the aluminium container containing the acid oil and boiling was done in a low flame for about 30 minutes. The mixture was sieved in a muslin cloth with repeated washing with tap water to get the bypass fat (Garg, 1997; Naik et al., 2007a; 2007b; 2009a). The important reproductive hormones *viz.* gonadotropin releasing hormone (GnRH) analogue

(Buserelin acetate), prostaglandin F<sub>2α</sub> (Dinoprost tromethamine) and estradiol benzoate was used. In double synch protocol PGF<sub>2α</sub> and GnRH were used twice each on any day of cycle in the manner of (0 day: PGF<sub>2α</sub>, 2<sup>nd</sup> day: GnRH, 9<sup>th</sup> day: PGF<sub>2α</sub>, 11<sup>th</sup> day: GnRH). Fixed time artificial insemination was conducted twice on 16 and 24 hours of last GnRH injection. The same protocol was used for both anoestrus and repeat breeding animals (Savalia et al., 2014). In extra-double synch protocol replacement of last GnRH injection of double synch with estradiol benzoate in the manner of (0 day: PGF<sub>2α</sub>, 2<sup>nd</sup> day: GnRH, 9<sup>th</sup> day: PGF<sub>2α</sub>, 10<sup>th</sup> day: Estradiol benzoate). Fixed time artificial insemination was conducted twice on 48 and 72 hours of last estradiol injection (Biradar et al., 2014).

Eighty reproductive disordered cross bred Jersey cattle consisting of 48 cows and 32 heifers were divided into four groups having 20 animals each (containing both anoestrus (12) and repeat breeder (8)). The ratio between cows and heifer in a group was kept 3:2. Group T<sub>0</sub> was kept as control (normal feeding practices of farmer consisting of straw-based diet and locally available concentrate), where as

T1 group was additionally supplemented with bypass fat @ 100g/day/animal. Animals in T2 and T3 were treated with double synch and extra double synch protocols along with bypass fat supplementation (100g/day/animal) respectively. The prepared bypass fat contains 6.90 % Ca and 72.50 % ether extract. The same protocol was used for both anestrus and repeat breeding animals. The experiment continued for 60 days.

All the treatment groups were maintained as per the standard managemental practices. At 60 days of the experimental feeding, 05 ml of blood was collected aseptically from each animal by jugular vein puncture in the morning (before watering and feeding), into clean and dry test tubes and kept in slanting position for 45 minutes at room temperature. The blood samples were then centrifuged at 3000 rpm for 15 minutes to harvest serum and stored at

“20°C for further analysis. Similarly, 2ml of blood was collected in an EDTA vial for the estimation of haematological parameters.

The body weight of the animals was recorded in monthly interval during the experimental period using Johnson's formula (1940). Body condition score (BCS) of the animals were measured at start and end of the experiments by observing the flesh covering at spinous process of loin and rump region, prominence of spinous processes, sharpness of spinous processes, prominence of depression in tail head region etc. (Ferguson et al., 1994). Representative feed and fodder (doob grass, paddy straw and concentrates viz. wheat bran and mung chuni) samples offered to the experimental animals were collected from the farmers and were analysed for proximate principles (Table 2) as per AOAC (1995).

Table 2. Composition and nutritive value of feeds and fodders offered to the animals on dry matter basis

Ingredients	DM (%)	CP (%)	CF (%)	NFE** (%)	EE (%)	Ash (%)	DCP* (%)	TDN* (%)
Paddy straw	90.0	2.90	37.4	48.3	2.70	8.70	0	41.1
Wheat bran	85.2	15.4	10.7	64.9	3.45	5.50	11.8	74.7
Mung chuni	89.5	24.5	16.0	48.6	2.80	8.10	-	-
Doob grass	21.0	6.30	28.8	53.1	1.30	10.5	3.89	47.8

\*Reported values (NDDB, 2012), \*\*Calculated values

The haemoglobin content of the blood samples was estimated by Hellige and Sahli's haemoglobin meter. The PCV (%) determinations of all the blood samples were carried out by the procedure given by Jain (1986). Total erythrocyte count (TEC) was estimated by Haemocytometer and is expressed as  $10^6$  cells/mm<sup>3</sup>. The serum concentration of glucose, total protein and albumin was estimated by automated biochemistry analyser (Turbo Chem 100, CPC Diagnostic Pvt. Ltd., Chennai, India) following standard procedure. Globulin concentration was determined by subtracting the albumin from the total protein concentration in the serum samples.

The animals were regularly monitored for the onset of heat. The heat was detected by behavioral symptoms (Layek et al., 2011). Animals exhibiting

the sign of heat were per-rectally inseminated artificially by the local Veterinary Asst. Surgeons as per the time fixed. Pregnancy diagnosis was conducted routinely per-rectum at 45 days post insemination. Statistical analysis of the data obtained was done by using Software Package for Social Sciences (SPSS) version 17.0 (2008) and one-way analysis of variance (Generalized Linear Model, ANOVA) with comparison among means was made by Duncan's multiple range test (Duncan, 1955) with significance level of  $P < 0.05$ .

## RESULTS AND DISCUSSION

The chemical composition of paddy straw, wheat bran, mung chuni and doob grass fed to the cross bred Jersey cattle during the experimental period was presented in Table 2. Similar to our observation FAO

(2012) formulated that wheat bran contains 86.80% DM and 15.10% CP. Similarly, NDDDB (2012) observed that wheat bran has 13-16% CP and 65% TDN, paddy straw has 3% CP and 40% TDN, pulse chuni has 20-25% CP and 55-65% TDN. Rahman et al. (2010) reported that different varieties of paddy straw had DM content that ranged from 92.21 to 93.05%, CP content ranged from 3.49 to 5.10%. The variation in proximate composition of paddy straw

might be due to geographical and different method of cultivation in the survey area. The bypass fat contains 6.90 % Ca and 72. 50 % ether extract. Similar to our observation Naik et al. (2007a) and Naik et al.(2007b) observed that bypass fat contains 70-75% fat and 7-8% Ca.

Average daily gain was significantly ( $P<0.05$ ) higher in all the treatments compared to control (Table 3).

Table 3. Body weight and body condition score of experimental animals before and after the experiment

Parameters	T0	T1	T2	T3	P value
BW <sub>0</sub>	252.4 ±5.21	251.9 ±5.11	250.6 ±5.44	253.3 ±6.21	0.310
BW <sub>60</sub>	262.1 ±5.21	265.7 ±10.12	266.6 ±5.42	271.9 ±6.18	0.140
ADG (g)	162.0 <sup>a</sup> ±9.51	230.58 <sup>b</sup> ±8.58	266.1 <sup>bc</sup> ±9.70	310.0 <sup>c</sup> ±11.30	0.017
BCS <sub>0</sub>	2.30 ±0.16	2.40 ±0.12	2.45 ±0.11	2.50 ±0.16	0.505
BCS <sub>60</sub>	2.35 <sup>a</sup> ±0.16	2.90 <sup>ab</sup> ±0.13	3.25 <sup>ab</sup> ±0.10	3.50 <sup>b</sup> ±0.08	0.013

Values bearing different superscripts in a row differ significantly ( $P<0.05$ )

No significant difference was observed among the hormone treated groups. Increase in body weight in dairy cows by feeding bypass fat (150-200 g/ day) has been reported by earlier workers (Naik et al. 2009b; Wadhwa et al., 2012). Scheffler et al. (2003) in Holstein cows also found that the ADG in animals treated with estradiol implant was significantly higher ( $P<0.05$ ) than that of control groups without any treatment. Contrary to this, Trenkle (1976) did not observed any significant ( $P>0.05$ ) effect of hormone treatment on body weight gain of cows. The increased ADG in treated groups might be due to the effect of extra energy (approximately 660 Kcal) supplementation in the form of bypass fat in treated animals than control. Body condition score (BCS) in all the treatment groups differed significantly compared to control indicated that

supplementation of bypass fat alone (Naik et al. 2009b) or with hormones (Sahoo et al., 2017) improved the BCS at 60 days of the experiment. Among the treatments, higher BCS was observed in T3 compared to T2, which was significantly ( $P<0.05$ ) higher BCS than T<sub>1</sub>. Higher BCS in hormone treated animals may be due to higher nutrient metabolism than alone bypass supplemented animals (Sahoo et al., 2017). The increased BCS was indicated by increased body weight, general health, glossy skin of the animals compared to control.

No significant ( $P>0.05$ ) difference between control and treatment groups was observed with respect to Hb, PCV and RBC concentration, which revealed that hormones along with bypass fat did not exert any effect on the blood haematology of cross bred cattle (Table 4).

Table 4. Haemato biochemical profile of experimental animals at end of the experiment

Parameters	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	P value
<b>Haematology</b>					
Haemoglobin (g/dl)	11.4 ±0.44	12.7 ±0.48	11.0 ±0.74	11.9 ±0.23	0.220
RBC (X 10 <sup>6</sup> / mm <sup>3</sup> )	5.72 ±0.16	6.03 ±0.31	6.42 ±0.63	6.13 ±0.10	0.548
Packed cell volume (%)	26.73 ±1.00	28.8 ±1.45	28.5 ±0.88	30.20 ±0.97	0.392
<b>Serum biochemical's</b>					
Glucose (mg/dl)	42.0 <sup>a</sup> ±1.62	53.3 <sup>b</sup> ±1.27	55.1 <sup>b</sup> ±3.50	58.6 <sup>b</sup> ±3.30	0.040
Total Protein (g/dl)	6.10 ±1.21	5.90 ±0.58	6.06 ±0.66	6.04 ±0.75	0.927
Albumin (g/dl)	3.25 ±0.18	3.14 ±0.30	3.20 ±0.21	3.15 ±0.21	0.170
Globulin (g/dl)	2.85 ±1.02	2.76 ±0.30	2.86 ±0.68	2.89 ±0.62	0.634

Values bearing different superscripts in a row differ significantly (P<0.05)

Similarly, Hamam et al. (2013) observed that hormonal treatment had no effect on blood haematology of cows. Savsani et al. (2013) reported that supplementation of bypass fats has no effect on Hb content of dairy cattle. Khamas et al. (2013) reported a significant reduction in Hb content of Holstein heifers after administration of PGF<sub>2a</sub>. Supplementation of bypass fat in hormone treated animals may be responsible for maintaining normal hematological picture throughout the experiment. The serum concentration of glucose was significantly (P<0.05) increased in by pass fat supplemented animals than control, whereas total protein, albumin and globulin concentration were similar (P>0.05) among the treatments. Similar to this experiment, Karcagi et al. (2010) observed significant increase (P<0.05) in blood glucose level after supplementation of rumen protected fat. Increased insulin levels in the blood are an indicator for increased glucose level in animals supplemented

with bypass fat at 2.5% of DMI per day (Tyagi et al., 2010). Treatments with hormones like double synch and estra double synch causes increased glucose level in blood by enhancing gluconeogenesis process (Savalia et al., 2014). Grewal et al. (2014) reported that supplementation of bypass fat (200g/day/animal) and niacin (12g/day/animal) had no influence on the plasma protein levels of crossbred animals. Similar to this study, many scientists observed no significant effect of hormones serum protein concentration (Nakrani et al., 2014; Parmar et al., 2015). Savalia et al. (2014) reported that administration of GnRH-PGF<sub>2a</sub>-GnRH (GPG) protocol to anestrus and repeat breeder buffaloes had no effect on the total protein, albumin and globulin concentration of treated animals. Examination of animals at 60 days of the experiment showed improved ovarian conditions in both anoestrus and repeat breeders treated with bypass fat and hormones (Table 5).

Table 5. Ovarian condition of anoestrous and repeat breeder animals of experimental animals before and after the experiment

Attributes (%)	At 0 day					At 60 days				
	T0	T1	T2	T3	Total	T0	T1	T2	T3	Total
<b>Anoestrous</b>										
Non functional	33.3	33.3	50	33.3	37.5	33.3	33.3	0	0	16.6
Sub active	50.0	66.6	33.3	50.0	50.0	33.3	16.6	33.3	16.6	25.0
Functional	16.6	0	16.6	16.6	12.5	33.3	50	66.6	83.3	58.3
Total	100	100	100	100	100	100	100	100	100	100
<b>Repeat breeders</b>										
Sub active	35.7	35.7	28.5	28.5	32.1	28.5	14.2	7.15	7.15	14.2
Functional	64.2	64.2	71.4	71.4	67.8	71.4	85.7	92.8	92.8	85.7
Total	100	100	100	100	100	100	100	100	100	100

Out of 12 anoestrus and 8 repeaters in bypass supplemented group (T1) 10 animals (50%) exhibited estrus and 8 animals conceived (40%). Similarly, in T2 group 15 animals (75%) showed estrus out of which 12 animals (60%) conceived. Animals in T3 group showed 80% (16) estrus symptoms, whereas 14 (70%) animals became pregnant. Similar observations were also reported in confirmatory to our findings by Rutigliano et al. (2008). Haider et al. (2017) reported 90% estrus response in controlled internal drug release (CIDR) along with GnRH treated non-descript cows of Punjab. Sahoo et al. (2017) observed 60% conception rate in estra double synch protocol, which has been increased to 70% due to additional supplementation of bypass fat in our experiment. But Diskin et al. (2002) observed that Ovsynch protocol yielded low conception rate in beef herds showing high percentage of anoestrous which was contradictory to our results.

## CONCLUSION

Dietary supplementation of bypass fat along with hormonal treatment (double synch and estra double synch) can be recommended to prevent anestrus and repeat breeding in cross bred cattle in field condition as they enhanced the growth and conception rate.

## ACKNOWLEDGEMENT

The authors are thankful to the Odisha University of Agriculture and Technology, Bhubaneswar and AICRP Project on “Nutritional and physiological approach for enhancing reproductive performance in cattle and buffalo” for providing necessary funds and facilities to carry out this research.

## REFERENCES

- A.O.A.C. 1995. Official Methods of Analysis, 16<sup>th</sup> Edn Association of Official Analytical Chemists, Washington, DC.
- Barros, C.M., Moreira, M.B.P., Figueiredo, R.A., Teixeira, A.B. and Trinca, L.A. 1999. Synchronization of ovulation in beef cows (*Bos indicus*) using GnRH, PGF<sub>2</sub> and Estradiol Benzoate. *Theriogenology*. 9:139-152.
- Biradar, S., Tandle, M.K., Haribabu, Y., Usturge, S.M., Patil, N.A. and Suranagi, M.D. 2014. Study on efficacy of Cosynch and Ovsynch protocol on fertility in repeat breeder buffaloes. *Indian Journal of advances in Plant Research*. 1: 1-3.
- Diskin, M.G., Kenny, D.A., Dunne, L. and Sreenan, J.M. 2002. Systemic progesterone pre and post AI and early embryo survival in cattle. *Proceedings of the Agricultural Research Forum, Tullamore, Ireland*, pp. 27.
- Duncan, D.B. 1955. Multiple range and multiple “F” tests. *Biometrics*. 11: 1-42.
- FAO. 2012. User of lesser known plants and plant parts as animal feed resources in tropical regions, Paper no.8, Rome.
- Ferguson, D., James, T., Galligan, D. and Neal, T. 1994. Principal descriptors of body condition score in Holstein cows. *Journal of Dairy Science*. 77(9): 2695-2703.
- Garg, M.R. 1997. Bypass fat production using acid oil, its effect on in vitro rumen fermentation and effect of its feeding on in sacco DM disappearance in sheep. *Asian-Australasian Journal of Animal Sciences*. 10 (6):571-574.
- Grewal, R. S., Tyagi, N., Lamba, J.S., Ahuja, C.S. and Saijpaul, S. 2014. Effect of bypass fat and niacin supplementation on the productive performance and blood profile of lactating crossbred cows under field conditions. *Animal Nutrition and Feed Technology*. 14(3): 573-581.
- Haider, M. S., Bilal, M., Ahmed, H., Anwar, M., Sattar, A. and Andrabi, S.M.H. 2017. Effect of CIDR with or without GnRH and double PGF<sub>2</sub> based estrus synchronization protocols on estrus response and pregnancy per AI in non-descript cows of the Punjab. *Journal of Animal and Plant Sciences*. 27 (4): 1108-1114.
- Hamam, A.M., Abdel Gawad, E.M.M., Ali, A.H. and Amer, H.A. 2013. Effect of CIDR -ovsynch regimen as a pharmacological agent on fertility, blood and hormonal patterns of cross breed cows. *Global Journal of*

- Pharmacology.7: 383-389.
- Imakawa, K., Day, M.L. and Zalesky, D.D.1987. Effects of 17 beta estradiol and diets varying in energy on secretion of luteinizing hormone in beef heifers. *Journal of Animal Science*.64: 805.
- Jain, M.C.1986. *Veterinary Hematology*. 4<sup>th</sup> Edn. Lea and Febiger, Philadelphia, USA.
- Johnson, P.W. 1940. *Livestock weights from measurements*. Minnesota Agricultural Experiment Station, Folder 70.
- Karcagi, G., Roland, T. G., Pirooska, R., Gyula, H. and Ferenc, H.2010. Milk production, peripartal liver triglyceride concentration and plasma metabolites of dairy cows fed diets supplemented with calcium soaps or hydrogenated triglycerides of palm oil. *Journal of Dairy Research*.77 (2): 151-158.
- Khamas, D. J., Al-Hamedawi, T.M.and Al-Jeburii, K.O. 2013. The effect of using different periods of estrus synchronization on the reproductive performance and subsequent haematological value before and during pregnancy in Holstein heifers. *International Journal of Science and Nature*.4 (1): 63-67.
- Layek, S. S., Mohanty, T.K., Kumaresan, A., Behera, K. and Chand, S. 2011. Behavioural signs of estrus and their relationship to time of ovulation in Zebu (Sahiwal) cattle. *Animal Reproduction Science*. 129(3-4): 140-145.
- Moriel, P., Goncalves, E.P., Nayigihugu, V., Aines, G., Block, E. and Hess, B.W. 2009. Conception rates of beef cows fed a supplement with rumen-protected fat. *Midwest ADSA-ASAS Abstr.* #281
- Naik, P. K., Saijpaal, S. and Rani Neelam. 2007a. Evaluation of rumen protected fat prepared by fusion method. *Animal Nutrition and Feed Technology*. 7: 95-101.
- Naik, P. K., Saijpaal, S. and Rani Neelam. 2007b. Preparation of rumen protected fat and its effect on nutrient utilization in adult buffaloes. *Indian Journal of Animal Nutrition*. 24: 212-15.
- Naik, P. K., Saijpaal, S. and Rani, Neelam 2009a. Effect of ruminally protected fat on *in vitro* fermentation and apparent nutrient digestibility in buffaloes (*Bubalus bubalis*). *Animal Feed Science and Technology*. 153: 68-76.
- Naik, P. K., Saijpaal, S., Sirohi, A. S. and Raquib, M. 2009b. Lactation response of crossbred dairy cows fed on indigenously prepared rumen protected fat - a field trial. *Indian Journal of Animal Sciences*. 79: 1045-1049.
- Naik, P. K. 2013. Bypass fat in dairy ration-a review. *Animal Nutrition and Feed Technology*. 13: 147-163
- Nakrani, B.B., Panchal, M.T., Dhama, A.J., Hadiya, K.K., Patel, J.A., Gosai, R.K. and Shah, R.G. 2014. Influence of controlled breeding techniques on oestrus induction response, conception rate and plasma progesterone profile in anoestrus buffaloes. *Global Journal of Medical Research*.14(3): 1-6.
- NDDB. 2012. *Nutritive value of commonly used feeds and fodders*, National Dairy Development Board, Anand-38001.
- Parmar, S.C., Khasatiya, C.T., Chaudhary, J.K., Patel, R.V. and Dhamsaniya, H.B. 2015. Serum metabolic and minerals profile in norgestomet primed postpartum anestrous Surti buffaloes. *Veterinary World*. 8: 625-630.
- Rahman, M.M., Alam, M.R., Amin, M.R. and Das, N.G. 2010. Comparative study of the nutritive values of the different varieties of rice straw, *Bangladesh Journal of Animal science*. 39(1-2):75 – 82.
- Rutigliano, H.M., Lima, F.S., Cerri, R.L., Greco, L.F., Vilela, J.M., Magalhães, V., Silvestre, F.T., Thatcher, W.W. and Santos, J.E. 2008. Effects of method of pre synchronization and source of selenium on uterine health and reproduction in dairy cows. *Journal of Dairy Science*.91:3323–3336.
- Sahoo, J. K., Das, S.K., Sethy, K., Mishra, S.K., Swain, R.K., Mishra, P.C. and Sahoo, S.P.2017. Comparative evaluation of

- hormonal protocol on the performance of crossbred cattle. *Tropical Animal Health and Production*. 49(2):259-263.
- Savalia, K.K., Dhama, A.J., Hadiya, K.K., Patel, K.R. and Sarvaiya, N.P. 2014. Influence of controlled breeding techniques on fertility and plasma progesterone, protein and cholesterol profile in true anestrus and repeat breeding buffaloes. *Veterinary World*. 7:727-732.
- Savsani, H. H., Murthy, K.S., Padodara, R.J., Bhadaniya, A.R. and Kalaria, V.A. 2013. Effect of bypass fat supplementation on haematology growth and reproductive performance in Jaffarabadi buffaloes. *Asian Journal of Animal Science*. 8(1): 12–15.
- Scheffler, J. M., Buskirk, D.D., Rust, S.R., Cowley, J.D. and Doumit, M.E. 2003. Effect of repeated administration of combination trenbolone acetate and estradiol implants on growth, carcass traits, and beef quality of long-fed Holstein steers. *Journal of Animal Science*. 81(10): 2395-2400.
- SPSS. 2008. Statistical packages for Social Sciences, Version 17.0, SPSS Inc., Illinois, USA.
- Staples, C.R., Burke, J.M. and Thatcher, W.W. 1998. Influence of supplemental fats on reproductive tissues and performance of lactating cows. *Journal of Dairy Science*. 81:856–871.
- Stevenson, J.S., Smith, J.F. and Hawkins, D.E. 2000. Reproductive outcomes for dairy heifers treated with combinations of prostaglandin F<sub>2a</sub>, norgestomet and gonadotropin-releasing hormone. *Journal of Dairy Science*. 83: 2008–2015.
- Trenkle, A. 1976. The anabolic effect of estrogens on nitrogen metabolism of growing and finishing cattle and sheep. *Environmental Quality and Safety Supplement*. 12:79-88.
- Tyagi, N., Thakur, S.S. and Shelke, S.K. 2010. Effect of bypass fat supplementation on productive and reproductive performance in crossbred cows. *Tropical Animal Health and Production*. 42(8): 1749-1755.
- Wadhwa, M., Grewal, R.S., Bakshi, M.P.S. and Brar, P.S. 2012. Effect of supplementing bypass fat on the performance of high yielding crossbred cows. *Indian Journal of Animal Science*. 82(2): 200.