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Identification and clinico-gynaecological characterization of reproductive disorders in crossbred cows under field conditions

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ABSTRACT

The present study was conducted on a total of 909 crossbred cows maintained in various private farms from Kamrup, Darrang and Lakhimpur districts of Assam. Breeding records provided by the farmers and characteristic genital changes detected on per rectum examination of 133 reported infertile cows were analyzed. The study revealed that the incidence of infertility due to different types of reproductive disorders was 14.63 per cent in cross bred cow under field conditions. Common clinically detectable reproductive disorders were repeat breeding with uterine infection, repeat breeding without uterine infection, true anoestrus and silent oestrus with the percentage frequencies of 36.09, 23.30, 20.30 and 17.29 respectively when estimated out of total number of infertile cows. Less frequent reproductive disorders were pyometra, ovarian cyst, infantile genitalia and ovario-bursal adhesion occurring in the frequencies of 36.09, 23.30, 20.30 and 17.29 per cent respectively. Irrespective of type the incidence of anoestrus and repeat breeding was 37.59 and 59.39 per cent respectively. Palpable corpus luteum was present in the ovary of silent oestrous cows but totally absent in cows affected with true anoestrus. Mucopurulent vaginal discharge was a distinct clinically detectable genital characteristic observed in 62.50 per cent repeat breeder cows with uterine infection. Of the infertile cows 53.38 per cent had body condition score between 2.5 and 3.5 and 46.61 per cent had the score less than 2.5. Out of repeat breeder cows with uterine infection 43.66 per cent had good body condition and 27.41 per cent poor body condition. Level of serum calcium, zinc, leptin, ghrelin and IGF-1 did not vary significantly between types of infertility. Level of phosphorus and iron was lower in cows affected with repeat breeding due to infection. Serum oestrogen level remained low in cows affected with silent oestrus and true anoestrus while level of progesterone was higher in cows affected with silent oestrus.

Key words: Body condition score, Crossbred cow, Infertility, Reproductive disorder.

INTRODUCTION

It is well known that rate of reproduction is the basis of production. Reproductive disorders in cows reduce their breeding efficiency making them incapable of producing a calf a year. Common reproductive disorders in cattle are repeat breeding, anoestrus, retention of placenta, dystocia and ovulatory defects which vary in occurrence with type of animal, breed, parity and level of nutrition and production. Studies have been conducted for identifying the underlying causes of various reproductive disorders. Hormonal imbalance, genital infections, nutritional deficiencies, managemental defects and production stresses have been recognized as the major causes of infertility in cattle (Pandey and Pandit, 2000; Singh *et al.,* 2009; Sagar *et al.* 2013). Proper understanding of the type of reproductive disorders and genital characteristics as per type is necessary for taking up effective therapeutic measures for their elimination and there by maintaining optimum productivity in animals. Moreover, relationship between reproduction and minerals have been recognized long back. Essential minerals are required for reproduction because of their cellular roles in metabolism, maintenance and growth. However these nutrients may also have specific role and requirement in the reproductive tissue. Assessment of Body Condition Score (BCS) is also equally important which is an easy, inexpensive but subjective method to evaluate the body tissues of lactating cows, independent of frame size and body weight (BW). During the early lactation period, mobilization of body reserve for milk production induces a negative energy balance that has been reported to affect the reproductive performance of dairy cows (Beam and Butler, 1999). It can also be mentioned that, blood serum constituents reflect the metabolic status of the animal and these are usually estimated to assess the reproductive and productive performance of the farm animals. The present study has been planned to keep on record the incidence of infertility and physiological status of the animals with infertility

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problems on the basis of body condition and blood biochemical profiles which were known to be associated with energy balance of the animals in crossbred cows maintained in few districts of Assam under unorganized system of management. Attempts have also been made to study clinically detectable genital changes as per type of reproductive disorders affecting the animals.

MATERIALS AND METHODS

The present study was conducted in a total of 909 crossbred cows maintained in 60 private farms and households of Kamrup, Darrang and Lakhimpur districts of Assam. Each farm was visited in person and surveyed for total number of breedable cows and numbers of animal with breeding problems specially repeat breeding and anoestrus. In total 133 cows reported to be affected with one or the other breeding problem were selected for clinico-gynaecological examinations. Each animal was examined per rectum on the day of reporting except repeat breeder animal which were examined on the day of oestrus and characteristics of vaginal discharge, uterine tone and presence of ovarian structures were recorded and different forms of reproductive disorders were determined. The incidence of various reproductive disorders was worked out based on total number of breedable cattle maintained in the farm as well as out of the total number of infertile animals examined. The animals were maintained under varied conditions of housing, feeding and management. Identification of the reproductive disorders were done on the basis of the following considerations-

Silent oestrus

Cows not showing signs of oestrus even after four months of calving and revealing distinctly palpable corpus luteum (CL) in either of the ovaries with apparently normal uterus were diagnosed to be affected with silent oestrus.

True anoestrus

Cows not showing signs of oestrus even after four months of calving and failing to reveal distinctly palpable corpus luteum in the ovaries with apparently normal uterus as per rectal examination were considered to be affected with True anoestrus.

Repeat breeding with uterine infection

An animal failing to conceive even after three consecutive inseminations and showing at least one of the following conditions was considered to be affected with uterine infection:

a) Muco-purulent vaginal discharge observed at the time of examination
b) Reported muco- purulent discharge in preceding or present oestrus.
c) Vaginal discharge testing positive for white side test in cows with normal duration of oestrus.

Repeat breeding without uterine infection

This referred to a condition in which a cow with prolonged oestrus (more than 2 days) fail to conceive even after three consecutive inseminations showed apparently normal vaginal discharge and no detectable abnormality of the uterus on clinical examination.

Physiological status of infertile animal

Physiological status of the animals with infertility problems was studied on the basis of body condition and blood biochemical profiles which were known to be associated with energy balance of the animals.

Body conditions

Body condition was categorized as good or poor based on body condition scores as determined by visual and manual assessment of thickness of fat cover and prominence of the bones of tail and loin region *viz.,* short ribs, pin bones and tail head as described by Mishra *et al.,* (2016). The body condition score ranged from 1 to 5 depending on the manual and visual assessment.

Score 1:
a) Depression below the tail head and between the pin bones being too deep with no fatty tissue under the skin of that area.
b) Short ribs and spines in the loin region were very sharp and individual bones could be felt distinctly.

Score 2:
a) Cavity below tail head and between pin bones was shallow, pin bones were prominent and some amount of fat could be felt under the skin.
b) Short ribs could be identified individually but ends were rounded.

Score 3:
a) Some amount of fat covered entire area of the tail head but individual bones could be felt.
b) Short ribs could be felt with pressure and there appeared a slight depression at the loin region area below tail head and between pin bones was not much depressed.

Score 4:
a) Tail head appeared entirely covered with evidence of patches of fat.
b) Short ribs could not be felt individually and ends appeared rounded.

Score 5:
a) Tail head appeared buried in the fatty tissue.
b) Bony structures of back bone, short ribs and pin bones were not apparent even with firm pressure due to subcut--aneous deposition of fat.

The intermediate scores were determined arbitrarily.

Cows with body condition ranging from 2.5 to 3.5 were considered to have good body conditions. Cows with body condition scores below 2.5 and above 3.5 were considered to have poor body condition. Incidence of infertility in the two categories of body condition was worked out.

Blood Biochemical constituents

Blood was collected on the day of first per-rectal examination in silent estrous and true anestrous animals but in repeat

breeder animals with or without uterine infection the blood was collected on the day of oestrus. The serum was separated by centrifugation method and stored at -20 degree centigrade for further analysis.

The Blood biochemical constituents like calcium (Ca) using Liquizyme Calcium Test Kit (Beacon Diagnostics Private Limited, India), phosphorus (P) using Phosphorus Monotest UV method (Greiner Diagnostic GmBH, Germany), iron (Fe) using Iron –NP kit (Greiner Diagnostic GmBH, Germany) and zinc (Zn) using Zinc –NP kit (Greiner Diagnostic GmBH, Germany) were estimated by colorimetric method as per manufacturers' instructions. ELISA technique was employed to estimate the serum oestrogen (Estradiol ELISA kit, LDN, Germany) and progesterone (Progesterone ELISA kit, LDN, Germany) level in the collected samples. Metabolic hormones like leptin, ghrelin and insulin like growth factor-I (IGF-I) were estimated by using ELISA kit (Cloud Clone Corpn., USA) following manufacturers' instructions.

The statistical analysis of the data was done using software IBM-SPSS-20 (http://www.spss.co.in) and Micro Soft Excel-2010 (http://office. microsoft.com).

RESULTS AND DISCUSSION

Incidence

The incidence of different types of reproductive disorders has been shown in Table 1. The overall incidence of infertility in crossbred cows was 14.63 per cent as calculated out of the total 909 breedable cows. Out of 133 infertile cows investigated in the present study the common reproductive disorders were repeat breeding with uterine infection, repeat breeding without uterine infection, true anoestrus and silent oestrus with the percentage frequencies of 36.09, 23.30, 20.30 and 17.29 respectively. Less frequent reproductive disorders were pyometra, ovarian cyst, infantile genitalia and ovario-bursal adhesion with the percentage frequencies of 0.75, 0.75, 0.75 and 0.75 respectively. Perusal of available literature revealed some amount of information on prevalence of different forms of infertility in crossbred dairy cows from different parts of the country, which was found to vary in wider range. However, there appeared no sufficient data on per cent total infertility in dairy cows in the country. In a recent study 30.23 per cent infertile cows out of a total of 3553 cows and heifers maintained in private farms in greater Guwahati areas as reported by Acharya (2016) which was higher than that observed in the present study (14.63). In a study conducted by Maji and Samanta (2013) in infertile cows reported the incidence of anoestrus and repeat breeding to be 67.68 and 32.32 per cent respectively in cows. However, various authors (Singh 2003; Bhat *et al.,* 2012; Dutta and Sinha, 2012) from different parts of India reported that lower incidences ranging from 7.44 to 21.42 per cent for anoestrus and 23.89 to 28.53 per cent for repeat breeding as compared to the incidence observed in the present study. The variation in the incidence of anoestrus and repeat breeding in dairy cattle might be due to wide range of variation in the level of nutrition, hormonal imbalance and frequency of occurrence of predisposing factors like dystokia, retention of placenta, abortion and uterine infection in the animals (Roberts 1971; Noakes 2009).

Characteristic genital changes

Characteristic changes of the genital organ as detected in clinico-gynaecological examination of cows affected with different reproductive disorders have been presented in Table 2. The only clinically detectable genital change leading to proper differential diagnosis of silent oestrus from true anoestrus was that all silent oestrous cows revealed presence of palpable corpus luteum in the ovary whereas in the true anoestrous cows no corpus luteum could be palpated. The condition as "silent heat" and stated that some cows and heifers failed to show overt signs of oestrus yet had normal cyclical activity as referred by Noakes (2009). Nation *et al.,* (1998) reported that some anoestrous cows had relatively large follicle of a premature size of 1.5 cm in diameter, which corroborated the findings of the present study. It had been reported that cows with very small, inactive ovaries that were devoid of any palpable structure such as follicle or corpus luteum were considered to be in greater depth of anoestrus than those with palpable follicles (Nation *et al.,* 1998).

Type of vaginal discharge appeared to be important for differential clinical diagnosis of repeat breeder cows with uterine infection from those without infection. Presence of normal vaginal discharge in 20.83 per cent repeat breeder cows with uterine infection might be an indication of subclinical endometritis in them.

Physiological status of infertile animals

In this study, physiological status of the crossbred cows

Table 1: Incidence of different types of reproductive disorders in crossbred cattle.

Reproductive Disorders	No. of observation	Incidence (%)	
		Out of total number of animals with infertility (133)	Out of total number of breedable cattle (909)
Repeat breeding with uterine infection	48	36.09	5.28
Repeat breeding without uterine infection	31	23.30	3.41
Total	**79**	**59.39**	**8.69**
True anoestrus	27	20.30	2.97
Silent oestrus	23	17.29	2.53
Total	**50**	**37.59**	**5.50**
Pyometra	1	0.75	0.11
Ovarian cyst	1	0.75	0.11
Infantile genitalia	1	0.75	0.11
Ovario-bursal adhesion	1	0.75	0.11
G. Total	**133**	**100.00**	**14.63**

Figures in the parentheses indicate total number of animal investigated.

Table 2: Changes in vaginal discharge, uterine tone and presence of ovarian structure in crossbred cows affected with different types of reproductive disorders.

Characteristic Genital changes	Reproductive disorders							
	Silent Oestrus (23)		True anoestrus (27)		Repeat breeding with uterine infection (48)		Repeat breeding without uterine infection (31)	
	No. of observation	Frequency (%)	No. of observation	Frequency (%)	No. of observation	Frequency (%)	No. of observation	Frequency (%)
Vaginal Discharge								
Normal	0	0.00	0	0.00	10	20.83	26	83.87
Mucopurulent	0	0.00	0	0.00	30	62.50	0	0.00
Absent	23	100.00	27	100.00	8	16.66	5	16.12
Uterine Tone								
Good	0	0.00	0	0.00	21	43.75	13	41.93
Moderate	1	4.36	1	3.70	27	56.25	17	54.83
Absent	22	95.65	26	96.26	0	0.00	1	3.22
Ovarian structure								
Palpable follicle	23	100.00	19	70.37	48	100.00	31	100.00
Palpable CL	23	100.00	0	0.00	0	0.00	0	0.00

Figures in the parentheses indicate number of the animals with the specific reproductive disorder.

Table 3: Frequency of occurrence of different types of body conditions in the crossbred cows affected with different types of reproductive disorders (n=133).

Body Condition	No. of observation	Frequency of occurrence (%)
Good	71	53.38
Poor	62	46.61

identified to be affected with different infertility problems was studied based on body condition score and blood biochemical constituents commonly associated with maintenance of energy balance in the animals.

Body condition

In the present study, out of the total 133 crossbred cows diagnosed to be affected with different types of reproductive disorders, 71 were with good body condition and 62 with poor body condition; the frequency of occurrence being 53.38 and 46.61 per cent respectively (Table 3).

Association of body condition with types of infertility

Table 4 represents incidence of different types of reproductive disorders in animals with good and poor body conditions. The difference in the percentage of affected animals due to type of body condition in repeat breeder crossbred cows with uterine infection was significant as revealed in the chi-square test where as in repeat breeder crossbred cows without uterine infection there was no significant variation due to body condition. There was no significant difference between type of body condition score in anoestrus and silent oestrus animals. Single cases of pyometra and ovario-bursal adhesion were found in cows with poor body condition while that of ovarian cyst and infantile genitalia was observed in cows with good body condition.

Table 4: Incidence of different types of reproductive disorders in crossbred cows withgood and poor body condition.

Type of Reproductive Disorders	Good body condition (71)		Poor body condition (62)	
	No. of observation	Incidence (%)	No. of observation	Incidence (%)
Repeat breeder with uterine infection	31	43.66*	17	27.41*
Repeat breeder without uterine infection	16	22.53	15	24.19
True anoestrus	13	18.30	14	22.58
Silent oestrus	9	12.67	14	22.58
Pyometra	0	0.00	1	1.61
Ovarian cyst	1	1.41	0	0.00
Infantile genitalia	1	1.41	0	0.00
Ovario-bursal adhesion	0	0.00	1	1.61

Figures in the parentheses indicate number of animals with specific body condition.

*, P<0.05

Out of 133 crossbred cows affected with one or the other reproductive disorders, 53.38 per cent were with good body condition having more than 2.5 to 3.5 body condition score. This was considered as the ideal body condition score in lactating cows (Mishra *et. al.,* 2016). Other worker also reported that the body condition score remain above 2.5 in anoestrous cows (Virmani *et. al.,* 2011). The body condition score was reported to be a subjective estimate of energy reserve in the adipose tissue in a dairy cow and a quick

method to estimate degree of fatness or thickness of fat cover at different skeletal check points (Mishra *et al.,* 2016). The body condition score was a subjective measure of the amount of metabolizable energy store in the live animal and changes in body condition score could be considered as an indicator of extent and duration of post partum negative energy balance as reported by Bastin and Gengler (2013). The difference in opinion regarding the relationship of the body condition score with occurrence of reproductive disorders as mentioned in the available literature might led to a conclusion that body condition score alone was not the sole factor for occurrence of reproductive disorders in crossbred cows, rather its interaction with others factors such as presence of uterine infection was more important for occurrence of reproductive disorders in cattle under field conditions.

Blood biochemical constituents

Average levels of the blood biochemical constituents in crossbred cows affected with silent oestrus, true anestrus, repeat breeding with uterine infection and repeat breeding without uterine infection have been presented in Table 5.

Serum calcium

The mean serum calcium level between the forms of reproductive disorders was not significant. The mean level of serum calcium in cows affected with different forms of infertility as recorded in the present study was found to be within the normal range given for cattle which varied from 9.7 to 12.4 mg/dl as reported by Jackson and Cockcroft (2002). Earlier studies however indicated that serum calcium level decreased significantly in cows affected with anoestrus (Das *et al.,* 2012; Munner *et al.,* 2013), repeat breeding (Kumar 2014; Agarwal *et al.,* 2015), uterine infection (Magnus and Lali 2009) and ovulatory disturbances such as anovulation and delayed ovulation (Das *et al.,* 2009). Reports were also available on higher level of serum calcium in cows affected with ovulatory disturbances than those with normal ovulation as reported by Deka (1994). The difference in opinion regarding level of serum calcium due to forms of infertility as revealed in the literature and in the present study might be indicative of the fact that causes of infertility were not the sole factor determining serum calcium level in animals. Concentration of serum calcium was found to vary with the stage of oestrous cycle as well as with the level of milk production.

Serum phosphorus

Variation in serum phosphorus level between the forms of reproductive disorders was significant. However there was no significant difference in serum phosphorus level between repeat breeder cows with uterine infection and repeat breeder cows without uterine infection. From the results obtained in the present study it was observed that mean serum phosphorus level in the infertile cows affected with different forms of infertility was lower ranging from 1.86±0.19 to 2.63±0.80 mg/dl that in normal cattle (5.6 to 6.5 mg/dl) as reported by Jackson and Cockroft (2002). Decreased fertility rate, decreased ovarian activity, anoestrus, irregular oestrous cycle, increased occurrence of cystic ovary and delayed sexual maturity had been reported to be associated with phosphorus deficiency (Bindari *et al.,* 2013). Lower concentration of serum phosphorus in cows affected with different types of reproductive disorders had also been reported by Das *et al.,* (2012). Significantly lower inorganic phosphorus concentration in anoestrous cows than in normal cyclic cows as reported by Agarwal *et al.,* (2015).

Serum iron

There was significant variation in serum iron level between different forms of infertility. As observed in the present study mean levels of serum iron in crossbred cows affected with different types of infertility varied from 231.71 to 282.60 µg/dl and the lowest value was recorded in repeat breeder cows with uterine infection. According to Vhora *et al.,* (1995) and Ramakrishna (1997) level of serum iron in normal cycling cow was 191.67± 8.75 and 129.83± 9.73 mg% respectively. On the other hand, Das *et al.,* (2012) recorded serum iron

Table 5: Average levels of blood biochemical constituents in infertile crossbred cows affected with different forms of infertility.

Blood Biochemical Constituents	Forms of infertility			
	Silent oestrus (9) Mean ± S.E.	True anoestrus (9) Mean ± S.E.	Repeat breeding with infection (21) Mean ± S.E.	Repeat breeding without infection (12) Mean ± S.E.
Calcium (mg/dl)	11.94±1.11	11.40±0.64	10.99±0.50	11.90±0.63
Phosphorus (mg/dl)	2.63^{a}±0.80	2.61^{a} ±0.34	1.86^{b}±0.19	2.36^{ab}±0.15
Iron (µg/dl)	260.30^{ab}±7.36	282.60^{b}±15.20	231.70^{a}±5.32	274.90^{b}±16.50
Zinc (µg/dl)	96.96±5.87	170.50±77.4	101.00±5.45	108.60±5.18
Oestrogen (pg/ml)	5.01^{a}±0.87	7.73^{a}±1.18	15.20^{b}±1.03	12.65^{b}±1.56
Progesterone (ng/ml)	7.58^{a}±1.61	0.89^{b}±0.19	1.10^{b}±0.15	1.91^{b}±0.72
Leptin (ng/ml)	3.35±1.02	2.33±0.24	2.47±0.17	2.84±0.28
Ghrelin (pg/ml)	128.30±0.49	439.30±60.90	588.80±71.30	485.90±99.30
IGF-1 (ng/ml)	37.75^{a}±3.14	49.58^{c}±4.01	34.59^{ab}±1.80	29.49^{b}±2.95

Figures in the parentheses indicate number of animals studied.

Means bearing similar superscript in a row do not differ significantly

concentration in normal cycling cow as 342.0 µg/dl. Das *et al* (2009) reported that concentration of iron did not differ significantly among different ovulatory groups of repeat breeder cows. It had also been reported that low iron level was associated with anaemia, debility, lack of appetite and failure of oestrus (Vhora *et al.*1995). Reports available in the literature and results obtained in the present study indicated that level of serum iron was not a characteristic determining infertility in crossbred cows under field conditions unless the concentration was severely low.

Serum zinc

Level of zinc did not vary significantly between forms of infertility. It had been reported that zinc was essential for proper sexual maturity, reproductive capacity and more specifically onset of oestrus, also played a critical role in repair and maintenance of uterine lining following parturition, resumption of reproductive functions (Yasothai 2014). Reports were also on records that serum zinc concentration decreased significantly in cows affected with anoestrus (Ceylan *et al.,* 2008) as well as repeat breeding (Das *et al.,* 2002; Ceylan *et al.,* 2008; Das *et al.,* 2009). While comparing the concentration of serum zinc between anoestrous and repeat breeder cows observed that the value was significantly lower in anoestrous cows (Das *et al.,* 2012). From the above findings it was concluded that serum zinc could not be taken as an important blood biochemical constituent for characterization of infertility in crossbred cows.

Oestrogen

Variation in serum oestrogen level between the forms of reproductive disorders was significant.The significant variation in the level of serum oestrogen between anoestrous and repeat breeder cows as observed in the present study might be due to difference in ovarian activity which determined the level of ovarian hormones in blood (Saleh *et al.,* 2011). The concentration of oestradiol significantly decreased in non cyclic cows compared to the cyclic cows as reported by Saleh *et al.,* (2011). Silent oestrous cows under the present study also showed lower levels of oestrogen which might be due to the fact that blood samples from these animals were collected at a time when there was a palpable corpus luteum in the ovary. Presence of palpable corpus luteum in the ovary of reported anoestrous cows was the important criterion for selection or identification of silent oestrous cows included in the present study.

Progesterone

Variation in serum progesterone level due to forms of infertility being highly significant. The higher level of serum progesterone in cows affected with silent oestrus as observed in the present study might be attributed to the presence of mature corpus luteum in the ovary of the animals at the time of collection of blood. Results obtained in the present study also showed that ovaries of infertile cows affected with either true anoestrus or repeat breeding with or without uterine infection were completely devoid of luteal activity as indicated by absence of palpable corpus luteum on rectal palpation. Mean concentration of progesterone in normal cyclic and anoestrous cows as 11.96±2.65 and 8.25±1.56 nM/L respectively as recorded by Pariza *et al.* (2013). Barui *et al.,* (2015) recorded lower level of plasma progesterone (3.3600±0.4988 ng/ml) in repeat breeder cows as compared to that in normal cyclic cows (5.6111±0.7472 ng/ml).

Leptin

In the present study level of serum leptin was not found to vary significantly between cows affected with different forms of infertility. Leptin, a metabolic hormone reported to be associated with regulation of nutritional status and reproductive functions played a definite role in energy expenditure (Agarwal *et. al.,* 2009) and hence serum leptin level was considered to be an indicator of energy balance in animals (Parello *et al.,* 2012). In the present study, serum leptin concentration was not found to vary in different forms of infertility. However, the values for mean leptin concentration ranging from 2.33±0.24 to 3.35±1.02 ng/ml was far below the serum leptin concentration in fertile cows (5.12±0.43 mg/dl) as reported by Guzel and Tanriverdi (2014).

Ghrelin

Variation in serum phosphorus level between the forms of reproductive disorders was not significant .The metabolic hormone ghrelin was found to be involved in food intake, energy balance and control of adiposity (Dickson *et al.,* 2011). It was also found to influence reproductive functions. Hence concentration of ghrelin also could be taken as the indicator of energy balance. As observed in the present study mean ghrelin level in cows affected with different forms of infertility varied in wide range of lowest 128.30±0.49 pg/ml in silent oestrous cows to 588.80±71.30 pg/ml in repeat breeder cows with uterine infection. However variation due to type of infertility was not significant. This might be indicative of the fact that ghrelin was not a good indicator for determination of forms of infertility. It had been reported that empty stomach stimulated immediate secretion of ghrelin and when the stomach got stretched secretion stopped immediately.

IGF-1

Serum IGF-1 level was found to vary significantly between forms of infertility. IGF-1 had been described as a potential mediator of nutritional effect on reproduction. IGF concentration in the peripheral blood of lactating dairy cow was found related directly to the energy status. Beam and Butler (1999) observed that higher concentration of IGF was associated with body condition score. Higher IGF concentration was also associated with nutrient intake as reported by Thissen *et al.,* (1994). Underfed animals were found to show low IGF concentration in blood as reported by Chase *et al.,* (1998). As per Kadivar *et al.,* (2012) high

IGF concentration was the main factor associated with better reproductive performance in animals. In the present study, serum IGF-1 concentration was found to vary significantly among different types of infertility; highest level being recorded in true anoestrous cows (49.58±4.01 ng/ml) and the lowest in the repeat breeder cows without uterine infection (29.49± 2.95 ng/ml). This clearly indicated that there was a distinct variation in energy level of cows affected with different forms of infertility. Lower serum IGF concentration of 38.46±1.58 ng/ml in non-cycling animals (53.16±1.41 ng/ml) as recorded by Saleh *et al.,* (2011).

CONCLUSION

It was concluded that repeat breeding with uterine infection, repeat breeding without uterine infection, true anoestrus and silent oestrus were the common forms of infertility in crossbred cows in the study area under field condition and the overall incidence of infertility in crossbred cows maintained in private farms of three districts of Assam was 14.63 per cent comprising 5.28 per cent for repeat breeding with uterine infection, 3.41 per cent for repeat breeding without uterine infection, 2.97 per cent for true anoestrus, 2.53 per cent for silent oestrus and 0.11 per cent each for pyometra, ovarian cyst, infantile genital organ and ovario-bursal adhesion. Out of the total number of infertile cows 59.39 per cent suffered from repeat breeding and 37.59 per cent for anoestrus. Of the infertile cows 53.38 per cent had body condition score between 2.5 and 3.5 and 46.61 per cent had the score less than 2.5. Out of repeat breeder cows with uterine infection 43.66 per cent had good body condition and 27.41 per cent poor body condition. Level of serum calcium, zinc, leptin, ghrelin and IGF-1 didnot vary significantly between types of infertility. Level of phosphorus and iron was lower in cows affected with repeat breeding due to infection. Serum oestrogen level remained low in cows affected with silent oestrus and true anoestrus while level of progesterone was higher in cows affected with silent oestrus.

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