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Pre-and-postpartum managemental intervention through herbal feed supplement (*Asparagus racemosus*) and its effect on production and reproduction performance during supplementation and post-supplementation period in crossbred cows

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ABSTRACT

Shatavari (Asparagus racemosus), a medicinal plant used in Ayurveda is well documented Rasayana for its galactopoietic and therapeutic properties. Objectives of the present study were to evaluate the effects of supplementation of herbal feed supplement *Asparagus racemosus (Shatavari*), during prepartum to postpartum on milk production and reproductive performance of crossbred cows. Animals (10) were classified in 2 groups of 5 each, viz. C (control) and PREPOS- prepartum (i.e. 50 to 60 days dry period) to continued postpartum period (up to 90 days postpartum). During prepartum, the cows in group PREPOS were supplemented with *Asparagus racemosus* root powder @100 mg/kg live body weight and it was continued during postpartum period @200 mg/kg live body weight. *A. racemosus* supplementation during both prepartum continued to postpartum (PREPOS) resulted in significant, improvement in per day milk production and reduction in first postpartum oestrus interval, service period (day) and services per conception, and rate of uterine involution in comparison to the control group.

Key words: *Asparagus racemosus*, Crossbred cows, Milk yield, Postpartum, Prepartum, Reproductive performance

High milk yield of cows has a negative correlation with their fertility. This trend is of more prominence in high yielder. In India, dairy farming is in hands of small and marginal farmers, invention of farmer's oriented low cost technique to improve the reproduction and production is in dire need. Technological interventions through indigenous herbal feed supplement, which is cheaper, effective and free from unwanted side effect, will be more effective to enhance the productive and reproductive performances of dairy animals (Mallick and Prakash 2010). So, use of indigenous herbal feed supplement has its importance to consumer interest point of view as well. In such a condition locally available cheaper herbal feed supplement which are natural and safer might be suitable substitute of chemical feed additives to improve the milk production and reproductive performance in dairy animals. Roots of *Asparagus racemosus* (*Shatavari*) are used in various medicinal preparations. This herb is traditionally used to rectify the gynaecological problems and sexual dysfunction (Ashajyothi *et al*. 2009). It also supports deeper tissue and builds blood and thus helps to remove infertility, prepare the womb for conception, prevents miscarriage and acts as a postpartum tonic where it helps to increase lactation and normalize the uterus after parturition, prolapse of uterus and the changing hormones (Tirtha 1998). In *Ayurveda* this amazing herb is called as the "queen of herbs" as it increases the capacity for milk production and side by side improves the vitality of foetus and newly born. Therefore, its supplementation is recommended during last trimester of pregnancy to first trimester of post parturition to the mother to boost milk quality and immunity of both mother and fetus (Simon 1997).

The scientific evidence of galactopoietic and mammogenic properties of *A. racemosus* are reported in dairy animals (Tanwar *et al*. 2008, Mishra *et al*. 2008) with varying dose without considering the body weight of supplemented animals thus, dissimilarity of dose/day/kg body weight of the animal in a group. Keeping view in mind, the importance of herbal feed supplement as a farmer's oriented low cost technique and its use in ancient Indian medicine, *A. racemosus* was used to assess the role in the improvement of reproduction and production in crossbred cows.

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MATERIALS AND METHODS

The study was conducted in the experimental cattle shed of National Dairy Research Institute, Karnal, India located at 29°423 202 N and 76°583 52.52 E at an altitude of 834 ft amsl. Minimum and maximum ambient temperature range from near freezing point in winter to 45°C in summer with annual rainfall of 700 mm. The experiment was conducted in September to March with daily minimum and maximum temperature averaging 5.6°C and 32.9°C. Minimum and maximum temperature averaging during lactation period was 5.1°C and 30.1°C.

The herbal feed supplement *Shatavari* was procured commercially (ISO 9001–2000 Certification, GMP Approved, FDA Licensed), Ujjain, Madhya Pradesh.

Pregnant Karan Fries crossbred cows (10) around 60 days prepartum were selected and divided randomly in 2 groups according to most probable production ability (MPPA), parity, body weight and supplementation during different stages. The animals groups were, viz. C— control (MPPA 3841.0±83.83, parity 2.6±1.12 and initial body weight 434.02±33.35 kg) and PREPOS — prepartum (i.e. 50 to 60 days dry period) to postpartum period (up to 90 days postpartum; MPPA 3864.2±81.46, parity 3.2±1.01, initial body weight 435.0±22.02 kg). All animals were fed as per NRC (1989). During prepartum, the cows in group PREPOS were supplemented with *A. racemosus* root powder @100 mg/kg live body weight and during postpartum period @200 mg/kg live body weight.

The dose of *Shatavari* during postpartum period was specified based on report by Berhane (2000), who supplemented *A. racemosus* to the freshly parturited crossbred cows @100 g/animal at alternate days irrespective of animal's body weights. Considering homogeneity in the groups and refinement in the doses at per kg body weight, *A. racemosus* was supplemented considering body weight of animals. Since the crossbred periparturient cow is highly susceptible to various diseases which impair its productive and reproductive performance postpartum, supplementation of *A. racemosus* is recommended during last trimester of pregnancy to first trimester after parturition. So, we explored the possibility of augmenting the performance of crossbred cows through supplementation of Shatavari at the rate equivalent to half the dose supplemented postpartum.

The root powder of *A. racemosus* was supplemented after milking with concentrate once at morning in a day. All animals were fed as per NRC (1989) during dry and lactation period. During prepartum period cows were fed chaffed (1–2cm) green *Sorghum (Sorghum bicolor*) and concentrate based total mixed ration with minimum 3.5 kg concentrate per day per cow. Depending upon the requirement of cows during lactation period all animals were fed with berseem *(Trifolium alexandrinum*), oat *(Avena sativa*) and wheat straw (1–2cm particle size) as a roughage and concentrate. During lactation period ratio of concentrate and roughage in the total mixed ration was 55:45. Composition (%) of the concentrate mixture was: maize grain 33, groundnut cake 21, mustard cake 12, wheat bran 20, deoiled rice bran 11, mineral mixture 2 and common salt 1. Left over, if any, was weighed next morning. DM content of forage and left over was determined to calculate the daily DMI. Fresh and clean water was provided free choice to each cow. The cows of PREPOS group were supplemented *A. racemosus* root powder 60 days from expected days of prepartum to up to 90 days postpartum and milk production was recorded up to 150 days of lactation under controlled feeding conditions, to estimate the carry over effect of supplementation (90 days) on milk yield.

Analytical techniques: The offered feed samples were analyzed for proximate principles and fibre content (NDF, ADF) as per AOAC (1995) and Van Soest *et al*. (1991), respectively. The *A. racemosus* samples were also analyzed for total phenolic and tannin content as per Makkar (2003). Cows were kept under similar housing system during entire period of experiment. Milking was done by milking machine thrice daily (morning, noon and evening). The interval of milking was at 4:30AM, 12:30PM and 7:30PM at the Institute. Daily milk yield was recorded. After parturition, onset of estrus was observed during morning, noon and evening. During estrus period the signs of estrus were recorded and scored as per Van Eerdenburg *et al*. (1996). The reproduction parameters such as service period (days), number of services per conception and reproductive disorders were recorded from reproduction record. All experimental animals of control and PREPOS group were scored for uterine discharges and Uterine Involution on 7, 14, 21, 28, 35 and 42 days postpartum as per Sheldon and Noakes (1998) for early diagnosis of uterine health.

Stataistical analysis: The least squares technique was applied to estimate the mean daily milk yield and the significance of treatment differences was examined by Duncan's multiple range test (Harvey 1975). Student's t test was employed to estimate the effect of treatment on reproductive performance and blood parameter (Snedecor and Cochran 1989).

RESULTS AND DISCUSSION

Chemical composition of concentrate, forage and Asparagus racemosus: Phytochemical and proximate composition of offered *A. racemosus* and feeds are presented in Table 1. Herbal feed supplement *A. racemosus* which was offered to the supplemented group contains total phenolics and total tannin 4.57 and 3.68% respectively.

Feed intake: A. racemosus supplementation during prepartum to postpartum did not affect the dry matter intake. Average dry matter intake during different fortnight of prepartum and postpartum (90 days) supplementation in Control and PREPOS was 9.56±0.26 and 10.25±0.29, and 13.00±0.26 and 13.19±0.32 kg/d, respectively (Table 2.). Our

Table 1. Plant secondary metabolites and nutritional properties of *Asparagus racemosus* herbal feed supplement

Parameter (% DM basis)	*Asparagus racemosus* (Root)	Concentrate	Berseem	Sorghum	Wheat straw
OM	90.7	91.33	89.93	91.65	91.16
CP	6.47	20.46	17.83	7.14	3.13
EE	0.35	4.23	3.34	0.85	0.96
Total ash	2.5	8.67	10.07	8.35	8.84
NDF	38.14	43.49	31.29	60.05	68.82
ADF	13.40	13.50	26.52	44.27	54.16
Total phenolics	4.57	-	-	-	-
Total tannin	3.68	-			

results indicated that there was improvement in total DMI/animal/day in the PREPOS group might be due to supplementation of *A. racemosus* however, during post supplementation period a drastic reduction was observed (Fig. 1). Our results are not similar to the findings of Berhane (2000) who reported that supplementation of Shatavari postpartum freshly parturited crossbred cows @100 g at alternate days improved feed intake significantly. Similar results were also found by Gupta *et al*. (2004) who reported that diet fortified with a combined herbal feed supplement containing *A. racemosus* increases dry matter intake significantly in growing crossbred heifers.

Milk production: Least square mean of daily milk yield/animal/day during 90 days of supplementation period in control and supplemented PREPOS group were 19.53±0.22 and 23.40±0.22 kg/d respectively with significant (P<0.01) difference between groups. The mean daily milk yield was maximum in supplemented group PREPOS followed by Control. Overall average daily milk yield (kg/d) was higher in supplemented groups PREPOS by 19.82% over that of un-supplemented C group (Table 2).

Supplementation of herbal feed supplement increased the fat content in the milk resulted increase in mean values of daily fat corrected milk yield (4%) during supplementation period in PREPOS group and it was 25.13±0.22, while in control (C) the value was 20.07±0.22 kg/day with significant (P<0.01) difference between the groups. The mean daily fat corrected milk yield was improved in supplemented group

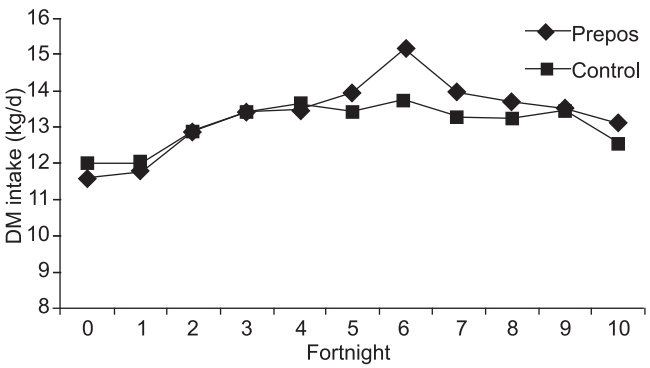

Fig. 1. Effect of herbal feed supplement on DM intake (kg/day).

Table 2. Mean (±SE) of fortnightly milk yield (kg/d) in Karan Fries cows supplemented with or without *Asparagus racemosus* herbal feed supplement during supplementation and post supplementation period

Parameters	Control	PREPOS
DM intake (kg/day) during supplementation	13.00±0.26	13.19±0.32
DM intake (kg/day) during post-supplementation	13.25±0.37	13.44±0.28
Milk yield (kg/day) during supplementation	19.53^{a}±0.22	23.40^{b}±0. 22
Milk yield (kg/day) during post supplementation	16.22^{a}±0.19	17.86^{b}±0.19
4% Fat corrected milk yield (kg/day) during supplementation	20.07^{a}±0.22	25.13^{b}±22
Milk yield (kg/day) during post supplementation	16.56^{a}±0.19	19.25^{b}±0.19

Means with different superscripts a, b in a row differ significantly (P<0.01).

PREPOS by 25.21%, over that of control group (Table 2).

Graphical representation of mean daily milk yield (kg/d) revealed that the milk yield trend (lactation curve) in supplemented groups was normal whereas it was abnormal in control group which could be due to mastitis incidence (2 vs. 0 animals) in early lactation in control group (Fig. 2). The significant improvement in milk production on supplementation of *A. racemosus* is in line with the findings of many workers. Mishra *et al*. (2008) and Tanwar *et al*. (2008) reported that postpartum supplementation of *A. racemosus* increases milk production significantly (P<0.05) in crossbred cows.

Higher productivity in supplemented group PREPOS could be attributed to higher fortnightly DM intake and its better digestibility (Gupta *et al*. 2004) by fortification of the diet with *Asparagus racemosus* and no incidence of mastitis (Sharma 2009). Sharma (2009) reported that supplementation of polyherbal immunomodulator containing *A. racemosus* at the rate of 250 mg/kg body weight during both pre and postpartum period in crossbred cow resulted in decrease in

mastitis incidence and increase in daily milk yield significantly. In other words, higher milk production in *A. racemosus* supplemented groups could also be attributed to its active components which stimulate the hypothalamus or pituitary gland leading to release of prolactin hormone in dairy animals (Singh 2010). Estrogenic effect of *A. racemosus* on mammary gland and higher level of blood prolactin hormone stimulating the alveolar secretary epithelial cell division, and proliferation in the lumen of the duct of mammary gland (Sabnis *et al.* 1966, Ghosh *et al.* 1987, Pandey *et al*. 2005) could have resulted in more milk synthesis and secretion.

Carry over effect of Asparagus racemosus *supplementation on milk production:* Throughout this period, cows of *A. racemosus* supplemented groups exhibited higher (P< 0.01) milk yield than that of control group. The average milk production was 10.11% higher in PREPOS than that of C group in the 60 days carry over period when the animals were monitored without supplementation after cessation of supplementation period of 90 days.

Our results indicated that even after discontinuation of *A. racemosus* feeding, better persistence of milk production was observed until the 150 days of lactation. The finding was similar to the supplementation of poly herbal preparation (with *A. racemosus*) to lactating crossbred cows increasing the milk production during supplementation, and effects persisted even after withdrawal of dietary supplement (Sharma 2009).

Effect of Asparagus racemosus *supplementation on reproductive performance:* The reproductive performances in terms of first estrus behavior score, first postpartum estrus, service period (SP), services per conception (SPC) and conception rate are the major determinants of profitability of dairy farm (Table 3).

The different signs of estrus according to Van Eerdenburg *et al*. (1996) were recorded and scored among dairy cows at the time of first postpartum estrus to know the variation in their estrus behavior. The average values of estrus behavior score were 178±13.68 and 208±11.02 in group C and PREPOS respectively. Average score was found maximum in PREPOS followed by C suggesting that weak estrus behavior may reduce the heat detection efficiency. There were no significant differences observed among the groups. It appeared that the effect of estrogenic properties of *A. racemosus* with this dose level improved the estrus behavior score in supplemented group PREPOS. The present findings were in conformity with those of Pandey *et al*. (2005).

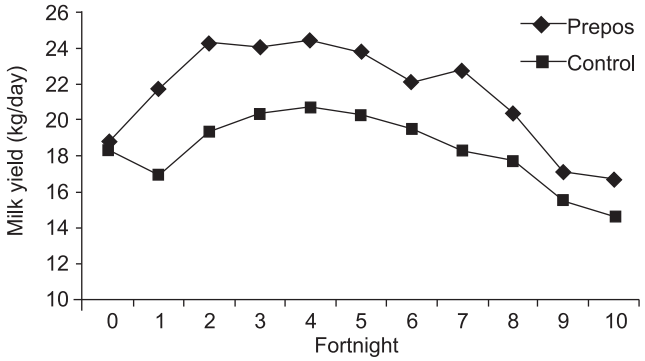

Fig. 2. Effect of herbal feed supplement on daily milk yield (kg/day).

Mean of first postpartum estrus (days to first postpartum) for C group was 55.59±6.83 and the corresponding values for supplemented group PREPOS were 30.0±6.83 days, respectively. The first postpartum estrus days were significantly less in PREPOS than that of control group C. Initiation of estrus cycle in PREPOS was earlier by 25.59 days from control group (C).

Earlier first postpartum estrus in supplemented group could be due to estrogenic property of *A. racemosus* which might have stimulated the ovarian function and uterine tonicity properties of *A. racemosus* that could have helped in early postpartum estrus. The findings were in accordance with the earlier reports.The commencement of cyclicity is also related with the process of involution of uterus, as the duration for uterine involution was reduced on *A. racemosus* supplementation, it may responsible for relatively early commencement of cyclicity. *A. racemosus* has rejuvenative properties and it stimulate the epithelial cell division resulted early healing of uterine wall and leads to early uterine involution and consequently early initiation of estrus cycle in supplemented groups (Pandey *et al*. 2005, Frawley and Lad 2006). Morrow *et al*. (1966) also stated that early uterine involution is directly related to early estrus cycle initiation. The resumption of estrus cycle after parturition depends on the nutritional status, body energy reserved and blood glucose level of the animal. As blood glucose is the main source of energy for ovarian function (Rabiee *et al*. 1997), and influences bovine thecal cell steroidogenesis *in vitro* (Stewart *et al*. 1995) which may play a major role in achievement of

Table 3. Effect of *Asparagus racemosus* herbal feed supplement supplementation on reproductive performance in crossbred (KF) cows

Group	First estrus behaviour score	First postpartum estrus (days)	Service period (days)	Services per conception	Uterine involution (days)	RFM	Metritis	Endometritis	Cervicitis	Pyometra
Control	178±13.68	55.59^{a}±6.83	151.01^{a}±0.97	2.80^{a}±0.57	40.20±3.89	3	3	2	1	1
PREPOS	208±11.02	30.0^{b}±6.83	93.4^{b}±20.97	1.59^{b}±0.57	30.80±2.80	1	1	0	0	0

Means with different superscripts a, b in a column differ significantly (P<0.05).

Table 4. Mean (±SE) of monthly plasma glucose, total protein and plasma urea concentration in KF crossbred cows supplemented with and without *A. racemosus*

Group	Plasma glucose (mmol/dL)	Plasma total protein (g/dL)	Plasma urea (mg/dL)
Control	3.73^{a}±0.08	5.24^{a}±0.18	45.14^{a}±1.22
PREPOS	4.11^{b}±0.12	8.31^{b}±0.29	40.21^{b}±1.94

Means with different superscripts a, b in a column differ significantly (P<0.05)

postpartum ovulation. In the present study the results in supplemented group PREPOS indicates that body energy reserve, nutritional status (based on blood plasma protein) and blood glucose levels were higher which could be attributed to earlier initiation of estrus cycle.

The present findings were in agreement with those of Tomer (1995) and who reported that Supplemention of herbs *chandrasoor (Lepidium sativum* L.) and *maithy (Trigoella foenum graecum*) with the combination of jaggery and linseed oil once in every four days for a period of 60 days, improved reproductive performance of buffaloes by 85.71% and 71.42%, respectively, in term of estrus occurrence within the 60 days of experiment. Mallick and Prakash (2010) also reported that peripartum *Guduchi* supplemented crossbred cows exhibited early commencement of cyclicity in comparison to unsupplemented control group of cows.

The means of service period (days) in control group (C) and PREPOS were 151.01±20.97 and 93.4±20.97, respectively (Table 3). The service period in group PREPOS was significantly less (P<0.05) than that of control group C. The reduction in service period (days) in supplemented PREPOS was might be due to stage of lactation and initiation of supplementation of *A. racemosus* which stimulate digestion and consequently higher dry matter intake and body energy reserve. The condition of animal at the time of parturition has eminence effect on the productive performance of a cow. In the present study, supplementation of *A. racemosus* in group PREPOS was initiated prepartum and continued to postpartum. It was observed that animals in this group had earlier initiation of estrus and consequently the service period was reduced significantly (P<0.05) when compared to control group. Service period in group PREPOS was reduced by 57.6 days over control group C.

The higher service period in control group might be attributed to higher RFM, metritis and endometritis (Table 3). Previous studies have also shown that cows which were affected with RFM, metritis, endometritis and other post parturient utero-vaginal disorders have significant (*P*<0.05) longer service period. The findings in literature have shown that normal cows have 2 ovulations during the first 30 to 35 days after parturition, whereas cows with periparturient diseases had only one ovulation during this period (Morrow *et al*. 1966, Marion and Gier 1968). The present results were also in agreement with those of Santos *et al*. (2004), Huszenicza *et al*. (2005) and Gunay and Gunay (2008), who reported that cows suffering with first clinical mastitis prior to first postpartum AI and first clinical mastitis between first postpartum AI and pregnancy diagnosis had significantly extended (P<0.05) duration of days open. Average body weight gain was observed negative in control, and positive and significantly (P<0.05) higher in supplemented groups which showed a sign of positive energy balance. Energy balance was shown in several studies to modulate plasma P_4 concentrations during early postpartum (Villa-Godoy *et al*. 1988, Spicer *et al.* 1990, Spicer *et al*. 1993). Concentration of P_4 is associated positively with fertility (Folman *et al*. 1973) and pregnancy rates (Sklan *et al.* 1991) and negatively with energy balance (Villa-Godoy *et al*. 1988, Spicer *et al*. 1990, 1993) and days open (Sklan *et al.* 1991). In addition, a negative energy balance reduces the weight of corpus luteum (Apgar *et al.* 1975) and decreases steroidogenic activity of luteal tissue (Villa-Godoy *et al.* 1990).

Services per conception: Services per conception in control group (C) and PREPOS were 2.8±0.57, 1.59±0.57, respectively (Table 3). The results showed that number of services per conception were significantly (P<0.05) less in the group PREPOS than the control group. The improvement in supplemented group PREPOS could be due to anti-oxytotic action of *A. racemosus* compound present in *A. racemosus* on uterus, which helps in conception (Gaitonde and Jetmalani 1969). Mitra *et al.* (1999) also reported that *A. racemosus* based herbal formulation did not possess oxytocin like activity which might be useful in condition associated with hypermotility of uterus as in threatened abortion, hence *A. racemosus* supplementation enhances conception. Further, Kumar and Singh (2001) reported that administration of *A. racemosus* based herbal formulation increases the thyroxin stimulating hormone, follicular stimulating hormone and luteinizing hormone, which help in regular ovulation and improved conception rate significantly (P<0.05) in infertile women. Positive energy balance and better nutritional status as observed in the present study through analysis of different blood metabolites could be attributed for better reproductive performance. Improved reproductive performance in *A. racemosus* supplemented groups could also be attributed to positive energy balance which helps in early ovulation and low plasma urea concentration. Canfield and Butler (1990) demonstrated a direct relationship between postpartum energy balance and first ovulation. It was reported that cows which has normal and higher plasma total protein concentration ovulated earlier as compared to lower plasma protein (Table 4). Greater serum or plasma urea nitrogen concentration reduces LH binding to ovarian receptors, leading to decrease in serum progesterone concentration and pregnancy rates (Agarwal and Maurya 2002, Sharma *et al.* 2006). Lower incidence of RFM and less time required for

involution of uterus would also facilitate early and successful conception of the cow (Butler *et al.* 1996, Agarwal and Maurya 2002). Frequent occurrence of metritis after RFM was identified as the main reason for reduced fertility and conception rate of cows (Laven and Peters 1996, Grohn and Rajala-Schultz 2000, Drillich *et al.* 2006). The findings were in accordance with the earlier reports of Santos *et al*. (2004), Huszenicza *et al*. (2005) and Gunay and Gunay (2008). The present result is in line with the report of Tillard *et al.* (2008), who revealed that infertility is related to nutritional factors. The improvement in conception rate observed in present study is also in agreement with the findings of Berhane (2000), who fed *A. racemosus* herbal feed supplement to dairy animals resulting in improved pregnancy rate (75%) compared with un-supplemented (50%) crossbred dairy cows. They concluded that the possible reason of better reproduction performance was higher minerals and trace elements content in feed supplement which are essential for normal physiological reproductive performance of animals. Recently it was reported that aqueous extract of *A. racemosus* root significantly ($P<0.05$) reduced the excretion of calcium and phosphorus in urine and thus enhance the availability resulted significant improvement in the mineralization of bone (Chitme *et al*. 2009). Tomer (1995) also stated that indigenous feed supplements such as fenugreek *(Trigonella foenum graecum*) and chandrasoor *(Lipidium sativum*) contains higher minerals and trace elements which leads to better reproductive performance in supplemented animals.

Based on the above results, it can be concluded that *A. racemosus* root powder supplementation during prepartum to postpartum has potential to improve the milk production and reproductive performance of dairy cows. Therefore, it is beneficial and could serve as potential management tool to improve productive and reproductive performance in crossbred dairy cows. However, comprehensive assessment of the effects on the different body system and mode of action is urgently required to establish potency, safety and its applicability in dairy animals.

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