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Effect of Feeding Herbal Preparations on Milk Yield and Rumen Parameters in Lactating Crossbred Cows

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ABSTRACT

The study evaluated the effect of feeding two herbal preparations (Ruchamax & Payapro) on the milk yield and rumen parameters in lactating crossbred cows. Fifteen lactating cows in their 1st-6th lactation were taken for the experiment after 3 days of calving to their full lactation. The cows were randomly divided into three uniform groups of 5 cows in each. All the animals were fed standard seasonally available roughages and concentrates to meet their nutritional requirements. The animals in group I were not given any supplement and acted as control. The animals in second and third group were given either Ruchamax @30 g per day or Payapro@4 tablets per day, respectively for 15 consecutive days in a month for 3 months, commencing 3 days after calving in addition to the usual feed/fodders and were termed as Ruchamax supplemented and Payapro supplemented animals. Significant (P <0.05) differences were observed in milk yield and rumen parameters of cows fed herbal preparations as compared to control. The ammonia nitrogen was highest (22.38 mg 100 mL^{-1}) in control animals, whereas total volatile fatty acids as well as bacterial and protozoal counts were highest in Ruchamax supplemented, moderate in Payapro supplemented and lowest in control animals, respectively. The use of herbal preparations increased the average milk production in cows, which was highest (11.8 L day^{-1}) in Ruchamax supplemented, moderate (9.3 L day^{-1}) in Payapro supplemented as compared to control animals (7.1 L day^{-1}). It is concluded that herbal preparations can increase milk yield in lactating dairy cows through improving their rumen environment.

Key Words: Herbal preparations; Milk yield; Rumen parameters; Galactagogue; Appetizer; Cows

INTRODUCTION

Optimal milk production is the key requirement in the management of dairy economics. The demand for the supply of milk and milk products is growing at a much faster rate than the supply. According to a forecast of Tetra Pak (2009), the global consumption of milk and other liquid dairy products is expected to increase by a compound annual growth rate (CAGR) of about 2.2% over the next 3 years. The global milk production for the year 2008 was estimated to be 693 million tones and the forecast for the year 2009 is about 710 million tones. The current slower global milk production rate is mainly attributed to higher feed prices (the dairysite.com). In China the milk production decreased in recent years, whereas India is expected to sustain its normal growth of about 3%. Pakistan on the other hand is looking to set up a goal of 6% increase in milk production as the high internal milk prices have stimulated investment in dairy sector (the dairysite.com). Milk production in developing countries is expected to rise, whereas in developed countries, it is anticipated to remain unchanged. As a result the share of developing countries for the global milk output is set to rise >48 % from 40% share 10 years ago. However the milk production per animal in developing countries, in particular in India is still very low as compared to world's average. This lower productivity might be attributed to many factors including the genetic and environmental factors such as non-availability of good quality feed resources, poor husbandry management practices and the small-scale dairy production units (Sharma, 2002; Hemme *et al*., 2003; Indiastat.com).

In order to restore the animal productivity and to optimize the milk production in individual animals for better profits, various drugs, herbal preparations, hormones, mineral supplements and feed additives have been tried with variable results (Ludri, 1983; Kronfeld, 1989; Singh *et al*., 1991; Zednik *et al.*, 1994; Ramesh *et al.*, 2000). Majority of these herbal preparations have however not been thoroughly scientifically evaluated but their traditional use suggests some safety and efficacy.

Ruchamax is a potent herbal formulation, which contains 28 different herbs and some minerals. The ingredients of Ruchamax include *Allium sativum*, *Azadirachta indica*, *Calotrophis orocera*, *Centratherum*

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anthelmenticum, Commiphora mukul, Eclipta elba, Embelica ribes, Picorrhiza kurora, Zinziber officinale and *Piper longum*, etc. It is used as an appetizer, restorative, carminative, stomachic and tonic. Payapro, a known galactagogue, is a combination of *Leptadenia reticulata, Nigella sativa, Foeniculam vulgare, Pueraria tuberosa, Glycerriza globra, Cuminum cyminum* and *Asparagus racemosus* etc. All these herbs are known to possess galactopoietics action (ICMR, 1987). *Leptadenia reticulata* has been shown to produce significant galactopoitic response in goats, sheeps, cows and buffaloes (Anjaria *et al.*, 1967). Galactagogues are believed to assist in the initiation, maintenance, or augmentation of milk production (Gabay, 2002; Abascal & Yarnell, 2008).

It has been suggested that Galog, a herbal product, may stimulate milk production (Arora, 1989; Zednik *et al.*, 1994). Singhal (1995) observed 30.1% increase in milk yield of Payapro fed cows. Qureshi (1999) not only observed an increase in milk yield but also an increase in the fat percentage of milk in dairy cows fed with Lectovet (a herbal combination). Galactin a non-hormonal herbal preparation significantly enhanced the milk production in dairy cows and ultimately improved the dairy economics (Ramesh *et al.*, 2000; Kumari & Akbar, 2006). Herbal preparations have also been shown to relieve the heat stress in dairy cows and ultimately improve their productivity (Zhang *et al.*, 2007). Kolte *et al.* (2008) reported that indigenous herbal preparations effectively restored the altered milk constituents and increased the milk production in cows with sub-clinical mastitis.

Keeping in view the paucity of scientific data on the effectiveness and safety of herbal preparations in dairy cows, the present study was conducted to evaluate the effect of feeding two herbal preparations (Ruchamax & Payapro) on milk production and rumen parameters in lactating crossbred cows.

MATERIALS AND METHODS

Fifteen healthy lactating crossbred (HF x Sahiwal) cows, weighing between 350 to 450 kg and in their 1st to 6th lactation, were taken from the university herd after three days of calving to be included in the experiment. The animals were randomly divided into three uniform groups of five animals in each. The experiment was conducted at the university research station of G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India. The animals were kept in an open enclosure having regular feeding and watering facilities. The floor was washed and cleaned twice daily in the morning and evening. The animals were fed twice daily at around 7 a.m. and 4 p.m. All the animals were fed standard seasonally available roughages and concentrates to meet their nutritional requirements according to NRC (2001) as offered to the rest of university herd (Table I). The cows in group one were not given any herbal preparation and acted as control. The cows in group two and group three were given, in addition to normal routine feeds and fodders, either Ruchamax@30 g per day or Payapro@4 tablets per day, respectively for fifteen consecutive days in a month commencing three days after calving for a period of three months. A readymade concentrate mixture, having 18% crude protein, 19.8%NDF and 12.25% ADF, 1.86 kilocalories of net energy per kilogram and 2.08% Ca, was given @ 400 g per L of milk yield. The total amount of concentrate mixture was divided into two halves and was offered twice daily at the time of milking. Daily milk yield of each animal was recorded for the full lactation period. At the end of 15 days treatment period, the rumen liquor samples were collected from all the animals in the control and treated groups. The samples were collected in sterile vials with rubber stoppers with the help of a 6 inches long 15 G needle and 15 mL syringe by inserting the needle in the ventral sac of the rumen. A few drops of preservative (saturated mercuric chloride) were added into the vials and the samples were stored in the refrigerator. For microbial counts, 10 mL of rumen liquor samples were collected in separate vials without any preservative and the vials were covered with liquid paraffin and stored in refrigerator. Soon after the collection of samples the pH was measured with the help of a pH meter (Toshiwal). The ammonia nitrogen (NH_3-N) was estimated by the method as described by Conway (1957), trichloroacetic acid precipitable nitrogen (TCA-ppt-N) by the method of AOAC (1975) and total volatile fatty acids (TVFA) were determined by the method of Annison (1954). The bacterial count was done by Nigrosine dye method (Gall, 1949) and protozoal count was done by the method as described by Wintrobe (1981). The data collected was subjected to statistical analysis using one way analysis of variance (ANOVA) and the means were compared by Duncan's Multiple Range Test (DMRT) as described by Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

The lactation trend of animals (average milk yield per day) as recorded during the various lactation weeks is shown in Fig. 1. The average daily initial milk yield in control, Ruchamax supplemented and Payapro supplemented animals were 8.42, 9.04 and 8.40 L per day, respectively and it reached to a peak level of 13.37, 16.04 and 12.85 L per day, respectively in the 12th week of lactation. The milk yield of animals in control group and Payapro supplemented group started declining after 12th weeks of lactation. The decline in milk yield was much sharper in control animals as compared to those given Payapro supplemented feed, where although a slightly lower peak level was obtained but the decline in milk yield was arrested to some extent giving a post peak slow but gradual decline that prolonged the lactation period. The animals in Ruchamax supplemented group maintained a peak milk yield period up to 24th week, which started declining slowly

thereafter but continued to produce higher milk yields as compared to Payapro supplemented and control animals. Overall, the highest milk yield was obtained from animals fed Ruchamax supplemented feed. Ruchamax is a herbal formulation that has been shown to be a good appetizer and stomachic (Kirtikar & Basu, 1957). Ruchamax increases the salivary secretions, boosts the populations of friendly bacteria and protozoa, optimizes the digestive functions and ultimately helps in the assimilation and metabolism of feeds (Singh *et al*., 1996). In addition to this it has also been reported to increases milk production (Pradhan *et al*., 1994). The moderate milk yield was recorded in Payapro supplemented animals, which may probably be attributed to effect of Payapro feeding. Payapro is a commonly available galactagogue. The constituent herbs of Payapro viz. *Leptadenia reticulata, Nigella sativa, Foeniculam vulgare, Pueraria tuberosa, Glycerriza globra, Cuminum cyminum* and *Asparagus racemosus* etc., are all known to possess galactopoietics action (ICMR, 1987). *Leptadenia reticulata* has been reported to produce significant galactopoietics response in goats, sheep, cows and buffaloes (Anjaria *et al.*, 1967). It is also used for correcting the irregularities of milk production in cows (Mazumdar, 1977). The use of *Nigella sativa* (Kalongi) medication resulted in substantial increase and sustained milk in clinical cases of agalectia in goats (Vihan *et al.*, 1987). The galactopoietics action of another herb in Payapro, *Asperagus recemosus* (satavari) has been reported in lactating goats (Vihan *et al.*, 1988). The potent combination of herbs in Payapro seems to correct the suppressed lactation on functional hypogalactia and ensure dependable galactagogue and galactopoietics action in the administered animals (Khurana *et al.*, 1996). Tiwari *et al.* (1993) reported that cows supplemented with Anifeed, another herbal combination, produced significantly higher milk yield during their mid lactation (91-180 days). However during the early (0-90 days) and late (181-270 days) lactation period, the milk production was similar to un-supplemented groups. The results obtained in the present study are in line with these findings. The results however strongly support the use of Ruchamax as compared to Payapro in increasing the milk yield in crossbred cows.

Rumen fermentation pattern. The results on different parameters of rumen fermentation in lactating dairy cows in various groups are given in Table II. No significant (P >0.05) differences were observed in the pH of rumen liquor samples in different groups and it was 6.15, 6.18 and 6.18 in control, Ruchamax and Payapro supplemented animals, respectively. The results are in agreement with the findings of Kumar *et al.* (1987), who reported that the animals fed with different herbal preparations (Rumbion, Ruchamax & Pachoplus) did not show any difference in the pH of rumen liquor at various time intervals. Singh *et al.* (1996) also did not observe any marked effect in the rumen pH of animals when given two herbal preparations (Ruchamax & Pachoplus). The amount of herbal preparations fed to the animals may not have been sufficient enough to modify the rumen pH or it may also probably be attributed to the buffering capacity of the same chemical constituents of feedstuffs offered to the animals. The type of substrate being

Table I. Roughage offered to the lactating crossbred cattle during the lactation trial

Months	Common name	Scientific name
January	Barseam + Oat + Lahi	*Trifolium alexandrium* + *Avina sativa* + *Brassica sinensis*
February	Barseam + Oat	*Trifolium alexandrium* + *Avina sativa*
March	-do-	-do-
April	Mature Oat + Barseam	*Avina sativa* + *Trifolium alexandrium*
May	-do-	-do-
June	Oat + Green Maize	*Avina sativa* + *Zea maize*
July	-do-	-do-
August	Oat straw + Sorghum	*Avina sativa* + *Sorghum bicolor*
September	-do-	-do-
October	-do-	-do-
November	Sorghum + Lobia + Lahi	*Sorghum bicolor* + *Vigna unguilata* + *Brassica sinensis*
December	-do-	-do

Table II. Effect of herbal preparations on different rumen fermentation parameters in the rumen liquor of crossbred lactating cows

Particulars	Groups		
	Control	Ruchamax	(Payapro)
pH	6.15 ± 0.11	6.18 ± 0.11	6.18 ± 0.11
NH_3-N (NH_3-N mg 100 mL^{-1})	22.38 ± 0.64^a	20.75 ± 0.64^b	20.07 ± 0.64^b
TCA-precipitable N (mg 100 mL^{-1})	21.76 ±1.65^{ac}	29.00^a ± 1.65^a	25.30 ± 1.65^b
TVFA (mM L^{-1})	83.37 ± 3.66^c	103.93 ± 3.66^a	100.49± 3.66^b
Bacterial count ($\times 10^4$ mL^{-1})	1.68 ± 0.56^c	1.97 ± 0.56^a	1.96 ± 0.56^b
Protozoal count ($\times 10^4$ mL^{-1})	1.76 ± 0.31^c	2.46 ± 0.31^a	2.07 ± 0.31^b

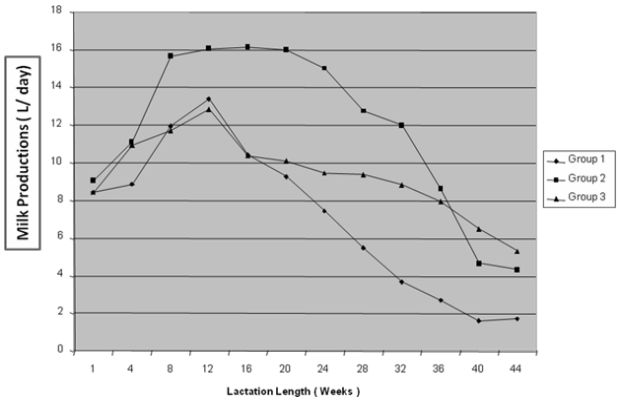
Figures bearing different superscripts in a row differ significantly (P < 0.05)

Table III. Economics for milk production in crossbred lactating cows

Particulars	Groups		
Income (Indian Rs d^{-1})	Control	Ruchamax	Payapro
Milk production (L d^{-1})	10.64	16.13	12.75
Cost of milk (IRs. d)	10	10	10
Total income from milk (Rs/d/cow)	106.4	161.3	127.5
Total feed consumed (kg d^{-1})	12.77	16.75	14.36
Roughage (kg d^{-1})	8.25	11.17	10
Concentrate (kg d^{-1})	4.25	5.58	4.36
Cost of feed stuff (IRs d^{-1} cow^{-1})	25.89	34.04	26.92
Cost of labor (IRs d^{-1} cow^{-1})	3.58	3.58	3.58
Cost of medicine (IRs/d/cow)	0	8	2
Total expenditure (IRs d^{-1})	29.47	45.62	32.5
Net income =Gross income – Expenditure	76.93	115.68	95
Percent monitory gain over control	0	50.37	23.49

Cost of Ruchamax = IRs 4 per 7.5 g
Cost of Payapro = IRs 1 per tablet
Currency conversion rate: 1 US $ = 48.08 IRs

Fig. I. Average milk production in crossbred cows during lactation period



fermented is attributed to changes in the rumen fermentation and subsequently to ruminal pH.

The highest levels of rumen ammonia nitrogen (22.38 mg 100 mL^{-1}) were observed in control animals and the lowest (20.07 mg 100 mL^{-1}) were in Payapro supplemented animals. It indicates that rumen microbes were using all the ammonia being produced and giving more precipitable nitrogen in herbal supplemented animals. The ammonia produced, together with some small peptides and free amino acids, is utilized by rumen microbes to synthesize microbial protein (Mc Donald *et al.*, 1990). Ruminal bacteria are considered good scavengers of ammonia and can grow on relatively low concentrations of ammonia in ruminal fluid (Schaefer *et al.*, 1980). No significant (P >0.05) differences were however observed in the ammonia nitrogen of rumen liquor samples between the Ruchamax and Payapro supplemented animals. Sardar *et al.* (1997) also did not find any significant differences (P >0.05) in ammonia nitrogen concentrations to the animals feeding various levels of Livol, a herbal preparation. Secondary metabolites, such as phenolic compounds, essential oils and sarsaponins, produced by certain plants can also affect the rumen microbial activity (Chesson *et al.*, 1982; Wallace *et al.*, 1994). Sarsaponins have been reported to decrease the ammonia nitrogen concentration and can alter the acetate and propionate proportions (Wallace *et al*., 1994; Ryan., 1997). Herbal preparations used in this study might have helped in optimizing the ruminal fermentation that ultimately increased the nutrient availability for milk production.

TCA-ppt-N is a relevant index of net microbial protein synthesis. The differences in the TCA-ppt-N concentrations were statistically significant (P <0.05). The highest concentration (29.0 mg 100 mL^{-1}) was observed in Ruchamax supplemented animals and lowest (21.76 mg 100 mL^{-1}) in control animals. It might be due to increased population of ruminal fauna and flora and also due to active degradation and hydrolysis of nitrogenous substances and their readily incorporation into microbial mass. When the microbial mass is carried through to abomasum and small intestine their cell proteins are digested, absorbed and utilized by the animal. One more important feature in the formation of microbial protein is that rumen bacteria are capable of synthesizing both indispensable as well as dispensable amino acids, thus rendering their host independent of dietary supplies of indispensable amino acids (Mc Donald *et al.*, 1990). Several *in-vitro* and *in-vivo* studies have shown that maximum TCA-ppt-N takes place when the ammonical nitrogen concentration is 2-29 mg per 100 mL SRL (Hume *et al.*, 1970; Sharma & Singh, 1991). The efficient synthesis of microbial protein at higher ammonia concentrations requires readily fermentable and available sources of energy (readily degradable carbohydrates), which can match the synthetic ability of rumen microbes (Oldham, 1981). A strong positive correlation (P <0.01) with TCA-ppt-N and milk production was recorded (r =1). It has been suggested that strategies, which increase N-recycling or increase the utilization of recycled N may benefit the animal performance and rumen environment (Cole & Todd, 2008).

The TVFA concentrations in the strained rumen liquor (SRL) of various groups differed significantly (P <0.05) and the highest values (103.9 mmoles 100 mL^{-1} SRL) were observed in Ruchamax supplemented animals. It might be due to increased population of rumen microbes as adequate levels of ammonia nitrogen can promote the rumen microbial growth, improving the carbohydrate fermentation and subsequently TVFA production (Jackson, 1971). The higher TVFA values in the same group showed a positive correlation (P <0.01) with milk production (r = 0.836). Higher concentrations of TVFA in galactagogue treated groups have been regarded as an indicative of better energy supply for milk production (Singh *et al.*, 1991). The proportion of volatile fatty acids in the rumen is affected by the diet composition and rumen pH. Our results are in line with these studies.

Significant differences (P <0.05) were observed in bacterial count and the highest count (1.97×10^8) was observed in Ruchamax supplemented group, whereas the lowest (1.68×10^8) values were found in control animals. Bacterial count exhibited a positive correlation (r = 0.783) with milk production. It appears that both the herbal preparations were equally good in increasing the bacterial counts. Phalphale (1997) reported an increased bacterial count in Ruchamax treated anorectic goats. Ruchamax is known to provide an optimum pH, which favours the efficiency of rumen fermentation leading to better growth and activity of many favourable rumen bacteria (Pradhan *et al.*, 1994). The higher amount of concentrate given to the Ruchamax supplemented animals (based on their milk production) might have resulted in higher fermentation rate, because of the availability of readily fermentable organic matter for ruminal microbes. Similar patterns for the protozoal counts were observed. Significantly higher (P <0.05) protozoal counts were observed in Ruchamax supplemented animals in comparison to Payapro treated and

control animals. Higher bacterial and protozoal counts observed in animals fed with herbal preparations showed a significantly (P <0.05) positive correlation (r = 0.994) with their milk production. Optimization of diet formulation and the utilization of feed additives have been shown to modify the rumen environment and can enhance or inhibit the specific microbial populations (Calsamiglia *et al.*, 2006). Feeding of stomachic and rumen tonics have been shown to increase the number, species and size of rumen microorganisms. Our results are in agreement with the findings of Singh *et al.* (1996), Pradhan *et al.* (1994) and Phalhphale (1997). Pal *et al.* (1994) reported an increase in the concentration of protozoal counts in Ruchamax treated dairy cows. Protozoa are considered to be the index of good animal health (Singh *et al.*, 1996). Restoration of rumen protozoal motility as well as counts, SAT, GFT and TVFA to normal levels within 72 h of feeding indicated beneficial effect of Ruchamax on rumen protozoa and carbohydrate fermentation (Tripathi & Misra, 1992). The constituent ingredients of herbal preparations can therefore be used to modulate the competition among different microbial populations for improving the efficiency of energy and protein utilization in the rumen.

Economics for milk production. A balance sheet indicating the economics of milk production is given in Table III. The net profit was calculated as US $ 1.58, 2.37 and 1.95 per animal per day in control, Ruchamax and Payapro supplemented animals, respectively. Overall the percentage monetary gains from animals fed either Ruchamax or Payapro was 50.37% and 23.49% more, respectively as compared to control.

CONCLUSION

The results of the present study indicated that supplementary feeding of herbal preparations (Ruchamax & Payapro) to lactating crossbred cows had beneficial effects on rumen parameters, increased their milk yield and overall boosted animal productivity. Since these preparations are non-hormonal and a combination of different herbs, they can be considered as safe, cost effective and environment friendly without side effects. Therefore, the inclusion of these herbal preparations in dairy cow's diet should be encouraged to improve the efficiency of feed utilization to alleviate adverse effects of environmental stress and to enhance the overall animal performance and health.

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