Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(5): 2508-2512
Received: 05-07-2018
Accepted: 06-08-2018

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Comparative assessment of different herbal galactogogue preparations on milk production and economics of lactating crossbred cows

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Abstract
A study was made to evaluate the effect of feeding three different herbal galactogogue preparations namely Galactin Vet, Payapro and Gomilk on the milk yield and its composition from crossbred cows. Twenty lactating crossbred cows were taken for the experiment and were randomly divided into four groups of five cows each i.e. T_0 (control group) without any galactogouge. T_1 cows fed with Galactin Vet @4 boli/day orally, T_2 cows with Payapro @ 4 boli/day orally while T_3 cows fed with Gomilk @ 10 tab bid orally per day for a period of two months. Significant ($P \leq 0.01$) difference was observed in the milk yield of cows fed with herbal galactogouge preparations as compared to the control. Highest average milk yield of 7.76±0.16 litres per day (4% FCM) was observed in the case of Payapro supplemented cows followed by 7.54±0.23 litres/day and 7.01±0.15 litres/day in the case of cows supplemented with Galactin Vet and Gomilk respectively while in the case of control animals average milk yield was observed to be 5.95±0.19 litres/day. The percentage increase in milk yield was 19.64 in case of Payapro supplemented cows where as in the case Galactin and Gomilk supplemented cows the percentage increase in milk yield was 14.01 and 10.83 respectively. In T_0, T_1, T_2 and T_3 group cows the increase in fat percentage was observed to be 4.01±0.04%, 4.26±0.03%, 4.34±0.03% and 4.46±0.03% respectively during the trial period where as mean SNF percentage of T_0, T_1, T_2 and T_3 group of cows increased to 7.32±0.03, 7.46±0.04, 7.71±0.05 and 7.84±0.04 respectively. After supplementation of galactogouges, mean fat percentage increase of T_1, T_2 and T_3 groups of cows increased by 3.40%, 5.60% and 9.31% respectively were as mean SNF increased by 3.32%, 3.49% and 2.75% respectively. Average net profit was estimated as Rs.70.35, Rs.87.90, Rs.97.45 and Rs.79.55 per cow per day respectively in T_0, T_1, T_2 and T_3 groups of cows where as cost-benefit ratio was calculated as 1: 1.52, 1: 1.55, 1: 1.61 and 1: 1.53 respectively.

Keywords: Galactogogue, Galactin Vet, Payapro, Gomilk, milk yield, milk composition, economics

Introduction
Milk production per animal in developing countries, in particular in India is still very low as compared to world's average and demand for the milk and milk products is growing at a much faster rate than their supply. This lower productivity might be attributed to many 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; Gaur, 2007; Solomon *et al.*, 2009; Mishra and Joshi, 2009; Changunda *et al.*, 2009; Komatwar *et al.*, 2010; Thornton *et al.*, 2010; Mirkena *et al.*, 2010; Amasaib *et al.*, 2011; Berman, 2011; Belay *et al.*, 2012; Zewdu Wondifraw *et al.*, 2013; Tesfai and Garikipati, 2014; Niraj *et al.*, 2014; Gebeyehu *et al.*, 2014) [27, 13, 11, 35, 20, 1, 6, 5, 38, 34, 22, 12]. In order to restore the animal productivity and to optimize milk production for better profits, various drugs, herbal preparations, hormones, mineral supplements and feed additives have been tried with variable results (Ludri, 1983; Singh *et al*., 1991; Zednik *et al.*, 1994; Ramesh *et al.*, 2000; Taylor *et al.*, 2011; Mirzaei and Hari Venkatesh 2012; Patel *et al.*, 2013; Behra *et al.*, 2013; Sukanya *et al.*, 2014; Divya *et al.*, 2015; Patel *et al.*, 2016) [17, 29, 37, 26, 33, 19, 23, 4, 32, 8, 24].

Galactogogues are medications or other substances believed to assist in the initiation, maintenance, or augmentation of milk production (Gabay, 2002) [9]. Herbs *Leptadenia reticulata, Asparagus racemosus, Nigella sativa* and many more are known for galactogogue effect. Payapro, a known galactogogue, is a combination of *Leptadenia reticulata, Nigella sativa, Foeniculam vulgare, Pueraria tuberosa, Glycyrrhiza glabra, Cuminum cyminum* and *Asparagus racemosus* etc as these herbs are known to possess galactopoietic action. Galactin a non-hormonal herbal preparation significantly enhanced the milk production in dairy cows and ultimately improved dairy economics (Ramesh *et al.*, 2000; Kumari & Akbar, 2006) [26, 16]. Gomilk is another galactogogue which contains *Leptadenia reticulate, Allium sativum, Trigonella foneumgracium, Glycyrrhiza glabra, Asparagus racemosus* and *Withania somnifera*.

There are several examples of indigenous herbal preparations effectively restoring altered milk constituents and increasing milk production in cows. Behra *et al.*, 2013 [4] stated that Shatavari a herbal galactogogue originating from a medicinal plant is used to augment milk production in nursing mothers and animals. Patel *et al.*, 2016 [24] stated that Galactogogues Shatavari (*Asparagus racemosus*), Jivanti (*Leptadenia reticulata*) and Methi (*Trigonellafoenum-graecum*) stimulate activities of alveolar tissues and increase their secretory activity resulting in regulating and restoring milk yield. However, most of these herbs have not been evaluated thoroughly but their traditional use suggests its potential in enhancing milk yield and its compositions. Therefore the objective of the present trial is to assess the effect of galactogogues on milk yield and its quality from cows having lower productivity.

Material and Methods

A. Selection of Animal

The present investigation was undertaken at Krishi Vigyan Kendra, Khagaria. Twenty crossbred cows were selected for this study. The cows were multiparous (lactation number 2 and 3) and in early to mid-lactation stages.

B. Experimental design and feeding

All crossbred cows were provided with basal diets comprising of dry fodder, green fodder and concentrates separately to meet maintenance and production requirement (NRC, 2001) [21]. The cows were fed with dry fodder @ 5 kg/day, green fodder @ 20 kg/day and maintenance concentrate ration @ 1 kg/day. The production ration consisted of the concentrate mixture @ 1 kg/3L of milk production. The concentrate mixture was prepared within the farm and composed of maize (50%), mustard cake (23%), wheat (25%), mineral mixture (2%) and salt (1%).

The cows were divided into four groups (T_0, T_1, T_2 and T_3) and each group consisted of 5 animals based on similar average milk yield and stage of lactation. T_0 acted as control group to which no galactogogue was supplemented. T_1 group of cows were supplemented with galactogogue Galactin Vet @ 4 boli/day orally. T_2 groups of cows were supplemented with galactogogue Payapro @ 4 boli/day orally while T_3 group of cows with galactogogue Gomilk @ 10 tab bid orally. The experiment was carried out for seventy days.

The galactogouge used in this experiment included *Leptadenia reticulata, Nigella sativa, Foeniculam vulgare, Pueraria tuberosa, Glycyrrhiza glabra, Cuminum cyminum* and *Asparagus racemosus*, the compositions of which is given in Table-1.

C. Sampling and Analysis

Daily milk yield was recorded for pre-trial period of 2 weeks, trial period of 6 weeks and post-trial period of 2 weeks respectively. Similarly, milk samples were drawn for analysis in morning and evening hours once in each week of the experimental period. Morning and evening milk yield of lactating cows were recorded individually at weekly intervals and corrected for 4% fat content (FCM) using the formula of 4% FCM = 0.4 x milk yield (kg) + 15 x fat yield (kg) as stated by Gains (1928) [10]. Milk, fat % and SNF were analyzed by using milk analyzer.

Majority of the farmers of the study were practicing intensive management system. The feed cost was apparently high under this management system as the cut and fed method was practiced. Cost calculations consist of the elements viz: total feed cost, cost of galactogogue, average daily milk yield, cost of milk production and daily income on milk sale. The total expense included cost of dry fodder, green fodder, homemade concentrate mixture and galactogogue while daily income on milk sale was calculated by multiplying average daily milk in litres and cost of milk production with average price per liter prevailing in the market. The analysis of the factors resulted in making comparative assessments of total cost of production and gross return from different trials.

D. Statistical Analysis

In the present study, mean as a measure of central tendency and the standard error as a measure of random error was employed for the statistical analysis. The student 't' test (P= 0.01) was used to know the significant variation between the two groups.

Results and Discussion

The effect of supplementation of galactogogue on milk yield is presented in Table –2 which shows mean values of weekly average milk production for the pre-trial period of two weeks, trial period of 6 weeks and post-trial period of two weeks for the treatments, T_0, T_1, T_2 and T_3 respectively. Mean (±SEM) daily milk yield was 5.74±0.36 L/day for control group and 6.45±0.32 L/day, 6.26±0.08 L/day and 5.98±0.18 L/day for T_1, T_2 and T_3 respectively. This means that there were no significant differences between all treatments before starting the experiment. From pre-trial period to the trial period the average milk yield in T_0 cows increased from 5.74±0.36 L/day to 5.95±0.19 L/day which was not significant. In group T_1 cows it increased from 6.45±0.32 L/day to 7.54±0.23 L/day while in T_2 group average milk yield increased from 6.26±0.08 L/day to 7.76±0.16 L/day and from 5.98±0.18 L/day to 7.01±0.15 L/day in T_3 group respectively. Milk yield in T_2 and T_3 group of cows was significantly higher than that of the control group. Milk production improvement response for the treatments supplemented with galactogogue was observed throughout the experimental period.

The effect of supplementing diet with galactogogue on milk fat percentage of crossbred cows is presented in Table- 2. Average fat percentage during pre-trial period of four treatments T_0, T_1, T_2 and T_3 was observed to be 3.81±0.07, 4.12±0.03, 4.11±0.02 and 4.08±0.12 respectively. This means that there were no significant differences among all four treatments before starting the experiment. During the trial period there was no significant increase in fat percentage of T_0 group as the enhancement in milk yield was from 3.81±0.07 to 4.01±0.04 during the period. In T_1, T_2 and T_3 group cows the increase in fat percentage was observed to be from 4.12±0.03 to 4.26±0.03, 4.11±0.02 to 4.34±0.03 and 4.08±0.12 to 4.46±0.03 respectively during the trial period. Increase in fat percentage in T_3 can be termed to be significant ($P \leq 0.01$) which indicated that the treatment T_3 was significantly superior to remaining treatments. There was no significant difference between T_1 and T_2 groups but both were moderately significant over control group.

The average SNF percentage during pre-trial period were observed as 7.23±0.04, 7.22±0.03, 7.45±0.06 and 7.63±0.06 for control group (T_0) and treatment groups T_1, T_2 and T_3 respectively which indicated that there was no significant difference among all four treatment groups before starting the experiment. After eight weeks of supplementation of galactogouge, mean SNF percentage of T_0, T_1, T_2 and T_3 increased to 7.32±0.03, 7.46±0.04, 7.71±0.05 and 7.84±0.04 percent respectively. There was no significant change in the

SNF of the milk in T_0 cows whereas in T_1, T_2 and T_3 treatment groups the increase in SNF was observed to be significant ($P \leq 0.01$). The Table-2 shows that there was higher average solid not fat percent in the milk of T_3 group of cows than that of other treatment groups viz. T_0, T_1 and T_2. So it can be concluded that supplementation of galactogogue resulted in improvement of the solid not fat percentage.

A number of studies have been carried out on the galactogogue properties of plants and their impact on animals. *Leptadenia reticulata* showed lactogenic property and also produced significant galactopoietics response in goats, sheep, cows, and buffaloes (Anjaria and Gupta, 1967) [2]. The roots of *Asparagus racemosus* have been found to have galactogogue action in buffaloes as their milk yield increased significantly after the use of the drug (Patil and Kantikar, 1969) [25]. The use of *Nigella sativa* (Kalongi) medication resulted in substantial increase in milk yield in the clinical cases of agalectia of goats (Vihan *et al.*, 1987) [36]. Payapro seems to correct the suppressed lactation on functional hypogalactia and ensure dependable galactogogue and galactopoietic action in the administered animals (Khurana *et al.*, 1996) [14]. Singhal, 1995 [28] observed as high as 31.10% increase in milk yield of Payapro fed cows. Baig and Bhagwat, 2009 [3] also reported improvement in milk yield, CLR, Fat % and SNF % by the use of Galactin Vet in dairy cows. Sridhar and Bhagwat, 2007 [31] reported significant improvement in heamoglobin, serum calcium and total protein levels after treatment of Galactin Vet with 5.48% increase in milk yield where as Ramesh *et al.*, 2000 [26] reported net gain in milk yield of 0.819 liters per day on average in individual HF cross-bred cow after feeding Galactin Vet, a polyherbal galactogogue. Taylor Preciado *et al.*, 2011 [33] observed that supplementation of plant extract results in significant increase ($p<0.05$) in milk production. Patel *et al.*, 2013 [23] reported the effect of polyherbal galactogogue biscuits on the milk yield of treatment group as significantly higher (14.24%) but there was no significant change in milk composition. Sukanya *et al.*, 2014 [32] observed that supplementation of polyherbal galactogogue 'Milk plus' enhanced milk yield from 8.26 to 10.11 L/d, milk fat% from 3.95 to 4.38, total dry matter intake from 8.72 to 9.26 kg/d respectively ($P \leq 0.05$). Divya *et al.*, 2015 [8] observed that supplementation of Shatavari roots in feed increased milk yield, fat, SNF and total solids significantly without altering quality and natural attributes of milk. Significant residual effect of feeding Shatavari root supplemented feed was observed in cows up to 10 days in terms of percentage increase in milk yield, fat, SNF and total solids (TS) after Shatavari root supplemented was stopped.

Economics of Galactogouge Supplementation

Economics of supplementing diet with the galactogogue is given in Table –3. During the pre-trial period of 2 weeks, trial period of 6 weeks and post-trial period of 2 weeks, feeding cost included the cost of roughages like maize, berseem, wheat straw, concentrate and probiotics. The cost of milk production was estimated to be Rs.136.50, Rs.158.50, Rs.160.50 and Rs.149.70 per cow per day in T_0, T_1, T_2 and T_3 groups of cows respectively. Daily earning was calculated as Rs.206.85, Rs.246.40, Rs.257.95 and Rs.229.25 per cow in T_0, T_1, T_2 and T_3 groups of cows respectively. Hence the daily profit was estimated as Rs.70.35, Rs.87.90, Rs.97.45, and Rs.79.55 per cow respectively in T_0, T_1, T_2 and T_3 groups respectively. The cost-benefit ratio was estimated as 1: 1.52, 1: 1.55, 1: 1.61, and 1: 1.53 in T_0, T_1, T_2 and T_3 respectively. It signifies that the productivity of the animals had improved significantly by the use of galactogouges which provided more earning to the farmers.

Table 1: Composition of different herbal galactogogue preparations

Galactin Vet	Payapro	Gomilk
Leptadenia reticulata (0.665 gm)	*Asparagus racemosus* (0.5 gm)	*Leptadenia reticulata* (200 mg)
Asparagus racemosus (0.625 gm)	*Cuminum cyminum* (0.5 gm)	*Allium sativum* (10 mg)
Withania somnifera(0.625 gm)	*Foeniculam vulgare* (0.5 gm)	*Trigonellafoneum gracium* (10 mg)
Arundodonex (0.625 gm)	*Glycyrrhiza glabra* (0.5 gm)	*Glycyrrhiza glabra* (60 mg)
Cissampelos pareira (0.504 *gm*)	*Leptadenia reticulata* (0.5 gm)	*Asparagus racemosus* (60 mg)
Foeniculum vulgare (0.416 gm)	*Nigella sativa* (0.5 gm)	*Withania somnifera* (60 mg)
Eclipta alba (0.624 gm)	*Pueraria tuberosa* (0.5 gm)	
Solanum nigrum (0.416 gm)		

Table 2: Effect of Galactogogue supplementation on milk yield and milk composition (Mean±SE) of lactating crossbred cows

Parameters	Trial	Technology option			
		T_0	T_1	T_2	T_3
Average milk yield (4%FCM)	Pre-trial period	5.74±0.36	6.45±0.32	6.26±0.08	5.98±0.18
	Trial period	5.95±0.19^{NS}	7.54±0.23*	7.76±0.16*	7.01±0.15*
	Post-trial period	5.93±0.36^{NS}	7.46±0.25*	8.40±0.09*	7.09±0.19*
Fat %	Pre-trial period	3.81±0.07	4.12±0.03	4.11±0.02	4.08±0.12
	Trial period	4.01±0.04^{NS}	4.26±0.03*	4.34±0.03*	4.46±0.03*
	Post-trial period	3.95±0.05^{NS}	4.32±0.04*	4.47±0.03*	4.32±0.04*
SNF %	Pre-trial period	7.23±0.04	7.22±0.03	7.45±0.06	7.63±0.06
	Trial period	7.32±0.03^{NS}	7.46±0.04*	7.71±0.05*	7.84±0.04*
	Post-trial period	7.34±0.03^{NS}	7.55±0.05*	7.96±0.06*	7.87±0.05*

*Significance ($P \leq 0.01$); NS=Non significance ($P \geq 0.01$)

Table 3: Economics of supplementing Galactogogue in the diet of lactating crossbred cows

Parameters	T_0	T_1	T_2	T_3
Total feed cost (Rs/animal/day)	136.50	136.50	136.50	136.50
Cost of galactogouge (Rs/animal/day)	-	22.00	24.00	13.20
Total expenses (Rs/animal/day)	136.50	158.50	160.50	149.70
Average daily milk yield (L/animal)	5.91	7.04	7.37	6.55
Cost of milk production (Rs/L)	23.10	22.51	21.78	22.58
Daily income on milk sale (Rs/animal/day)	206.85	246.40	257.95	229.25
Profit (Rs/day)	70.35	87.90	97.45	79.55
Cost benefit ratio	1 : 1.52	1 : 1.55	1 : 1.61	1 : 1.53

Conclusion

The results of our study indicates that supplementing herbal galactogogue in the diet of lactating crossbred cows is cost effective and also beneficial in enhancing milk yield and its composition. Among the galatogagues, supplementation of Payapro increased milk production by 19.64% followed by the supplementation of Galactin and Gomilk with the increase by 14.01% and 10.83% respectively. After supplementation of galactogouge, mean fat of T_1, T_2 and T_3 groups of cows increased by 3.40, 5.60, and 9.31 percent respectively were as mean SNF increased by 3.32%, 3.49%, and 2.75% respectively. Highest B:C ratio was obserbed in T_2 group i.e 1:1.61 followed by 1:1.55 and 1:1.53 in T_1 and T_3 group respectively.

Acknowledgement

Authors of this research paper are thankful to the Hon'ble Vice-Chancellor, Bihar Agricultural University, Sabour, Bhagalpur for providing for his encouragement and support in conducting the experiment. Special thank is also due to the Sudha Dairy Cooperative, Khagaria for providing required support.

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