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Full Length Research Paper

Economical and managerial analysis of effective managerial strategies for the prevention of milk fever in transition period in commercial dairy farms

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The purpose of this research was to investigate the effects of managerial strategies for the prevention of milk fever in transition period in Shahroud commercial dairy farms. For this purpose, all required information were collected by preparing a questionnaire. Relevant questions about applying managerial strategies for the prevention of milk fever in transition period were inserted in first part. These strategies include the application of anionic salts in close up period, calcium restriction before calving (close-up period) and also benefiting from analogue of vitamin D (AD_3E). Therefore, the questions were on implementation condition and relevant costs. Next part was on relevant information about involvement with milk fever which includes incidence rate and treatment costs based on clinical signs of disorders. Last part was about reproduction information, average fertility and fertility costs. Then, all obtained results were analyzed using the SAS software. Finally, it was specified that application of effective managerial strategies for the prevention of milk fever in transition period had a significant effects on economic and managerial indices; and it is recommended to cattlemen as well.

Key words: Transition period, milk fever, managerial strategies, economic parameters.

INTRODUCTION

As the most important step of life of a dairy cow, transition period starts three weeks before calving and ends three weeks after calving. This period involves major changes in nutritional template, ethical and physiological patterns in cows. These changes are specific in mammary, genital, immune, metabolic and digestion systems. Performance and future health of dairy cow is based upon successful transfer of this period. Any disorders in this period may cause different diseases and a lot of economic losses (Badiey, 2009). The most important disease related to calcium and phosphorus homeostasis is calving hypocalcaemia with serious consequences and clinical or sub-clinical forms (Mohebbi, 2005). Milk fever is an economically important disease and can reduce the productive life of a dairy cow by 3.4 years. Each case of milk fever leads to a loss of $334 to producer by way of treatment charges and milk loss; and if left untreated, about 60 to70% of cows die (McDowel, 2002). There are a lot of managerial strategies for prevention of this metabolic disorder, with each one of them having an effective role in preventing suffering from/ or progress of this disorder throughout the herds till date. For instance, in a research test made by Goff and Horst (2003) at Colorado University, any difference between cation–anion difference or CAD was changed in different diets by the use of anionic salts. Anionic salts are able to prevent milk fever, even when there is average rate of calcium ration for a dry cow (about 100 g/day). The cows fed with anion salts had little milk fever (4% against 17%) and more blood with calcium concentration at calving day compared to other cows.

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Roch et al. (2003), in considering the effect of adding anion salt to milk production and the prevention of milk fever in a research, stated that reducing the DCAD of rations before calving will not cause a significant difference in milk production, but may cause more calcium absorption. Therefore any reduction of DCAD is an applicable method for reducing milk fever occurrence and hypo-calcaemia as well. Townsend (2003) considers also the regulation of DCAD of rations as one of the effective strategies in preventing milk fever by benefiting from anion salts in dairy cows feeding in calving period. This theory may approve any application of anion salts feed with negative ions like chloride and sulfate for more considerable acidity of blood. The response of cow to this mobilization and more absorption of calcium helps to buffer blood calcium and activate all required mechanisms for supplying the required calcium at calving time. In another research published by Saffar Marvi and Nouri Deldar (2008), it was stated that adding any anions to the rations before calving is not only useful for the prevention of milk fever, but also for the prevention of subclinical hypo-calcaemia, which may cause further problems like retained placenta and displaced abomasums.

In a report published by Smith (2002) about calcium restriction in rations before calving, it was stated that low level calcium diets may cause the start of more effective calcium absorption from small intestine. Prepartal low-Ca diets are associated with increased Plasma Parathyroid Hormones (PTH) and 1,25-$(OH)_2D_2$ and 1,25-$(OH)_2D_3$ concentration during the prepartal period. These increased PTH and 1,25-$(OH)_2D$ concentrations resulted in "prepared" and effective intestinal and bone calcium homeostatic mechanisms at parturition, preventing parturient paresis (McDowel, 2002). If the cow is fed with a ration with very low amount of calcium before calving and with high volume of calcium after calving, it is possible to prevent completely calving hypocalcaemia. These rations could not supply minimum needs of the animal in calcium and may cause active absorption of calcium from small intestine and re-absorption, which is from bones (Mohebbi, 2005).

Goff and Horst (1988) studied the effect of injecting 24F- Di-Hydroxy vitamin D_3 on incidence rate of hypocalcaemia in Jersey breed cows and stated that an injection of 100 IU of this analogue may reduce incidence rate of hypocalcaemia by 43% as well as by 85% in control groups. By injecting about 150 IU of this analogue it was possible to reduce incidence rate up to 29%. Also higher doses may have more effects accordingly.

In addition, they evaluated in another research any effects of implants 1&25- di-hydroxy vitamin D_3 on incidence rate of milk fever and it was stated that these implants may cause a reduction in milk fever occurrence from 80% in control cow to 9% in treatment group (Goff and Horst, 1988). Any application of high doses of vitamin D metabolites and relevant analogues for the prevention of milk fever is still under discussion.

Evaluation of the effect of these managerial strategies on important economical, management and production indices is the goal of this research and we try to investigate this effect among commercial dairy herds.

MATERIALS AND METHODS

This research was carried out in November 2010 to June 2011 on Shahroud Commercial Dairy Farms, Islamic Republic of Iran. There were questionnaires distributed among 65 commercial dairy farms, from which required information about 50 herds was got for further analysis. The first part of the questionnaires included necessary information about managerial strategies considered by the management in transition period and the prevention of milk fever metabolic disorder which includes the use of anion salts for acidifying the rations before calving, calcium restriction in close-up period and benefiting from vitamin D_3 metabolites (AD_3 E) by injection or eatable forms. Relevant costs of these strategies have been measured in the same part.

Then, we obtained relevant information about milk fever incidence rate per cow in the next part and by relying upon clinical signs, treatment and health records. The next part of the questionnaire is related to production and economic information including average production parameters per cow and gross income of milk sales per cow in one lactating cycle. The final part of the questionnaire is about production records, average fertility and its costs.

After obtaining information through multiple linear regression method (MLR) and by SAS 9.1 statistical software, we could analysis the same through the following model:

$$Y_1=\beta_{01}+\beta_{11}X_1+\ldots+\beta_{q1}X_q+\varepsilon_1$$
$$Y_2=\beta_{02}+\beta_{12}X_1+\ldots+\beta_{q2}X_q+\varepsilon_2$$
$$\vdots$$
$$Y_p=\beta_{0p}+\beta_{1p}X_1+\ldots+\beta_{qp}X_q+\varepsilon_p$$

In this model, Y_1, Y_2 and Y_p are dependent variables that contain the incidence rate of milk fever, treatment costs of this metabolic disorder, average production, gross income, average fertility and fertility costs. X_1, X_2, X_q are independent variables that contain the above managerial strategies. ε_1, ε_2 and ε_p are experimental errors and β is a coefficient that can be different in various experiment circumstances.

Furthermore, we could measure correlation rate of effective managerial strategies on acidosis and related variables through correlation method and by SAS software.

The following is the related model of this part of the study:

$$\rho_{x,y}=\frac{\operatorname{cov}(x,y)}{\sqrt{(\operatorname{var} x)(\operatorname{var} y)}}=\frac{\sigma_{xy}}{\sigma_x\sigma_y}$$

RESULTS AND DISCUSSION

The followings are the results of the considered managerial strategies in this period and would be considered based on the type of strategy.

Table 1. The effect of significant managerial strategies on milk fever on managerial and economic indices.

Economic and management indices	Management strategies in transition period effective on acidosis prevention					
	Anionic salt		CA restriction		AD_3E	
	F-Test	t-Test	*F*-Test	t-Test	*F*-Test	t-Test
Incidence rate of milk fever	62.67^{**}	-7.92^{*}	63.59^{**}	-7.97^{*}	10.57^{**}	-3.25^{ns}
Treatment cost	23.11^{**}	-4.81^{ns}	37.42^{**}	-6.12^{ns}	5.23^{*}	-2.29^{ns}
Average production	33.44^{**}	5.78^{ns}	28.29^{**}	5.32^{ns}	13.52^{**}	3.68^{ns}
Gross income	16.22^{**}	4.03^{ns}	3.41^{ns}	1.85^{ns}	2.30^{ns}	1.52^{ns}
Average fertility	11.03^{**}	3.32^{ns}	14.78^{**}	3.84^{ns}	23.67^{**}	4.87^{ns}
Fertility costs	9.31^{**}	-3.05^{ns}	12.82^{**}	-3.58^{ns}	18.49^{**}	-4.30^{ns}

**Significant difference (P<0.01); *significant difference (P<0.05); ^{ns}non significant differences (P>0.05).

Table 2. Correlation coefficients of effective managerial strategies on prevention from milk fever and other managerial and economic indices.

Economic and management indices	Milk fever incidence rate	Treatment cost	Average production	Gross income	Average fertility	Fertility cost
Anionic salts	-0.75	-0.57	0.64	0.50	0.43	-0.40
CA restriction	-0.75	-0.66	0.60	0.25	0.48	-0.45
AD3E injection	-0.42	-0.31	0.46	0.21	0.57	-0.52
Implementation cost	-0.76	-0.69	0.72	0.45	0.67	-0.66
Implementation rate	-0.90	-0.72	0.80	0.46	0.69	-0.64

Applying of anion salts in rations before calving

From total 50 commercial herds at Shahroud District, about 58% of them considered this strategy as a successful method for the prevention of milk fever, but 42% of them had no much knowledge about it and did not use it for various reasons.

Regarding the mentioned effects and after applying MLR and considering the results of analysis of variance (Table 1), it was specified that applying anion salts has a positive and significant effect on the betterment of economic and managerial parameters such as incidence rate of milk fever, treatment costs, average production, gross income, average fertility and fertility costs (P<0.01). Therefore, it is possible to say that any benefit from all herds may cause betterment in the variables. The obtained results were in compliance with previous results of researches made by Goff and Horst (2003), who stated that cows fed with anion salts had little milk fever (4% against 17%) and more blood with calcium concentration at calving day compared to other cows. Also Oetzel (1993) stated that it is recommended to use anionic salts in the herds suffering from parturient paresis. Of course, according to the results of different researches and due to its positive effect on these rations, it is also useful in milk production and reproduction of herds. In another research made by Horst and Goff (1997), it was concluded that any diets before calving with negative CAD (Cation Anion Difference) may cause considerable reduction in clinical and subclinical hypocalcaemia in cows with a readiness to be infected with milk fever.

The results obtained from average comparisons show that there is a significant difference, as shown in Table 1, between both groups as per milk fever incidence rate (P<0.05). But there is not a statistically significant difference between both groups as per treatment costs, average production, gross income, average fertility and fertility costs (P>0.05).

Correlation coefficient between applying anion salts and average production (r=0.64), gross income (r=0.50), average fertility (r=0.43) and fertility costs (r=-0.40) show the effect of anion salts on managerial, production and economic parameters (Table 2).

CA restriction in close-up ration

This strategy generally includes application of low calcium rations in a way that there is a reduction in calcium consumption through eating, by which the body is made to mobilize calcium from bones in order to prevent fall in blood calcium and increase reabsorption which is from the intestine.

In this study and for 50 considered herds, about 56% of cattlemen considered it as an effective method for preventing milk fever and performed it accordingly; and the remaining 44% gave not much attention to it and did not apply it much.

Upon applying MLR and variance analysis, average comparisons and correlation coefficients we could find the following.

As shown in Table 1, after applying variance analysis, it was specified that calcium restriction in rations before calving has a significant effect on milk fever incidence rate, treatment costs, average production, average fertility and fertility costs ($P<0.01$), but has not much effects on gross income as a result of milk sales ($P>0.05$).

The mentioned results were in compliance with the findings of published researches by Green et al. (1981), Goff et al. (1987) and Smith (2002) who stated that low calcium rations in dry period will prevent milk fever. Also it was stated in a report made by Mohebbi (2005) that in feeding the cows with low volume of calcium, it is completely possible to prevent calving hypocalcaemia. As shown in Table 1, the obtained results of average comparisons show that there is a significant difference between both groups as per incidence rate ($P<0.05$), but there was no significant difference between both groups from the view points of treatment costs, milk production average, gross income, fertility average and fertility costs ($P>0.05$).

As shown in Table 2, the obtained results of correlation coefficients show that there is a significant relation between CA restriction in dry period and close-up and milk fever incidence rate. ($r=-0.75$). Furthermore, there is a significant relation between this strategy and treatment costs of milk fever ($r=-0.66$). The relation amount between CA restriction in close-up period and average production was $r=0.60$; gross income, $r=0.25$; average fertility, $r=0.48$; and fertility costs, $r=-0.45$.

Injection of vitamin D metabolites

This managerial strategy includes injection of vitamin D analogues in close-up period which may cause better absorption of calcium from intestines and bones.

For this reason, it may cause the prevention of milk fever. From total 50 commercial herds at Shahroud District, about 80% of them considered this strategy in close-up period effective in preventing milk fever and used this compound; and 20% of them had no much knowledge about it.

As shown in Table 1, After applying variance analysis, it was specified that applying vitamin D analogues (AD_3E) has a significant effect in reducing milk fever incidence rate ($P<0.01$). Also injection of AD_3E in close-up period has a statistically significant effect on treatment costs of milk fever ($P<0.05$). Therefore, applying AD_3E in close-up period has also a great role in increasing average production, average fertility and reducing fertility costs ($P<0.01$). But the results of variance analysis could not prove a significant effect of AD_3E injection on gross income of milk sale ($P>0.05$).

The results of this research were in compliance with findings of Goff and Horst (1988) and Goff and Horst (1988) who stated that benefiting from active analogues of 1&25-di- hydroxyl vitamin D_3 prevents milk fever. Amanlou and Abuzar (2008) have recommended feeding or injection of high doses (more than 10 million IU) within 10 days up to 2 weeks before calving for prevention of milk fever.

The obtained results of average comparisons in this part of the research in Table 1 made it clear that of course there are some differences between both groups from different viewpoints of milk fever incidence rate, treatment costs, average production, gross income, average fertility and fertility costs, but there are not so much statistical significance ($P>0.05$).

Any consideration of these correlation coefficients of this variable and other indices as shown in Table 2 revealed that the correlation coefficient of applying vitamin D_3 analogues and milk fever incidence rate is $r=-0.42$; treatment cost, $r=-0.31$; average production, $r=0.46$; gross income, $r=0.21$; average fertility, $r=0.52$. Although there is little relation with managerial and economic indices compared to both previous strategies, it is so much considered as well.

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