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Economic and Managerial Analysis of Effective Managerial Strategies to Acidosis Prevention in Transition Period in Commercial Dairy Farms

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ABSTRACT

The aim of this study was investigate the effects of managerial strategies on acidosis prevention in transition period in Shahroud commercial dairy farms. The mentioned strategies include pay attention to the fiber importance and following up suitable rate of which with concentrate in required shares through transition diets, increasing the feeding frequency through day and benefiting from sodium bicarbonate for more buffering of rumen environment. All required information of this research obtained by distribution of questionnaire. The mentioned questionnaire includes the application method of above mentioned managerial strategies, relevant implementation costs and percentage of which in first part, involvement rate and occurrence of acidosis with relying upon clinical signs, therapeutic costs at second part and producing records such as production average for a head, gross income out of milk selling for a head per year, reproduction records, fertility average and its costs. Upon personal refer and distribution of relevant questionnaire about 50 herds, finally it was possible to specify the effects of these strategies on mentioned variables by applying of Multiple Linear Regression method (MLR). The results show a significant relation among these indices. Also the relation between variables were specified by Pearson correlation coefficients as well.

Key words: Managerial strategies, acidosis, transition period, commercial dairy farms

INTRODUCTION

Acidosis metabolic disorder may appear in a group of cows which have no familiarity with it and in transition period and mainly after calving which is mostly due to taking high level of concentrate (Radostits *et al.*, 2000). In sudden disorder we have 10 to 50% of cows which may suffer and according to the type and quantity of grain and also previous habits of animal. In lack of treatment the lethargy level of this disease will reach to 90% and if there is a treatment method it may reach to 30 to 40% (Mohebbi, 2005). Rumenal acidosis may cause destruction of rumen, reduction of fiber digestion, decrease of feed intake, reducing of microbial protein, reduction of production and finally laminitis and reduction of feed efficiency (Akhundi *et al.*, 2008).

According to Solorzano *et al.* (1989), it was stated that any applying of sodium bicarbonate or sodium sesco carbonate to the diet of dairy farms, especially if it is according to a corn silage base may adjust the reduction of milk fat level. Also by adding a buffer of sodium bicarbonate

will increase the rumen pH. It was stated in the same research that any applying of sodium bicarbonate may increase the Dry Matter Intake (DMI) about 13.2% in comparison with control group. Furthermore dry matter, crude protein and Neutral Detergent Fiber (NDF) digestibility will be increased in buffered ration. Ghorbani *et al.* (1989) has reported that any applying of sodium bicarbonate 1% to the diets of dairy cows (60% of corn grain) may considerably increase the average pH of the rumen (from 6.06 to 6.24). Regarding the effect of feeding frequency in day, French and Kennelly (1990) stated that increasing the feeding frequency may cause an increase in feed distribution through the day as well. As a result continuous entrance of nutrients into rumen in a day will be effective on pH fixed condition and reducing any danger of acidosis. Pitt and Pell (1997) had a research on two groups of cows with supplying 3 and 5 times of feeding in a day. They compared any changes of pH and it was revealed that there is a significant difference in second feeding and fluctuations of pH with the first one.

In a research made in Israel (Shabi *et al.*, 1999) about the effects of feeding frequency, it was stated that increase of feeding times may reduce the negative effect of serious fermentation of nonstructural carbohydrates and also reduce the fluctuation of Volatile Fatty Acids (VFA), pH and Ammonia. At the same time, it was stated that if the cows have 2 and 4 times feeding through the day, there is a change in average daily pH respectively for 6.48 and 6.29%. Also the reductions of pH fluctuations were respectively 6.08 and 4.11%. Furthermore any increase in feeding frequency will increase DMI, milk production and milk production efficiency. Kohn and Dunlap (1998) stated that applying of sodium bicarbonate complement into feeding will increase the buffering capacity of rumen fluids. Of course this may increase the rumen pH through increasing dilution of rumen fluids (Increasing the salivation) therefore, the liquid starch and small particles flow from rumen may increase accordingly.

Beauchemin *et al.* (2001) stated that reducing of rumen degradation of starch is other benefit of sodium bicarbonate. This is because of its prevention from quick fermentation of grain starch in rumen and changing their digestion site towards intestines.

It was stated in a report that chewing activity out of Physical Effective Neutral Detergent Fiber (peNDF) intake may increase pH of rumen and facilitates the reduction of acidosis of rumen in dairy cows (Krause *et al.*, 2002; Teimouri-Yansari *et al.*, 2004). It was stated in a report that feeding based upon once per day will reduce labor costs but since it will make cows to separate feeding for finding fresher and more palatable part of feed, this may threaten them to suffer from rumen acidosis (Shaver, 2002).

According to Beauchemin *et al.* (2003), it was concluded that although, there is no relation between peNDF and chewing time and average pH rate of rumen but the mentioned items have a positive effect on reducing acidosis damages.

Ghorbani and Asadi Alamuti (2004) stated that 1 year dairy heifers with two times feeding by full grain diets in days had shorter time of anorexia than those with 1 time feeding per day. Therefore, it is recommended to have multi times feeding per day. Reducing meal amount and supplying enough feeds are positive steps towards reducing rumen acidosis occurrence. De Vries *et al.* (2005), concluded that any increase in number of feeding will caused harmonized distribution of feed through the day. This may cause a reduction in rumen pH changes and further reduction of rumen acidosis as well. Hu and Murphy (2005) evaluated any effects of applying sodium bicarbonate on the diet of dairy cows at early and mid lactation. It was revealed that adding sodium bicarbonate has no more effects on milk production but may increase the milk fat

percentage and also its production rate. There was an increase in pH of rumen for about 0.13 units with an increase of acetate:propionate ratio of 0.26 unit. In the same research optimum level of sodium bicarbonate was specified between 0.7 and 1%. Regarding any usage of sodium bicarbonate in the diets of dairy cows, Khadem (2005) stated that if it includes 0.75% of animal's diet, it may fix the rumen pH upper than 6. Free access to sodium bicarbonate and feeding of animals with long forages will increase rumen pH and make the animal to have more rumination and also increase the salivation and increasing of rumen pH.

Beauchemin *et al.* (2006) concluded in a research that applying of sodium bicarbonate on ad libitum or mixed to ration have no more effects on pH increase. But it may reduce considerably involvement time with acidosis problem. Also it is recommended that using of sodium bicarbonate in mixed with diets is better and more effective than ad libitum as well.

Regarding the effects and importance of ration fiber, Akhundi *et al.* (2008) stated that by feeding cows with fine chop length it is possible to change starch digestion site from rumen to intestine and increase chewing time, rumination, salivation and buffer materials. Finally it may decrease incidence rate of ruminal acidosis. Seyyed-Almusavi *et al.* (2008) stated that major factor of acidosis is the increase of fermented product level which is most due to high level of consuming grains which in itself may be resulted from improper ration balancing ,ignoring PeNDF and chopping or more processing of the diets. Haghparvar *et al.* (2008) stated that feeding with high forage and incomplete processes of grains will prevent from acidosis epidemic. Regarding the importance of effective fiber, Roodbari *et al.* (2008) stated that the role of effective fibers is important in regulation of volatile fatty acids template and regulating a suitable rate of them through fixation of rumen pH by feeding methods. With considering enough eNDF (for maintenance of rumen pH) with proper forage length, it is possible to prevent from different diseases like acidosis and laminitis. In another research it was specified that any reduction of rumen acidosis after increasing of ration peNDF not only is under the effect of chewing but is related to betterment of internal condition of rumen as well (Yang and Beauchemin, 2009).

MATERIALS AND METHODS

This research was time schedule from November, 2010 up to June, 2011 in Shahroud commercial dairy farms. There were questionnaires for this purpose which distributed among 65 commercial dairy farms from which we could find required information about 50 herds for our further analysis. The first part of that questionnaire includes necessary information about managerial strategies considered to manage cows in transition period and for prevention from acidosis metabolic disorder including pay attention to fiber importance and proper fiber ratio to concentrate in transition period's diets, increase of feeding frequency in day and benefiting from sodium bicarbonate for facilitation of buffering of rumen. Also the application or implementation costs of these strategies have been measured in this part as well.

The next part is about relevant information of incidence rate of acidosis by relying upon clinical sign and hygienic and treatment records and also acidosis therapeutic costs for each cow. The next part of questionnaire is related to producing and economic information including average production parameters per cow and also gross income of milk sale in each lactation cycle. The last part of questionnaire is related to reproductional records, average fertility and its costs. Upon regulating the obtained information it was possible to analysis the factors through Multiple Linear Regression method (MLR) and by statistical SAS 9.1 software with following model:

$$\begin{aligned}
 Y_1 &= \beta_{01} + \beta_{11} X_1 + \dots + \beta_{q1} X_q + \epsilon_1 \\
 Y_2 &= \beta_{02} + \beta_{12} X_1 + \dots + \beta_{q2} X_q + \epsilon_2 \\
 Y_p &= \beta_{0p} + \beta_{1p} X_1 + \dots + \beta_{qp} X_q + \epsilon_p
 \end{aligned}$$

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

Following is the related model of this study:

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

RESULTS AND DISCUSSION

In this part we may separate the type and any effects of mentioned items on economic and managerial variables.

Pay attention to the importance of fiber and following up the suitable rate of which with concentrate in rations of transition period: Generally 70% of cattlemen had good knowledge about the importance of fiber regulation and its correct rate with concentrate throughout Shahroud commercial dairy farms. They applied this subject after calving and under supervision of nutrition advisor for relevant diets. But 30% of them were unfamiliar and had no information in this regard. The results of analysis of variance upon applying of Multiple Linear Regression method (MLR) made it clear that any applying of this managerial strategy has a significant effect on variables of acidosis incidence rate, treatment costs, average production, fertility costs ($p < 0.01$) and average fertility ($p < 0.05$). But it did not have a statistically significant effect on gross income parameter ($p > 0.05$) (Table 1).

The mentioned findings are in compliance with the obtained results by Seyyed-Almusavi *et al.* (2008) who did consider that improper ration balancing on Total Mixed Ration (TMR), ignoring PeNDF and physical effective fiber in rate, chopping or processing more than limited parts of the diets as the major factors of acidosis. Also these findings may confirm the obtained results by Haghparvar *et al.* (2008) who stated that in order to have acidosis control it is necessary to change the ration gradually plus feeding with high forage and incomplete processed grains for prevention from acidosis epidemy.

Table 1: The effect of managerial strategies to prevention from acidosis on economical and managerial variables

Economic and management indexes	Management strategies in transition period effective on acidosis prevention					
	Fiber importance		Feeding frequency		Sodium bicarbonate	
	F-test	T-test	F-test	T-test	F-test	T-test
Incidence rate of acidosis	246.66**	-15.71*	259.93**	-16.12*	83.06**	-9.11*
Treatment cost	86.47**	-9.30*	199.01**	-14.11*	79.79**	-8.93*
Average production	22.50**	4.74 ^{ns}	13.83**	3.72 ^{ns}	22.11**	4.70 ^{ns}
Gross income	3.89 ^{ns}	1.97 ^{ns}	11.73**	3.42 ^{ns}	14.02**	3.74 ^{ns}
Average fertility	6.45*	2.54 ^{ns}	1.62 ^{ns}	1.27 ^{ns}	5.18*	2.28 ^{ns}
Fertility costs	13.40**	-3.66 ^{ns}	5.04*	-2.25 ^{ns}	11.75**	-3.43 ^{ns}

**Significant difference ($p < 0.01$), *Significant difference ($p < 0.05$), ^{ns}Non Significant differences ($p > 0.05$)

Hoseini-Nejad *et al.* (2008), stated that high grain rations and low forage instead of increasing the efficiency may cause twine problems with acidosis such as reducing of milk production, digestive diseases, laminitis and undesirable cullings. It has been stated in a report made by American National Research Center (NRC, 2001) that high forage and low fiber may even increase milk production but may cause some metabolic disorders such as rumen acidosis, laminitis and milk fat syndrome. Krause *et al.* (2002) and Teimouri-Yansari *et al.* (2004) stated that any increase in chewing activity resulted from increase PeNDF consumption may cause an increase in pH of rumen and facilitate the reduction of acidosis in dairy farms. Yang and Beauchemin (2009) specified that any increase of rumen acidosis after PeNDF increase is not only under the effect of chewing but is related to betterment of rumen circumstances.

Also the results of average comparison show that there is statistical significant difference between studied groups and about incidence rate of acidosis and relevant treatment costs ($p < 0.05$). But there is not a significant difference between both groups from average production, gross income, average fertility and fertility costs ($p > 0.05$) (Table 1).

Also according to the study of correlation coefficient between current variables and other managerial and economic indices, it was specified that pay attention to fiber and its suitable rate with ration concentrate has an extra ordinary relation with reduction of acidosis incidence ($r = -0.91$). We could calculate the relation between this managerial strategy with treatment costs by Pearson correlation coefficient ($r = -0.80$) which is a sign of its role in reduction of acidosis treatment costs. Furthermore we could obtain the correlation coefficient for this variable and average production ($r = 0.56$), gross income ($r = 0.27$), average fertility ($r = 0.34$) and fertility costs ($r = 0.46$) (Table 3).

Increasing the number of feeding times in day: The real purpose of this strategy is to increase feeding distribution in day and continuous entrance of nutrition to rumen along with fixing rumen pH which may reduce any suffering from acidosis.

Although, 66% of cattlemen in this research believed that any applying of that method needs an increase in power and labor costs but considered it as an effective solution in prevention of acidosis and performed it accordingly. About 34% of cattlemen ignored the method for various reasons and did not perform it at all.

The obtained results of variance analysis show that applying of this managerial strategy has a significant effect on betterment of acidosis incidence rate, treatment costs, average production, gross income of milk sale ($p < 0.01$) and fertility costs ($p < 0.05$). But it has not a statistically significant effect on average fertility ($p > 0.05$) (Table 1).

The mentioned results are in compliance with findings of Pitt and Pell (1997) who have stated that increase supplying of feeding may cause lower fluctuations of rumen pH. Shabi *et al.* (1999) stated that any increase in meal times may reduce any negative effect of serious fermentation of non structural carbohydrates. Also any increase in feeding time may increase dry matter intake, milk production efficiency as well. It was stated according to Shaver (2002) that feeding based upon once per day will reduce labor costs but since it will make cows to separate feeding for finding fresher and more palatable part of feed, this may threaten them to suffer from rumen acidosis. De Vries *et al.* (2005), concluded that any increase in number of feeding will cause harmonized distribution of feed through the day. This may cause a reduction in rumen pH changes and further reduction of rumen acidosis as well.

Ghorbani and Asadi Alamuti (2004) stated that any reduction in meal rate along with supplying enough feeding, are positive steps towards reducing of rumen acidosis incidence rate. The results obtained from average comparisons among studied groups show that there is statistically significant difference between acidosis incidence rate and treatment costs ($p < 0.05$).

Although, there are some differences in studied variables such as average production, gross income, average fertility and fertility costs but it was not so much statistically significant ($p > 0.05$) (Table 1).

The obtained results out of calculation the correlation coefficients for this variables show that applying of this strategy has a great relation with reduction of acidosis incidence rate ($r = -0.90$) and its treatment costs ($r = -0.89$). The correlation coefficient between current variable and production average was $r = 0.47$, gross income $r = 0.44$, average fertility $r = 0.18$ and fertility costs $r = -0.30$ (Table 3).

Applying of sodium bicarbonate for facilitating of rumen buffering circumstances: In this part we will study the effects of sodium bicarbonate as a buffering compound in complex with concentrate or in free choice form. In total 50 studied farms about 60% of them benefited from this managerial strategy and the remained 40% did not apply it no more.

The obtained results of variance analysis showed that any applying of this managerial strategy has a significant effect on acidosis incidence rate, treatment costs, average production, gross income, average fertility and fertility costs ($p < 0.01$) (Table 1). Therefore, any applying of which may cause significant betterment of above mentioned variables.

These findings are in compliance with the results of Ghorbani and Asadi Alamuti (2004) who stated that benefiting from sodium bicarbonate make betterment in milk production and milk fat percentage. Furthermore the mentioned findings will approve the obtained results of Solorzano *et al.* (1989) who stated that benefiting from sodium bicarbonate will increase rumen PH, dry matter digestibility, crude protein and NDF. Ghorbani *et al.* (1989) reported that adding 1% of sodium bicarbonate to the shares of dairy cows will significantly increase the pH of rumen. Hu and Murphy (2005) evaluated the effect of adding sodium bicarbonate to the rations of dairy cows at early and mid lactation and concluded that it has no more effects in milk production but may increase milk fat percentage accompanied with an increase of 0.13 in rumen pH.

The obtained results out of comparing the average amount show that there is a statistically significant difference among studied groups from incidence rate variable and treatment costs ($p < 0.05$). But there is not a significant difference among mentioned groups from 4 other variables including average production, gross income, average fertility and fertility costs ($p > 0.05$). By calculation regression coefficients for evaluation any relation of this variable with other managerial and commercial indices it was revealed that sodium bicarbonate and incidence rate is $r = -0.79$. It is a sign of applying which for reducing treatment costs. The correlation coefficients for various variables including average production, gross income, average fertility and fertility costs respectively was equal to 0.56, 0.47, 0.31 and -0.44 as a sign of correlation rate of this variable with other indices (Table 3).

Effect of managerial strategies to acidosis prevention in transition period on production, economical and managerial parameters: This index is an average of performing

Table 2: The effect of applying rate and costs of effective managerial strategies on prevention from acidosis on economical and managerial variables

Management and economic indexes	Implementation cost		Implementation rate	
	F-test	T-test	F-test	T-test
Acidosis rate	81.61**	-9.03*	829.46**	-28.80*
Treatment cost	78.66**	-8.87*	271.03**	-16.46*
Average production	20.02**	4.47 ^{ns}	25.93**	5.09 ^{ns}
Gross income	13.25**	3.64 ^{ns}	11.78**	3.43 ^{ns}
Average fertility	8.45**	2.91 ^{ns}	5.09*	2.26 ^{ns}
Fertility costs	17.62**	-4.20 ^{ns}	12.26**	-3.50 ^{ns}

**Significant difference (p<0.01), *Significant difference (p<0.05), ^{ns}Non Significant differences (p>0.05)

Table 3: Correlation coefficients among effective managerial strategies on prevention from acidosis and other managerial and economical indices

	Acidosis rate	Treatment cost	Average production	Gross income	Average fertility	Fertility cost
Fiber importance	-0.91	-0.80	0.56	0.27	0.34	-0.46
Increase feeding frequency	-0.90	-0.89	0.47	0.44	0.18	-0.30
Sodium Bicarbonate	-0.79	-0.79	0.56	0.47	0.31	-0.44
Performance cost	-0.79	-0.78	0.54	0.46	0.38	-0.51
Performance percentage	-0.97	-0.92	0.59	0.44	0.30	-0.45

considered managerial strategies for betterment of herds from acidosis viewpoint which is in fact a sign of applying these strategies in transition period.

Upon performing multiple linear regression method for this variable and other indices and also variance analysis, it was revealed that percentage rate of effective managerial strategies had a positive and significant effect on acidosis incidence rate, treatment costs, average production, gross income, fertility costs (p<0.01) and average fertility (p<0.05). It is in a way that any increase in the level and implementation rate of these strategies may cause better conditions of these indices (Table 2).

According to the results of average comparison for different parameters among studied groups from view point of percentage of performing managerial strategies show that there was a statistically significant difference for acidosis incidence rate and treatment costs (p<0.05). In spite of some differences among these groups it was not significant for the average production, gross income, average fertility and fertility costs (p>0.05) (Table 2).

Also upon study the correlation coefficients among this variable and other related variables, it was revealed that correlation coefficients for implementation percentage of strategies and incidence rate was $r = -0.97$ and for treatment costs $r = -0.92$. It is a sign of further effects of increasing of applying level of effective managerial strategies on acidosis prevention and its result in reduction of treatment costs. Furthermore the calculated correlation coefficient for performing of managerial strategies and average production was $r = 0.59$, gross income $r = 0.44$, average fertility $r = 0.30$ and fertility costs $r = -0.45$ (Table 3).

The effect of applying costs of effective managerial strategies on prevention from acidosis on managerial and commercial parameters: The above mentioned parameter includes total costs for prevention from acidosis per head. This part is allocated to study any effects of which on managerial and economic parameters.

Upon performance of Multiple Linear Regression (MLR) and study of the results of analysis of variance, it was revealed that implementation costs of effective managerial strategies on acidosis prevention have a statistically significant effect on incidence rate and also treatment costs, average production, gross income, average fertility and fertility costs ($p < 0.01$). It is in a way that any increase in applied costs for management of this metabolic disorders will make more betterment in mentioned parameters (Table 2).

The results of average comparisons show that there is a significant difference among various groups for applying costs of managerial strategies and incidence rate and treatment costs ($p < 0.01$). On the other hand, it was not so much significant for other variables such as average production, gross income, average fertility and fertility costs ($p > 0.05$) (Table 2).

Followings are the results of correlation coefficients on implementation costs and other indices:

- Correlation coefficient between implementation costs of strategies and incidence rate and also treatment costs were respectively $r = -0.79$ and $r = -0.78$ which is a confirmation of positive relation between applying of effective managerial strategies on acidosis in reducing of incidence rate and treatment costs (Table 3)
- Correlation coefficient for implementation costs of strategies and production average and also gross income were respectively $r = 0.54$ and $r = 0.46$
- The relation between implementing managerial strategies and average fertility and it's costs were have been calculated by correlation coefficient and as $r = 0.38$ and $r = -0.51$

Also followings are the results of general study of correlation coefficients for effective managerial strategies on prevention from acidosis:

- From among three mentioned managerial strategies, increase of feeding frequency has the most relation with acidosis incidence rate and treatment costs ($r = -0.91$) and after that regulation of fiber ration ($r = -0.91$) and applying of sodium bicarbonate ($r = -0.79$) has the most relation with above mentioned variables (Table 3)
- The most relation and correlation with average production variable among relevant three managerial strategies are regulation of fiber in ration ($r = 0.56$) and after that sodium bicarbonate ($r = 0.56$) (Table 3)
- Regarding the cross income, the most correlation was any applying of sodium bicarbonate supplementary ($r = 0.47$)
- Average fertility and it's cots had the most correlation with regulation of fiber ration which were respectively equal to $r = 0.34$ and $r = -0.46$ (Table 3)

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