

Effect of Adding Two Levels of Niacin in Milk Production and Controlling Indicators of Ketosis in Friesian Cows Postpartum

Emad GH. Al-Abbasy

Department of Animal Resources, College of Agriculture, University of Tikrit, Iraq

Abstract: This study was conducted in AL-Ishaqi Cattle Station, north of Baghdad and use of 36 multiparous Friesian cows in the early lactation, cows were assigned randomly into three main groups, includes all cows. They were received a basal diet and 0 niacin (group 1), 6 g niacin (group 2) 12 g niacin (group 3) of supplementation niacin per day over 22 week experimental period to study the effect of niacin supplementation on average of weekly milk production and level of β -Hydroxybutyrate (BHBA), acetone, triglycerides, glucose and glucagon hormone in blood. The results showed a highly significant effect of niacin supplementation level 6 and 12 g in increase of weekly milk production for the months of June, July and August, also reduce the level of β -Hydroxybutyrate (BHBA), acetone, triglycerides compared to the control group, rate this amounted materials for two levels respectively 0.449 ± 0.029 (mmol/L), 11.00 ± 0.89 and 16.16 ± 1.76 (mg/dL) and 0.237 ± 0.013 (mmol/L) and 6.16 ± 0.47 and 13.39 ± 1.49 (mg/dL) compared to the control group for the first month of the study, this influence continued for the subsequent two months, well as the effect of niacin levels mentioned above significantly ($p < 0.01$) in high blood glucose levels and glucagon hormone. Appears the niacin has improved energy use for cows postpartum, so reduced the indicators of metabolic diseases which usually infect cows in the beginning of the lactation period such as disease of ketosis.

Keywords: β -hydroxybutyrate, dairy cow, ketosis, niacin

INTRODUCTION

The cows need to high-energy postpartum to confronting the increase in milk production and may be less their feed consumption, especially in the summer causing they occur under negative energy balance happens through demolition of fat stored in the body and release of free fatty acids in the blood and absorbed into the liver, it turns part of it into ketone bodies caused ketosis disease and often high incidence of the disease is a common metabolic disease in cows producing milk postpartum occurs due to unbalance between the rates of taking food and production and typically occurs within 2 months after calving (Grummer, 1993; Radostits *et al.*, 2000). It tend cows during late pregnancy and early lactation period to reduce the consumption of feed and take of Stockpiled the body has to meet the needs of breast, milk collection and synthesis udder tissue, cause this case appears acetone ketone bodies, acetone and (BHBA) β -Hydroxybutyratec result of excessive fat metabolism (Sahinduran *et al.*, 2010).

Harb (2011) has pointed that the sequence of events for the ketosis disease is in the calving and then milk production and energy requirements and intensify the use of fat can lead to capacity over the ability of the liver and therefore toxic extra ketones in the blood and it had to be to find solutions to deal with this disease by certain transactions dietary, researches have shown

some that the addition of niacin instrumental in reducing injuries

As Hutjens (2010) explained that the role of niacin as feed additives in dairy cattle feed is to increase the efficiency of the representation of fats, carbohydrates and proteins and improve the utilization rate of food and reduce (BHBA) and free fatty acids and increase the level of glucose in the blood, while Sarwar *et al.* (1999) pointed out that niacin supplementation not only result in an increase in milk production and ruminal microbial protein synthesis but also reduce the heat stress and ketotic problems of dairy cows, while Al-Soghier (2002) that the addition of niacin resulted in to an increase in milk production and significantly lowered the level of β -Hydroxybutyratec in the blood.

The research aims to find out the possibility of improving the productivity performance and decrease the incidence of ketosis disease for Friesian cows via niacin supplementation through its positive effect on energy metabolism and the occurrence of these disease indicators.

MATERIALS AND METHODS

This study was conducted in AL-Ishaqi Cattle Station, north of Baghdad, for the period from 1/6/2010 to 30/8/2010, change in feeding cattle station from season to another and from year to year depending on

Table 1: Percentage of ingredients and nutrient composition of the experimental diets

Composition of feed	(%)
Wheat bran	40
Grindery barley	20
Sun flower meal	15
Soya bean meal	10
Grindery corn	10
Limestone	2.5
Salt	2.5
Total	100

the availability and cost of feed materials and for the duration of the experiment were a unified nutrition and feed rate of 6 kg/cow concentrate feed spread over two meals morning and evening, relied primarily on feeding concentrate feed 12-14% crude protein (Table 1).

Addition hay and alfalfa hay, who was present when the availability of green fodder scarves, the water was always available to the animals, use of 36 multiparous Friesian cows in the in the early lactation period. Cows were divided randomly Into three groups is a control group and a group (6 g/day/cow) and group (12 g/day/cow) by 12 cows per group, Niacin in the form of crystalline powder was mixed with concentrate feed in the morning meal was given to the groups at 0, 6 and 12 g niacin/cow/day during the period of the experiment, Cows were milked automatically twice a day morning and night and the production will be recorded daily for the period of the experiment each cow.

Blood samples were collected on a regular basis from the jugular vein once a month at seven o'clock in the morning before the morning meal feed by syringe capacity 10, this blood samples placed in plastic tubes clean and sterile and leave for an hour at laboratory temperature, were placed in the centrifuge for a period of twenty minutes at the speed of 3000 rev/min for the purpose of separating blood serum from the rest of the ingredients, serum is used directly in screening tests (β -Hydroxybutyrate (BHBA), acetone, triglycerides, glucose and glucagon hormone).

Complete Random Design (CRD) were used in the analysis of experiment data to Study the effect of the treatments studied in different qualities and compared the differences between the test averages (Duncan, 1955) polynomial and use the program (SAS, 2004) in the statistical analysis.

RESULTS AND DISCUSSION

Weekly milk production: The results of the current study to a highly significant effect ($p < 0.01$) for niacin on weekly milk production, where during the month of July, increase in milk production weekly for group 12 g niacin/cow/day of 18.27 and 40.33 kg/day compared with a 6 g niacin/cow/day and the group that did not receive any level of niacin, respectively (Table 2), this improvement may be due to the role of niacin in improving energy use and increase the percentage of sugar in the blood and reduce the lipid metabolism or may be due the positive effect of niacin on milk production through the relationship between niacin and tryptophan, where (Horner *et al.*, 1988) noted that the cows that are in the early lactation period notes have a decrease in plasma concentration of tryptophan in the blood due to be exploited by rumen microbes in synthesis of niacin which has a positive effect on production or may be added niacin had increased the level of assistants enzymes NAD and NADP who are entering in the metabolism of fats and proteins and carbohydrates and improve the utilization rate of food and encouraging protein microbial and increased of volatile fatty acids composition and increase in appetite and food intake and increased blood sugar levels so that reflected positively on production milk (Hutjens, 1984; EL-Barody *et al.*, 2001), these results agreed (Yanxia *et al.*, 2008; Karkoodi and Tamizrad, 2009) while you disagree with the results of another group of researchers (Madison-Anderson *et al.*, 1997; Wagner *et al.*, 1997; Ghorbani *et al.*, 2008).

Ketosis indicators: The results showed a significant reduction ($p < 0.01$) to concentration of BHBA, acetone and triglycerides for cows that were given niacin level of 12 g/cow/day and to a lesser extent for those that received 6 g/cow/day during the month of June compared to the control group, where concentration of averages this material g 0.237 ± 0.013 (mmol/L) and 6.16 ± 0.47 and 13.39 ± 1.49 (mg/dL), respectively for the group (12 g niacin), while this rate was the concentration of the remaining two groups (6 g/cow/day and control) is 0.449 ± 0.029 (mmol/L), 11.00 ± 0.89 and 16.16 ± 1.76 (mg/dL) and 1.140 ± 0.202 (mmol/L), 14.17 ± 0.75 and 18.22 ± 1.58 (mg/dL), respectively Table 3 to 7, the positive effect of niacin

Table 2: Effect of niacin supplementation in weekly milk production

Effect of factors	No. obser.	Mean \pm standard error (Kg)		
		June	July	August
General mean	36	55.87 \pm 3.67	63.18 \pm 5.10	55.52 \pm 4.70
Control	12	49.89 \pm 3.14 b	42.39 \pm 2.54 c	33.12 \pm 1.68 c
6 g niacin	12	52.62 \pm 3.60 b	64.45 \pm 6.32 b	59.74 \pm 5.99 b
12 g niacin	12	65.12 \pm 4.28 a	82.72 \pm 6.44 a	73.70 \pm 6.43 a

Mean with like letters are not significantly otherwise they differ significantly ($p < 0.01$)

Table 3: Effect of niacin supplementation in level of β -Hydoxybutyrate (BHBA)

Effect of factors	No. obser.	Mean \pm standard error (mmol/L)		
		June	July	August
General mean	36	0.608 \pm 0.093	0.589 \pm 0.086	0.585 \pm 0.088
Control	12	1.140 \pm 0.202 a	1.092 \pm 0.184 a	1.107 \pm 0.185 a
6 g niacin	12	0.449 \pm 0.029 b	0.446 \pm 0.027 b	0.425 \pm 0.024 b
12 g niacin	12	0.237 \pm 0.013 c	0.229 \pm 0.013 c	0.224 \pm 0.024 c

Mean with like letters are not significantly otherwise they differ significantly (p<0.01)

Table 4: Effect of niacin supplementation in level of acetone

Effect of factors	No. obser.	Mean \pm standard error (mg/dL)		
		June	July	August
General mean	36	10.62 \pm 0.70	11.55 \pm 0.57	11.72 \pm 0.54
Control	12	14.17 \pm 0.75 c	17.00 \pm 0.77 c	18.83 \pm 0.75 c
6 g niacin	12	11.00 \pm 0.89 b	9.17 \pm 0.60 b	10.50 \pm 0.42 b
12 g niacin	12	6.16 \pm 0.47 a	8.50 \pm 0.34 a	5.83 \pm 0.47 a

Mean with like letters are not significantly otherwise they differ significantly (p<0.01)

Table 5: Effect of niacin supplementation in level of triglycerides

Effect of factors	No. obser.	Mean \pm standard error (mg/dL)		
		June	July	August
General mean	36	14.59 \pm 1.61	15.50 \pm 1.40	18.15 \pm 1.21
Control	12	18.22 \pm 1.58 b	19.67 \pm 1.70 c	23.67 \pm 1.55 b
6 g niacin	12	16.16 \pm 1.76 b	15.86 \pm 0.95 b	16.32 \pm 0.79 a
12 g niacin	12	13.39 \pm 1.49 a	13.97 \pm 1.57 a	14.48 \pm 1.30 a

Mean with like letters are not significantly otherwise they differ significantly (p<0.05)

Table 6: Effect of niacin supplementation in level of glucose

Effect of factors	No. obser.	Mean \pm standard error (mg/dL)		
		June	July	August
General mean	36	55.22 \pm 1.8	49.88 \pm 1.3	58.67 \pm 2.0
Control	12	44.47 \pm 1.3 c	42.39 \pm 0.8 c	49.09 \pm 2.6 c
6 g niacin	12	54.72 \pm 2.3 b	48.46 \pm 1.3 b	58.66 \pm 2.9 b
12 g niacin	12	66.47 \pm 1.6 a	58.79 \pm 1.4 a	68.26 \pm 2.8 c

Mean with like letters are not significantly otherwise they differ significantly (p<0.01)

Table 7: Effect of niacin supplementation in level of glucagon hormone

Effect of factors	No. obser.	Mean \pm standard error (pg/mL)		
		June	July	August
General mean	36	96.26 \pm 0.13	93.5 \pm 0.76	92.74 \pm 0.53
Control	12	90.50 \pm 0.10 c	87.1 \pm 0.10 c	88.12 \pm 0.30 c
6 g niacin	12	96.10 \pm 0.20 b	94.7 \pm 0.90 b	92.70 \pm 0.40 b
12 g niacin	12	104.20 \pm 0.10 a	100.7 \pm 0.40 a	96.40 \pm 0.90 a

Mean with like letters are not significantly otherwise they differ significantly (p<0.05)

continued throughout the experiment period, with regard glucose and glucagon hormone during the first month of the experiment notes that the niacin supplementation in levels mentioned may impact was significantly (p<0.01) to increase the concentration of glucose by an average of 66.47 \pm 1.6, 54.72 \pm 2.3 (mg/dL) and glucagon average 104.2 \pm 0.1, 96.1 \pm 0.2 (pg/mL), respectively balancing control group 44.47 \pm 1.3 (mg/dL) and 90.5 \pm 0.1 (pg/mL), this has continued this effect until the end of the experiment, appears clear that the cows in the control group was located under the balance of energy negative was accompanied by lack of eating forage, especially with the high in temperature resulted in a demolition of fat stored in the body and liberate of volatile fatty acids in the blood absorbed by the liver and around the part to ketone bodies cause ketosis disease (Al-Soghier, 2002). It seemed so

obvious from is recorded by an increase in the concentration of BHBA and acetone and triglycerides and it seems that niacin has reduced from the decomposition of fat stored in the body, which is usually used by the cow at the beginning of season production to meet increasing demand for energy thus reduced the concentration of these substances, the results of this study have agreed with (Zhang *et al.*, 2009; Sahinduran *et al.*, 2010; Ghorbani *et al.*, 2008) and disagreed with each of Skaar *et al.* (1989) and Cervantes *et al.* (1996), with regard to glucose and glucagon hormone notes that the addition of niacin have influenced significantly increase their concentration after that record significant decrease in cattle control group, may be attributed the reason for increasing glucose that niacin increased fermentation rumen and raise the level of propionate rumen which stimulated a

process gluconeogenesis (Al-Abbasy, 2012), niacin increased and raise the level of glucagon hormone in the blood after the marked reduction of glucose, which in turn stimulate the get process glucogenolysis to compensate glucose missing.

CONCLUSION

From the above it is clear that cows in the early lactation period requires high energy due to the increase in milk production, leading to a sharp drop in glucose as a result consumed by the cow and an increase in the concentration of ketone bodies of BHBA and acetone and triglycerides that cause ketosis disease for milking cows, seem to be add niacin to feed had a positive effect in increasing concentration of glucagon hormone and glucose levels and improve the use of energy and reduce fat metabolism and reduce these bodies and thus reduce the incidence of this metabolic disease.

REFERENCES

- Al-Abbasy, E.G., 2012. Effect of niacin and water spray under heat stress condition in performance of production and physiological for Friesian cows in mid-Iraq. Ph.D. Thesis, Department of Dairy Cattle Management, University of Tikrit, Iraq.
- Al-Soghier, A.M., 2002. Effect of adding niacin on physiology response for dairy cattle high production during the summer. M.A. Thesis, College of Food and Agricultural Sciences, King Saud University.
- Cervantes, A., T.R. Smith and J.W. Young, 1996. Effects of nicotinamide on milk composition and production in dairy cows fed supplemental fat. *J. Dairy Sci.*, 79: 105-113.
- Duncan, D.D., 1955. Multiple range and multiple F-test. *Biometrics*, 11: 1-42.
- El-Barody, M.A.A., H.A. Daghsh and Z.B.H. Rabie, 2001. Some physiological responses of pregnant Egyptian buffalo to niacin supplementation. *Livest. Prod. Sci.*, 69: 291-296.
- Ghorbani, B., N. Vahdani and S. Zerehdaran, 2008. Effects of niacin on milk production and blood parameters in early lactation of dairy cows. *Pak. J. Biol. Sci.*, 11: 1582-1587.
- Grummer, R.R., 1993. Etiology of lipid-related metabolic disorders in periparturient dairy cows. *J. Dairy Sci.*, 76: 3882-3896.
- Harb, M.Y., 2011. Metabolize nutrients during the transitional period. *Magazine of Bovine Ovine Middle East North Africa*, pp: 97-98.
- Horner, J.L., M. Windle, C.E. Coppock, J.M. LaBore and J.K. Lanham, 1988. Effects of whole cottonseed, niacin and nicinamide on in vitro rumen fermentation and on lactating Holstein cows. *J. Dairy Sci.*, 71: 3334-3344.
- Hutjens, M.F., 1984. Use of niacin to balance a diet of dairy cow. *Vet. Med. Small Anim. Clin.*, 79: 1302-1305.
- Hutjens, M.F., 2010. *Feed Additives for Dairy Cattle*. University of Illinois, Urbana. Retrieved from: www.extension.org/pages/11774.
- Karkoodi, K. and K. Tamizrad, 2009. Effect of niacin supplementation on performance and blood parameters of Holstein cows. *S. Afr. J. Anim. Sci.*, 39: 349-354.
- Madison-Anderson, R., D.J. Schingoethe, M.J. Brouk, R.J. Baer and M.R. Lentsch, 1997. Response of lactating cows to supplemented unsaturated fat and niacin. *J. Dairy Sci.*, 80: 1329-1338.
- Radostits, O.M., J.H. Arundel and C.G. Clive, 2000. *Veterinary Medicine: A Textbook of the Diseases of Cattle, Sheep, Pigs, Goats and Horses*. 9th Edn., Elsevier Health Sciences, pp: 512, ISBN: 0-7020-2604-2.
- Sahinduran, S., K. Sezer, T. Buyukoglu, M.K. Albay and M.C. Karakurum, 2010. Evaluation of some haematological and biochemical parameters before and after treatment in cows with ketosis and comparison of different treatment methods. *J. Anim. Vet. Adv.*, 9: 266-271.
- Sarwar, M., Z. Iqbal and M. Un-Nisa, 1999. Effect of niacin on the performance of dairy cow. *Int. J. Agri. Biol.*, 1: 79-81.
- SAS, 2004. *SAS/STAT User's Guide for Personal Computers*. Release 7.0 SAS Institute Inc., Cary, N.C., USA.
- Skaar, T., R. Grummer, M.R. Dentine and R.H. Stauffacher, 1989. Seasonal effect of prepartum and postpartum fat niacin feeding on lactation performance and lipid metabolism. *J. Dairy Sci.*, 72: 2028-2038.
- Wagner, K., P. Mockel, P. Lebzien and G. Flachowsky, 1997. Influence of duodenal infusion of nicotinic acid on the milk fat composition of dairy cows. *Arch. Anim. Nutr.*, 50: 239-244.
- Yanxia, G., L. Jianguo, J. Wenbin, L. Qiufeng and C. Yufeng, 2008. Response of lactating cows to supplemental rumen protected methionine and niacin. *Front. Agric. China*, 2: 121-124.
- Zhang, Z., G. Liu, X. Li, Z. Wang and T. Kong, 2009. B-hydroxybutyrate, glucose, calcium, phosphorus and vitamin c concentrations in blood of dairy cows with subclinical ketosis during the early lactation. *Bull. Vet. Inst. Pulawy*, 53: 71-74.