RESEARCH OPINIONS IN ANIMAL & VETERINARY SCIENCES

ISSN 2221-1896 (PRINT) www.roavs.com ISSN 2223-0343 (ONLINE)

An evaluation on the effects of zeolite on milk characteristics in cows

Kamoun Mounir, Jemmali Borni, Tayachy Lassad, Yahyaoui Afef, Kaab Lassaad, Amraoui Marouen, Chalghoumi Raja and Zouari Kamel

ESAM, Mateur, 7030 Bizerte, Tunisie

Abstract

A total of 160 Tunisian Holstein cows were divided into three groups. First and second group of cows got 100 g and 200 g of zeolite respectively through forage mixture. The control diet was based on greenery, silages, hay and concentrate and did not contain zeolite. Milk contents were studied for each animal during five weeks. Chemical composition of milk samples was studied with an automate Ultrasonic Milk Analyzers. Zeolite supplementation significantly influenced milk composition during experimental period. Milk protein, lactose and solids not fat of analyzed samples were significantly varied according to zeolite rate in diet, whereas milk fat and total solids were not affected ($P>0.05$). The inclusion of 200 g of zeolite produced better results compared to control and 100 g zeolite supplementation.

Keywords: Cows, Milk Composition, Zeolite

Introduction

The variations in milk characteristics and milk yield within a species depends on many factors such as genetics, stage of lactation, daily variation, parity, type of diet, age, udder health and season (Haenlein, 2003). In particular, feeding system and environmental conditions have the major effect on milk characteristics. With increasing environmental regulations, producers will need to incorporate efficient, cost effective methods to reduce losses from feedlots without negatively affecting production performance. Ruiz et al. (2008) reported that zeolite addition is known and practiced in animal nutrition and the inclusion of these aluminosilicates is due to their physicochemical properties that permit better nutritional efficiency in ruminants, mainly when using poor-quality roughages. This natural resource ion permits better use of the nitrogen by rumen microflora and favors the degradation of nutrients. Numerous options have been studied which include decreasing diet digestibility by adding matter which could be beneficial for increasing nutrient efficiency, feeding less total protein and cleaning pens more frequently (Ruiz et al., 2008).

Zeolites are crystalline, hydrated aluminosilicates of alkali and alkaline earth cations which have infinite, three dimensional structures (Shariatmadari, 2008; Durali and Tulay, 2011). Different kinds of zeolite are used in many fields like detergent industry, herbal and animal production (Durali and Tulay, 2011). One of the most important properties is its selective adsorption and excluding depending on its cavities/channels, as well as volume of liquid and gaseous molecules of the medium. The wide range of zeolite applications was based on their physicochemical properties (Yolcu, 2010; Lithourgidis et al., 2011), in particular, biological characteristics of zeolite such as ion exchange capacity, adsorption and related molecular sieve. Research data reported in the published literature provide evidence of growth promoting effect when zeolite is used as feed additive in animal nutrition (Yazdani and Hajilari, 2009). Improved weight gain has been obtained in fattening animal (Çabuk et al., 2004). Due to worth mentioned properties of Zeolite, a research study was planned to find the effect of this product (100 and 200 g/day) on milk composition in dairy cows.

Materials and Methods

Farming system practiced in study was intensive. Diet of the cows was essentially based on green fodder (berseem, sulla, ryegras), silage, hay and concentrates. A total of 160 cows were divided into three groups according to their age (6-8 years), stage of lactation

Corresponding Author: Jemmali Borni, ESAM, Mateur, 7030 Bizerte, Tunisie

(mid) and parity (2 and 3). First and second group of cows received 100 and 200 g of zeolite through forage mixture for five weeks while the control group did not get any zeolite. The experimental periods lasted for 53 days. Cows were milked by automatic milking system that allowed daily milk yield recording. Individual and bulk milk samples were collected on 3, 5, 7 and 8 weeks of trial. Data were obtained by randomly collecting 160 samples of milk. Milk samples were collected aseptically during the routine morning milking in sterilized recipients and transported immediately to the laboratory. Milk samples were stored in sterile plastic container at 4°C. Total solids, fat, not fat solids, lactose and protein were determined using an automate "Ultrasonic Milk Analyzers" (Migliorati et al., 2007).

Statistical analysis

The experiment was analyzed as a randomized complete block design with the pen of cows considered as the experimental unit. Data for each response criterion were analyzed using the GLM procedure. The data were analyzed using SAS (SAS System for Windows 9.0) software. All values were presented as means (± SEM). The differences were considered statistically significant if $P \leq 0.05$.

Results

The overall mean of milk components are given in table 1. Milk protein, lactose and not fat solid were significantly high in cows fed zeolite at the rate of 200 gm. The non significant weekly variations of the milk composition of control and treated cows are given in Figure 1-5.

Discussion

In the present trial, fat content was not improved by the zeolite addition. Hornig et al. (1999) observed a non-significant effect in milk fat content when they fed cows, a diet containing 2% zeolite for a period of 13 weeks. Lopez et al. (1988) found the same result in milk fat with the same dietary addition.

In 2002, Bosi et al. (2002) reported that the zeolite supplementation did not affect milk fat. Dschaak et al. (2010) also reported that milk fat concentration did not differ among treatments with zeolite. The absence of effect in our experiment could be related to the lower dose of supplementation or the effect of season.

Zeolite did not have any effect on total solids. Previous study of Hornig et al. (1999) reported similar results that feeding different levels of zeolite had no effect on milk total solids content.

Not fat solids were significantly affected by increasing zeolite in diet. The increase in concentration of zeolite had a direct effect on the not fat solids. This result is similar to that of Dorica et al. (2006).

Results, in our study indicated that cows fed ration contained 200 g/day zeolite showed increase levels of milk protein and lactose. The same findings were observed by Hemken et al. (1984) and Roussel et al.

Table 1: Overall milk composition of control and treated cows

Parameters	Control	100 g zeolite	200 g zeolite
Fat g/kg	41.03 ± 0.66	42.56 ± 0.52	43.03 ± 2.05
Protein g/kg	32.19 ± 0.40^b	33.17 ± 0.33^b	34.85 ± 0.44^a
Lactose g/kg	45.56 ± 0.42^b	43.76 ± 0.45^b	46.59 ± 0.49^a
Not Fat Solids g/kg	86.43 ± 0.66^b	86.45 ± 1.12^b	88.84 ± 1.41^a
Total solids g/kg	130.43 ± 1.29	129.68 ± 1.36	131.93 ± 3.56

^{ab}Means having different superscripts in a row differ significantly ($P<0.05$)

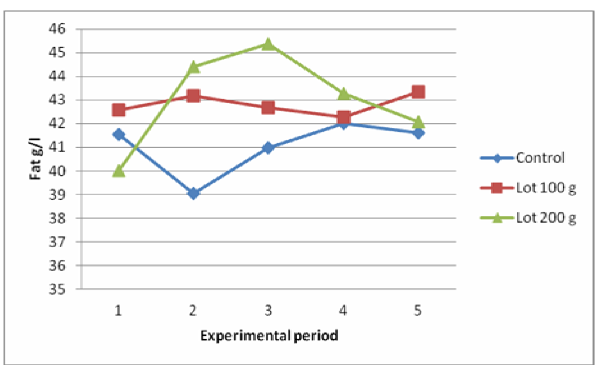

Fig. 1: Variation in fat content (g/l) during experimental period (weeks)

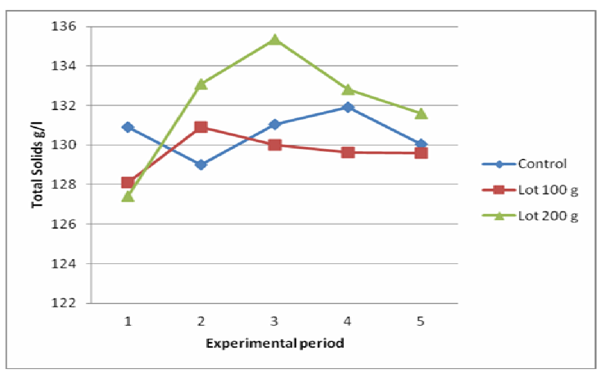

Fig. 2: Variations in total solids (g/l) during experimental period (weeks)

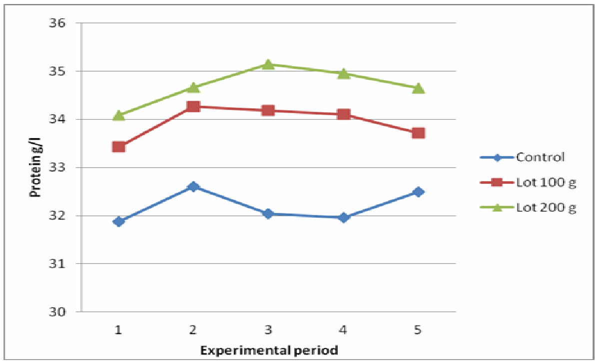

Fig. 3: Variations in protein (g/l) during experimental period (weeks)

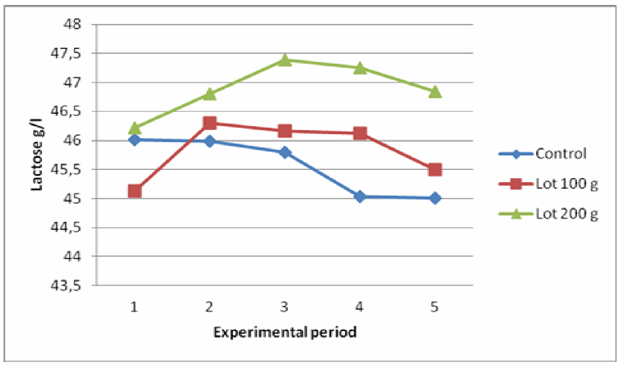

Fig. 4: Variations in lactose (g/l) during experimental period (weeks)

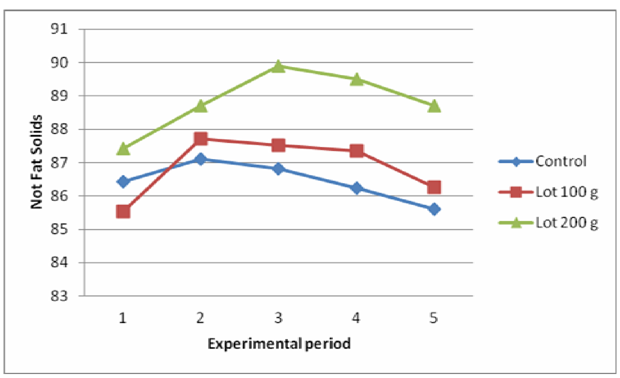

Fig. 5: Variations in Not fat solids (g/l) during experimental period (weeks)

(1992). Zeolite plays important roles in nitrogen and protein supply in the rumen. The ammonium level in rumen fluid is an indicator of rumen nitrogen metabolism with particular reference to ruminal protein degradation (Godelitsas and Armbruster, 2003). Urea can be effectively used by ruminal bacteria to build body protein (that is afterwards digested and used by the cow as a source of amino acids). A diet with a high percentage of soluble nitrogen can release large amount of ammonium in the rumen fluid, especially in the ammonium peak, during the initial post-prandial time (Culfaz and Yagiz, 2004). Zeolite reduces the ammonia concentration in the rumen (Jacobi, et al., 1984). The ammonium level in rumen fluid is an indicator of rumen nitrogen metabolism with particular reference to ruminal protein degradation (Bergero et al., 1997). Rumen ammonia was lowered by the addition of zeolite and lower rumen ammonia is indication of improved utilisation of protein (Hemken et al., 1984).

Pearson et al. (1985) reported that the addition of zeolite to the diet of animal did not improve growth performance. In the majority of studies dietary zeolites has improved animal performance (Cool and Willard 1982; Sadeghi and Shawrang, 2006; Pearson et al., 2008; Jonathan et al., 2008). The ameliorative effects of zeolite was also reported by Vrzgula and Bartko (1984) who observed that animal having diarrhea, after having been given a feed mixture supplemented with zeolite, produced compact feces after 48 hours and the appetite of the animal became normal, and they began to gain weight.

The better effects of zeolite has been associated with increase feed efficiency, improve production rates and rumen microbial activity and decrease mortality rate (Forouzani et al., 2004; Sadeghi and Shawrang, 2006). Zeolite was effective in eliminating poisonous effects of toxicants, thus reducing the need for antibiotics and veterinary medicines (Burgess et al., 2004). Moreover, it has been shown that zeolite has the potential to prevent ammonia related health problems and extending ammonia and related odorous gases and trapping them into crystalline structure (Mumpton, 1978).

Conclusion

The results obtained from this experiment indicate that zeolite supplementation, with 200 g/day showed better effect in improving milk contents. Feeding zeolite at 200 g/day did not significantly altered total solids contents and milk fat. Not fat solids, protein and lactose levels were significantly affected by zeolite incorporation in animal feed. Zeolite incorporation in animal feed can be effective in improving milk quality.

References

Bergero, D., Rumello, G., Sarra, C. and D'angelo, A. 1997. Effect of natural clinoptilolite or phillipsite in the feeding of lactating dairy cows. Proccedings of the Sofia Zeolite Meeting. Kirov, G., Filigova, L. and Petrov, O. (Eds) Pp: 67-72.

Bosi, P., Creston, D. and Casini, L. 2002. Production performance of dairy cows after the dietary addition of clinoptilolite. *Italian Journal of Animal Science*, 1: 187-195, 2002 187.

Burgess, R. M., Perron, M. M., Cantwell, M. G., Ho, K. T., Serbst, J. R. and Pelletier, M.C. 2004. Use of zeolite for removing ammonia and ammonia-caused toxicity in Marine toxicity identification evaluations. *Archive of Environmental Contamination and Toxicology*, 4: 440-447.

Cabuk, M., Alcicek, A., Bozkurt, M. and Akkan, S. 2004. Effect of Yucca schidigera and Natural Zeolite on Broiler Performance. *International Journal of Poultry Science*, 3: 651.

Cool, W.M. and Willard, J.M. 1982. Effect of clinoptilolite on swine nutrition. *Nutrition Reports International*, 26: 759-766.

Durali, D. and Tulay, A. 2011. Effects of zeolite (clinoptilolite) on some water and grouth parameters of rainbow trout (oncorhynchus mykiss Walbaum, 1792). *Digest Journal of Nanomaterials and Biostructures*, 6: 1111-1116.

Çulfaz, M. and Yağiz, M. 2004. Ion exchange properties of natural clinoptilolite: leadsodium and cadmium-sodium equilibria. *Separation and Purification Technology*, 37: 93-105.

Dschaak, C.M., Eun, J.S., Young, A. J. and Peterson. S. 2010. Effects of Supplementation of Natural Zeolite on Intake, Digestion, Ruminal Fermentation, and Lactational Performance of Dairy Cows1. Utah State University, Logan, Zeotech Corporai on, Fort Worth, TX. http://findarticles. com/p/articles/mi_qa4035/is_201012.

Dorica, V., Nicolae, M., Ioanca, I., Alexandrina, D., Voicu1, I., Sanda V., Calin, A. and Duca, R. 2006. Use of feed additives as source of fat and fatty acids on cow milk production and quality. *Archiva Zootechnica*, 9: 2006 85.

Forouzani, R., E. Rowghani and M.J. Zamiri. 2004. The effect of zeolite on digestibility and feedlot performance of Mehraban male lambs given a diet containing urea-treated maize silage. *Animal Sciences*, 78: 179-184.

Garcia Lopez, R., Elias A., de la Paz, J.P. and Gonzalez, G. 1988. The utilization of zeolite by dairy cows. 1. The effect on milk composition. *Cuban Journal of Agricultural Science*, 22: 22-33.

Godelitsas, A. and Armbruster, Th. 2003. HEU-type zeolites modified by transition elements and lead. *Microporous and Mesoporous Materials*, 61: 3-24.

Haenlein, G. 2003. Goat milk in human nutrition. *Small Ruminant Research*, 51: 155–163.

Hemken, R.W., Harmon, R.J. and Mann, L.M. 1984. Effect of clinoptilolite on lactating dairy cows fed a diet containing urea as a source of protein, in: Pond W.G. and Mumpton F.A. (Eds), Jeo Agriculture, Use of Natural Zeolites in Agriculture and Aquaculture, pp. 171- 176.

Hornig, G., Scherping, E. and Hasselman, L. 1999. The effect of the mineral clinoptilolite as feed additive for dairy cows. In R. Schubert, G. Flachowsky, R. Bitsch, G. Jahreis (Eds.) Vitamine und Zuzatzstoffe in der Ernahrung von Meusch und Tier, 7th Symp. Jena-Thuringen, Friedrich Schiller University; Jena, Germany, Pp: 527-530.

Jacobi, U., Vrzgula, L., Josef, B. and Havassy, I. 1984. Study of the effect of zeolite (clinoptilolite) on the dynamics of some parametersof nitrogen metabolism after feeding in the portal and jugular veins and in the rumen fluid of bulls. *Veterinarni Medicina*, 29: 207-216.

Jonathan, C.E., Andrea, P., Iyerusalem, H. and Premalathan, J. 2008. Effects of dietary Zeolites (bentonite and mordenite) on the performance of juvenile rainbow trout *Onchorhynchus myskis*. *Australian Journal of Basic and Applied Sciences*, 2: 961-967, 2008.

Lithourgidis, A.S., Dordas, C.A., Damalas, C.A. and Vlachostergios, D.N. 2011. Annual intercrops: an alternative pathway for sustainable agriculture. *Australian Journal of Crop Sci*ence, 5: 396-410.

Migliorati, L. Abeni, F., Cattaneo, M. P., Tornielli, C. and Pirlo, G. 2007. Effects of adsorbents in dairy cow diet on milk quality and cheese-making properties. *Italian Journal of Animal Science,* 6(1): 460-462.

Mumpton, F.A. 1978. Natural zeolite: a new industrial mineral commodity, in: natural zeolites : occurance, properties, use, sand, L. b. and Mumpton, F. B. eds., Pergamen Press, Elmosford, New York, pp: 3-31.

Pearson, G., Smith, W.C. and Fox, J.M. 1985. Influence of dietary zeolite on pig performance over the liveweight range 25-87 kg. *New Zealand Journal of Experimental Agriculture*, 13: 151-154.

Prvulovic, D., Kojic, D., Lajsic, G.G. and Kosarcic, S. 2008. The effects of dietary inclusion of hydrated aluminosilicate on performance and biochemical parameters of broiler chickens. *Turkish Journal Vettrinary Animal Sciences*, 32: 183-189.

Roussel, J.D., Thibodeaux, J.K., Adkinson, R.W., Toups, G.M. and Goodeaux, L.L. 1992. Effect of feeding various levels of sodium zeolite on milk yield, milk composition and blood profiles in thermally stressed Holstein cows. *International journal for vitamin and nutrition research*, 62: pp 91-98.

Ruiz, O., Castello, Y., Elias A., Arzola, C., Rodreguez, C., Salinas, J., LaO, O. and Holguin C. 2008. Effect of four zeolite levels on the digestibility and intake of nutriments in sheep fed alfalfa hay and concentrate. *Cuban Journal of Agriculture Science*, 32:4.

Sadeghi, A.A. and Shawrang, P. 2006. The effect of natural zeolite on nutrient digestibility, carcass traits and performance of Holstein steers given a diet containing urea. *Animal Sciences*, 82: pp 163-167.

Shariatmadari, F. 2008. The application of zeolite in poultry production. *World's Poultry Science Journal*, 64: 76-84.

Trckova, M., Matlova, L., Dvorska, L. and Palvic, I. 2004. Kaolin, bentonite, and zeolites as feed supplements for animals: health advantages and risks. *Vetrinarni Medicina*, 49: 389–399.

Vrzgula, L. & Bartko, P. 1984. Effects of Clinoptilolite on Weight Gain and some Physiological Parameters of Swine. In Zeo-Agriculture Use of Natural Zeolites in Agriculture and Aquaculture. 1st Edition. Ed. Pond. W.G., F.A. Mumpton. Use of Natural Zeolites in Animal Science and Nutrition, Pp: 157-169.

Yazdani, A.R. and Hajilari, D. 2009. Application of natural zeolite on blood characteristics, physiological reactions and feeding behaviours of finishing Holstein beef steers. *Indian Journal of Animal Research*, 43: 295-299.

Yolcu, H., Gunes, A., Dascı, M., Turan, M. and Serin, Y. 2010. The effects of solid, liquid and combined cattle manure applications on yield, quality and mineral contents of common vetch and barley intercropping mixture. *Ecology*, 19: 71-81.