International Scholars Journals

African Journal of Internal Medicine ISSN 2326-7283 Vol. 9 (2), pp. 001-005, February, 2021. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

The effects of magnetic water on milk and blood components of lactating Saanen goats

M. M. Sargolzehi[1]*, M. Rezaee Rokn-Abadi[2] and A. A. Naserian[1]

[1]Department of Agriculture, Ferdowsi University of Mashhad, Iran.
[2]Department of Physics, Ferdowsi University of Mashhad, Iran.

Accepted 13 November, 2020

Change in milk and blood components of lactating Saanen goats when consuming magnetic water were studied. Twelve goats in a completely randomized design with 3 treatments including: 1) Control; 2) Consuming conditioned water with 1200 Gauss permanent magnet and; 3) Consuming conditioned water with 3600 Gauss permanent magnet, were used. Results indicated that conditioning of the water did not affect blood metabolites (glucose and urea), blood ions (Na, K, Mg and P) and milk composition (fat, protein, lactose, solid not fat and total solid) significantly.

Key words: Saanen goats, magnetic water, blood metabolites, blood ions, milk composition.

INTRODUCTION

The first component being used in milk producing by mammals is water which is named as the second essential nutrient for lactating dairy cattle (Donaldson and Grimes, 1988). One of the methods being used to affect water components to avoid lame-scale depositing in pipes is conditioning of the water by magnets (Chynoweth, 1985). It is shown that crossing of water among magnetic field causes an increase in solubility of calcium salts so that avoids from lame-scale depositing in pipes and also cleans pipes from lame-scales being deposited in the past (Skeldon, 1990). The general operating principle for the magnetic technology is a result of the physics of interaction between a magnetic field and a moving electric charge, in this case in the form of ion. When ions pass through the magnetic field, a force is exerted on each ion. The forces on ions of opposite charges are in opposite directions (Lock, 1986). The redirection of the particles tends to increase the frequency with which ions of opposite charge collide and combine to form a mineral precipitate or insoluble compound. Since this reaction takes place in a low-temperature region of a heat exchange system, the scale formed is non-adherent. At the prevailing temperature conditions, this form is preferred over the adherent form, which attaches to heat exchange surfaces. Magnetic water has also biological effects. For example, magnetic or electrostatic scale control technologies can be used as a replacement for most water softening equipment. Spe-cially, chemical softening (lime or lime-soda softening), ion exchange and reverse osmosis, when used for the control of hardness, could potentially be replaced by non-chemical water conditioning technology. This would include applications both to cooling water treating and boiler water treatment in once through and recirculating systems. Lin et al. (1989 - 1990) mentioned that there is a change in mineral contents of water by magnetizing that causes them to pass biological membranes more easily. It is shown that by magnetizing of water with a permanent magnet, both quality and yield of some vegetables and fruits such as melon (Harari and Lin, 1989) and grapefruit improves. In the other hand, Harari et al. did not find any effect by using a permanent magnet on circulating nutrient solution for tomato. Also improvement in gain for calves and sheep with reduction in carcass fat in sheep were reported (Bergsrud et al., 1990).

As we know, there is no publication evaluating effect of using magnetic water for dairy animal which reports milk component changes. The aim of this study is to find changes in milk and blood component of Saanen goats when they are consuming magnetic water.

MATERIALS AND METHODS

In these experiments, 12 Saanen goats with 75 ± 10 days of lactation were used. All of them were kept in metabolic cages and

*Corresponding author. E-mail: sargolzehi@gmail.com.

Table 1. Composition of the ration

Percentage	Feed stuff
30	Alfalfa hay
15	Barley silage
26	Corn grain
13	Soybean meal
14.5	Wheat bran
0.5	Calcium carbonate
0.8	Mineral
0.2	Salt

Table 2. Chemical composition of the magnetic water.

Maximum upper level for livestock[1]	Concentration in experimental water	Chemical composition
	2168	Total hardness (ppm $CaCO_3$)
960.0	0.821	TDS (% (w/v)
1000.0	372	HCO^-_3 (ppm)
	121	CO_3^{2-} (ppm)
50.0	3212	SO_4^{2-} (ppm)
20.0	38.1	NO_3^- (ppm)
0.7	3.8	PO_4^{3-} (ppm)
100.0	1824	Cl^- (ppm)
50	428.1	Na^+ (ppm)
20.0	21.6	K^+ (ppm)
100.0	89.4	Ca^{2+} (ppm)
50.0	51.3	Mg (ppm)
	3.2	NH_4^+ (ppm)

[1]Bergsrud et al., (1990); Hutcheson (1996).

twice daily were milked (08:00 and 20:00). The ration which all treatments consumed during the experiment is shown in Table 1. The water used in this experiment was very low quality water and its composition is shown in Table 2. Two permanent magnets were used for conditioning of water that both of them were bought from Lhasa, USA, first a 1200 Gauss magnet and second a 3600 Gauss magnet which were produced for pipe water conditioning.

Lin et al. (1988) claimed that a conditioned water with permanent magnet keep its characteristics for at least 6 hour. Based on their report conditioning of the water was done two times a day (08:00 and 14:00) and from 20:00 to next day 08:00, there were no access to water for goats.

A completely randomized design with 3 treatments, including 1.) Control, 2.) Consuming conditioned water with 1200 Gauss permanent magnet and 3.) Consuming conditioned water with 3600 Gauss permanent magnet, were used. Sampling was done 5 times with 12 days interval including 5 days sampling. For the first sampling, 15 days adaptation with experimental feed following with 7 days adaptation with experimental water was given. Blood sampling was done from jugular vein at the last day of sampling and serums were immediately frozen. Milk sampling was done in sampling times of each period (5 samples) and in the last sampling day, samples were mixed and kept in refrigerator (4°C).

At the end of the experiment, all of the samples were analyzed for their composition. Milk fat, protein and lactose were measured by Foss Electric, integrated milk testing^{TM} conveyor 4000. Serum glucose, urea (BUN), inorganic phosphate and magnesium were measured by BT 3000 PLUS, Italy. For glucose measurement an enzymatic, calorimetric (GOD- PAP) method was used. Blood urea nitrogen was measured by Urease- GLDH method. An UV method for measuring of phosphorus was used. Magnesium measuring was done by using Xylidylblue method which Xylidylblue in an alkaline environment makes a colorful complex in which the color intensity indicates magnesium concentration. Sodium and potassium measurement were done by SEAC fp20. SAS 9.1 was used for statistical analyze.

RESULTS AND DISCUSSION

Milk composition (fat, protein, lactose, solid not fat and total solid) of goats consuming experimental water is shown in Table 3. Tables 4 and 5 shows blood metabolites (Na, K, Mg and P) and ions (glucose and urea). Baker and Judd (Baker et al., 1996) reviewed papers reporting effects of different magnets on water. They have concluded that although there are many differences in conditioners but it could be said that some

Table 3. Effect of magnetic water to 1200 and 3600 Gauss and water not magnetic (control) the concentration of milk fat, protein, lactose, solid not fat and total solid of Saanen goats with 75 ± 10 days of lactation.

Milk components (%)	Period	Treatments			P
		Control	1200 Gauss	3600 Gauss	
Fat	1	3.28	3.08	2.77	0.72
	2	3.87	3.04	2.68	0.55
	3	3.06	3.00	2.66	0.53
	4	3.18	2.99	2.56	0.48
	5	3.77	2.98	2.64	0.30
Protein	1	2.30	2.27	2.28	0.99
	2	2.14	2.38	2.24	0.71
	3	2.21	2.39	2.23	0.76
	4	2.21	2.33	2.11	0.72
	5	2.28	2.32	2.12	0.68
Lactose	1	3.36	3.38	3.61	0.48
	2	3.84	3.76	3.87	0.82
	3	3.68	3.75	3.84	0.75
	4	3.88	3.78	3.88	0.77
	5	3.74	3.68	3.88	0.56
Solid not fat	1	6.59	6.58	6.80	0.86
	2	6.92	7.08	7.04	0.93
	3	6.84	7.09	7.17	0.83
	4	7.04	7.07	6.92	0.93
	5	6.99	6.95	6.94	0.99
Total solid	1	10.31	10.09	9.95	0.91
	2	11.16	10.46	10.04	0.65
	3	10.21	10.49	9.99	0.61
	4	10.55	10.40	9.81	0.41
	5	11.12	10.30	9.90	0.45

of them if were installed properly, would work. Also all sources of water don't have affinity to be conditioned maybe because it is not the water that get conditioned but they are colloidal component and ions that are present in the water. So because these components differ in water sources, there is no similar effect of magnets for different waters.

We were not succeed in finding a publication which reports milk composition of an animal after consuming a conditioned water with permanent magnets. Lin and Yotvat (1989) claimed that an increase in milk yield of dairy cattle consuming magnetic water without any changes in milk composition of them occurred, but they did not report any data. As it is shown in Tables 3, 4 and 5, there is no significant difference between treatments in milk contents of goats and also blood metabolites and ions. This means that the water conditioned in this experiment was not affected by 1200 and 3600 permanent magnets or the experimental method was not able to provide conditions needed for such experiment. For glucose in period 3 there is a significant difference between treatments that seems to be an error. Levy et al. (1990) reported that blood metabolites of beef calves consuming magnetic water were not changed significantly. Also Patterson and Chestnutt (Patterson et al., 1994) reported no significant difference in ash content

Table 4. Effect of magnetic water to 1200 and 3600 Gauss and water not magnetic (control) in serum concentrations of glucose, blood urea nitrogen, sodium, potassium, magnesium and phosphate of Saanen goats with 75 ± 10 days of lactation.

Serum concentrations (mg/dl)	Period	Treatments			P
		control	1200 Gauss	3600 Gauss	
Glucose	1	63.00	6.67	66.33	0.46
	2	51.00	51.67	49.67	0.82
	3	58.33[a]	53.67[b]	59.00[a]	0.00
	4	48.33	45.33	46.00	0.70
	5	57.00	53.67	52.33	0.31
Blood urea nitrogen	1	23.33	27.67	29.67	0.41
	2	26.33	27.33	28.00	0.89
	3	27.33	28.33	26.67	0.86
	4	24.00	27.33	27.00	0.68
	5	26.67	24.67	23.00	0.25
Sodium	1	183.33	171.00	168.67	0.51
	2	169.00	176.33	167.00	0.53
	3	171.00	203.00	173.00	0.31
	4	165.67	183.00	176.67	0.65
	5	180.67	170.67	172.67	0.25
Potassium	1	4.90	5.17	5.00	0.73
	2	4.37	4.73	4.47	0.63
	3	4.67	5.37	4.73	0.42
	4	4.53	4.50	4.23	0.55
	5	4.33	4.23	4.33	0.80
Magnesium	1	0.32	0.35	0.27	0.50
	2	0.25	0.26	0.30	0.73
	3	0.28	0.28	0.29	0.99
	4	0.19	0.21	0.26	0.25
	5	0.28	0.18	0.24	0.52
Phosphate	1	7.17	10.40	8.23	0.19
	2	8.40	8.67	9.40	0.92
	3	8.23	7.57	7.70	0.92
	4	4.47	6.93	8.00	0.42
	5	7.50	6.83	6.50	0.86

content of sheep bone following magnetic water consumption. Jaster et al. (1978) reported that consuming saline water dose not change mineral content of blood and serum significantly.

Conclusion

On the basis of the experimental conditions and the results obtained we conclude that: magnetized water at

Table 5. Serum ions.

Serum concentrations (mg/dl)	Period	Treatments			P
		Control	1200 Gauss	3600 Gauss	
Sodium					
	1	183.33	171.00	168.67	0.51
	2	169.00	176.33	167.00	0.53
	3	171.00	203.00	173.00	0.31
	4	165.67	183.00	176.67	0.65
	5	180.67	170.67	172.67	0.25
Potassium					
	1	4.90	5.17	5.00	0.73
	2	4.37	4.73	4.47	0.63
	3	4.67	5.37	4.73	0.42
	4	4.53	4.50	4.23	0.55
	5	4.33	4.23	4.33	0.80
Magnesium					
	1	0.32	0.35	0.27	0.50
	2	0.25	0.26	0.30	0.73
	3	0.28	0.28	0.29	0.99
	4	0.19	0.21	0.26	0.25
	5	0.28	0.18	0.24	0.52
Phosphate					
	1	7.17	10.40	8.23	0.19
	2	8.40	8.67	9.40	0.92
	3	8.23	7.57	7.70	0.92
	4	4.47	6.93	8.00	0.42
	5	7.50	6.83	6.50	0.86

1200 and 3600 Gauss does not influence the serum concentration blood urea nitrogen, sodium, potassium, magnesium and phosphate, but it increase the concentration of glucose. Even more, does not interfere with the concentration of fat, protein, lactose, solid not fat and total solid milk of Saanen goats with 75 ± 10 days of lactation.

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