

TRISODIUM CITRATE USE IN DAIRY COWS AND EFFECTS ON DAILY MILK YIELD AND QUALITY

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Abstract

The aim of this study was to determine whether the use of trisodium citrate can reduce milk somatic cell counts and consequently increase the milk yield and quality in dairy cows on third and fourth lactation. Twelve holstein cows were divided into 2 groups, 5 of them were chosen as trial which have received orally 30 mg trisodium citrate per kg of body weight in diluted form daily during 7 days. Apart from daily milk yield, milk sampling was performed before, after and during trisodium citrate treatment in both trial and control groups. Individual milk protein, fat, total dry matter, milk pH, somatic cell counts and oxidation reduction potential (ORP) were measured in each of milk samples. There was no significant difference regarding daily milk yield, fat, protein, dry matter of milk and milk ORP values between 2 groups. But somatic cell counts were significantly lower in trisodium citrate-given group during experimental period. In conclusion, trisodium citrate may be useful for improving milk quality regarding somatic cell counts.

Key words: Dairy cow, somatic cell count, trisodium citrate, milk quality.

Introduction

Milk production and quality are both affected by several factors. These are principally individual traits such as genetics and age of cow, and environment (hygiene, nutrition etc). It is mostly possible to improve milk production level in lactation and quality of milk by taking notice to manageable factors. Nowadays, it is well known that milk amount obtained per lactation may increase with the age of cow, relatively. However, milk quality generally tends to decrease by ageing of cows, mostly in poor management conditions. Subclinical mastitis which provokes increased somatic cell counts is principal cause in decreased milk quality and modification of its compound, i.e. lower lactose, casein and fat content in contrast to higher chlorides, Na, immunoglobulins, serum proteins and pH (Jensen and Eberhart, 1981; Izgur, 1984; Mukesh 2009). Citrate is the main constituent playing a buffer role in the udder. It regulates the homeostasis between Ca⁺⁺ and H⁺ ions for maintaining the fluidity of milk through its effect on casein micelles (Faulkner and Peaker 1982; Shennan and Peaker 2000). In case of citrate deficiency in udder, the clumping of

Ca⁺⁺ appears then the parenchymatous tissue in the udder alveoli should be injured. It means subsequent events such as the damage of barriers between blood and milk and inflammatory reactions would be appeared (Poutrel 1982).

In this study, the use of tri-sodium citrate for improving some milk quality properties was investigated.

Material and method

This study was conducted in 59 lactation cows kept in Dairy Cattle Stabling of Haymana Research and Application Farm of Faculty of Agriculture of Ankara University. Twelve cows which were on 3rd lactation rank or more were chosen for the trial. Seven of them were randomly defined as control, the others (5 cows) were considered as trial. All cows were kept under usual management condition without receiving any special treatment. Cows were milked twice a day and fed with corn silage, dried alfalfa and cereal straw beside concentrated feed containing 2450 Kcal/Kg of energy and 17% of crude protein. Each of trial group has daily received 30 mg per body weight of Tri-sodium citrate during 7 days.

Tri-sodium citrate was diluted in 1 litre of water and given at once. Milk sampling started at 2 weeks before tri-sodium citrate treatment from 11th February, continued until after 2 weeks since the end of treatment to 29th March. In every milk sample, milk protein (Kjeldhal method), fat (Gerber analysis), total dried matter, somatic cell counts, pH and ORP (Oxidation-Reduction Potential) measurement (MP103 EZDO) were performed. Somatic cell counts were performed by using direct microscopic counting method (Gurgun and Halkman 1990). The scores of somatic cell counts were transformed into logarithmic values for more reliable calculation. Repeated measures of ANOVA and Duncan multiple range testing were used for data analysis through SPSS 20 package software.

Result and discussion

Somatic cell counts

There was no significant difference in control group during the period of the trial. However, there was a significant difference between trial and control groups, and as well as within trial group according to sampling day ($P>0.01$) during trial period. Highest somatic cell value was observed on the day before tri-sodium citrate giving (213,356 scc/ml). Lowest was at first day following the end of tri-sodium citrate giving. Dhillon et al (1995), reported that continuous tri-sodium citrate giving to milking Water buffalos should decrease bacteria content of milk when mastitis is detected. Prakash et al (2010) observed that once a day injection of tri-sodium citrate together with trimethoprim intra venously during 7 days should cure mastitis powerfully in dairy cows.

Table 1: The values of Somatic Cell counts by groups and sampling day (SCC/ml)

Group	n	February			1st hMarch			8 th March			29 th March		
		Min	Mean	Maxs	Min	Mean	Maxs	Min	Mean	Max	Min	Mean	Max
Control	7	16284 1	202056 ± 10786A a	24658 8	15818 9	213356 ± 16572A a	29311 5	15353 6	198068 ± 11525A a	24193 6	17679 9	221331 ± 17434A a	28846 2
Trial	5	19541 0	230770 ± 12536A a	26519 9	15353 6	200993 ± 16144A a	24658 8	88400	106079 ± 8112Cb	12562 0	11631 5	144231 ± 11491B b	18610 5

* Capital letters show significance between milk sampling times. Minuscule letters are for comparing trial and control group in every sampling day.

Milk fat

There was a slight decrease either in trial or control groups regarding milk fat rate. This

decrease was more remarkable in control group. But it can be suggested that fat rate was almost constant in the trial group (See table 2).

Table 2: Milk fat (%)

Groups	N	Parameters	February	March	Mean
Control	7	Min	2,45	2,05	2,05
		Max	3,90	4,05	4,05
		$\bar{x} \pm SD$	3,10±0,194	3,02±0,270	3,06 ±0,160
Trial	5	Min	2,50	2,70	2,500
		Max	4,25	4,10	4,250
		$\bar{x} \pm SD$	3,430±0,283	3,420±0,222	3,425±0,170
Control+Trial	12	Min	2,45	2,05	
		Max	4,25	4,10	
		$\bar{x} \pm SD$	3,238±0,163	3,188±0,184	

Milk Protein

Milk protein rate did not vary according to the groups. But this value varies significantly

according to sampling days during trial period ($p<0.01$).

Table 3: Protein rates in the milk (%)

Groups	N	Parameters	February	March	Mean
Control	7	Min	3,00	2,95	2,95
		Max	3,67	3,48	3,67
		$\bar{x} \pm SD$	3,323±0,110	3,19±0,831	3,255±0,690
Trial	5	Min	2,54	2,39	2,39
		Max	3,55	3,15	3,55
		$\bar{x} \pm SD$	3,06±0,167	2,86±0,13	2,96±0,105
Control+Trial	12	Min	2,54	2,39	
		Max	3,67	3,48	
		$\bar{x} \pm SD$	3,215±0,0977A	3,051±0,0841B	

A-B: $p < 0.01$

Total dry matter in milk

Total dry matter by sampling days was found as 11,94%±0.228 and 12,21%±0.247 in control and 11,86%±0.233 and 12,29%±0.245 in trial groups, respectively. Dry matter content was higher on third sampling day in trial group. There was no significant difference between groups and sampling days.

Milk pH and ORP values

Milk pH values were found as 6,69±0,274, 6,67±0,244, 6,75±0,320 and 6,74±0,216 in control, 6,65±0,013, 6,68±0,203, 6,82±0,246 and 6,72±0,170 in trial group, respectively. There was a slight increase which was not attributable to tri-sodium citrate use in both groups.

Same observation was found regarding ORP (Oxidation-Reduction Potential). There was no significant difference neither by groups nor

sampling days. Average ORP values were 198,33 ±0.847, 201,08 ±0.701, 193,08 ±1,08 and 214,75±0.77. Sing et al (1997) reported that milk pH values and the rate of milk components should return to normal level following tri-sodium citrate use in dairy cows.

Milk yield

Milk yield was registered weekly in both trial and control groups from 16th February to 29th March in total of 6 weeks. There was no significant difference among milk yields per week and cow groups. But in both groups, weekly milk yields varied slightly from tri-sodium citrate period to next two week after interruption of tri-sodium citrate use. Although it was not significant, weekly milk yield remained steadier in cows received tri-sodium citrate.

Table 4: Average weekly milk yield from 16th February to 29th March.

Goups	n	Paramet ers	16-22 February	23 Feb.- 1 March	2-8 March	9-15 March	16-22 March	23-29 March
Control	7	Min	146	139	143	143	139	135
		Max	257	255	259	222	244	233
		$\bar{x} \pm SD$	187,8±15,8	186,6±15,3	184,9±15,4	182,1±11	181,6±13,5	180,4±19,9
Trial	5	Min	139	139	135	130	129	125
		Max	272	270	276	267	224	249
		$\bar{x} \pm SD$	186,4±22,9	186,2±22,6	186,6±23,9	183,4±23,3	172,4±15,7	175,2±21
Control +Trial	12	Min	139	139	135	130	129	125
		Max	272	270	276	267	244	249
		$\bar{x} \pm SD$	187,3±12,6A	186,4±12,3A	185,6±12,7A	182,6±1 AB	177,75±9,9B	178,3±11B

*Different letters indicate significant difference ($p < 0.05$)

Conclusion

Mastitis, especially subclinical type is a perpetual problem of all milk producing farms. It is one of most important economical loss for dairy industry. Although our research was conducted in no mastitis-detected cows, a considerable decrease of somatic cell counts was observed in the milk.

Tri-sodium citrate is safe, economical, very effective, avoided culling and discarding of milk. Also, it does not require withdrawal periods because of residual problems in milk and meat. Some encapsulated form of tri-sodium citrate should make easier its usage in animals, instead of giving orally its diluted form in water. However, more information from a large number of animals in different

exploitations should be beneficial for its further widespread application in the field.

References

1. DHILLON, K.S., SINGH, T.J., SODHI, S.S., SANDHU, H.S., DWIVEDI, P.N., SINGH, J. AND GILL, B.S., 1995. Milk bacteriology: Pre and post-trisodium citrate mastitis treatment in buffaloes. *Ind. J. Anim. Sci.*, **65**: 9-11
2. FAULKNER, A. & PEAKER, M. (1982). Reviews of the progress of dairy science. Secretion of citrate into milk. *Journal of Dairy Research*, *Journal Dairy Research* 49,159-169
3. GURGUN, V. and HALKMAN, A.K., 1990. Mikrobiyolojide Sayım Yöntemleri. Gıda Teknolojisi Derneği Yay.55-57 Ankara
4. IZGUR, H., 1984. Mastitise Predispoze Faktörler. I. Mastitis Semineri. 15-16 Kasım, 17-19 Ankara
5. JENSEN, D. and EBERHART, R., 1981. Total and Differential Cell Counts in Secretion of the non Lactating Bovine Mammary Gland. *Ann. Jour. Vet. Res.* 42(5), 743-747
6. MUKESK, S., 2009. Recent Trends in Mastitis Management. *General Manager-Abis Dairy pvt*, 7.
7. POUTREL, B., 1982. Susceptibility to Mastitis. A review of Factors Related to the Cow. *Ann. Rec. Vet.* 13(1), 85-99
8. PRAKASH, V, YADAV, M. and SINGH, S. 2010. Effect of Different Treatment of Mastitis in Cow and Biochemical Changes in Their Milk. *Asian J. Animal Sciences*, 4:202-204
9. SHENNAN, D.B. and PEAKER, M, 2000. Transport of Milk Constituents by the Mammary Gland. *Physiological Reviews*, 80, 3, 925-951
10. SINGH, T.,VARINDA, J., SINGH, S. and DHILLON, K.S., 1997. Effect of Tri-Sodium Citrate for Mastitis Treatment on some Milk Constituents in Cows. *Indian J. Anim. Sci.*, 67, 1055-1056