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Effect of copper on the milk quality and prevention of mastitis in dairy cows

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Copper deficiency is reported to be widespread in dairy animals and is of major clinical importance as it causes delayed puberty, anoestrous, suboestrous or poor pregnancy rates and infertility (Takkar and Randhawa 1992). Xin *et al.* (1991) showed that bactericidal capacity of PMN decreased in Cu deficient animals, which makes them more susceptible to various infections. Therefore, present study was undertaken to determine the effect of copper supplementation on milk quality and prevention of mastitis.

Fourteen apparently healthy pregnant cows approaching dry period were given copper glycinate (75 mg/ml) @ 2 ml per animal subcutaneously in brisket region before drying off, followed by second injection at the same dose rate after parturition. In control group, 10 animals going dry during almost at the same period were kept and these did not receive copper. Blood was collected twice, once at drying off and second after parturition for copper estimation. Milk samples were collected before giving copper (0 day) and then at 3–7 days and 60 days after parturition and subjected for bacteriological examination, california mastitis test (CMT), electrical conductivity (EC), fat, SNF, pH, lactose, density, total protein and copper estimation. Plasma and milk samples were digested for copper estimation by atomic absorption spectrophotometer.

The present study showed a reduction in occurrence of postpartum mastitis in supplemented cows (50%) as compared to unsupplemented control group (70%) which were supported by the findings of Harmon and Torre (1994) and Nockels and Blair (1996) who also reported reduced cases of mastitis in copper supplemented cows. The reason of higher incidence of postpartum mastitis in unsupplemented group could be due to the effect of copper on the immune functions of the body. Copper was found to increase phagocytic and killing capacity of neutrophils (Jones and Suttle 1981). It appeared that in Cu supplemented dairy cows, the phagocytic activity of neutrophils might have improved. Percival (1995) found that copper deficiency increases the invastion of pathogens.

The effect of copper on different milk compositional parameters in supplemented and unsupplemented groups including mastitis animals (Table 1) showed significant decrease in the fat percentage in unsupplemented group at 3–7 days after parturition but the decrease was nonsignificant in supplemented group as compared to unsupplemented group. Comparative analysis of effect of copper on fat percentage in copper supplemented and unsupplemented non mastitic dairy cows showed that fat percentage significantly

Table 1. Composition of milk in copper supplemented and unsupplemented dairy cows including mastitic animals (mean±SD)

Parameter	Milk samples					
	Supplemented			Unsupplemented		
	0 day	3–7 day	60 days	0 day	3–7 days	60 days
EC (mS/cm)	5.30±0.19	5.23±1.40	4.87±0.62	5.62±0.61	5.53±0.70	5.01±0.36
Fat (%)	4.28±0.45	4.26±0.57	3.89±0.60	4.54±0.33	3.64±0.83*	4.07±0.51
Total protein (%)	3.35±0.26	3.25±0.15	3.05±0.35	3.36±0.11	3.28±0.23	3.20±0.11
Lactose (%)	5.14±0.25	5.16±0.27	4.84±0.30	5.14±0.19	5.03±0.56	4.94±0.37
SNF (%)	8.60±0.40	8.74±0.39*	7.94±1.07	8.63±0.28	8.28±0.54*	8.30±0.35
Density	31.03±1.65	29.25±1.62	26.89±3.70	28.99±1.64	28.69±3.02	28.80±1.65
pH	6.61±0.08	6.57±0.13	6.74±0.15	6.6±0.80	6.62±0.13	6.65±0.16

*Values significant at P<0.05.

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increased from 4.28 ± 0.45 on day 0 to 4.39 ± 0.52 on day 3–7 postpartum and the mean value at day 60 was 4.25 ± 0.60. However, in unsupplemented group, the milk fat percentage showed signficant decline from 4.54 ± 0.33 on day 0 to 3, 3.70 ± 0.69 on day 3–7 postpartum and the mean value was markedly low (3.91 ± 0.37) at day 60 postpartum. With respect to SNF, a significant increase in copper supplemented group and decrease in unsupplemented group was seen at 3–7 days post calving. In the present study, the decrease in fat percentage in unsupplemented group could be due to the presence of subclinical infections. Ashworth *et al*. (1967) observed that milk fat percentage falls as a result of udder infection and this could be due to impaired synthetic and secretory activity of the udder epithelial cells (Schultz, 1977). The fall is less in copper supplemented group which is supported by the findings of Engle *et al*. (2001), who reported that copper supplementation alters lipid metabolism in high-producing dairy cows. The mechanism by which copper affects the profile of fatty acids was not clear but it might be due to its effect on desaturation, esterification and mobilization from triacylglycerols.

Further, higher mean copper levels were observed in milk (12.50 ± 5.59 μg/l) and plasma samples (64 ± 19.85 μg/l) of unsupplemented group as compared to supplemented group (milk, 10.30 ± 2.20 and plasma, 54.64 ± 12.31 μg/l) when recorded at 3–7 days postpartum. These higher levels in unsupplemented group could be due to increased observance of mastitis in these animals. During mastitis, inflammatory reaction occurs which results in increased copper levels in milk. Bansal (1999) observed a higher plasma copper level in mastitis animals as compared to healthy cows. This increase in plasma copper is most likely due to release of copper containing acute phase protein ceruloplasmin. It was presumed that the increase in plasma copper might have increased milk copper levels in mastitis cows. The exact reason for non-signficantly low milk and plasma copper levels in supplemented dairy animals could not be explained on the basis of the present investigation. However, the monitoring of the incidence of subclinical mastitis and somatic cell count in relation to plasma copper level in the present study might have been more helpful in interpreting the results of plasma copper levels in both the groups.

SUMMARY

To study the effect of copper on milk quality and prevention of mastitis, copper glycinate (75mg/ml) @ 2 ml/ animal was given subcutaneously in the brisket region, first before drying off followed by second injection at the same dose rate after parturition. Plasma and milk copper levels, and milk parameters, viz. bacteriology, CMT, EC, fat, SNF, total protein, lactose, density and pH were studied. A reduction in occurrence of postpartum mastitis in supplemented cows (50%) than unsupplemented control (70%) was seen. A slightly less marked increase in plasma copper and higher increase in milk copper levels and consistent increase in milk fat content was recorded in supplemented cows as compared to unsupplemented dairy cows.

REFERENCES

Ashworth U S, Forster T L and Luedecke L O. 1967. Relationship between california mastitis test reaction and composition of milk from opposite quarters. *Journal of Dairy Science* **50**: 1078–82.

Bansal B K. 1999. ‘Studies on mastitis in cows with emphasis on antibiotic residues in milk and the role of copper in its control’. Ph.D. dissertation, Punjab Agricultural University, Ludhiana, India.

Engle T E, Fellner V and Spears J W. 2001. Copper status, serum cholesterol and milk fatty acid profile in Holstein cows fed varying concenration of copper. *Journal of Dairy Science* **84**: 2308–13.

Harmon R J and Torre P M. 1994. Copper and Zinc: Do they influence mastitis? *Proceedings of 33rd Annual Meeting of National Mastitis Council*. Inc. Orlando, Florida.

Jones D G and Suttle N F. 1981. Some effects of copper deficiency on leucocyte function in sheep and cattle. *Research in Veterinary Science* **31**: 151–56.

Nockels C F and Blair R. 1996. Antioxidants improve cattle immunity following stress. *Animal Feed Science and Technology* **62**: 59–68.

Percival S S. 1995. Neutropenia caused by copper deficiency—Possible mechanisms. *Nutrition Review* **53**: 59–66.

Schultz L H. 1977. Somatic cells in milk-physiological aspects and relationship to amount and composition of milk. *Journal of Food Protection* **40**: 125–31.

Takkar P N and Randhawa S S. 1992. Trace elements in Soil-Plant-Animal-Human interrelationships. *Proceedings of International symposium on Nutrient Management for Sustained Productivity* Volume1. 254–71.

Xin Z, Waterman D F, Hemken R W and Harmon R J. 1991. Effects of copper status on neutrophil function, superoxide dismutase and copper distribution in steers. *Journal of Dairy Science* **74**: 3078–85.