

VITAMIN E AND OXIDATIVE STATUS OF DAIRY COWS

Comparison Of The Oxidative Status Between Oral Vitamin E Supplemented And Non-Supplemented Cows Under Field Conditions

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1. INTRODUCTION

Vitamin E supplementation around calving is associated with enhanced health of dairy cows (Smith et al., 1997, LeBlanc et al., 2002, Politis et al., 2004). When free radical generation exceeds anti-oxidant capacity, oxidative stress develops. Around parturition lipid peroxidation increases (Brzezinska-Slebodzinska et al., 1994, Bernabucci et al., 2005, Castillo et al., 2005), indicating a higher level of oxidative stress which subsequently can lead to reduced health in cattle (Miller et al., 1993). Serum α -tocopherol in cows decreases in the last month before calving (Brzezinska-Slebodzinska et al., 1994, LeBlanc et al., 2004). Vitamin E, as the primary lipid-soluble antioxidant is important for the body's defence against oxidative stress (Ibrahim et al., 1997). Combining these findings it is reasonable that the link between vitamin E supplementation and improvement of health is reduced oxidative stress. The oxidative status of vitamin E supplemented en non-supplemented dairy cows was evaluated as well as the relationship between serum levels of vitamin E and oxidative stress parameters.

2. MATERIALS AND METHODS

Ninety eight Holstein Friesian dry cows were selected from 26 different commercial herds in The Netherlands. The daily vitamin E intake of the fifty-two supplemented cows was 1000 international units; the control cows were not supplemented. All cows were sampled once between 0 and 28 days before calving. Vitamin E, cholesterol and triglycerides levels were analyzed and the ratio of α -tocopherol to cholesterol was calculated. The markers of oxidative status measured were 1) the intracellular working enzymatic anti-oxidants superoxide dismutase (SOD) and glutathione peroxidase (GSHpx) 2) the low-molecular weight antioxidants uric acid and vitamin E 3) the extracellular working anti-oxidant albumin and 4) the non-antioxidants; malondialdehyde (MDA), a degradation product of lipid peroxidation, protein thiol oxidation level (pSH), reactive oxygen metabolites (ROM), iron (Fe) and the ferric reducing ability of plasma (FRAP). Parameters were chosen because they are all implicated in the pathways of the oxidative stress cascade and are directly or indirectly correlated to vitamin E. Data were analyzed using the statistical program SPSS 12.0.1 for Windows. The oxidative status of the two groups was compared using one sampled T-test for each parameter.

3. RESULTS

The mean concentration of serum α -tocopherol in the control group was significantly lower than in the supplemented group as was the ratio of α -tocopherol to cholesterol. Significant differences in serum MDA, pSH, Fe and uric acid levels were observed between the two groups.

Table 1. Mean values and standard deviation (SD) of α -tocopherol, cholesterol, triglycerides, ratio α :ch, GPx, SOD, Albumin, Fe, Uric acid, PSH, MDA, ROM, FRAP in the control group and the vitamin E+ group

Parameter	Mean (SD)		P
	Control group	Vitamin E+ group	
α -Tocopherol ($\mu\text{mol/l}$)	6,68 (1,80)	9,02 (2,92)	<0.0001
Cholesterol (mmol/l)	2,44 (,510)	2,35 (,573)	n.s.
Triglycerides (mmol/l)	0,29 (,098)	0,30 (,080)	n.s.
Ratio α :ch ¹ (mmol/l)	2,76 (,619)	3,82 (,715)	<0.0001
GSHpx ² (U*/l)	7,30 (6,18)	7,11 (3,05)	n.s.
SOD ³ (U*/l)	188 (89,3)	194 (81,1)	n.s.
Albumin (g/l)	37,3 (2,79)	37,3 (2,45)	n.s.
Fe ($\mu\text{mol/l}$)	30,3 (7,39)	33,2 (6,46)	<0.05
Uric Acid ($\mu\text{mol/l}$)	22,7 (9,37)	30,2 (9,91)	<0.0001
pSH ⁴ ($\mu\text{mol/l}$)	192 (39,0)	166 (25,6)	<0.0001
MDA ⁵ ($\mu\text{g/l}$)	15,0 (3,01)	11,6 (4,74)	<0.0001
ROM ⁶ (U ⁸ /ml)	64,3 (19,8)	58,1 (18,6)	n.s.
FRAP ⁷ ($\mu\text{mol/l}$)	325 (11,3)	326 (6,70)	n.s.
Haemolytic index	42,5 (60,0)	32,2 (27,2)	n.s.

¹ratio α -tocopherol:cholesterol (ratio α :ch)

²glutathione peroxidase (GSHpx)

³superoxide dismutase (SOD)

⁴protein thiol oxidation (pSH)

⁵malondialdehyde (MDA)

⁶reactive oxygen metabolites (ROM)

⁷ferric reducing ability of plasma (FRAP)

⁸U. Carr. is an arbitrary unit; 1 U. Carr. is equivalent to 0.08 mg of H₂O₂/100 mL

4. DISCUSSION

The aim of this study was to compare the oxidative status of orally vitamin E supplemented and non-supplemented housed cows under field conditions in the four weeks period before calving. As expected levels of serum α -tocopherol are influenced by the concentration of vitamin E in the diet, although correlation was low. The significant difference in serum MDA levels observed between the two groups suggests that in the control group higher levels of free radicals are present which cause more lipid peroxidation than in the vitamin E+ group. The MDA levels around parturition have been analyzed in a previous report (Castillo et al., 2005) and are in accordance with the results obtained by (Turk 2005) on serum paraoxonase activity of dairy cows, showing an increase of oxidative stress during the transition period. As we did, (Castillo et al., 2005) also observed a great inter-individual variation in MDA levels. Interpretations of the MDA results are therefore difficult and require further research.

5. CONCLUSION

Results of the present study demonstrated that MDA is a useful parameter to define a part of the oxidative status and the relation between supplementation and lipid peroxidation. But to determine the total oxidative status under field conditions and the exact influence of vitamin E on other oxidative stress parameters, further research is required.

6. REFERENCES

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