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EFFECT OF SELENOPROTEINATE ON COLOSTRUMS PRODUCTION AND IMMUNE RESPONSE OF LACTATING DAIRY COWS UNDER DIFFERENT DIETARY REGIMES

Caribu Hadi Prayitno [1] and T. Sutardi [2]

Abstract

Dairying is impeded by feed shortage due to the decline in agricultural land and lack of immune response associated with mineral deficiencies. This experiment is designed to test the efficacy of selenoproteinate in promoting colostrums and immune response under five dietary regimes. Diet K was a control containing 65% TDN and 13% CP, A = K + 2.5 $mgkg^{-1}$ selenoproteinate (0.3 ppm), B : improved diet containing 67% TDN, 14.5% CP and 3% hydrolyzed poultry feather, C = B + 0.7% urea, and D = C + 10 gkg^{-1} Zn-lysinate. All diets supplemented with selenoproteinate yielded more colostrums and resulted in significant changes in the parameter related to metabolism and immune response. Blood triiodothyronine increased from 0.42 to 1.05 nM, suggesting an improvement in metabolic rate that might lead to the increase in protein synthesis, including those related to immunity. This is apparent from the increase in blood IgG from 1.433 to 2.871 units Elisa and colostrums globulin from 236.67 to 326.76 $gday^{-1}$. It is apparent from this experiment that selenoproteinate could be used as an effective supplement in promoting immune response.

Key word: Selenoproeteinate, Cattle, Somatic cell count, Triiodothyronine, Immunoglobulins

Introduction

Selenium (Se) was found to be an essential trace element in 1957 when it was discovered that animals deficient in Se had increased susceptibility to liver necrosis (1). In 1973, Se deficiency was found to be associated with glutathione peroxides (GSH Px) deficiency (2). Se is needed for GSH Px activity, which decomposes hydrogen peroxides and lipid peroxides. Control of radicals produced in phagocytic and hydrolyte cells is required for normal immune activity (3). Dietary deficiencies of Se decreases immunoglobulin (Ig) G and IgM in plasma. Calves failing to absorb enough IgG have higher risk of morbidity (4) It was later discovered that selenocysteine was part of the enzyme molecule and essential for activity (5). In recent years, the essentiality of selenium has taken on a far more complex

[1] Animal Nutrition Dept. of Animal Science, Soedirman University, Indonesia
[2] Animal Nutrition Dept. of Animal Science, Bogor Agricultural University (IPB), Indonesia

perspective, with the identification of over 30 distinctive selenoproteins, virtually all containing selenocysteine, and each with its own distribution, local function (see Table 1; 5, 6).

This study was designed to investigate the effect of selenoproteinate in the dairy diet under different regimes on the colostrums and globulin colostrums production, Somatic Cell Count (SCC) of milk, Triidothyronine (T_3) and total IgG of blood.

Table1 1. Selenoproteins which have been purified and/or cloned, their location and possible functions

Nomenclature	Selenoprotein	Principal location	Function
GPX1	Cytosolic GSH peroxidases (GPX)	Tissue cytosol, RGC	Storage, antioxidant
GPX2	Plasma GPX	Plasma, kidney, lung	Extracellular antioxidant
GPX3	Phospholipid hyperoxide GPX	Intracellular membranes, particularly testes	Intracellular antioxidant
GPX4	Gastrointestinal GPX	Intestinal mucosa	Mucosal antioxidant
ID1	Iodothyronine 5'-deiodinase Type I	Liver, kidney, muscle	} antioxidant
ID2	Iodothyronine 5'-deiodonase Type II		
ID3	Iodothyronine 5'deiodonase Type III	Placenta	
TRR	Thioredoxin reductase	Tissue cytosol	Redox/antioxidant
Sel P	Selenoprotein P	Plasma	Transport, antioxidant, storage, heavy metal detoifier
Sel W	Selenoprotein W	Muscle	Antioxdant (?)
	Testes selenoprotein	Testes	Structural (?)

From : Underwood and Suttle (2001)

Methods

Cow and diets

All procedures for this study complied with recognized standards for humane care and treatments of animals. Twenty multifarious Holstein cows (average BW 450 kg) were used in this experiment. *Pennisetum purpureum* was provided for ad libitum consumption after calving and was given a limited amount before calving (dry period). Cows were fed their experimental diets from 60 d prepartum and were grown until 60 d post calving. Diet K was a control containing 65% TDN and 13% CP, A = K + 2.5 $mgkg^{-1}$ selenoproteinate (0.3 ppm Se), B = improved diet containing 67% TDN, 14.5% CP, and 3% hydrolysed poultry feather, C= B + 0.7% urea, and D: C + 10 gkg^{-1} Zn-lysinate.

Colostrums were recorded until 1 – 4 days after parturition. Samples of globulin were prepared with composite colostrums, and protein was analyzed using biuret methods. Milk (200 ml) samples were drawn weekly, beginning at d 7, from each quarter after milk letdown (all samples were taken at the a.m. milking). A composite sample was taken from the weigh jar at the end of milking and after agitation and milk yield was recorded. All samples were analyzed SCC milk samples were analyzed SCC within 24 h, samples were refrigerated overnight, and no preservatives were added. The SCC of milk samples was counted using a coulter electronic cell counter (Coulter Electronics, Inc., Hieleah, FL). Plasma concentrations of 3,3',5-triiodothyronine (T_3) were determined with radioimmunoassay kits (Coat-A-Count procedures; Diagnostic Products, Los Angeles, CA). Concentration of IgG in plasma was measured by radial immunodiffusion (VMRD Inc., Pullman, WA).

Statistical Analysis.

Data from globulin colostrums, SCC of milk, triiodothyronine and IgG in plasma were analysed according to a completely randomized design with repeated measures using the General Linear Models procedures of SAS (1989).

Results and Discussion

Treatments affected ($P<0.05$) colostrums production and globulin colostrums. Immunoglobulin concentrations in colostrums of cows ranged from 50 to 150 g/L; 85 to 90% is IgG , 7%, IgM, and 5% IgA. The mammary gland produced relatively large amounts of IgM and IgA but little IgG, which is mainly transferred from the serum of cows into their milk (7). In the present study, supplementation of selenoproteinate increased colostrums production and globulin, mainly on treatment with selenoproteinate and urea. Ammonia from urea perhaps increased microbial protein to supply protein for the colostrums synthesis.

Treatments affected ($p < 0.01$) the concentration of T3. Conversion of T4 to T_3 subsequently to T_2 (5'-deiodonase) is controlled by three is enzymes: type IDI (liver, kidney, and thyroid), type IDII (brain, brown adipose tissue, and pituitary), and type IDIII (brain and placenta). About 80% of T_3 in plasma is produced in the liver, kidney, and muscle, and all these tissue contain the Se-dependent enzymes type IDI (11), Se is required for conversion of thyroxine into the more active triiodothyronine via the type 1 deiodinase enzyme. Nutritional deficiency of Se in rats caused a significant decrease in plasma T_3, increased in plasma T_4, and inhibition of type IDI activity in liver. In another trial, a Se deficiency caused a 23% decrease in T_3 concentrations in plasma of rats, the ratio of T3: T_4 was reduced by 35%, and growth rate were depressed (12). However, the concentration of T3 in plasma of cows with acces to salt with 20 ppm Se was 14% lower than in cows supplemented with 60 ppm Se as selenite or Selenized yeast (13). Se as integral part of site active deiodonase more actively converted T_4 to T_3, respectively. Most probably T_3 had function on protein metabolism, especially protein related immunity.

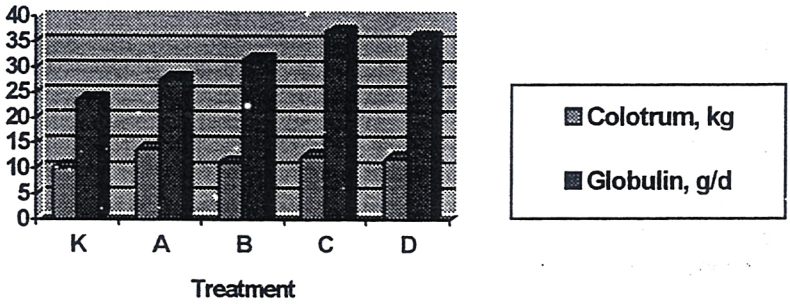

Figure 1. Colostrums and globulin production under different regiment

Diet K was a control containing 65% TDN and 13% CP, A = K + 2.5 $mgkg^{-1}$ selenoproteinate (0.3 ppm), B = improved diet containing 67% TDN, 14.5% CP, and 3% hydrolysed poultry feather, C= B + 0.7% urea, and D: C + 10 gkg^{-1} Zn-lysinate.

Treatments affected ($P<0.01$) immunoglobulin (IgG). Dietary deficiencies of Se decreased IgG and IgM in plasma (3). However, concentration of IgG was significantly lower in plasma of cows when given salt with 20 ppm Se as selenite compared to higher Se level (13). Concentration of IgG was significantly higher in plasma of cows that was given selenoproteinate 2.5 mg/kg DM (0.3 ppm Se). Supplementation of selenoproteinate increased immunoglobulin plasma more than 100%.

Treatment affected ($P<0.01$) limfosit. Limfosit was responsible for the immune sistem of the body.

Table 2. Effects of treatment on colostrum and immune response

Item	Treatments				
	K	A	B	C	D
Colostrum, kg/d	10.1 [a]	13.9 [b]	11.2 [a]	12.5 [b]	12.0 [b]
Globulin colostrum, (10g/d)	23.6[a]	27.6 [a]	31.5[a]	37.0[b]	35.8[b]
SCC, (10^5 sel/ml)	3.48 [c]	2.08 [a]	2.34 [b]	1.71 [a]	2.05 [a]
Triiodothyronine (nM)	0.42[a]	1.07[b]	1.07[b]	1.08[b]	0.98[b]
Total IgG (Elisa unit)	1.44 [a]	2.94 [b]	2..28 [b]	3.70 [b]	3.57 [b]

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