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Supplementing mineral selenium and vitamin e in diets on *in vivo digestibility*, blood glucose, and urea levels of cows

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Abstract. In such condition as of mating, pregnant and delivering calves, cows were often having deficiency in micro minerals, causing their reproductive functions to be less than optimal. The aim of this study was to determine the effect of Selenium and Vitamin E (SeVE) addition in diets on in vivo digestibility, blood glucose and urea levels. A total of 30 Ongole Crossbred cows (I3-I4 Aged, Body Weight 423.8 ± 75.0 kg, and Body Condition Score 3.1 ± 0.2) were used in this experiment. The study was conducted for 13 weeks. Animals were prepared to be inseminated by the Belgian Blue straws. They were kept in individual cages and were divided into two treatments, namely (P0) = basal diets and (P1) = basal diets + SeVE. The diets given were elephant grass and concentrate (3% of body weight). The results showed that addition SeVE increased digestibility of organic matter and crude protein, increased blood Se and urea levels, but did not show significant effect on blood glucose levels. In subsequent observations, SeVE addition turned out to have a positive effect on the incidence of pregnancy.

1. Introduction

The reproductive status of cow must be a major concern in terms of obtaining optimal pregnancy and birth rates. Several cases of reproductive failure and disturbance that occurred in the field were related to nutritional shortages, including macro and micro minerals and or vitamin. Selenium is an essential component of selenoproteins playing an important role in many biological functions, such as antioxidant defense, formation of thyroid hormones, DNA synthesis, fertility and reproduction. Selenium can be converted in the organism into various metabolites. Some, like methylselenol, play a role in cancer prevention [1].

However, selenium supplementation of feedstuffs appears to have no significant effect in chemical composition milk production as of lactose fat and protein [2], [3]. The last months of gestation cows represent the critical period for the selenium availability. The transfer of selenium to the fetus and subsequently to the calf occurs even when cows are deficient in selenium. Cows sacrifice selenium available to them to ensure adequate intake for newborns [5]. The right selenium concentration can reduce the incidence of metritis and ovarian cysts in the postpartum period, conversely, chronic selenosis decreases fertility by supporting the prolonged growth of ovarian cysts and anesthesia [6].

In addition, [7] and [8] reported deficiency of selenium leads to disorders in the perinatal period altering milk quality of cows. Selenium consumption is affected by dietary of Vitamin. It should be noted that selenium and vitamin E antioxidant functions are interdependent. A diet low in vitamin E may increase the amounts of selenium necessary for the prevention of certain anomalies [9].

The results of previous studies showed that the administration of selenium and vitamin E injections at a dose of 1.5 mg / mL of selenium and 50 mg / mL of vitamin E five times during gestation at seven months to the 14th day after childbirth encourages the successful involution of the uteri in dairy cows. Cows will soon return to estrus [10]. The condition of the cows after giving birth is associated with immune pressure which results in increased susceptibility to infection. This is mostly related to endocrine changes and decreased nutritional intake which have implications for the performance and health status of cows.

Selenium and vitamin E (SeVE) are closely involved with biological functions and antioxidant activities. Increased energy diets together with SeVE reduce oxidative stress in cows, improve immune function and improve reproductive performance of cows after calving [11]. In another study [12], antioxidant supplementation (SeVE) increases insulin sensitivity thereby reducing the effects of oxidative stress which can lead to insulin resistance. Zigo et al. [13] reported that parenteral administration of SeVE in dairy cows showed a positive effect on increasing the concentration of alpha-tocopherol and Se in blood plasma.

Based on the statements above, this study examined the supplementation of mineral Selenium combining Vitamin E in diets which initiate the changes on in vivo digestibility, blood glucose and urea levels and encourage the performance of cows specially to maintain reproductive states of the cows.

2. Methodology

A total of 30 Ongole Crossbred cows (I3-I4 Aged, Body Weight 423.8 ± 75.0 kg, and Body Condition Score 3.1 ± 0.2) were used in this experiment. The study which conducted for 13 weeks was located in Beef Cattle Research Institute (BCRI) barns at Grati, Pasuruan Indonesia. Animals were prepared to be inseminated by the Belgian Blue straws. They were kept in individual cages and were divided into two treatments, namely (P0) = basal diets and (P1) = basal diets + SeVE. The diets given were elephant grass and concentrate (3% of body weight).

The chemical composition of feed was shown in Table 1. The mixture of Selenium and vitamin E were given in powder form as of 9 g/kg concentrate. Parameter observed were: intake and the feed digestibility (dry matter, organic matter, and crude protein), and the level of Glucose, Uric, and Selenium in the blood. They were analyzed using Spectrophotometry. Meanwhile the data collected were analyzed by using T test.

Table 1. Chemical composition of feed (dry matter basis)

Note: CP = crude protein; EE = ether extract; CF = crude fibre; TDN = total digestible nutrient

Feed	Ash	CP	EE	CF	Starch	TDN[1]	Selenium
			(%)				(ppm)
Basal diets	11.6	17.3	6.3	12.5	52.3	72.7	0.70
Concentrate + SeVe	13.8	17.1	6.0	13.0	50.1	69.9	12.5
Grasses	12.2	10.9	1.8	34.3	40.8	48.0	0.2

3. Result and Discussion

3.1. Dietary selenium

The selenium content appeared to be higher in the P1 diet, as a logical consequence of supplementation in concentrate feed. Se content within grasses at P0 and P1 is relatively the same (1.4 vs 1.4 ppm). As shown in Fig1. there was a significant increase in the Selenium content in the total feed, namely an increase of 59.7 ppm (93.0%). This means that there is a significant contribution of Se content in the concentrate. This is in line with the report of Setyowati [16] that organic selenium supplementation (0.03 ppm) in concentrate increased the selenium content of treated feed.

Our findings showed the crude protein intake was increased (Table 2). Although research has been conducted to evaluate the effect of organic and inorganic selenium supplementation in beef cattle, it was found that different form of selenium did not affect average daily intake, average daily gain, and feed efficiency [17]. Dietary selenium intake can be affected by different form of selenium because of its difference in bioavailability and biopotency [18]. Both form of selenium supplementation in diet could increase blood selenium concentration although organic selenium has the highly impact [19], [20].

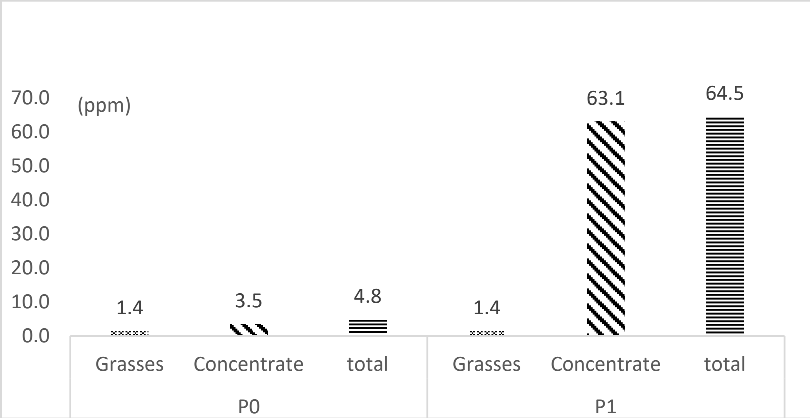

Figure 1. Dietary Selenium

Selenium levels in plants are influenced by selenium levels in the soil, plant species, plant age, plant production levels and climate [21]. Selenium levels are not evenly distributed in the soil resulting in different levels in plants. In addition, plants have different abilities to absorb selenium.

3.2. Intake and digestibility

Supplementation SeVE in the diet was not different among the intake of dry mater, organic matter and crude protein. This condition reflected that the diets was preferred by animals, and this is a way to explore this supplement in regards increasing feed digestibility and cow's performance. The average of daily DMI in this research (11.2 kg/head) was higher compared to earlier experiment (0.92 kg/head) [22]. Another experiment reported that animal supplemented with different form of selenium (organic vs inorganic) has similar daily feed intake [17].

Although not significantly different, data showed that average daily OMI and CPI obtained in this research was in agreement with earlier report [23]. There is an interesting result that although the dry matter digestibility of P1 is lower than P0, the digestibility crude protein of P1 is higher than that of P0. This shows positive effect resulting from SeVE supplementation in the diet in regard to digestibility. *In vivo* dry matter digestibility (DMD) and crude protein digestibility (CPD) were affected ($P<0.05$) by SeVe supplementation, while organic matter digestibility (OMD) was not ($P>0.05$) (Table 2).

Inorganic selenium supplementation in this research decreased DMD, similar with earlier experiment although animal received organic selenium supplementation [22], [24]. Previous study conducted by Kumar et al. [23] showed that OMD was similar between control and supplemented group. In agreement with this research, higher CPD was found in earlier experiment with animal supplemented lower to medium selenium yeast [24] while other experiment reported lower CPD affected by selenium supplementation [22].

Table 2. Feed intake and *in vivo* digestibility

Treatment	Daily intake (kg/head)			Digestibility (%)		
	DM	OM	CP	DM	OM	CP
P0	11.2 ± 1.0	9.7 ± 0.1	1.3 ± 0.1	72.1 ± 0.5^a	74.5 ± 0.4	65.1 ± 0.7^b
P1	11.2 ± 1.1	9.5 ± 0.0	1.3 ± 0.1	68.3 ± 0.9^b	74.2 ± 0.2	66.7 ± 1.0^a

Note: DM : dry matter; OM: organic matter; CP: crude protein; Means followed with different letters in same column differ significantly ($P<0.05$).

The apparent digestibility reflects process in the body to ensure the energy available and to estimate the protein microbial synthesis in the rumen. The report of [25] that the supplementation of highdegradation feed ingredients has increased digestibility and nutrient uptake, especially in the use of ingredients which from agricultural residues as basal feed.

According to the National Research Council [26], selenium can be legally supplemented in beef cattle diets to provide 3 mg/head daily or 0.3 mg/kg in complete diets, although the selenium requirement of beef cattle can be met by 0.1 mg/kg of diet. From this research, it was found that without SeVE supplementation, the diets contain enough selenium for animal according to NRC recommendation. Selenium supplementation can increase fertility and reduce embryonic death in first moth of gestation [6] and has an antioxidant role during belated follicular development as reported by previous research [27].

3.3. Blood glucose, urea, and selenium

Blood glucose levels did not show a significant difference even though blood glucose at P1was higher than that of P0. This result was reasonable due to the energy content of the feed with mineral Se + vitamin E supplementation and the control treatment feed relatively the same. Blood glucose in the results of the study ranged from 69.5 to 73.8 mg/dl.

The glucose level is still in the normal ranges. [28] reported that normal bovine blood glucose levels were in the range of 43-100 mg / dl. Blood glucose concentration of the heifers was 57 ± 2 mg/dL in the low group and 78 ± 2 mg/dL in the high group. Heifers that had low blood glucose at arrival consumed more feed (P=0.02), tended to have increased final bodyweight and rate of gain (P<0.10), had increased backfat thickness (P<0.05), and tended to have heavier hot carcass weights and fewer standard carcasses (P<0.10) compared with heifers that had high blood glucose at arrival.

Meanwhile, blood urea levels showed a significant difference. Blood urea levels at P1 was higher than those of P0. The increasing blood urea level was reasonable due to simultaneously effects of supplementation. Blood urea levels in dairy cows in the study of Juniper et al. [20] with supplementation of 0.40 mg / kg selenium yeast in the feed was 8.4 mmol / L. The blood urea levels in the study ranged from 39-44.8 mg / dl. The blood urea levels were still in the normal range.

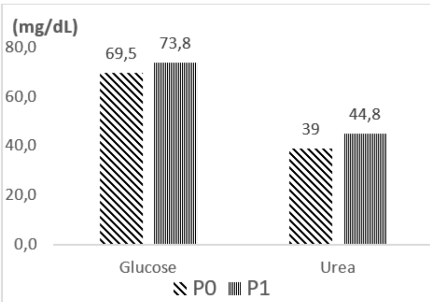

Figure 2. The level of glucose and urea in the blood

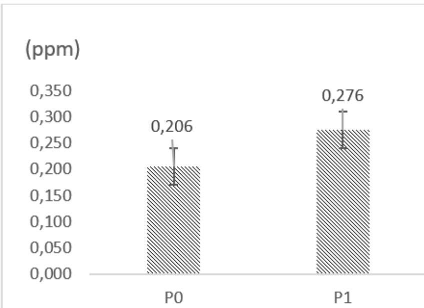

Figure 3. The level of selenium in the blood

In blood, the selenium is bound to the α and β-globulins, LDL (low density lipoprotein) and VLDL (very low density lipoprotein) and albumin [29]. Ten selenium atoms as selenocysteine are included in the selenoprotein-P which is a selenoprotein supplier of selenium to body tissues [30]. According to [31], the rate of adequate selenium in the blood of cattle is between 0.08 and 0.16 mg/L. In plasma, the selenium is mainly found in the albumin fraction.

According to Villar et al. [32], the appropriate level in plasma selenium is between 51 and 85 μg/L. To achieve this adequate rate, additional dietary intake of 0.5 mg/kg DM may be enough [9]. An increase in Hungate [33] stated that normal blood urea levels in cattle range from 26.6 to 56.7 mg / dl. In this study blood selenium levels showed a significant difference. Blood selenium in the supplementation treatment was higher than the control treatment. This is because the selenium supplements in feed are absorbed to bloodstream. Juniper et al. [20] reported levels of selenium in the blood of dairy cows in the selenium yeast supplementation treatment to the feed of 0.40 mg / kg was 251 μg / L. The treatment without supplementation of selenium was 211 μg /L.

In subsequent observations (after a period of 13 weeks), we found that the cattle in P1 (four out of 15 animals) showed pregnancy, after insemination with *Belgian Blue* straw as donors, whereas in P0 still did not show signs pregnancy of animals.

4. Conclusion

Supplementation of SeVE to the basal diet gives positive impact of cows in regard to crude protein digestibility and the level of glucose, urea, and mineral selenium in the blood.

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