Optimizing Vitamin-Mineral Supplementation in King Grass-Based Rations to Maximize Productivity of Bali Cattle

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Abstract

Bali cattle have a great potency to supply national meat demand which is increasing progressively every year. The main constrain in Bali cattle farming is the deficiency of trace minerals on native grass resulting in low Bali cattle productivity. The present study was done to determine the optimum vitamin-mineral supplementation in King grass-based rations to maximize productivity of Bali cattle steers. Randomized Complete Block Design used in this study consisted of four treatments and five groups based on differences in live weight cattle. Treatments consisted of: S0 = concentrate as much as 5 kg + King grass given ad libitum, S1, S2, and S3 = S0 successively added 0.1%, 0.2% and 0.3% vitamin-mineral in concentrate. Variables observed were nutrients intake, deposition of nutrients, energy retention, live weight gain of the animals, and feed efficiencies. The data were analyzed by analysis was of variance, and regression analysis used to predict the optimal level of supplementation. Results showed that vitamin-mineral supplementation significantly (P <0.05) affected all the observed variables. Supplementation levels of 0.2 to 0.3% can reduce the consumption of nutrients, but supplementation levels of 0.1 to 0.3% increased deposition of nutrients, energy retention, feed efficiency, and increased a live weight gain of Bali cattle steer up to 14% (0.58 vs. 0.66 kg/ day) compared to those cattle without supplements. It is concluded that vitamin-mineral supplementation of 0.1 to 0.3% in ration based on King grass can increase deposition of nutrients, energy retention, feed efficiency, and live weigh gain of Bali cattle steers. Based on regression analysis, it is obtained that the optimum level of vitamin-minerals supplementation in concentrate was 0.16% which can produce maximum live weight gain of Bali cattle steer fed King grass-based rations.

Keywords: bali cattle, supplementation, vitamin-mineral

Introduction

Bali cattle has a great potency to supply the national meat demand which is increasing progressively every year. However, the main constraint of fattening Bali

cattle agribusiness is the limited forages available for the farm and trace mineral deficiency in the native grass.

King grass and concentrates are usually given to cattle by farmers in Bali, but still need to be supplemented with minerals to maximize the productivity of cattle because plants of tropical feed are deficient in trace minerals (Kaunang, 2004). Therefore, the productivity of Bali cattle can still be improved by feeding an adequate and balanced nutrients .

The present study was done to determine the optimum vitamin-mineral supplementation in King grass-based rations to maximize productivity of Bali cattle steers.

Materials and Methods

This study consisted of a series of field and laboratory experiments. Field trial was conducted in the Serongga village, Gianyar regency. Laboratory analysis was conducted at the Lab. of Nutrition, Fapet - Unud, and Lab. of Analytical Udayana University.

The experiment was conducted in individual cages. Cage is designed to meet the maintenance requirements of fattening Bali cattle. Required 20 individual cages to accommodate 20 steers of Bali cattle with an average live weight of 319 kg or with the range of 279-367 kg steers.

Ration treatments consisted of King grass and concentrates supplemented with pignox (commercial product as a source of vitamins and minerals). There were four treatments in concentrate rations i.e., S0 is concentrate without pignox addition, while concentrate on the S1, S2, and S3 supplemented with 0.1%, 0.2% and 0.3% pigox (Table 1).

Table 1. Nutrient content of diets

Nutrient	Concentrates				King grass
	S0	S1	S2	S3	
Dry matter (%)	87.64	87.64	87.64	87.64	24.80
Organic matter(%)	64.13	64.13	64.13	64.13	71.84
Crude protein (%)	12.13	12.13	12.13	12.13	5.01
Crude fiber (%)	7.76	7.76	7.76	7.76	27.20
Energy (GE. Mcal/kg)	3.22	3.22	3.22	3.22	3.39
Sulfur (S. ppm)	685.50	694.09	702.68	711.28	-
Zinc (Zn. ppm)	45.09	65.09	85.09	105.09	26.12

Description: S0, S1, S2, and S3= vitamin-mineral supplementation in concentrate with 0%, 0.1%, 0.2% and 0.3% pignox, respectively.

Variables observed were nutrients intake, deposition of nutrients, energy retention, live weight gain of the animals, and feed conversion ratio Energy retention was calculated by deposition of nutrients and deposition of nutrients was calculated by converting live weight gain with body composition (by urea space technique). Based on this nutrient deposition, it can be calculated the energy retention with the provisions of 1g of fat deposition equivalent to 9.32 kcal, while the deposition of 1 g protein equivalent to 5.5 kcal (Ørskov and Ryle, 1990). So the retention of energy per day per cattle can be calculated by summing the energy content of the deposition of body fat and protein per cattle per day.

The data obtained were analyzed by analysis of variance, and regression analysis used to predict the optimal level of supplementation (Steel and Torrie, 1986).

Results and Discussion

Vitamin-mineral supplementation significantly ($P < 0.05$) affected dry matter intake, protein intake, energy intake, deposition of nutrients, energy retention and live weight gain of Bali cattle (Table 2).

There is a clear relationship between vitamin-mineral supplementation with live weight gain of Bali cattle, following regression quadratic equation: $Y = 0.583 + 0.959\ X - 2.95\ X^2$ with a coefficient of determination (R^2)= 0.414* with the understanding of X= supplementation of vitamin-mineral (%), Y= live weight gain of Bali cattle (kg/day) as seen in Figure 1. From this regression equation can be pre-

Table 2. Dry matter and nutrients intake, nutrients deposition, retention of energy and live weight gain of Bali cattle fed King grass-based rations with vitamin-mineral supplementation

Variables	Supplementation Treatment			
	S0	S1	S2	S3
Dry matter intake (kg/h/d)	6.65[b]	6.58[b]	6.29[a]	6.18[a]
Protein intake (g/kgW$^{0.75}$/d)	7.92[b]	7.87[b]	7.44[a]	7.32[a]
Energy intake (Kcal/kgW$^{0.75}$/d)	271.52[b]	267.47[b]	254.54[a]	247.33[a]
Protein deposition (g/ kgW$^{0.75}$/d)	1.18[a]	1.31[b]	1.30[b]	1.19[a]
Fat deposition (g/ kgW$^{0.75}$/d)	2.6[a]	3.0[b]	2.9[b]	2.7[a]
Retention of Energy (NEp. Kcal/kgW$^{0.75}$/d)	31.14[a]	34.92[b]	34.64[b]	32.06[a]
Feed Conversion Ratio (FCR)	11.48[b]	10.06[a]	9.68[a]	10.18[a]
Live weight gain (kg/d)	0.58[a]	0.66[b]	0.65[b]	0.61[a]

Values with different superscript in the same line means significantly different ($P<0.05$).
NEp= Net energy for production.

dicted the optimum vitamin-mineral supplementation was 0.16% which produces the maximum live weight gain of Bali cattle of 0.66 kg/day.

Rations tested in this study met the nutrient requirement which consisted of 5 kg concentrate and an average of 15 kg king grass per cattle per day, so that these rations contained dry matter (DM) 40.51%, crude protein (CP) 10.31%, and energy (GE) 3.27 Mcal/kg, equivalent to 56.29% of TDN (Total Digestible Nutrients). However, the results of this experiment showed that feed intake and nutrient levels such as dry matter and energy significantly ($P<0.05$) decreased when given vitamin-mineral supplementation in concentrate, especially at supplementation of 0.2 to 0.3% (Table 2). This decline in consumption may be caused by an imbalance of nutrients in diet, especially minerals. Decrease in consumption level has not yet led to nutrient-deficient cattle and this can be proved by live weight gain of cattle during the experiment, although feed intake decreased with increasing levels of vitamin-mineral supplementation.

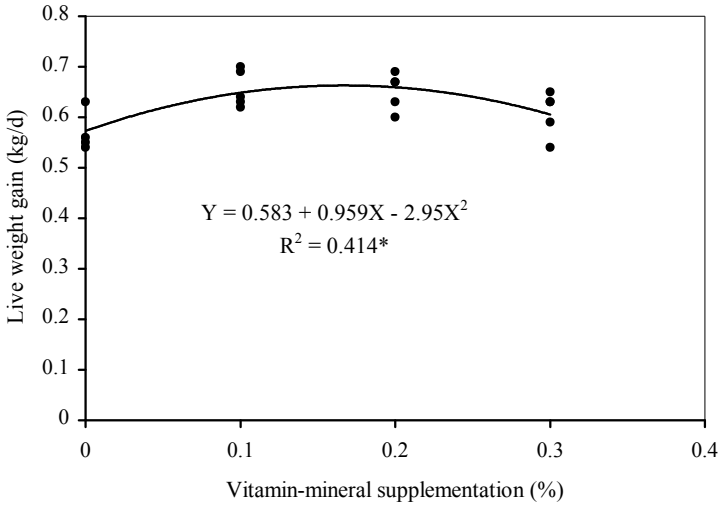

Figure 1. The relationship between vitamin-mineral supplementation with live weight gain of Bali cattle fed King grass-based rations

Vitamin-mineral supplementation from 0.1 to 0.2% in concentrate gave a positive influence on energy utilization and productivity of Bali cattle fed King grass-based rations which were characterized by higher energy retention and live weight gain (Table 2). This was supported by higher levels of ammonia ($N\text{-}NH_3$) and propionic acid, lower methane emission and higher rumen microbial protein synthesis at the level of supplementation from 0.1 to 0.2%. Rumen microbial protein as a major source of amino acids for the host animals, so the higher rumen microbial protein production of higher protein deposition in the body of cattle. Meanwhile, the lower the methane gas production means less energy is wasted so that more energy is stored in the form of animal protein and fat (Partama *et al*., 2010).

High deposition of nutrients, energy retention and live weight gain in cattle with vitamin-mineral supplementation of 0.1% due to the sufficient and balanced nutrients in the ration. Concentrate with a vitamin-mineral supplementation of 0.1% containing balanced ratio of N:S, and contains enough minerals Zn and S (Table 1). S is an essential mineral in amino acids synthesis contains sulfur, and is needed in large numbers for microbial protein synthesis. Meanwhile, Zn minerals involved in metalo enzyme synthesis such as DNA and RNA polymerase, alkaline phosphatase, amylase and neutral protease (Jouany, 1991).

The research was supported by N-NH_3 concentration sufficient to support the relatively high concentration of VFA (from 166.33 to 198.06 mM), consequently would strongly support the rumen microbial protein synthesis (Partama *et al*., 2010). Stern *et al* (2006) states that the rumen bacteria can use protein and carbohydrates as energy sources. Carbohydrate is the main energy source for bacteria, and can also be used as a carbon skeleton that combines with ammonia (NH_3) to rumen microbial protein synthesis.

Vitamin-mineral supplementation of 0.1% in concentrate gave the best effect in productivity of Bali cattle fed King grass-based rations. This shows that supplementation at the level of 0.1% pignox in the rations contained enough nutrients and balanced. Mineral content of Zn in concentrate was 65.09 ppm (Table 1), slightly higher than the recommendation of Georgievskii (1982), i.e., 40-60 ppm due to differences in cattle breeds used.

Conclusions

Vitamin-mineral supplementation at 0.1 to 0.3% in rations based on King grass can increase deposition of nutrients, energy retention, feed convertion ratio, and live weigh gain of Bali cattle steers. Based on regression analysis, the optimum level of vitamin-minerals supplementation in concentrate was 0.16%.

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