Growth and Rumen Environment of Pre-weaning Bali Calves Offered Different Forage-Based Calf Supplements

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ABSTRACT: Replacing part of the concentrate based calf supplement with high quality forages may result in reducing the price of the supplement which makes it affordable by small tenant farmer thereby improving its adoption rate. Sixteen pre-weaning Bali calves were involved in this experiment with the objective to investigate the effect of replacing 2/3rd of concentrate-based supplement with leucaena (*Leucaena leucocephala*), siratro (*Macroptilium atropurpureus*) and king grass (*Pennisetum typhoides*) on growth rate, rumen environment and blood metabolites of Bali calves. Calves were randomly grouped into four groups and they were offered a concentrate-based calf supplement (CSc) or different forage based cal supplement made by replacing 2/3rd of the concentrate on dry matter (DM) bases with leucaena (CSl), siratro (CSs), and king grass (CSg). Concentrate supplement was formulated using rice bran, corn meal and fishmeal to contain 18% crude protein. Parameters measured included mortality rate, growth rate, and rumen environment (concentration of total and individual volatile fatty acid, VFA). All forage-based calf supplement are as good as concentrate supplement in preventing calf losses since no calf died during the experiment. Calves consumed siratro-based supplement have comparable ($P>0.05$) growth rate with those offered the concentrate supplement and significantly higher ($P<0.05$) than those offered other forage-based supplement. Bali calves offered CSl had significantly lower ($P<0.05$) rumen total VFA concentration particularly that of propionate and butyrate. It can be concluded that siratro can be used to replace 2/3rd of concentrate supplement thereby can used for cost effective calf supplement.

Keywords: calf supplement, forage, growth rate, mortality rate, VFA

INTRODUCTION

The substantially high calf mortality and slow growth rate during pre-weaning period has been considered as apredominant factor resposible for the low cattle productivity in cattle producing areas in Indonesia including The Province of East Nusa Tenggara. Supplementation of calves during the dry season before weaning has been proven to be a promising option to improve beef cattle production and hence potentialy benefiting small scale famers. Provision of a small amount (2% live weight, LW) of locally blended concentrate supplement to Bali calves before weaning can significantly reduce mortality rate (from 20 to 50% to less than 1%) and increase growth rate (206 versus 100 g/day live weight gain) (Jelantik *et al.,* 2008). The yearling weight for the supplemented calves was almost double that of the control calves (Copland *et al.,* 2011).

Whilts the supplementation strategy using concentrate-based supplements is readily accepted

by larger scale farmers, its adoption by small tenant farmer remained low. The most prominent reason is that even when the concentrate based supplement was composed of locally available feeds on local market, a concentrate based supplement was still considered to be expensive and unavordable by farmers (Parker *et al*., 2012). Therefore, replacement most of the concentrate-based supplement with high quality forages, hence become 'a forage-based supplement' may improve its adoption rate. This experiments was conducted to investigate the effect of replacement of 2/3rd of concentrate supplement with different forages, i.e. grass, leucaena and siratro (*Macroptilium atropurpureus*) that can be produced by farmer, on pre-weaning Bali calves survivability and performance.

MATERIALS AND METHODS

Sixteen pre-weaning Bali calves were involved in this experiment with the objective to investigate the effect of replacing 2/3rd of concentrate-based supplement with respectively leucaena leaf (*Leucaena leucocephala*), siratro (*Macroptilium atropurpureus*) and king grass (*Pennisetum typhoides*) on growth rate, rumen environment and blood metabolites of Bali calves. Calves were randomly grouped into four groups of four with balanced sex and they were offered a concentrate-based calf supplement (CSc) or different forage-based supplement made by replacing 2/3rd of the concentrate supplement on dry matter (DM) bases with fresh leucaena leaf (CSl), siratro (CSs), and king grass (CSg). Concentrate supplement was formulated using rice bran, corn meal and fishmeal to contain 18% crude protein. All supplements were introduced to calves one month after calving in a creep feeder during night time when cow-calf pairs were back from grazing.

Calves were weighed beweekly and the weight difference between two consecutive weighing was calculated as average daily gain (ADG). Any calf death was recorded and calculated for mortality rate. Rumen liquid was taken from calves at three months after supplementation and measured for pH and thereafter acidified to pH <3 using few drops of concentrated hydrochloric acid before frozen to await determination for concentrations of ammonia as well as total and individual volatile fatty acids (VFA).

RESULT AND DISCUSSION

Mortality rate of Bali calves offered different forage-based calf suplements was firtually zero since the was no calf died during the experiment. Results of the present experiment appeared were comparable to previous results with concentrate-based supplements. In a large scale experiment involving nearly 946 pre-weaning Bali calves, Jelantik *et al.* (1998) and Copland *et al.* (2011) reported that providing 2% BW locally blended concentrate supplement reduced mortality rate to 3% compared to 34% in the unsupplemented calves.Our finding showed that replacing 2/3rd of the concentrate supplement with different good quality forages were still able to prevent calf death. This could mean that farmer adoption of calf supplementation strategy can be expected to increase since high price fo concentrate supplements was one of the reason for low farmer adoption on such strategy (Parker *et al*., 2014). Therefore, it would be expected that cattle production can be substantially improved since the exceptionally high calf mortality, i.e. reaching a level of 47% (Wirdahati and Bamualim, 1990) up to 53% (Fattah, 1998), has been considered as the main factors contributing for the low cattle production in The Province of Nusa Tenggara Timur as well as other dry land areas in Indonesia.

Further benefit of calf supplementation on cattle production will be obtained when weight gain is also improved. Previous reports (Jelantik *et al.*, 2008; Copland *et al.,* 2011) recorded a

significant increase in average daily weight gain (ADG) when Bali calves were offered with concentrate supplement while their dam were out for grazing. In those experiments, the level of ADG for supplemented calves varied between 120 g to 249 g per day compared to 90 g in the unsupplemented calves. In the present experiment, ADG of supplemented Bali calves felt within that level. As shown in table 1, of the different forages evaluated to replace 2/3rd of the concentrate supplement, siratro (*M. atropurpureus*) gave the highest ADG make the only forages that gave comparable result to that of concentrate supplement. Meanwhile, ADG of Bali caves offered leucaena-based supplement was the lowest. Part of the explanation for the superiority of siratro to replace 2/3rd of concentrate in calf supplement is due to its nutritive value. With relatively high in crude protein content and degradability in the rumen (Bowen *et al.*, 2008), siratro was very close to CP content of concentrate supplement.Moreover, siratro is known to have negligible concentration on antinutritive factors (Norton and Poppi, 1996). Young calves are very sensitive to ANF (Lalles, 1993). This perhaps the reason for the low performance of Bali calves offered leucaena-based supplement. Leucaena leaf has been reported to contain high concentration of ANF in the form of mimmosine (Devendra, 1996).

Table 1. Means of daily weight gain and body linier measurements of Bali calves offered different forage-based calf supplements

Variables	Calf Supplement				SEM	P
	CSc	CSg	CSl	CSs		
ADG (g/d)	187.50^{ab}	136.82^{a}	126.69^{a}	236.49^{b}	0.023	0.019
HG(cm/d)	0.118	0.108	0.107	0.112	0.021	0.375
WH increase (cm/d)	0.118	0.117	0.108	0.128	0.020	0.928
BL increase (cm/d)	0.088	0.117	0.108	0.128	0.020	0.810

Values within similar raw followed by different alphabed shows significant difference (P<0.05)
CSc=concentrate, CSg=1/3 concentrate 2/3 king grass, CSl=1/3 concentrate 2/3 leucaena, CSs=1/3 concentrate 2/3 siratro
ADG = average daily weight gain, WH=wither height, BL=body length, HG=heart girt

Data on body measurements which indicate frame size of Bali calves recorded in the present experiment was in agreement with report by Leu-penu *et al.* (2008) who recorded increase in heart girt varied from 0.13 to 0.15 cm/d for Bali calves offered similar concentrate supplement. Increase in heart girt, body length and wither height did not differ (P>0.05) between calves offered concentrate or different forage-based supplements.

Another reason for better performance of Bali calves on siratro-based supplement may lay on the end product of fermentation in the rumen. Table 2 showed that the total VFA and particularly propionate concetration in rumen liquid of calves fed siratro-based supplement was very close to that in concentrate supplemented calves and significantly (P<0.05) higher than that of other forage-based supplement fed calves. This indicate better energy status of the calves since part of energy supply in young calves beside from milk is from VFA absorbed in the rumen (Orskov and Ryle, 1990). Moreover, propionate is known as glucogenic and readily converted into glucose to fulfill the requirement which then allowing more amino acids availability for tissue deposition (Preston and Leng, 1987) and higher weight gain. Higher VFA concentration also positively

correlated rumen pH and with better and faster rumen development. Optimal villae developement of rumen wall requires acids particularly butyric acid (Davis and Drackley. 1998). In general, all supplemented calves have low rumen pH, i.e. less than 6, indicating optimal and fast rumen developement. However, calves offered leucaena-based supplement had significantly (P<0.05) higher rumen pH. This may be related to significantly lower total VFA concentration and higher rumen ammonia concentration since leucaena contained highest crude protein compared to other forages and it is partly degraded in the rumen (Jelantik, 2001). Nevertheless, fast growing rumen is particularly important when for early weaning strategy which require fully developed rumen as soon as possible enabling the calves to acquare solid feeds. Early weaning is considered as one strategy to improve cattle production by removing feed requirement for suckling and hence the nutrient intake can be directed for increasing body cow condition and more successfull reproduction.

Table 2. Means of pH and vollatile fatty acids (VFA) concentration of rumen liquid of Bali calves offered concentrate or different forage-based supplement

Variables	Calf Supplement				SEM	P
	CSc	CSg	CSl	CSs		
pH	5.13a	5.16a	5.37b	5.10a	0.011	0.013
Asetate	50.99	47.88	38.05	51.84	5.719	0.119
Propionate	16.68bc	12.01ab	10.56a	19.01c	2.213	0.010
Butyrate	8.58b	6.84ab	5.88a	8.54b	0.954	0.043
Total VFA	76.39b	66.73ab	54.49a	79.39b	7.906	0.038

Values within similar raw followed by different alphabed shows significant difference (P<0.05)
CSc=concentrate, CSg=1/3 concentrate 2/3 king grass, CSl=1/3 concentrate 2/3 leucaena, CSs=1/3 concentrate 2/3 siratro

CONCLUSION

All forages are able to replace 2/3rd of concentrate suplement to improve Bali calves pre-weaning survivability. However, siratro (Macroptilium atropurpureus) is the best candidate to replace most of concentrate supplement to improve rumen VFA concentration particularly propionate and daily weight gain.

REFERENCE

Bamualim, A. B., R. B. Wirdahayati and A. Saleh. 1990. Bali cattle production from Timor island. Research report, BPTP, Lili, Kupang.

Bowen, M. K., D. P. Poppi, and S. R. McLennan. 2008. Ruminal protein degradability of a range of tropical pastures. Australian Journal of Experimental Agriculture. Volume 48 Issue 6-7 pp. 806-810.

Copland, RS., IGN Jelantik, and ML Mullik. 2011. Evaluating Strategies to Improve Calf Survival in West Timor Vilages. ACIAR GPO Box 1571, Canberra ACT 2601 Australia

Davis, C. L. and J. K. Drackley. 1998. The Development, Nutrition and Management of the Young Calf. Iowa State Univ. Press, Ames, Iowa.

Devendra, C. 1996. Composition and nutritive value of browse legumes. In: Tropical Legumes in Animal Nutrition. J. P. F. D'Mello and C. Devendra (Eds). CAB International.

Fattah, S. 1998. The productivity of Bali cattle maintained in natural grassland: a case of Oesuu, East Nusa Tenggara. PhD Thesis, Universitas Padjajaran, Bandung.

Jelantik, I G. N. 2001. Improving Bali Cattle (Bibos banteng Wagner) Production through Protein Supplementation. PhD Thesis. The Royal Veterinary and Agricultural University, Copenhage, Denmark.

Jelantik, I G. N., R. Copland and M. L. Mullik. 2008. Mortality rate of Bali cattle (Bossondaicus) calves in West Timor, Indonesia. Animal Production in Australia. Vol 27, p. 48.

Jelantik, I. G. N., M. L. Mullik, C. Leo-Penu, J. Jeremias and R. Copland. 2008. Improving calf survival and performance by supplementation in Bali cattle. Australian Journal of Experimental Agriculture. Volume 48 Issue 6-7 pp. 950-953.

Lalles, J. P. 1993. Nutritional and antinutritional aspects of soybean and field pea protein used in veal calf production: a review. Livest. Prod. Sci. 34: 181-202.

Norton, B. W. And D. P. Poppi. 1996. Composition and nutritional attributes of pasture legumes. In: Tropical Legumes in Animal Nutrition. J. P. F. D'Mello and C. Devendra (Eds). CAB International.

Orskov, E. R. And M. Ryle. 1990. Energy Nutrition in Ruminants. Elsevier Applied Science, London and New York.

Parker, A., R. Copland, T. Schatz, C. L.Penu, M.L.Mullik, I.G.N.Jelantik, I.Benu. 2012. Improving Calf Survival and Growth Rates for The Beef Supply Chain in Indonesia. ACIAR, Canberra, Australia

Preston, T. R. And R. A. Leng. 1987. Matching Ruminant Production Systems with Available Resources in The Tropics and Sub-Tropics. Penambul Books. Armidale.