

## NITROGEN REQUIREMENTS FOR MAINTENANCE OF GROWING THAI NATIVE BUFFALO FED WITH RICE STRAW AS ROUGHAGE

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### ABSTRACT

This study was aimed to investigate protein requirement for maintenance in swamp buffalo calves. Four male swamp buffalo calves (12-18 months of age and 218 kg average body weight) were randomly assigned according to a 4 x 4 Latin square design to receive four levels of crude protein (5, 7, 9 and 11% CP). The experimental consisted of four periods of 21-d, 14 days for adaptation and the last 7 days for sampling feces and urine. Animals were fasted for measuring N-retention on the last 4 days of the experiment. The N requirement for maintenance was estimated by the N balance and N intakes were inserted into a regression equation. The crude protein intake, N excretion in urine and N balance increased ( $P < 0.05$ ) with the increase CP content in the diet. However, dry matter intake and fecal N were not different. The result indicated that the nitrogen requirement for maintenance of growing Thai swamp buffalo calves is 0.75 g N or 4.69 g CP/ kg BW<sup>0.75</sup>.

**Keywords:** swamp buffalo, *Bubalus bubalis*, protein requirement, N balance, protein for maintenance

### INTRODUCTION

Nutrition of male buffalo calves is importance as it plays a role in the onset of puberty in calves raised for breeding and it influences the quantity and quality of beef produced by the calves. Study of nutritional requirements of buffalo is necessary as the NRC standard suggested is for dairy or beef cattle. Basra *et al.* (2003b) reported that lower protein requirements of male *Nili-Ravi* buffalo calves than cattle calves. Furthermore, research on the requirements of nutrients of Thai swamp buffalo does not exist and adequate information on the nutritional requirements of growing male buffalo calves is lacking. Swamp buffaloes are used for multiple purposes: draft power, transportation, capital, credit, meat, milk, social value, hides, and sources of natural fertilizer for cropping. In many places, buffaloes are preferred over cattle because of their superior quality of milk, better efficiency in utilization of nutrients from poor-quality fibrous tropical feeds and relatively better disease resistance and adaptability to tropical climates (Paul and Patil, 2007). In order to achieve their production potential, buffaloes have to consume their required amounts of nutrient from

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their diets. The nutrition of young male buffalo is also important as it plays a major role in the onset of puberty when they are raised for breeding and it influences the quantity and quality of the meat they produced. Dietary protein supply is one of the factors that influence the productivity of animals and is supplied from microbial and dietary sources. Generally, microbial protein supplies 70 to 80% of the required amino acids to ruminants and microbial yield in the rumen depends largely on the availability of carbohydrate and nitrogen (N) in the rumen (Chumpawadee *et al.*, 2006). Feeding high levels of protein may be effective in promoting rapid live-weight gains, especially in growing buffalo (Basra *et al.*, 2003a). Currently, there is insufficient information concerning the effects of protein on nutrient digestibility and nitrogen metabolism in Thai swamp buffaloes. A study of the nutritional requirements of buffaloes is necessary because the current standards of NRC (1996 and 2001) are used for beef or dairy cattle. Although, the nutrition requirements of buffalo have been determined by Kearl (1982), they cannot be accurately applied for swamp buffalo. Basra *et al.* (2003b) reported lower protein requirements for male *Nili-Ravi* buffalo calves than cattle calves, and found that the CP requirements for growth may be the same as for Holstein Friesian calves (Basra *et al.*, 2003a). However, an optimum growth rate and feed utilization efficiency, according to inherent genetic potentiality of a particular category of animal, can only be achieved through an accurate valuation of their nutrient requirements (Paul and Patil, 2007). Hence, this experiment was conducted to determine the CP requirements for maintenance of growing Thai swamp buffalo.

## MATERIALS AND METHODS

Four male swamp buffalo calves (12-18 months of age and 218 kg average body weight) were randomly assigned according to a 4 x 4 Latin square design to receive four levels of crude protein (5, 7, 9 and 11% CP). The experimental consisted of four periods of 21-d, 14 days for adaptation and last the 7 days for sampling feces and urine. Animals were fasted for measuring N-retention on the last 4 days of experiment. The N requirement for maintenance was estimated by the N balance and N intakes were inserted into a regression equation.

The total feces and urine were collected daily from day 3 to 7 of each collection period. The feces were weighed and mixed well and a 10% sub sample was taken and frozen. At the end of each collection period, the daily fecal samples were bulked for each animal. Ten percent of each mixed bulked sample was taken for chemical analysis and calculations of digestibility of DM, OM, CP, NDF and ADF were done. Urine samples were acidified with 25% H<sub>2</sub>SO<sub>4</sub> to keep the final pH of the urine below 3 (to prevent ammonia losses during the day) and then weighed and sampled (similar to feces). Representative samples of feed and feces were collected during the digestibility trial and analyzed according to AOAC (1984) and fiber components (Van Soest *et al.*, 1991). Urine was sampled for determination of urine nitrogen and purine derivative excretion. Urine was diluted five times with distilled water and mixed thoroughly and stored at -20°C for later analysis for N. To estimate the dietary N requirement for growth, the ADG and N intake were inserted into a regression equation:  $ADG = ADG \text{ index} \times (N \text{ intake}) - ADG \text{ at zero N intake}$ , where the N requirement (Nm) for maintenance equals N intake when ADG is zero.

The data were analyzed by the general linear

models procedure of the Statistical Analysis System Institute SAS (1988) using Duncan's New Multiple Range Test (Steel and Torrie, 1980) to compare treatment means. Unless otherwise noted, high significance was declared at  $P < 0.01$ , significance was declared at  $P \leq 0.05$ , and non-significance was declared at  $P > 0.05$ .

## RESULTS AND DISCUSSION

Daily DM intake for calves fed different CP diets did not significantly (Basra *et al.*, 2003a). In contrast average daily CP intake in calves increased with increasing CP level in the diet (Basra *et al.*, 2003a; 2003b). N excretion through urine and N balance increased significantly due to CP diet and N intake (Mehra *et al.*, 2006). However, fecal N was not significant (Table 1). Therefore, the nitrogen requirement for maintenance for growing swamp buffalo calves is  $0.75 \text{ g N/kg BW}^{0.75}$  (Figure 1). Basra *et al.* (2003b) found that protein requirements of male *Nili-Ravi* buffalo calves were 20% lower than dairy cattle calves whereas the protein requirement for growth of *Nili-Ravi* buffalo calves was the same as cattle (Basra *et al.*, 2003a). This study concluded that protein requirements for maintenance for growing swamp buffalo calves is  $4.69 \text{ g CP/kg BW}^{0.75}/\text{d}$ .

Protein requirements can be determined through nitrogen balance studies. In these studies, healthy adult animals should be fed an adequate amount of energy and other nutrients in diets that contain different levels of protein or nitrogen. The minimum protein intakes that will support nitrogen equilibrium are the maintenance requirement. Protein requirements can be determined through the regression equation, the relationship between nitrogen intake and average daily gain. Therefore,

the maintenance requirement increases with body size. However, it is difficult to determine the precise protein requirements because protein can be used as a source of energy whenever an animal experiences an energy shortage.

For maintenance nitrogen balance in buffaloes, protein must be provided in a sufficient amount to allow for metabolic fecal losses and provide for growth, production and (or) reproduction (Kearl, 1982). NRC (1996; 2001) reported that metabolic fecal, urinary, and scurf losses represent the requirement needed for maintenance. The maintenance requirement increases with body size and decreases as the animal approaches maturity due to the decreasing protein content in the body tissue. Every animal, regardless of the diet or the physiological function being performed, will have urinary nitrogen losses. This loss is reasonably constant per unit of body size. Fecal losses normally will vary with the composition of the maintenance diet and the metabolic fecal nitrogen. The metabolic fecal portion in the feces contains substances that indicate their origin in the animal's body such as bacterial residues, cells from the walls of the gastro-intestinal tract and in residues of the digestive juices and other secretions (Kearl, 1982). Although the metabolic fecal nitrogen may be relatively constant in terms of body size and the total fecal nitrogen depends on the digestibility of the dietary protein provided to the animal, it is difficult to measure fecal and urinary losses independently of each other. It is also difficult to separate microbial losses in the feces from true metabolic fecal losses. For most ruminants, metabolizable protein (MP) and crude protein (CP) requirements, using the calculation based on indigestible dry matter intake, are unrealistically high (NRC, 1996). The high requirement can be attributed to the fact that nitrogen is being excreted

Table 1. Effect of dietary protein on nutrients intake, body weight change and N metabolites in swamp buffalo calves.

Items	Dietary crude protein levels				SEM
	5%	7%	9%	11%	
Body weight change (kg)	0.75a	-0.25a	-2.75a	4.75a	2.496
Dry matter intake (kg/calf/d)	3.84a	3.888a	3.85a	3.84a	0.036
Dry matter intake (g/kg BW <sup>0.75</sup> /d)	67.85a	68.34a	67.65a	67.54a	0.306
Crude protein intake (g/kg BW <sup>0.75</sup> /d)	3.47d	4.85c	6.15b	7.55a	0.037
Crude protein intake (g/calf/d)	51.10c	71.01c	90.94b	111.78a	0.199
N intake (g/ kg BW <sup>0.75</sup> )	0.55d	0.78c	0.98b	1.21a	0.006
Urine N (g/d)	6.93b	11.70b	22.93a	28.52a	1.757
Fecal N (g/d)	22.71a	23.58a	25.09a	23.12a	0.937
N balance (g/ kg BW <sup>0.75</sup> )	0.03c	0.16b	0.14b	0.31a	0.026

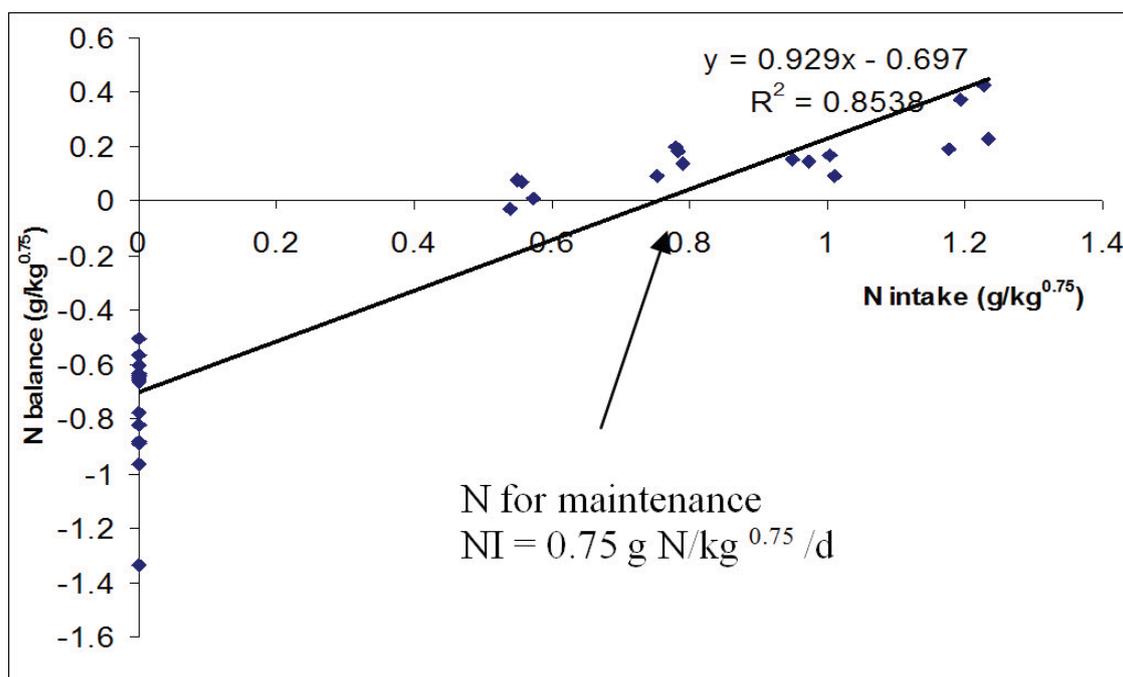


Figure 1. Relationship between N balance (g/ kg BW<sup>0.75</sup>) and N intake (g/ kg BW<sup>0.75</sup>) in buffaloes.

in the feces as microbial protein rather than as urea in the urine as a result of the microbial growth in the post-ruminal digestive tract. NRC requirements (1996) based on MP requirement state that the CP intake needed can be estimated by dividing the total MP requirement by 0.67, which is based on 80 percent of the MP from microbial protein (MCP) and 20 percent from undegradable intake protein (UIP). The CP required is determined as  $MP/0.67$ .

The digestible protein (DP) requirement for maintenance of buffaloes recommended by Kears (1982) is  $DP = 2.54 \text{ g/kg BW}^{0.75}/\text{d}$ .

The metabolizable protein (MP) for maintenance of beef cattle recommended by NRC (1996) is  $MP = 3.8 \text{ g/kg BW}^{0.75}/\text{d}$ .

The values of N balance regressed linearly for the determination of dietary N requirement for maintenance (Figure 1). The regression equation between N balance and N intake of buffalo was  $0.75 \text{ g N/kg BW}^{0.75}$ . These findings are in an agreement with previous reports in yearling Thai swamp buffaloes (Tatsapong *et al.*, 2010), in Thai-indigenous heifers ( $176 \text{ g CP/d}$  or  $4.5 \text{ g CP/kg BW}^{0.75}/\text{d}$ ) (Chantiratikul *et al.*, 2009), in male Thai native cattle ( $4.28 \text{ g CP/kg BW}^{0.75}$ ) (Paengkoum, 2010). The current results for the protein requirement for maintenance are approximately 12% and 14% lower than Kears (1982) recommendation for growing domestic buffaloes ( $5.24 \text{ g CP/kg BW}^{0.75}$ ) and growing crossbred cattle ( $5.36 \text{ g CP/kg BW}^{0.75}$ ). However, the current results are in an agreement with Basra *et al.* (2003a) and Tauqir *et al.* (2009a) who found that the protein requirements of *Nili-Ravi* buffalo calves were lower than the dairy calf recommendation by the NRC (2001). In contrast, Tauqir *et al.* (2009b) suggested that the CP requirements of *Nili-Ravi* buffalo calves were higher than those recommended by the NRC

(2001) for dairy cattle. Buffaloes seem to have a lower requirement for protein than cattle; the reason for this may be that buffaloes use a greater proportion of the OM for biomass production at the expense of VFAs compared with cows (Calabro *et al.*, 2008). Protein requirement for maintenance of animals appears to depend on climatic conditions (Marai and Haebe, 2009), breed, mature body size, composition of body tissue, feed quality and growth rate (Kears, 1982; NRC, 1996).

## CONCLUSION

From this study it can be concluded that increasing dietary nitrogen in buffalo diets significantly increased ( $P < 0.05$ ) N intake and N retention or N balance. The present findings suggest that the protein requirements for maintenance of growing Thai swamp buffalo were  $4.68 \text{ g CP/kg BW}^{0.75}/\text{d}$  or  $0.75 \text{ g N/kg BW}^{0.75}/\text{d}$ . However, further studies should be conducted for the validation of nutrients requirement (especially protein and energy) for different physiological stages of buffaloes. To optimize energy and protein efficiency and to reduce nitrogen wastage, diets need to be formulated to provide optimum fermentable energy sources and nitrogen concentration for maximum rumen microbial yield and growth.

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