

## SUPPLEMENTATION OF *BOS INDICUS* CROSS CALVES GRAZING WET SEASON TROPICAL PASTURES

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### SUMMARY

Three experiments were carried out over 3 years involving 135 Droughtmaster calves (57-143 kg liveweight) grazing native and improved tropical pastures. Calves without supplementation, grazing an improved pasture, gained 0.40 kg/day while those supplemented with a range of protein or energy levels on native and improved pastures achieved 0.46-0.58 kg/day. Increasing levels of protein or energy supplementation did not significantly improve growth rates above those achieved with a minimal rate of protein meal supplementation. The plasma urea concentrations were significantly correlated with the rates of crude protein supplementation. Other metabolic indicators were not significantly correlated with growth rate in any year.

**Keywords:** *Bos indicus*, calves, grazing, supplementation, liveweight change.

### INTRODUCTION

Cattle herds in tropical regions of Australia have a 50-60% weaning rate while economically viable levels for the region are considered to be 70-75% (Entwistle 1984). Schlink *et al.* (1988) showed that a reduction in lactational anoestrus in *Bos indicus* cross cattle due to early weaning significantly improved cow conception rates above those of a conventionally managed herd. This involved weaning calves to a minimum of 50 kg liveweight onto dry rations in covered pens. However, the limited information available on the performance of this category of calf on tropical pastures is inhibiting wide application of the technology to the cattle industry.

Previous studies in tropical regions with grazing calves have been restricted to dairy calves. In these studies the growth rates of unsupplemented calves has been low and followed by poor compensatory gain (Moore 1984). Without supplementation the calves gained less than 0.30 kg/day, but with supplementation growth rates of up to 0.60 kg/day have been achieved in dairy calves grazing tropical pastures (Moss and Murray 1992; Moss and Goodchild 1992; Kaiser 1975). Mortalities of 32% in 140-205 kg weaners have been reported with conventional weaning systems in northern Australia (Holroyd and O'Rourke 1987) and the rate is assumed to increase with lighter calves. In the current studies responses in daily gain to protein and maize supplementation were investigated in early weaned Droughtmaster calves grazing native and improved wet season tropical pastures. The effects of supplementation on the concentration of some plasma and rumen metabolites were also monitored.

### MATERIALS AND METHODS

The experiments were carried out at Lansdown Research Station (19°13'S, 146°48'E) near Townsville. Rainfall between January-May in 1990, 1991 and 1992 was 811, 1395 and 255 mm, sufficient to provide green feed for the calves. Native pasture was predominantly *Heteropogon contortus* and *Bothriochloa pertusa*, and the established improved pasture consisted of *Stylosanthes hamata*, *S. scabra* and *Urochloa mosambicensis* fertilised bi-annually with 10 kg/ha of phosphorus as Superphosphate. Each pasture type was divided into 9 equal sized paddocks providing 3 replicates per treatment and treatments were randomly allocated to paddocks each year. Calves were weaned in January, then held in yards and offered supplement and hay *ad libitum* (Schlink *et al.* 1988) for a minimum of 7 days before being randomly allocated to the experimental treatments. There were 5 calves/paddock to achieve a stocking rate of 3.7 calves/ha on native pasture and 6.5 calves/ha on improved pasture.

Calves grazing native pastures in 1990 (57-136 kg liveweight) were provided with 1 of 3 energy supplements and in 1991 (57-143 kg liveweight) with 1 of 3 protein supplements. In 1992 calves (70-125 kg liveweight) grazed improved pastures with zero or the 2 lower levels of energy supplement used in 1990. The calves were weighed at 3 weekly intervals for 15 weeks in 1990 and 1991, and for 12 weeks in 1992. Supplement ingredients, daily issue and composition are given in Table 1. The supplements were provided on Monday, Wednesday and Friday in troughs; water was available on demand. Calves

grazing native pasture in 1990 and 1991 were sampled via the oesophagus for rumen liquor, and blood samples were collected by jugular puncture, at the final weighing, 24 hours after supplementation. No rumen and plasma samples were collected in 1992.

Rumen volatile fatty acids (VFA) were determined by gas-liquid chromatography with isobutyric acid as an internal standard (Erwin *et al.* 1961). Urea in the plasma was determined by a modified urease-Berthelot reaction (Boehringer Kits), glucose by glucose oxidase, plasma inorganic phosphate by vanado-molybdate reaction and non-esterified fatty acids (NEFA) by enzymatic colorimetric methods (Nako NEFAC Kit). Crude protein (CP) content of the feed was determined by a semi-automatic distillation procedure (Tecator Kjeltac 1030 Analyser) and energy content estimated from feed tables (ARC 1980). Data based on paddock means were subjected to analysis of variance. Least squares regression was used to relate growth rate to supplementation rates, plasma and rumen metabolic concentrations within years.

## RESULTS

Increasing energy supplementation to calves grazing native pastures in 1990 did not affect liveweight gain ( $0.47 \pm 0.01$  kg/day). Similarly in 1991, increased rates of protein supplementation did not affect liveweight gain ( $0.53 \pm 0.02$  kg/day). In 1992 calves grazing an improved pasture without supplementation had a liveweight gain of  $0.40 \pm 0.05$  kg/day despite low pasture production with reduced rainfall. A supplement of 0.68 kg/day (Treatment 1, Table 1) did not significantly improve daily gain but the addition of maize to the supplement (Treatment 2, Table 1) significantly increased daily gain in comparison with unsupplemented calves (Table 2).

**Table 1. Composition, daily issue and analysis of supplements for early weaned calves**

Type of supplement Treatment	1	Energy 2	3	4	Protein 5	6
<i>Ingredients (% as fed basis)</i>						
Nor-Pro <sup>A</sup>	89.2	46.1	11.2	29.7	51.6	68.7
Molasses	4.6	4.4	5.2	5.6	5.1	4.6
Maize		45.4	81.2	49.8	21.9	
Mcat Meal				10.5	17.3	23.0
Mineral Mix <sup>B</sup>	6.2	4.1	2.4	4.4	4.1	3.7
<i>Issue (on dry matter basis/day)</i>						
Feed (kg)	0.68	1.02	1.72	1.00	1.11	1.22
Crude Protein (g)	197	208	214	210	335	455
Metabolisable Energy (MJ)	6.5	11.8	21.9	11.2	11.2	11.2

<sup>A</sup>Nor-Pro - manufactured from sunflower seed meal protected with 0.7 g formaldehyde/100 g crude protein, Norco Co-operative, South Lismore, N.S.W.

<sup>B</sup>Providing 2 g P from mono-sodium phosphate, 12.2 g Ca from limestone and 2.3 g Na from salt/day.

Plasma urea concentrations were significantly reduced at the highest rate of energy supplementation in 1990 and the basal level of protein supplementation in 1991 (Table 3). Changes in plasma urea concentrations were not significantly related to daily gain in 1990 or 1991. Plasma glucose, phosphate and total rumen volatile fatty acids averaged 720 mg/L, 82 mg/L and 57 mM/L, respectively, and VFA concentrations were not significantly affected by supplementation or year. Plasma NEFA concentrations were influenced by year averaging 0.54 meq/L in 1990 and 0.31 meq/L in 1991 (Table 3) and significantly correlated with average daily gain and rate of energy supplementation only in 1990. No other relationships between average daily liveweight gain and measured metabolic parameters were statistically significant. Plasma urea concentration was correlated with the rate of protein supplementation in 1990 ( $r^2 = 0.73$ ) and 1991 ( $r^2 = 0.58$ ) and negatively correlated with supplementary energy intake in 1990 ( $r^2 = 0.86$ ).

**Table 2. Liveweight (kg) and daily gain (kg) of Droughtmaster calves grazing wet season pastures**

Type of supplement Treatment	No suppl.	1	Energy 2	3	4	Protein 5	6	Pooled sd
<i>Native Pasture 1990</i>								
Initial liveweight		100.9	99.7	103.3				4.1
Final liveweight		147.4	148.5	155.3				6.4
Daily gain		0.46	0.47	0.50				0.04
<i>Native Pasture 1991</i>								
Initial liveweight					96.0	97.2	96.7	28.3
Final liveweight					148.9	154.4	151.9	28.6
Daily gain					0.50	0.54	0.53	0.05
<i>Improved Pasture 1992</i>								
Initial liveweight	86.7	86.7	87.5					1.4
Final liveweight	123.1 <sup>a</sup>	132.0 <sup>ab</sup>	138.2 <sup>b</sup>					5.0
Daily gain	0.40 <sup>a</sup>	0.50 <sup>ab</sup>	0.58 <sup>b</sup>					0.06
Within rows means with different superscripts are significantly different ( $P < 0.05$ ).								

**Table 3. Plasma and rumen fluid metabolic concentrations in calves grazing wet season native pastures**

Type of supplement Treatment	1	Energy 2	3	Pooled sd	4	Protein 5	6	Pooled sd
<i>Plasma</i>								
Urea (mg/L)	176 <sup>a</sup>	144 <sup>a</sup>	80 <sup>b</sup>	19	103 <sup>a</sup>	137 <sup>ab</sup>	173 <sup>b</sup>	27
NEFA (meq/L)	0.65	0.53	0.45	0.10	0.30	0.31	0.32	0.03
<i>Rumen Fluid</i> (volatile fatty acid molar proportions)								
Acetic acid (%)	72.7	72.3	72.2	1.4	74.3	74.5	74.2	1.2
Propionic acid (%)	16.1	15.1	16.0	0.7	15.2	15.1	15.5	0.5
Butyric acid (%)	8.4	8.8	8.2	0.6	8.8	8.4	8.0	0.7
Within supplement type means with different superscripts are significantly different ( $P < 0.05$ ).								

## DISCUSSION

A growth rate of 0.4 kg/day for non-supplemented early weaned Droughtmaster calves was higher than the 0.25 kg/day reported for grazing dairy calves in the region (Moss and Murray 1992; Deans *et al.* 1976). Frisch and Vercoe (1984) clearly demonstrated that tropically adapted Brahman have the highest growth rates in a tropical environment despite their low genetic growth potential compared with the non-adapted Hereford/Shorthorn British breeds of high growth potential. Differences in pasture types and season may account for some of the observed differences in calf growth rates between this experiment with Droughtmaster calves and the reported dairy calf studies.

Supplementation resulted in average liveweight gains ranging from 0.47-0.58 kg/day for the 3 years of experimentation, similar to that reported by Moss and Murray (1992) using maize and cotton seed meal combinations fed at 1 kg/day. Protein or energy supplementation above 6.5 MJ ME/day and 197 g CP/day did not significantly improve daily gain in calves grazing an improved wet season pasture in 1992. This contrasts with the findings of Moss and Goodchild (1992) where daily gain was still increasing with the highest level of supplement offered (1.5 kg/day). It may reflect the lower growth potential of *Bos indicus* cross cattle in a pasture environment (Frisch and Vercoe 1984) or a nutrient imbalance induced by supplementation. Calf liveweight gain grazing tropical pastures is significantly

less than those reported for supplemented calves on temperate pastures (Moore 1984). The reduced growth rate of cattle in tropical Australia has been reported previously and is considered to be associated with the climatic stresses of high temperatures and humidity (Donaldson and Larkin 1963; Deans *et al.* 1976). However, liveweight gains above 0.8 kg/day have been reported for pen fed and suckling Droughtmaster calves (Schlink *et al.* 1988) indicating that the current grazing systems place a restriction on calves growth that is not overcome by supplementation.

Of the rumen and plasma indicators of metabolic status in calves grazing native pasture only plasma urea concentrations reflected the rate of protein supplementation in 1990 and 1991. Moss and Murray (1992) found a similar relationship with the dairy calves grazing irrigated pastures, and a range of other significant correlations, but these were not supported in this study. In 1990 and 1991 plasma urea concentrations were correlated with the increased rates to protein supplementation, similar to the observations of Preston *et al.* 1965 with total protein intakes in cattle. Plasma urea concentration fell with increasing maize supplementation, indicating that the calves were able to utilise the protein available although this improved utilisation of protein was not reflected in increased daily gain.

Fennesy *et al.* (1972) reported high plasma NEFA concentrations immediately following weaning in lambs and concluded that early weaning results in the mobilisation of body fat in response to low energy intake. In 1990 with different rates of maize supplementation there was an inverse relationship between liveweight gain and plasma NEFA levels in calves approximately 16 weeks after weaning. The elevated NEFA and presumably fat metabolism in 1990, despite protein-supplementation, indicates the low daily gains may be attributed to limited energy intakes.

Early weaning is one strategy that northern producers can use to improve branding rates and improve the rate of cow turn-off. Under the management conditions of these experiments it was possible to achieve liveweight gains of 0.4 kg/day on improved pastures in 1992 and this was below the gains achieved with supplementation regardless of pasture or year. The growth rates achieved with early weaned calves in these experiments are in the lower range of those reported for wet season suckling calves but are higher than for calves suckling during the dry season (Holroyd and O'Rourke 1987). Thus it should be possible to wean calves as light as 55 kg with supplementation on green pastures without an overall loss of weaner liveweight. In northern Australia the majority of calves will be weaned on to early dry season pastures and the development of appropriate supplementation strategies for these pastures will be required to ensure an adequate liveweight gain in weaners until the following wet season.

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