Methyl-donor supplementation effect on pregnant cows fed poor-quality tropical forage

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Typically, commercial supplements that are used in northern Australian beef enterprises contain macro-nutrients (crude protein, sulfur and phosphorus) to correct for the deficiencies of these factors in the forage grazed by cattle. Poor nutrition in the late dry season and increased nutrient requirements during the onset of lactation in northern production systems likely leads to a shortfall in methionine, choline or cobalt/Vit B12 co-factors. These are the sources of labile methyl groups which are essential for animal tissue metabolism, fetal development and immune function by altering DNA synthesis and gene expression (Du *et al.*, 2010; Murdoch *et al*., 2016). Our hypotheses are that supplementation of undernourished pregnant cattle with methyl-donor compounds and co-factors will improve rumen efficiency and the metabolic and immune status of the cow, resulting in an increase of productivity gains of offspring later in life.

Forty five pregnant cows (Droughtmaster) (late-gestation), fed a poor-quality hay (~ 3.3 % crude protein), were randomly allocated to 3 groups: Control /head/day (125 g baseline supplement: 30% urea); Choline /head/day: (125 g baseline supplement + 70 g RP-choline + 1 g cobalt + 2 g B12 co-factors); and Methionine /head/day: (125 g baseline supplement + 30 g RP-methionine). Supplementation started 3 months before calving until 2 months of lactation. Animal body weight, rumen fluid and blood samples were collected during late pregnancy (150-250 days) and lactation to study the treatment effects on rumen fermentation and microbial profile and animal methyl donor levels. Calf weight and blood samples were collected to study the effect on the offspring.

A significant ADWG was observed from pregnant cows supplemented with Methionine ($P<0.001$). Interestingly, significant higher total volatile fatty acids (VFAs) concentration and a shift to propionic acid were observed ($P<0.05$) in the Choline group (Table 1). The blood concentration of methionine and homocysteine were significantly ($P<0.05$) higher in the Methionine group. Illumina Miseq sequencing of rumen microbial community structure showed increases of fibrolytic microbial populations (*Fibrobacteraceae* and *Ruminococcaceae* families) in animals supplemented with Methionine and Choline. Calves birth weights were not significantly different between treatments ($P>0.05$), while growth and blood urea nitrogen of the female calves from Methionine supplemented cows were significantly greater ($P<0.05$) even 4-5 months after the supplements had been withdrawn. However, the male calves did not show a response ($P>0.05$) to supplementation of the dam.

	Treatments				
	Control	Methionine	Choline	SEM	P-value
Body weight (kg)	469	488	460	6.85	0.265
ADWG (kg)	0.199[b]	0.327[a]	0.085[c]	0.02	0.001
Blood urea nitrogen mg/100 mL	15.6	12.8	15.3	0.60	0.121
Ammonia-N mg/100dL	5.11	4.21	5.47	0.32	0.274
Total VFA mM	48.9[b]	53.0[ab]	60.6[a]	1.54	0.012
Propionate %	14.8[b]	15.2[ab]	15.4[a]	0.09	0.034
Acetate:Propionate	5.13[a]	4.99[ab]	4.92[b]	0.03	0.043
Serum metabolites (µmol/L)					
Methionine	17.1[b]	279.9[a]	13.4[b]	16.4	0.001
Homocysteine	6.59[b]	25.86[a]	5.04[b]	1.41	0.001

Table 1. Supplement effects on body weight, blood urea nitrogen and rumen fermentation parameters in pregnant cows supplemented for 14 weeks.

The results showed a positive response of the supplements on the pregnant cows, particularly Methionine, with increases in bodyweight, blood methyl donor levels, shifts in the VFAs profiles and rumen microbial structure. The effects on the rumen were unexpected as the nutrients in the methyl donor supplements were rumen protected which suggest that a percentage of the compounds were used by rumen microorganisms, or nutrients were recycled to the rumen. Interestingly, growth and blood urea nitrogen of the female calves from the Methionine group were significantly greater during the supplementation and after weaning, which might indicate an effect on animal tissue metabolism in these offspring. Further analysis will be done to understand the effect on the offspring. The trial findings should generate new supplement formulations containing micro-nutrients essential for optimum tissue metabolism in pregnant and lactating beef cows.

References

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Murdoch B M, Murdoch G K, Greenwood S, McKay S (2016) *Frontiers in Genetics* **7,** Article 182.
This work was supported by Meat and Livestock Australia.