final report

ANIMAL PRODUCTION

Project code: **B.NBP.0522**

Prepared by: **Sally Leigo**

NT Government
Department of Resources

Date published: **March 2011**

ISBN: **9781741918458**

PUBLISHED BY
Meat & Livestock Australia Limited
Locked Bag 991
NORTH SYDNEY NSW 2059

Determining the effectiveness of PEG in the utilisation of topfeed in central Australia

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Abstract

Beef producers of central Australia requested research into Poly-Ethylene Glycol (PEG) supplementation to determine if it could improve the performance of cattle grazing mulga (*Acacia aneura*) during severe dry periods. Previous research has found that PEG binds with the condensed tannins (found in the leaves of some plants including mulga) allowing more protein to be digested by ruminants. An eight week long pen trial was conducted with Droughtmaster heifers (n=10, average liveweight 289kg ±6kg) individually penned with half receiving PEG-4000 supplement (14g – 105g PEG/head/day for weeks 1-6 and 200g PEG/head/day in weeks 7 & 8) and the other half no supplement. To replicate the diet of cattle during severe dry periods, the diet was comprised of (on average) 79% mulga (7.6 ME MJ/kgDM, 18.2 CP%) and 21% poor quality hay (8.4 ME MJ/kgDM, 4.9%CP). The study found no significant difference ($P>0.05$) in live weight gain between the PEG and control heifers (mean 0.188 vs 0.314 kg/day), nor in DM intake (mean 4.3 vs 4.8 kgDM/day) or *in vivo* dry matter digestibility (mean 48% vs 50%). There was significantly less nitrogen excreted in the faeces of the PEG heifers ($p<0.001$) (1.04% PEG v 1.36% control faecal DM) and significantly more nitrogen absorbed (N absorbed gDM/N intake kgDM) by the PEG heifers (802.8 N absorbed gDM/N intake KgDM PEG vs. 762.8 N absorbed gDM/N intake KgDM Control). It was concluded that in this trial PEG supplementation had not been shown to have any effect on beef cattle performance and therefore could not be recommended to Central Australian pastoralists as a viable strategy for cattle management in dry conditions. It is hypothesised that other nutrients are required in addition to PEG to produce a benefit.

Executive summary

The pastoral industry in central Australia, as represented by the Alice Springs Pastoral Industry Advisory Committee (ASPIAC), requested that further research be conducted into the use of Poly-Ethylene Glycol (PEG) as a supplement to cattle grazing or browsing mulga (*Acacia aneura*).

Previous research has found that PEG binds with the condensed tannins, found in mulga and similar plants, allowing more protein to be digested by ruminants (Jones and Mangan 1977, Perez-Maldonado 1994 and Miller *et al.* 1997). These condensed tannins are found in mulga (Plumb *et al.* 1999 and Pritchard *et al.* 1988), commonly browsed by cattle in central Australia (Chippendale 1964).

The objectives of this project were to determine the cost effectiveness of PEG supplementation at various levels and if there was a positive response from the pen feeding trial, provide economic and grazing recommendations for supplementing breeder cattle. The first objective was achieved as a result of the pen trial. The second objective was not completed due to there being no improvement in the heifer performance from the PEG supplementation and seasonal conditions were not conducive to a paddock trial being conducted.

An eight week pen trial was designed with ten Droughtmaster heifers individually penned; half supplemented with PEG-4000 and half as a control without PEG. During the first six weeks the PEG heifers were supplemented with PEG in their drinking water at a variable low rate (due to variation in water intake) with a median amount of 60g/head/day (range 14 - 105 g/head/day). During the final two weeks the PEG heifers were drenched daily at a higher level of PEG supplementation (200g/head/day). To replicate the diet of cattle during severe dry periods, the diet was comprised of on average 79% mulga (7.6 ME MJ/kgDM, 18.2% Crude Protein(CP)) and 21% poor quality hay (8.4 ME MJ/kgDM, 4.9%CP).

Animals were weighed weekly for eight weeks and during the final two weeks daily dry matter intake and weekly dry matter digestibility and nitrogen excretion were recorded. There was no difference ($P>0.05$) in liveweight gain between the PEG and control heifers for the entirety of the pen trial (mean 0.188 vs 0.314 kg/day), in Dry Matter (DM) intake (mean 4.7 vs 4.2 kg/day) and DM digestibility (mean 50% vs 48%). There was significantly less nitrogen excreted in the faeces of the PEG heifers ($p<0.001$) during the period of high PEG supplement (1.04% PEG v 1.36% control animals faecal DM). As such more nitrogen was significantly ($P<0.001$) absorbed (measured as N absorbed gDM/N intake KgDM) by the PEG heifers (802.8 N absorbed gDM/N intake KgDM PEG vs. 762.8 N absorbed gDM/N intake KgDM Control).

The cost of the PEG delivered to Alice Springs was $7.20/kg. At the higher recommended level of supplementation for PEG this resulted in a cost of $1.44/head/day. This is very expensive in comparison to other forms of supplementation, eg. urea lick blocks delivered to Alice Springs that cost $1.65/kg or approximately $0.24/head/day. Given the high cost of PEG supplementation and the lack of response found in this study it is concluded that there is little potential for use of PEG supplementation of cattle grazing mulga in central Australia. It is hypothesised that other nutrients are required in addition to PEG to give a benefit.

This project has been useful for the central Australian pastoral industry by raising awareness and understanding of the potential for the use of PEG as a supplement for cattle grazing mulga. This report will provide information for not only beef producers in central Australia but those throughout the rangelands of Australia where mulga is dominant in the landscape, i.e. approximately 1.5 million km^2 (Plumb *et al.* 1999).

Acknowledgements

The author would like to thank and acknowledge the team of people involved in this project, without whose assistance, good humour and hard work this project would never have been completed. Thank you to:

- Prof. Dennis Poppi, the University of Queensland, for his guidance on the methodology of the trial and his comments on this report.
- Mark Hearnden, NT Department of Resources (DoR), for his assistance with the design of the pen trial and statistical analyses.
- The 'Mulga Pluckers' of the NT DoR AZRI, Bryan Gill, Sally Sims, Doug Sims, Jocelyn Coventry, Tracey May, Jillian Fisher, Chris Materne, Rod Gobbey, Ben Beumer, Coral Allan, Pieter Conradie and Andrew Bubb for their assistance during the long eight weeks of the pen trial.
- Geoff Weir, The NT Department of Justice, Alice Springs Correctional Centre, for organising men to assist during the pen trial, their assistance was invaluable.
- Tim Schatz and Neil MacDonald, NT DoR, for their assistance with the editing of this report.
- The Alice Springs Pastoral Industry Advisory Committee who requested that this research be undertaken.
- Meat and Livestock Australia and NT DoR for their funding of this project.

Contents

1 Background to Project

The pastoral industry in central Australia, as represented by the Alice Springs Pastoral Industry Advisory Committee (ASPIAC), requested information on whether Poly-Ethylene Glycol (PEG) supplementation was a viable solution for improving survival and performance of breeder cows in periods of drought. During these dry periods cattle in central Australia often survive on topfeed species such as mulga (*Acacia aneura*), witchetty bush (*Acacia kempeana*), Whitewood (*Atalaya hemiglauca*) and Ironwood (*Acacia estrophiolata*). The nutrient quality of these topfeed species can best be described as only suitable for the maintenance requirements of cattle (Askew and Mitchell 1978).

Pastoralists were interested to learn whether previous research into PEG could be applied to cattle production in central Australia. Previous research had found that PEG binds with the condensed tannins (in the leaves of plants) allowing more protein to be digested by ruminants (Jones and Mangan 1977, Perez-Maldonado 1994 and Miller *et al.* 1997). These condensed tannins are found in mulga (Plumb *et al.* 1999 and Pritchard *et al.* 1988), which is commonly grazed by cattle in central Australia (Chippendale 1964).

The majority of research into PEG supplementation had been carried out with sheep and goats (Pritchard *et al.* 1992, Miller *et al.* 1997 and Rogosic *et al.* 2008). Pritchard *et al.* (1992) found that sheep fed mulga and supplemented with 24g of PEG per day increased their dry matter intake by 78%. Miller *et al.* (1997) found that sheep on a diet dominated by mulga supplemented with 12g of PEG per day improved their wool growth by 9% and their liveweight gain by 100%. Research conducted in Croatia found that sheep supplemented with PEG ate more shrubs than un-supplemented sheep, while goats supplemented with PEG ate no more shrubs than unsupplemented goats (Rogosic *et al.* 2008). This may have been because goats are better able to digest shrubs than sheep.

To date there has been very little research on cattle intakes of PEG and topfeed species such as mulga. One trial conducted in south-west Queensland found that providing PEG with phosphate, urea and sulphate of ammonia to steers increased dry matter intake of mulga by 32% (Strachan *et al.* 1988). A more recent study in Israel found that PEG supplementation with protein and energy supplementation did not affect average cow liveweight but did increase the amount of time spent grazing in the paddock (Henkin *et al.* 2009). A study conducted in the USA found that supplementing steers with PEG, grain and molasses increased intake of a weed species containing condensed tannins (Mantz *et al.* 2009) and increased average daily gain by 0.20kg/day.

There appears to have been no research examining the response to PEG alone when cattle browse mulga. This research project aimed to determine if PEG supplementation would be beneficial to cattle grazing topfeed species such as mulga.

2 Project objectives

By the 31st January 2012 the following objectives were to be achieved:

1. Established the cost effectiveness of supplementing cattle fed a topfeed diet in the Alice Springs district at various levels of inclusion of Poly Ethylene Glycol (PEG) in a pen feeding situation.
2. Developed economic and sustainable grazing recommendations and practical supplementation applications for supplementing breeder cattle in the Alice Springs region with PEG if positive cost benefits were established in the initial pen feeding trials above.

3 Methodology

The project was designed to be comprised of two parts. The first part involved a pen trial with 10 heifers kept in individual pens for eight weeks. The second part depended on the result of the pen trial and was planned to be based in a commercial paddock over a period of three to six months with mature age breeders. The pen trial failed to demonstrate any response by the heifers on a mulga diet to PEG supplementation and therefore the second part of project was not undertaken. For the remaining part of this final report all discussions only refer to the pen trial.

This research project was approved for animal ethics by the Charles Darwin University Animal Ethics Committee (Project Reference Number A10013).

3.1 Animals

Ten one year old Droughtmaster heifers were selected for the pen trial. All heifers had been sired by the same bull and they were of a similar weight (average weight = 289 ± 6kg). There were two treatments in the experiment and these were:

- PEG supplementation (PEG)
- No PEG supplementation (Control)

The heifers were allocated to the treatments by stratified randomisation based on live weight.

An un-fasted and a fasted weight (after a 20 hour curfew) were recorded at the start and at the end of the experiment. Un-fasted weights were recorded weekly throughout the trial. The heifers were housed in individual pens (3.05 x 3.7m) with shade and shelter provided.

Photo 1 – Droughtmaster heifers in individual pens with shelter

3.2 Diet

Prior to the commencement of this project, faecal samples were taken from a commercial cattle station near Alice Springs and at the Department of Resources' (DoR) Old Man Plains Research Station in December 2009 to determine the proportion of the diet that was browse (mostly mulga) and grass. This occurred during a period when browse would be a high proportion of the diet due to the prevailing dry conditions. These results indicated that a similar diet for the pen trial would consist of 75% mulga and 25% poor quality hay. Measurements of feed consumption during the pen trial found that on average the actual diet consumed was 79% mulga and 21% hay (on a dry matter basis).

Mulga and water were provided *ad lib*, with feed intake recorded during the final two weeks of the pen trial. In addition the heifers received 1kg of poor quality hay (8.4 ME MJ/kgDM, 4.9% Crude Protein (CP)) at 8am every morning prior to the arrival of the freshly cut mulga branches. Mulga was fed out in the morning and in the late afternoon.

The mulga offered during the pen trial was selected from three sites on DoR's Old Man Plains Research Station. The variety of mulga selected was the more palatable broad leaf mulga, *Acacia aneura* var: *aneura*. Every morning fresh branches of mulga were cut from trees and brought to the DoR's Arid Zone Research Institute (AZRI). They were processed by hand into branch lengths of 15 – 30cm to be fed to the cattle.

Photo 2 – Prisoners and author breaking mulga branches into smaller branches

The location and different land types, from which mulga was harvested are shown in Figures 1 and 2.

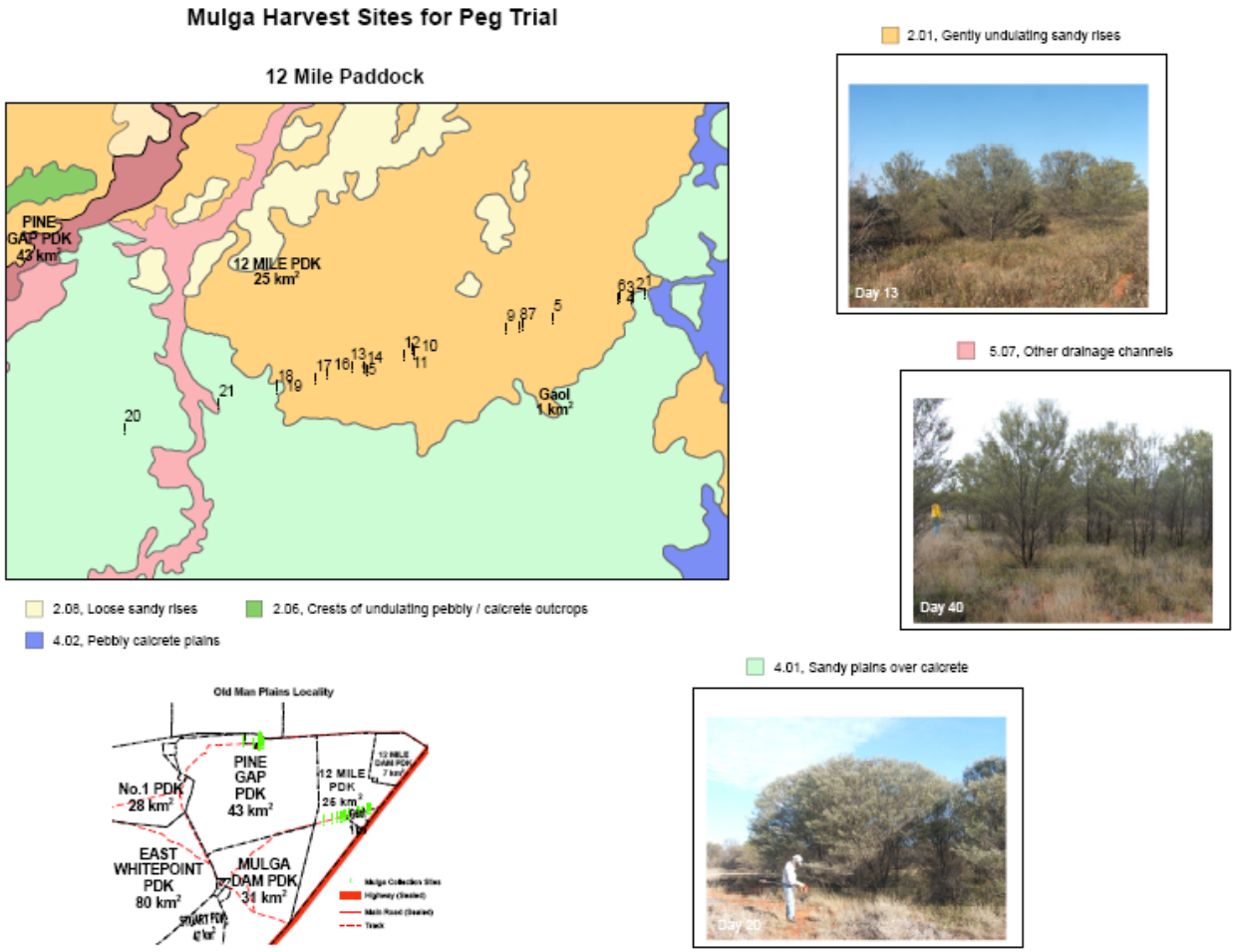

Figure 1 Mulga harvest sites – 12 mile paddock, harvest sites are numbered 1 – 21, representing days 1 - 21 and coloured areas represent different land types.

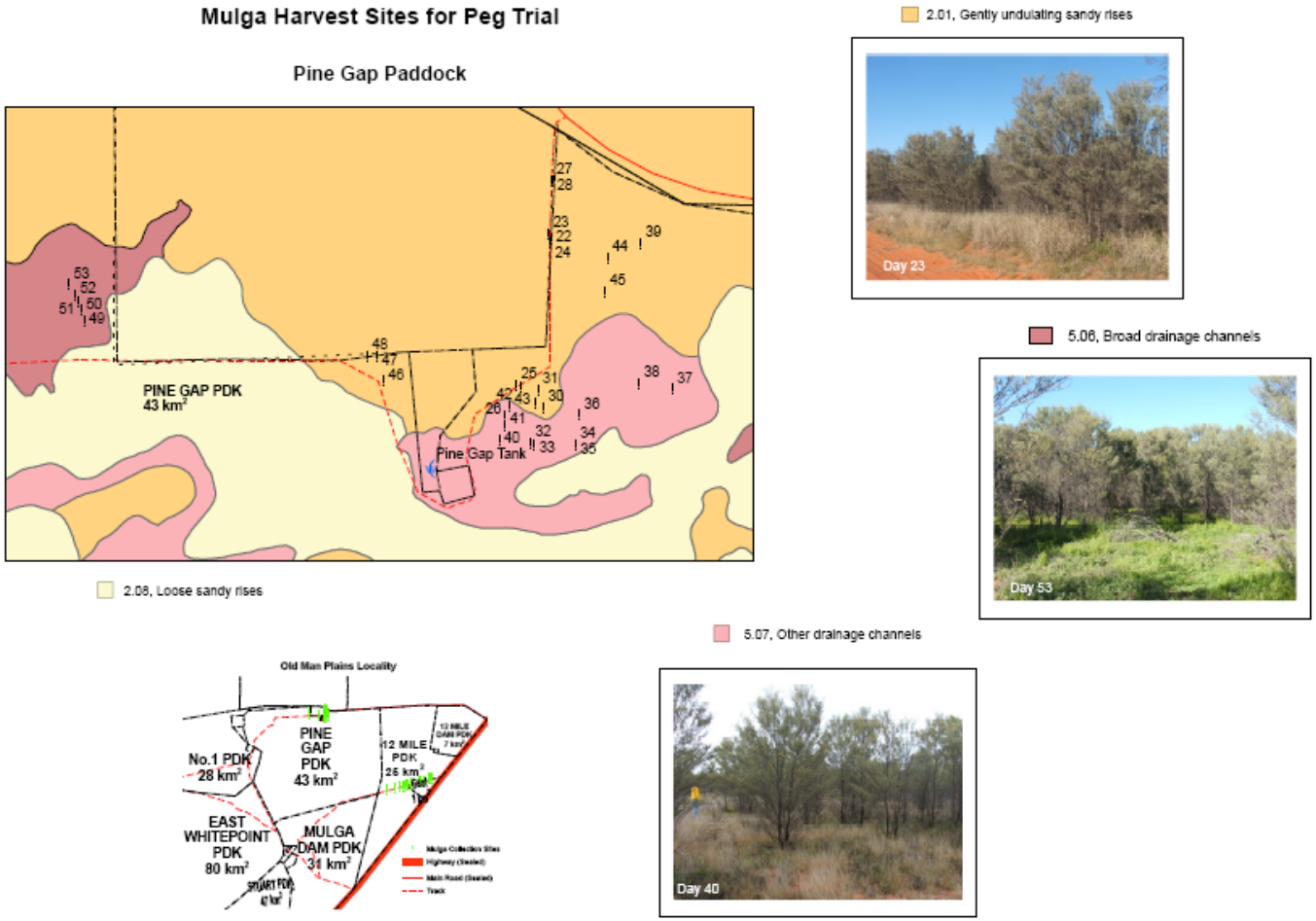

Figure 2 Mulga harvest sites – pine gap paddock, harvest sites are numbered 22 - 52, representing days 22 – 52 and coloured areas represent different land types.

3.3 Experimental timeline

The experiment lasted for eight weeks. In the first six weeks, weekly liveweights and samples of the hay and mulga offered and mulga refused were collected. The final two weeks (weeks seven and eight) represented an intensive phase with daily measurements of feed intake, DM digestibility (by measuring faecal output), faecal Nitrogen (N) output and level of condensed tannin in the diet. The methods by which this data was collected are described in section 3.5.

3.4 PEG supplementation

Previous research indicated that the intake of mulga was likely to be 3.7 kg DM/day for heifers, based on an average liveweight of 289 kg (Jeffery and McIntosh 2000), and that the tannin content was likely to be 6.4% (Norton 1999). Also Strachan *et al.* (1988) suggested that PEG should be fed at a PEG:tannin ratio of 1:1. Therefore it was decided to feed PEG at a rate of 205 g/head/day.

PEG dissolves well in water and was intended to be feed via the drinking water at a rate of 7.08 g PEG per litre of water. However during the first 6 weeks of the trial the water intake by the heifers varied greatly (there were some cold days on which water intake was very low) and so PEG intake was variable and often lower than intended (14g – 105g/head/day). Therefore during the final two weeks of the pen trial it was decided to drench each heifer daily with a higher level of PEG so that the amount of PEG supplied was consistent with that recommended by previous research. As a result during weeks 7 and 8 of the trial the PEG heifers were drenched daily (at the same time each day) with a PEG solution (600ml/head/day) to provide 200g PEG/head/day.

3.5 Data collection and sampling

3.5.1 Weeks two to six

There was a one week adjustment period (week one) at the start of the experiment in which heifers were not weighed. Following this there was a five week period in which weekly un-fasted liveweights were recorded and feed samples collected.

The weekly liveweights were collected every Tuesday at 10:30am, which was the start of each week of collections and the heifers were weighed in the same order (pens one to ten) each time. The cattle were weighed over *Ruddweigh* scales.

Feed samples were collected for the hay offered, the mulga offered and the mulga that the heifers had left over (feed refusals). A single hay sample was taken once a week from the large round hay bale and it was weighed and then oven dried for a minimum of three days at 60^{o}C. Once dried the sample was weighed, ground (through a 1mm sieve) and sent for laboratory analysis.

A daily grab sample was taken from the mulga fed. Each daily sample collected during a week was bulked with the week's other samples and stored in a coolroom (5^{o}C) until the end of the week. At the end of the week the bulked samples were mixed further and two samples were taken (from the bulked samples), weighed and oven dried for a minimum of three days at 60^{o}C. Once dried the samples were weighed, ground (through a 1mm sieve) and sent for laboratory analysis.

A daily grab sample of the feed that had not been consumed (feed refusals) was collected each morning from the feed bin in each individual pen. These samples were bulked with the rest of the week's samples and stored in a coolroom (5^{o}C) for the week. At the end of the week the bulked

samples were mixed further and two samples were taken, weighed and oven dried for a minimum of three days at 60^{o}C. Once dried the samples were weighed, ground (through a 1mm sieve) and sent for laboratory analysis.

In addition daily notes were made relating to the health of individual animals and estimates on the amount of water consumed and amount of feed left over each day. Water intake was estimated from the amount of water required to refill each container, each water container was filled to a 30L mark each morning. The amount of mulga left over was estimated as a percentage of the volume of the feed container for each pen eg. 25%.

3.5.2 Weeks seven and eight - intensive measurement phase

During the final two weeks of the pen trial additional data and samples were collected. Measurements to determine, daily feed intake and weekly digestibility and nitrogen and phosphorus absorption were recorded. Feed samples were collected to measure daily condensed tannin, Metabolisable Energy (ME), CP, Phosphorus (P) and Sulphur (S) levels.

Daily feed intake was measured for individual animals. All feed offered during the day (10am – 5pm) was weighed and recorded and then on the following day at 9am, the amount of feed not eaten (feed refused) was also weighed and recorded. Feed intake was determined by subtracting feed refused from feed offered. To determine the dry matter feed intake daily samples were taken of the feed offered (hay and mulga) and feed refused (predominately mulga), weighed and oven dried for a minimum of three days at 60^{o}C.

In addition once the feed offered and feed refused samples were dried, weighed and recorded they were then ground (through a 1mm sieve) and sent for laboratory analysis. The laboratory analysis was for nutritional quality (ME, CP, P and S) and also for Condensed Tannin (CT) content.

Digestibility was also measured for individual animals. It was determined by the collection of all faeces that were excreted in a twenty four hour period. For each pen these total daily faeces collections were weighed, recorded and stored in a coolroom (5^{o}C). At the end of each week each pen's faeces were bulked and mixed thoroughly before three samples were taken. Two samples were weighed, recorded and oven dried for a minimum of three days at 60^{o}C. Once dried the samples were weighed again to determine the moisture and subsequent dry matter content. The samples were then ground (through a 1mm sieve) and sent for laboratory analysis. The faecal samples were analysed to determine levels of excreted nitrogen and phosphorus. Dry matter digestibility was calculated on a weekly basis for each animal. The third sample was taken and frozen for storage in case of damage or loss of the other samples.

Blood samples were collected from each animal on the final day of the pen trial. Unfortunately these samples were damaged in their shipment and were unable to be analysed. As a result samples were taken again a week later but the results may have been influenced by the green pasture that the heifers were grazing on. The samples were analysed by the Department of Resources (DoR) Berrimah Veterinary Laboratory for biochemical analyses that reflected nutrition and renal function (creatinine, P, protein (total), urea).

The weekly (un-fasted) liveweights were collected every Tuesday at 10:30am and the heifers were weighed in the same order (pens one to ten) each time. The cattle were weighed over *Ruddweigh* scales.

3.6 Laboratory analyses

3.6.1 Feed quality

The nutritional analysis of the hay and mulga offered and refused was conducted by Weston Food Laboratories. Analysis of the feed by Near Infrared Spectroscopic technology was conducted on weekly samples of hay, mulga offered and mulga refused. Each of the bulked weekly samples were thoroughly analysed but those reported on were CP%, P%, N%, S% and ME (MJ/Kg).

3.6.2 Condensed tannin content

The condensed tannin analysis of the mulga offered and refused was conducted by the University Of Queensland's laboratory. The method saw each sample extracted with 70% acetone and the condensed tannins measured by the Butanol/HCl (BuOH/HCl) colorimetric procedure using a representative CT reference standard.

3.6.3 Faecal nitrogen and phosphorus levels

The faecal nutrient levels were conducted by the DoR's Berrimah Laboratory. The N levels were determined by using the flow injection analysis method. The remaining nutrient levels in the faeces were determined using the Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES) method.

3.7 Statistical analyses

The experimental design of the pen trial involved using stratified randomisation to pair the heifers by their initial weight and then randomly allocating one of the pair to each treatment.

Comparison of the overall liveweight gain between treatments was done by a dependant samples t-test on the liveweight gain differences between the control and PEG paired heifers, based on the difference between the final and initial fasted liveweights over the 57 days of the pen trial. Analysis of average daily liveweight gain between treatments and over time was conducted as a repeated measure ANOVA. Daily dry matter intake (kg) and weekly dry matter digestibility (kg) over time were also analysed as a repeated measures ANOVA. The comparison of liveweight gain between the low supplementation period (weeks 1-6) and high (weeks 7 and 8) was conducted by pairing the individual heifers liveweight gain in the low period with its liveweight gain in the high period and conducting a paired t-test.

Faecal nitrogen and phosphorus levels were statistically analysed using a repeated measures ANOVA to assess for mean Treatment effect (Control v PEG over both weeks) and for the interaction over time (Treatments by Week). Faecal nitrogen excreted (g/day), faecal nitrogen absorbed (g/day) and faecal nitrogen absorbed/Nitrogen intake (gDM/KgDm) were analysed using the same method.

The feed quality data for hay, mulga offered and mulga refused and the condensed tannin levels for each component was analysed by a single factor ANOVA with the weeks representing independent samples. Comparisons between the paired means of hay, mulga offered and mulga refused for statistical analysis was conducted with simultaneous 95% confidence interval's whose bounds do not include zero (Tukey method) were deemed to be significantly different. The PEG:Condensed Tannin ratio was only applicable to the PEG treated heifers and the daily averages are expressed with a 95% confidence interval.

4 Results and discussion

4.1 Results

4.1.1 Animal performance

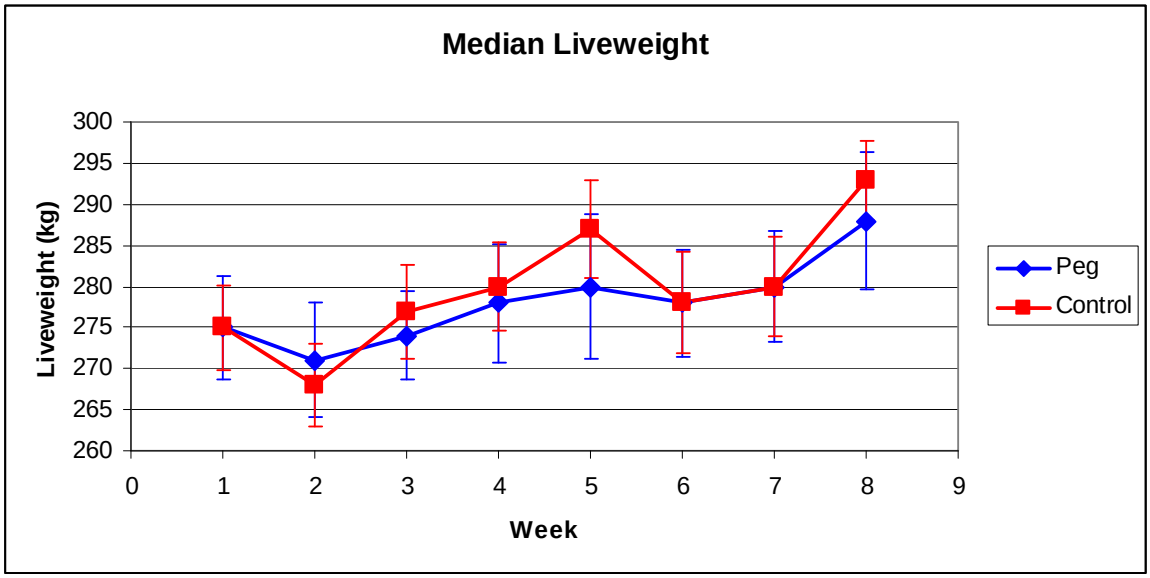

Figure 4.1 –Weekly Median Liveweight (kg) for heifers supplemented with PEG (PEG) and without (Control).

Figure 4.1 shows the liveweight performance of the two treatment groups (PEG and Control). During weeks 1 – 6 a low level of PEG was supplied (14g – 105g/head/day) based on water intake levels. This intake was below the levels recommended by Strachan *et al.* (1988) but reflected the variability in water intake and the practical challenge of achieving high PEG intakes. In weeks 7 – 8 a higher level of PEG supplementation (200g/head/day) was achieved by drenching the heifers. Mantz *et al.* (2009) has shown that cattle respond quickly to PEG supplementation, allowing for two day adjustment periods to PEG supplementation and in this experiment the two weeks allowed for a good test of the animals' response to higher PEG intakes.

Figure 4.1 shows that there was no significant difference in performance between the treatment groups. In addition, a dependant samples t-test of matched liveweight gains indicated that the mean difference of the liveweight gains between matched PEG and control heifers (mean difference of 8.4kg over the 57 days of the trial) was not significantly different ($t_{(0.05,4)}$=1.29, p=0.2649).

Overall for the whole period of the pen trial the mean liveweight gain, based on fasted weights, for the control heifers were 0.314 kg/day (±0.143kg/day) and the PEG heifers 0.188 kg/day (±0.13kg/day). A repeated measures analysis of average daily liveweight gain (kg/day) indicates there was no overall significant difference in the treatments ($F_{1,8}$=1.97, p=0.1979) nor was there any significant difference in the treatments over time ($F_{6,48}$=0.67, p=0.6725).

To determine if there was a treatment effect by the PEG in either the low supplementation period (weeks 1-6) or high supplementation (weeks 7-8), the differences in liveweight gain for the two periods must be reviewed. For both the Control and PEG heifers the average daily liveweight gain increased when changed from the low supplementation to the high. Increases in average daily liveweight gain from low to high supplement periods were 0.5857 kg/day (±0.1571 kg/day) for the Control heifers and 0.4095 kg/day (±0.1128 kg/day) for the PEG heifers. These mean increases for the Control and PEG treatments were not significantly different (paired t-test, t_{4df}=0.88, p=0.427).

It may be concluded that PEG did not increase liveweight or liveweight gain in those heifers consuming mulga.

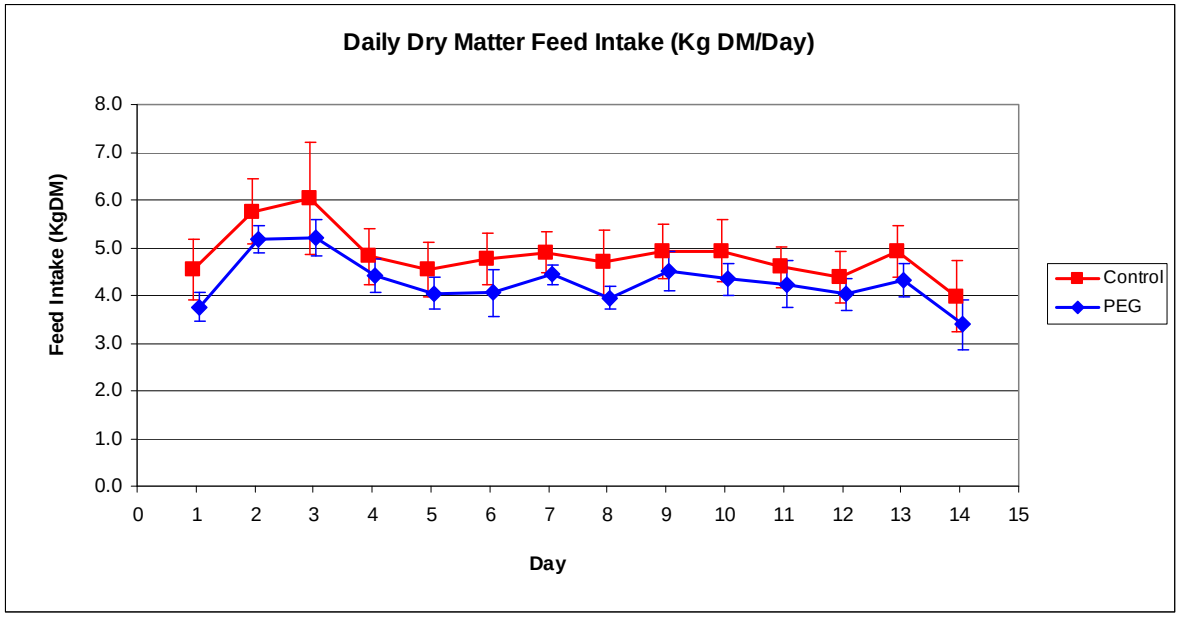

Figure 4.2 – Daily Dry Matter Intake (Kg DM/day) over time for heifers supplemented with PEG (PEG) and without (Control) for weeks 7 and 8.

Figure 4.2 shows the total DM intake (mulga plus hay) from the final two weeks (weeks 7-8). There was no significant difference between the groups overall ($F_{1,8}$=1.62, p=0.2386) nor over time ($F_{13,104}$=0.59, p=0.8544), with a mean intake of 4.7 (control) vs 4.2 (PEG) kg DM/day. Dry matter intake on average was 4.6 ±0.45kg DM/day and comprised of 3.63 kg DM/day mulga (79%) and 0.97kg DM/day hay (21%). These values equate to a mean intake of 14.9g/kg liveweight/day for PEG vs 16.1g/kg liveweight/day for control heifers.

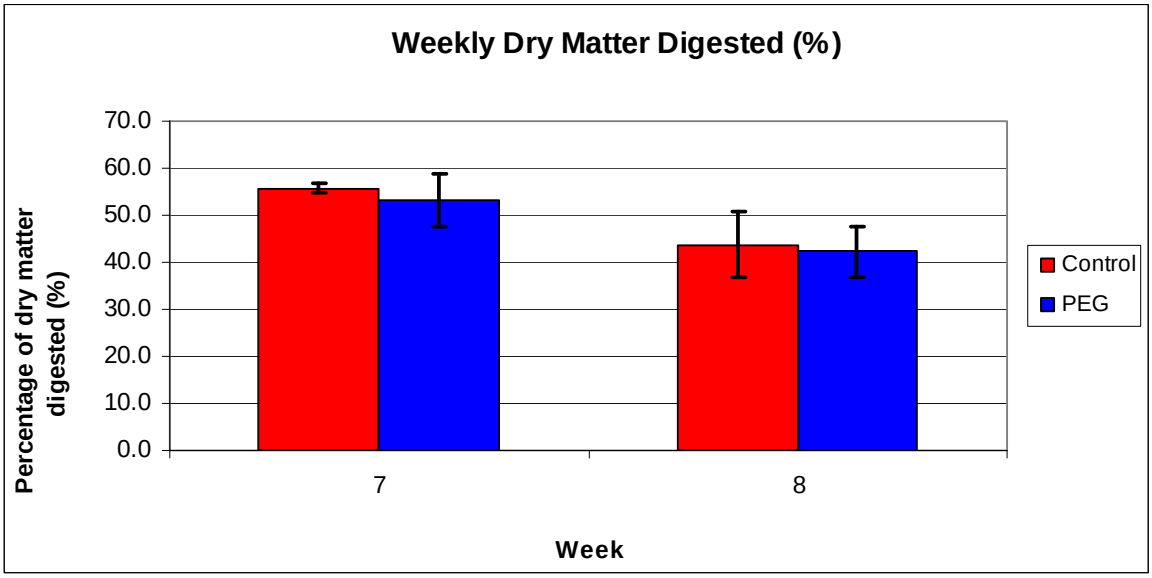

Figure 4.3 – Weekly Dry Matter Digestibility (%) for the final two weeks of the pen trial

There was no significant difference in DM digestibility between the treatments ($F_{1,8}$=2.35, p=0.1636), or between weeks 7 and 8 ($F_{13,104}$=1.05, p=0.4024) (Figure 4.3). Week 8 was significantly lower in DM digestibility than week 7 (mean dry matter digestibility 54.4% week 7 vs 43.2% Week 8) reflecting differences between the mulga harvested but there was no difference between PEG and control animals. The mean dry matter digestibility was 50% for the control and 48% for the PEG heifers.

Table 4.1 – Mean faecal %N and %P by week and mean for the Control and PEG Treatments. The 95% confidence intervals for the means are shown in brackets.

Faecal Content	Control	PEG
%Nitrogen		
Week 7	1.38 (0.118)	1.10 (0.082)
Week 8	1.33 (0.089)	0.98 (0.122)
Mean	1.36 (0.060)	1.04 (0.073)
%Phosphorus		
Week 7	0.18 (0.029)	0.18 (0.029)
Week 8	0.19 (0.032)	0.21 (0.044)
Mean	0.18 (0.018)	0.19 (0.023)

For faecal %N there was a significant treatment effect (p<0.001). Mean faecal %N was higher in the Control animals (1.36% v 1.04% in the PEG animals). There was no significant change in %N from week 7 to week 8 (p=0.063) nor was there any interaction between treatment and week (p=0.368) (No interaction means that levels of %N changed similarly from week 7 to week 8 for both treatments).

For faecal %P there was no significant effect of treatment (p=0.532) or week (p=0.084) and no significant interaction (p=0.651).

By extrapolating the faecal nitrogen content to the DM faecal output, the mean amount of faecal N excreted per day was 20.1g DM/day PEG vs. 27.3g DM/day control and there was a significant difference between the PEG and control treatment means ($F_{1,8}$=10.8, p=0.0111).

The amount of nitrogen absorbed by the animals was also extrapolated into two measures, as nitrogen absorbed/day (g DM/day) and as a ratio of N absorbed/N intake (gDM/KgDM). The ratio measure minimises the amount of variance influencing the data, variances such as the size of the animal influencing its' intake levels. The mean amount of nitrogen absorbed (g DM/day) was 86.9 g DM/day Control vs. 92g DM/day PEG and there was no significant difference between these means ($F_{1,8}$=0.43, p=0.53). Given this result is in contrast to the findings in the faecal nitrogen content, variation in animal intake due to size needs to be accounted for and expressed as the nitrogen absorbed proportionally to the amount N eaten, N absorbed/N intake (gDM/KgDM). The N absorbed/N intake (gDM/KgDM) ratio means were 762.8 gDM/KgDM Control vs. 802.8gDM/KgDM and there was a significant difference between the control and PEG treatment means ($F_{1,8}$=28.3 p=0.0007). Therefore, with significantly less nitrogen present in the faeces of the PEG heifers (gDM/day) and significantly more nitrogen absorbed by the PEG heifers {N absorbed/N intake (gDM/KgDM)} it can be concluded that heifers supplemented with PEG were able to absorb more nitrogen from the mulga and hay supplied than the control heifers.

4.1.2 Nutritional quality

The mean ME for mulga offered (7.6 MJ/Kg DM) was significantly lower ($F_{2,18}$=6.7, p=0.007) than the means for hay (8.4 MJ/Kg DM) and mulga refused (8.6 MJ/Kg DM; Table 4.2). The effects were similar for %S ($F_{2,18}$=59.4, p<0.0001). For CP, the mean for hay was significantly lower ($F_{2,18}$=124.7, p<0.0001) than for mulga offered and refused. There were no significant (P>0.05) differences in the means for %P. Weekly nutritional analysis is provided in Appendix 9.1.

There was no significant (P>0.05) difference in the means for any of the tannin variables (Table 4.3).

Table 4.2 Mean metabolisable energy (ME), crude protein (CP), phosphorus (P) and Sulphur (S) content (DM basis) of hay and mulga offered and mulga refused (±SEM) fed over the eight week pen trial period. Means in columns with the same superscript are not significantly different (P>0.05).

	ME (MJ/Kg DM)	CP%	P%	S%
Hay	8.35 (±0.194)[a]	4.86 (±0.729)[a]	0.033 (±0.0152)[a]	0.303 (±0.0192)[a]
Mulga offered	7.61 (±0.194)[b]	18.2 (±0.729)[b]	0.071 (±0.0152)[a]	0.081 (±0.0192)[b]
Mulga refused	8.56 (±0.194)[b]	19.6 (±0.729)[b]	0.061 (±0.0152)[a]	0.363 (±0.0192)[b]

Table 4.3 Mean tannin content (DM basis) of mulga offered and refused (±SEM) over the eight week period of the pen trial

	Free tannin %	Bound Tannin %	Total Tannin %
Mulga offered	5.39 (±0.406)	0.431 (±0.067)	5.82 (±0.418)
Mulga refused	5.54 (±0.406)	0.356 (±0.067)	5.89 (±0.418)

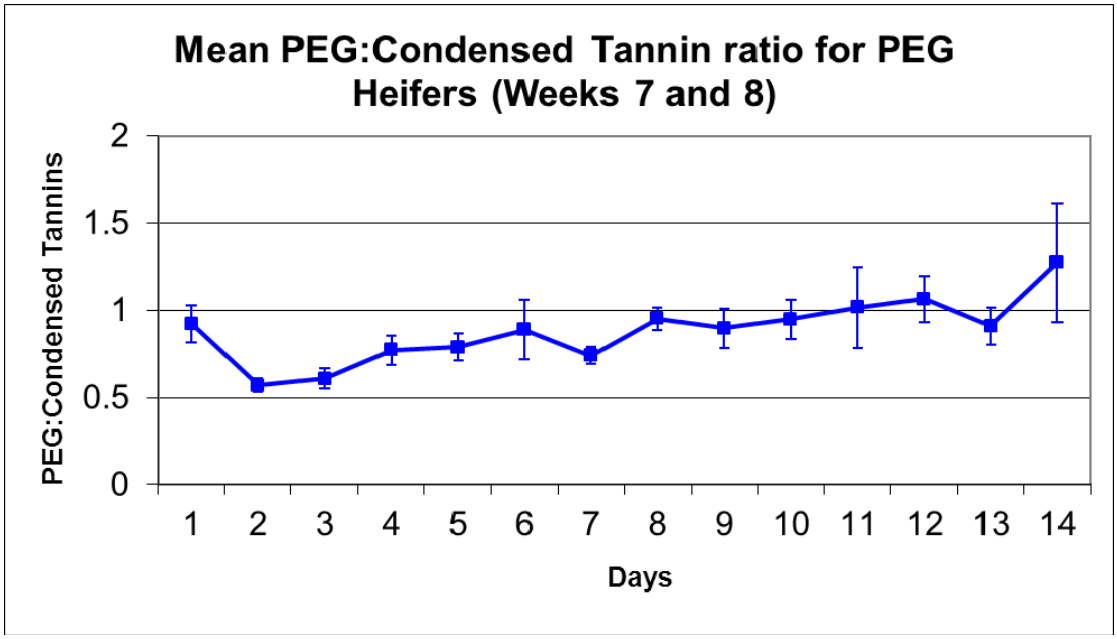

Figure 4.4 - Mean PEG:Condensed Tannin Ratio (Weeks 7 and 8) for PEG heifers.

Figure 4.4 demonstrates the variation in the actual PEG:Condensed tannins ratios for the five PEG heifers during the high supplementation period (Weeks 7 and 8). These ratios are extrapolated from the daily dry matter intake of mulga and its' condensed tannin content and the amount of PEG supplemented (200g/head/day). The average PEG:Condensed tannin ratio for the period was 0.88(±0.14):1. Current recommendations for PEG supplementation rates are for a PEG:tannin ratio of 0.7:1 to 1:1 (Strachan *et al.* 1988) and the average falls within this range. In conclusion, the PEG supplementation rate during the final two weeks of the trial was at an adequate level for the amount of condensed tannins present in the diet.

4.2 Discussion

There were no significant differences between the treatments for three of the four animal performance indicators (ie. liveweight gain, dry matter feed intake and digestibility). The only indicator that showed a treatment effect was the amount of nitrogen in the faeces, which was higher in the heifers who received no PEG supplementation (Control). In the discussion to follow, the difference in the results from this pen trial to other pen trials, where supplementation was found to be beneficial, will be explored.

4.2.1 Previous success with PEG supplementation

These results differ from the results of other trials in which PEG supplementation was demonstrated to be beneficial for cattle that were consuming diets containing tannins (eg. Mantz *et al.* 2009, Henkin *et al.* 2009 and Strachan *et al.* 1988). These all differed from the current trial in that energy and protein was also included in the supplement ration provided. Mantz *et al* (2009) found that PEG supplementation increased intake and preference for a legume species containing CT and liveweight gain in steers. Henkin *et al* (2009) demonstrated that PEG supplementation affected cow grazing behaviour (increased foraging time and daily foraging distance), increased usage of woody species containing CT but not average cow liveweight.

In the only published trial where cattle were fed mulga and supplemented with PEG the results showed that dry matter intake was increased by 32% (Strachan *et al.* 1988) at a PEG:tannin ratio of 1:1. In the current research the ratio was close to the Strachan *et al.* (1988) ratio in weeks 7 and 8, at a ratio of 200g PEG:210g tannin or a 0.95:1 ratio. The difference between this research and the Strachan *et al.* (1988) was the supplement ration. In the Strachan *et al.* (1988) study PEG supplementation was also accompanied by a ration that contained nitrogen, phosphorus and sulphur. Jeffrey and McIntosh (2000) state that supplementing with nitrogen sources, when nitrogen is a limiting factor, such as urea can improve roughage intake by 20-30%. The action of PEG is to bind mulga and as such to make available the CP. The degradability of mulga CP is not known but it would be expected to contribute to the rumen ammonia pool. Rumen ammonia levels could not be monitored in this experiment but a comparison of the results to the previously mentioned research suggests that there may be a response to extra nutrients.

PEG alone may not be enough to improve animal performance. Previous studies with sheep fed mulga found that supplements with PEG, true protein, nitrogen, phosphorus and sulphur markedly improved dry matter intake and digestibility and wool growth (Pritchard *et al.* 1992) and liveweight gain (Miller 2003). It is hypothesised that other nutrients are required in addition to PEG to give a benefit.

4.2.2 Influence of the level of PEG supplementation

In exploring what factors may have contributed to the lack of a treatment effect, the supplementation levels must be considered. Recommendations exist on the amount of PEG to supplement, and these are based on the ratio between PEG and condensed tannins. Current recommendations are for a PEG:tannin ratio of 0.7:1 to 1:1 (Strachan *et al.* 1988). For this

research the PEG supplementation rate was based on the condensed tannin content of mulga varying between 31 – 96 g/kg DM (Barry and Manley 1986, Pritchard *et al.* 1992, Norton 1994 and Norton 1999) and using a PEG:tannin ratio of 0.7:1. For the first six weeks the PEG heifers were supplemented at a low variable rate, median 60g/head/day (range 14 - 105 g/head/day), estimated PEG:tannin ratio of 0.07:1 – 0.5:1. During the last two weeks of the pen trial the PEG heifers were drenched at a higher rate (200g PEG, PEG:tannin ratio 0.88:1). Neither the low or high supplementation rates caused a significant difference in daily liveweight gain between the PEG and control heifers. During the final two weeks of the pen trial there was also no significant difference ($P>0.05$) in dry matter feed intake and dry matter digestibility. Nitrogen content in the faeces was the only animal performance indicator that showed a significant treatment effect between the PEG and control heifers.

It is concluded that up to 200g/day PEG had no effect on intake and liveweights of the heifers consuming mulga in this trial. Certainly low levels associated with drinking water had no effect.

4.2.3 Faecal nitrogen content in the faeces

There was more faecal N excreted in the control heifers and more N absorbed by the heifers supplemented with PEG. This indicated that the condensed tannins in mulga were binding protein and a proportion was being excreted. PEG as expected decreased this level of excretion and this agrees with research conducted by Jones *et al.* (1977), Perez-Maldonado (1994) and Miller *et al* (1997) on the action of PEG. However as there was no difference in liveweight gain then the extra N absorbed, most likely as amino acids, were not having a beneficial effect. This may be due to the amount of extra amino acid N absorbed was not large enough to result in a higher live weight gain or because other things may affect faecal N excretion rather than simply absorption of amino acids.

4.2.4 Diet quality

In exploring the reasons why in this trial there was no significant benefit in supplementing heifers with PEG we must consider the quality of the diet in regards to the amount of condensed tannins present in the diet, the interaction between PEG and the tannins and other nutritional factors such as energy and sulphur.

Laboratory analysis found that there was no significant difference between the total condensed tannin content of the mulga offered and the mulga refused. This meant that the cattle were not significantly preferentially eating leaf with a lower content of condensed tannin. The mean total condensed tannin of the mulga fed in this study was 58 – 59 g/kg DM and this was within the range reported in previous research of tannin content in mulga, 31 – 96 g/kg DM (Barry and Manley 1986, Pritchard *et al.* 1992, Norton 1994 and Norton 1999).

The PEG to condensed tannin content ratio in the diet in the final two weeks of the Pen trial, was 0.88g PEG:1g condensed tannin (mean). This is relatively close to the 1:1 ratio recommended by Strachan *et al.* (1988) and unlikely to contribute to the lack of difference in performance by the PEG heifers in weeks 7-8. In weeks 1-6 it is estimated to be much lower (0.5 – 0.7:1) and this may have contributed to the lack of a difference in that period only. However in weeks 7-8 the level was high enough to test the response and there were no differences.

Previous research trials with PEG ensured that there was also an energy supplement available such as molasses or grain to either increase the energy content in the diet or the palatability of the PEG supplement (Mantz *et al.* 2009, Henkin *et al.* 2009 and Strachan *et al.* 1988). The energy content of the mulga offered to the heifers in this study was 7.61 MJ ME/kgDM and could be regarded as being at a maintenance level (Strachan *et al.* 1988, Everist *et al.* 1958). Without higher energy content in their diet the PEG heifers may have had limited ability to utilise the

additional protein made available to them by the PEG. Mulga is known to contain high crude protein levels but to be low in sulphur and phosphorus. Sulphur deficiency in particular, can limit the ability of the ruminant to metabolise protein. The sulphur and phosphorus levels in the mulga fed to the cattle would be regarded as deficient (CSIRO 2007).

PEG as a supplement for cattle grazing topfeed species such as mulga may require the provision of additional nutrients such as sulphur and energy to ensure improved cattle performance. Additional energy could be provided by either direct supplementation with feed high in energy such as cotton seed meal, grain or molasses. Sulphur levels would need to be reviewed to ensure additional feed additives meet the animal's requirements for sulphur. Strachan *et al.* (1988) demonstrated that PEG supplementation with additional nutrients can increase dry matter intake of steers when they are grazing mulga. However PEG supplementation alone had no effect and this is important to know in assessing the efficacy of PEG supplementation.

4.2.5 Other contributing factors

The failure of PEG supplementation to improve the heifers' performance on a diet dominated by mulga may also have been influenced by other factors. For example there is anecdotal evidence that cattle in central Australia choose which mulga tree they graze. This preferential grazing may allow the cattle to select leaves that are more palatable influenced either by the presence of less condensed tannins or higher sugar levels. The mulga used in this pen trial though had a condensed tannin content of on average 5.8% (±0.4) and was not as high (3.1 – 9.6%) as those reported by Barry & Manley (1986), Pritchard *et al.* (1992), Norton (1994) and Norton (1999). Heifers consumed a high level of mulga so they did find it palatable.

A factor not measured during the pen trial was the rumen microflora and the presence of microbe species which are tolerant or able to degrade mulga condensed tannins. In research conducted by Rogosic *et al.* (2008), it was found that a significant difference in PEG supplementation occurred in the sheep but not in the goats. The authors suggested that this could be attributed to the goats being able to consume and detoxify secondary compounds. Research in Australia suggests that feral goats and camels contain microbes that are capable of countering the condensed tannins found in mulga (Tjakradidjaja *et al.* 1997). If these microbes were also found in cattle from central Australia then it may be possible that the control heifers were able to match the performance of the PEG heifers because their rumen microbial population was able to tolerate the condensed tannin content of their diet.

4.2.6 Impact of findings for beef producers

The findings from this trial need to consider in addition the cost of PEG supplementation, as this will be an important consideration for beef producers. The PEG supplement used for this trial cost $7.20/kg, delivered to Alice Springs. During the first six weeks of the pen trial the PEG heifers on average consumed 2.52kg PEG/head/day and 2.8kgs PEG/head/day in the final two weeks. Therefore for the eight weeks of the pen trial a total of 5.32kg PEG/head/day was consumed equating to $38.30/head. This cost was incurred with no improvement in liveweight gain over the eight week period.

At the higher PEG supplementation rate (200g/head/day) this equated to a cost per day of $1.44/head/day. This amount is six times the cost of urea lick blocks ($0.24/head/day), which are commonly used by beef producers during dry periods. Beef producers, if planning to solely supplement with PEG, need to consider the findings from this research and the cost of the supplement in their decision making.

5 Success in achieving objectives

Each of the individual objectives are addressed in regards to the success of the research project in achieving these objectives.

5.1 Objectives

5.1.1 Established the cost effectiveness of supplementing cattle fed a topfeed diet in the Alice Springs district at various levels of inclusion of Poly Ethylene Glycol (PEG) in a pen feeding situation.

This objective was met.

PEG supplementation was evaluated during the eight week long period of the pen trial. During the first six weeks the PEG heifers were supplemented a low amount of PEG in their water, with intake varying according to water intake (14 – 106g/head/day). During this low intake period there was no significant difference in weekly liveweights between the control and PEG heifers. In the final two weeks the PEG heifers were drenched with a PEG solution containing 200g of PEG. There were also no significant differences between the treatments in the final two weeks of the pen trial in weekly liveweights, daily dry matter feed intake or weekly dry matter digestibility. The only significant difference was that the PEG heifers excreted less nitrogen in their faeces than the control heifers, suggesting that the PEG had caused additional nitrogen to be absorbed.

With neither the high or low levels of PEG supplementation giving any improvement in animal performance, and given the high cost of PEG, these results demonstrate that PEG supplementation of cattle grazing mulga in central Australia is unlikely to be cost effective at any price.

The cost of the PEG supplemented delivered to Alice Springs was $7.20/kg. During the higher level supplementation period for the PEG heifers this resulted in a cost of $1.44/head/day. In comparison urea lick blocks delivered to Alice Springs are $1.65/kg and cost $0.24/head/day. Supplementing with PEG alone gave no benefit to animal performance. It may be possible that supplementing with other nutrients in addition to PEG may achieve a benefit for beef production from mulga but this would also increase the cost of the ration and seems unlikely to be cost effective at current prices.

Current literature has not demonstrated that supplementing breeding cows with PEG will increase liveweight gain.

5.1.2 Developed economic and sustainable grazing recommendations and practical supplementation applications for supplementing breeder cattle in the Alice Springs region with PEG if positive cost benefits were established in the initial pen feeding trials.

Since the pen trial found that PEG supplementation gave no improvement in animal performance and given the high cost of PEG supplementation, the only recommendation to come out of this work is that PEG supplementation is not recommended for animals grazing mulga in central Australia as it is not cost effective.

The second phase of this project (a paddock trial to test and develop practical strategies for PEG supplementation) was not conducted because and lack of any evidence to show that PEG on its own will produce any enhanced livestock productivity in cattle. Therefore practical recommendations for feeding PEG in paddock situations could not be formulated. ASPIAC has

expressed some interest in seeing the paddock trial conducted but appreciates that this will need to wait for drier seasonal conditions. Conducting the paddock trial component of this project should be reviewed once seasonal conditions are drier and take into account the findings from the pen trial. This review may need to be completed with representatives from ASPIAC, MLA and DoR.

6 Impact on meat and livestock industry

6.1 Impact on central Australian pastoral industry 2011

This project has impacted on the central Australian pastoral industry by raising awareness and understanding of the use of PEG as a supplement for cattle grazing mulga. Cattle producers now know that PEG supplementation is very expensive and is unlikely to improve weight gain. This information was not previously known and was requested by ASPIAC.

Two articles have been published in the *Alice Springs Rural Review* about the research project and a third is to be published in March 2011, see appendix 9.3. Information about the research project has also been provided at industry meetings of the Alice Springs branch of the Northern Territory Cattlemen's Association and ASPIAC. Individual pastoralists from the central Australian region and interstate have also sought out additional information about the project and its findings.

6.2 Impact on central Australian pastoral industry 2016

It is anticipated that the findings from this research project will provide better information for pastoralists about their supplementation options especially during the next severe dry period in the region.

Cattle producers now know that PEG supplementation is unlikely to be a profitable strategy to improve performance during times of drought.

7 Conclusions and recommendations

In conclusion, the pen trial studies in this project found that PEG supplementation on its own did not improve the performance of cattle on a mulga diet.

The lack of improvement in heifer performance from PEG supplementation may have been due to the low energy, sulphur and phosphorus content of the diet in this study. If the PEG heifers in this trial were also fed an energy supplement such as molasses then better performance could be expected. However this would come at an additional cost for the producer. PEG supplementation is very expensive as PEG costs approximately $7.20/kg (delivered in Alice Springs) and the costs of other nutrients supplemented would be additional to this.

It is recommended that for beef production from mulga, PEG alone is not a cost effective supplement.

8 Bibliography

Askew K and Mitchell AS (1978), *The fodder trees and shrubs of the Northern Territory*, Extension Bulletin No. 16, Agdex 330, Department of Primary Industry and Fisheries, Northern Territory Government, Darwin

Barry TN & Manley TR (1986), Interrelationships between concentrations of total condensed tannin, free condensed tannin, and lignin in *Lotus* spp and their possible consequences in ruminant nutrition, *Journal. of the Science of Food and Agriculture* 37 pp248 - 254

Chippendale GM (1964), Determination of plant species grazed by open range cattle in central Australia, *Australian Society of Animal. Production, Proceedings* Vol 5 pp 256 - 257

CSIRO (2007), *Nutrient Requirements of Domesticated Ruminants*, CSIRO publishing, Collingwood Victoria Australia

Everist SJ, Harvey JM and Bell AT (1958), Feeding sheep on mulga, *Queensland Agricultural. Journal.* 84, pp 352 - 361

Henkin Z, Perevolotsky A, Rosen A, Brosh A, Provenza F and Silanikove N (2009), The effect of polyethylene glycol on browsing behaviour of beef cattle in a tanniferous shrubby Mediterranean range, *Livestock Science* 126 pp. 245 - 251

Jeffery M & McIntosh F (2000), *Northern Nutritional. Update Workshop Technical. Manual.*, the State of Queensland, Department of Primary Industries, Brisbane, Queensland Australia

Jones WT and Mangan JL (1977), Complexes of the condensed tannins of sainfoin (*Onobrychis viciifolia* Scop) with fraction 1 leaf protein and with submaxilar mucoprotein and their reversal by polyethylene glycol and pH. *Journal. of Science Food Agriculture* 28 pp126 - 136

Lowry JB, Petheram JR and Tangendjaja B (1992), Plant Fed to Village Ruminants in Indonesia, ACIAR Technical Reports 22, Australian Centre for International Agricultural Research, Canberra, Australia p.60

Mantz GK, Villalba JJ and Provenza FD (2009), Supplemental polyethylene glycol affect intake of and preference for *Sericea lespedeza* by cattle, *Journal. of Animal. Science* 87 pp761-769

McMeniman NP, Beale IF and Murphy GM (1986), Nutrition evaluation of south-west Queensland pastures, *Australian Journal. of Agricultural. Research* 37 pp303-314

Miller SM, Pritchard DA, Eady SJ and Martin PR (1997), Polyethylene glycol is more effective than surfactants to enhance digestion and production in sheep fed mulga (*Acacia aneura*) under pen and paddock conditions. *Australian Journal. of Agricultural. Research* 48 (8) pp1121-7

Miller SM (2003), The role of *Acacia aneura* in animal production, In: Forage tree legumes in tropical agriculture. Editors, GC Gutteridge and HM Sheldon. CAB International

Norton BW (1994), The nutritive value of tree legumes, In: Forage tree legumes in tropical agriculture. Edited by RC Gutteridge and HM Sheldon. CAB International

Norton BW (1999), The significance of tannins in tropical animal production. In: Tannins in livestock and human nutrition. Proceedings of an international workshop, Adelaide, Australia, May 31 – June 2. Editor JD Brooker

Perez-Maldonado RA (1994), The chemical nature and biological activity of tannins in forage legumes fed to sheep and goats. PhD Thesis, The University of Queensland, Department of Agriculture, Australia

Plumb JJ, Blackall LL, Klieve AV and Brooker JD (1999), Rumen bacterial diversity with and without mulga (*Acacia aneura*) tannins' *in* Tannins in livestock and human nutrition. Proceedings of an international workshop, Adelaide, Australia 31 May – 2 June 1999, Australian Centre for International Agricultural Research (ACIAR), Canberra Australia pp 146 – 150

Pritchard DA, Stocks DC, O'Sullivan BM, Martin PR, Hurwood IS and O'Rourke PK (1988), The effect of Polyethylene Glycol (PEG) on wool growth and liveweight in sheep consuming a mulga (*Acacia aneura*) diet, *Proceedings of the Australian Society of Animal. Production* Vol 17 pp. 290 - 293

Pritchard DA, Martin PR and O'Rourke PK (1992), The role of condensed tannins in the nutritional value of Mulga (*Acacia aneura*) for sheep, *Australian Journal. of Agricultural. Research* 43 pp1739 -1746

Rogosic J, Pfister JA, Provenza FD and Pavlicevic (2008), The effect of polyethylene glycol on intake of Mediterranean shrubs by sheep and goats, *American Society of Animal. Science* 86 pp 3491 - 3496

Strachan DB, Pritchard DA, Clarke MR, and O'Rourke PK (1988), Effect of polyethylene glycol:tannin ratio on dry matter intake and digestibility of mulga leaf by steers, *Proceedings of the 5th Biennial. Conference of the Australian Rangeland Society* pp. 177-178

Tjakradidjaja AS, Brooker JD and Bottema CDK (1997), Are *Streptococcus caprinus* and *Selenomonas ruminantum* K2 the only tannin-resistant bacteria in feral. ruminants*?* Microbiology Australia 18:A114(PO4.5)

9 Appendices

9.1 Appendix 9.1 – Raw Data for Nutritional Quality of Diet

Table 9.1.1 – Nutritional Analysis of Hay Fed

Week	ME (MJ/kg DM)	CP%	P%	S%
2	7.29	5	0.08	0.07
3	7.61	4.8	0.06	0.05
4	7.81	4.5	0.05	0.12
5	7.25	4.4	0.1	0.11
6	7.6	4.9	0.06	0.07
7	7.6	4.7	0.09	0.06
8	8.08	5.7	0.06	0.09

Table 9.1.2 – Nutritional Analysis of Mulga Fed

Week	ME (MJ/kg DM)	CP%	P%	S%
2	7.96	19	0.14	0.39
3	8.32	17.2	0.02	0.3
4	7.79	17.1	0.01	0.32
5	7.87	19.4	0.01	0.3
6	7.71	16.8	0.01	0.34
7	9.07	15.1	0.01	0.31
8	9.71	23	0.03	0.16

Table 9.1.3 – Nutritional Analysis of Feed Refused

Week	ME (MJ/kg DM)	CP%	P%	S%
2	8.58	18.1	0.01	0.34
3	8.67	16.5	0.03	0.35
4	7.81	21.3	0.06	0.35
5	8.74	17.9	0.01	0.35
6	8.73	19.8	0.13	0.42
7	8.48	21.9	0.1	0.43
8	8.9	21.6	0.09	0.3

Table 9.1.4 – Tannin Content of Mulga fed

Week	Free Tannin Wt %	Bound Tannin Wt %	Total Tannin Wt %
2	4.46	0.53	4.98
3	3.99	0.77	4.76
4	4.71	0.28	5.00
5	5.51	0.23	5.74
6	5.16	0.28	5.44
7	7.57	0.47	8.04
8	6.30	0.46	6.76

Table 9.1.5 – Tannin Content of Mulga Refused

Week	Free Tannin Wt %	Bound Tannin Wt %	Total Tannin Wt %
2	4.62	0.23	4.85
3	4.14	0.17	4.31
4	6.42	0.25	6.66
5	5.39	0.38	5.77
6	6.25	0.35	6.60
7	6.45	0.66	7.11
8	5.49	0.45	5.94

9.2 Appendix 9.2 – Weather for the duration of the pen trial

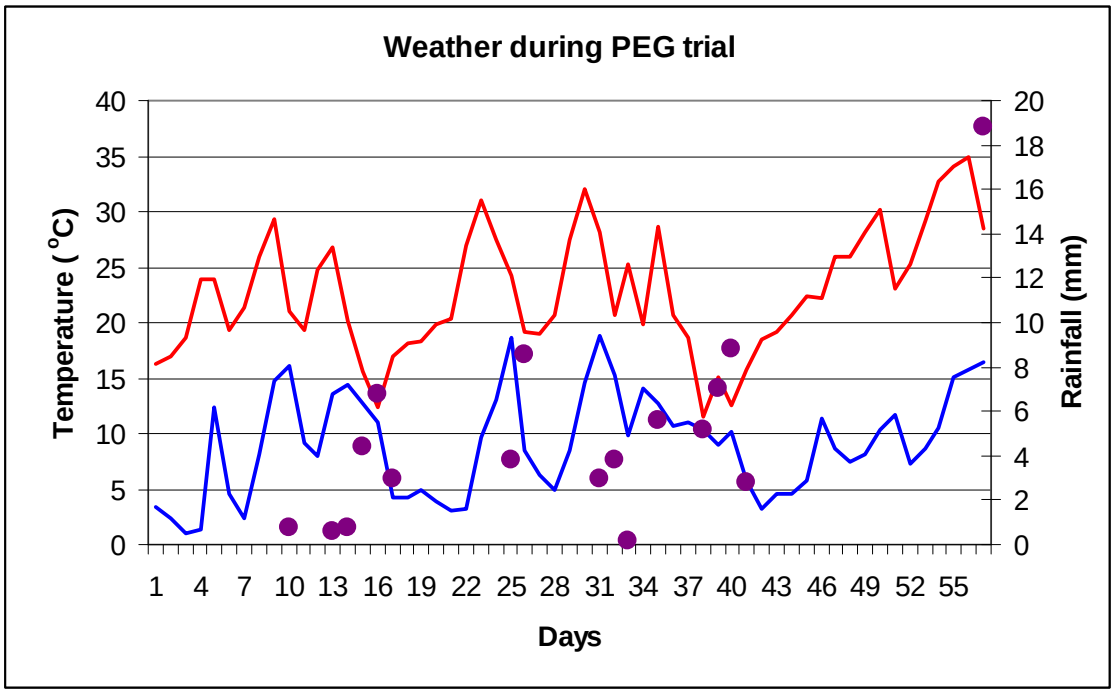

Figure 9.2.1 – Daily weather conditions for the length of the pen trial, maximum temperatures shown in red, minimum temperatures shown in blue and rainfall shown by purple.

9.3 Appendix 9.3 – Alice Springs Rural Review Articles

Article 1 – September 2010 issue
http://www.nt.gov.au/d/Content/File/p/NL/ASRR/asrr2010_09.pdf

PEG Pen Trial

Sally Leigo Pastoral Extension Officer Alice Springs

Alice Springs Pastoral Industry Advisory Committee (ASPIAC) has been interested in exploring the benefits of feeding Poly-Ethylene Glycol (PEG) to cattle when they are grazing topfeed species such as mulga (*Acacia aneura*). Current scientific knowledge has found that PEG binds to the condensed tannins that are found in mulga allowing more protein to be digested by the animal. This research will give us a better understanding of the effects PEG supplement has on cattle eating top feed. Funding and support for the two year project has been obtained from Meat & Livestock Australia (MLA) and the Department of Resources (DoR).

Above: Mulga from Paddock to Plate!

The first phase of the research project, the pen trial, commenced at the Arid Zone Research Institute (AZRI) on 5th August 2010. We have 10 heifers housed in individual pens and are being fed a diet of mulga and hay and will continue for 8 weeks. Half of these heifers are receiving the PEG supplement. Weights are being collected weekly, as well as data on their feed and water intake, nitrogen absorption and digestibility.

Early next year a field day is planned to present initial findings from the project trial. If you would like to find out more information please feel free to contact me 08 8951 8144 or catch up with me at AZRI.

Left:
Mixing the PEG into the water for the cattle.

Above:
Alice Springs Correctional Services assisting with the collection of mulga and breaking it down to be feed to the cattle.

Right:
The cattle are housed in separate pens, half being supplemented with PEG.

Article 2 – December 2010 issue
http://www.nt.gov.au/d/Content/File/p/NL/ASRR/asrr2010_12.pdf

PEG has no effect – Preliminary findings from the PEG pen trial

Sally Leigo, Pastoral Extension Officer, Alice Springs

Pen #2 tucking into her freshly plucked mulga

The eight week PEG pen trial has now wrapped up and the process of finalising all of the results is being undertaken. Before presenting the results we have to date, here is a bit of background to how the project approached supplementing cattle with PEG.

Background

PEG stands for Poly-Ethylene Glycol (PEG) and is synthetic (or man-made) compound that is used in a range of pharmaceutical (eg. laxatives), cosmetic (eg. shampoos, skin cream) and chemical products (eg. green wood stabiliser, lubricants). Most importantly, PEG dissolves in water, which made it very easy to administer to the cattle in the trial.

For the purpose of the trial we had ten head of one year old Droughtmaster heifers, who were daughters of the same sire, with an average weight of 290kg at the start of the trial. Each animal was housed in individual sheltered pens and half were supplemented with PEG (PEG Group) while the other half were not (Control group).

The cattle were weighed weekly for the entire eight weeks to monitor their live-weight. In the final two weeks of the trial a more intensive phase of data collection was undertaken, where the following was monitored:

- Feed intake
- Feed refusal
- Faecal output

We also collected numerous samples:

- Faecal samples to look for any changes in nitrogen absorption
- Mulga samples to look at nutrient and tannin levels
- Hay samples to look at nutrient levels
- Blood samples to analyse for blood urea and phosphorus levels

It was decided that PEG 4000 which is the most common among the various ruminant supplements available would be used and was sourced from a supplier in Queensland. The costs were $5.50/kg excluding transport or $7.40/kg with transport.

How we supplemented with PEG for the trial

The aim was for the cattle being supplemented with PEG to receive 212g PEG/head/day. This ration was mixed in with water at a ratio of 212g PEG:30L water or 7g PEG:1L water. For the first six weeks of the trial this intake was not achieved as individual water intake was lower than expected, due to cooler weather and the cattle being penned and not exercising at they would in a paddock. Water intake during this period varied from 2L – 15L/head/day resulting in a PEG supplement intake of 14g – 105g/day. For the final two weeks of the project to increase intake we drenched the cattle daily with a PEG solution. Each animal received 600ml of solution containing 200g of PEG.

The Results

At the time of writing this article the samples collected were in the process of being analysed and as such those results can not be presented, but keep an eye out in coming *Alice Springs Rural Review* issues!

The results presented here relate to the liveweight performance of the cattle, their feed intake and digestibility of the mulga.

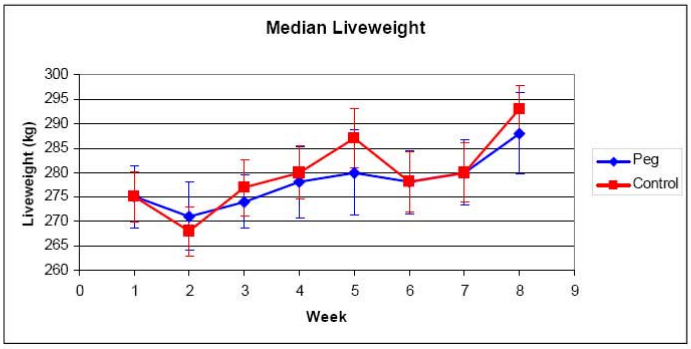

Figure 1: Shows the live-weight performance of the two groups of cattle, those supplemented with PEG (PEG) and those that were not (Control). The graph shows that there is no significant difference between the groups of cattle. Weeks 1 – 6 was the period of low supplementation (14g – 105g/head/day) with PEG and weeks 7 – 8 was the period of high supplementation (200g/head/day).

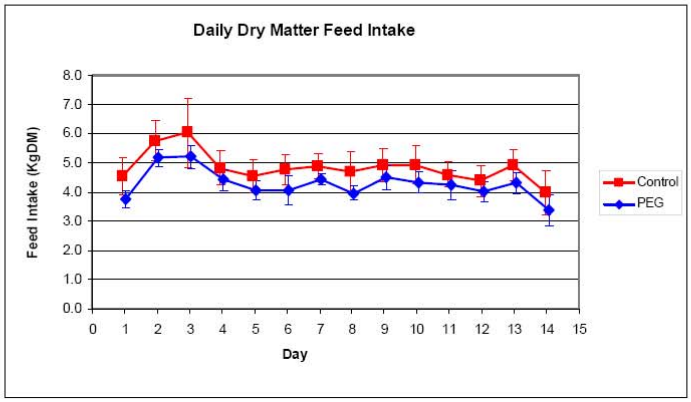

Figure 2: Shows the feed intake (mulga and hay) results from the final two weeks, again demonstrating no significant difference between the two groups of cattle.

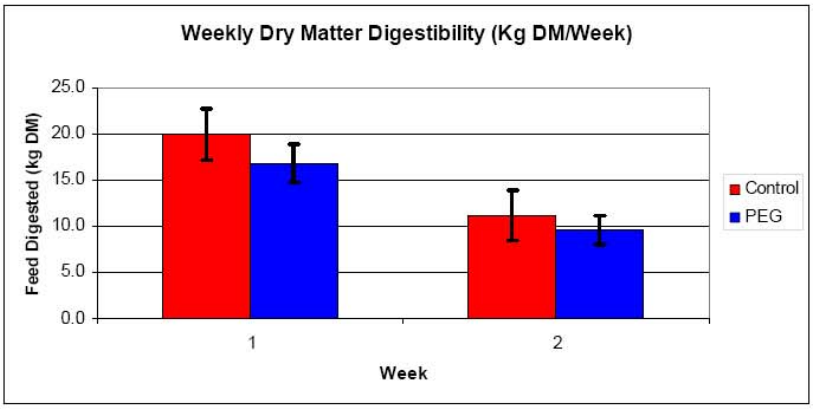

Figure 3: Looks at how much of the feed was actually digested by the cattle over a week. This graph again shows that there was no significant difference between the cattle supplemented with PEG or not supplemented at all.

At this stage the pen trial indicates that there does not appear to be any benefit from supplementing cattle eating mulga with PEG. These results are vastly different to what we were expecting and with analysis of our samples we hope to explain why this has occurred during this trial.

The completion of this pen trial has taken a huge effort from the staff at AZRI and also the men from the Alice Springs Correctional Centre. I thank them whole heartily for all their efforts to ensuring that the best data possible could be collected.

If you have any questions about the PEG trial please do not hesitate to contact Sally Leigo, 08 8951 8144 or sally.leigo@nt.gov.au

Sally Sims and Bryan Gill preparing faecal samples, which are currently being analysed