final report

Animal Production

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Evaluation of the electronic identification rumen boluses for improved lamb growth

Abstract

This project has shown that boluses are a competitive option to electronic ear tags for reliable on-farm identification and tracking of lambs within the processing system. Excellent retention and readability results demonstrated that boluses can be reliably used on-farm when using the approved equipment.

This project aimed to establish whether sheep electronic identification boluses provide lamb growth advantages on-farm. If bolus use is associated with accelerated growth as shown in the a previous project it is likely that the sheep industry would experience additional benefits apart from utilising boluses solely for identification.

No growth advantages were shown for bolused lambs born in spring. Although there was a small adverse impact for autumn born lambs, the margin between growth rates of control and bolus lambs equate to only minor economic impact. Trial results showed the weight of the lamb at bolus administration does not have an impact on the subsequent growth rate.

For new technology to be successfully introduced to an industry it is important that the impact of the technology is assessed at the different user levels prior to implementation. Processor feedback indicates that more work in conjunction with processors is required to develop a cost efficient processing system capable of handling bloused lambs and potentially recovering boluses at slaughter.

Executive Summary

Department of Primary Industries (DPI) Biosecurity Victoria division is responsible for maintaining surveillance of the disease and residue status of Victoria's livestock industries, mitigating the economic and social effects of disease and residue incidents, to facilitate access to domestic and international markets and optimising the welfare of farm animals. Robust animal identification and tracking systems are essential for the maintenance of our disease and food safety reputation and the future market access of our industries.

In spring 2005 an experiment was conducted at DPI, Rutherglen on lambs and adult sheep to evaluate rumen boluses as an alternative to ear tag electronic identification. The project established that boluses can play a useful role in the identification and tracking of sheep and in addition has provided preliminary information on the potential on-farm advantages and opportunities. Additionally there were unanticipated statistical differences observed for growth rate of control and bolus lambs resulting in bolus lambs growing at 15 g/day faster than the control lambs.

The aim of this 2006 project was to establish whether boluses provide on-farm advantages and opportunities. If bolus use is associated with accelerated growth as shown in the 2005 project it is likely that the sheep industry would experience additional benefits apart from utilising boluses solely for identification. The implications of faster lamb growth will possibly lead to more accepted and widespread adoption of the bolus technology as producers could finish their lambs at an earlier date. This project aimed to scientifically validate the trend shown in the 2005 trial and overseas work, towards accelerated growth rates for lambs that were administered boluses.

For new technology to be successfully introduced to an industry it is important that impact of the technology is assessed at the different user levels prior to implementation. Anecdotal evidence suggests that there may be some reluctance from the meat processing sector to process animals that have been administered an electronic identification bolus. A secondary objective of this project was to obtain processor feedback on the practicality of processing bolused lambs, and to determine if there was a reluctance to process bolused lambs and to clarify reasons for their reluctance.

The project was conducted at the Department of Primary Industries (DPI) Victoria, Rutherglen Centre research farm in 2006 and included a total of 498 single born, second cross lambs (Poll Dorset x 1st cross ewe) which were born in autumn or spring 2006. Lambs were weighed and identified with a bolus or electronic ear tag at marking and liveweights recorded at regular intervals until slaughter. Growth rates were calculated to enable comparison of bolus and control treatments.

Boluses were administered to lambs aged between 2 and 7 weeks with weights ranging from 8.5 kg to 31 kg live weight. No statistical growth rate differences were shown between weight categories at administration, indicating the weight of the lamb at administration did not influence the effect of the bolus at any stage of the lamb's growth.

Results from the Autumn trial showed that lambs from the bolus group had significantly lower growth ($P<0.05$) from bolus administration at marking to 6 months of age (256 g/day) than control lambs (267 g/day), indicating the boluses had a small adverse effect on the growth of lambs that were administered a bolus in autumn. There was no statistical difference in growth rates between the bolus (238 g/day) and control (235 g/day) lambs in the spring trial from bolus administration to 6 months of age.

Although the results showed a statistical difference for autumn lambs, the margin between growth rates of control and bolus lambs equate to only minor economic impact. Furthermore the variability of growth results shown between the spring 2005, autumn and spring 2006 trials make it difficult to confidently conclude there are additional growth benefits or disadvantages associated with the application of an electronic identification bolus. Trial results showed the weight of the lamb at bolus administration does not have an impact on the subsequent growth rate.

To further explain the differences between lambs born in the autumn or spring season, the interaction between nutritional influences and the presence of a bolus in the rumen on lamb growth rate requires further investigation.

Discussions with the processing sector clarified the risk to boluses damaging rendering equipment is due to the boluses being non-magnetic and there is currently no procedure to identify a ceramic bolus prior to reaching the rendering plant. The rendering plant at Cobram is equipped only with a magnetic detection device that detects foreign objects such as steel bolts from entering the rendering plant. The QAO commented that providing the bolus is in the rumen and the rumen is destined for tripe consumption the bolus should not pose a risk to equipment. However if the rumen is not destined for tripe consumption and is to be processed in the rendering equipment it may still be possible to manually retrieve the bolus from the rumen prior to rendering, providing the bolus is in the rumen and not the omasum. If boluses are to be used extensively further investigation is recommended to determine if the placement of boluses in the omasum results in a risk of damage to rendering equipment in processing works.

It was noted by DPI observers at a retrieval operation late in 2005 that a very small percentage of boluses fell out of the oesophagus as the throat was cut. The observations were made on lambs which had been administered a bolus within 48 hours of slaughter; the lambs were supplied by a different source and processed at a different abattoir. Although there was no incidence of ceramic boluses falling out of the oesophagus at processing for the 2006 trial, the risk of boluses falling out into the blood pit as reported needs further investigation as this could potentially cause serious damage to the blood pump and related equipment.

This project demonstrated boluses have excellent retention rate and can be read reliably on-farm when using the approved equipment. From the 247 lambs which were administered a bolus only one loss was recorded. All boluses were successfully read by the electronic reader at each weighing, apart from the one lamb which lost a bolus prior to the Day 127.

Further work is required to identify the physiological interactions associated with the administration of the bolus and the nutritional regime of the lamb. Unless a cost effective processing system is developed in conjunction with the processing sector, it is unlikely boluses will be readily accepted by processors due to their concern with damage to plant equipment.

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1 Background

1.1 Industry Background

DPI, in partnership with industry, manages and delivers programs designed to protect and enhance the reputation of Victoria's livestock industries as suppliers of 'clean' wholesome food and fibre products. Today's consumers demand "clean", wholesome food and their concerns about chemical residues in meat and livestock products must be addressed to protect our valuable domestic and export markets. The disease and residue status of our meat and livestock products is becoming an increasingly important factor in international trade. Demonstrating a high standard of produce underpins our 'clean' image on domestic and export markets, adding value to our meat and livestock products and underpinning their competitiveness.

To ensure the long term future of Australia's meat and livestock industries, a number of programs of disease surveillance and control, livestock quality assurance and chemical residue minimisation have been jointly developed by the Commonwealth Government, States/Territories, and various livestock industry and producer groups. Such programs include the National TSE Freedom Assurance Program, National Antibacterial Residue Minimisation (NARM), National Organochlorine Residue Minimisation (NORM), and the National Livestock Identification System (NLIS).

DPI Biosecurity Victoria division is responsible for maintaining surveillance of the disease and residue status of Victoria's livestock industries, mitigating the economic and social effects of disease and residue incidents, to facilitate access to domestic and international markets and optimising the welfare of farm animals. Robust animal identification and tracking systems are essential for the maintenance of our disease and food safety reputation and the future market access of our industries.

In May 2004, Australia's Primary Industries Ministerial Council (PIMC) endorsed the National Livestock Traceability Performance Standards, which specify that it must be possible within 24 hours to determine the properties where affected Foot and Mouth Disease susceptible species, including sheep, have resided over the past 30 days.

The aim of this experiment was to establish whether boluses provide additional on-farm advantages and opportunities. If bolus use is associated with accelerated growth it is likely that the sheep industry would experience additional benefits apart from utilising boluses solely for identification. The implications of faster lamb growth will possibly lead to more accepted and widespread adoption of the bolus technology as producers could finish their lambs at an earlier date.

1.2 On - farm

A previous project was conducted in spring 2005 at DPI, Rutherglen on lambs and adult sheep to evaluate rumen boluses as an alternative to ear tag electronic identification. The project established that boluses can play a useful role in the identification and tracking of sheep and in addition has provided preliminary information on the potential on-farm advantages and opportunities.

The previous project achieved the following outcomes:

⇒ Confirmed that 20g sheep rumen boluses can be orally administered quickly, easily and safely to sheep from marking weight (8kg minimum wt) to heavier adult animals.

⇒ Determined the reliability of identifying sheep administered with rumen boluses when processed in single file down a race equipped with electronic identification equipment.
⇒ Provided information on the long term retention rate of the bolus after it has been administered to the sheep.

Additionally there were unanticipated statistical differences observed for growth rate of control and bolus lambs resulting in bolus lambs growing at 15 g/day faster than the control lambs. Although data analysis showed a statistical difference ($P<0.05$) for overall growth rate, due to the limited number of lambs assessed for growth rate (as the numbers assessed were selected to clarify that there were no detrimental effect on growth) caution must be taken in interpretation of results. The project concluded more work would need to be done on lambs to scientifically validate the possibility that boluses also provide accelerated growth rates.

At birth the lamb rumen is very small and non-functional and the abomasum is well developed for milk digestion. As lambs mature and start consuming solid food rumen development occurs, which is encouraged by chemical and mechanical action. Garin *et* al (2003) reported that the presence of a bolus may increase the absorption of nutrients through the reticulorumen wall, and it is most likely that this is a consequence of a friction effect and a greater stimulation of rumen activity by the ruminal boluses. This project hypothesises that the administration of boluses to lambs on a predominately milk fed diet may encourage stimulation of rumen activity earlier than it would normally occur. Consequently as the digestion process is accelerated lamb growth rate may be improved.

This project aimed to scientifically validate the trend shown in the 2005 Rutherglen trial and overseas work, towards accelerated growth rates for lambs that were administered boluses.

1.3 Meat Processing Sector

For new technology to be successfully introduced to an industry it is important that the impact of the technology is assessed at the different user levels prior to implementation. Anecdotal evidence suggests that there may be some reluctance from the meat processing sector to process animals that have been administered an electronic identification bolus. A secondary objective of this project was to obtain processor feedback on the practicality of processing bolused lambs, and to determine if there is a reluctance to process bolused lambs and to clarify reasons for their reluctance.

2 Project Objectives

2.1 On-farm

The objectives of the trial were:
1. To determine if administering a 20g sheep rumen electronic identification bolus to lambs at marking time, results in growth rate advantages to the lamb
2. Assess the reliability of reading and retention of electronic identification boluses administered to lambs at marking

2.2 Meat Processing Sector

After the trial commenced a secondary objective was included which involved following the bolus lambs through a processing abattoir to obtain information on the following:

- Observe placement of the bolus within the stomach
- Observe if the boluses had any adverse impact on processor operations
- Obtain processor feedback

3 Methodology

3.1 Summary

The project was conducted at DPI Victoria, Rutherglen Centre research farm in 2006 and included a total of 498 single born, second cross lambs (Poll Dorset x 1st cross ewe) which were born in autumn or spring. Lambs were weighed and identified with a bolus or electronic ear tag at marking and liveweights recorded at regular intervals until slaughter. Growth rates were calculated to enable comparison of bolus and control treatments.

Following administration of the boluses, 3 additional weights per lamb were obtained at 2-4 weekly intervals from marking to weaning. Following weaning, the lambs were weighed at 4-10 weeks until the first draft of lambs was sent to slaughter (45kg liveweight, age approximately 6 to 8 months).

Figure 1. Rumitag® Z20 bolus, applicator and visual tag

Ceramic rumen boluses (Rumitag® Z20, Rumitag, Australia) as shown in Figure 1, were administered to sheep orally using applicators that have been specifically designed for use with young lambs or adult sheep. Each bolus contains a microchip encoded with a unique unalterable number. The microchips used in rumen boluses are the same technology as present in national livestock identification systems (NLIS) approved ear tags. Operators were trained in the procedure and supervised by a representative of the Rumitag Australia company that manufactures the boluses.

Bolus specifications: Boluses were supplied by Rumitag and matched the following specifications: Weight = 20 g, Length = 56.4 mm, Width = 11.2 mm and Specific gravity >3.

Figure 2. Administration of lamb bolus

All animals were tagged with a visual ear tag as it is standard procedure to visually identify project animals on the Rutherglen farm. The boluses were administered to the lambs at marking time (minimum liveweight of 8.5 kg) and the procedure took place at the same time as other standard operating procedures i.e. marking, tail docking, drenching and vaccination were performed.

Both the autumn and spring born lambs (and their dams) grazed annual pasture (80% rye grass and 20% clover) in the same paddock for 3 weeks post bolus administration. Autumn lambing ewes were supplementary fed barley and pasture hay during lambing until July 2006. FEEDTEST pasture analysis was conducted on pasture cuts taken within a week of bolus administration.

Growth rate data was statistically analysed using analysis of variance (ANOVA) in GenStat.

3.1.1 Autumn Trial

Single born lambs in the autumn trial (n=246) were weighed and identified with boluses (n=123) or electronic ear tags (control, n=123) at lamb marking on 23 May 2006 (Day 1). Weight range at administration was 8.5 - 21.2 kg and lambs less than 8.5 kg were excluded from administration. Lambs ranged from 2-7 weeks of age. At the subsequent weighing on 14th June (Day 22) a further 14 lambs previously below minimum weight for bolus administration on Day 1 were administered with either a bolus or electronic ear tag (control). Lambs were allocated to treatment via weight stratification to ensure each treatment had a similar weight range representation. All lambs (and ewes) were managed within the one mob before and after weaning which occurred on 26/7/06 (Day 64).

Lambs were weighed post-bolus administration at Days 22 (GR22), 50 (GR50), 64 (GR64), 93 (GR93) with the final weight on Day 127 (GR127). Growth rates have been calculated for each time interval, with Day 1 being the start date.

3.1.2 Spring Trial

Single born lambs in the spring trial (n=251) were weighed and identified with boluses (n=124) or electronic ear tags (control, n=127) at lamb marking on 22 September 2006 (Day 1). Weight range at administration was 8.8 - 31 kg and lambs less than 8.5 kg were excluded from administration.

Lambs ranged from 2-7 weeks of age. Lambs were allocated to treatment via weight stratification to ensure each treatment had a similar weight range representation. All lambs (and ewes) were managed within the one mob before and after weaning which occurred on 7/12/06 (day 76).

Lambs were weighed post-bolus administration at Days 21 (GR21), 48 (GR48), 76 (GR76) and 146 (GR146) and growth rates calculated.

3.1.3 Meat Processing Sector

Arrangements were made with Tasman Meats, Cobram, Victoria to follow 36 autumn born bolus lambs through the processing chain on 18th November, 2006. Three DPI staff (including Ken Evers, Biosecurity Division, Animal Standards Branch) attended the lamb kill and using a hand held reader the boluses were read pre-slaughter (race), post-slaughter (chain) and on the visceration table.

To determine the exact location of the bolus in the stomach each bolus was retrieved from the stomach on the visceration table. Comments on the practicalities of the processing procedure were obtained from the Tasman Meats Quality Control Officer.

4 Results and Discussion

4.1 Autumn Trial

Growth rates have been calculated for each time interval, with Day 1 being the start date (Table 1). Statistical analysis (ANOVA) showed there was a significant difference ($P<0.05$) between bolus and control lambs, except for growth rate from Day1-50. Lambs from the bolus group had significantly lower overall growth (11g/day) than control lambs, indicating the boluses had a small adverse effect on the growth of lambs that were administered a bolus in autumn.

Table 1: Growth rate (g/day) of bolus and control autumn 2006 lambs

	Growth Rate (g/day)					
	Day 1-22	**Day 1- 50**	**Day 1- 64**	**Day 1 - 93**	**Day 1 -127**	**Overall**
Bolus	311^{a}	278	242^{a}	256^{a}	263^{a}	256^{a}
Control	326^{b}	287	253^{b}	269^{b}	273^{b}	267^{b}
Difference (bolus – control)	-15	-9	-11	-13	-10	-11

Values with different superscripts differ significantly $P<0.05$

The liveweight of treatment groups were relatively the same at Day 1 (Table 2), indicating lambs were accurately stratified. By Day 127 the control lambs weighed 1.0 kg heavier than the bolus lambs, or 1.1kg taking into account the bolus lambs weighed 0.1 kg heavier at Day 1.

Table 2: Liveweight (kg) of bolus and control autumn 2006 lambs

	Liveweight (kg)					
	Day 1	**Day 20**	**Day 50**	**Day 64**	**Day 93**	**Day 127**
Bolus	12.8	19.3	26.4	28.0	36.3	46.0
Control	12.7	19.6	26.9	28.6	37.4	47.0
Difference (bolus – control)	0.1	-0.3	-0.5	-0.6	-1.1	-1.0

Lambs were allocated into a weight range category based on their liveweight at administration on Day 1. Table 3 shows that the original weight (before treatment was administered) was relatively the same within weight categories for both groups, which indicates that groups were well balanced for liveweight.

Table 3: Number and average liveweight of autumn born lambs in each category at Day 1

Treatments	Bolus Lamb No.	Liveweight (kg)	Control Lamb No.	Liveweight (kg)
8-9.9kg	21	9.3	20	9.3
10-11.9kg	32	10.9	33	11
12-13.9kg	30	12.8	33	12.9
14-15.9kg	31	14.9	27	14.9
16-17.9kg	11	16.8	12	16.8
18kg	5	19.5	5	19.7

Further analysis of growth rate within each weight category was performed to determine if the weight of the lamb at administration influenced the effect of the bolus treatment (Table 4). No statistical growth rate differences were shown between weight categories and treatments, indicating the weight of the lamb at administration did not influence the effect of the bolus. Table 4 shows the growth rate for control lambs in all weight categories were higher than the bolus treated lambs.

Table 4: Average growth rate of autumn lambs by treatment and weight categories (g/day)

Weight Category	Treatments	GR22	GR50	GR64	GR93	GR127	Overall
8-9.9kg	Bolus	282	257	222	246	253	249
10-11.9kg	Bolus	279	256	227	242	232	247
12-13.9kg	Bolus	321	288	251	262	267	259
14-15.9kg	Bolus	324	289	257	270	278	265
16-17.9kg	Bolus	319	280	242	260	265	258
≥18kg	Bolus	316	278	250	259	264	258
8-9.9kg	Control	302	269	232	255	269	266
10-11.9kg	Control	315	278	241	258	263	256
12-13.9kg	Control	323	291	260	256	270	265
14-15.9kg	Control	339	290	260	272	278	270
16-17.9kg	Control	344	302	261	290	288	286
≥18kg	Control	322	298	266	298	276	286

Further information:

At Day 127 all lambs were present in the control treatment group, while 3 lambs were missing from the bolus treatment group (cause unknown). All boluses were successfully read by the electronic reader at each weighing, apart from Day 127 when the bolus of one lamb did not read.

4.2 Spring Trial

Growth rates have been calculated for each time interval, with Day 1 being the start date (Table 5). Statistical analysis (ANOVA) showed there were no significant differences between bolus and control lambs. Lambs from the bolus group had similar growth to control lambs, indicating the boluses had no effect on the growth of lambs that were administered a bolus in spring.

Table 5. Growth rate (g/day) of bolus and control Spring 2006 lambs

	Growth Rate (g/day)				
	Day 1-21	**Day 1- 48**	**Day 1- 76**	**Day 1 – 146**	**Overall**
Bolus	213	250	231	143	238
Control	213	249	229	146	235
Difference (bolus – control)	0	1	2	-3	3

The liveweight of treatment groups were relatively the same at Day 1 (Table 6), indicating lambs were accurately stratified. At Day 146 the control lambs weighed 0.9 kg heavier than the bolus lambs, or 0.7kg taking into account the bolus lambs weighed 0.2 kg lighter at Day 1.

Table 6: Liveweight (kg) of bolus and control spring 2006 lambs.

	Liveweight (kg)				
	Day 1	**Day 21**	**Day 48**	**Day 76**	**Day 146**
Bolus	17.9	22.4	29.9	35.5	38.0
Control	18.1	22.6	30.0	35.4	38.9
Difference (bolus – control)	-0.2	-0.2	-0.1	0.1	-0.9

Lambs were allocated into weight range categories based on their liveweight at administration of the bolus on Day 1. Table 7 shows that the original weight (before treatment was administered) was relatively the same within weight categories for both groups, which indicates that groups were well balanced for liveweight.

Table 7: Number and average liveweight of spring born lambs in each category at Day 1

Treatments	Bolus Lamb No.	Liveweight (kg)	Control Lamb No.	Liveweight (kg)
8 to 11.9 kg	19	10.8	18	10.7
12 to 15.9 kg	26	13.8	27	13.8
16 to 19.9 kg	36	18.2	34	18.2
20 to 23.9 kg	26	21.5	27	21.6
24 kg and above	17	26.0	19	26.0

There were no statistical differences for the bolus and control groups for growth rate within weight categories as shown in Table 8. Within all weight categories the growth rate for control lambs were relatively similar to the bolus treated lambs. This supports the liveweight observations in Table 6, which indicates that the bolus did not have any effect on growth rate of lambs.

Table 8: Average growth rate of spring lambs by treatments and weight categories (g/day)

Weight Category	Treatments	GR21	GR48	GR76	GR146	Overall
8 to 11.9 kg	Bolus	231	261	240	151	239
12 to 15.9 kg	Bolus	233	259	237	153	239
16 to 19.9 kg	Bolus	202	237	218	137	223
20 to 23.9 kg	Bolus	197	255	243	144	247
24 kg and above	Bolus	207	246	222	118	253
8 to 11.9 kg	Control	240	253	232	144	224
12 to 15.9 kg	Control	230	258	241	159	251
16 to 19.9 kg	Control	205	242	219	139	217
20 to 23.9 kg	Control	205	248	230	151	248
24 kg and above	Control	187	245	223	134	245

Further information:

Data from two control lambs were removed prior to statistical analysis due to lambs being lame or flystruck. All lambs were present at Day 76, prior to Day 146 there were 10 lambs removed from the bolus group and 7 lambs removed from the control group as they had reached slaughter weight. All boluses were successfully read by the electronic reader at each weighing.

4.3 Autumn and Spring

Although the autumn trial showed a small statistical difference against bolus lambs, it is unlikely the overall growth rate difference of 11g/day/head less than control lambs would have enough impact on production to be of economic importance. In this trial the control lambs weighed 0.9kg more than bolus lambs at approximately 6 months of age. The calculated economic difference between treatments is $1.24 kg based on 46% dressing percentage @ $3.00 kg.

Although the results showed a statistical difference for autumn lambs, the margin between growth rates of control and bolus lambs equate to only minor economic impact. Furthermore the variability of growth results shown between the spring 2005, autumn and spring 2006 trials make it difficult to confidently conclude there are additional growth benefits or disadvantages associated with the application of electronic identification bolus.

The difference in results shown between the spring and autumn trials are likely to be due to varying seasonal conditions such as climate and feed quality and quantity. FEEDTEST results (Table 9) of pasture assessed in autumn and spring 2006 show pasture quality (digestibility and metabolisable energy) in spring is higher than autumn.

Table 9. FEEDTEST results for Autumn and Spring pasture samples

Test	Autumn	Spring
Crude Protein (% of DM)	16.0	14.0
Neutral Detergent Fibre (% of DM)	43.9	43.5
Digestibility (% of DM) NIR	64.4	78.6
Digestibility (% of DM) Calculated	61.4	73.4
Metabolisable Energy (MJ/kg DM)	9.5	11.9

To provide optimum feed requirements to Autumn lambing ewes in North East Victoria supplementary feeding is a common management practice. Pasture quality and availability in Spring is generally sufficient to meet lambing ewe feed requirements and supplementary feed is not generally required.

The 2006 year was particularly dry and ewes with autumn born lambs were supplementary fed barley and pasture hay prior to lambing, feeding ceased in July 2006. Furthermore there is more pasture roughage carried over from the previous spring which is available to autumn born lambs. Lambs do not supplement their milk diet with solid feed until they are 2 weeks of age after which the quantity of supplementation is dependant on ewe nutrition and subsequent milk supply. Since autumn pasture quality and quantity were poorer than spring it is likely autumn lambs consumed solid feed earlier than spring lambs. Lambs were observed to be eating supplementary grain in the paddock at 8 weeks of age. Conversely the spring born lambs had higher quality pasture feed and less roughage available than autumn born lambs and were not supplementary fed grain until after weaning in December 2006 which explains the difference in lamb weights at administration.

For these reasons it is likely that rumen activity commences earlier for autumn born lambs than spring born lambs and therefore the effect of the bolus stimulating the rumen process is probably less likely to be observed in autumn lambs than spring lambs. To further explain the differences between lambs born in the autumn or spring season, the interaction between nutritional influences and the presence of a bolus in the rumen on lamb growth rate requires further investigation.

It is difficult to speculate on the reason for an adverse impact on bolus lambs in autumn. However, at the retrieval process conducted at the abattoir on a portion (n=35) of autumn born lambs (see meat processing sector below) one third of the boluses (n=12) were retrieved from the omasum of the lamb. Since it was hypothesised that early rumen stimulation may be caused by the bolus friction effect, the recovery of the bolus from the omasum would negate the perceived stimulation effect. Additionally the placement of the bolus in the omasum may have welfare implications due to possible obstruction therefore limiting milk supply. Rumitag currently recommends 12kg as the minimum weight for bolus administration (or 10 kg for some breeds).

Since individual identities were not obtained at abattoir processing it is not possible to determine if the lambs with a bolus in the omasum had different growth rates than those that were found in the rumen or which liveweight category they were in at bolus administration. It is likely all lambs processed on November 18th were in the heavier weight category at administration as they were the first draft of lambs sold from the autumn lamb drop. Further investigation is required to determine if the weight of the lamb at bolus administration influences bolus placement and if the position of the bolus in the stomach has an impact on lamb growth or welfare.

4.4 Meat Processing Sector

All boluses read successfully at three different reading locations at the abattoir supporting previous trial results for reliability and retention rate.

The bolus is expected to be found in the reticulum; however the observers found 12 (33%) of the 35 boluses in the omasum which made the retrieval process more difficult for DPI staff. Ken Evers (DPI) commented that he has not seen this occurrence at previous processing and it created disruption on the kill floor as until plastic tubs were provided and AQIS approval granted, the chain had to be stopped due to the high difficulty in removing the boluses from the omasum. One bolus was not recovered due to its position in the omasum and DPI staff reluctance to request the chain to be stopped again.

Discussion with the Quality Assurance Officer (QAO), Tasman meat Group Services, Cobram clarified the risk to boluses damaging rendering equipment is due to the boluses being non-magnetic and there is currently no procedure to identify a ceramic bolus prior to reaching the rendering plant. The rendering plant at Cobram is equipped only with a magnetic detection device that detects foreign objects such as steel bolts from entering the rendering plant. The QAO commented that providing the bolus is in the rumen and the rumen is destined for tripe consumption the bolus should not pose a risk to equipment. However if the rumen is not destined for tripe consumption and is to be processed in the rendering equipment it may still be possible to manually retrieve the bolus from the rumen prior to rendering, providing the bolus is in the rumen and not the omasum.

If boluses are to be used extensively further investigation is recommended to determine the implications of bolus placement within the stomach and the risk of damage to rendering equipment in abattoirs. Additionally, consideration should be given to processor perception of plant damage compared to the actual risk to plant as sheep are commonly treated with mineral bullets and anathelmintic capsules which are not metallic and appear to be handled successfully during rendering.

It was noted by DPI observers at a retrieval operation late in 2005 that a very small percentage of boluses fell out of the oesophagus as the throat was cut. The observations were made on lambs supplied by a different source and at a different processing plant. It is possible that the occurrence in 2005 was due to boluses being administrated within 48 hours of slaughter which may not have allowed sufficient time for the bolus to pass into the rumen.

Although there was no incidence in this project of ceramic boluses falling out of the oesophagus at processing on 18th November, 2006, the risk of boluses falling out into the blood pit as observed in the 2005 retrieval operation needs further investigation as this could potentially cause serious damage to the blood pump and related equipment.

5 Success in Achieving Objectives

5.1 On-farm

This objective was achieved as both spring and autumn trials were completed within the specified time line and methodology.

5.2 Meat Processing Sector

This objective was achieved by following a portion of autumn born lambs through a local processing plant and obtaining feedback. It was not within the scope of this project to follow all lambs though processing works as lambs were sold through various processors or sale yards.

6 Impact on Meat and Livestock Industry

The high retention rate and readability of boluses observed in all trials has shown the bolus is a competitive option to electronic ear tags for reliable identification on-farm and tracking lambs within the processing works. Reliable identification and tracking systems will enable more accurate producer feedback and assist to maintain Australia's high reputation for disease and food safety and enhance export market opportunities.

Since a bolus is a permanent device the key advantage compared to an electronic ear tag is that it cannot be removed or easily lost, which can more readily occur with ear tags. The loss of an ear tag generally results in the loss of information about an individual animal however the high retention rate of a bolus ensures information will be indefinitely retained.

In the event that boluses are to be used for on-farm identification purposes it will be necessary to establish systems in abattoirs to alert processors to the presence of a bolus and allow automation of recovery. Automation of recovery will also provide the opportunity for the industry to recycle and therefore reduce the cost of using an electronic identification device.

7 Conclusions and Recommendations

This project has shown that boluses are a competitive option to electronic ear tags for reliable on-farm identification and tracking of lambs within the processing system. Excellent retention and readability results demonstrated that boluses can be reliably used on-farm when using the approved equipment.

If boluses are to be used extensively in the future, further work in conjunction with the processing sector will be required to develop a cost efficient processing system capable of addressing current processor concerns relevant to their operating plant. To alert abattoirs that lambs with boluses are to be processed it may be necessary to include a question in sheep National Vendor Declarations on whether boluses are present, as occurs with cattle NVDs.

Although the results for autumn lambs showed a small adverse impact for autumn lambs, the margin between growth rates of control and bolus lambs equate to only minor economic impact. Furthermore the variability of growth results shown between the spring 2005, autumn and spring 2006 trials make it difficult to confidently conclude there are additional growth benefits or disadvantages associated with the application of an electronic identification bolus. Trial results showed the weight of the lamb at bolus administration does not have an impact on the subsequent growth rate.

Although there has been extensive research on sheep boluses in Spain, there has been little research work done in Australia. Further investigation is recommended for the following areas to better understand the implications of using sheep boluses under Australian conditions:

<u>On-farm</u>

- To explain the differences between lambs born in the autumn or spring season, there is a need to investigate the interaction between nutritional influences and the presence of a bolus in the rumen on lamb growth rate
- Determine if the placement of the bolus in the stomach has an impact on lamb growth or welfare
- Determine if the weight of the lamb at bolus administration influences bolus placement

Meat Processing Sector

- Implications for the placement of boluses in the stomach and the risk of damage to rendering equipment in abattoirs
- Consideration should be given to processor perception of plant damage compared to the actual risk to plant equipment
- The risk of boluses falling out into the blood pit needs further investigation as this could potentially cause serious damage to the blood pump and related equipment

8 Bibliography

Garin. D, Caja. G and Bocquier. F. (2003) *Effects of small ruminal boluses used for electronic identification of lambs on the growth and development of the reticulorumen*. J. Anim. Sci. 81:879-8