EFFECT OF SODIUM BROMIDE ON FEED INTAKE OF FINISHER PIGS OVER SUMMER

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Executive Summary

Feed intake of growing pigs declines during the hot summer months typical of Southern Australia. As a direct result, growth rates also reduce and pigs take longer to reach target slaughter weights. Summer is also a period of peak pork sales in the lead up to Christmas and as such strategies to maintain growth performance during this time are worthy of investigation. Previous studies have shown that the addition of bromide to the finisher diet can enhance feed consumption in group housed entire boars (Dunshea *et al*. 2000). The aim of this study was to determine if sodium bromide (NaBr) could be used as a summer strategy to improve feed intake and therefore growth rates of finisher pigs. As such, this study tested the hypothesis that dietary NaBr increases feed intake of finisher pigs (entire males, immunocastrated (Improvac®) males and females) when included in the diet offered during summer. A total of 792 pigs (Large White x Landrace, PrimeGro™ Genetics) were selected at 17 weeks of age (average weight 64.6kg ± 0.24 kg) and housed in pens of 9 pigs of the same sex. Pens were randomly allocated to a 2 x 3 factorial experiment with the respective factors being dietary NaBr (0 or 0.04 g/kg) and sex (female, entire male and Improvac® vaccinated male). Diets were formulated to contain 0.52 g available lysine/ MJ digestible energy (DE) and 13.8 MJ DE/kg. Pen weights were recorded at Day 0, 14 and 35 and pen feed intake (FI) measured by feed disappearance during this time. Pigs were slaughtered in a commercial abattoir at the conclusion of the 35 day test period.

Pigs offered the NaBr diet consumed more feed (2.39 and 2.47 kg/d respectively for the control and NaBr treatment groups, P=0.020), with the response consistent across the sexes. The magnitude of the response was however insufficient to increase growth rate during this time (0.852 and 0.872 kg/d respectively, P=0.27). There was no impact of NaBr supplementation on carcass weight, P2 or dressing percentage. Climatic conditions during the test period (Summer 2010/11) were mild, with only 6 days in which the maximum temperature exceeded 35^{0}C. It is unclear if a greater response may have been obtained under more 'normal' climatic conditions. The results from this study support the hypothesis that NaBr can enhance feed intake of group housed finisher pigs. However, as the improvement in feed intake was modest and did not translate into enhanced growth, the use of NaBr, at least at the dose tested here, to maintain finisher performance during summer is not supported at this time.

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1. Introduction

Feed intake of growing pigs generally declines over the summer months due to the high temperatures typically observed in southern Australia at this time. As a direct result of the lower feed intakes, growth rates also begin to decline and pigs take longer to reach target slaughter weights. In Australia, summer is also a period of peak pork sales in the lead up to Christmas, and as such strategies to maintain growth performance during this time are worthy of evaluation. Sodium bromide (NaBr) and lithium chloride (LiCl) were investigated as feed markers in a recent pork CRC project (CRC project number 2A-101). In this study, the authors hypothesised that the addition of LiCl (up to 1.0 g/kg diet) and NaBr (up to 0.2 g/kg diet) would enable the monitoring of feed intake of individual animals housed in groups. While neither NaBr nor LiCl was found to be suitable for this purpose, the results from the feeding studies suggested that the inclusion of both LiCl and NaBr in the diet in combination may enhance the feed intake of growing pigs. There was no evidence in this study that the dietary inclusion of LiCl alone could enhance feed intake, and given the potential hazards of using LiCl in feed (handling issues as well as the potential for residue build up in pork tissues) it was decided that further research on the use of this product would not proceed. In contrast, previous studies have suggested that the inclusion of bromide in the diet of growing pigs may alter feed intake. Early studies by Eidrigevich *et al.* (1967) reported an increase in growth rate when growing pigs were offered diets containing a mixture of bromide salts (sodium, potassium and ammonium bromides). In this study, the authors reported that a daily intake of 5 mg bromide salts per kg live weight increased weight gain of growing pigs. The authors noted that sexual activity was reduced during the period of bromide consumption, but upon withdrawal of the bromide salts the pigs were successfully used for breeding. In contrast, a follow up study by Barber *et al.* (1971) found the addition of a similar mixture of bromide salts to the diet of growing pigs (200 mg bromide salts/ kg diet, fed from 20-90 kg) had no impact on feed consumption, growth rate or feed efficiency. In a more recent study, Dunshea *et al.* (2000) investigated the use of bromide salts to improve the performance and efficiency of entire male pigs under commercial conditions (17 to 22 weeks of age). In this study, the authors reported greater feed consumption during the initial 14 days when bromide was included in the finisher diet (140 mg bromide chloride / kg diet). Over the entire finisher period, marginal increases in feed intake and growth rate resulted in a heavier carcass weight. The mechanism for the enhanced intake was proposed to be a reduction in the sexual activity of the boars and therefore more time spent eating. The aim of this current study was to determine if NaBr can be used to improve feed intake in female and Improvac vaccinated male pigs over the summer period, or if the effects of bromide are limited to modifying the behaviour of entire boars. As such, this study tested the hypothesis that low concentrations of dietary NaBr can increase the feed intake of female, Improvac male and entire male finisher pigs when included in the diet offered during summer.

2. Methodology

Animals and treatments

A total of 792 pigs (Large White x Landrace, PrimeGro™ Genetics) were identified at 17 weeks of age and transferred to finisher accommodation (pens of 8-9 pigs of the same sex, 0.75 m^2/pig). Pigs were selected over a 7 week period commencing November 2010. Pen weights were recorded at entry to the finisher pens (average weight 64.6kg ± 0.24 kg) and pens randomly allocated to a 2 x 3 factorial experiment with the respective factors being NaBr (0 or 0.04 g/kg) and sex (female, entire male and Improvac vaccinated male). The composition of the two test diets are displayed in Table 1. All diets were formulated to contain 0.52 g available lysine/ MJ DE and 13.8 MJ DE/kg. Diets were pelleted and offered *ad libitum* from 17 weeks of age through to slaughter at 22 weeks of age. All animals had *ad libitum* access to water via nipple drinkers for the entire experimental period.

Management and measures

The priming Improvac vaccination was administered at 13 weeks of age and the second vaccination at 17 weeks of age. Pen weights were recorded at the beginning of the experimental period (day 0, 17 weeks of age) and again at day 14 and day 35 (prior to slaughter). Pen feed intake was recorded over these time periods as measured by feed disappearance and feed conversion efficiency subsequently calculated. All deaths and removals were recorded and taken into account when calculating feed intake and feed efficiency by the adjustment of the number of days that pigs were on trial. Pigs were slaughtered in a commercial abattoir at the conclusion of the 35 day experimental period and hot standard carcass weight (HSCW) and fat depth at the P2 site (65mm from the midline, measured using a PorkScan ultrasound system) were measured, with dressing percentage calculated from live weight and carcass weight on a pen basis.

Statistical analyses

Data were analysed using a residual maximum likelihood (REML) mixed model analysis due to the uneven number of pens that commenced this study each week. The model included the random effect of replicate and the fixed effects of the 2 x 3 factorial for NaBr and sex. Differences in the number of mortalities and removals due to the main effect of diet were analysed using chi squared analyses. The experimental unit for all analyses was the pen of pigs. All analyses were performed using Genstat 8th Edition (Payne *et al.* 2005).

Table 1 - Ingredient composition and analysed nutrient profile of each of the experimental finisher diets, % of diet (as fed basis).

	Control	**NaBr**
Wheat	56.8	56.8
Barley	10.0	10.0
Millmix	20.0	20.0
Canola meal	4.1	4.1
Meat meal	1.7	1.7
Water	1.0	1.0
Natuphos 5000	0.01	0.01
Tallow	3.7	3.7
Salt	0.2	0.2
Limestone	1.7	1.7
Lysine HCL	0.41	0.41
Threonine	0.13	0.13
Copper premix	0.10	0.10
Rivalea finisher premix	0.07	0.07
Rumensin	0.10	0.10
Betaine	0.10	0.10
Sodium bromide		0.004
*Estimated nutrient composition, %**		
DE, MJ/kg	13.8	13.8
Crude protein	15.1	15.1
Crude fat	5.4	5.4
Crude fibre	4.3	4.3
Total Lysine	0.84	0.84
Available lysine: DE ratio g/MJ DE	0.52	0.52

*Estimated from Rivalea Australia Pty Ltd composition data

3. Outcomes

There were no negative effects of NaBr supplementation on animal welfare during this study. There were a total of 4 deaths during the test period (all caused by *Actinobacillus pleuropneumoniae* (APP)). These four pigs had all been offered the control diet during the study. In addition, 4 animals were removed from the group due to lameness (3 pigs from the control group and 1 pig from the NaBr group). One additional pig fed the NaBr diet was removed due to poor condition.

The impact of sodium bromide supplementation on feed intake and growth performance during the finisher period is displayed in Table 2. The addition of NaBr to the test diet improved feed intake during the initial 14 day feeding period. This increase in feed intake was associated with a marginal improvement in rate of gain (not significant). Feed efficiency remained similar between the two treatment groups during this time. During the subsequent period from 14 to 35 days, there was a tendency for feed intake to remain elevated in the pigs offered the NaBr diet (P=0.089). Once again, the increase in feed intake resulted in only a very marginal increase in growth rate (834.0 and 850.0 g/d for the control and NaBr treatment groups respectively, P=0.50). Over the entire experimental period, the addition of NaBr to the finisher diet increased feed intake by 3.3 %. This improvement in intake was insufficient to significantly increase rate of gain, although growth rates were numerically greater in the NaBr treatment group (0.852 and 0.872 kg/d respectively, P=0.27). Feed efficiency was unaffected by dietary treatment. Carcass weight, P2 back fat depth and dressing percentage were similar between the two treatment groups.

The impact of NaBr supplementation was generally consistent across the three sexes, with no significant interactions between sex and dietary NaBr addition. The improvement in feed intake during the initial 14 day period was similar between the gilts, Improvac males and entire male pigs (Figure 1). The impact of this improvement in feed intake on rate of gain and feed efficiency did however appear to be greater in the entire males (Figures 2 and 3). Over the entire test period, the impact of NaBr on feed intake, rate of gain and feed efficiency was consistent between the sexes (figures 4-6).

As anticipated, sex had a substantial influence on growth performance and carcass characteristics (Table 2). Over the entire test period, the Improvac vaccinated males consumed more feed and gained weight faster than either the female or entire male finishers, while the entire male utilized feed more efficiently for weight gain. As a result of the improved growth rates, the Improvac males displayed a heavier carcass weight and greater back fat depth at slaughter than either the entire male or female pigs. Dressing percentage was however lower in the Improvac vaccinated males.

Table 2 - Influence of sodium bromide on feed intake, growth rate and carcass characteristics of gilts, entire males and Improvac males.

	Sex			SED	Diet		SED	Significance		
	Female	**Entire Male**	**Improvac**	**Sex**	**Control**	**NaBr**	**Diet**	**Sex**	**Diet**	**Sex x Diet**
Live weight										
Day 0	64.3	64.7	64.7	0.24-0.25	64.5	64.6	0.20	0.16	0.51	0.77
Day 35	92.6	94.2	97.4	0.69-0.73	94.3	95.2	0.58	<0.001	0.14	0.95
0-14 days										
ADG (kg/d)	0.872	0.877	0.927	0.027-0.028	0.880	0.905	0.022	0.096	0.31	0.15
ADFI (kg/d)	2.23	2.22	2.30	0.038-0.040	2.21	2.29	0.032	0.069	0.012	0.43
FCR (kg/kg)	2.59	2.55	2.51	0.064-0.066	2.54	2.56	0.053	0.45	0.59	0.16
14-35 days										
ADG (kg/d)	0.767	0.820	0.940	0.029-0.030	0.834	0.850	0.024	<0.001	0.50	0.32
ADFI (kg/d)	2.43	2.35	2.87	0.060-0.062	2.50	2.59	0.049	<0.001	0.089	0.60
FCR (kg/kg)	3.22	2.89	3.07	0.078-0.082	3.04	3.09	0.065	<0.001	0.48	0.57
0-35 days										
ADG (kg/d)	0.809	0.842	0.935	0.021-0.022	0.852	0.872	0.018	<0.001	0.27	0.87
ADFI (kg/d)	2.35	2.30	2.64	0.043-0.045	2.39	2.47	0.036	<0.001	0.020	0.71
FCR (kg/kg)	2.92	2.73	2.83	0.044-0.046	2.81	2.85	0.037	<0.001	0.37	0.92
Carcass characteristics										
Carcass weight (kg)	71.9	71.7	73.7	0.59-0.61	72.2	72.6	0.48	0.002	0.38	0.92
Carcass P2 (mm)	8.1	7.8	8.7	0.20-0.21	8.2	8.3	0.17	<0.001	0.86	0.95
Carcass P2*	8.2	7.9	8.6	0.20-0.22	8.2	8.2	0.17	0.005	0.85	0.93
Dressing %	77.6	76.2	75.6	0.26-0.27	76.6	76.3	0.22	<0.001	0.28	0.31

* Carcass weight included as a covariate in the analysis

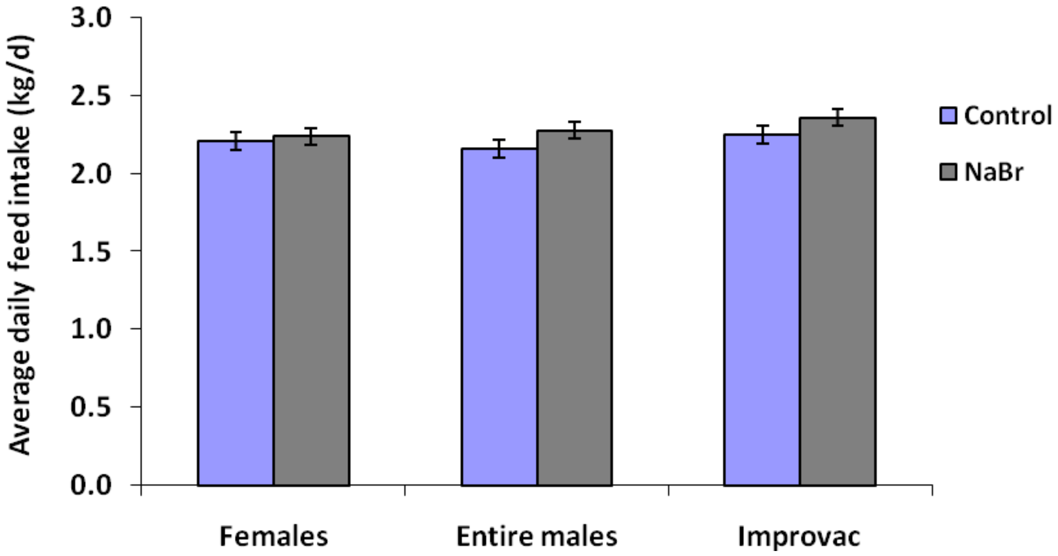

Figure 1 - Influence of NaBr on feed intake of female, entire male and Improvac vaccinated male pigs from day 0-14. Significance Sex: P= 0.069; NaBr: P=0.012; Interaction P=0.43.

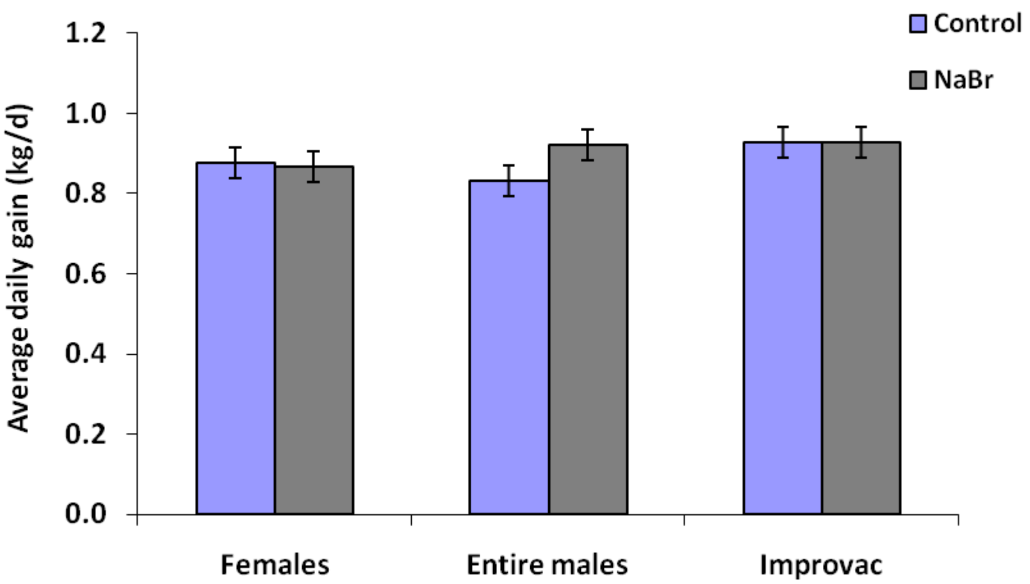

Figure 2 - Influence of NaBr on growth rate of female, entire male and Improvac vaccinated male pigs from day 0-14. Significance Sex: P= 0.096; NaBr: P=0.31; Interaction P=0.15.

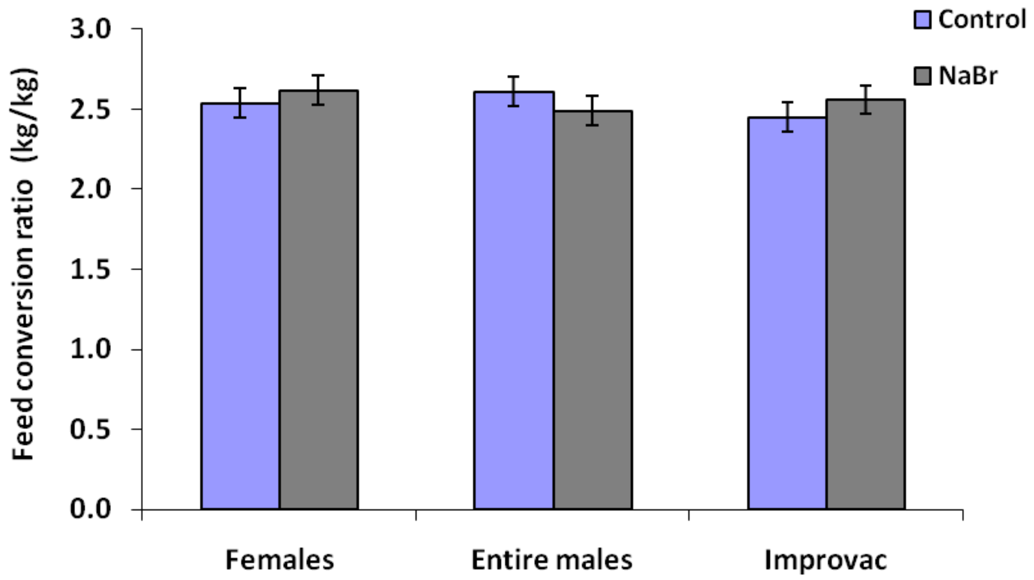

Figure 3 - Influence of NaBr on efficiency of feed utilization in female, entire male and Improvac vaccinated male pigs from day 0-14. Significance Sex: P= 0.45; NaBr: P=0.59; Interaction P=0.16.

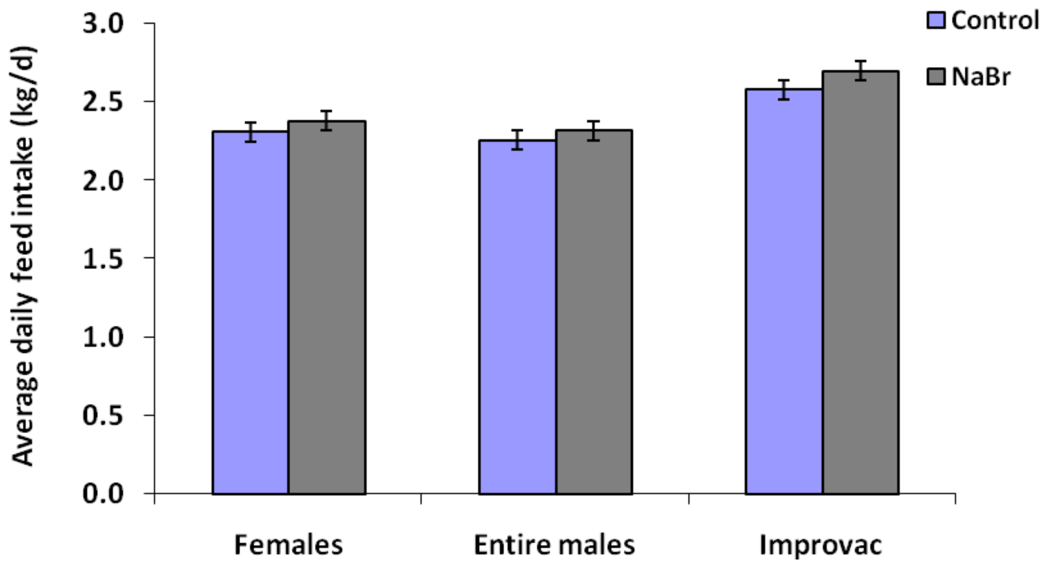

Figure 4 - Influence of NaBr on feed intake of female, entire male and Improvac vaccinated male pigs from day 0-35. Significance Sex: P<0.001; NaBr: P=0.020; Interaction P=0.71.

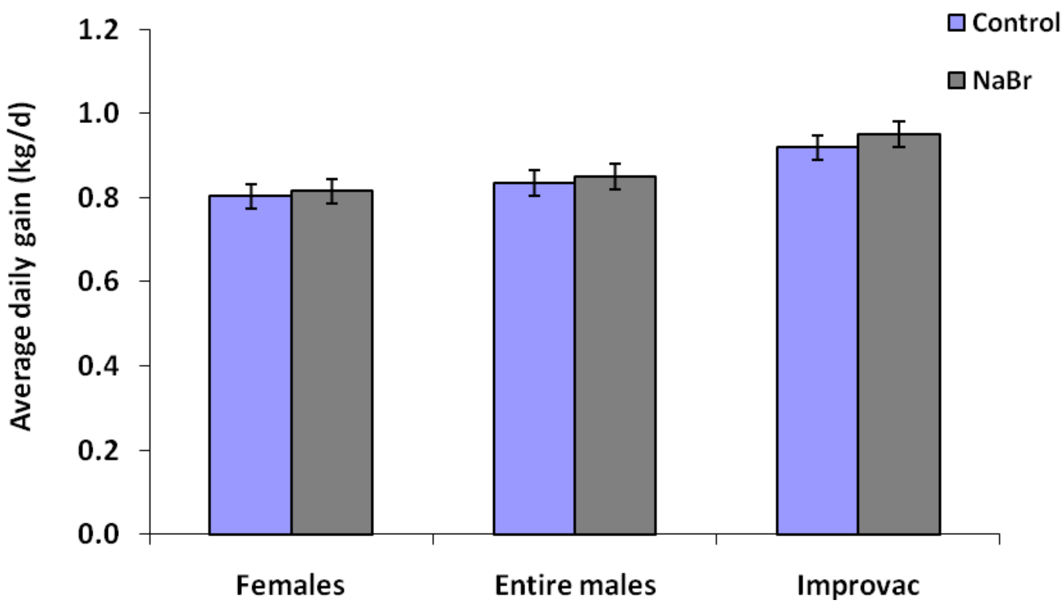

Figure 5 - Influence of NaBr on growth rate of female, entire male and Improvac vaccinated male pigs from day 0-35. Significance Sex: P<0.001; NaBr: P=0.27; Interaction P=0.87.

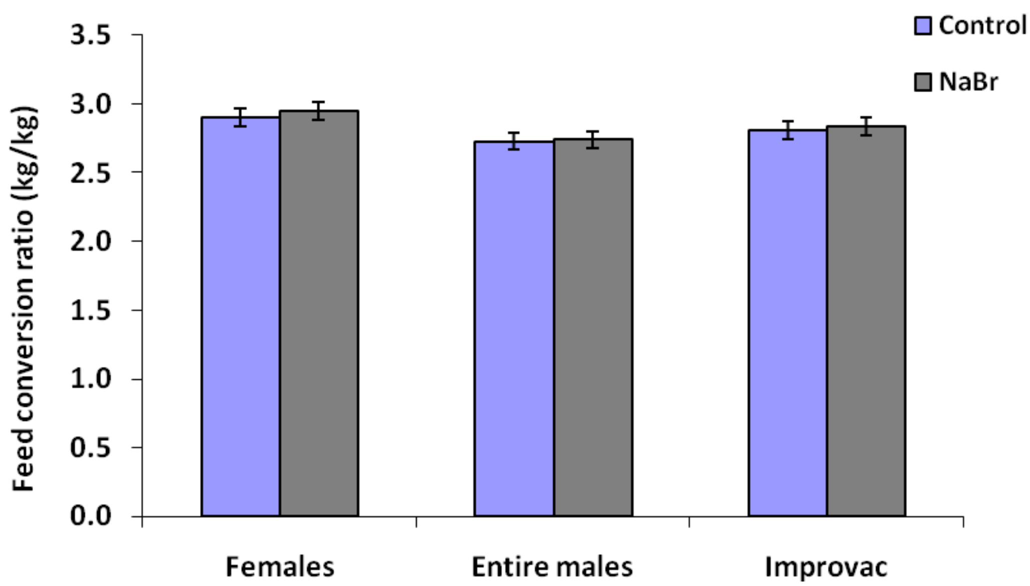

Figure 6 - Influence of NaBr on efficiency of feed utilization in female, entire male and Improvac vaccinated male pigs from day 0-35. Significance Sex: P<0.001; NaBr: P=0.37; Interaction P=0.92.

4. Application of Research

The results from this study support the hypothesis that NaBr can be used in the diet of finisher pigs to enhance feed intake. The increase in feed intake was consistent across sexes, with females, entire males and Improvac vaccinated males all increasing feed intake in a similar manner during the test period. The improvement in feed intake was however modest in magnitude, with feed intake over the entire experimental period only increasing by 80 g/d (3.3 %). Previous studies have reported more pronounced improvements in intakes, with Dunshea *et al.* (2000) reporting a 6.4 % improvement in feed intake over the 35 day test period (ADFI 2.20 and 2.34 kg/d respectively for the control and bromide fed finishers, entire boars only). Of interest, Dunshea et al. (2000) reported a greater improvement in intake during the initial two weeks of feeding (1.88 and 2.21 kg/d respectively for the control and bromide fed finishers) compared to the subsequent period (19 to 22 weeks of age) when feed intake was similar between the pigs offered the control and bromide diets (2.41 and 2.35 kg/d respectively). In the present study, feed intake tended to remain elevated during the latter three weeks of the test period (2.50 and 2.59 kg/d respectively, P=0.089). The dose of NaBr used in this investigation (0.04 g/kg diet) was low in comparison to the dose utilized by Dunshea *et al.* (2000) (140 mg bromide chloride/kg), which may explain the difference in the magnitude of the feed intake response. The dose utilised in this present study was based on results from CRC project 2A-101, in which a similar elevated feed intake response was observed between pigs offered diets containing 0.04 to 0.20 g/kg NaBr in combination with LiCl. It is recognized that this previous CRC study was not designed to measure the effects of NaBr on intake or performance, and as such it is possible that a higher dose of NaBr may have had a greater impact on performance.

The increase in feed intake in this current study was not associated with a significant improvement in growth rate. As such, the use of NaBr in the diet of finisher pigs to maintain weight gain during the summer period is not supported at this time, at least at the dose rate tested in this study. It was unfortunate that this evaluation was conducted during a relatively mild summer in southern Australia. During the test period, there were only 6 days in which the maximum temperature exceeded 35^{o}C, a very unusual situation for this location in southern NSW. The relatively mild conditions experienced during the 2010/11 summer resulted in higher than normal feed intakes of growing pigs across the site during this time. It is unclear if the impact of NaBr would have been more pronounced during a more ‘normal’ summer in which feed intakes were reduced due to heat stress. Further research may be warranted with growing pigs during a hotter summer or utilizing a facility in which temperatures can be experimentally controlled. It is also unclear if a greater response may have been obtained with a higher concentration of dietary NaBr, and as such further studies may include some dose response investigations.

NaBr was effective at increasing feed intake, albeit modestly, of the female and Improvac males as well as the entire males. Previous studies have suggested that the primary mode of action of NaBr in group housed entire male pigs is a sedative effect, thus reducing sexual and aggressive activity and therefore increasing the amount of time spent eating (Dunshea *et al.* 2000). Results from this present investigation suggest that the inclusion of NaBr in the finisher diet can have an impact across the sexes. The exact mode of action of NaBr across the sexes is however not fully understood and may require further in depth investigation.

If there is found to be a true effect of NaBr on feed intake, there is the possibility that such an additive could be utilized during other stages of growth – for example during the weaner period to enhance intake immediately after weaning. Feed intake and growth performance during the weaner period play an important role in maximizing lifetime performance of the pig and as such, any benefits from the addition of this dietary additive may be worthy of consideration.

5. Conclusion

The results from this study support the hypothesis that NaBr can be used in the diet of finisher pigs (female, entire male and Improvac male) to enhance feed intake, albeit modestly. Unfortunately, this improvement in feed intake did not translate into an enhanced growth rate during the test period. As such, the dietary inclusion of NaBr at the dose rate tested in this study (0.04 g/kg diet) is not supported at this time for the purpose of maintaining finisher growth rates during the summer period.

6. Limitations/Risks

The study was undertaken during an unusually mild summer (2010/11) and as such feed intakes were generally high across the site at this time. It is unclear if the magnitude of the differences in feed intake may have been greater during a more normal Australian summer with higher temperatures.

7. Recommendations

As a result of the outcomes in this study the following recommendations have been made:

- The use of NaBr (0.04 g/kg) in the diet of finisher pigs to maintain weight gain during the summer period is not supported at this time.
- Further research may be warranted to assess the impact of NaBr on feed intake and growth rates under more typical summer conditions in Australia and at a range of doses.

8. References

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