Agri-Food and Biosciences Institute

AFBI Hillsborough

An investigation into the influence of group size on the performance and behaviour of weaned pigs

Report prepared for: UFU and PPDC Committees

Niamh E O'Connell, R Norman Weatherup
and Violet E Beattie

April 1999

www.afbini.gov.uk

TABLE OF CONTENTS

INDEX OF TABLES

INDEX OF FIGURES

INDEX OF PICTURES

ACKNOWLEDGEMENTS

The authors gratefully acknowledge joint funding for this research, conducted at the Agricultural Research Institute of Northern Ireland, from the Pig Production Development Committee in conjunction with the Ulster Farmers' Union Pigs Committee and the Department of Agriculture and Rural Development for Northern Ireland. The authors would also like to acknowledge the help of Mr D J Armstrong and Mr P Ffrench-Mullen in data collection, and Mrs L P Wright in data analysis.

1. EXECUTIVE SUMMARY

The effect of increasing group size on the performance and behaviour of pigs between 4 and 10 weeks of age was assessed. The pigs were assigned to groups of ten, twenty, thirty, forty and sixty at weaning. There were eight groups of each size on the experiment giving one thousand, two hundred and eighty pigs in total. The groups were balanced for gender and weight and were randomised across litters. One four-space dry feeder and separate drinking bowl was provided per ten pigs in each group.

Increasing group size did not have a significant effect on mean growth rate, feed intake or feed conversion ratio over the treatment period. However small pigs in groups of ten tended to show lower growth rates than small pigs in larger groups. It is suggested that large pigs dominate the feeder in groups of ten and make it difficult for small pigs to gain access to the feeder. The difference in growth rate between small and large pigs led to a greater within-group variation in weight in groups of ten than in larger groups.

Behavioural observations showed a lower demand for the feeder during off-peak periods in groups of forty or sixty pigs than in smaller groups. There were no differences between group sizes in the incidence of aggressive behaviour at the feeder. In all treatments there was a greater incidence of small and medium sized pigs at the feeder than large pigs, which may indicate a slower rate of eating among smaller animals.

The results of this study indicate that the group size of weaned pigs can be increased from ten to sixty animals without any adverse effects on performance or welfare as measured by aggression at the feeder. There may be benefits in increasing group size to twenty or more animals in order to reduce demand for the feeder and within-group weight variation. In addition, increasing group size to sixty animals will reduce building costs and provide more usable space per pig. However, the temptation to reduce stocking rate or to reduce the number of feeders with larger groups must be avoided.

2. INTRODUCTION

Increasing the group size of weaned pigs has potential benefits for producers in terms of more efficient use of resources and greater ease of management. There are concerns however about the effects of increasing group size on productivity and welfare. Previous studies have yielded conflicting results, with some researchers reporting reduced productivity and increased aggression when group size is increased (Spoolder *et al*., 1999), and others finding no effect on productivity and reduced aggression when group size is increased (Nielsen *et al*., 1995). A key concern with large groups is the welfare of smaller pigs, which may have difficulty gaining access to resources such as the feeder. However, the greater choice of feeding spaces in larger groups and the increase in available or free space (McGlone and Newby, 1994) may benefit small pigs in particular by allowing them to escape from, and feed away from, larger animals.

The aim of the present study was to assess the effect of increasing group size up to sixty pigs per group on the performance and behaviour of weaned pigs in commercial housing. The effect of group size on small, medium and large animals in particular was assessed.

3. MATERIALS AND METHODS

3.1 Pre experimental treatment

All piglets were born in crated farrowing accommodation and were offered a commercially available creep feed from 10 days of age in a forward creep area. Piglets were weaned at 4 weeks of age and allocated to treatments.

3.2 Treatments

Pigs were assigned to groups of ten, twenty, thirty, forty or sixty pigs at weaning. All groups were balanced for weight and gender, and were randomised over litters. The experiment was carried out over eight replicates.

3.3 Animals and housing

A total of 1280 pigs were used in this experiment. The pigs were the progeny of Landrace x Large White dams and one of eight different sire types: Landrace, Large White, Duroc, Landrace x Large White, Landrace x Duroc, Large White x Duroc, Landrace x Large White x Duroc and Landrace x Large White x Pietrain. The dams were mated in equal numbers to the eight different sire types. The pigs were weaned at 4 weeks of age at an average weight of 9.7 kg and assigned to treatments. Pigs were retained in their respective treatment groups throughout stage 1 (4 to 7 weeks of age) and stage 2 (8 to 10 weeks of age). The average weight of the pigs at the end of stage 1 was 16.7 kg and at the end of stage 2 was 31.8 kg. There were no significant treatment differences in live weight at 4, 7 or 10 weeks of age (Table 1).

Table 1 Mean live weight (kg) at weaning at 4 weeks of age and at 7 and 10 weeks of age

	Group size						
	10	**20**	**30**	**40**	**60**	**SEM**	**P**
4 weeks of age	10.2	9.7	9.4	9.7	9.6	0.30	NS
7 weeks of age	16.8	16.8	16.2	17.0	16.7	0.29	NS
10 weeks of age	32.0	31.8	31.2	32.0	31.9	0.57	NS

The pigs were housed in combined stage 1/stage 2 accommodation with plastic slatted floors, thermostatically controlled ventilation and a space allowance of 0.38 m^2 per pig. Temperature was 28^{o}C for the first day of the treatment period and was then reduced by 0.5^{o}C/day to 19^{o}C where it remained for the rest of the treatment period. The pigs were exposed to natural lighting through windows and artificial lighting was supplied continuously.

The pens in which the pigs were housed were rectangular in shape and were all 3 m long from front to back. The width of the pens varied with group size and was 1.5, 3,

4.5, 6 and 9 m wide for groups of ten, twenty, thirty, forty and sixty pigs, respectively. Feeders were located along the front of the pen next to an access passageway. Figure 1 shows the layout of a pen for a group of ten pigs and for a group of sixty pigs.

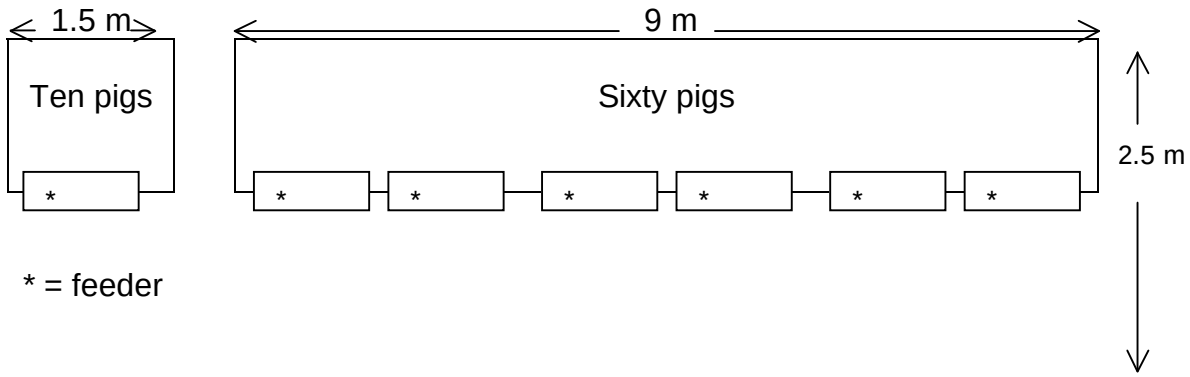

Figure 1 Shape and layout of pens for housing groups of ten and sixty pigs.

The pigs were provided with one dry multi-space feeder (Etra feeders, Benburb, Northern Ireland), providing four feeding spaces, per ten pigs. One drinking bowl (Drik-O-Mat®, Egebjerg Maskinfabrik A/S, Denmark) was also provided per ten pigs.

3.4 Diet

From 10 days of age, piglets were offered a commercial creep feed which contained (g/kg) 220 crude protein (CP), 110 oil, 60 ash, 15 crude fibre (CF) and 17 lysine. The pigs were then offered three commercial diets consecutively between 4 and 7 weeks of age. These included 3 kg/pig of diet 1, followed by 3 kg/pig of diet 2 and then 6 kg/pig of diet 3. Diet 1 contained (g/kg) 235 CP, 90 oil, 60 ash, 20 CF and 16.5 lysine; diet 2 contained (g/kg) 210 CP, 80 oil, 60 ash, 30 CF and 15 lysine; and diet 3 contained (g/kg) 220 CP, 66 oil, 65 ash, 25 CF and 14 lysine. All commercial diets were manufactured by John Thompson and Sons Ltd., Northern Ireland.

Between 8 and 10 weeks of age the pigs were offered a grower diet which was produced at the Agricultural Research Institute of Northern Ireland. Individual ingredients included (g/kg) 500 wheat, 250 soya bean meal, 93 barley, 50 fish meal, 32 soya oil, 30 molaferm, 20 water and 25 minerals and vitamins. This supplied 14.2 MJ/kg DE and contained (g/kg) 255 CP, 63 oil, 26 CF, 67 ash and 12 lysine

All diets used in this experiment were offered *ad libitum* and were in pelleted form.

3.5 Parameters measured

Pigs were individually weighed at weaning at 4 weeks of age, and at 7 and 10 weeks of age. Individual growth rates were calculated for stage 1 (4 to 7 weeks of age) and stage 2 (8 to 10 weeks of age). The feed intake of each group was recorded on a weekly basis by subtracting the weight of feed remaining in the feeder from the weight of feed which had been placed in the feeder. The average feed intake and food conversion ratio during stages 1 and 2 were calculated.

In each group the pigs were assigned to a small, medium and large category on the basis of weaning weight and were marked accordingly on their backs. The average weaning weight of small, medium and large pigs was 8.2, 9.6 and 11.4 kg, respectively. The performance of these pigs was assessed throughout stages 1 and 2.

Variation in weight within groups was calculated at the end of stage 2 at 10 weeks of age by subtracting the mean weight of the third smallest animals in the group from the mean weight of the third largest animals in the group.

Behaviour around the feeder was videotaped for continual 24-hour periods when the pigs were 5, 7 and 9 weeks of age. The feeder which was recorded was chosen in a predetermined order for each observation. Video tapes were later analysed to determine the number of small, medium and large pigs at the feeder at 20 minute intervals. In addition, the frequency of fights, headthrusts and displacements from the feeder were recorded for 30 seconds at each sampling interval. Fighting was defined as when two or more pigs engaged in mutual pushing and headthrusting, with or without biting. Headthrusts were defined as when a pig rammed or pushed another pig with its head. Displacements were defined as when a pig moved another pig away from the feeder and took the place of that pig at the feeder.

4. RESULTS AND DISCUSSION

4.1 Mortality

There were no significant differences in mortality across treatments with the average mortality rate being 0.5%. There were no deaths recorded in groups of ten or twenty pigs and the mortality rate was 0.4% in groups of thirty pigs, 1.6% in groups of forty pigs and 0.6% in groups of sixty pigs.

4.2 Production performance

The influence of group size on mean production performance is given in Table 2. Group size did not have a significant effect on mean growth rate of the group during stage 1 (4 to 7 weeks), stage 2 (8 to 10 weeks) or stages 1 and 2 combined (4 to 10 weeks). This agrees with previous studies which assessed the effects of increasing group size up to a maximum of thirty pigs (Randolph *et al*., 1981; Walker, 1991). Feed intake did not differ between treatments, however the food conversion ratio tended to be better in groups of ten and twenty pigs than in larger group sizes during stage 2 ($P<0.06$). Although this 10% deterioration in food conversion in larger groups was not significant, it is equivalent to approximately 32 p/pig sold. This deterioration was due to regular fouling of one feeder per group in the larger groups. This did not influence overall food conversion over stages 1 and 2, which was similar across treatments.

Pigs which were small at weaning showed lower growth rates in groups of ten than in bigger group sizes (Table 3). This was particularly apparent during stage 1 when growth rates of small pigs in groups of ten were over 100 g/day lower than the average growth rate of small pigs in other group sizes ($P<0.05$).

Table 2 Mean performance during stage 1 (4 to 7 weeks), stage 2 (8 to 10 weeks) and stages 1 and 2 combined (4 to 10 weeks)

	Group size						
	10	**20**	**30**	**40**	**60**	**SEM**	**P**
Food intake (g/day)							
Stage 1	352	354	325	366	347	13.9	NS
Stage 2	1111	1086	1143	1106	1177	55.6	NS
Stages 1 and 2	770	746	788	774	808	38.9	NS
Growth rate (g/day)							
Stage 1	436	459	428	462	467	16.5	NS
Stage 2	725	717	714	714	723	17.0	NS
Stages 1 and 2	543	540	524	544	540	13.7	NS
Food conversion ratio							
Stage 1	1.22	1.19	1.36	1.26	1.30	0.063	NS
Stage 2	1.57	1.67	1.78	1.77	1.84	0.063	<0.06
Stages 1 and 2	1.42	1.43	1.50	1.51	1.52	0.039	NS

During stage 2 the growth rate of small pigs in groups of ten was 50 g/day lower than the average growth rate of small pigs in all other group sizes, however this difference was not significant (P>0.05). The growth rate of large pigs in groups of ten was 48 g/day higher than the average growth rate of large pigs in other groups sizes during stage 1, and 23 g/day higher than the average growth rate of large pigs in other group sizes during stage 2. These differences did not reach statistical significance (P>0.05).

Table 3 Growth rate (g/day) of small, medium and large pigs during stage 1 (4 to 7 weeks), stage 2 (8 to 10 weeks) and stages 1 and 2 combined (4 to 10 weeks)

	Group size						
	10	**20**	**30**	**40**	**60**	**SEM**	**P**
Small							
Stage 1	268	338	329	331	339	19.3	<0.1
Stage 2	632	667	694	685	681	25.2	NS
Stages 1 and 2	449	510	517	515	513	20.2	NS
Medium							
Stage 1	383	343	319	372	345	23.4	NS
Stage 2	760	716	708	712	720	14.4	NS
Stages 1 and 2	577	540	519	546	536	16.8	NS
Large							
Stage 1	409	371	324	390	357	21.5	NS
Stage 2	777	768	740	736	770	21.7	NS
Stages 1 and 2	598	566	537	564	571	18.4	NS

These results show that small pigs performed worse in groups of ten animals, especially during stage 1, than in other group sizes. A possible explanation for this was that the pigs only had access to one feeder in groups of ten whereas in bigger

groups there was a choice of feeders (Picture 1). This may have meant that in groups of ten, large pigs gained priority access to the feeder to the disadvantage of small pigs. This problem may have been exacerbated by the decrease in available or 'free' space in smaller groups (McGlone and Newby, 1994), which may have meant more pigs lying or standing in front of the feeder (Picture 2). Walker (1995) discussed the term 'social workload' which referred to the 'effort required and aggression encountered in negotiating a route through pen mates to a feeder and dislodging pigs which are either feeding or obstructing the feeder'. The results from the present study suggest that the 'social workload' involved in getting to the feeder may have been higher for small pigs in groups of ten than for small pigs in bigger groups.

Picture 1 Choice of feeders in large groups

Picture 2 Blocking the feeder in small groups

4.3 Within-group weight variation

As a result of the differences in growth rate between small and large pigs, within-group variation in weight at 10 weeks of age was almost 3 kg higher in groups of ten animals than in bigger groups at the end of stage 2 (P<0.01) (Figure 2). This increase in weight variation in groups of ten pigs may have implications when the animals reach slaughter weight. Previous research at this Institute showed that a 3 kg spread at the end of stage 2 resulted in a 15 kg spread at slaughter (O'Connell *et al*., 1999). If this effect was also shown in the present study then this would result in substantially greater variation in slaughter weight in groups of ten pigs than in bigger groups. This greater variation could result in a less efficient use of finishing accommodation if pigs are slaughtered weekly at a target slaughter weight.

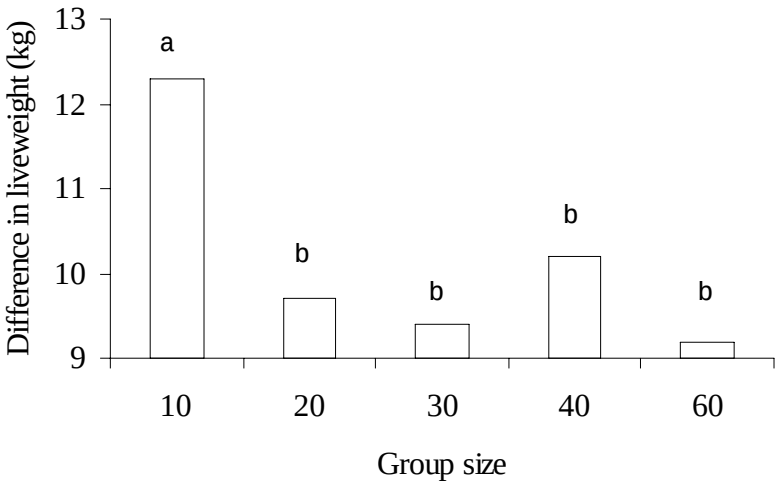

Figure 2 Difference in live weight between the smallest and largest third of pigs in groups of different sizes at 10 weeks of age (bars with different superscripts are significantly different, P<0.05)

4.4 Use of feeders

The use of different feeders in groups with access to more than one feeder was assessed on a weekly basis over the treatment period (Table 4). The results showed that different feeders within a pen were not used equally. On average 75% of feed was consumed from one of the two feeders in groups of twenty pigs, 83% of feed was consumed from two of the three feeders in groups of thirty pigs, 92% of feed was consumed from three of the four feeders in groups of forty pigs and 94% of feed was consumed from five of the six feeders in groups of sixty pigs. This agrees with previous observations in the present study that at least one feeder in a pen tended to be fouled on a regular basis (see section 4.2).

Table 4 Percentage of total feed intake which came from different numbers of feeders in groups of twenty, thirty, forty and sixty pigs over the six-week post weaning period

No. of feeders	Treatment	Week					
		1	2	3	4	5	6
1 feeder	20	68	67	73	76	79	87
1 feeder	30	47	52	47	52	62	65
2 feeders	30	79	83	81	83	84	85
1 feeder	40	46	38	37	44	44	52
2 feeders	40	74	68	65	74	80	85
3 feeders	40	90	88	88	92	93	98
1 feeder	60	33	29	27	28	33	34
2 feeders	60	56	50	48	51	60	60
3 feeders	60	71	65	65	70	80	79
4 feeders	60	84	79	79	84	91	91
5 feeders	60	93	91	92	94	98	98

The feeder which was used least within a pen tended to vary between weeks of the study. This is illustrated in Figure 3 which shows the use of six different feeders by a group of sixty pigs over the treatment period. This figure also demonstrates that a feeder showing a relatively low level of usage at the start of the post weaning period (feeder 1) can show the highest level of usage at the end of this period.

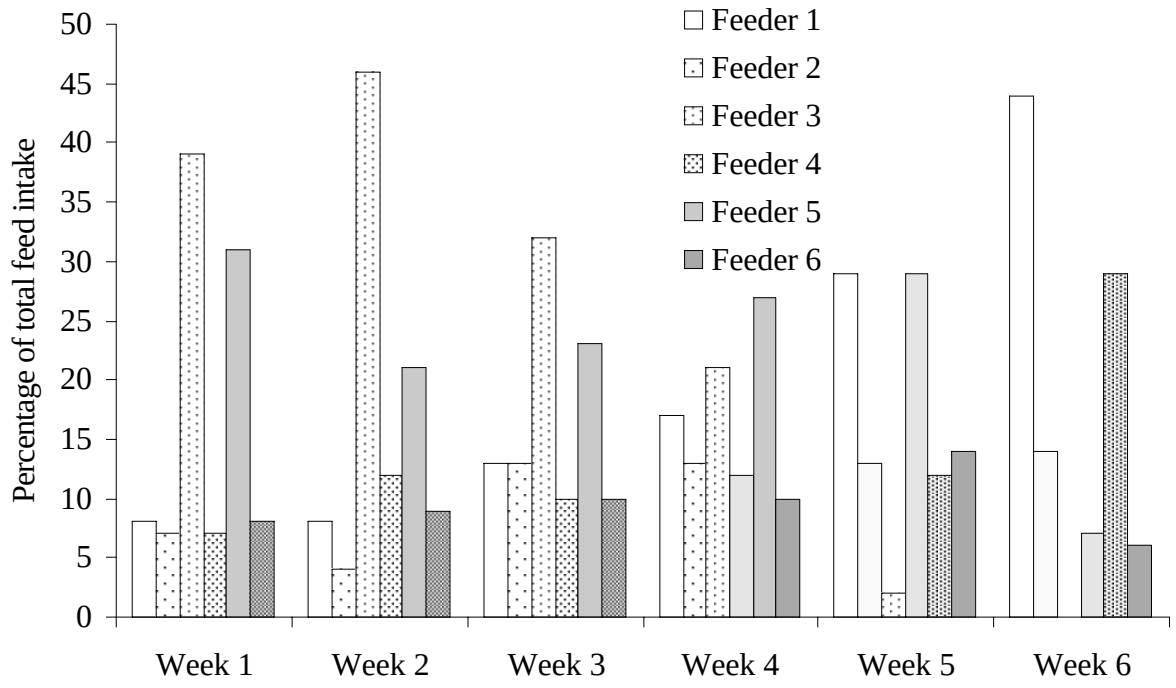

Figure 3 Use of six different feeders by a group of sixty pigs over the 6-week post weaning period (feeders 1 to 6 were located in order along the front of the pen)

4.5 Behaviour

Analysis of diurnal patterns of behaviour showed two peaks in feeding behaviour, a smaller one in the morning and a larger one in the afternoon (Figure 4). These peaks in feeding behaviour have been described previously in pigs (Morrow and Walker, 1994; Nielsen *et al*., 1995), and are thought to be related to stockman activity (Morrow and Walker, 1994). In the present study, pigs which were housed in groups of forty or sixty pigs showed lower levels of feeder occupancy during the period between these two peaks than pigs in smaller groups. This reduction in feeder occupancy may suggest lower levels of competition for feeding spaces in bigger groups (Walker, 1991). This corresponds with earlier findings in this study that the lowest levels of within-group weight variation were also shown in the larger group sizes.

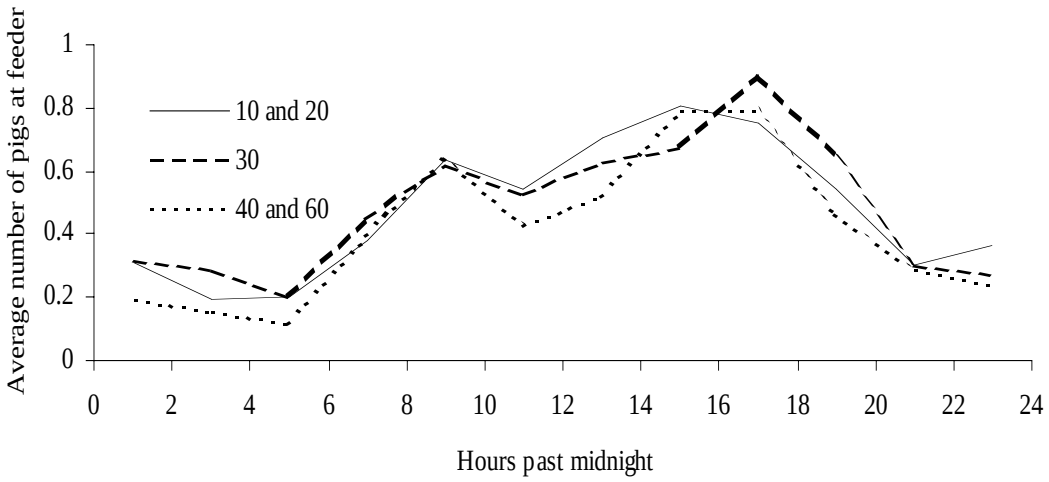

Figure 4 Patterns of feeder usage by pigs in different group sizes between 4 and 10 weeks of age

The apparent increase in demand for the feeder in smaller groups was not accompanied by an increase in aggressive behaviour at the feeder (Table 5).

Table 5 Influence of group size on the average incidence of aggressive behaviour at the feeder over a 24-hour period by pigs between 4 and 10 weeks of age

	Group size						
Parameter	**10**	**20**	**30**	**40**	**60**	**SEM**	**P**
Headthrusts	0.13	0.10	0.00	0.14	0.04	0.055	NS
Fights	0.01	0.01	0.00	0.01	0.00	0.006	NS
Displacements	0.03	0.03	0.01	0.04	0.02	0.011	NS

An interesting finding in the present study was that in all treatments the average number of small and medium sized pigs at the feeder was greater than the number of large pigs. Figure 5 shows the number of small, medium and large pigs at the

feeder over a 24 hour period which has been averaged across all treatments. One explanation for the greater number of small and medium sized pigs at the feeder is that these animals have a slower rate of eating than large pigs and therefore have to remain longer at the feeder. The suggestion that pigs of different sizes have different rates of eating is of potential importance to producers as this means that smaller animals are penalised by requiring longer to achieve the required feed intake and may suffer competition for access to the feeder.

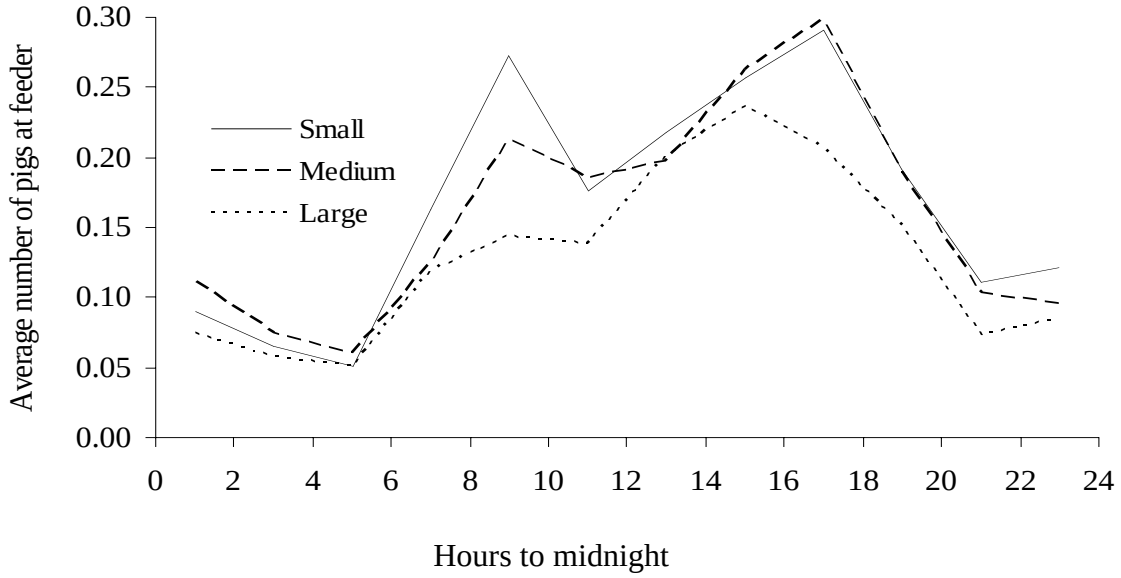

Figure 5 Patterns of feeder usage by small, medium and large pigs between 4 and 10 weeks of age

4.6 Management

The only apparent problem with increasing the group size of weaned pigs was fouling of the feeders. In groups of both forty and sixty animals at least one feeder, however not always the same feeder, tended to be fouled on a regular basis and had to be cleaned out by hand. This was reflected in the tendency for poorer food conversion associated with the larger groups (see section 4.2).

5. CONCLUSIONS

The results from the present study suggest that the group size of weaned pigs can be increased from ten to sixty animals without any significant adverse effects on performance or welfare as measured by aggression at the feeder. However, feed wastage is higher in groups of thirty, forty and sixty pigs than in groups of ten and twenty pigs. It is difficult to determine if the increase in feed wastage is simply due to the larger group sizes, or if it is the result of the extra feeder availability in larger groups.

There may be some beneficial effects of increasing group size to more than ten animals in terms of a reduction in within-group weight variation. This may be due to

a reduction in competition for feeding spaces in bigger groups, which is supported by observations of lower levels of feeder occupancy.

Extra care may be needed in terms of management of feeders in larger groups as at least one feeder per group tended to be fouled on a regular basis in the present study. This did not appear to be confined to a particular 'problem' feeder in the pen, however, but varied between different feeders over time.

6. REFERENCES

McGlone, J.J. and Newby, B.E. (1994). Space requirements for finishing pigs in confinement: behaviour and performance while group size and space vary. *Applied Animal Behaviour Science,* **39:** 331-338.

Morrow, A.T.S. and Walker, N. (1994). Effects of number and siting of single-space feeders on performance and feeding behaviour of growing pigs. *Journal of Agricultural Science, Cambridge,* **122:** 465-470.

Nielsen, B.L., Lawrence, A.B. and Whittemore, C.T. (1995). Effect of group size on feeding behaviour, social behaviour, and performance of growing pigs using single-space feeders. *Livestock Production Science,* **44:** 73-85.

O'Connell, N.E., Beattie, V.E. and Weatherup, R.N. (1999). Feeder choice for weaned pigs. In: *Pig Production and Welfare Research*. *Occasional Publication No. 28, Agricultural Research Institute of Northern Ireland*, pp. 5-19.

Randolph, J.H., Cromwell, G.L., Stahly, T.S. and Kratzer, D.D. (1981). Effects of group size and space allowance on performance and behaviour of swine. *Journal of Animal Science,* **53:** 922-927.

Spoolder, H.A.M., Edwards, S.A. and Corning, S. (1999). Effects of group size and feeder space allowance on welfare in finishing pigs. *Animal Science,* **69:** 481-489.

Walker, N. (1995). A note on siting of single-space feeders for growing pigs. *Irish Journal of Agricultural and Food Research,* **34:** 57-61.

Walker, N. (1991). The effects on performance and behaviour of number of growing pigs per mono-place feeder. *Animal Feed Science and Technology,* **35:** 3-13.