High-copper Mineral Mixture for Fattening Pigs

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(*Received* 26 *April* 1955)

Barber, Braude, Mitchell & Cassidy (1955, and unpublished work) have observed that the growth rate of fattening pigs can be enhanced by including in their rations a mineral mixture supplying 250 p.p.m. copper in the diet. In order to substantiate these findings a field trial was carried out in which eight centres co-operated. At four of the centres two replicates of the test were run, so that altogether results from twelve replicates were available and are reported below.

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EXPERIMENTAL

Plan of experiment. The trial was planned in such a way that, in each replicate, litter-mates of the control pigs, receiving a diet normally used at each of the centres, were given the same diet to which 2½% of the special mineral mixture XF were added or replaced 2½% of some other constituent. The mineral mixture was the same as the one used in the preliminary experiments of Barber *et al.* It consisted mainly of calcium carbonate and sodium chloride, and contained 4% copper sulphate, a small amount of ferrous sulphate, and traces of manganese sulphate, cobalt sulphate and potassium iodide. The main feature in which the experimental diets differed from similar mixtures used in commercial pig feeding was that they contained 250 p.p.m. copper.

The two groups, control and treated, were housed in two separate pens at each of the centres. The pigs were fed either *ad lib.* or as much as they would eat within 30 min at two daily meals. Details of the composition of the diets used at each centre are given in Table 1.

For the experiment weaners 10–12 weeks old were used. Their mean initial weights are given in Table 2. The trials extended over the whole of the fattening period. On reaching bacon weight, the pigs were sent to slaughter and their carcasses were commercially graded. During the trials the pigs were weighed at regular intervals and the amounts of food eaten by them were recorded.

Biometrical methods. The effect of the XF supplement on the growth rate and the food conversion was studied replicate by replicate, in analyses of measurements taken at the time of the slaughter of the first pig in the replicate under consideration. The weights of the individual pigs were corrected for variations in the initial weight by regression analyses, in which the within-treatment regression coefficients of weight at 'first' slaughter on the initial weight were averaged within each replicate, and the pooled coefficient was used in correcting the 'first' slaughter weights to a constant initial weight.

Measurements on pigs that were obviously 'bad doers'—four in all—were omitted from the analyses, and values for these pigs, and for pigs removed from the experiments at a very early stage—seven in all—were estimated by the missing-plot technique. The corrected weights for each replicate, completed in this way, were analysed by a randomized block analysis, the blocks being the pairs of pigs used in the allocation to treatments.

In the summary analysis over replicates, the interaction of treatments × replicates was compared with the pooled residual from the randomized block analyses, and since this test gave a non-significant result, the overall treatment effect was also tested against the pooled residual.

The efficiencies of food conversion, which were expressed in the form of a single measurement for each treatment in each replicate, were analysed by a randomized block analysis, the blocks in this instance being replicates.

Table 1. *Method of feeding and diets used at each centre*

Centre	Method of feeding	Composition of the meal mixture (%)			Method by which XF mineral mixture was added
Compton	*ad lib.*	Barley meal	40		2½% replacing 2½% of fine wheat offal
		Fine wheat offal	40		
		Flaked maize	10		
		White fish meal	10		
Dorset	*ad lib.* up to 120 lb. and then gradual increase up to a maximum of 6½ lb./head daily	Barley meal	60		2½% added to meal
		Fine wheat offal	30		
		White fish meal	10		
			Up to 150 lb.	Over 150 lb.	
Plumpton	*ad lib.*	Barley meal	50	55	2½% replacing 1% of other minerals and 1½% of fine wheat offal
		Maize meal	10	10	
		Fine wheat offal	25	25	
		Lucerne meal	4	4	
		Extracted soya meal	5	5	
		White fish meal	5	—	
		Chalk	¾	¾	
		Salt	¼	¼	
Riseholme	*ad lib.*	Proprietary Sow and Weaner meal up to 16 weeks old and then:			
		Barley meal	50		2½% added to meal
		Flaked maize	20		
		Fine wheat offal	20		
		Groundnut meal	5		
		White fish meal	5		
		Cod-liver oil*			
			Up to 150 lb.	Over 150 lb.	
Rowett	Hand-fed to appetite	Barley meal	62·5	67·5	2½% replacing other minerals
		Fine wheat offal	20·0	20·0	
		Dried grass	5·0	5·0	
		Extracted groundnut meal	7·5	5·0	
		White fish meal	2·05	—	
		Adisco†	0·45	—	
		Rowett mineral mixture‡	2·5	2·5	
Seale-Hayne	As much as the pigs would eat within 30 min twice daily	Barley meal	40		2½% added to meal
		Fine wheat offal	40		
		Flaked maize	10		
		White fish meal	10		
Shinfield (Reading)	As much as the pigs would eat within 30 min twice daily up to a maximum of 7 lb./head daily	Barley meal	40		2½% replacing 2½% of fine wheat offal
		Fine wheat offal	40		
		Flaked maize	10		
		White fish meal	10		
		Cod-liver oil*			
Sparsholt	*ad lib.*	Barley meal	30		2½% added to meal
		Fine wheat offal	30		
		Flaked barley	20		
		Flaked maize	10		
		White fish meal	10		

* Small amount.
† Adisco (Isaac Spencer and Co., Aberdeen) contains 1000 i.u. vitamin A and 200 i.u. vitamin D/g.
‡ Ground limestone 88%, salt 10%, barley meal 2%.

RESULTS

The results of the individual replicates are given in Table 2, together with relevant details of the statistical analyses. The only replicates in which there was a significant benefit in 'first' slaughter weight from the XF supplement were Compton 2, Plumpton, Riseholme 1 and Shinfield 2, but the overall benefit—corresponding to an increase in growth rate from 1·40 to 1·48 lb./day—was highly significant. The interaction, replicate × treatment, although rather large, was not quite significant at the 5% level; the overall effect of treatment compared with this interaction was still significant, but only at the 5% level.

Table 2. *Weights, growth rates and values for the efficiency of food conversion of the experimental pigs up to the time when the first pig in each replicate attained bacon weight*

Centre and replicate	No. of pigs	Mean initial weight (lb.)	Mean weight at the end of experimental period (lb.)			Mean growth rate (lb./day)		Mean conversion ratio (lb./lb. live-weight gain)	
			Control	Copper supplement	Standard error	Control	Copper supplement	Control	Copper supplement
Compton 1	20	56·1	189·7	188·0	3·79	1·75	1·73	4·05	3·53
Compton 2	20	54·2	171·5	187·2	3·03	1·51	1·72	3·72	3·58
Dorset	12	65·6	197·0	200·8	4·27	1·55	1·60	3·48	3·37
Plumpton	12	39·8	186·0	199·8	3·78	1·30	1·43	3·37	3·46
Riseholme 1	16	51·3	170·9	186·0	2·42	1·44	1·62	4·12	3·66
Riseholme 2	12	54·2	157·5	150·2	3·46	1·33	1·24	3·52	3·43
Rowett	14	40·4	166·0	169·1	6·37	1·29	1·32	3·85	3·66
Seale-Hayne	12	49·1	181·2	180·0	5·39	1·34	1·33	3·46	3·91
Shinfield 1	14	56·9	212·9	223·0	4·94	1·33	1·41	3·61	3·75
Shinfield 2*	22	41·3	174·5	191·4	3·75	1·37	1·54	3·29	3·05
Sparsholt 1	14	48·9	184·1	184·6	7·77	1·28	1·28	3·58	3·69
Sparsholt 2	14	39·9	173·1	171·7	4·24	1·27	1·25	3·37	3·43
Total	182	49·8	179·9	186·5	1·30	1·40	1·48	3·62†	3·53†

* Shinfield 1 and Shinfield 2 were replicates carried out on different farms.

† By omitting the replicates in which only approximate corrections could be used for bad doers and pigs removed from the experiment because group feeding was used, mean food-conversion efficiencies of 3·66 and 3·57 with standard error 0·048 were obtained.

The effect on efficiency of food conversion, although in general agreement with that on growth rate, was not significant.

The carcass-grading results showed no difference between the control and the treated pigs.

DISCUSSION

The results indicate that an addition to the diet of fattening pigs of a mineral mixture supplying 250 p.p.m. copper improved significantly the rate of growth of the pigs. The difference in average live-weight values for the control and treated pigs at the time when the first pig reached bacon weight was only 6·6 lb., but owing to the number of replicates available for analysis, it was possible to arrive at the conclusion that the difference was due to the feeding of the high-copper mineral mixture. The results point clearly to the necessity of having a large number of replicates in field trials of this kind in which only a relatively small response to treatment is obtained.

Although the effect on efficiency of food utilization was not significant, an improvement of 0·09 lb. meal per lb. live-weight gain was recorded for the pigs receiving the high-copper supplement. It is worth recalling that even as small a saving as 0·1 lb. meal per lb. live-weight gain has a marked commercial value. At present-day prices such a difference amounts to a saving of approximately 6*s.*/pig fattened for bacon.

It is not known at present how the high-copper mineral mixture exerts the beneficial effect, but it appears likely that one of the factors involved may be a stimulation of appetite. As the cost of copper sulphate is so small, it appears that the addition of these relatively high amounts of copper to the diet of fattening pigs would be economically worth while. However, before wide-scale practical application can be envisaged, information is needed on the distribution within the animal body of the ingested copper, and on the effect, if any, on the consumer of meat from animals given relatively high amounts of copper.

SUMMARY

1. In a co-ordinated experiment involving 182 pigs in eight centres, an addition of 250 p.p.m. copper in a mineral mixture to the diet of fattening pigs resulted in an improvement in the mean growth rate of the pigs.

2. The mean growth rate up to bacon weight of the treated animals was 1·48 lb./day, that of the untreated controls 1·40, the difference being statistically significant.

3. The efficiency of food conversion of the treated animals was 3·53 lb./lb. live-weight gain and that of the untreated controls 3·62. This difference was, however, statistically not significant.

We are indebted to Minsal Ltd, Northwich, Cheshire, for supplies of the mineral mixture XF.

REFERENCE

Barber, R. S., Braude, R., Mitchell, K. G. & Cassidy, J. (1955). *Chem. & Ind.* p. 601.