THE VALUE OF MEAT MEAL OR MEAT AND BONE MEAL IN DIETS FOR GROWING PIGS

E. S. BATTERHAM*

Summary

A nutritional evaluation of diets containing meat meal (MM) or meat and bone meal (MBM) for growing pigs indicated that:-

(a) A level of approximately 20 per cent meal in wheat based diets gave optimal performance.

(b) The protein quality of MMs and MBMs appeared, to be similar despite large differences in chemical composition.

(c) There was no incidence of parakeratosis despite dietary calcium levels of 1.5 to 3.3 per cent.

(d) No differences in growth promoting ability between a MM or MBM occurred under restricted feeding but, under ad libitum feeding, growth on the MBM diet was depressed.

(e) Meals varied greatly in uniformity and this appeared to be related to the method of production.

(f) MM was suitable as the sole protein supplement to barley, oats and wheat based diets but not to sorghum or maize.

I. INTRODUCTION

Meat meals (MM) and meat and bone meals (MBM) form the major source of locally produced protein supplements in N.S.W. They are produced as by-products from the slaughter of cattle, sheep and pigs at regional abattoirs and from butchers’ wastes at stock feed and tallow manufacturers’ plants. The meals are classified as meat meal (<10 per cent P₂O₅) or meat and bone meal (>10 per cent P₂O₅). Research with chickens (McDonald and Solvyns 1964; Sathe, Cumming and McClymont 1964a, 1964b; Sathe and McClymont 1965a, 1965b) and field reports related to pigs indicated that different brands varied greatly in their chemical composition and growth promoting ability. As a result, pig producers were using imported soybean meal and fish meal (30 to 40 cents/kg crude protein) in preference to locally produced MM or MBM (16 to 18 cents/kg crude protein).

The use of MM or MBM as a protein supplement for pigs appeared to be limited also by their high calcium content (approximate range 6 to 15 per cent). The requirement of pigs for calcium is approximately 0.8 per cent (Agricultural Research Council 1967) and levels above 1.0 per cent have induced a zinc deficiency characterised by slow growth and parakeratosis (Lewis et al. 1956; Stevenson and Earle 1956; Luecke et al. 1957; Ritchie et al. 1963). As a result, many pig production advisors were advocating only limited inclusion of MM or MBM in pig diets.

*N.S.W. Department of Agriculture, Agricultural Research Station, Wollongbar, New South Wales.
II. EXPERIMENTAL PROCEDURES

This paper reviews a series of experiments that were conducted at the Agricultural Research Station, Wollongbar, to provide information on the value of local MMs or MBMs as protein supplements in diets for growing pigs.

Different brands of MMs or MBMs were selected from regional abattoirs or stock feed and tallow manufacturers’ plants in N.S.W. They were fed as the sole protein supplement in diets based on grain. Pig performance was assessed in terms of gain/day, feed conversion ratio and lean in the ham over the 18 to 45 or 18 to 73 kg range. Unless dietary feeding rate was an experimental treatment, diets were fed at restricted intakes (3.5 to 4.3 per cent of liveweight daily) designed to produce pigs of local premium carcass quality (Wilson 1967). Chick and rat performances were assessed in standard laboratory tests over 6 and 14 day experimental periods respectively, with gain per experimental period and feed intake recorded.

III. RESULTS AND DISCUSSION

(a) Inclusion Level of MM or MBM

The inclusion level of MM or MBM was found to be important. A level of approximately 20 per cent MM or MBM in wheat based diets gave optimal growth, feed conversion efficiency and lean in the ham (Batterham and Holder 1969b). This level corresponded to approximately 60 mg of an equal mixture of MM or MBM and grain protein/kcal digestible energy/kg liveweight/day. The meals also contained considerable quantities of minerals and, at this level of inclusion, the diets were adequate relative to the estimated requirement of pigs for major minerals (Agricultural Research Council 1967).

(b) Variability in Growth Promotion

When different brands of MM or MBM were compared on an equal protein basis there was little difference in their growth promoting ability for pigs under restricted feeding. MBMs produced from butchers’ wastes were found to have similar growth promoting abilities as MMs produced from abattoir by-products (Table 1). This result occurred despite the large proportion of bone protein in the MBMs and has been confirmed with additional experiments (unpublished data). It indicated that the sources of starting material for the different meals had no apparent effect on the supplementary protein value of the meal for growing pigs.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium (%)</td>
<td>1.6</td>
<td>3.0</td>
<td>1.5</td>
<td>3.3</td>
</tr>
<tr>
<td>Gain (g/day)</td>
<td>404</td>
<td>401</td>
<td>436</td>
<td>438</td>
</tr>
<tr>
<td>Feed conversion ratio</td>
<td>3.3</td>
<td>3.5</td>
<td>3.4</td>
<td>3.4</td>
</tr>
<tr>
<td>Lean in ham (%)</td>
<td>64.7b</td>
<td>67.1a</td>
<td>62.5</td>
<td>64.9</td>
</tr>
</tbody>
</table>

Means with different subscripts differ significantly (P < 0.05). Experiments 1 and 2 — 8 and 5 animals/treatment respectively.
(c) Tolerance to Calcium

No evidence of parakeratosis or response to zinc supplementation of a wheat-MBM diet which contained 2.9 per cent calcium was observed (Wilson and Holder 1967). Possible reasons for the lack of parakeratosis in wheat-animal protein in contrast to corn-vegetable protein diets have been discussed by Batterham and Holder (1969a). They reported, however, that the addition of calcium carbonate to a wheat-animal protein diet severely depressed growth. In subsequent experiments, there was no apparent effect of similar dietary calcium levels as a result of the inclusion of high levels of MBM (Table 1). These results are interpreted as indicating that the tolerance of pigs to dietary calcium may be affected by its source. Such tolerance may reflect differences in availability or a reduction in the depressing effects of calcium by the levels of other nutrients (minerals, vitamins or amino acids) contributed by the MBM. Rats also appeared to be more tolerant to dietary calcium levels contributed by MBM than by calcium carbonate (unpublished data). In contrast, chicks appeared equally susceptible to either source of calcium, and this is in agreement with the findings of Sathe and McClymont (1965a).

(d) The Effect of Feeding Rate

The rate of feeding was found to affect the growth promoting ability of different meals. No differences occurred between meals under restricted feeding, but under ad libitum feeding pig performance was depressed when fed a diet containing MBM (Table 2). The reason for this interaction was not established. It may indicate that the nutrient requirements, expressed per unit of energy intake, may vary for different rates and types of development, or that, under ad libitum feeding, an induced deficiency developed due to an excessive intake of one or more nutrients e.g. calcium. In this regard, the determination of the nutrient requirements of pigs in terms of intake/day rather than percentage in a diet seems especially applicable.

The depressed performance of the pigs fed the MBM diet ad libitum indicated that MBM may be unsuitable as the sole protein supplement under that method of feeding. This does not appear to be a problem of commercial significance at present as restricted feeding is normally practiced and is needed to produce pigs

<table>
<thead>
<tr>
<th>Type of Meal and Rate of Feeding</th>
<th>Liveweight Gain (g/day)</th>
<th>Feed Conversion Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM — restricted</td>
<td>358</td>
<td>2.79</td>
</tr>
<tr>
<td>MBM — restricted</td>
<td>349</td>
<td>2.86</td>
</tr>
<tr>
<td>MM — ad libitum</td>
<td>640</td>
<td>2.93</td>
</tr>
<tr>
<td>MBM — ad libitum</td>
<td>522</td>
<td>3.04</td>
</tr>
</tbody>
</table>

Significance of main effects and interactions (P < 0.05)

<table>
<thead>
<tr>
<th>Type of meal</th>
<th>Feeding rate</th>
<th>Meal × feeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

*P < 0.05.
NS — Not significant
of the desired premium carcass quality. In the future, however, as progress is made in the genetic selection of local strains of pigs that are capable of producing carcasses of premium quality under ad libitum feeding, then the use of MBM as the sole protein supplement may be limited.

(e) Uniformity of Meals

Bone analysis of each bag within batches of meals from different manufacturers indicated that different brands varied widely in their uniformity. This variability appeared related to the method of production. One manufacturer used a large mixer to blend the material from different “cooks”, and analyses of different bags of this brand over a four-year period indicated that material of consistent bone content could be produced (approximately 30 to 35 per cent bone). In contrast, variable meal (33 to 61 per cent bone within a batch) was produced at a plant where the starting material was separated to produce two grades of tallow, and the material from the different digesters was stored in the one bin which was not equipped with mixing equipment. Such variation indicated that there is a need to ensure that each sample taken for biological or chemical tests is in fact truly representative of the batch.

(f) The Effect of the Grain Component

The amino acids contributed by the grain component were found to effect the value of MM as a protein supplement (unpublished data). MM was suitable as the sole protein supplement to barley, oats and wheat based diets. Marginal and inferior pig performance occurred with sorghum and maize based diets respectively. The cause of the marginal performance from the sorghum-MM diet has not been investigated but, with a maize-MM diet, dl-tryptophan and l-lysine were the first and second limiting amino acids respectively. Responses to l-lysine supplementation of wheat-MM or MBM diets were also recorded, although these responses were variable (Batterham 1970).

These results emphasised the importance of the amino acid composition of the grain component, a factor which is commonly overlooked when a protein supplement is being evaluated. In addition to the variation that may occur in the amino acid composition between grains, variation within a grain type also occurs (Block and Weiss 1956; Pfander and Tribble 1957; Jones, Cadenhead and Livingstone 1968). If maximum utilization of amino acids from grains, protein supplements and commercially available synthetic sources is to be achieved, it is desirable that the available amino acid content of feed ingredients be determined to allow rational diet formulation. If it is necessary to formulate diets in the absence of such information, it is suggested from this series of experiments that MM or MBM may be used successfully as the sole protein supplement to barley, oats and wheat based diets. While the present high cost of synthetic dl-tryptophan limits the use of maize-MM diets, the recent development of the Opaque-2 variety (Cromwell, Pickett and Beeson 1967) which contained approximately 104 per cent and 67 per cent greater levels of lysine and tryptophan respectively, indicated that MM may be an adequate protein supplement for that variety.
VI. REFERENCES


