EFFECT OF THE LEVEL OF FISH MEAL ON GROWTH AND FEED CONVERSION OF CATTLE FED MOLASSES/UREA AND RESTRICTED AMOUNTS OF FORAGE

H Gaya, R Nasseeven, B Hulman and T R Preston[1]

Animal Production Division, Ministry of Agriculture, Reduit, Mauritius

Fifty Creole x Friesian heifers (initial weight 136.3 + 13.6 kg).were Used to compare five dietary treatments in a randomized block design with two replicates. The levels of fish meal were 0, 150, 300, 450 and 600 g/d in a basal diet of sugar cane tops (3X body weight fresh basis) and molasses with 2.5% urea and minerals, fed ad libitum. Daily liveweight gain increased curvilinearly from 208 g/d without fish meal, tending to plateau at 500 g/d with 450 g/d of fish meal. Daily intake of DM increased when fish meal was added to the diet and this appeared to be due mainly to greater consumption of molasses. Conversion rate was relatively poor even on the best treatment (13.1 kg DM/kg gain). It is proposed that the inefficient utilization of the dietary energy may be due to low rumen turnover rate associated with the feeding of cane tops. Their very low degradability appears to be associated with poor roughage characteristics.

Key Words: Cattle, molasses/urea fish meal, by-pa5s protein

The first practical demonstration of the importance of by-pass protein in ruminant diets was in Cuba in the late 1960's when it was shown that rate of liveweight gain and feed conversion rate could be tripled by adding fish meal to a basal diet of molasses/urea and restricted forage (see Preston and Willis 1974). It is now an accepted concept that the protein requirements of ruminants should be separated into the needs of the rumen microorganisms (mainly for non-protein nitrogen) and those of the host animal which depend on pre-formed protein reaching the duodenum (see Kempton et al 1977).

The rate of degradation therefore becomes a major factor governing the escape of dietary protein from rumen degradation and its availability for the animal. This dietary protein, undegraded in the rumen and available for digestion by the host animal, has been termed 'by-pass protein' (Kempton et al 1977).

Protein degradability in the rumen can be reduced by processing (chemical, heat treatment, encapsulating), but this may not always be practical or economical. However, many protein meals receive some degree of heat treatment in their manufacture and this may make them suitable sources of by-pass proteins. Fish meal was chosen as the major supplement for molasses in the large scale feeding of cattle in Cuba because it combines low rumen degradability and a good balance of essential amino acids. However, despite its widespread use for this purpose, there has only been a preliminary report (see Preston and Willis 1974) concerning the determination of the optimum level of fish meal that should be used in a molasses based diet.

---

[1]UNDP/FAO Consultant to the project MAR/75/004

The objective of this study was to corroborate the earlier Cuban work and to report in more detail on the effect of level of fish meal on the different parameters of performance in growing cattle.

Materials and Methods

Animals, Treatments and Design: Ten groups each of 5 Friesian x Creole heifers weighing 136.3 + 13.6 kg were allocated to two replicates of five dietary treatments in a randomized block design. The five levels of fish meal used were: 0, 150, 300, 450 and 600 g/d. The basal diet consisted of molasses containing 2.5% urea which was provided ad libitum together with restricted amounts of fresh sugar cane tops (3% of body weight). A mixture of salt and dicalcium phosphate (50/50) was available on a free choice basis.

Feeding and Management: The experiment was conducted at the Palmar Livestock Station of the Ministry of Agriculture, and lasted 157 days. The groups of animals were housed in pens with concrete floors (4.2 m /animal) in partly covered sheds; The molasses/urea, fish meal, forage and water were all given in separate troughs. The cane tops were given every morning at 7am at the same time as the fish meal. The molasses/urea and the minerals were always available.

Measurements: The animals were weighed weekly for the first two months and then at intervals of 14 days. Weighing was done in the morning before feeding the forage. The amount of roughage to be fed was adjusted to 3% of body weight after each weighing.

Samples of fish meal were taken every 4 days (when a fresh bag was used). Samples of cane tops were taken every 14 days. The proximate analysis of these samples was carried out by the Chemistry Division of the Ministry of Agriculture using conventional procedures. The Brix (total dissolved solids) of the molasses was determined at the beginning and half way through the experiment.

The average weight of each pen of animals was used in the regression and variance analyses. Liveweight gain was calculated by regression of liveweight on time.

Table 1:
Chemical analysis of feeds

	Fish meal	Cane tops	Molasses/urea
No of samples	38	12	2
Dry matter (DM), %	91.8 ± 2.4	29.5 ± 5.5	84.2 ± 1.4
N x6.25, %[1]	51.6 ± 3.2	6.35 ± 2.6	**
Crude fibre, %[1]	0.22 ± .14	32.2 ± 2.4	**
Ether extract, %[1]	9.2 ± 1.5	1.1±.67	**

[1]DM basis ** Not analysed

Results

There were a few cases of "pink eye" disease which were treated; otherwise the health of the animals was generally good during the whole experiment

Data on the chemical analysis of the feed samples are given in Table 1. There was quite wide variation in the composition of the cane tops since at times these came from fields which had been burned. The composition of the fish meal was relatively constant.

Mean values for liveweight gain, feed intake and feed conversion are given in Table 2. The relationship between intake of fish meal and the principal performance

Table 2:
Mean values for liveweight gain, feed intake and conversion of heifers fed restricted cane tops, molasses/urea and different levels of fish meal

	Level of fish meal					
	0	150	300	450	600	SEx
Liveweight, kg						
Initial	139	138	135	133	136	+ 14
Final	175	207	210	215	224	
Weight gain, g/d	208	396	444	500	514	+ 21.8***
Feed intake, kg/d						
Molasses/urea	4.66	5.39	5.26	5.31	5.44	
Cane tops	4.49	4.89	4.87	4.97	5.27	
Fish meal	0	0.15	.30	.469	.593	
Minerals	.05	.05	.05	.05	. 05	
Total DM	5.29	6.16	6.19	6.40	6.73	+.15***
Consumption index[1]	3.38	3.57	3.58	3.68	3.74	+.087
Conversion[2]	25.5	15.6	13.9	12.8	13.1	+ 1.67

[1] 100.DM intake/liveweight ** P<.01
[2] DM intake/weight gain *** P<.001

parameters: liveweight gain, feed consumption index and feed conversion rate are in Figures 1, 2 and 3, respectively. These relationships show the marked effect of fish meal supplementation on animal performance. All the responses were curvilinear and indicated that optimum animal performance was achieved with an intake of about 450 g/d of fish meal.

The voluntary consumption index (from 3.4 to 3.7 kg DM/100 kg liveweight) is high and the level of animal performance in terms of growth and feed conversion is low, as compared with the data reported by Preston and Willis (1974).

It is a normal procedure in our feeding trials to measure rate of liveweight gain by regressing liveweight against the number of days on experiment. In this experiment, this procedure was compared with the more conventional method of using initial and final weights (see Table 3). The coefficient of variation (100.SD/mean) was considerably lower (7.5%) for the regression technique then when initial and final weights were used (11.4%).

Figure 1:
Relationship between level of fishmeal in the ration and feed conversion

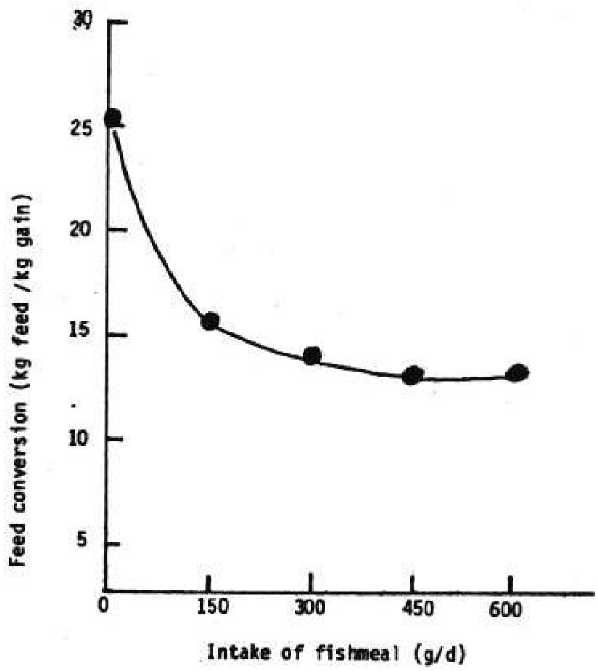


Figure 2 :
Mean consumption index in relation to intake of fishmeal

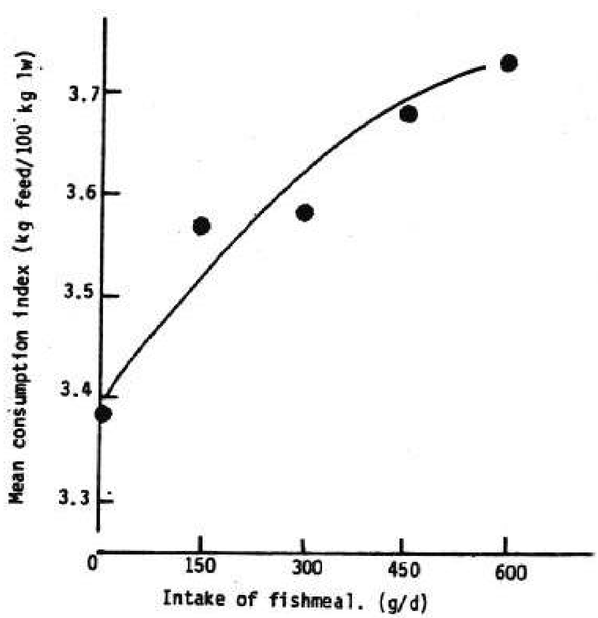
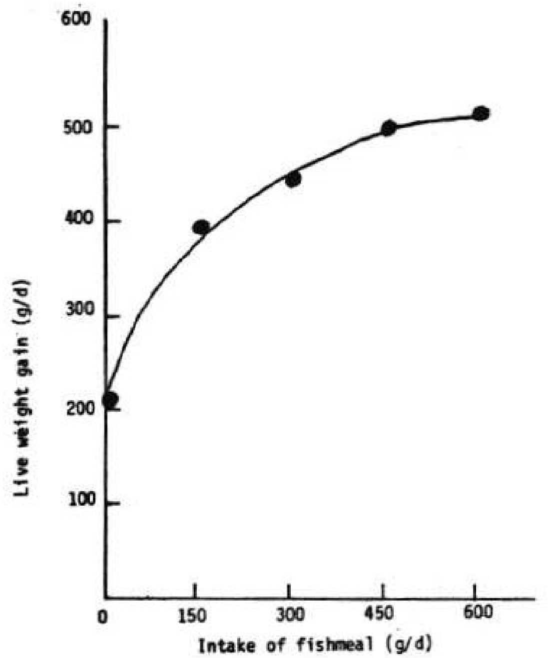


Figure 3:
Weight gain estimated by regression of cattle receiving fishmeal supplement and a basal diet of Molasses /urea and restricted forage



Discussion

The results of this experiment confirm the earlier Cuban observations (reported by Preston and Willis 1974) that the response to increasing levels of fish meal in a molasses based diet is curvilinear with maximum biological response being achieved with an input of approximately 200 g protein/d as fish meal. This is equivalent to about 100 g fish meal protein/100 kg liveweight.

Table 3:
Mean daily liveweight gains of animals receiving fish meal supplements

Fish meal, g/d	Gain, g/d	Regressed gain/d, g
0	226	208
150	440	396
300	477	444
450	520	500
600	562	514
SE	±35.9	±21.84
Coefficient of variation	11.4	7.5

The difference between the results reported here and those from Cuba is in the lower overall rate of liveweight gain and the poorer feed conversion rate. Most research in Cuba was carried out using pangola and elephant grass as the forage sources, whereas in the present trial fresh cane tops were fed. It was reported by Salais et al (1977) that on a molasses based diet, chopped cane tops and chopped whole sugar cane were inferior roughage sources as compared with Bermuda grass or mixtures of Bermuda grass and Leucaena leucocephala.

This finding is further supported by practical observations (Preston T R 1979 unpublished data) from several intensive feedlots in Mauritius in which molasses based diets are used. Frequently, when cane tops are the roughage source, the rates of liveweight gain and feed conversion are poorer then would normally be expected for this type of diet.

It has been shown conclusively by Losada and Preston (1973) and Rowe et al (1979) than one effect of the forage in a liquid molasses diet is in increasing the rate of rumen turnover and therefore the flow of nutrients to the duodenum. If it is assumed that cane tops are a poor source of roughage then this may well be due to their inadequacy in stimulating rumen turnover and flow. It is an obvious priority for future research to confirm that cane tops are indeed an unsuitable forage in terms of providing essential roughage characteristics in molasses based diets; and later to ascertain why this should be so.

References

Kempton T J, Nolan J V and Leng R A 1977 Principles for the use of non-protein nitrogen and by-pass proteins in ruminants Animal Review 22:2-10

Losada H and Preston T R 1973 Effect of forage on performance, content of reticulo rumen ant VFA in rumen and caecum of calves fed diets based on molasses/urea. Revista Cubana Ciencia Agricola 7:185

Preston T R and Willis M B, 1974 Intensive Beef Production 2nd edition Pergamon Press: Oxford

Rowe J B, Bobadilla Milagros, Fernandez Angela, Encarnacion J C and Preston T R 1979 Molasses toxicity in cattle: rumen fermentation and blood entry rates associated with this condition Tropical Animal Production 4:78-79

Salais F J, Sutherland T M and Wilson A 1977 Effect on animal performance of different sources of forage in diets based on molasses and urea Tropical Animal Production 2:158-162

Received 10 June 1979