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PAIRED COMPARISON ANALYSIS OF PALATABILITIES OF TWENTY FOODS TO DAIRY COWS

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SUMMARY

The relative palatabilities of 20 foods were determined by exposing Jersey cows to all possible pairs of foods. The cows were required to press a nose plate to produce, aperiodically, a brief presentation of one food or another and these responses were scaled to produce a preference ranking.

High-rated foods (scaled 6 to 10) included crushed barley, dairy meal, maize silage, hay, sainfoin, fresh and frozen pasture; mid-rated foods (scaled 4 to 5) included brewer's grain, pressed pasture, brewer's trub and concentrated plant juice whey; and low-rated foods (scaled 1 to 2) were molasses block, typha silage and salt block.

INTRODUCTION

Although pasture grasses and legumes will remain the major dietary components for farmed ruminants in New Zealand, the growth of processing industries provides a number of surplus by-products as potential supplements. This paper reports the relative preference ratings of 20 selected foodstuffs by two dairy cows using an established technique for the assessment of animal food preference (Matthews and Temple, 1979).

MATERIALS AND METHODS

Two 4-year-old Jersey cows (A, B) experienced with the equipment and concurrent schedule choice procedures were used. The food delivery apparatus was similar to that described by Cate *et al.*, (1978). Presses given by the cows to two nose plates occasionally allowed the cow access to either of two comparison foods for a nominal 4 second period.

Each food of a pair was available on average once every 60 seconds but the interval varied from 8 to 120 seconds (concurrent variable interval (VI) schedule). With this procedure and with palatable foods, cows typically respond steadily throughout a choice session (Matthews and Temple, 1979). Exclusive responding

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for one of the paired foods was prevented by requiring the cow to select the non-preferred food as it became available before the preferred food could again be obtained.

Each of the 20 foods was compared with each and every other food twice, once on the right and once on the left. Individual cow choice sessions of 1000 second duration were run each morning and afternoon over a 5-month period with pairs of randomly selected foods. Both cows were exposed to the same food pair on a given session. Both animals were kept in a closely cropped (ca 2 cm) paddock between test sessions and received hay as a supplemental ration. The animals were exposed to all the foods used in the comparisons for several days prior to and throughout testing. The 20 foods (Table 1) were selected as representative of known preferred items (e.g. crushed barley and dairy meal) and regular pasture and supplemental materials.

The numbers of plate presses and the numbers of reinforcements obtained on each plate were recorded for all comparisons.

RESULTS

For each cow on each pair of foods the data were calculated as the sum of the numbers of responses for each food on the two sessions (left and right side) run. These data were used to calculate preference ratios (Matthews and Temple, 1979) for each pair of foods. Simple preference orders were determined for each cow by ranking the foods according to the frequency with which each item was preferred (response ratio greater than 1.00) over the remaining materials. Foods with equal preference frequency were ranked by reference to the preference shown on the paired comparison of the items. These orders are shown in Table 1. The between-cow rank correlation was 0.902 ($P < 0.01$). Each cow was tested on 190 different pairs of foods. For cow A, 14 of the preferences shown on the paired comparisons were in the opposite direction to that predicted by the ranking in Table 1 (i.e. intransitive). For cow B, there were 16 such intransitivities.

The geometric means of the preference ratios for each food when compared with every other food were calculated for each cow (1.00 recorded for comparison with itself). These values, averaged for the two cows, were used to construct a preference scale (Fig. 1) which indicates the magnitudes of the relative preferences. The most preferred food (crushed barley) was given a ranking of 10, with the remaining foods scaled accordingly. The preference values

TABLE 1: FOODS RANKED IN ORDER OF PREFERENCE FOR EACH COW

Rank	Food	COW A		COW B	
			No of times preferred	Food	No of times preferred
1	Crushed barley		19	Dairy meal	18
2	Lucerne meal		17	Crushed barley	17
3	Dairy meal		15	Dried peas	17
4	Grass silage		14	Lucerne meal	16
5	Maize (corn) silage		14	Chopped hay	14
6	Sainfoin		14	Sainfoin	13
7	Tama ryegrass		13	Grass silage	13
8	Fresh pasture grasses		13	Pressed pasture silage	12
9	Dried peas		11	Maize silage	11
10	Chopped (meadow) hay		11	Tama ryegrass	10
11	Pressed pasture silage		10	Fresh pasture grasses	9
12	Pressed pasture (after protein extraction)		8	Frozen lucerne silage	8
13	Frozen cut pasture		7	Pressed pasture	7
14	Spent brewer's grain		7	Frozen cut pasture	7
15	Concentrated deproteinised plant juice whey (CDPJ)		6	Spent grain	6
16	Frozen lucerne silage		5	Brewer's trub	5
17	Brewer's trub		3	Molasses block	3
18	Molasses block		2	Plant juice whey	3
19	Typha (sewage pond plant) silage		1	Salt block	1
20	Salt block		0	Typha silage	0

Rank correlation between cows 0.902 ($P < 0.01$). The lines linking pairs of foods indicate that the paired comparison preference was in the opposite direction.

showed a ninefold change from least (salt block) to most preferred. The averaged values were typical of the individual cow data both in ordering and magnitude. The between-cow rank correlation of the order of the items on the preference scales was 0.797 ($P < 0.01$).

For each cow, the ordering of the 20 foods on the preference frequency ranking and the preference scale was similar (rank correlations of 0.911 for cow A and 0.941 for cow B).

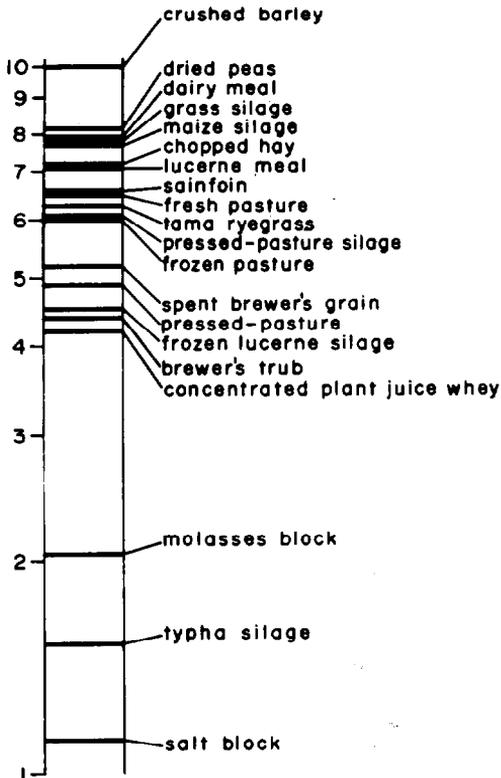


FIG 1: Food preferences: scale (Log) fixed on 10 for crushed barley.

DISCUSSION

The ranking of foods based on the frequency of preference for each item over the remaining materials (Table 1) allows the reliable prediction of the preferences between most pairs of foods.

The scale based on the geometric means of the preference ratios for each food provides quantitative estimates of the magnitude of the preferences. Further analysis of several paired comparisons over periods of 3 to 4 weeks with additional cows has confirmed both the directions and magnitudes of the preferences indicated in Fig. 1.

The preference scale (Fig. 1) gives an ordering which is consistent with the known intakes of some of the foods. Most of the regular pasture and supplemental foods were scaled from 6 to 10. The acceptability of these foods does not usually lead to any intake restrictions. Four by-product materials, spent brewer's grain, pressed pasture, brewer's trub and concentrated plant juice whey ranked about 4 to 5, approximately a factor of 2 below crushed barley. Based on experience with pressed pasture (T. E. Trigg, pers. comm.), it is likely that there will be intake restrictions with these materials corresponding to the low preference values. The low-valued foods not readily eaten included molasses and salt blocks, and typha silage. The variable and often low rates of intake of molasses lick blocks (Graham *et al.*, 1977) illustrates the reluctance of cattle to feed when a low-preferred material is on offer.

Further analysis of foods grouped on the preference scale can lead to the identification of textural, chemical, or other factors important for acceptance or non-acceptance.

The preference scale was derived from paired comparisons which involved relatively few exposures of each food to the animals over a period of months. The scale represents the initial reactions of the cows to each of the foods. Those foodstuffs ranked high should be readily consumed while those ranked low may require long periods of adjustment or training (Arnold, 1976) to improve intakes. Alternatively, the addition of preferred items to unpalatable feeds (Coppock, 1970) may ensure acceptance. It may not be possible to force the acceptance of some very unpalatable items especially if it is not desirable to have the animals lose condition while becoming hungry.

CONCLUSIONS

Preference values can be assigned to dietary foods which predict the acceptance of those materials by cattle. With the establishment of a food preference scale it is possible (a) to indicate the readiness

with which a food will be eaten; (b) to look for common factors among foods which affect acceptance; (c) to experiment with the mixing of by-products to improve palatability and intake and (d) to assess quickly the acceptance of new foodstuffs.

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