Ife Journal of Agric. Vol. 3, Nos. 1 & 2 (1981)

Studies on the Feeding value of Agro-Industrial By-Products for Livestock: 1. Consumer acceptance of Beef from Cattle fed Cocoa-pod diets.

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Abstract

The effect of feeding cocoa-pod, hitherto considered a waste product, to cattle on the organoleptic qualities and consumer acceptance of the resulting beef was investigated. Two consumer acceptance tests were carried out, with the cooking method controlled in one and uncontrolled in the other. The results of the latter test showed that the favourite beef cooking method was to boil (or steam), fry and stew (40%), followed by boiling and stewing (34%). In both tests, beef from cattle fed cocoa-pod and control diets had similar scores (P. > 05) for both tenderness and flavour. Overall acceptability scores were also not different (P. > 05). The majority of consumers (75%) indicated a preference for beef as tender as the experimental samples obtained from rapidly grown cattle as opposed to the usually tougher market beef from older, range grown cattle. Apparently, feeding cattle cocoa-pod at dietary levels of up to 40% would have no adverse effect on the organoleptic qualities and acceptability of beef.

Introduction

Evidence exists that certain feedstuffs adversely affect the organoleptic quality of meats to such an extent that regardless of the nutritional merit, their use in animal feed has had to be discontinued, restricted to certain species of livestock, or withdrawn a few days before slaughter. Fish meal inspite of its high protein content and quality, cannot be fed at levels higher than 7-8% to swine, particularly if it has a high oil content, because of the "fish taint" it imparts to pork (Pond and Maner, 1974). Unsaturated fats are rarely fed to swine because they tend to be deposited

as such in the body, resulting in unsually soft carcasses which are unacceptable to the consumers.

Inspite of the legendary degradative and synthetic roles of rumen microbes which apparently minimise the impact of dietary treatments on beef quality, data exist showing that nutritional treatments may affect the chemical composition of beef (Edwards *et al.*, 1961; Ellis *et al.*, 1962; Tove and Mochrie,, 1963), and hence its organoleptic quality (Waldman *et al.*, 1965; Dryden and Machello, 1970). The effect of novel sources of nutrients such as single cell proteins and agro-industrial by-products now being actively evaluated as animal feeds on the composition, organoleptic qualities and consumer acceptance of meats has not been adequately documented.

It is important that nutritional evaluation of these novel feedstuffs, and even unusual combinations of conventional ones should include an evaluation of the quality and consumer acceptability of meat from animals fed such feeds. The present study was designed to evaluate the consumer acceptance of beef from cattle fed cocoa-pods as an energy source.

Materials and Methods

A total of 36 local type cattle including Keteku, Ndama and crosses of Ndama and White Fulani averaging an initial weight of 106kg were randomly assigned to three diets whose compositions are shown in Table 1. The diets were fed for 112 days at the end of which three animals were randomly selected from each treatment and slaughtered after a 24 and 18 hr. feed and water fast respectively. The dressed carcasses were quartered, the hind and fore quarters being separated at the 12th rib. The 5th to 8th rib cut from the left side of each carcass was deboned and trimmed to isolate the longissimus dorsi muscle, which was packed in a polythene bag and stored at -20°C till processed as detailed under test 2.

Test 1: Immediately after slaughter, one kg portions of meat taken randomly from either the front of hind quarter were given out to a cross section of consumers from the University population. Each consumer received a one kg packet of meat from one treatment i.e. either control low cocoa-pod (LP), or high cocoa-pod (HP). The consumer was asked to prepare the meat the way beef was usually prepared in his or her home, to taste the meat and compare it with a reference market beef (Table 2), that is beef the consumer could remember eating recently. Thus utilising a classical consumer test technique of relying on the consumer's power of recall.

Test 2: The nine longissimus dorsi muscles obtained from the 5th to 8th rib cut were thawed to room temperature and diced into small pieces weighing an average of 30g. Meat samples from the same treatment were then processed together as described below. The diced pieces were weighed and salted at the rate of 6g per 100g of meat. The salted meat was then boiled in water with onion added at the rate of 4g per 100g of meat. After boiling for 45 minutes the samples were fried in fresh vegetable oil till all three groups were uniformly browned. Total processing time was 1hr. 2mins., and the gas stove dial was left at the same point for all three treatment groups. The meat was then cooled to room temperature and served in pre-determined treatment pairs to a cross-section of randomly chosen consumers from the University population.

The pair of treatment tasted and compared by each consumer was determined in the following manner. Each treatment was paired with the other two to make 3 pairs viz: control vs. low cocoa-pod diet (LP), control vs. high cocoa-pod diet (HP) and LP vs HP. Each of the 3 pairs was then rearranged so that the second named treatment was now named first viz: LP vs control, HP vs. control, HP vs LP. A total number of six paired comparisons in which each treatment has a chance of being tasted first was thus constructed. The six pairs were presented in a random manner to the consumers as they came into the test room. Each consumer tasted and compared only one pair of treatment, and the order of presentation of the paired treatment was changed after each set of 6 consumers.

A sample of the questionnaire answered by each consumer during the test is reproduced in Table 3. Response to the paired comparison difference or preference questions were coded using a modified Hedonic point scale, and subjected to an analysis of variance as described by Larmond (1970).

Results.

Test 1:

Questions 2 and 5 on table 2 were formulated to ascertain the effect of dietary treatment on tenderness. There was good agreement in the responses to both questions. Consumers that indicated that a test sample took less time to cook in response to question 2, also thought that the sample was more tender than the reference sample in response to question 5. There was therefore, a certain degree of consumer consistency. Table 4 shows a summary of the comparisons for tenderness. Regardless of dietary treatment, the test samples were uniformly judged more tender than the

reference market beef. This is understandable, since the experimental cattle were raised under an intensive system, and reached slaughter weight at a younger age compared to the older range fed animals which supply the major bulk of market beef.

It is interesting to note that in response to question 6, 75% of consumers rated intensively produced beef just right in terms of tenderness. Comparing the proportions of consumers that indicated this preference in favour of the test samples 100, 82 and 100% for the control, LP and HP samples respectively (table 4), it is clear that feeding cocoa-pod to cattle had no discernible effect on beef tenderness. Responses to the question on flavour indicated a similar trend, suggesting that feeding cocoa-pod to cattle had no untoward effect on beef flavour. Table 5 shows a summary of cooking metnods employed by the consumers. The three major methods were boiling, frying and stewing (40%), boiling and stewing (34%) and boiling and frying (13%). Less than 3% of the consumers roasted or braised the samples. Apparently most consumers would boil and fry beef with or without stewing. Meat samples for test no. 2. were therefore boiled and fried in our laboratory in an attempt to eliminate variation in sensory perception due to method of preparation.

Test 2:

Table 6 shows the mean scores on a modified Hedonic scale for tenderness and overall acceptability. The observed differences were not significant ($P > .05$). In concrete terms, consumers found all samples regardless of treatment a bit tender, and the overall acceptability good. Most consumers (80%) went on to indicate that they would like beef to be as tender as the test samples from intensively raised cattle. This is similar to the 75% that expressed the same desire in test no. 1. A smaller number (9%) would prefer more tender beef while another 9% could not make up their mind one way or the other.

The effect of feeding cocoa-pod to cattle on beef flavour was ascertained by asking a 3 fold question. (Questions 4, 5a and b on table 3). A summary of the responses is shown on table 7. More consumers detected an unfamiliar flavour in the control beef samples (39%) than in the LP (33%) of HP (28%) beef samples. More interestingly, the strange flavour was not considered unpleasant by most consumers. Furthermore, very few consumers could identify or describe the flavour which was qualified as being oily in the case of HP beef.

Each consumer was asked to express a preference for one of the sample in the pair tasted. The paired preference scores were not significantly different ($P > .05$), although a definite trend was indicated. Beef from

low cocoa-pod fed cattle was preferentially rated higher than beef from the control or high cocoa-pod fed cattle. Beef from the control and high cocoa-pod fed cattle were rated similarly. Apparently feeding high levels of cocoa-pod to cattle (up to 40% of dietary content) had no adverse effect on overall acceptability of the resulting beef by consumers.

Discussion

Consumer acceptance studies similar to the present one need to be incorporated into nutritional studies designed to evaluate novel sources of nutrients for livestock. These studies unlike analytical taste panel tests can be carried out on a large scale, and give first hand information on the overall acceptability of the product. Taste panels on the other hand are difficult to train and organize, and can only be used on a restricted scale. Moreover, they often fail to accurately predict consumer responses. Since the final decision regarding eatability rests with the consumer, consumer acceptance studies should be given preference over analytical taste panel tests whenever feasible, as in this case.

About 8% of the consumers detected an oily flavour in the high-cocoa-pod beef. The oily flavour could have been caused by a quantitative and, or qualitative modification of tissue lipids by the diet. Evidence exist in the literature that high levels of dietary fat may result in changes in the adipose tissue composition of cattle (Edwards *et al.*, 1961; Ellis *et al.*, 1962;. Tove and Mochrie, 1963). These changes may in turn affect the organoleptic quality of beef, since significant correlations between total lipids and fatty acid composition of muscle on the one hand, and its organoleptic quality on the other hand have been documented (Waldman *et al.*, 1965; Dryden and Marchello, 1970). In the present study, dietary fat content was low and similar across treatments (Table 1). It is possible, however, that the high levels of cocoa-pod in HP diet, altered the fatty acid profile of the diet and consequently of the meat from HP diet fed cattle. Further studies in which total lipids and fatty acid composition of meat of animals fed varying levels of cocoa-pod appear worthwhile.

Cooking method and temperature may affect the extent of perception of organoleptic qualities of meats (Hamm, 1966; Hedrick *et al.*, 1968; Parish *et al.*, 1973). In conducting consumer preference studies, it is important to employ cooking methods ordinarily used by the consumer in order to obtain meaningful results. Roasting, a method of choice in analytical taste panel tests was employed by less than 3% of the consumers sampled (table 5). Steaming and frying was the method of choice used by the consumers in the first test, and hence selected by us in the

controlled second test. In other words, the meat cooking methods of the Nigerian population sampled differ sufficiently from the classical methods of grilling, broilling or roasting that have been reported in the literature, as to necessitate the establishment of standard cooking methods and objective test criteria in consonance with our cooking habits. More studies in line with the present one need to be carried out to achieve this objective.

Acknowledgement

This study was funded by the Food and Agriculture Organisation (FAO) Rome. We are grateful to Dr. E.B. Sonaiya for reviewing the manuscript.

TABLE 1 – FEED INGREDIENT AND NUTRIENT COMPOSITION OF EXPERIMENTAL DIETS

Feed Ingredient	*Diets (% as fed)*		
	Control	*Low cocoa-pod (LP)*	*High cocoa-pod (HP)*
Guinea-corn	62.3	43.2	24.4
Brewers' dried grains	19.5	19.4	19.3
Cocoa-pods	0.0	19.3	38.4
Groundnut cake	4.7	4.7	4.7
Molasses	11.7	11.6	11.5
Oyster shell	0.9	0.6	0.3
Dicalcium phosphate	0.4	0.7	0.9
Trace mineral salt	0.5	0.5	0.5
	100	100	100
Nutrient composition (% of dry matter)			
Crude protein (N x 6.25)	14.0	13.9	13.2
Ether extract	3.6	3.8	3.4
Acid detergent fibre	12.5	22.8	31.9
Metabolisable energy (MJ/Kg D.M.)[1]	11.7	11.3	10.5
Calcium[1]	0.6	0.6	0.5
Phosphorus[1]	0.4	0.4	0.4

[1] Calculated.

TABLE 2: QUESTIONNAIRE FOR TEST 1

Meat Quality Test

Identification _____ Date _____

You must have some problems with the beef you buy from this farm and elsewhere. We would like to solve these problems if you identified them for us. Towards this end, please prepare this meat the way you usually do, eat it then answer the following questions by putting an (X) on the appropriate line.

1. Please indicate how the meat was prepared:
   (a) Boiled .....
   (b) Boiled and fried.....
   (c) Boiled, fried and put into stew .....
   (d) Boiled and put in stew.....
   (e) Cooked directly in stew ingredients.....
   (f) Any other ..... please specify.....

2. Compared to the beef you bought recently from this farm or elsewhere, does this beef take.
   (a) More time to cook to your taste .....
   (b) Less time to cook to your taste.....
   (c) Same amount of time to cook to your taste .....

3. Compared to the beef you recently bought, what can you say about the flavour of this beef:
   (a) Tastes the same.....
   (b) Tastes different.....

4. If this beef has a different flavour, is the flavour:
   (a) More delicious.....
   (b) Less delicious .....
   (c) Really bad.....

5. Apart from the flavour, how does this beef feel when you chew it, as compared to beef you bought recently.
   (a) Tougher or harder.....
   (b) More tender or softer .....
   (c) Same thing, no difference.....

6. Is this beef you are eating now:
   (a) Too tough or hard.....
   (b) Too tender or soft.....
   (c) Just right.....

7. Assuming this beef and market beef were sold at the same price, which would you buy:
   (a) This beef.....
   (b) Market beef.....
   (c) Either .....

8. Any other comments.

TABLE 3: QUESTIONNAIRE FOR TEST 2.

Name:
Date:

Please taste the beef samples in the order presented to you and evaluate them for tenderness and flavour by answering the following questions. An honest expression of your personal feeling will help us.

Sample	Sample .....

1. How is this piece of meat?

Very good	Very good .....
Good	Good .....
O. K.	O. K. .....
Not too good.	Not too good. .....
Not good at all	Not good at all .....

2. Would you say it is:

Very tough ?.....	Very tough ?.....
A bit tough ?.....	A bit tough ?.....
A bit tender?.....	A bit tender?.....
Very tender?.....	Very tender?.....

3. Do you like your meat as tender as this?

Yes	No.....
	(a) More tender
	(b) More tough

4. Does this meat give a strange flavour (taste)?

Yes	No	Yes	No

5. (a) Do you like the flavour

Like it	Like it .....
Not like it	Not like it .....

(b) Can you describe the flavour?

6. (a) Which piece of meat do you prefer

1st piece	2nd piece.....

Neither .....

(b) Why?

7. Other comments:-

TABLE 4 – SUMMARY OF COMPARISON OF TEST VERSUS REFERENCE BEEF SAMPLES FOR TENDERNESS

Samples	*% Consumers indicating test sample*		
	More tender	*Less tender*	*Similar*
Control	100	0.0	0.0
Low cocoa-pod diet	81.5	0.0	18.0
High cocoa-pod diet	100	0.0	0.0

TABLE 5 – SUMMARY OF BEEF PREPARATION METHODS EMPLOYED BY CONSUMERS.

Method	*No. of Consumers*	*% Total*
Boiled or steamed	1	2.6
Boiled and fried	5	13.2
Boiled, fried and stewed	15	39.6
Boiled and stewed	13	34.2
Stewed	1	2.6
Others – roasted	1	2.6
Braised	1	2.6
Fried	1	2.6
Total	38	100.0

TABLE 6 – EFFECT OF FEEDING COCOA–POD TO CATTLE ON BEEF TENDERNESS AND OVERAL ACCEPTABILITY

Samples	*Tenderness*[a]	*Overall acceptability*[b]
Control Diet	1.94 + 0.11	3.77 + 0.10
Low Cocoa-Pod Diet	2.09 + 0.16	3.87 + 0.10
High Cocoa-Pod Diet	2.22 + 0.15	3.83 + 0.16

a_1 = Very tender, 2 = a bit tender, 3 = a bit tough, 4 = very tough.

b_1 = Not good at all, 2 = Not too good, 3 = O.K., 4 = good, 5 = very good

TABLE 7 — CONSUMER RESPONSE TO THREE-FOLD QUESTION ON THE EFFECT OF FEEDING COCOA–POD TO CATTLE ON BEEF FLAVOUR

Dietary Treament	*Strange Flavour Dected*	*Detected Flavour Unpleasant*	*Flavour Identifiable Unidentifiable*
Control	39.0[a]	8.0	0.0
Low Cocoa-Pod	33.0	3.0	0.0
High Cocoa-pod	28.0	17.0	8.0

[a]% of consumers responding in the affirmative.

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