Producción Animal Tropical 1983 8:279-287

THE EFFECT ON PERFORMANCE AND THE ECONOMIC FEASIBILITY OF SUBSTITUTING MAIZE HOMINY FOR MAIZE IN TROPICAL BROILER DIETS

A B Chestnut[1], E A O Laseinde and D B Olumeyan

College of Agriculture and Animal Science
Ahmadu Bello University
P M P 2132, Kaduna, Nigeria

The effect of substituting maize hominy for maize in broiler diets was investigated. Diets were mixed using grain and a commercial broiler concentrate in a 1:1 ratio. Diets A, B, C and D were formulated by substituting 0.0, 33.33, 66.67 and 100.0% respectively of the maize in the grain portion of the diet with maize hominy.
Weight gains were not affected by substitution of maize hominy for maize in any diet. Due to the lower energy content of maize hominy, feed efficiency of birds on diet D was poorer ($P < .05$) than those on diet A.
Maize hominy can be substituted for maize up to at least 50% of the total diet without depressing weight gains. Substitution of maize hominy for maize is economically feasible when the price of maize hominy is 75% or less of the price of maize grain.

Key Words: Poultry growth, maize hominy

Maize hominy (MH) is a by-product of dry milling maize to produce maize flour, a major constituent of many african diets. MH accounts for about 10% of the products from the mill process (Bana 1980). The components of MH are bran, part of the endosperm and sometimes the germ (Anon 1978). MH should contain at least 5.0% ether extract. The crude protein content is similar to whole maize; but crude fiber, ash and ether extract are all higher in MH than in whole maize. Metabolizable energy value of MH was determined to be 13.81 MJ/kg, while that of yellow maize was 16.84 MJ/kg on a dry matter basis (Hill et al 1960).

Previous work (Davidson et al 1945) showed little difference in weight gains and feed efficiency of broilers when yellow maize was replaced with MH at 30% of the mash portion of the diet (25% of the total diet). This fact is very significant to producers in areas lacking sufficient quantities of grains for poultry production. Little information exists on the limits of substituting MH for maize or the relative value of MH compared to maize in broiler diets, particularly in the tropics. Owners of small poultry farms, who constitute a large part of the poultry industry in Nigeria, find it convenient to mix ground maize with a commercially prepared "concentrate" that contains additional protein, vitamins, minerals and feed additives needed to properly balance the diet. The objective of these feeding trials was to determine how much MH could be satisfactorily substituted for maize in broiler diets formulated with a commercially prepared concentrate.

[1]*Present address: 126 Animal Sciences Lab., University of Illinois, Urbana, Illinois 61801, U.S.A.*

Materials and Methods

Diets and experimental design: Diets A, B, C and D (Table 1) were formulated using a commercial broiler concentrate mixed in a ratio of 1:1 with grain. The four diets were altered by substituting 0.0, 33.33, 66.67 and 100.0% of the maize in the grain portion of the diet with MH on an equal weight basis. In terms of the complete diet, MH was fed at levels of 0.0, 16.67, 33.33 and 50.0% of the diets A, B, C and D, respectively.

Table 1:

Composition of rations.

		Grain	
Diet	% Broilers Concentrate	% Maize	% Maize Hominy
A	50.0	50.0	-
B	50.0	33.3	16.7
C	50.0	16.7	33.3
D	50.0	-	50.0

Three replications per treatment were used. A complete randomized design was used in assigning each of the four diets to three pens for a total of 12 pens. A broiler starter concentrate was used in all diets to four weeks of age and then replaced by a broiler finisher concentrate to the end of the trial. The calculated analysis of diets formulated from these two broiler concentrates are given in Table 2. A proximate analysis of the MH used in the trial is shown in Table 3. Two trials were run at different times because only cockerels were available at the start of the first trial. A total of 360 day old Warren cockerels were randomly distributed to the 12 deep litter pens resulting in 30 birds per pen. The second trial used the same number of day old Ross broiler chicks of mixed sex which were distributed to the same pens in the same manner. Each pen contained 9 square meters floor space.

Measurements: Total weight of birds and feed consumption in each pen were recorded weekly and used to calculate average weight gain per bird and average feed consumption per bird in each pen on a weekly basis. Total weight gain per bird and total feed consumption per bird by diets is a summation of the weekly gains per bird and feed consumptions per bird in each pen (Tables 4 and 5).

Statistical analysis: Weight gains, feed consumptions and feed efficiencies were analyzed by analysis of variance, according to Snedecor and Cochran (1967). The test for significance of b in the regression equations was done by comparison of mean squares (Draper and Smith 1966).

Table 2:

Calculated composition of broiler starter and finisher diets. Values are expressed on a dry matter basis

	Diet Composition[1]							
	Broiler Starter				Broiler Finisher			
	A	B	C	D	A	B	C	D
Crude protein, %	23.00	22.96	22.93	22.90	19.50	19.47	19.43	19.40
ME MJ/kg	13.00	12.52	12.01	11.51	13.72	13.21	12.70	12.20
Fibre, %	3.85	4.42	4.98	5.55	3.10	3.67	4.23	4.90
Ether extract, %	4.20	4.25	4.70	4.95	4.20	4.45	4.70	4.95
Calcium, %	1.01	1.01	1.02	1.02	1.01	1.01	1.02	1.02
Phosphorus, %	0.66	0.70	0.74	0.78	0.66	0.70	0.74	0.78
Methionine, %	0.54	0.52	0.50	0.48	0.42	0.41	0.39	0.38
Lysine, %	1.28	1.21	1.34	1.37	1.03	1.06	1.09	1.12

In addition, each diet contained the following micronutrients: Vit A 10,000 IU/kg, Vit D 3,000 IU/kg, B group vitamins, trace elements, oxytetracycline 35 mg/kg and coccidiostat 60 mg/kg.

[1] Calculated composition based upon the analysis of maize, yellow (International Feed No. 4-020935), Hominy (IFN 4-02-887) and analysis of the broiler starter concentrated and the broiler finish concentrate from Livestock Feeds Ltd (Pfizer), Ikeja Nigeria

Table 3:

Analysis of maize hominy and maize (dry matter basis).

	Maize Hominy (IFN 4-02-887)	Maize (IFN 4-02-935)
Crude Protein %	9.8	9.9
Ether Extract %	5.9	4.3
Crude Fiber %	5.6	2.5
N F E %	77.1	82.2
Ash %	1.7	1.2

Results and Discussion

Performance: Weight gains of both broilers and cockerels from 0 - 12 weeks of age were not affected by inclusion of MH up to at least 50% of the diet (Table 4 and 5). There were no statistical differences in feed consumption among treatments for broilers, but there was a difference ($P < 0.05$) between treatments A and D of the cockerels. Within both the broiler and the cockerels the birds fed diet D had a poorer feed efficiency ($P < 0.05$) than those fed diet A. Davidson et al (1945) saw no significant change in feed efficiency when MH was fed at rates up to 25% of the total diet, but that is less than the level of MH in diet C of these trials. These trials

Table 4:

Efficiency of growth of broilers from 0-12 weeks.

Diet	Total feed/bird, g	Wt. gain/bird, g	Feed/gain	% Mortality
A	7813[a]	2378[a]	3.30[a]	11.9[a]
B	7734[a]	2200[a]	3.52[a, b]	10.6[a]
C	7566[a]	2186[a]	3.45[a, b]	13.5[a]
D	8254[a]	2244[a]	3.68[b]	14.1[a]
SE diff	276.7	96.3	0.083	3.54

[a,b]Means within the same column having the same superscript are not significantly different ($P < .05$).

Table 5:

Efficiency of growth of cockerels from 0-12 weeks.

Diet	Total feed/bird, g	Wt. gain/bird, g	Feed/gain	% Mortality
A	4998[a]	1334[a]	3.75[a]	3.3[a]
B	5466[b]	1336[a]	4.09[b]	0.0[a]
C	5226[a]	1304[a]	4.01[b]	5.6[a]
D	5557[b]	1360[a]	4.09[b]	2.2[a]
SE diff	114.7	29.0	0.080	2.29

[a,b]Means within the same column having the same superscript are not significantly different ($P < .05$).

show that a significant difference ($P < 0.05$) does not appear until MH is increased to 50% of the diet. There were no differences ($P > 0.10$) in mortality rates among diets in either trial.

Age differences: In order to see if age was a factor in the bird's ability to utilize MH the performances of the broilers and cockerels were partitioned into two stages: from 0 - 4 weeks of age, when a broiler starter concentrate was used (Tables 6 and 7) and 5 - 12 weeks of age, when a broiler finisher concentrate was used (Tables 8 and 9). Weight gains were not affected by the level of MH in the diet for either age group. The only significant differences noted were in the 0 - 4 week age group. Broilers exhibited a poorer feed efficiency ($P < 0.05$) on diet D compared with diet A. Cockerels on diets C and D consumed more feed ($P < 0.05$) than on diet A.

Predicting feed efficiency: An attempt was made to predict the feed efficiency of broilers and cockerels as a function of the percentage MH in the diet. A linear regression was used because it was assumed that the change in feed efficiency would be due to lowering the caloric density of the diet as MH replaced maize. The equation $Y = 0.0064407X + 3.33$ was the best fit to the 12 observations of feed efficiencies of broilers (Figure 1) and $Y = 0.0056206X + 3.84$ was the best fit to the 12 observations of

Figure 1:

Feed efficiency of broilers as a function of the level of hominy in the diet

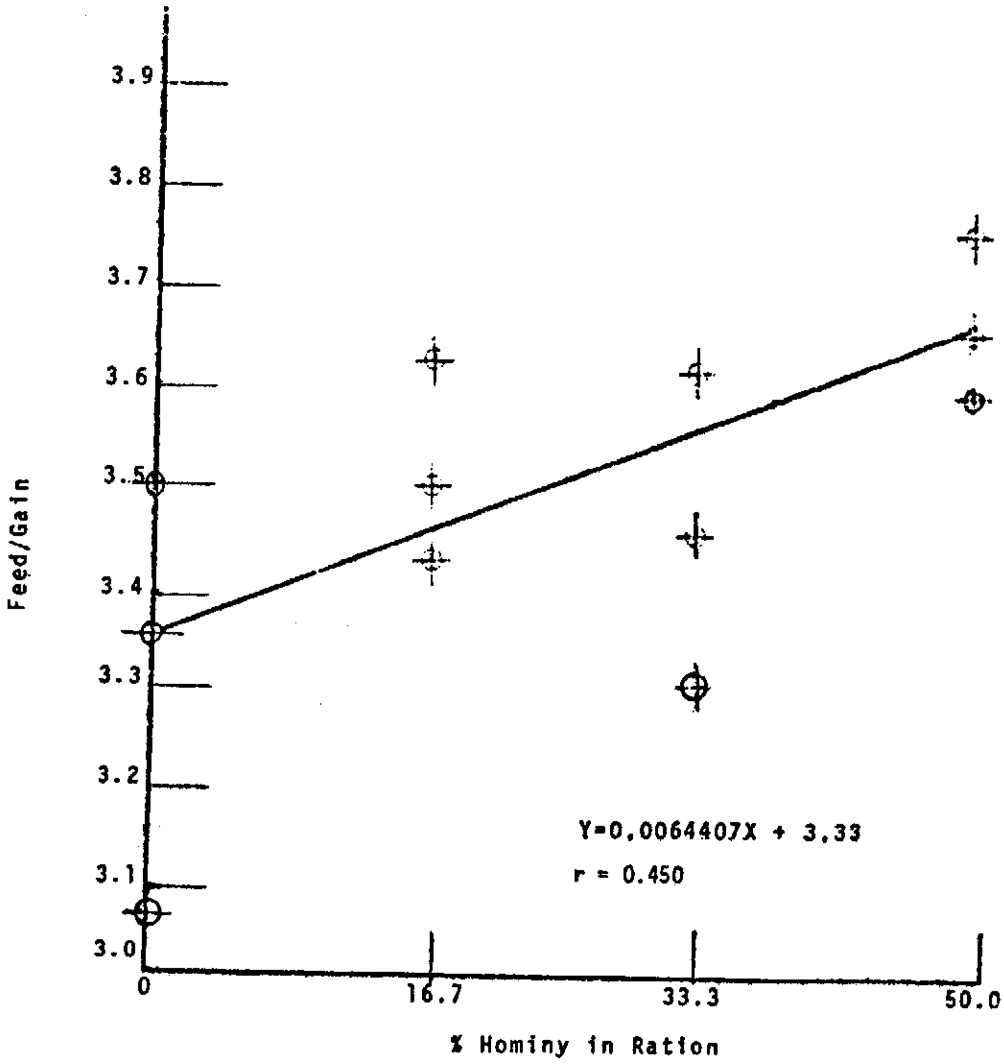


Table 6:

Efficiency of growth of broilers from 0-4 weeks.

Diet	Total feed/bird, g	Wt. gain/bird, g	Feed/Gain
A	1034[a]	470[a]	2.20[a]
B	1123[a]	459[a]	2.44[a,b]
C	1193[a]	476[a]	2.51[a,b]
D	1197[a]	446[a]	2.67[b]
SE diff	87.3	22.6	0.125

[a,b] Means within the same column with the same superscript are not significantly different (P < .05).

Table 7:

Efficiency of growth of cockerels from 0-4 weeks.

Diet	Total feed/bird, g	Wt. gain/bird, g	Feed/Gain
A	623[a]	339[a]	1.86[a]
B	781[b]	299[a]	2.61[a]
C	716[a,b]	316[a]	2.26[a]
D	784[b]	313[a]	2.50[a]
SE diff	39.0	23.6	0.268

[a,b] Means in the same column with the same superscript are not significantly different (P < .05)

Table 8:

Efficiency of growth of broilers from 5-12 weeks.

Diet	Total feed/bird, g.	Wt. gain/bird, g	Feed/Gain
A	6779[a]	1908[a]	3.58[a]
B	6612[a]	1741[a]	3.80[a]
C	6373[a]	1709[a]	3.73[a]
D	7057[a]	1798[a]	3.92[a]
SE diff	210.7	84.9	0.105

[a] Means in the same column with the same superscript are not significantly different (P <.05).

Table 9:

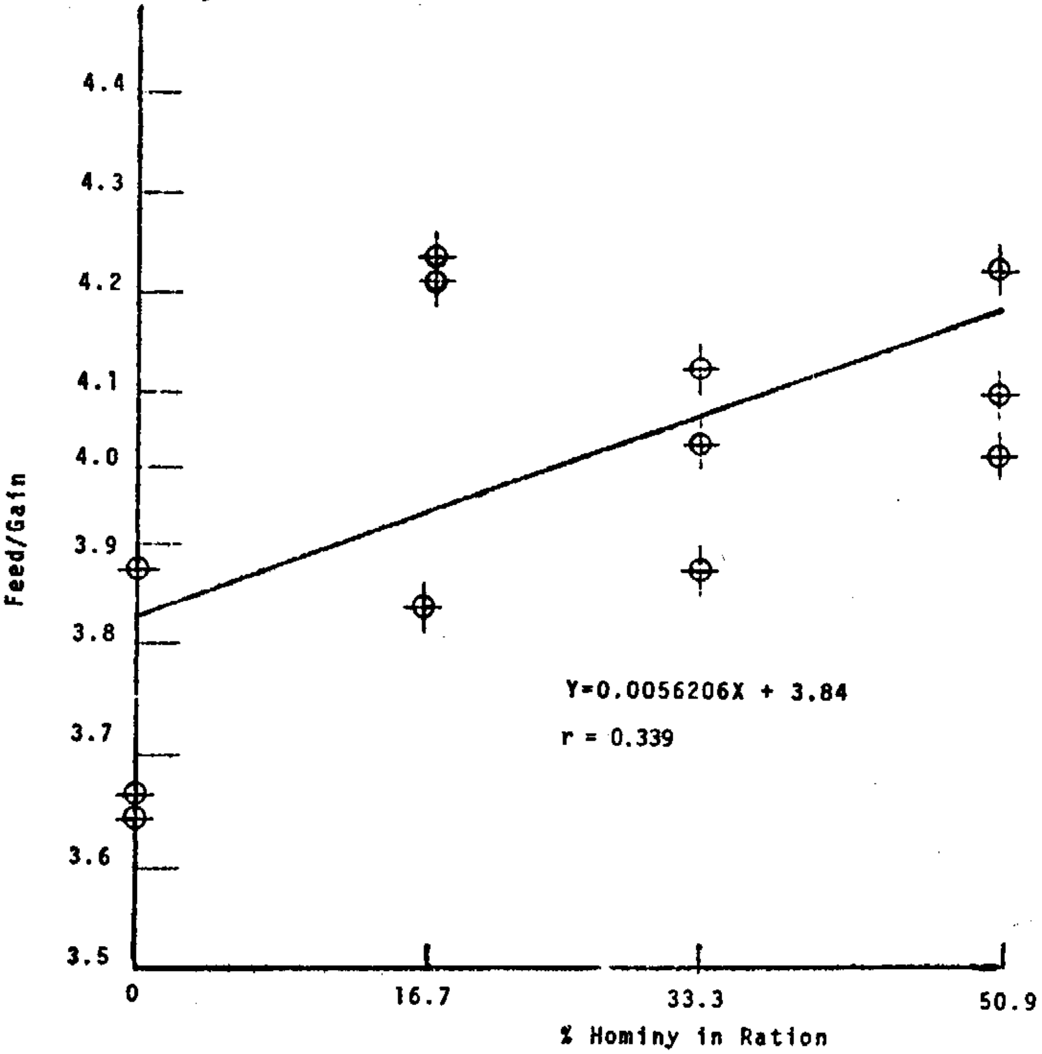
Efficiency of growth of cockerels from 5-12 weeks.

Diet	Total feed/bird, g.	Wt. gain/bird, g.	Feed/gain
A	4384[a]	998[a]	4.39[a]
B	4685[a]	1037[a]	4.52[a]
C	4515[a]	988[a]	4.57[a]
D	4773[a]	1047[a]	4.56[a]
SE diff	119.4	31.1	0.132

[a] Means in the same column with the same superscript are not significantly different (P < .05).

cockerels (Figure 2). In both equations Y is the feed efficiency expressed as units feed per unit weight gained and X is the percent MH in the diet. In both regression equations b, was significantly different from 0.0 (P<.05)

Figure 2:
Feed efficiency of cockerels as a function of the level of hominy in the diet



and the correlation coefficients were 0.670 and 0.575, respectively, for broilers and cockerels. These regression equations should not be used to extrapolate what the expected feed efficiency would be if more than 50% of the diet is MH because physical fill may limit intake somewhere beyond this point.

Economic feasibility: A comparison of the feed efficiency shows that replacing maize with MH will reduce the weight gained per kg of diet D to 91.2% of the gain per kg of diet A. In order to determine how much less should be paid for MH relative to maize, the following equation was derived:

(Cost/t maize +Cost/t Broiler Conc.x.912)-Cost/t Broiler Conc. = Maximum cost/t MH

Because the grain and broiler concentrate are mixed in a ratio of 1:1, the cost per ton of maiae plus the cost per ton of broiler concentrate will equal the cost of two tons of diet A. This is multiplied by .912 to get the relative value of two tons of diet D compared with two tons of diet A. The cost of one ton of broiler concentrate is then substracted from the cost of the two tons of diet D to find the value of the MH on a per ton basis.

The following example demonstrates how the equation is used. If maize costs ₦200.00 per ton and the broiler concentrate costs ₦350.00 per ton, the maximum value of MH would be ₦151.60 per ton.

(₦200.00 + ₦350.00 x .912) - ₦350.00 = ₦151.60/ton of MH

Other examples of the relative value of maize hominy compared to maize at given costs of maize and concentrate are given in Table 10. The cost of the concentrate, as well as that of the maize, determines the maximum price payable for MH. An increase in the cost of concentrate will mean a small decrease in what should be paid for MH, but an increase in the cost of maize means an increase also in what could be feasibly paid for MH.

The conclusion from these results is that MH can satisfactorily replace maize at levels of up to 50% of the broiler's diet and is economically feasible if it can be purchased for less than 75% of the cost of maize.

Table 10:

Maximum value of maize hominy as a function of the value of maize and broiler's concentrate fed to broilers.

Maize ₦/ton	Broiler's Conc. ₦/ton	Max. value of maize hominy, ₦/ton	Relative value of maize hominy to Maize
200.00	350.00	151.60	75.8%
200.00	400.00	147.20	73.6%
250.00	350.00	197.20	78.9%
250.00	400.00	192.80	77.1%

Acknowledgements

The authors thank the Division of Agricultural Colleges, Ahmadu Bello University and particularly the College of Agriculture and Animal Science for providing the necessary materials for the trials. Thank is also given to the students of the 1979/80 Higher Diploma Poultry Production Class for their daily care of the birds and help in data collection.

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Received 19 July 1983