AN EVALUATION OF CEREAL GRAINS COMPARING CHICK GROWTH AND FEED UTILIZATION

by

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REVIEW OF LITERATURE

Feeding cereal grains has become increasingly important in midwest agriculture because of growth and concentration of livestock numbers. Likewise, increased emphasis has been placed on growing sorghum grain in areas of scant rainfall as well as intense summer heat.

Commensurate with increased feeding grains to livestock, extensive work in animal nutrition has increasingly pointed toward substitution of sorghum grain for corn in areas where sorghum grain is well-adapted agronomically and is economically feasible.

Numerous nutritional studies have been conducted with the meat-strain chicken. Penquite (1931), in describing his work in Oklahoma, found that kafir and darso could be substituted for yellow corn if supplemented daily with green feed. Heywang and Morgan (1932) utilized either yellow milo or hegari effectively to replace yellow corn in the chick ration when it was not deficient in any way. Payne (1934) observed small differences in feeding value of kafir, milo and corn. He concluded that kafir or milo can replace white or yellow corn pound for pound in a chick growing ration. Ackerson et al. (1939) presented evidence of lower feeding value in kalo (intermediate type grain sorghums) as opposed to corn. Melass (1943) substituted milo with alfalfa leaf meal supplement for corn on an equal weight basis. In his study, Adams (1955) reported that a combination of corn and sorghum grain gave superior gains when compared to either corn or

sorghum diets alone. Thayer et al. (1957) reported that a combination of corn and sorghum grains were equal to yellow corn in growth-promoting value and efficiency of feed utilization, although seed color was not found to be a reliable criterion of feeding value. Adrian (1958) found African sorghum grains had 90% protein digestibility of corn. Smith and Stephenson (1960) found no differences in growth and feed conversion between milo and ground yellow corn. West (1961) stated that milo could replace corn if proper attention were given to energy-protein balance, amino acid balance, palatability of milo, and need for xanthophyll pigments. Ozment et al. (1963) noted that corn and milo, on an equivalent basis, had equal nutritive value as measured by body weight and feed consumption. Baelum and Petersen (1964) reported that corn, sorghum, and barley diets resulted in equal gains when 40% of the diet was a cereal grain. Kemmerer and Heywang (1965) observed that efficiency of feed utilization was not consistently different between corn and sorghum diets. Stephenson et al. (1968) noted no significant difference in weight gain or efficiency of feed utilization in 4-week-old chicks using sorghum and corn. Sanford et al. (1968) found a 17% protein sorghum grain diet supplemented with methionine and lysine resulted in nonsignificant differences in chick growth when compared with a 17% protein diet of corn.

Workers have noted varying results when observing the finished broiler. Harms et al. (1958) found that as the percentage of yellow corn increased, the finish score increased, as well as pigmentation of the skin. Harms et al. (1958a) noted that some consumers preferred a broiler lacking in yellow skin pigment. Sanford (1965) noted broiler

size at 8 weeks of age averaging 1622 grams or 3.56 lbs. on a sorghum ration. Sanford (1966) observed a feed conversion of 1.8 lbs. of feed per lb. of gain with 8-week-old broilers fed a diet consisting of 35 parts sorghum grain and 30 parts of corn.

Nutritionists have noted a dietary relationship between energy and protein. Sunde (1956) suggested that changing the protein level of a ration varied the optimal energy:protein ration indicating that a high protein ration required a high energy level just as a low protein diet required less energy for optimum growth. Donaldson et al. (1956) noted that when the ratio of productive energy (PE) to crude protein (C/P) in the ration was increased, less protein was required per unit of gain, indicating a sparing effect of energy on protein. Hill et al. (1960) measured metabolizable energy (ME) of corn with 10.5% protein as 1,830 cal./lb. of dry matter as compared to 1,640 cal./lb. of dry matter for 12.1% protein milo. Deyoe et al. (1968) indicated a lower energy value with low test weight sorghum grains. Fraps (1946) reported a lower productive energy (PE) value for sorghum grains than for corn.

Variable protein levels have been reported in sorghum grains. Miller et al. (1964) found protein from Kansas sorghum grains to vary from 6.6% to 12.8% protein in 1961 and from 5.9% to 12.1% in 1962 with differences due to location and hybrid variety. Heller and Sieglinger (1964) observed wide variation among 28 sorghum varieties with drought conditions tending to increase percent of protein. Deyoe and Shellenberger (1965) verified that amino acid profile varied with location and hybrid. Stephenson et al. (1971) found variable amino acid

content among 28 varieties. Waggle et al. (1966) reported increased nutritive value in low protein sorghum grain as compared to high protein sorghum grain when rats were fed isonitrogenous diets. Sauberlich et al. (1953) had similar results using high and low protein corn diets. Vavich et al. (1959) noted the 10.5% protein of sorghum grain was superior to 15.3% protein of sorghum grain fed on an equal protein basis.

Relationship of protein level and amino acid composition has been observed in sorghum grain. Waggle and Deyoe (1966) found the following:

> Protein content of sorghum grain affects amino acid content and distribution. The higher the protein content, the greater the quantities of amino acids. Some amino acids (glutamic, proline, alanine, isoleucine, leucine, and pheylalanine) are higher in concentration in the protein of higher protein content grain. The concentration in protein of lysine, histidine, arginine, threonine, and glycine tends to decrease as the protein content increases. The amino acids whose concentrations in the protein were relatively unaffected by protein level of grain were aspartic acid, serine, valine and methionine.

Shelton et al. (1951) reported lysine to be the first limiting amino acid of milo. Sanford et al. (1967) observed that methionine was most limiting with lysine next in a sorghum grain-soybean meal diet. Pond et al. (1958) found lysine and threonine to be deficient in grain sorghum for growth of rats. Waggle et al. (1967) noted a significant reduction in 4-week-old chick growth when methionine, lysine, and arginine were not supplemented in a 17% protein diet of sorghum grain and soybean meal. Waggle et al. (1967) found sorghum grain-soybean meal diets to be most limited in methionine and glycine. Shoup et al. (1969) observed that weight gain in rats was related to the lysine level of the diet. Bragg et al. (1967) measured retention values of amino acids of sorghum grain in the 4-week-old chick with cystine, arginine, phenylalanine, methionine, and others, in order. Stephenson et al.

(1971) have shown amino acid availability to vary markedly between sorghum grain hybrids.

Other work has shown wide variations in results when feeding sorghum grains. Ortman (1956) found feed consumption varied from 62.5 to 98.5 lbs. of total feed. McClymont and Duncan (1952) reported a toxic factor depressing growth 50% and increasing mortality rate. Chang and Fuller (1964) compared high and low tannin sorghum grains noting depressed growth with high tannin diets. Damron et al. (1969) fed bird-resistant varieties of sorghum grain and observed neither feed intake nor body weight gain depression. Fuller et al. (1966) showed that tannin content of 0.64 to 0.83% of the diet did not depress growth and had no effect upon feed consumption or feed conversion. Ringrose and Morgan (1940) observed that at 2% of the ration, tannic acid depressed growth, but without mortality. They concluded that growth depression was a result of reduced feed consumption. Petersen (1969) found a 4% level of tannic acid in the sorghum grain diet depressed growth. Baelum and Petersen (1964a) observed that including tannin in a corn and soybean meal diet depressed gain and feed conversion.

Analytical and biological assays of milling fractions of sorghum grain have been reported. Normand et al. (1965) found protein distribution to be heterogeneous, with outer portions of the kernel being highest in protein. Hubbard et al. (1950) reported the germ of sorghum had the highest percent of protein, followed by the endosperm and bran. Shoup et al. (1969) compared these fractions in feeding the rat, noting the gain in relation to the lysine content of the diet, even though all diets contained 9.3% protein.

FEEDING TRIAL I

Materials and Methods

Studies were undertaken to compare the nutritive availability or biological feeding value of early maturity white corn (E.M.W.C.) and late maturity yellow corn (L.M.Y.C.), early and late maturity sorghum grain (S.G.), Funk's Hybrid sorghum grain (F.H.S.G.), white sorghum grain (White S.G.) and Corn Products' waxy sorghum grain (C.P.S.G.) as dietary ingredients for growing broiler chicks. All diets were formulated on an equal dry matter basis. Diets were calculated to contain 20-22% protein.

Day-old Cobb's Strain-cross White Rock chicks were wing-banded and placed in wire-floor Petersime batteries in a completely randomized design of 7 diets of 5 lots per diet and 16 birds per lot, totaling 560 birds. Feed and water were provided ad libitum. The chicks were allowed artificial light from 6:00 a.m. to 8:00 p.m. each day. Room temperature was thermostatically controlled at 70 degrees Fahrenheit throughout the 4-week growing period.

Data were collected at 2-week intervals on feed consumption and weight gains. Each of the 7 diets was analyzed for crude protein (CP), using the Kjeldahl method, and for moisture. Metabolizable energy (ME) of each diet was determined using the Parr oxygen bomb calorimeter.

Grain, for individual diets (Table 1), was ground and ingredients mixed in a 100-pound horizontal mixer for 5 minutes as specified by the Kansas State University Department of Grain Science and Industry.

Table 1. Composition of diets for Feeding Trial I (per 100 lbs.).

Ingredient	E.M. W.C.	L.M. W.C.	Early S.G.	Late S.G.	F.H. S.G.	White S.G.	C.P. S.G.
% Protein in grain	9.3	9.2	11.9	9.4	9.4	7.8	11.0
Grain[1]	54.77	55.13	56.63	56.44	57.21	57.95	57.48
H_2O[2]	3.18	2.82	1.32	1.51	0.74	--	0.47
Soybean meal 44% protein	30.55	30.55	30.55	30.55	30.55	30.55	30.55
Dehydrated alfalfa 17%	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Fish meal, 60% protein	2.00	2.00	2.00	2.00	2.00	2.00	2.00
DDS, 25%	2.00	2.00	2.00	2.00	2.00	2.00	2.00
$CaCO_3$	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ca_2PO_4	2.00	2.00	2.00	2.00	2.00	2.00	2.00
NaCl	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Fat	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Premix[3]	1.00	1.00	1.00	1.00	1.00	1.00	1.00
% Protein (calculated)	20.57	20.55	22.22	20.78	20.86	20.00	21.80
Diet	1	2	3	4	5	6	7
Crude Protein[4]	19.7	19.2	22.3	22.3	20.0	23.00	21.9
ME kcal./kg.	4051	4194	4127	4078	4116	4135	4121
% Moisture	13.0	12.5	13.5	12.3	12.9	12.8	12.7

Table 1 (continued).

Footnotes for Table 1:

[1]Equal amounts of dry matter added in each diet.

[2]Diet calculated to equal water content.

[3]Premix ingredients (g./100 lb.): Vit. A (10,000 I.U./g.) 10; Vit. D_3 (15,000 I.C.U./g.) 5; B-complex (Merck 1233) 12; Methionine 45; Vit. B_{12} (Proferm-20) 10; Choline Chloride (25%) 80; Amprol (25%) 23; Aurofac-10 23; Santoquin 23; Corn 200; Trace Mineral 23; Total 454.

[4]Kjeldahl method of analysis.

Results and Discussion

Feed utilization and weight gain were calculated for the 3 growth periods and are listed in Table 2. At the end of the feeding trial, an analysis of variance (AOV) was computed. Results are summarized in Tables 3 and 5.

The chicks fed the early maturity white corn showed significantly slower growth (Table 6) and poorer feed utilization at the 0-2 week growth period (Table 4) than chicks of the other diets. White corn was significantly lower in feeding value than white sorghum grain, although the analyzed crude protein of the two treatments differed by 3.3% and the ME differed by 84 kcal./kg. (Table 1). National Research Council's (NRC) ME requirements were easily met by all diets. Chicks fed maturity yellow corn performed significantly better than

Table 2. Calculated means.

Diet	No.	0-2 wk.		2-4 wk.		0-4 wk.	
		Wt. Gain(g)	Fd. Util.	Wt. Gain(g)	Fd. Util.	Wt. Gain(g)	Fd. Util.
E.M.W.C.	1	168.89	1.77	375.82	1.91	541.47	1.87
L.M.Y.C.	2	183.77	1.66	396.31	1.87	577.87	1.80
Early S.G.	3	177.24	1.65	387.91	1.91	566.40	1.83
Late S.G.	4	186.69	1.65	384.21	1.88	564.69	1.80
F.H.S.G.	5	184.97	1.61	388.63	1.90	573.53	1.81
White S.G.	6	186.05	1.62	386.35	1.97	572.40	1.86
C.P.S.G.	7	187.17	1.58	396.94	1.83	585.49	1.75

Table 3. Analysis of variance of feed utilization, Feeding Trial I.

Source of variation	d.f.	Mean Squares		
		0-2 wk.	2-4 wk.	0-4 wk.
Diet	6	.019**	.010	.008
Lot/Diet	28	.003	.008	.004

**Significant at the 1% level of probability.

Table 4. Analysis of variance of feed utilization at the 0-2 week growth period, Feeding Trial 1.

Source of variation	d.f.	Mean Square	F-ratio
Diet	6	.0194	6.40**
Lot/Diet	28	.0030	--

Ranked diets based upon Fischer's LSD method for feed utilization[1]

Ranked diets:	7	5	6	4	3	2	1
Ranked Means:	1.58	1.61	1.62	1.65	1.65	1.67	1.77

**Significant at the 1% level of probability.

[1]LSD was .07 at the 5% level of probability. Any two diets not underscored by the same line are significantly different at the 5% level of probability.

Table 5. Analysis of variance for weight gain, Feeding Trial 1.

Source of variation	d.f.	Mean Squares		
		0-2 wk.	2-4 wk.	0-4 wk.
Diet	6	3622.50	4195.61	15540.66**
Lot/Diet	28	2177.02**	3163.63**	4085.88
Bird/Lot/Diet	525	1083.30	1517.40	2786.95

**Significant at the 1% level of probability.

Table 6. Analysis of variance for weight gain at the 0-4 week growth period, Feeding Trial I.

Source of variation	d.f.	Mean Square	F-ratio
Diet	6	15540.66	3.803**
Lot/Diet	28	4085.87	1.466
Bird/Lot/Diet	525	2786.95	--

Ranked diets based upon Fischer's LSD method for weight gain[1]

Ranked diets:	7	2	5	6	3	4	1
Ranked Means:	585.49	577.89	573.54	572.40	566.40	564.69	541.47

**Significant at the 1% level of probability.

[1]LSD was 20.73 at the 5% level of probability. Any two diets not underscored by the same line are significantly different at the 5% level of probability.

chicks fed early maturity white corn (Tables 4 and 6) even though crude protein differed by .3% and ME was higher by 143 kcal./kg., again well above NRC suggestions. Chicks fed early maturity sorghum grain were significantly different in weight gain than chicks fed early maturity white corn, at the 0-4 week growth period (Table 6) with a 2.5% greater crude protein and ME of 56 kcal./kg.

The performance of chicks fed Corn Products' waxy sorghum grain was superior in feed utilization and weight gain in all 3 growth periods (Table 2). Chicks that received diet 7 were significantly greater in feed utilization at the 0-2 week growth period than the early or late

maturity grains (Table 4). Weight gain at the 0-4 week growth period showed significantly greater growth for waxy sorghum grain (Table 6) than for chicks fed early maturity white corn or late maturity sorghum grain, both with lower ME (Table 1).

Late maturity yellow corn, in spite of containing the least percent of crude protein in the grain and in the diet, was inferior only to waxy sorghum grain in weight gain and feed utilization at the 0-4 week growth period (Table 2). Late maturity yellow corn performed significantly better than early maturity corn in feed utilization at the 0-2 week growth period (Table 4) and weight gain at the 0-4 week growth period (Table 6).

Mortality for the 4-week period was .3% for Feeding Trial I. There were 3 birds showing perosis-like symptoms. The statistical analyses took into consideration all viable birds.

FEEDING TRIAL II

Materials and Methods

Studies were undertaken to compare the nutritive availability of sorghum grain as a dietary ingredient for the broiler chick. Diets included peeled and unpeeled sorghum grain, DeKalb's waxy sorghum grain, white sorghum grain and light test weight sorghum grain.

Day-old Cobb's Strain-cross White Rock chicks were wing-banded, weighed and placed in wire-floor Petersime batteries in a randomized design. Each diet was replicated with 3 lots, with the first 4 diets having 16 birds per lot and the last diet having only 8 birds per lot

due to a shortage of grain. The total number of observations was 216. Feed and water were provided ad libitum.

Data on feed consumption and weight gain were collected at 2-week intervals for a total of 4 weeks. Diets were formulated as given in Table 7, using materials available in the Kansas State University Department of Grain Science and Industry.

Diets were analyzed for crude protein according to the Kjeldahl procedure. Metabolizable energy (ME) of each diet was determined using the Parr oxygen bomb calorimeter.

Results and Discussion

Weight gains and feed utilization are summarized in Table 8. An unequal subclass AOV was computed for weight gain and a one-way AOV for feed utilization. Results are summarized in Tables 9 and 11.

Performance of chicks fed peeled sorghum grain was superior to all other diets in weight gain and feed utilization at the 0-4 week growth period (Table 8). In all 3 growth periods, feed utilization of diet 1 was significantly different from light test weight sorghum grain (Tables 12, 13 and 14), even though crude protein differed by .9% with diet 1 having the lowest ME (Table 7). Notably, feed utilization in the 0-2 week growth period was significant at the .01% level of probability. Weight gain at the 0-4 week growth period was significantly superior for peeled sorghum grain over all other diets (Table 10), even though crude protein of the diet was neither the greatest nor the least (Table 7). All diets were well above NRC crude protein and ME recommendations.

Table 7. Composition of diets for Feeding Trial II.

Ingredient	Peeled S.G.	Unpeeled S.G.	White S.G.	DeKalb's S.G.	Light S.G.
% Protein in grain	11.1	10.98	7.8	10.8	9.19
Grain[1]	60.04	58.71	61.62	60.39	60.04
H_2O[2]	1.58	2.91	--	1.23	1.58
Soybean meal 50% protein	26.88	26.88	26.88	26.88	26.88
Dehydrated alfalfa 17%	2.00	2.00	2.00	2.00	2.00
Fish meal 60% protein	2.00	2.00	2.00	2.00	2.00
DDS, 25%	2.00	2.00	2.00	2.00	2.00
$CaCO_3$	1.00	1.00	1.00	1.00	1.00
Ca_2PO_4	2.00	2.00	2.00	2.00	2.00
NaCl	.50	.50	.50	.50	.50
Fat	1.00	1.00	1.00	1.00	1.00
Premix[3]	1.00	1.00	1.00	1.00	1.00
% Protein	21.00	21.93	20.28	22.00	21.00
Diet	1	2	3	4	5
Crude Protein[4]	23.10	22.40	24.20	24.20	22.20
% Moisture	11.2	11.4	11.7	11.7	10.2
ME kcal./kg.	3938	4032	4011	4204	4050

[1]Equal amounts of dry matter added in each diet.

[2]Diet calculated to equal water content.

[3]Premix ingredients (refer to Table 1, footnote 3).

[4]Kjeldahl method of analysis.

Table 8. Calculated means of Feeding Trial II.

Diet	No.	0-2 wks.		2-4 wks.		0-4 wks.	
		Wt. Gain(g)	Fd. Util.	Wt. Gain(g)	Fd. Util.	Wt. Gain(g)	Fd. Util.
Peeled S.G.	1	203.52	1.47	423.08	1.77	626.08	1.68
Unpeeled S.G.	2	192.75	1.64	394.29	1.95	587.25	1.85
White S.G.	3	182.25	1.61	396.83	1.87	577.70	1.78
DeKalb's S.G.	4	170.75	1.60	364.15	1.89	534.81	1.80
Light S.G.	5	189.95	1.91	392.08	2.24	581.58	2.13

Table 9. Unequal subclass analysis of variance for weight gain, Feeding Trial II.

Source of variation	d.f.	Mean Squares		
		0-2 wk.	2-4 wk.	0-4 wk.
Diet	4	7138.20	20959.51	50577.96**
Lot/Diet	10	3905.10*	6560.47	3987.56

**Significant at the 1% level of probability.

*Significant at the 5% level of probability.

Table 10. Unequal subclass analysis of variance for weight gain at the 0-4 week growth period, Feeding Trial II.

Source of variation	d.f.	Mean Square	F-ratio
Diet	4	50577.96	11.616**
Lot/Diet	10	3987.56	.916
Bird/Lot/Diet	201	4354.00	--

Ranked diets based upon Fischer's LSD method for weight gain[1]

Ranked diet:	1	2	5	3	4
Ranked means:	626.08	587.25	581.58	577.71	534.81

**Significant at the 1% level of probability.

[1]LSD was 36.26 at the 5% level of probability. Any two diets not underscored by the same line are significantly different at the 5% level.

Table 11. One-way analysis of variance of feed utilization, Feeding Trial II.

Source of variation	d.f.	Mean Squares		
		0-2 wks.	2-4 wks.	0-4 wks.
Diet	4	.077**	.092*	.084**
Lot/Diet	10	.004	.023	.008

**Significant at the 1% level of probability.

*Significant at the 5% level of probability.

Table 12. One-way analysis of variance of feed utilization at 0-2 week growth period, Feeding Trial II.

Source of variation	d.f.	Mean Square	F-ratio
Diet	4	.0769	19.6**
Lots/Diet	10	.0039	--

Ranked diets based upon Fischer's LSD method for feed utilization[1]

Ranked diets:	1	4	3	2	5
Ranked means:	1.470	1.600	1.607	1.643	1.907

**Significant at 1.0% level of probability.

[1]LSD was 0.114 at 5% level of probability. Any two diets not underscored by the same line are significantly different at the 5% level of probability.

Table 13. One-way analysis of variance of feed utilization at 2-4 week growth period, Feeding Trial II.

Source of variation	d.f.	Mean Square	F-ratio
Diet	4	.0917	4.034*
Lots/Diet	10	.0227	--

Ranked diets based upon Fischer's LSD method for feed utilization[1]

Ranked diets:	1	3	4	2	5
Ranked means:	1.777	1.867	1.893	1.953	2.237

*Significant at the 5% level.

[1]LSD was 0.274 at 5% level of probability. Any two rations not underscored by the same line are significantly different at 5% level.

Table 14. One-way analysis of variance of feed utilization at the 0-4 week growth period, Feeding Trial II.

Source of variation	d.f.	Mean Square	F-ratio
Diet	4	0.0843	10.614**
Lots/Diet	10	0.0079	--

Ranked diets based upon Fischer's LSD method for feed utilization[1]

Ranked diets:	1	3	4	2	5
Ranked means:	1.680	1.783	1.800	1.847	2.127

**Significant at the 1% level.

[1]LSD was 0.162 at the 5% level of probability. Any 2 rations not underscored by the same line are significantly different at 5% level.

The unpeeled sorghum grain diet was superior in weight gain at the 0-4 weeks to all other diets except peeled sorghum grain (Table 10). This was seemingly contradictory to the findings of Shoup et al. (1969). Unpeeled sorghum grain, white sorghum grain, and DeKalb's waxy sorghum grain did not differ significantly from each other throughout the growth periods as to feed utilization (Tables 12, 13 and 14).

Light test weight sorghum grain was surpassed significantly by all diets in feed utilization for all growth periods (Tables 12, 13 and 14). These results concur somewhat with the findings of Deyoe et al. (1968). Light test weight sorghum grain and unpeeled sorghum grain differed by .2% in crude protein (Table 7) and were comparable in weight gains

throughout the 3 growing periods (Table 8), although feed utilization was significantly different for all growing periods (Tables 12, 13 and 14).

Although 7 birds of the total 216 showed perosis-like symptoms, only 1 showed a retarded weight gain. No mortality was recorded from 0-4 weeks. The statistical analyses took into consideration all viable birds.

CONCLUSION

The superior performance of waxy sorghum grain in Feeding Trial I did not repeat itself in Feeding Trial II, although crude protein was increased in the second trial.

Light test weight sorghum grain was consistently inferior in weight gain and feed utilization, seeming to confirm earlier findings by Shoup et al. (1970). Sorghum grain and corn, containing similar percentages of protein in the grain and in the diet, performed similarly, both in weight gain and feed utilization. White sorghum grain, although fed in both trials, did not show superiority in either. In Feeding Trial I, white sorghum grain was most often near the median, whereas in Feeding Trial II, white sorghum grain was most often nearer the inferior level.

In summary,

(1) Sorghum grain with methionine supplementation, can replace corn in rations for broiler chicks to 4 weeks of age.

(2) Light test weight sorghum grain is inferior to normal test weight sorghum grain in nutrient availability for broiler chicks.

(3) Peeled sorghum grain has greater nutrient availability than unpeeled sorghum grain apparently due to amino acid contact as reflected in the analysis for crude protein.

(4) Sorghum grains differ widely in nutrient availability.

(5) Late maturity yellow corn is superior to early maturity white corn in biological feeding value for the chick.

(6) Consistent results have not been found in weight gain and feed utilization in Feed Trials I and II.

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AN EVALUATION OF CEREAL GRAINS COMPARING CHICK GROWTH AND FEED UTILIZATION

by

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Two feeding trials of 4 weeks each were conducted using Cobb's Strain-cross White Rock chicks. The 7 diets of Feeding Trial I consisted of early maturity white corn, late maturity yellow corn, early and late maturity sorghum grain, Funk's Hybrid sorghum grain, white sorghum grain and Corn Products' waxy sorghum grain, each calculated to contain 20-22% crude protein. Diets were analyzed for crude protein, moisture and metabolizable energy (ME). Three growth periods were examined: 0-2 weeks, 2-4 weeks and 0-4 weeks. Corn Products' waxy sorghum grain was found to be superior in promoting weight gain and feed utilization in the chick. Analysis of variance showed significant difference in feed utilization at the 0-2 week growth period and weight gain at the 0-4 week growth period. Chicks fed late maturity yellow corn performed significantly better than early maturity white corn in feed utilization at the 0-2 week growth period and weight gain at the 0-4 week growth period. As all diets contained energy and protein well above the National Research Council's recommendations, it was felt that variations in ME for the 7 diets were not noticeable as reflected by weight gain and feed utilization.

The 5 diets for Feeding Trial II consisted of peeled and unpeeled sorghum grain, DeKalb's waxy sorghum grain, white sorghum grain and light test weight sorghum grain. Again, three growth periods were examined for weight gain and feed utilization. An unequal subclass analysis of variance showed that peeled sorghum grain was significantly superior in feed utilization values in all 3 growth periods, and in weight gain in the 0-4 week growth period. Feeding light test weight

sorghum grain was found to be significantly inferior to all other diets in feed utilization for all 3 growth periods.

In summary, it appears that sorghum grains differ widely in nutrient availability for the chick. Feeding quality is most accurately reflected in the quality of protein of the grain. Corn can be replaced by sorghum grain with methionine supplementation for the chick. Late maturity yellow corn is superior in feeding value to early maturity white corn.