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COLLEGE OF AGRICULTURE UNIVERSITY OF NEBRASKA
AGRICULTURAL EXPERIMENT STATION
RESEARCH BULLETIN 109

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LINCOLN, NEBRASKA
MARCH, 1939

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SUMMARY

1. The effect of replacing 31 per cent of ground corn in a ration by 31 per cent of ground kalo was studied in a growth and body-analysis experiment with two lots of newly hatched chicks.

2. The amounts of feed consumed by all chicks of both lots were kept identical by hand-feeding equal amounts of the pelleted rations daily.

3. There were no significant differences in the growth rate or composition of the chicks at the end of a six weeks' feeding trial.

The Utilization of Food Elements by Growing Chicks

VII. A Comparison of Corn and Kalo in a Ration for Growing Chicks

C. W. ACKERSON, M. J. BLISH AND F. E. MUSSEHL

Reasons for the renewed interest in the sorghums are given by Kiesselbach, Cushing, and Frolik (1), who discuss the agronomic phases of the crop in Nebraska. The value of sorghum as a forage crop has been demonstrated but it is commonly believed that the grain sorghums have a lower feeding value than corn. This belief is based in part on comparisons of yellow corn and sorghums made before the differences in vitamin content of the two feeds were recognized.

Since the nutritive value of feeds varies with the type of animal fed and its vitamin requirements, it is important that conclusions are based on the particular type concerned. The replacement value of the sorghums in livestock feeding has been reinvestigated in recent years but only a limited amount of this work has been concerned with poultry feeding. Thompson (2) concluded that milo is satisfactory in a laying mash, and Hinds (3) believes that milo can be used in poultry rations if vitamin supplements are provided. Heywang and Morgan (4) and Payne (5) concluded from growth experiments that grain sorghums can replace corn in the diet of growing chicks when adequately supplemented with other nutrients. The digestibility of grain sorghums for poultry is given by Kaupp and Ivey (6) and Fraps (7), but studies on the utilization of nitrogen, calcium, and phosphorus from rations where sorghum replaced corn have not been made with growing chicks.

PREPARATION OF THE RATIONS

The purpose of this experiment was to compare the utilization of the nitrogen, calcium, and phosphorus of Nebraska ration No. 8 with a ration in which the corn of No. 8 was replaced with kalo. Since the kalo used contained more protein than the corn the former was adjusted to the protein level of the latter by the addition of starch. As No. 8 formula contains 31 parts of corn, the modified ration was mixed with 31 parts of a mixture of kalo and starch and designated as ration No. 8-kalo. The two rations were mixed as follows:

A quantity of the rations without either the corn or kalo was mixed in sufficient quantity for the two lots. One-half of this quantity

Ingredients	Ration	Ration
	No. 8	No. 8-kalo
	<i>Lbs.</i>	<i>Lbs.</i>
Ground yellow corn.....	31	0
Ground kalo.....	0	25.6
Corn starch.....	0	5.4
Shorts.....	20	20
Bran.....	10	10
Pulveried oats.....	10	10
Alfalfa meal.....	10	10
Meat meal.....	5	5
Fish meal.....	5	5
Dried buttermilk.....	5	5
Calcium carbonate.....	2	2
Sodium chloride.....	1	1

was mixed with either the corn or kalo plus cornstarch to form the complete rations. After mixing, the rations were pelleted by means of a 5/32-inch die. The experimental variable lies in the substitution of corn for kalo. The corn or kalo contributed 16 per cent of the total protein of the rations. The compositions of the rations are given in Table 1.

TABLE 1.—*Analyses of the rations.*

Ration	Water	Ash	Nitrogen	Calcium	Phosphorus
	<i>P.ct.</i>	<i>P.ct.</i>	<i>P.ct.</i>	<i>P.ct.</i>	<i>P.ct.</i>
No. 8	9.1	8.0	3.37	1.66	0.93
No. 8-kalo.....	9.1	8.5	3.47	1.77	0.97

Ration	Crude fat	Crude fiber	Protein	N-free extract	Ratio Ca:P
	<i>P.ct.</i>	<i>P.ct.</i>	<i>P.ct.</i>	<i>P.ct.</i>	
No. 8	4.6	7.4	21.1	49.8	1.77
No. 8-kalo	4.9	7.4	21.7	48.4	1.83

EXPERIMENTAL FEEDING

The chicks used in the feeding trial were White Rocks chosen in a weight range of 35 to 39 grams with an average initial weight of 37 in each lot. The practice of feeding all chicks in both lots the same quantity of food daily was continued. The manner of feeding the pelleted rations was described in earlier work (8) and need not be repeated here. Twenty-one chicks were started in each lot. Three chicks of each lot fell slightly behind the feeding schedule during the final week and were discarded, so 18 chicks completed the trial in each lot. The chicks were housed in two electrically heated brooders in a room maintained at a temperature above 70° F. Cod-liver oil was fed individually by burette at a level of 0.5 per cent of the ration.

The experiment progressed without incident until the fourth week at which time there were three cases of wing picking among the chicks of the 8-kalo lot. These chicks were segregated until the wounds healed and both lots were closely watched for further outbreaks. Cannibalism was limited to the 8-kalo lot, with several more cases occurring before the close of the experiment. No cases were permitted to become severe as victims were immediately segregated. No cases occurred in the No. 8 lot. This is of interest in view of the observations of Miller and Barse (9) on the cannibalism-preventing properties of oats and oat hulls. The rations of both lots contained 10 per cent of pulverized oats and thus should have contained the cannibalism-preventing factor in equal amounts, yet cases were frequent in the 8-kalo lot and absent in No. 8 lot. The difference thus lies in the substitution of 25.6 lbs. of kalo and 5.4 lbs. of starch for 31 lbs. of yellow corn, the amount of protein from each source being kept the same in both instances. In previous work at the Station (10) the

dilution of a 22 per cent ration with starch resulted in cannibalism and coprophagic tendencies.

Records of interval weights of individual chicks were kept, and by comparison with the food-intake records rates of gain of all chicks were calculated. The averages are presented by sex and lot both for the interval gain and the period gain in Table 2. At the outset the chicks of lot No. 8-kalo made greater gains on the same dry-matter intake than those of lot No. 8, but lost this advantage so that over the period of six weeks the average gains on yellow corn exceeded those on kalo.

TABLE 2.—*Rates of gain of chicks.*

RATES OF GAIN ON SUCCESSIVE INCREMENTS OF DRY MATTER						
Age of chicks (<i>days</i>).....	17	24	29	33	37	41
Dry matter increment (<i>g.</i>).....	141	136	137	127	136	143
Lot Ration No. 8						
12 males, rate of gain (<i>p.ct.</i>).....	52	56	50	50	27	55
6 females, rate of gain (<i>p.ct.</i>).....	55	56	48	43	32	51
Lot Ration No. 8-Kalo						
12 males, rate of gain (<i>p.ct.</i>).....	59	52	48	46	24	52
6 females, rate of gain (<i>p.ct.</i>).....	60	55	45	44	26	46
RATES OF GAIN OF CHICKS, CALCULATED AT ATTAINED WEIGHT ON GAIN OVER INITIAL WEIGHT						
Total dry matter fed (<i>g.</i>).....	141	277	414	541	677	820
Lot Ration No. 8						
12 males, rate of gain (<i>p.ct.</i>).....	52	54	53	52	47	49 ¹
6 females, rate of gain (<i>p.ct.</i>).....	55	56	53	51	47	48 ¹
Lot Ration No. 8-Kalo						
12 males, rate of gain (<i>p.ct.</i>).....	59	56	53	51	46	47 ¹
6 females, rate of gain (<i>p.ct.</i>).....	60	57	53	51	46	46 ¹

¹ These values differ from the ones in Table 5, since the latter are based on the net-weight and these on the live-weight figures.

The feeding was started October 11 and continued to November 21, at which time the chicks were killed by ether anesthesia after feed had been withheld for 16 hours. Individual live weights were taken, and after the contents of the digestive tract had been removed their net weights were noted. The amount of "fill" under these conditions was slightly under 4 per cent of the average live weight. The mean net weights of the chicks are given in Table 3. Differences between means are small and the analysis of the net body weights fails to reveal any statistically significant difference as is evident in Table 4.

TABLE 3.—*Mean net weights¹ at slaughter and their standard errors.*

Lot	Males	Females	Males and females (unweighted mean)
	g.	g.	g.
Lot Ration No. 8	419.50±4.80	412.50±6.79	416.00±3.92
Lot Ration No. 8-kalo	410.33±4.80	399.50±6.79	404.91±3.92
Unweighted mean	414.91±3.92	406.00±3.92	410.45±2.77

¹ The net weight is the weight of the chick after removal of the contents of the digestive tract.

TABLE 4.—*Primary analysis of the net body weights.*

Source of variation	Degrees of freedom	Sum of squares	Variance	Standard deviation
Subclass	3	1,647.22	539.07	
Error	32	8,854.67	276.71	16.63
Total	35	10,501.89		

F=1.95.

DISCUSSION

The data derived from this experiment are presented in Tables 2, 3, 4, and 5. Table 2 shows that the kalo-fed lot made greater initial gains but that the corn-fed lot made greater gains during the rest of the period. Tables 3 and 4 show that these differences were not significant. An inspection of Table 5 shows that differences were slight and that the composition of the chicks of each lot was not affected by the ration fed. Likewise the retentions of nitrogen, calcium, and phosphorus failed to show material differences which could be attributed to the rations.

The one difference observed was in the incidence of wing- and toe-picking by the chicks of the lot fed No. 8-kalo. Serious interference with the progress of the feeding trial was avoided by separating the victims, and the pens were closely watched to detect further outbreaks.

TABLE 5.—*Summary of growth and analytical data on chicks.*

Item	Ration No. 8		Ration No. 8-kalo	
	Males	Females	Males	Females
Number of chicks.....	12	5	12	6
Net weight (g.).....	420	415	410	400
Gain in weight (g.).....	382	377	373	363
Dry matter fed (g.).....	820	820	820	820
Rate of gain (p.ct.).....	46.6	46.0	45.5	44.3
Gain per gram nitrogen fed (g.)..	12.5	12.4	11.9	11.6
Nitrogen in chick (p.ct.).....	3.34	3.32	3.34	3.30
Calcium in chick (p.ct.).....	0.94	0.92	1.01	0.92
Phosphorus in chick (p.ct.).....	0.64	0.64	0.69	0.63
Ratio, Ca:P in chick.....	1.46	1.44	1.48	1.46
Nitrogen in gain (p.ct.).....	3.43	3.41	3.42	3.38
Calcium in gain (p.ct.).....	0.99	0.97	1.07	0.98
Phosphorus in gain (p.ct.).....	0.68	0.67	0.72	0.67
Ratio, Ca:P in gain.....	1.47	1.45	1.48	1.46
Ether extract (p.ct.).....	4.5	5.2	3.7	4.7
Nitrogen intake (g.).....	30.48	30.48	31.38	31.38
Nitrogen in gain (g.).....	13.09	12.85	12.75	12.26
Nitrogen retained (p.ct.).....	42.9	42.2	40.6	39.1
Calcium intake (g.).....	15.01	15.01	15.99	15.99
Calcium in gain (g.).....	3.80	3.67	3.99	3.55
Calcium retained (p.ct.).....	25.3	24.5	25.0	22.2
Phosphorus intake (g.).....	8.05	8.05	8.74	8.74
Phosphorus in gain (g.).....	2.59	2.54	2.70	2.43
Phosphorus retained (p.ct.).....	30.8	30.2	30.9	27.8

CONCLUSIONS

1. The substitution of kalo for corn in an otherwise complete ration for growing chicks had no significant effect on the growth rate of chicks up to six weeks of age.
2. The retention of nitrogen, calcium, and phosphorus was not significantly altered by the use of kalo in the ration.
3. Instances of cannibalism were confined to the kalo-fed lot.

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