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A COMPARISON OF HAWAIIAN MEAT AND BONE MEAL, SOYBEAN OIL MEAL, AND HERRING MEAL IN CHICK STARTER RATIONS

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INTRODUCTION

Proteins are supplied in mixed poultry diets in the form of concentrates such as soybean oil, herring, meat and bone meals, and other sources. The first two protein supplements are imported but the latter meal is produced locally. Since these feed ingredients are used in poultry diets in varying degrees, it was the object of this study to determine if these protein concentrates could be used singly or in combination in chick starter rations with proper supplementation to meet local needs relative to the efficiency of utilization of these feeds and, subsequently, the cost of feed to produce a unit of gain.

At the present, there are no available data regarding the optimum amount of local meat and bone meal that could be used in chick starter rations. Due to the fact that the above meal is a by-product of the local meat industry, there is reason to study the economic possibilities of this feed. The meat and bone meal produced locally is a by-product obtained from the bones, viscera, fat, and offal which are steam cooked, rendered, compressed, dried, and then ground. It contains approximately 46 to 50 percent protein. Its supplementary effect with other feeds could very well be surveyed to learn more of its economic importance for growing chicks to 6 weeks of age.

REVIEW OF LITERATURE

The use of meat scraps in chick rations has been studied by Hammond and Titus *(5)*. They found that a chick diet containing fish meal was superior to one containing meat scrap. Ewing *(4)* reported that meat scraps are used principally in the preparation of mixed poultry feeds, of which it constitutes from 6 to 10 percent, by weight. Wilder, *et al. (10)* noted that 8 percent meat and bone scrap in a chick growing ration provides the necessary vitamin B_{12}. They also found evidence that it contained unidentified growth factors not found in some protein supplements.

Hayward, *et al. (7)* reported that soybean oil meal was unsatisfactory as the sole protein supplement in poultry rations. Hayward and Hafner *(6)* found that the addition of either cystine and/or methionine to autoclaved soybeans stimulated growth rate of chicks. Berry, *et al. (2)* observed with chicks that neither solvent nor expeller processed soybean oil meal supplied an adequate amount of available choline for satisfactory growth. Sherwood and Couch *(9)* demonstrated that soybean oil meal may be used as the sole source of protein for growing chicks when properly supplemented. Later Palafox and Rosenberg *(8)* found that both terramycin and a combination of aureomycin and vitamin B_{12} significantly improved a soybean oil meal diet containing 6 percent herring meal when cockerels were used as experimental animals.

Berg, *et al. (1)* reported that the addition of A.P.F. supplement to an all-soybean oil meal supplementary protein ration promoted growth equal to that obtained on a ration having supplementary protein composed of soybean oil meal plus 6.8

percent herring meal. Bieley and March *(3)* reported that a growth stimulating substance distinct from vitamin B_{12} found in A.P.F. supplement B caused a marked weight increase of chicks fed either an all-vegetable protein ration or a ration containing fish meal.

PLAN OF EXPERIMENT

Straight-run, day-old New Hampshire chicks were weighed and randomized into groups of the same number of chicks within each of four trials. There were 12 groups of 12 chicks each in trial 1, 10 groups of 15 chicks each in trial 2, 7 groups of 16 chicks each in trial 3, and 16 groups of 20 chicks each in trial 4. These chicks were brooded in raised wire-floor starter batteries up to 3 weeks of age, after which they were moved into intermediate grower batteries without heat to 6 weeks of age. The chicks were provided with feed and water *ad libitum.* Body weight and feed consumption were recorded on the third and sixth weeks of the experiment. The composition of diets in the series of studies are shown in tables 1, 3, 5, and 7. All diets were calculated to contain 20 percent protein.

RESULTS

Trial 1

The composition of diets and body weights are shown in table 1. The data show that at 3 weeks of age the birds fed the mainland-style control diet (S49) weighed 0.54 pound compared with 0.54–0.63 pound for those fed the test diets (E101 to E105). The test diets were as good as or better than the control ration. The birds fed 25 percent herring meal were 17 percent heavier, those that were fed 15 percent herring meal were 15 percent heavier, and those that were fed 5 percent herring meal were 4 percent heavier than those fed the control diet. The chicks fed 29 percent soybean oil meal as the main source of protein were 100–104 percent as heavy as the controls.

At 3 weeks the amount of feed required to produce a pound of gain ranged from 1.70 to 2.17 pounds. The most efficient diet (E101) contained 25 percent herring meal as the main source of protein, whereas, the least efficient diet (E103) contained 20 percent soybean oil meal. The birds fed the control diet needed 2.06 pounds of feed to produce a pound of gain, whereas the birds fed 25 percent herring meal (E101) needed 1.70 pounds, and those that were fed soybean oil meal (E105) needed 2.08 pounds.

The cost of feed to produce a pound of gain ranged from 12.5 to 15.0 cents to 21 days of age. For the birds fed 25 percent herring meal (E101), 12.5 cents worth of feed was needed to produce a pound of gain, whereas the control birds needed 12.9 cents worth of feed. The birds fed ration E101 were 17 percent heavier and were more efficient in converting feed to body weight than those fed the control diet. It was noteworthy that the control diet was $1.10 less expensive than the diet containing 25 percent herring meal. However, the birds fed the control diet needed 0.3 cent worth of feed more than those fed diet E101.

In table 2 is shown the summary obtained to 6 weeks of age. The average weight of the cockerels ranged from 1.55 to 1.77 pounds, whereas the pullets ranged from 1.30 to 1.50 pounds. The males fed the test diets were 99–113 percent as heavy as the controls, whereas the females fed the test diets were 91–105 percent as heavy. The control cockerels, however, were 11 percent lighter and the control pullets were 5 percent lighter than those fed 25 percent herring meal (E101). The

TABLE 1. Composition of starter rations tested and the results obtained in trial 1.

INGREDIENTS[1]	EXPERIMENTAL RATIONS					
	S49[2]	E101	E102	E103	E104	E105
Ground wheat	20.0	....	....	....	....	....
Ground oats	10.0	....	....	....	....	....
Ground yellow corn	27.0	68.0	68.0	67.5	63.0	63.0
Meat and bone meal	5.0	....	....	....	....	....
Soybean oil meal	25.0	....	10.0	20.0	29.0	29.0
Herring meal	5.0	25.0	15.0	5.0	....	....
Alfalfa meal	5.0	5.0	5.0	5.0	5.0	5.0
Defluorinated phosphate[3]	0.5	1.5	1.5	2.0	2.5	2.5
Ground oyster shell	1.0	....				....
Iodized salt	0.5	0.5				0.5
Delsterol, gm.[4]	....	30.0				30.0
Fortafeed 2–22C, gm.[5]	....	50.0				....
Choline chloride, gm.[6]	125.0	250.0				250.0
Aurofac, gm.[7]	....	200.0	Remainder of experimental			200.0
Manganese sulfate, gm.	10.0	11.0	rations 102 through 104 as			11.0
Fish oil, gm.[8]	....	35.0	shown for ration E101.			....
Thiamine hydrochloride, gm.	....	180.0				....
Riboflavin, mg.	160.0	160.0				160.0
Niacin, mg.	....	900.0				900.0
Calcium pantothenate, mg.	....	500.0				500.0
Pyridoxine hydrochloride, mg.	....	160.0				....
Estimated cost per cwt., dollars	6.26	7.36	7.15	6.93	6.90	6.57
Growth index at 3 weeks	100	117	115	104	104	100
Average weight at 3 weeks, lb.	0.54	0.63	0.62	0.56	0.56	0.54
Average feed consumed, lb.	0.92	0.91	1.03	1.01	1.01	0.93
Pounds of feed per pound of gain	2.06	1.70	1.95	2.17	2.14	2.08
Feed cost per pound of gain, cents	12.9	12.5	13.9	15.0	14.8	13.7

[1]Unless otherwise specified the unit of measure is pound(s).
[2]Two replicate groups of 12 chicks each were fed each test diet.
[3]Defluorophos (International Mineral Chemical Corp.) = 31.5 percent calcium and 13.1 percent phosphorous.
[4]Delsterol (Du Pont) = 2,000 A.O.A.C. units of D per gram.
[5]Fortafeed 2-22C (Lederle) = 4.4 mg. each of riboflavin, calcium pantothenate, and niacin, and 2.2 mg. choline chloride per gram.
[6]Choline chloride, 25 percent (Lederle).
[7]Aurofac (Lederle) = 1.8 mg. B_{12} activity and 1.8 gm. aureomycin per pound.
[8]Shark oil = 9,344 I.U. of vitamin A per gram.

amount of feed to produce a pound of gain was 2.37 pounds for the control ration as compared with 2.01–2.54 pounds for the test rations. The cost of feed to produce a pound of gain for birds fed test ration E101 was 14.8 cents, the same as the control.

Statistical analysis showed that the cockerels fed 5, 15, and 25 percent herring meal (E101, E102, E103) were significantly heavier than those fed the control diet. The body weights of cockerels fed the all-vegetable rations E104 and E105 were not statistically different to those fed the control ration. There was no statistically significant difference in body weights of the pullets fed ration E104 and those fed the control mash.

TABLE 2. Summary of data obtained in trial 1, to 6 weeks of age.

TRIAL 1	STARTER RATIONS					
	S49	E101	E102	E103	E104	E105
Average weight at 6 weeks, males, lb.[1]	1.56	1.73	1.77	1.69	1.60	1.55
Average weight at 6 weeks, females, lb.[2]	1.43	1.50	1.48	1.39	1.39	1.30
Growth index, males	100	111	113	108	103	99
Growth index, females	100	105	103	97	97	91
Average feed consumed, males and females, lb.	3.31	3.11	3.31	3.39	3.52	3.13
Average feed cost, males and females, cents	20.7	22.9	23.7	23.5	24.3	20.6
Pounds feed per pound gain	2.37	2.01	2.16	2.39	2.54	2.39
Cost of feed per pound of gain, cents	14.8	14.8	15.4	16.6	17.5	15.7

[1]Between treatments = $F = 5.15$, $P < 0.01$, df = 5, 66. Least significant difference = 0.08 pound.
[2]Between treatments = $F = 2.44$, $P < 0.05$, df = 5, 75. Least significant difference = 0.12 pound.

Trial 2

Four all-vegetable diets were compared with a mainland-style ration. The data in table 3 show that at 21 days of age the birds fed the all-vegetable diets were 111–121 percent as heavy as those fed the mainland-style control mash. This result corroborates the data obtained in trial 1. It was also observed that when aurofac was increased from 200 grams (E106) to 341 grams (E107) per 100 pounds of mixed feed, no significant difference in body weight was obtained. The data also showed that fish oil as a source of vitamin A may be omitted in the presence of 5 percent alfalfa meal. Birds fed ration E104.1, which contains fish oil, were as heavy as those fed ration E109, which does not include fish oil.

The all-vegetable protein diets produced birds which were 11–13 percent heavier than those fed the control mash. At 3 weeks the average feed consumption was 0.91 pound for the control birds, whereas those fed the all-vegetable protein diets consumed 0.99 to 1.04 pounds. The birds fed the test diets grew 113–121 percent as fast as those of the control. The cost of feed to produce a pound of gain was 12.6 cents for the controls and 12.3–13.5 cents for those fed the all-vegetable protein diets.

The result obtained to 6 weeks showed that the growth index for males ranged from 100 to 112 for the cockerels and 100 to 108 for the pullets. The birds fed the all-vegetable diets were as heavy as or heavier than those fed the control diet. The cockerels ranged in weight from 1.62 to 1.81 pounds and the pullets 1.41 to 1.52 pounds. The average feed consumption for both sexes was 3.42 pounds for the control birds and the birds on the all-vegetable test diets ranged from 3.54 to 3.84 pounds. The cost of feed to produce a pound of gain ranged from 21.4 to 26.0 cents. Feed efficiency was 2.39 for the control and 2.31–2.49 for the all-vegetable diets. The cost of feed to produce a pound of gain was 15.0 cents for the control and for the all-vegetable diets the range was 15.3–16.9 cents.

TABLE 3. Composition of starter rations tested and the results obtained in trial 2.

INGREDIENTS	EXPERIMENTAL RATIONS				
	S49[1]	E104.1	E106	E107	E109
Ground wheat	20.0	....	....	....	....
Ground oats	10.0	....	....	....	....
Ground yellow corn	27.0	62.0	62.0	62.0	62.0
Meat and bone meal	5.0	....	....	....	....
Soybean oil meal (44%)	26.0	30.0	30.0	30.0	30.0
Herring meal	5.0	....	....	....	....
Alfalfa meal	5.0	5.0	5.0	5.0	5.0
Defluorinated phosphate	0.5	2.5	2.0	2.0	2.0
Ground oyster shell	1.0	....	0.5	0.5	0.5
Iodized salt	0.5	0.5	0.5	0.5	0.5
Delsterol, gm.	....	30.0	30.0	30.0	30.0
Choline chloride (25%), gm.	125.0	250.0	250.0	250.0	250.0
Aurofac, gm.	....	200.0	200.0	341.0	200.0
Manganese sulfate, gm.	10.0	11.0	11.0	11.0	11.0
Fish oil, gm.	....	35.0	35.0	35.0	....
Riboflavin, mg.	160.0	160.0	160.0	160.0	160.0
Niacin, mg.	....	900.0	900.0	900.0	900.0
Calcium pantothenate, gm.	....	500.0	500.0	500.0	500.0
Estimated cost per cwt., dollars	6.26	6.62	6.61	6.77	6.58
Growth index at 3 weeks	100	111	121	119	113
Average weight at 3 weeks, lb.	0.53	0.59	0.64	0.63	0.60
Average feed consumed, lb.	0.91	1.04	1.04	1.03	0.99
Pounds of feed per pound of gain	2.02	2.04	1.86	1.91	1.94
Feed cost per pound of gain, cents	12.6	13.5	12.3	12.9	12.8

[1]Two replicate groups of 15 birds each were fed each test diet.

An analysis of the data at 6 weeks revealed that the cockerels fed the all-vegetable diets E106 and E107 were significantly heavier than those fed the control diet containing 5 percent herring meal. Further analysis showed that weights of cockerels fed the other two all-vegetable diets (E104.1 and E109) and those fed the control diet were not statistically different. The pullets fed the control diet were lighter than those fed the all-vegetable rations but no statistical differences in body weights were noted.

Trial 3

In table 5 is shown the results of a test comparing a mainland-style control ration to 6 all-vegetable diets with or without ground oats. At 4 weeks of age the growth index ranged from 100 to 119. The average weight was 0.89 pound for the control and the test diets ranged from 0.92 to 1.06 pounds. Ration E70.4, which contains 20 percent herring meal as the main source of protein, showed a growth index of 106. The all-vegetable diets E116.1, E120.1, E124.1, E125, and E126 showed growth indexes ranging from 103 to 119. When the calcium pantothenate was decreased from 500 mg. (E116.1) to 250 mg. (E120.1), the growth indexes were 116 and 119, respectively. This indicated that 250 mg. of added calcium pantothenate was sufficient to meet the requirement of the chick. An addition of this vitamin above 250 mg. did not make a significant difference in growth. When

TABLE 4. Summary of data obtained in trial 2, to 6 weeks of age.

TRIAL 2	STARTER RATIONS				
	S49	E104.1	E106	E107	E109
Average weight at 6 weeks, males, lb.[1]	1.62	1.62	1.81	1.75	1.69
Average weight at 6 weeks, females, lb.[2]	1.41	1.51	1.52	1.49	1.49
Growth index, males	100	100	112	108	104
Growth index, females	100	107	108	106	106
Average feed consumed, males and females, lb.	3.42	3.65	3.65	3.84	3.54
Average feed cost, males and females, cents	21.4	24.2	24.1	26.0	23.3
Pounds of feed per pound of gain, males and females	2.39	2.47	2.31	2.49	2.36
Cost of feed per pound of gain, cents	15.0	16.4	15.3	16.9	15.5

[1]Between treatments = $F = 4.16$, $P < 0.01$, df = 4, 75. Least significant difference = 0.12 pound.
[2]Between treatments = $F = 0.30$, $P < 0.05$, df = 4, 68. Least significant difference = 0.24 pound.

TABLE 5. Composition of starter rations and the results obtained in trial 3.

INGREDIENTS	EXPERIMENTAL RATIONS						
	S49[1]	E116.1	E120.1	E124	E125	E126	E70.4
Ground wheat	20.0	....	....	....	....	....	....
Ground oats	8.25	....	....	10.0	....	10.0	....
Ground yellow corn	30.0	56.5	56.5	46.5	54.5	44.5	73.0
Meat and bone meal	5.0	....	....	....	....	....	....
Soybean oil meal (44%)	26.0	37.5	37.5	37.5	37.5	37.5	....
Herring meal (70%)	5.0	....	....	....	....	....	20.0
Alfalfa meal	5.0	3.0	3.0	3.0	5.0	5.0	5.0
Defluorinated phosphate	....	2.0	Remainder of experimental rations E120.1 through E125 as shown for ration E116.1.			2.0	....
Ground oyster shell	0.25	0.5				0.5	1.5
Iodized salt	0.5	0.5				0.5	0.5
Delsterol, gm.	15.0	30.0				30.0	30.0
Choline chloride (25%), gm.	....	200.0				200.0	200.0
Aurofac, gm.	....	200.0				175.0	175.0
Manganese sulfate, gm.	10.0	11.0				11.0	15.0
Riboflavin, mg.	160.0	160.0				160.0	160.0
Niacin, mg.	....	900.0				900.0	900.0
Calcium pantothenate, mg.	....	500.0	250.0	500.0	500.0	500.0	500.0
Estimated cost per cwt., dollars	6.26	6.69	6.61	6.61	6.67	6.57	6.70
Growth index at 4 weeks	100	116	119	107	103	107	106
Average weight at 4 weeks, lb.	0.89	1.03	1.06	0.95	0.92	0.95	0.94
Average feed consumed, lb.	1.63	1.47	1.94	1.72	1.74	2.00	1.88
Pounds of feed per pound of gain	2.04	1.56	2.00	2.01	2.09	2.31	2.22
Feed cost per pound of gain, cents	12.8	10.4	13.2	13.3	13.9	15.2	14.9

[1]One group of 16 chicks each was fed each ration.

aurofac was decreased from 200 gms. (E124) to 175 gms. (E126), the growth rate was the same. This was also interpreted to mean that 175 gms. of aurofac was sufficient to supplement the all-vegetable diet. Feed efficiency was 1.56 for ration E116.1 and 2.00 for ration E120.1.

In table 6 may be seen the data obtained to 6 weeks of age. The cockerels ranged in weight from 1.65 to 1.88 pounds and the pullets weighed 1.45 to 1.65 pounds. The cockerels fed the test diets were 101–114 percent, and the pullets fed the same rations were 96 to 109 percent, as heavy as those fed the control mash. Feed efficiency was 2.53 for the control, whereas the test diets ranged from 2.08 to 2.90. Only one (E116.1) of the all-vegetable diets tested showed a lower feed cost per pound of gain than the control. It took 15.8 cents worth of control feed to produce a pound of gain compared to 13.9, 16.1, 16.8, 17.1, and 19.1 cents for the all-vegetable rations, E116.1, E120.1, E124, E125, and E126, respectively.

Trial 4

The data in table 7 show the result of tests with chicks fed soybean oil, meat and bone, and/or herring meals as the main source of protein. At 21 days the average weights ranged from 0.59 to 0.68 pound. The control birds weighed 0.65 pound. The growth indexes ranged from 91 to 105 percent. The diets containing 14.25–16.0 percent meat and bone meal were 98–105 percent as heavy as the controls. The average feed consumed was 1.04 pounds for the control (E116) and the test diets showed a range of 0.97 to 1.07 pounds. The chicks fed ration E269 (18.0 percent meat and bone meal) consumed the least amount of feed, were the lightest of the birds tested, and consumed the most feed per pound of gain. The amount of feed to produce a pound of gain ranged from 1.78 to 1.94 pounds.

The data also showed that Fortafeed 2-22C may be incorporated in the diet to supplement the crystalline vitamins riboflavin, niacin, and calcium pantothenate in three out of four pairs of rations tested. Chicks fed rations E116, E264, and

TABLE 6. Summary of data obtained in trial 3, to 6 weeks of age.

TRIAL 3	STARTER RATIONS						
	S49	E116.1	E120.1	E124	E125	E126	E70.4
Average weight at 6 weeks, males, lb.	1.65	1.84	1.88	1.66	1.71	1.70	1.80
Average weight at 6 weeks, females, lb.	1.51	1.65	1.46	1.50	1.48	1.51	1.45
Growth index, males	100	112	114	101	104	103	109
Growth index, females	100	109	97	99	98	100	96
Average feed consumed, males and females, lb.	3.75	3.46	3.74	3.83	3.74	4.32	4.00
Average feed cost, males and females, cents	23.5	23.1	24.7	25.3	24.9	28.4	26.8
Pounds of feed per pound of gain	2.53	2.08	2.44	2.54	2.56	2.90	2.72
Cost of feed per pound of gain	15.8	13.9	16.1	16.8	17.1	19.1	18.2

TABLE 7. Composition of starter rations and the results obtained in trial 4.

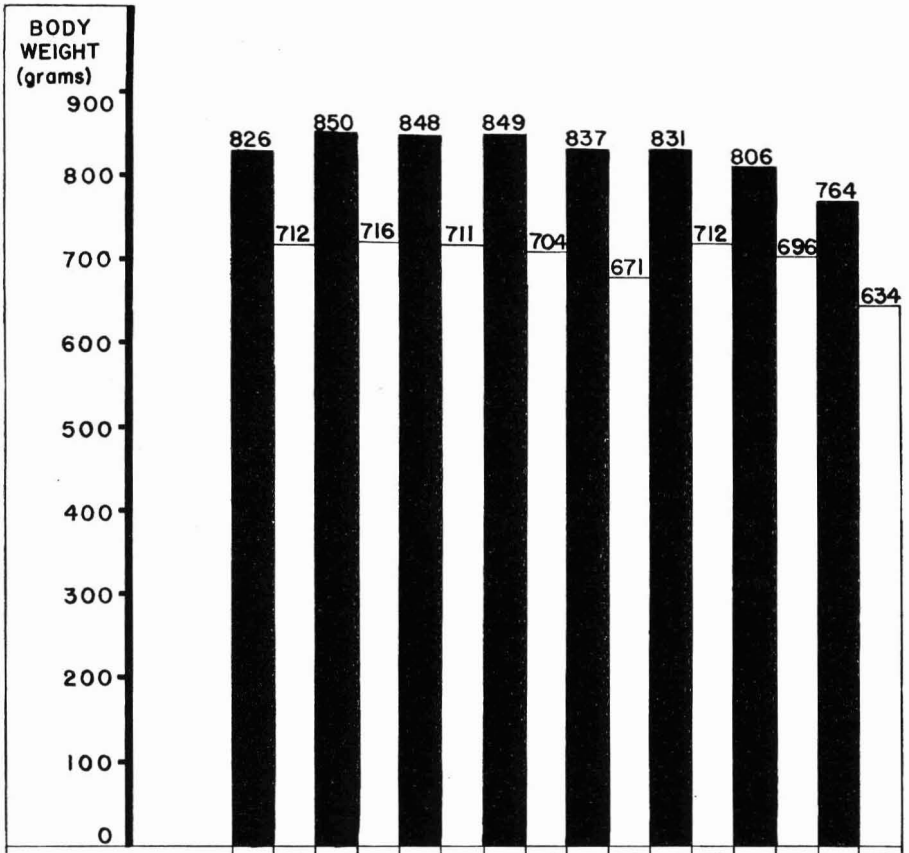
INGREDIENTS	EXPERIMENTAL RATIONS							
	E116[1]	E263	E264	E265	E266	E267	E268	E269
Ground yellow corn	56.5	56.5	63.0	63.0	62.0	60.5	60.5	60.5
Meat and bone meal	....	....	14.25	14.25	16.0	16.0	18.0	18.0
Soybean oil meal	37.5	37.5	14.25	14.25	16.0	16.0	18.0	18.0
Herring meal	....	....	5.0	5.0	2.5	2.5	....	....
Alfalfa meal	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Defluorinated phosphate	2.0	2.0	....	....	....	....	....	....
Ground oyster shell	0.5	0.5	....	....	....	....	....	....
Iodized salt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Delsterol, gm.	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Fortafeed 2–22C, gm.	....	150.0	....	150.0	....	150.0	....	150.0
Choline chloride, gm.	200.0	125.0	200.0	125.0	200.0	125.0	200.0	125.0
Aurofac, gm.	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
Manganese sulfate, gm.	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Riboflavin, mg.	160.0	....	160.0	....	160.0	....	160.0	....
Niacin, mg.	900.0	....	900.0	....	900.0	....	900.0	....
Calcium pantothenate	500.0	....	500.0	....	100.0	....	100.0	....
Estimated cost per cwt., dollars	6.69	6.64	6.41	6.36	6.33	6.29	6.26	6.22
Growth index at 3 weeks, lb.	100	102	105	100	100	98	98	91
Average weight at 3 weeks, lb.	0.65	0.66	0.68	0.65	0.65	0.64	0.64	0.59
Average feed consumed, lb.	1.04	1.06	1.07	1.06	1.01	1.01	1.03	0.97
Pounds of feed per pound of gain	1.83	1.83	1.80	1.89	1.78	1.81	1.88	1.94
Feed cost per pound of gain, cents	12.2	12.2	11.5	12.0	11.3	11.4	11.8	12.1

[1]Two replicate groups of 20 chicks each were fed each ration.

E266 which contained crystalline riboflavin, niacin, and calcium pantothenate were not significantly different in weights to those fed rations E263, E265, and E267 which contained Fortafeed 2-22C as a vitamin supplement. Chicks fed ration E263 (with crystalline vitamins), however, were 7 percent heavier than those fed the same ration (E269) which contained Fortafeed 2-22C as a vitamin supplement. In ration E269, 150 grams of Fortafeed 2-22C was not sufficient to supplement the vitamin requirement of the chick.

At 6 weeks, cockerels fed soybean oil, herring, and/or meat and bone meal ranged in body weight from 1.76 to 1.87 pounds and 1.41 to 1.59 pounds for pullets. Cockerels fed 0–18 percent meat and bone meal in combination with soybean oil meal and/or as much as 5 percent herring meal were statistically equal in weight, $P > 0.05$, $F = 1.04$, $df = 7, 172$. The least significant difference, however, showed that cockerels fed ration E269 which contained no supplementary crystalline vitamins were significantly lighter than those fed the other diets. The pullet data showed that there was no significant difference in body weight at 6 weeks, $P > 0.05$, $F = 1.76$, $df = 7, 143$. Further analysis showed that the pullets fed ration E269 with 18 percent meat and bone meal and not supplemented with crystalline vitamins were significantly lighter than those fed the other test diets. Figure 1 shows the effect of meat and bone meal, soybean oil meal, and herring meal on the final 6-week weights of cockerels and pullets.

The average feed consumed for males and females to 6 weeks ranged from 3.34 to 3.73 pounds, and the average pounds of feed to produce a pound of gain



Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Growth index	100	100	103	99	103	99	103	97	102	94	102	99	99	99	97	89
Ration No.	116		E263		E264		E265		E266		E267		E268		E269	
Soybean oil meal, %	37.5		37.5		14.25		14.25		16.0		16.0		18.0		18.0	
Herring meal, %	0		0		5.0		5.0		2.5		2.5		0		0	
Meat & Bone meal, %	0		0		14.25		14.25		16.0		16.0		18.0		18.0	
Fortafeed, gm.	0		150.0		0		150.0		0		150.0		0		150.0	
Cost/lb. gain, cents	15.5		14.7		14.2		14.1		14.7		13.0		13.8		14.2	

FIGURE 1. Effect of meat and bone meal, soybean oil meal, and herring meal on the final 6-week weights of cockerels and pullets.

ranged from 2.06 to 2.33 pounds. The birds fed all-vegetable protein diets E116 and E263 consumed more feed per unit of gain than those fed meat and bone meal in combination with herring meal and/or soybean oil meal. The cost of feed to produce a pound of gain at 6 weeks was 14.7, 14.1, 13.0, and 14.2 for rations E263 (all-vegetable), E265 (14.5 percent meat and bone meal), E267 (16.0 percent meat and bone meal), and E269 (18.0 percent meat and bone meal), respectively.

DISCUSSION

The results of these studies have shown that herring meal and soybean oil meal may be used singly or in combination with local meat and bone meal for good growth of chicks to 6 weeks of age. The use of these three protein concentrates may depend on prevailing prices for these ingredients.

These investigations have shown that although in trial 1 the control ration was $1.10 less than the ration (E101) containing 25 percent herring meal, the cost of feed to produce a unit of gain was the same. The most expensive ration was not always the best ration. While ration E101 was expensive, the birds fed this diet grew faster and needed less feed per unit of gain than those fed the control diet. However, the similarity of cost of feed to produce a unit of gain permits a choice between the two diets. Nevertheless, if fast growth is desired, then the diet containing 25 percent herring meal may be preferred. On the other hand, if good growth is desired and not necessarily fast growth, the control ration may be chosen.

In the study of all-vegetable rations, the data showed that while diets of chicks may be formulated with soybean oil meal as the main source of protein for good growth equal to or better than that of a mainland-style control ration containing 5 percent herring meal, there are other efficiency factors that do not favor the exclusive use of all-vegetable rations for chicks. The difference of $2.13 in the cost of herring meal ($9.52 per cwt., 70 percent protein) and soybean oil meal ($7.39 per cwt., 44 percent protein) in this study was not enough to offset the greater efficiency of feed conversion of birds fed herring meal than those fed soybean oil meal as the main source of protein (table 2). Therefore, the use of an all-vegetable protein diet with soybean oil meal as the only protein concentrate would be dependent on a reduced cost of this ingredient compared to other protein concentrates. The cost of the all-vegetable diet should be low enough so that the cost of a mixed feed would be equal to or less than that of a diet containing about 5 percent herring meal.

As shown in table 4, at 6 weeks of age chicks fed the all-vegetable diet were as heavy as or heavier than those fed the control mash. However, although two of the all-vegetable diets (E106 and E109) were more efficient than the control ration, the cost of feed to produce a pound of gain was 0.3–0.5 cent more than the control. The difference was attributed to the higher cost of feed per cwt. for these two mixed mashes over that of the control. The cost of the added crystalline vitamins accounted for most of the difference in the cost of the mixed feed.

In table 6, the data show that the birds fed the all-vegetable diets were 100–114 percent as heavy as the controls. Only one (E116.1) of the all-vegetable diets showed less cost of feed to produce a pound of gain than the mainland-style control ration. Again, the difference was not so much as the rate of growth but the cost per unit of mixed feed.

Another approach to the use of economical starter rations was the use of local meat and bone meal in practical and simple rations by incorporating vitamin

concentrates instead of crystalline vitamins. In table 7, composition of diets has been simplified by the use of Fortafeed 2-22C as a source of niacin, riboflavin, calcium pantothenate, and choline. The addition of this vitamin concentrate (6.66 pounds Fortafeed 2-22C per ton) makes easy mixing, and the simplification of the formula makes it more practical than the use of crystalline vitamins. It is simple in that only one ingredient is needed instead of four crystalline vitamins which require a sensitive balance for weighing. A simple and practical diet has a decided appeal to poultrymen who mix their feed.

This study has also shown that meat and bone meal may be used in chick rations to 6 weeks of age in concentrations of 14.25–18.00 percent without sacrificing efficient growth and efficient feed conversion. Although cockerels fed 18.00 percent meat and bone meal (E268 and E269) showed only 99 and 97 percent growth of the controls, respectively, the difference was not significant. Since this by-product of the meat industry is locally produced and is a cheaper feed than soybean oil or herring meals per cwt., this local source of protein concentrate may be used in greater concentrations in chick rations than heretofore have been practiced.

Although no significant differences were observed in average weights of chicks fed the different combinations of meat and bone meal with or without soybean oil meal (table 8), there was a marked difference in cost to produce a pound of gain. This was attributed to the difference in feed cost. The all-vegetable diets (E116 and E263) were more costly than those containing 0–5 percent herring meal and/or 14.25–18 percent meat and bone meal. The prevailing price of soybean oil meal of $7.39 charged to the University was partly responsible in the high cost of the mixed all-vegetable diets.

In table 9, when the cost of feed was calculated on the basis of soybean oil meal prices ranging from $5.00 to $7.50 per cwt. with cost of the other ingredients remaining the same, the difference in cost of feed to produce a pound of gain

TABLE 8. Summary of data in trial 4, to 6 weeks of age.

TRIAL 4	STARTER RATIONS							
	E116	E263	E264	E265	E266	E267	E268	E269
Average weight at 6 weeks, males, lb.[1]	1.81	1.87	1.87	1.87	1.84	1.84	1.79	1.76
Average weight at 6 weeks, females, lb.[2]	1.59	1.58	1.57	1.55	1.49	1.57	1.58	1.41
Growth index, males	100	103	103	103	102	102	99	97
Growth index, females	100	99	99	97	94	99	99	89
Average feed consumed, males and females, lb.	3.73	3.64	3.62	3.59	3.68	3.34	3.50	3.42
Average feed cost, males and females, cents	25.0	24.2	23.2	22.8	23.3	21.0	21.9	21.3
Pounds of feed per pound of gain	2.31	2.22	2.22	2.21	2.33	2.06	2.20	2.28
Cost of feed per pound of gain, cents	15.5	14.7	14.2	14.1	14.7	13.0	13.8	14.2

[1]Between treatments = $F = 1.04$, $P > 0.05$, $df = 7, 172$. Least significant difference = 0.18 pound.
[2]Between treatments = $F = 1.76$, $P > 0.05$, $df = 7, 143$. Least significant difference = 0.13 pound.

TABLE 9. Cost of feed per pound of gain on the basis of different prices of soybean oil meal.

COST OF SBOM[1] PER CWT.	COST OF FEED TO PRODUCE A POUND OF GAIN							
	E116	E263	E264	E265	E266	E267	E268	E269
dollars	*cents*	*cents*	*cents*	*cents*	*cents*	*cents*	*cents*	*cents*
5.00	13.4	12.8	13.5	13.3	13.9	12.2	12.8	13.2
5.50	13.8	13.2	13.6	13.5	14.0	12.3	13.0	13.4
6.00	14.3	13.6	13.8	13.6	14.2	12.5	13.2	13.6
6.50	14.7	14.0	13.9	13.8	14.4	12.7	13.4	13.8
7.00	15.1	14.4	14.1	13.9	14.6	12.8	13.6	14.0
7.50	16.4	14.8	14.3	14.1	14.8	13.0	13.8	14.2

[1]SBOM = soybean oil meal.

became more evident. Up to $6.50 a hundred pounds of soybean oil meal, an all-vegetable diet may be used effectively without sacrificing efficiency of cost to produce a pound of gain.

Ration E263, which is an all-vegetable diet, shows that the cost of feed to produce a pound of gain was 12.8 cents when soybean oil meal costs $5.00 per cwt., whereas ration E265 which contains 5.0 percent herring meal and 14.25 percent meat and bone meal and 14.25 percent soybean oil meal costs 13.3 cents to produce a pound of gain when soybean oil meal costs remain the same. However, the cost of feed to produce a pound of gain of 13.6 cents for these two diets were the same when soybean oil meal sells at $6.00 per hundred pounds. When soybean oil meal costs $7.50 per cwt., the cost of feed to produce a pound of gain was 14.8 cents for ration E263 and only 14.1 cents for ration E265. Therefore, the practicability of using an all-vegetable diet depends in some measure on the prices charged for soybean oil meal. When soybean oil meal costs more than $6.50 per cwt., according to the result of this study, the cost of feed to produce a unit of gain is high for an all-vegetable diet so that other combinations of feeds may be more profitably used. Ration E267 which contained 16.0 percent each of meat and bone meal and soybean oil meal and 2.5 percent herring meal showed the least amount of 13.0 cents worth of feed to produce a pound of gain (table 9). This ration is simple, practical, and contains a vitamin concentrate to supplement the vitamin requirements of the chick.

SUMMARY

Four experiments involving 726 straight-run, day-old New Hampshire chicks were conducted to ascertain the use of simple and practical chick starter rations using local meat and bone meal with soybean oil and/or herring meals as the main source of protein concentrate.

Birds fed local meat and bone meal in concentrations of 14.25–16 percent and in combination with soybean oil meal and/or 0–5 percent herring meal weighed 1.76–1.87 pounds. No significant difference between rations was noted.

At 6 weeks of age, chicks fed all-vegetable diets containing soybean oil meal as the main source of protein were statistically equal in body weight to those fed a mainland-style control ration.

In the study of the use of local meat and bone meal, the cost of feed to produce a pound of gain at 42 days of age ranged from 13.0 to 15.5 cents. The birds fed 16 percent each of soybean oil and meat and bone meals and 2.5 percent herring

meal (E267) consumed the least amount (13.0 cents) of feed to produce a pound of gain, whereas, the birds fed an all-soybean protein diet (E116) consumed the greatest amount (15.5 cents) of feed. The average weights of birds fed the above two diets were statistically the same.

The average feed consumed for pullets and cockerels to 6 weeks of age ranged from 3.34 to 3.73 pounds. The birds fed 16 percent meat and bone meal (E267) consumed 3.34 pounds, whereas, those fed the all-vegetable diet (E116) consumed 3.73 pounds.

There was no significant difference between diets supplemented with 150 mg. riboflavin, 900 mg. niacin, plus 500 mg. calcium pantothenate and diets supplemented with 150 gms. of Fortafeed 2-22C when diets used contained either 37.5 percent soybean oil meal or a combination of meat and bone meal, soybean oil meal, and 2.5 or 5.0 percent herring meal.

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