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# A Study of Chick Starter and Grower Rations in Hawaii

*by*

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## CONTENTS

	Page
Introduction .....	3
Plan of Experiment .....	3
Results .....	4
Discussion and Conclusion .....	6
Tables .....	7-11
Composition of six chick starter rations .....	7
Composition of five chick grower rations .....	8
Efficiency of gains and body weights of chicks fed the starter rations .....	9
Biweekly body weights of cockerels and pullets fed the grower rations .....	9
Biweekly feed consumption and cost per pound gain of chickens fed the grower rations to 14 weeks of age .....	10
Biweekly body weight, feed consumption, age to sexual maturity, and cost of feed from 14 to 24 weeks of age .....	11

## INTRODUCTION

Chicks in the Hawaiian Islands are started almost exclusively in electric battery brooders and are reared either in wire-floor developer pens or growing batteries. This system of management, although efficient as a means of reducing parasitism, sometimes results in losses to the poultryman because of the birds' inability to thrive on the rations fed. These losses may be due to reduced efficiency of gain, rate of growth, or perosis resulting from nutritional deficiencies in the diets of the growing birds. Since growing chickens cannot supplement their diet under this system of management, as they may when reared on range, the consideration of rations that are capable of supporting optimum and efficient growth is of real importance and vital concern to persons who raise poultry for a livelihood. Therefore, efficient rations are essential for success in any poultry enterprise and this is particularly true in Hawaii.

The data presented in this circular were compiled at the poultry farm of the University of Hawaii Agricultural Experiment Station under conditions comparable to those of typical local commercial poultry farms. The rations tested, although selected from formulas recommended by representative mainland experiment stations, will be designated by numbers because it was not possible to duplicate them in their entireties. Certain of the feed ingredients included in the mainland rations are not imported in Hawaii, and it was not possible therefore to include such items as wheat bran, dried skim milk, and wheat flour middlings. Despite this handicap, however, substitutions and additions were designed to approach closely the calculated nutrient contents of the original formulas. Two simplified starter rations and one grower ration (formulated by A. L. Palafox) were also tested in this study.

## PLAN OF EXPERIMENT

### CHICK STARTER RATIONS

Three hundred and thirty-six day-old crossbred chicks (Rhode Island Red X New Hampshire) were randomized and placed into four tiers of three electric starter battery brooders. No chicks were placed in the bottom tiers of these brooders. Each of the six chick starter rations was fed to two lots of chicks, so that ration 1 was fed to lots 1 and 7, ration 2 was fed to lots 2 and 8, etc. The rations were fed until the chicks were 42 days of age; body weight measurements and feed consumption data were recorded biweekly. The formulas of the six starter rations may be seen in table 1.

## CHICK GROWER RATIONS

In another experiment 75 8-week-old pullets were randomized into five lots, and 70 8-week-old cockerels were similarly assigned to five other groups. These chickens (RIR X NH) had been reared on the same ration and under the same system of management until they were assigned to wire-floor grower pens. Five grower rations were fed, and each ration was offered to a group of pullets and a group of cockerels. These rations are shown in table 2. The grower rations were fed to the males until they were 14 weeks of age and to the pullets until they were 24 weeks of age. Data on feed consumption and body weight gains were recorded biweekly. Data on sexual maturity were recorded to 246 days of age.

## RESULTS

### CHICK STARTER RATIONS

The body weights attained at 6 weeks of age and efficiency of gains calculated biweekly may be seen in table 3. Marked differences in efficiency of feed utilization were observed among the differently fed groups. Following 42 days on these rations, a difference of 0.89 pounds of feed per pound of gain existed between the most efficient and least efficient rations. Similarly, marked differences were observed among the body weights attained on the six rations. The most efficient ration (5) did not produce the greatest net gain. The heaviest chicks were produced on ration 6. Converting the data in table 3 to pounds, rations 1, 5, and 6 in this experiment supported growth so that the male chicks averaged, at the minimum, 1.25 pounds and the female chicks 1.12 pounds at 6 weeks of age.

An analysis of variance of the body weights among the lots fed the six chick starter rations revealed a highly significant difference between rations ( $P < 0.01$ ). The value of the mean squares between replicates was not significant.

The least significant difference between body weight means, at the 1 percent probability level, was 86.76 grams. From this it was concluded that rations 2 and 4 were significantly poorer than rations 1, 5, and 6. Ration 3 was significantly poorer than the better rations at the 5 percent probability level.

Based on the prices of ingredients charged the University of Hawaii (January 1, 1949), a pound of gain, produced by each ration to 6 weeks of age, cost as follows:

Ration 1—	18.1 cents of feed
Ration 2—	21.2 cents of feed
Ration 3—	18.4 cents of feed
Ration 4—	22.1 cents of feed
Ration 5—	18.0 cents of feed
Ration 6—	18.2 cents of feed

The difference in cost of feed per pound of gain between rations 1, 5, and 6 was slight.

Only three chicks died during this study and they were in the lots fed ration 4.

#### CHICK GROWER RATIONS

The results of the grower ration study are shown in tables 4, 5, and 6. As may be seen in table 4, the average body weights at 14 weeks of age of the male groups ranged from 4.21 to 4.75 pounds, and the female groups ranged from 3.30 to 3.46 pounds. During the 6-week feeding trial the average gain in weight for all males was 2.49 pounds and 1.75 pounds for the females.

There was no significant difference between the body weights of either the males or females fed the five rations. All the rations supported a rapid rate of growth during this feeding trial. Although ration 4 produced the largest average gain among the males, ration 2 produced a slightly greater average gain among the females. As anticipated, there was a highly significant difference in body weights between the two sexes.

During this 6-week feeding trial the male groups' average feed consumption ranged from 9.85 to 11.25 pounds of feed, and the female groups' ranged from 7.72 to 8.44 pounds of feed. In terms of cost of feed per pound of gain, the males were more efficient than were the females. The average feed cost per pound of gain on all rations was 22.3 cents for the males and 24.7 cents for the females. As may be seen in table 5, there was no significant difference in the efficiency of feed utilization between the five rations when the data for males and females were combined. Nevertheless, there was a range in feed cost per pound of gain of 3.03 cents between the most efficient and least efficient rations, namely, ration 4 and ration 5, respectively. This difference exceeded the least significant difference at the 5 percent level (2.06), but was smaller than the 1 percent value (3.42).

Biweekly feed consumption and body weight measurements were procured on the five female groups to 24 weeks of age. As may be seen in table 6, there was little difference in the average body weights among the 5 groups. When analyzed, the F value ( $P > 0.05$ ) was not significant and the maximum variation did not exceed the least significant difference at the 5 percent probability level. Since the number of pullets per lot was not large, it was assumed that these variations were also influenced by sampling and that these differences in body weight, therefore, were not significant. There was no significant difference between the average gains from 14 to 24 weeks of age among the five lots. Nor was there any significant difference in total feed consumed during this period by the five lots. It is of interest to note, however, that the females fed grower ration 1 showed

the greatest net gain and the lowest average total feed consumption during this period.

The average age to sexual maturity of the pullets ranged from 186.2 to 194.4 days. As noted below (table 6) two pullets fed grower ration 5 had not reached sexual maturity at 246 days of age when this experiment was terminated. There was no significant difference between the five groups in average age to sexual maturity when the data analyzed included only those birds that did lay during this study.

The cost of feed per pound of gain for the pullets (table 6) from 14 to 24 weeks of age ranged from 33.6 to 38.6 cents, and the average for all rations was 37.4 cents. The variation between rations when measured by  $X^2$  was highly significant. Ration 1 was the most efficient grower ration from 14 to 24 weeks of age and ration 2 was the least efficient. There was practically no difference in efficiency between rations 3, 4, and 5.

There was no mortality during this phase of the study.

## DISCUSSION AND CONCLUSION

The data from this investigation support the conclusion that the starter rations were not equally effective in supporting growth. Chick starter rations 2 and 4 were decidedly inferior under the conditions of this experiment. Although ration 3 produced economical gains, it was not as good as the three better rations (namely 1, 5, and 6) because it failed to produce an excellent rate of gain. In the final analysis, there was little to choose among chick starter rations 1, 5, and 6. Ration 6 produced the greatest total gain with the least variation, although the cost of feed per pound gain was 0.2 cent more than the most economical ration. It contains a wider array of amino acid-bearing ingredients and may be least affected therefore by an inferior grade of protein in any one ingredient.

All the chick grower rations were not alike in supporting an efficient rate of growth to sexual maturity. The fact that the average body weight for all pullets produced on these rations was 5.02 pounds at 24 weeks of age, however, indicated that the rations adequately met the nutritional requirements of the birds. This is of practical significance since almost all Hawaii poultry are raised on wire where they cannot supplement their diets. From an inspection of tables 4, 5, and 6, it may be observed that grower rations 3 and 4 were the most desirable for rapid, economical growth to 14 weeks of age whereas ration 1 proved to be most superior during the period of growth from 14 to 24 weeks of age. Grower ration 1 produced the greatest total gain during the latter period of growth and at the lowest cost per pound of gain (table 6).

These data definitely indicate that males are superior to females for economy of meat production during the growing period from 8 to 14 weeks. The average body weight increase for the males was 2.49 pounds whereas the females gained an average of 1.76 pounds. Furthermore, the average cost of feed per pound of gain on all rations was 22.3 cents for the cockerels and 24.7 cents for the pullets. During the period from 14 to 24 weeks of age, the average cost of feed per pound of gain for the pullets was 37.4 cents.

This investigation indicates that it is possible and practical to mix rations that can produce efficient rates of gain in growing chickens from ingredients sold by local feed dealers. This study has demonstrated the superiority of chick starter rations 1, 5, and 6 as well as grower rations 1, 3, and 4. Grower rations 3 and 4 were most efficient for rapid growth to 14 weeks of age, and grower ration 1 was most efficient for rearing pullets to sexual maturity.

TABLE 1. Composition of six chick starter rations fed to experimental chicks  
(In pounds unless otherwise stated)

INGREDIENTS	RATION NUMBERS					
	1	2	3*	4*	5*	6*
Ground wheat.....	25.00	35.00	15.00	10.00	15.00	20.00
Ground yellow corn.....	30.00	25.00	45.00	40.00	25.00	27.00
Ground oats.....	13.00	10.00	—	10.00	—	10.00
Ground barley.....	—	—	—	—	15.00	—
Millrun.....	—	—	15.00	20.00	16.00	—
Fish meal.....	6.00	—	4.00	5.00	12.50	5.00
Meatscrap (local).....	—	8.00	4.00	5.00	—	5.00
Soybean oil meal.....	18.00	16.00	8.00	7.50	5.00	26.00
Dehydrated alfalfa.....	6.00	4.50	5.00	—	7.50	5.00
Bone meal.....	—	—	—	—	1.00	.50
Ground oyster shell.....	.75	1.00	1.50	2.00	2.00	1.00
Granite grit.....	—	—	1.50	—	—	—
Salt.....	.50	.50	.50	.50	.50	.50
Riboflavin (mg.).....	60.00	50.00	50.00	70.00	30.00	160.00
Manganese sulfate (gm.)...	5.00	5.00	—	—	—	7.50
Desterol (Dry D) (2000 A.O.A.C./gm.)....	10.00	10.00	—	10.00	—	10.00
Fish oil (200 D <sub>3</sub> ).....	—	—	.25	—	.25	—

\* Modified mainland experiment station rations.

TABLE 2. Composition of five grower rations fed to experimental cockerels and pullets (in pounds unless otherwise stated)

INGREDIENTS	RATION NUMBERS				
	1*	2*	3	4*	5*
Whole wheat.....	15.00	10.00	10.00	8.30	6.00
Cracked corn.....	30.00	20.00	20.00	16.70	13.40
Ground wheat.....	11.00	10.00	17.00	7.50	12.00
Ground corn.....	15.00	17.50	21.00	30.00	36.00
Ground barley.....	5.00	10.50	9.00	7.50	—
Millrun.....	—	11.40	—	15.00	12.00
Fish meal.....	2.75	8.75	4.20	3.75	3.20
Meatscrap.....	2.75	—	—	3.75	3.20
Soybean oil meal.....	14.00	3.50	12.50	5.50	6.60
Dehydrated alfalfa.....	2.70	5.25	4.20	—	4.00
Ground oyster shell.....	1.00	1.40	.50	1.50	1.30
Bone meal.....	.30	.70	.60	—	—
Salt.....	.50	.50	.50	.50	.50
Granite grit.....	—	—	—	—	1.20
Manganese sulfate (gm.).....	7.50	5.00	5.00	5.00	5.00
Desterol (Dry D) (2000 A.O.A.C./gm.).....	10.00	10.00	10.00	10.00	10.00
Fortafeed (gm.).....	30.00	30.00	30.00	30.00	30.00
Total (pounds).....	100.00	100.00	100.00	100.00	100.00

\* Modified mainland experiment station rations.



TABLE 3. Efficiency of gains and body weights of groups fed six chick starter rations (pounds feed per pound gain)

AGE OF CHICKS	RATION 1	RATION 2	RATION 3	RATION 4	RATION 5	RATION 6
0-14 days	2.34	2.79	2.62	2.74	2.75	2.68
15-28 days	3.12	3.61	3.41	4.19	2.97	3.41
29-42 days	3.48	4.11	4.02	4.29	3.39	3.27
0-42 days	3.17	3.80	3.56	4.06	3.15	3.22
$\bar{x}$ body weight in grams of ♀ ♀ at 42 days	523.1 ± 68.5	415.1 ± 73.3	487.2 ± 63.5	392.0 ± 54.6	509.1 ± 72.8	522.8 ± 66.3
$\bar{x}$ body weight in grams of ♂ ♂ at 42 days	571.1 ± 85.5	465.9 ± 60.7	526.4 ± 63.3	453.6 ± 79.8	582.6 ± 78.7	599.0 ± 72.3

Between rations:  $F = 13.48$   $P = < 0.01$

6

♂ = male  
♀ = female

TABLE 4. Average biweekly body weights of cockerels and pullets (RIR × NH) fed five grower rations from 8 to 14 weeks of age

RATION	COCKEREL WEIGHT (POUNDS)					PULLET WEIGHT (POUNDS)				
	8 weeks	10 weeks	12 weeks	14 weeks	Average gain	8 weeks	10 weeks	12 weeks	14 weeks	Average gain
1	2.01	2.77	3.40	4.21	2.20	1.62	2.17	2.80	3.30	1.68
2	1.90	2.64	3.45	4.30	2.40	1.61	2.15	2.92	3.46	1.85
3	1.94	2.64	3.70	4.62	2.68	1.65	2.32	2.95	3.39	1.74
4	2.00	2.65	3.82	4.75	2.75	1.56	2.20	2.87	3.34	1.78
5	2.02	2.65	3.63	4.45	2.43	1.68	2.27	2.95	3.39	1.71
Average	1.97	2.67	3.60	4.46	2.49	1.62	2.22	2.88	3.38	1.76

Between sexes:  $F = 109.08$   $P = < 0.01$

Between rations:  $F = 0.94$   $P = > 0.05$

TABLE 5. Average biweekly feed consumption and cost of feed to produce a pound of gain for cockerels and pullets (RIR×NH) fed five grower rations from 8 to 14 weeks of age

RATION	COCKEREL FEED CONSUMPTION (POUNDS)					PULLET FEED CONSUMPTION (POUNDS)					Average feed cost per pound gain of males and females
	10th week	12th week	14th week	Total	Feed cost per pound gain	10th week	12th week	14th week	Total	Feed cost per pound gain	
					cents					cents	cents
1	3.04	3.23	3.58	9.85	23.69	2.25	2.64	2.83	7.72	24.02	23.86
2	2.91	3.39	3.70	10.00	22.68	2.52	2.76	3.11	8.39	24.70	23.69
3	2.96	3.68	3.70	10.34	20.53	2.47	2.77	2.95	8.19	25.06	22.80
4	2.84	3.77	4.30	10.91	20.29	2.50	2.83	3.00	8.33	23.91	22.10
5	3.32	3.77	4.16	11.25	24.31	2.60	2.91	2.93	8.44	25.94	25.13
Average	3.01	3.55	3.89	10.45	22.29	2.45	2.78	2.96	8.19	24.73	23.52

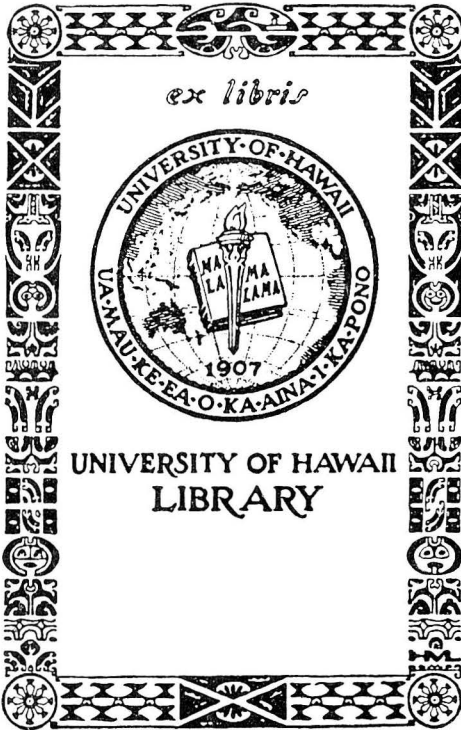
Between sexes: F=10.69 P= <0.01

Between rations: F= 1.90 P= >0.05

TABLE 6. Body weight, feed consumption, age at maturity, and cost of feed to produce a pound of gain for crossbred pullets (RIR×NH) fed five grower rations

RATION	AVERAGE BODY WEIGHT (POUNDS)							AVERAGE FEED CONSUMPTION (POUNDS)						Average age at sexual maturity	Cost of feed per pound gain 14 to 24 weeks
	14th week	16th week	18th week	20th week	22nd week	24th week	Average gain	16th week	18th week	20th week	22nd week	24th week	Total		
1	3.30	3.68	3.90	4.34	5.03	5.13	1.83	2.79	2.73	3.02	2.95	3.11	14.60	days	cents
2	3.46	3.89	4.08	4.66	5.19	5.08	1.62	3.25	3.07	3.38	3.76	3.32	16.78	189.4	39.44
3	3.39	3.89	4.10	4.80	5.05	5.02	1.63	2.91	2.87	3.38	3.67	2.94	15.77	189.8	37.82
4	3.34	3.73	4.09	4.67	4.88	4.86	1.52	2.98	3.09	3.22	3.50	2.96	15.75	186.2	37.30
5	3.39	3.80	4.05	4.47	4.99	4.99	1.60	3.00	2.83	3.28	3.62	3.18	15.91	193.8*	38.64
Average	3.38	3.80	4.05	4.59	4.63	5.02	1.64	2.99	2.92	3.26	3.50	3.10	15.77	190.7	37.36

\* Average of all birds that had laid to 246 days of age (two birds had not laid).



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