HIGH and LOW ENERGY DIETS FOR CHICKS

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In developing diets for use in growing chicks for studies beyond the starting period, it was necessary to obtain information on the performance of chicks during the starting period. In addition, other objectives were to develop rations that make use of feed ingredients native to North Dakota, and to demonstrate the effects of recently found nutritional principles.

The effect of varying protein and energy levels on growth and feed efficiency, and the effects of unidentified growth substances were also compared.

Two trials were conducted testing chick starter rations. Diets were fed in duplicate in both trials. Brooding facilities were utilized on both floors of a 2-story building. Chicks were randomized into lots of approximately 100 each and each diet was randomized into a pen on the first and second floor. A different strain of broiler chicks was used in each trial. Growth and feed utilization data were obtained at 6 and 9 weeks of age.

The same vitamin premix was used in fortifying all diets. The allowance range covered the variation between the diets with a safety factor margin to take care of any normal over-estimate of vitamins supplied by natural feed ingredients. To each pound of ration was added: Vitamin A, 2,000 U.S.P. units; vitamin D_3, 500 I.U.; vitamin E, 2 I.U.; riboflavin 1.5 mg.; calcium pantothenate, 4 mg.; niacin, 10 mg.; Choline Chloride, 200 mg.; vitamin B_{12}, 3 mcg.; procaine penicillin, 2 mg.; manganese sulfate, 30 ppm.

Two commercial diets were fed in each trial. These feeds were purchased on the open market and represent 4 different commercial chick starter rations being fed in North Dakota. The two commercial rations were fed during each trial to determine how the station diets compare with the commercial feeding standard within the state.

During the past 10 years, important concepts of poultry nutrition have been developed. While the same ones apply in general to all domesticated farm animals, the broiler chick has been used extensively to show that certain nutritional concepts are important. The Maryland Experiment Station pioneered the idea of energy-protein ratio.

The symbol C:P is often used to designate such a ratio and is interpreted to mean that for each 1 percent of protein in a unit of feed there also exist a certain number of large calories of energy. It has been found that for optimum growth, feed efficiency and other performance

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studies, certain calorie-protein ratios were most desirable.

A productive energy-protein ratio of 41:1 or 42:1 was found to be optimum during the 1 to 6 weeks age period and a ratio of approximately 53:1 during 7 to 9 weeks period. A corresponding metabolizable calorie:protein ratio is approximately equal to 1.45 times the productive calorie:protein ratio.

Table 1 gives the starter formulas used in trial 1. Diets 1 through 4 in Table 2 show what happens to feed efficiency performance when the caloric content of the diet increases. The feed ingredients which had a tendency to lower the efficiency of utilization were oats, wheat middlings and alfalfa leaf meal. These and similarly high fiber feed ingredients have a low metabolizable caloric value in comparison with corn. By observing the caloric levels per pound of ration and the C:P ratio, it is noted that there is an increase in the units of energy for each unit of protein.

Protein quality, with respect to amino acid composition and digestibility, may have been responsible for some of the differences in response, but the metabolizable energy deficiency in oats, wheat middlings and alfalfa leaf meal is a more serious problem in using these feeds than is protein quality.

TABLE 1. Diet Formulas, Ingredients and Calculated Analysis of Trial 1.

Ingredients	Experimental Rations 1 %	2 %	3 %	4 %	5 %	6 %	Commercial Rations A	B
Ground corn	41.50	49.30	56.80	59.55	53.20	64.50	.....	.....
Ground oats	10.00	5.00	.....	.....	.....	.....	.....	.....
Wheat middlings	10.00	5.00	.....	.....	.....	.....	.....	.....
Alfalfa leaf meal	5.00	2.50	2.50	2.50	2.50	2.50	.....	.....
Soybean oil meal (44%)	18.00	26.50	25.00	20.50	24.00	17.50	.....	.....
Meat meal (50%)	10.00	5.00	5.00	3.50	4.50	2.50	.....	.....
Fish meal (60%)	.....	.....	.....	3.50	4.50	2.50	.....	.....
Dried fish solubles (54%)	.....	.....	2.00	2:00	2.00	2.00	.....	.....
Dried grain solubles (25%)	.....	.....	.....	2:00	2.00	2.00	.....	.....
Dried whey	2.00	2.00	2.00	2:00	2.00	2.00	.....	.....
Salt (NaCl)	.50	.50	.50	.25	.25	.25	.....	.....
Di-calcium phosphate	.50	1.50	1.50	1.50	1.00	1.50	.....	.....
Calcium carbonate	1.00	1.70	1.70	1.70	1.50	1.70	.....	.....
Vitamin premix	1.00	1.00	1.00	1.00	1.00	1.00	.....	.....
Nicarbizin	.05	.05	.05	.05	.05	.05	.....	.....
Soybean oil	.....	.....	.....	.....	1.50	.....	.....	.....
CALCULATED ANALYSIS								
Crude protein—percent	20.23	20.37	20.19	20.30	22.40	18.30	20.0*	20.0*
Calcium—percent	1.82	1.72	1.64	1.77	1.66	1.58	.....	.....
Crude phosphorus—percent	.94	.87	.80	.89	.84	.77	.....	.....
Available phosphorus—percent	.67	.62	.58	.68	.64	.57	.....	.....
Metabolizable calories/lb.	1210.00	1248.00	1260.00	1306.00	1330.00	1325.00	.....	.....
C:P (calorie:protein ratio)	60.0:1	61.5:1	62.5:1	63.5:1	59.0:1	72.0:1	.....	.....

*Guaranteed analysis

TABLE 2. Body Weight Averages and Feed Efficiency Data for Trial 1.

	Six weeks of Age		Nine Weeks of Age		
	Av. Body Weights	Feed/Gain	Av. Body Weights		Feed/Gain
			Male	Female	
Diets	lbs.	lbs.	lbs.	lbs.	lbs.
1	1.56	2.53	3.10	2.45	3.03
2	1.56	2.45	2.97	2.39	2.88
3	1.52	2.32	3.04	2.41	2.60
4	1.60	2.26	3.11	2.57	2.53
5	1.64	2.22	3.18	2.50	2.45
6	1.53	2.34	2.96	2.43	2.55
A	1.56	2.62	3.12	2.51	2.78
B	1.63	2.63	3.05	2.52	2.95

The greater feed efficiency response of ration 3 over that of ration 2 is due not only to the slight increase in metabolizable energy but to the inclusion of dried fish solubles which contain an unidentified growth promoting factor.

Diets 4, 5 and 6 vary in protein and C:P levels. The quality of the protein varied only in the exchange of corn with meat meal, fish meal and soybean oil meal which were used in the same ratio at each protein level. The C:P ratios in diets 5 and 6 were respectively too low and too high, according to present day feeding standards, during the first 6 weeks of growth. Diet 6, during the 7 to 9 week age period, had a better C:P ratio for this period of growth than did either diets 4 or 5.

Chick growth data are shown in Table 2. All diets performed reasonably well. Diet 5 which contained 1.5 percent fat and 22 percent protein produced the largest chicks as well as the best feed efficiency. Diet 6, which contained 18 percent protein, showed at 6 and 9 weeks to be a weaker diet in supporting growth than either diet 4 or 5. However, the feed efficiency was only slightly inferior to that of diet 4 and superior to that of diet 3.

Trial 2 was conducted primarily to determine the effects upon growth and feed efficiency of ingredients used in diets at a low level. Fish meal, meat meal, dried grain fermentation solubles, dried whey and dried buttermilk were varied among the different diets. Protein and caloric levels varied only slightly between diets. Experimental diets are given in Table 3.

Growth and feed efficiency data are given in Table 4. A second feed efficiency column is given, adjusting this data to what might have been expected if all treatments had been tested in one trial. Diet 4 was fed in both trials and acted as the control for making this adjustment.

The growth response to the several diets exceeded the general growth response of trial 1. This most likely can be explained on the basis that a different strain of chicks was used for each trial. The average weights of the pullets at 9 weeks varied within a range of only 0.12 pounds while the range for the males was 0.24 pounds. The males fed diet 6 lagged considerably in growth. This also was noticeable by subjective observation.

The 6 weeks feed efficiency responses placed the diets according to their effec-

TABLE 3. Diet Formulas, Ingredients and Calculated Analysis of Trial 2.

Ingredients	Experimental Rations 1 %	2 %	3 %	4 %	5 %	6 %	Commercial Rations A %	B %
Ground corn	61.15	62.15	62.15	60.05	57.35	57.45	.....	.....
Alfalfa leaf meal (17%)	2.50	2.50	2.50	2.50	2.50	2.50	.....	.....
Soybean oil meal (44%)	21.00	20.00	20.00	20.00	27.50	27.70	.....	.....
Meat meal (55%)	3.50	3.50	3.50	3.50	.....	3.50	.....	.....
Fish meal (60%)	3.50	3.50	3.50	3.50	3.50	.....	.....	.....
Grain solubles (25%)	.....	.....	2.00	2.00	2.00	2.00	.....	.....
Dried whey	2.00	.....	.....	2.00	2.00	2.00	.....	.....
Dried fish solubles (54%)	2.00	2.00	2.00	2.00	.....	.....	.....	.....
Dried skim milk (32%)	.....	2.00	.....	.....	.....	.....	.....	.....
Salt (NaCl)	.25	.25	.25	.25	.25	.25	.....	.....
Di-calcium phosphate	1.50	1.50	1.50	1.50	2.30	2.00	.....	.....
Calcium carbonate	1.50	1.50	1.50	1.70	1.50	1.50	.....	.....
Vitamin premix	1.00	1.00	1.00	1.00	1.00	1.00	.....	.....
Unistat	.10	.10	.10	.10	.10	.10	.....	.....
CALCULATED ANALYSIS								
Crude protein—precent	20.32	20.36	20.25	20.30	20.28	20.27	20.0*	20.0*
Calcium—percent	1.64	1.65	1.63	1.77	1.59	1.59	.....	.....
Crude phosphorus—percent	.85	.85	.83	.89	.88	.86	.....	.....
Available phosphorus—percent	.65	.65	.61	.68	.64	.62	.....	.....
Metabolizable energy/lb.	1305.00	1309.00	1312.00	1306.00	1288.00	1285.00	.....	.....
C:P (calorie:protein ratio)	64:1	64.5:1	64.5:1	64:1	63.5:1	63.5:1	.....	.....

*Guaranteed analysis.

TABLE 4. Body Weight Averages and Feed Efficiency Data for Trial 2.

	Six Weeks of Age			Nine Weeks of Age			
	Av. Body Weights lbs.	Feed/Gain lbs.	Adjusted Feed/Gain lbs.	Av. Body Weights Male lbs.	Female lbs.	Feed/Gain lbs.	Adjusted Feed/Gain lbs.
1	1.58	2.10	2.24	3.39	2.78	2.42	2.49
2	1.70	2.01	2.14	3.49	2.87	2.34	2.42
3	1.65	2.12	2.25	3.41	2.81	2.46	2.54
4	1.69	2.12	2.25	3.45	2.81	2.45	2.53
5	1.66	2.11	2.24	3.49	2.90	2.43	2.50
6	1.64	2.15	2.29	3.25	2.81	2.52	2.59
A	1.69	2.24	2.38	3.37	2.79	2.60	2.68
B	1.74	2.21	2.35	3.45	2.88	2.51	2.58

tiveness at this age. Observing the feed per gain column, it can be seen that each diet maintained the same efficiency position at 9 weeks as was observed at 6 weeks of age.

Diets 1, 2 and 3 are identical, with the exception of dried whey, dried buttermilk and grain fermentation solubles. The diet 2, containing dried buttermilk, gave superior growth and feed efficiency as compared with diets 1 and 3, and superior to all other diets with respect to feed efficiency. Neither the dried whey nor dried grain fermentation solubles was found as a comparable substitute for the dried milk.

Diets 1 and 3 which, respectively, contained dried whey and dried grain solubles, were compared with diet 4 which contained both ingredients and differed only in this respect. The growth and feed per gain are very much the same. Dried whey seemed to have supported slightly better feed efficiency at 6 and 9 weeks but growth was slightly inferior to the diets containing grain solubles. The growth factors involved do not appear to be highly additive in response and possibly the using of one or both in formulation of diets will give approximately the same response.

Diet 6 contained neither fish meal nor dried fish solubles. Feed per gain is inferior to ration 4 which contains both fish ingredients and to diet 5 which contained fish meal but no meat meal. Diets 5 and 6 differ, respectively, only in the absence of meat meal and fish meal. Diet 5 gave a higher feed efficiency and a greater growth response than did Diet 6.

Of the several classes of nutrients which are dietary and physiologically important, only the energy, protein and unidentified growth factors have been considered. In the formulation of diets, several sources of protein ingredients are preferred to any single source. In general, a combination of protein ingredients improves the efficiency of protein utilization for body tissue synthesis.

Energy from fats, carbohydrates and proteins are additive in meeting the body requirement. However, the inclusion of unidentified growth factors in poultry diets may or may not be additive in their effect upon growth. The addition of growth substances singly or in combination beyond the amount required for a single growth factor, as a rule, will not improve the growth response greatly.

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