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The study to be reported here was conducted to determine if the protein level of layer diets could be lowered from the commonly used 16% level to 12% without reducing the performance of hens. Thirty-six 24-week-old Babcock 300 pullets in groups of six were placed in cages and randomly assigned to each dietary treatment. The formulas for the basal diets are shown in table 1. The first treatment consisted of the 11.8% protein diet with the second treatment containing an additional 0.15% methionine hydroxy analogue. Treatments 3, 4 and 5 were obtained by cumulatively supplementing the diet of the second treatment with 0.2% L-lysine, 0.1% DL-tryptophan and 0.4% DL-isoleucine (table 2). Treatment 6 consisted of the standard 16% protein diet.

The data on average hen-day egg production, feed intake, feed efficiency, mortality and body weight changes for fifteen 28-day periods are presented in tables 3, 4 and 5. As shown in table 3, the 11.8% protein diet supported an average of 67% hen-day egg production as compared to 70% for the hens receiving the 16% protein diet. The combined addition of methionine and lysine depressed production to 61%. Tryptophan appeared to somewhat alleviate the depression effect caused by methionine and lysine, whereas isoleucine was ineffective in improving production. Similar trends were observed in feed efficiency expressed as kilograms of feed required to produce a dozen eggs (table 4). A significant reduction in feed efficiency was observed only when lysine was added to the low protein diet. The isoleucine addition improved feed efficiency to a level that was statistically comparable to that obtained from the basal low or high protein diets. Had larger numbers been used, hens on the latter diet would most likely have been shown to be superior in all categories, as they were for the amount of egg per gram of feed.

Further data showed that feed intake (table 4), egg shell thickness, interior egg quality, body weight changes and mortality (table 5) were not significantly affected by the dietary treatments. Amino acid concentrations of egg albumen showed that eggs produced from hens fed the unsupplemented low protein diet contained somewhat lower levels of lysine and glutamic acid. Concentrations of lysine, glutamic acid and arginine were slightly increased as a result of methionine and combined methionine and lysine additions.

The slightly superior performance of hens on the 16% protein diet indicated that there may be need for further amino acid supplementation of the 11.8% protein diet. This year's experiment, therefore, includes an additional treatment containing 0.25% DL-valine. Also, a 10% protein diet was formulated to be supplemented

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with the above mentioned essential amino acids, since the performance of the birds receiving the unsupplemented 11.8% protein diet was surprisingly satisfactory. Three strains are being used in the present study to investigate genetic effects, since previous work had shown mediocre performance with a low protein diet similar to that used in the study reported here.

Table 1. Composition of Basal Diets

	Dietary protein (percent)	
	16.0	11.8
	Percent of the diet	
Ground yellow corn	71.0	82.0
Soybean meal (47% protein)	20.0	9.0
Alfalfa meal (17% protein)	2.0	2.0
Dicalcium phosphate	1.5	1.5
Limestone	5.0	5.0
Salt mix[1]	0.5	0.5
Vitamin mix[2]	+	+

[1]Contained in grams per kg of salt mix: sodium chloride, 920; zinc, 10.0; iron, 6.0; manganese, 4.0; copper, 0.8; cobalt, 0.15 and iodine, 0.07.

[2]Contained per kg of diet: vitamin A, 5,280 USP; vitamin D_3, 1,375 USP; vitamin E, 22 IU; vitamin B_{12}, 0.0088 mg; niacin, 44 mg; choline chloride, 440 mg; riboflavin, 6.6 mg; d-calcium pantothenic acid, 8.8 mg; vitamin K, 1.1 mg; folic acid, 1.1 mg and biotin, 0.11 mg.

Table 2. Amino Acid Supplementation of the Low Protein Diet

	Added amino acids as percent of the diet			
Treatment	Methionine hydroxy analogue	L-lysine	DL-tryptophan	DL-isoleucine
1 (11.8% protein)	--	--	--	--
2	0.15	--	--	--
3	0.15	0.20	--	--
4	0.15	0.20	0.10	--
5	0.15	0.20	0.10	0.40
6 (16.0% protein)	--	--	--	--

Table 3. Egg Production and Egg Weight

	Treatment	Means of 15 periods: Egg production, Hen-day	Means of 15 periods: Egg production, Daily	Means of 15 periods: Average egg weight
		%	gm	gm
1	11.8% protein	66.79bc[1]	42.39ab	63.61a
2	As 1 + methionine	63.02ab	40.38a	64.36a
3	As 2 + L-lysine	60.76a	38.74a	63.98a
4	As 3 + DL-tryptophan	64.69ab	41.82ab	65.16a
5	As 4 + DL-isoleucine	63.20ab	40.57a	64.59a
6	16.0% protein	70.34c	45.18b	64.38a

[1]Data followed by unlike letters are significantly different (P>.05).

Table 4. Feed Consumption and Efficiency

	Treatment	Means of 15 periods: Hen-day feed intake	Means of 15 periods: Feed per dozen eggs	Means of 15 periods: Amount of egg per gram of feed
		gm	kg	mg
1	11.8% protein	115.5a[1]	2.21ab	369a
2	As 1 + methionine	117.1a	2.32bc	347a
3	As 2 + L-lysine	114.0a	2.44c	343a
4	As 3 + DL-tryptophan	117.2a	2.37bc	359a
5	As 4 + DL-isoleucine	111.7a	2.21abc	368a
6	16.0% protein	112.6a	1.95a	405b

[1]Data followed by unlike letters are significantly different (P>.05).

Table 5. Mortality and Body Weight

	Treatment	Mortality	Body weight: Initial	Body weight: After 15 periods	Body weight: Percent change
		%	kg	kg	
1	11.8% protein	7.4	1.53	1.72	+12
2	As 1 + methionine	7.4	1.51	1.74	+15
3	As 2 + L-lysine	9.8	1.50	1.78	+19
4	As 3 + DL-tryptophan	8.3	1.55	1.75	+13
5	As 4 + DL-isoleucine	17.6	1.52	1.70	+12
6	16.0% protein	12.2	1.55	1.76	+13