occur in commercial processing. The major differences are that, under commercial conditions, oil and gossypol are present when the meal is heated, and both factors could affect the nature of changes that take place in the meal protein. Therefore, extrapolation of these results to commercially processed meal should not be attempted until additional information of the same type has been obtained with commercial meals.

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PROTEIN EFFICIENCY

Relative Nutritive Values of Proteins in Various Foods at Increasingly High Levels of Protein Intake

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The nutritive value of the proteins in various foods at increasingly high levels of protein intake was studied for possible practical application in poultry and livestock feeding. Protein efficiency decreases with increased protein intake because there is greater waste in metabolism with the increased ingestion of protein. In all the foods studied, 15% was the most efficient level of protein intake.

THE RELATIVE NUTRITIVE VALUES of the proteins in corn gluten meal, degossypolyzed cottonseed meal, defatted soybean flour, dried nonfat milk solids, defatted dried whole eggs, wheat germ meal, and defatted germ at 15 to 30% planes of intake were studied. In all these foods, 15% was the most efficient level of protein intake. The protein efficiency decreases with the increased protein intake because there is greater waste in metabolism with the increased ingestion of protein. The supplementation of the proteins in corn gluten meal fed at a 20% level of protein intake, with 0.2% L-lysine and 0.4 DL-tryptophan, resulted in a 17.3% increase in efficiency of utilization.

Table I. Protein Content of Various Foods

	Protein, %
Corn gluten meal	42.1
Cottonseed meal[a]	39.7
Wheat germ meal	28.5
Defatted wheat germ	33.7
Dried nonfat milk solids	35.1
Defatted dried whole eggs	65.6
Defatted soybean flour	51.3

[a] Degossypolyzed by extraction with methyl ethyl ketone.

Experimental Procedure and Materials

Results have been reported on the relative nutritive values of proteins in various foods at levels of protein intake ranging from 5 to 12% (*5*). In this study, information is given on the relative nutritive values of high-protein containing foods fed at planes of intake ranging from 15 to 30%. The foods used furnished all the proteins in the rations and in sufficient amounts to provide the desired levels of proteins. The protein content of the various foods used (Table I) was determined from nitrogen analyses, using the factor 6.25 for the corn gluten meal, cottonseed meal, soybean flour, and eggs; the factor 6.38 for the nonfat milk solids; and the factor 5.83 (*3*) for the wheat germ meal.

The rations also contained 4% of Sure's salt mixture No. 1 (*6*), 7% of

Table II. Relative Nutritive Values of Proteins in Various Foods at Increasing High Levels of Protein Intake

(Growth of 10 weeks. Average results per animal)

Type of Ration	Protein in Ration, %	No. of Animals	Gains in Body Wt., G.	Total Food Intake, G.	Protein Intake, G.	Protein Efficiency Ratio[a]
Corn gluten meal	15	24	82.4	677.8	101.7	0.81 ± 0.04
	20	24	117.1	729.4	145.9	0.81 ± 0.04
	25	24	151.6	857.0	214.3	0.71 ± 0.03
	30	12	121.1	630.5	189.1	0.64 ± 0.03
+ 0.2% L-lysine	20	24	119.9	685.5	137.1	0.88 ± 0.05
+ 0.2% L-lysine + 0.4% DL-tryptophan	20	24	116.9	618.3	123.7	0.95 ± 0.04
Cottonseed meal[b]	15	24	180.4	999.3	149.9	1.23 ± 0.06
	20	24	146.6	924.8	185.0	0.79 0.04
	25	24	153.5	945.0	236.3	0.66 ± 0.05
	30	24	136.3	873.6	262.1	0.52 ± 0.04
Defatted soybean flour	15	24	166.7	896.7	134.6	1.24 ± 0.07
	20	24	156.4	875.5	175.1	0.89 ± 0.05
	25	24	145.3	892.3	223.1	0.65 ± 0.03
	30	12	116.0	654.7	196.4	0.59 ± 0.04
Dried nonfat milk solids	15	24	193.5	924.1	138.6	1.40 ± 0.06
	20	24	179.7	882.3	176.5	1.02 ± 0.05
	25	24	184.3	902.1	225.5	0.82 ± 0.04
Defatted whole eggs[c]	15	24	193.7	853.2	128.0	1.51 ± 0.05
	20	24	192.7	848.4	169.7	1.14 ± 0.04
	25	24	171.1	790.9	197.7	0.86 ± 0.06
	30	12	151.6	684.1	205.2	0.73 ± 0.03
Wheat germ meal	15	24	173.1	864.2	129.6	1.33 ± 0.05
	20	24	176.3	844.0	168.8	1.04 ± 0.04
Defatted wheat germ	15	12	165.3	835.1	125.2	1.32 ± 0.06
	20	12	143.6	780.9	156.2	0.92 ± 0.03
	25	12	133.4	722.5	180.6	0.73 ± 0.04

[a] Gains in body weight per gram of protein intake.
[b] Degossypolyzed by extraction with methyl ethyl ketone.
[c] Dried.

hydrogenated shortening, 2% of cod liver oil, 1% of wheat germ oil, and a proportional amount of glucose (Cerelose). The fat-soluble vitamins A, D, and E were supplied by the cod liver oil and wheat germ oil in the rations. All rations were supplemented separately with a liberal supply of the B vitamins (4). Vitamin B_{12} was administered in doses of 0.1 γ per animal per day. Folic acid was not added to the rations, as under the dietary regime followed this vitamin is synthesized in the intestinal tract of the rat. Because, in diets containing large proportions of dried eggs, biotin becomes unavailable as the protein complex, avidin (1, 2, 7), the defatted dried whole egg rations were supplemented with 20 γ of biotin to each animal, administered six times weekly.

The animals, 28 to 32 days old when started on the experiments and weighing 50 to 63 grams each, were divided into groups, each having equal numbers of both sexes. The rats, in a limited number of groups, had to be reduced from 24 to 12 because of the insufficiency of certain foods. In several groups, one to two animals were discarded because they were in poor physical condition and consequently their rates of growth were not representative of the rest of the individuals in this set. The animals were weighed once weekly and accurate records were kept of food consumption. From these data the protein efficiency ratios were calculated and expressed as gains in body weight per gram of protein intake.

The results of this study are summarized in Table II.

Discussion of Results

The order of the rations, based on their protein efficiency ratios, varies somewhat at different planes of protein intake.

For example, at the 15% level of intake the protein efficiency of defatted soybean flour and cottonseed meal are far superior to that of corn gluten meal, while at the 25 and 30% planes of intake, the protein efficiency ratio of the corn gluten meal is appreciably higher than that of either the soybean flour or cottonseed meal.

The supplementation of corn gluten meal, at the 20% plane of protein intake, with 0.2% L-lysine resulted in an increase of only 8.8% in protein efficiency ratio, and the supplementation with 0.2% L-lysine and 0.4% DL-tryptophan in an increase of only 17.3% in protein efficiency ratio.

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