A STUDY OF DEHYDRATED FORAGE PRODUCTS IN POULTRY RATIONS

by

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ABSTRACT

A study of dehydrated forage products in poultry rations

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A comparative study was undertaken to evaluate dehydrated alfalfa leaf meal and dehydrated cereal grass meal in poultry rations. These investigations were designed to determine the relative effect of these products on palatability, growth, feed conversion, mortality, hatchability, egg production and egg quality. Diets containing graded levels of alfalfa and cereal grass were fed separately, combined and incorporated into standard rations for day old chicks and breeding hens. One experiment was conducted with turkey poults.

Results indicate that chicks showed preference for alfalfa over cereal grass when these products were offered separately free choice in dry form, but they showed no preference when each of the two forage meals were included separately at various levels in rations. The inclusion of alfalfa and cereal grass up to the 5 per cent level produced equivalent growth rate and feed conversion in chicks to that obtained on the basal ration devoid of all forage products. At levels above 5 per cent there was a progressive decline in growth rate and a lowering of feed efficiency. Although these conditions were evident for both forages, the alfalfa diets caused a more severe depressing effect than the cereal grass rations. Chick mortality was not influenced by the inclusion of either forage meal up to the 20 per cent level.

Increasing levels of alfalfa in breeding rations improved hatchability while similar levels of cereal grass resulted in a depressing

effect on hatchability. The inclusion of cereal grass in breeding rations had a significantly greater effect than alfalfa on intensifying yolk color. Egg production was not affected by the use of either forage product in the ration. A separate study on the rate of carotene destruction in these two forage meals was conducted. The rate of carotene destruction of these two forage meals were very similar although in all cases the dehydrated cereal grass meal initially contained substantially more carotene than the dehydrated alfalfa meal.

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INTRODUCTION

Prior to the discovery of vitamins and their function in poultry nutrition, fresh succulent pasture was regarded as being indispensable for profitable poultry production. As early as 1905, Jaffa spoke of the "hygienic value" that fresh succulent pasture provided for poultry. The importance placed on fresh forage, by practical poultry men, in the past has now been elucidated with increasing knowledge of nutrition. Today it is known that fresh pasture is not only an excellent source of vitamin A (carotene), riboflavin, vitamin E, vitamin K and many other of the B-complex vitamins but also of proteins, minerals and other nutrients, some of which have not as yet been identified.

The incorporation of dry forage products into poultry rations is practised mainly as a pasture substitute when fresh green forage is not available. This is of prime importance in Western Canada as fresh green pasture is only accessible to poultry from 4 to 6 months of the year. Early management practices proved the value of feeding ground alfalfa hay to poultry during the winter months. As the poultry industry grew and the demand for a pasture substitute increased, sun-cured alfalfa meal appeared on the market. This product was mentioned in the poultry text written by Lippincott (1916). It is of interest to note that the production of sun-cured alfalfa meal in the United States reached a peak of 573,700 tons in 1945-46. As early as 1930 processing by dehydration began and, at present in the United States, dehydrated alfalfa leaf meal is the main forage product used. In Canada, dehydrated cereal grass and dehydrated alfalfa leaf meal are extensively used as green feed substitutes.

Economically these two forage products are valued for their

vitamin A activity. The incorporation of them into poultry rations is based mainly on their vitamin A (carotene) riboflavin and vitamin K content. With the increasing commercial production of vitamin A and riboflavin the importance of dehydrated alfalfa leaf meal and dehydrated cereal grass as constituents of poultry rations requires reappraisal. It is important to ascertain if a basis exists other than carotene content which justifies a price differential between the meals or whether the meals could be used interchangeably or combined in poultry rations as is the present practice.

While there are many published reports on the value of alfalfa meals, there are few dealing with cereal grass in poultry rations. This research work has been conducted mainly in the United States. In neither Canada nor the United States are there reports dealing extensively with the comparative feeding value of dehydrated alfalfa leaf meal and dehydrated cereal grass.

This comparative study was undertaken to evaluate dehydrated alfalfa leaf meal and dehydrated cereal grass* in poultry rations. An attempt was made to measure their effect on rate of growth, feed conversion, palatability, hatchability, mortality, egg production and egg quality. In addition to the foregoing a separate study of a chemical nature was undertaken to ascertain the rate of destruction of carotene in these two products when dry stored under natural conditions.

* The products used in all the experiments in this study are sold commercially in Canada under the trade name, Vita-Greens (dehydrated alfalfa leaf meal) and Vita-Gras (dehydrated cereal grass meal). The Vita-Greens consisting of alfalfa (Medicago sativa) and Vita-Gras of orchard grass (Dactylis glomerata) and New Zealand rye grass (Lolium sp.). The manufacturer of these products states that in their dehydration process no chemicals or antioxidants are used.

REVIEW OF LITERATURE

Extensive research has been conducted to determine the value of alfalfa in poultry rations. There is a paucity of information concerning the use of cereal grass. In view of this the literature will be dealt with under the following general headings:

(a) Alfalfa meal in chick rations

(b) Alfalfa meal in laying rations

(c) Alfalfa meal in turkey growing rations

(d) Cereal grass in poultry rations

(a) Alfalfa meal in chick rations

An early reference to the use of alfalfa meal was made by Lippincott (1916) in which was stated, "During the last few years finely ground alfalfa hay has appeared on the market as alfalfa meal, and if of good quality is a good substitute for wheat bran as it is high in protein, ash and fat." Twenty-three years later Kennard and Lingle (1928) reported that the best substitute for green feed undoubtedly is a high quality immature cut legume hay which may be regarded as dried green feed.

The first paper dealing with the availability of vitamin A from alfalfa meal was by Heywang and Titus (1932). They observed that the inclusion of sun-cured alfalfa leaf meal in a chick ration at the 10 per cent level did not provide sufficient vitamin A to maintain life. Paley (1938) reported, on the other hand, that a basal ration supplemented with only 3 per cent alfalfa leaf meal provided ample vitamin A for chicks. More recent work by Bolin et al (1943) and Farrin and associates (1949) indicated that carotene supplied by alfalfa leaf meal was an adequate source of vitamin A for growing chicks.

A number of workers have measured the value of alfalfa meal in chick rations by determining its effect on rate of growth and feed conversion. Cooney et al (1948), Jensen (1947), and Heywang (1950) all reported that as the level of alfalfa meal was increased in a chick ration above 5 per cent there was a gradual decrease in growth rate and a lowering of feed efficiency.

German and Couch (1954) used two samples of dehydrated alfalfa, one designated as inhibitory, the other non-inhibitory. These were included in chick rations at a 10 per cent level with and without the Animal Protein Factor. The inhibitory sample depressed growth with and without the Animal Protein Factor, while the non-inhibitory one produced growth depression only when the Animal Protein Factor was excluded from the ration.

Kodras et al (1951 a) stated that fibre does not appear to be the depressing agent in alfalfa leaf meal because, on equal feed intake, the rate of growth for chicks receiving a basal ration plus either 20 per cent sun-cured or dehydrated alfalfa was less than for chicks receiving a basal ration plus 20 per cent mill run. It was found that the addition of 1 per cent cholesterol was effective in counteracting growth depression effects.

Kodras (1951 b) reported further that alfalfa leaves caused a greater depression in chick growth than an equivalent weight of alfalfa stems. This substantiated his contention that fibre is not the only growth depressing factor in alfalfa meal.

Lepkovsky and associates (1950) observed that the growth depressing effects of alfalfa meal were not altered by different drying temperatures and periods of storage. The following were their conclusions:

(1) Dehydrated alfalfa contains a substance or substances probably organic in nature which depresses growth in chicks.

(2) Storage of alfalfa meal at room temperatures or in cold at 16° F. has little effect on the growth depressing substance of alfalfa meal.

(3) The growth depressant is apparently stable to existing methods of preparing alfalfa meal and to autoclaving in neutral, alkaline or acid medium.

(4) The depressing agent can be removed from alfalfa by repeated extraction with hot water.

(5) Vitamins of the B-complex in the amount fed had no effect in counteracting the depressing agent.

Wilgus and Madsen (1954) conducted an intensive study using 100 different samples of alfalfa meal to determine the inhibiting effect on chick growth. When the alfalfa samples were incorporated in the ration at the 10 per cent level, approximately one fifth of them depressed early growth, one third exhibited moderate depression and one half showed no appreciable effect. They concluded that the inhibition was not due to fibre per se nor was it related to ash constituents.

Peterson (1950 a) obtained a growth depression in chicks by feeding them an aqueous extract of alfalfa meal. The strong foaming properties of this fraction suggested saponins as the growth depressing agent. In a later study Peterson (1950 b) found that the depression of growth caused by the inclusion of 20 per cent dehydrated alfalfa leaf meal in a chick ration was more completely counteracted when a combination of 4 per cent cotton seed oil and 1 per cent cholesterol was added to the diet than when cholesterol was used alone as the counteracting agent. Heywang and

Bird (1954), following Peterson's (1950) work, fed saponin extract from alfalfa to day-old chicks. Their results showed that the saponin in alfalfa retarded growth and feed consumption, and reduced efficiency of feed utilization. The lowest level at which there was an unmistakable inhibition of growth was at the 0.20 per cent level. This amount of saponin extract was equivalent to that contributed by feeding 25 per cent of this particular alfalfa.

Some workers have found that the inclusion of dehydrated alfalfa leaf meal in purified and semi-purified basal rations stimulated growth in chicks. Scott (1952) tested the difference between sun-cured and dehydrated alfalfa leaf meal by adding these ingredients to a purified basal ration at the 5 per cent level, replacing an equivalent amount of cerelose. The results showed that with the six samples tested both types of alfalfa meal gave significantly improved growth over the basal diet and that the sun-cured meal exhibited growth promoting properties superior to those of the dehydrated meal.

Hansen et al (1953) concurred with Scott (1953) and postulated that both dehydrated and sun-cured alfalfa meal contain a factor, probably unidentified, that improves chick growth and that sun-cured meal is a better source of the factor than dehydrated leaf meal.

Vavich et al (1953) related the growth stimulation in chicks to unknown growth factors in the dehydrated alfalfa leaf meal. Greatest stimulation was observed when the chicks were held on a vitamin A depleted diet prior to the test.

Ackerson et al (1951) found no depression of growth using 2, 3, 4, 5, 6, 9, 10, 12 and 15 per cent dehydrated alfalfa leaf meal in high corn chick rations. The rations were fed in pellet form to chicks in

individual cages, each chick being allotted 920 grams. It was found that the lots receiving alfalfa ate more readily than the lots without the alfalfa and consumed the allotted amount 3 to 6 days earlier. The pelleted feed was quite readily accepted even when it contained up to 15 per cent of alfalfa.

(b) Alfalfa meal in laying rations

One of the earliest investigations to determine the effect of green feed substitutes on egg production and hatchability was conducted by Stuart (1929). Various substitutes were tested including alfalfa leaves, alfalfa meal and sprouted oats. It was found that alfalfa meal fed hens were the third highest in egg production whereas in incubation studies the eggs from such hens gave the highest hatchability.

Heywang (1933) tested sun-cured alfalfa leaf meal, sun-cured alfalfa meal and alfalfa hay as green feed substitutes for layers and found in hatchability studies that the group receiving the alfalfa leaf meal produced a much greater percentage of hatchable eggs than the group receiving a similar amount of alfalfa meal. The alfalfa hay proved to be an unreliable substitute.

Nestler and associates (1936), Hunt and associates (1939), and Bethke et al (1946) stated that there is a factor or factors in alfalfa leaf meal other than riboflavin which appears to improve the hatchability of eggs from hens receiving the meal.

Heywang (1950) found that when dehydrated alfalfa meal was included above the 5 per cent level and sun-cured alfalfa meal was included above the 10 per cent level there was a decrease in egg production. In another test he fed dehydrated alfalfa meal at 10, 15, 20 and 25 per cent levels and observed that as the amount of alfalfa meal was increased egg

production decreased. However, the average total feed consumption was about the same in all groups.

Jensen and workers (1952) conducted production tests with laying pullets fed diets containing levels of alfalfa meal varying from 2.5 to 25.0 per cent in both mash and pellet form. All groups fed pellets made substantial gains in body weight during the experiment and all the groups fed mash except the one at the 2.5 per cent alfalfa level lost weight in direct proportion to the amount of alfalfa meal included in the diet. Total feed consumption increased in the pelleted diets as the level of alfalfa increased. No significant difference in egg production or egg weight was evident among the various treatments. An increase in egg yolk color was noted with the higher levels of alfalfa.

Jacobs and associates (1953) conducted a production and hatchability test with White Leghorn pullets reared in individual cages on raised screen floors. The ration used was a corn-soybean basal diet with alfalfa included at the 5 per cent level and the diet fortified with 50 micrograms of B_{12} per kilogram. The hatchability results were:

Basal ration (no alfalfa nor B_{12})	51.59 per cent
Basal ration + Vitamin B_{12}	59.14 per cent
Basal ration + Vitamin B_{12} and alfalfa meal	68.89 per cent

Alfalfa meal alone did not improve hatchability but in combination vitamin B_{12} and alfalfa leaf meal did, which suggests a relationship between vitamin B_{12} and alfalfa leaf meal. Jacobs et al, in contrast to Ayala (1951), did not detect any vitamin B_{12} activity in alfalfa leaf meal as there was an increase in the number of embryos showing vitamin B_{12} deficiency symptoms when dehydrated alfalfa leaf meal was added to the ration.

On the other hand there was an increase in the vitamin B_{12} content of the eggs when B_{12} was added to the diet.

Cravens and associates (1942) conducted a series of experiments to determine the effect of alfalfa leaf meal and dried cereal grass on egg production and hatchability. Cereal grass was fed at a 2.5 per cent level and alfalfa was included at levels of 0.5, 2.5, 5.0 and 10 per cent. It was observed that in egg production there was very little difference between the alfalfa fed and cereal grass fed hens but in hatchability the alfalfa diets proved superior. In further tests the manganese and riboflavin levels of the diets were increased but these ingredients had no additional effect on hatchability. It was concluded that rations composed largely of grains, grain by-products, minerals and fish oil were deficient in some factor or factors supplied by alfalfa leaf meal and to a lesser extent by cereal grass. These workers suggest that at least 2 per cent alfalfa leaf meal is essential for maximum hatchability.

(c) Alfalfa meal in turkey rations

A number of workers have investigated the value of including dehydrated alfalfa leaf meal in turkey rations. Alder (1949) suggested that starting mashes for poults should contain 15 to 18 per cent by weight of alfalfa meal for best results. In growing mashes there was no difference in final growth weight and finishing conditions of turkeys when alfalfa meal was included at varying levels from 5 to 40 per cent.

Using a mixture of equal parts of dehydrated alfalfa leaf meal and dehydrated cereal grass, Slinger et al (1949) reported no significant depression of growth in turkey poults fed this mixture at levels of 10, 15 and 20 per cent in both pelleted and unpelleted form. They found greater differences between the pelleted and unpelleted mashes than

between the levels of dehydrated products fed.

German and Couch (1950) obtained detrimental results on growth when 8 per cent and 20 per cent dehydrated alfalfa leaf meal replaced ground grain and grain products in a poult ration. The incorporation of these two levels in poult rations decreased growth respectively by 18 and 36 per cent.

Draper (1952) showed that the inclusion in a poult starter ration of alfalfa meal in varying levels from 10 to 22 per cent gave comparable gains and feed efficiencies. Alfalfa at levels in excess of 25 per cent definitely depressed the weight and efficiency of gain. Mortality was not affected in any of the lots.

(d) Dehydrated cereal grass in poultry rations

Lampman and associates (1938) observed that orchard grass contained four times as much manganese as did alfalfa meal. A perosis producing ration was used replacing 5 per cent alfalfa meal with cereal grass. They found that the latter proved as efficient in preventing perosis as manganese salt. Cravens and workers (1941) found that 1 per cent dried cereal grass or 2 per cent alfalfa meal supplied sufficient vitamin K in a breeding ration for hens to maintain normal blood clotting time of day-old chicks. This suggests that cereal grass contains a higher content of this vitamin than does alfalfa meal.

With reference to the value of cereal grass in starting rations Slinger et al (1949) stated that unpublished results from their department indicate that one pound of dehydrated cereal grass can replace two pounds of dehydrated alfalfa meal in practical poultry starting rations and that a mixture of the two supplements gives superior results than either one alone. Hansen et al (1953) found that chick growth was less on 5 per cent

dehydrated cereal (oat) grass than on 5 per cent forage juice concentrate. These workers postulated that dehydration destroys the growth activity of the cereal grass.

Scott and co-workers (1948) substituted 6 per cent "Cerograss" for an equal weight of red dog flour and found no significant difference in growth rate in comparison with that produced by the high energy basal ration. Scott (1951 a) observed that the addition of 5 per cent oat grass to a poult starter ration resulted in no increase in growth of turkey poults up to four weeks of age. On the other hand the inclusion of 5 per cent alfalfa juice or grass juice resulted in a marked gain in weight of the turkey poults. It was concluded that the unknown factor was not stable under the conditions used for the dehydration of the grass. Using a corn-soybean basal with and without aureomycin, Scott and associates (1951 b) found no significant difference in growth rate in turkey poults over the basal ration when dehydrated alfalfa leaf meal and dehydrated cereal (rye) grass were included at the 5 per cent level.

EXPERIMENTAL PROCEDURE

A. Alfalfa meal and cereal grass in chick rations

Experiment I - Palatability studies

Graham (1932) in his classic studies concerning the ability of chickens to balance their own rations when given free access to separate feed ingredients showed that alfalfa meal was the least consumed with the sole exception of sodium chloride. These findings suggest that the alfalfa meal offered was either not palatable or that the birds had little physiological need for alfalfa. Dove (1935) stated that chicks showed a strong dislike for alfalfa leaf meal. Large numbers of chicks were exposed to a wide variety of feed stuffs including alfalfa leaf meal. Over a period of 11 weeks no alfalfa leaf meal was consumed.

Experiment I was conducted to compare the palatability of dehydrated alfalfa leaf meal and dehydrated cereal grass. These dry forage meals were offered to chicks free choice and constituted their only source of vitamin A.

The experiment was performed with 160 White Leghorn chicks of mixed sex. These were individually wing-banded, weighed and randomly distributed at hatching time into 8 equal lots. Each lot was placed in a separate compartment of an electrically heated battery brooder. Four of the lots were subjected to four different dietary treatments. Each treatment was replicated once.

The basal ration (see Table I) conformed to the 1950 recommendations of the National Research Council's Nutrient Allowance for poultry*

* Recommended Nutrient Allowances for Poultry. Issued by the National Research Council, 2101 Constitution Avenue N.W., Washington 25, D.C. 1950.

TABLE 1

Composition of Basal Diet used in Experiment I

Ingredients	%
Wheat	49.12
Oat-groats	24.00
Soybean oil meal (41% protein)	18.00
Meat meal (50% protein)	5.50
Fish meal (65% protein)	1.00
Milk Powder	1.00
Salt (iodized)	0.50
Limestone	0.88
	gms/100 lbs.
Manganese sulphate	10.00
Choline chloride	24.00
Riboflavin premix*	4.00
Dry vitamin D_3**	3.20
Dry vitamin A***	40.00
Vitamin B_{12} and antibiotic supplement****	25.00
Calculated Analysis	%
Protein	21.02
Fat	4.17
Fibre	2.73
Calcium	1.01
Phosphorous	0.72

* Riboflavin premix - 1 oz. of premix contains 1 gram of pure riboflavin

** Dry vitamin D_3 - 11,000,000 units per pound

*** Dry vitamin A - 5,000 I.U. per pound

**** Vitamin B_{12} and antibiotic supplement - 3 mgs. of vitamin B_{12} and 4 gms. of procaine penicillin per pound.

with the vitamin A allowance being met by use of dry vitamin A.

Treatment A - basal ration

Treatment B - basal ration devoid of vitamin A but the chicks were permitted free choice of dehydrated alfalfa leaf meal.*

Treatment C - basal ration devoid of vitamin A but the chicks were permitted free choice of dehydrated cereal grass.*

Treatment D - basal ration devoid of vitamin A but the chicks were permitted free choice of both alfalfa and cereal grass.

In the case of treatments B, C and D separate feed troughs contained the basal ration, the alfalfa and the cereal grass. The troughs were rotated weekly to preclude habit forming tendencies that might develop due to the location of the feeders. At the termination of the experiment the amount of each of basal ration, alfalfa and cereal grass consumed on each treatment was determined.

Experiment II - Palatability studies extended

Experiment II was conducted to obtain information on the relative palatability of alfalfa and cereal grass when these two ingredients are incorporated at increasing levels into the basal chick starter used in Experiment I.

One hundred Rhode Island Red day-old male chicks were distributed at random into two lots of 50 chicks each. All the chicks were floor

* Hereafter referred to as alfalfa and cereal grass. These products contained by analysis a minimum of 20 per cent protein and 21 and 33 milligrams carotene per 100 grams respectively.

TABLE 2

Composition of Diets used in Experiment II

Ingredients	Treatments A %	B %	C %	D %	E %	F %	G %
Wheat	49.12	48.62	48.62	46.62	46.62	44.60	44.20
Oat groats	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Soybean oil meal	18.00	17.50	17.50	15.50	15.50	13.00	13.00
Meat meal (50% protein)	5.50	5.50	5.50	5.50	5.50	5.50	5.50
Fish meal (65% protein)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Milk powder	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Salt (iodized)	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Limestone	0.88	0.88	0.88	0.88	0.88	0.40	0.80
Dehyd. alfalfa leaf meal	--	1.00	--	5.00	--	10.00	--
Dehyd. cereal grass	--	--	1.00	--	5.00	--	10.00
	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.
Manganese sulphate	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Choline chloride	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Riboflavin premix*	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Dry vitamin D_3**	3.20	3.20	3.20	3.20	3.20	3.20	3.20
Dry vitamin A***	40.00	20.00	20.00	--	--	--	--
Vitamin B_{12} and sntibiotic supp.****	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Calculated Analysis	%	%	%	%	%	%	%
Protein	21.02	20.98	20.97	20.74	20.74	20.52	20.53
Fat	4.17	3.41	3.42	3.32	3.41	4.16	4.34
Fibre	2.73	2.86	2.85	3.35	3.28	3.98	3.85
Calcium	1.01	1.00	1.44	1.10	1.04	1.03	1.08
Phosphorous	0.72	0.72	0.72	0.73	0.75	0.75	0.76

* Riboflavin premix - 1 oz. of premix contains 1 gram of pure riboflavin

** Dry vitamin D_3 - 11,000,000 units per pound

*** Dry vitamin A - 5,000 I.U. per pound

**** Vitamin B_{12} and antibiotic supp. - contains 3 mg. vit. B_{12} per lb. and 4 gms. of procaine penicillin per lb.

brooded in 2 pens of equal size throughout the 6 week experimental period.

Seven different treatments were tested. Treatment A consisted of the basal ration alone. Treatments B, C, D, E, F and G consisted of the basal ration with alfalfa and cereal grass respectively being incorporated into the basal ration at the 1, 5, and 10 per cent levels (see Table 2). The alfalfa and cereal grass were incorporated into the basal ration at the expense of ground wheat and ground oat groats in such proportions and amounts that would balance the protein in all diets at the 20 per cent level. The vitamin A level supplied by carotene in the alfalfa and cereal grass was calculated and dry vitamin A was added in sufficient amount to each treatment to maintain a constant level of vitamin A in each of the rations.

Thus each lot of chicks was given access to the seven treatments by placing each ration in a separate feed trough. The troughs were so positioned that the chicks had free and equal access to any feed they desired. The troughs were rotated systematically each week to obviate habit forming tendencies that might occur. At the termination of the experiment the quantity of each ration consumed was ascertained.

Experiment III - Growth and feed efficiency studies

Following the palatability studies a series of experiments were undertaken to determine if differences exist between alfalfa and cereal grass with respect to their ability to promote rapid and economical growth.

Four hundred and forty White Leghorn day-old chicks of mixed sex were distributed at random into 22 equal lots which were subjected to eleven different replicated treatments. All the chicks were reared in battery brooders to 5 weeks of age, with feed and water being supplied ad libitum. The chicks were weighed and wing-banded individually when hatched and

TABLE 3

Composition of Diets used in Experiment III

Ingredients	Treatments A %	B %	C %	D %	E %	F %	G %	H %	I %	J %	K %
Wheat	49.12	48.62	48.62	46.62	46.62	44.60	44.20	37.80	37.50	34.00	33.80
Oat-groats	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Soybean Oil Meal (41% protein)	18.00	17.50	17.50	15.50	15.50	13.00	13.00	15.00	15.00	14.00	14.00
Meat meal (50% protein)	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50
Fish meal (65% protein)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Milk powder	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Salt (iodized)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Limestone	0.88	0.88	0.88	0.88	0.88	0.40	0.80	0.20	0.50	--	0.20
Dehyd. alfalfa leaf meal	--	1.00	--	5.00	--	10.00	--	15.00	--	20.00	--
Dehyd. cereal grass	--	--	1.00	--	5.00	--	10.00	--	15.00	--	20.00
	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.
Manganese sulphate	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Choline chloride	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Riboflavin premix*	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Dry D_3**	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
Dry vitamin A***	40.00	20.00	20.00	--	--	--	--	--	--	--	--
Vitamin B_{12} and **** antibiotic supplement	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Calculated Analysis	%	%	%	%	%	%	%	%	%	%	%
Protein	21.02	20.98	20.97	20.74	20.74	20.52	20.53	21.60	21.60	21.70	21.70
Fat	4.17	3.41	3.42	3.32	3.41	4.16	4.34	3.43	3.51	4.41	4.51
Fibre	2.73	2.86	2.85	3.35	3.28	3.98	3.85	5.21	5.03	5.92	5.89
Calcium	1.01	1.00	1.44	1.10	1.04	1.03	1.08	1.02	1.04	1.08	1.08
Phosphorous	0.72	0.72	0.72	0.73	0.75	0.75	0.76	0.76	0.77	0.77	0.78

* Riboflavin premix - 1 oz. of premix contains 1 gram pure riboflavin
** Dry vitamin D_3 - 11,000,000 units per pound
*** Dry vitamin A - 5,000 I.U. per pound
**** Vitamin B_{12} and antibiotic supplement - contains 3 mgs. of vitamin B_{12} and 4 gms. of procaine pencillin per pound

weighed weekly thereafter until the experiment was terminated. Feed conversion, body weight and mortality data were recorded at weekly intervals for each lot.

Treatment A consisted of the same basal ration used in Experiments I and II. Treatments B, C, D, E, F, G, H, I, J and K consisted of the basal ration with alfalfa and cereal grass included separately at levels of 1, 5, 10, 15 and 20 per cent respectively. In this experiment as with the foregoing the alfalfa and cereal grass were incorporated into the basal ration at the expense of ground wheat and soybean oil meal (see Table 3).

Experiment IV - Growth and feed efficiency studies extended

The object was to study further the effect of varying levels of alfalfa and cereal grass on growth and feed efficiency in chicks. This experiment differed from Experiment III in that the range of inclusion of dried forage products was reduced from 0 to 20 per cent to a range of 0 to 10 per cent. Moreover this test investigated the effect on chick growth, mortality and feed conversion when alfalfa and cereal grass were mixed together in proportions of 1:1 and 3:1.

The same experimental set up used in Experiment III was employed with the exception that the experimental stock in each lot consisted of 12 day-old White Leghorn female chicks. The duration of the experiment was 5 weeks.

The alfalfa and cereal grass were again incorporated into the different diets at the expense of ground wheat and soybean oil meal. The eleven replicated treatments or diets comprising the basis for this experiment were as follows:

Treatment A - Basal ration containing no dry forage (used in Experiment I and II)

Treatment B - Basal ration plus 1.00% alfalfa and 0.00% cereal grass

Treatment C - " " " 0.75% " " 0.25% " "

Treatment D - " " " 0.50% " " 0.50% " "

Treatment E - " " " 0.25% " " 0.75% " "

Treatment F - " " " 0.00% " " 1.00% " "

Treatment G - " " " 10.00% " " 0.00% " "

Treatment H - " " " 7.50% " " 2.50% " "

Treatment I - " " " 5.00% " " 5.00% " "

Treatment J - " " " 2.50% " " 7.50% " "

Treatment K - " " " 0.00% " " 10.00% " "

Experiment V - Growth and feed efficiency studies extended

In experiment IV it was observed that there was a significant difference in growth rate and feed efficiency between the chicks fed on the diets containing the 1 per cent level and 10 per cent level of dry forage meals. Experiment V was therefore undertaken to determine the effect on chick growth and efficiency of feed conversion when the levels of inclusion of alfalfa and cereal grass were reduced to a range of 0 to 5 per cent and using the same ratio for mixing the two ingredients that were used in Experiment IV.

The experimental set up employed was identical to Experiment IV with no exceptions.

Treatments A, B, C, D, E and F all were identical to the corresponding treatments used in the former trial. Treatments G, H, I, J and K were the same as their counterparts in Experiment IV with the exception

that the level of inclusion of alfalfa and cereal grass in the basal ration was 5 per cent instead of 10 per cent as used formerly.

Treatment A - Basal ration - no dry forage included in the diets

Treatment B - Basal ration plus 1.00% alfalfa plus 0.00% cereal grass

Treatment C - " " " 0.75% " " 0.25% " "

Treatment D - " " " 0.50% " " 0.50% " "

Treatment E - " " " 0.25% " " 0.75% " "

Treatment F - " " " 0.00% " " 1.00% " "

Treatment G - " " " 5.00% " " 0.00% " "

Treatment H - " " " 3.75% " " 1.25% " "

Treatment I - " " " 2.50% " " 2.50% " "

Treatment J - " " " 1.25% " " 3.75% " "

Treatment K - " " " 0.00% " " 5.00% " "

Experiment VI - Growth and feed efficiency data extended

The object of this experiment was to determine the effect on chick growth and efficiency of feed conversion when alfalfa and cereal grass were incorporated into a chick ration at the same levels as used in their maternal diets.

To produce chicks for this experiment eight breeding pens of White Leghorns were fed for 16 weeks on rations containing the same levels of alfalfa and cereal grass as were to be fed to the resulting progeny, namely 0.0, 0.5, 2.0 and 4.0 per cent and a combination of these two forages in the proportion of 1 part of alfalfa to 1 part of cereal grass at the 2.0 per cent level. During the 16th week the eggs from each breeding pen were saved, trayed separately and set. At hatching time 50 chicks were selected at random from each of these trays and placed on their respective diets.

Basically the eight experimental diets or treatments were as follows: (see Table 4)

Treatment A - Basal ration (same basal ration used in all former experiments)

Treatment B - Basal ration plus 0.50% alfalfa

Treatment C - " " " 0.50% cereal grass

Treatment D - " " " 2.00% alfalfa

Treatment E - " " " 2.00% cereal grass

Treatment F - " " " 1.00% alfalfa plus 1.00% cereal grass

Treatment G - " " " 4.00% alfalfa

Treatment H - " " " 4.00% cereal grass

The eight lots composed the experiment. No replicates were used in this test as it was felt that 50 chicks per lot would be a valid test. The usual experimental procedure was followed with the chicks being weighed and wing-banded when put on test and then weighed weekly thereafter for five weeks, the duration of the test. Feed and water were supplied ad libitum.

TABLE 4 — Composition of Diets used in Experiment V

Ingredients	Treatments A %	B %	C %	D %	E %	F %	G %	H %
Wheat	49.12	49.04	49.04	48.29	48.22	48.15	47.11	47.05
Oat groats	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Soybean oil meal (41% protein)	18.00	17.66	17.66	16.99	16.99	16.99	16.33	16.33
Meat meal (50% protein)	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50
Fish meal (65% protein)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Milk powder	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Limestone	0.88	0.80	0.80	0.72	0.79	0.86	0.56	0.62
Dehyd. alfalfa leaf meal	--	0.50	--	2.00	--	1.00	4.00	--
Dehyd. cereal grass	--	--	0.50	--	2.00	1.00	--	4.00
	gms per 100 lbs	gms per 100 lbs	gms per 100 lbs	gms per 100 lbs	gms per 100 lbs	gms per 100 lbs	gms per 100 lbs	gms per 100 lbs
Manganese sulphate	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Choline chloride	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Riboflavin premix*	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Dry D_3 vitamin**	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
Dry vitamin A***	40.00	20.00	20.00	--	--	--	--	--
B_{12} and antibiotic supplement****	17.50	17.50	17.50	17.50	17.50	17.50	17.50	17.50
Calculated Analysis	%	%	%	%	%	%	%	%
Protein	20.79	20.75	20.73	20.70	20.73	20.71	20.72	20.72
Fat	4.17	4.16	4.17	4.17	4.19	4.20	4.18	4.17
Fibre	2.73	2.80	2.78	2.99	2.96	2.97	3.24	3.20
Calcium	1.01	1.14	1.15	1.10	1.13	1.14	1.10	1.27
Phosphorous	0.72	0.72	0.73	0.73	0.71	0.72	0.73	0.76

* Riboflavin premix - 1 oz. of premix contains 1 gram pure riboflavin
** Dry vitamin D_3 - 11,000,000 units per pound
*** Dry vitamin A - 5,000 I.U. per pound
****Vitamin B_{12} and antibiotic supplement - contains 3 mgs. of vitamin B_{12} and 4 gms. of procaine pencillin per pound.

B. Alfalfa meal and cereal grass in poult rations

Experiment I - Poult growth and feed efficiency study

The object of this experiment was to gather information on the comparative value of alfalfa and cereal grass as they affect growth and efficiency of feed conversion when included in a turkey poult ration.

The experimental stock consisted of 120 Broad Breasted Bronze one week old poults of mixed sex. These were individually weighed, banded and randomly distributed into 12 lots. The poults were floor brooded in equal size pens containing identical accessories (feed troughs, water fountains, brooders). Six lots of poults were subjected to six treatments, and replicated once. Treatments A, C and D (Table 5) contained soybean oil meal and meat meal as the main protein source. Treatments B, E and F contained soybean oil meal only as the protein concentrate. The forage meals were included in treatments C, D, E and F at the 8 per cent level. Ground whole oats were added to treatments A and B to raise the fibre levels of these two rations to the same level as the other treatments. Sulfa quinoxaline and 2 amino - 5 nitrothiazole were added to all diets as prophylactic agents to control coccidiosis and enterohepatitis.

The experiment was conducted for a period of five weeks. Feed conversion, body weight and mortality data were calculated for each lot of poults at weekly intervals. Feed and water were supplied ad libitum to all lots of poults during the experimental period.

TABLE 5

Composition of Rations used in Turkey Experiment I

Ingredients	Treatments A %	B %	C %	D %	E %	F %
Wheat	18.17	8.00	33.00	33.00	29.37	29.37
Oat groats	20.00	20.00	20.00	20.00	20.00	20.00
Whole oats	24.00	26.00	--	--	--	--
Soybean oil meal (41% protein)	16.00	38.00	24.50	24.50	33.63	33.63
Meat meal (50% protein)	18.00	--	10.00	10.00	--	--
Whey powder	2.00	2.00	2.00	2.00	2.00	2.00
Limestone	1.33	2.67	2.00	2.00	2.00	2.00
Bonemeal	--	3.33	--	--	4.50	4.50
Salt (iodized)	0.50	0.50	0.50	0.50	0.50	0.50
Dehydrated alfalfa leaf meal	--	--	8.00	--	8.00	--
Dehydrated cereal grass	--	--	--	8.00	--	8.00
	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.	gms. per 100 lbs.
Dry vitamin A*	80.0	80.0	80.0	80.0	80.0	80.0
Dry vitamin D_3**	9.9	9.9	9.9	9.9	9.9	9.9
Riboflavin premix***	5.6	5.6	5.6	5.6	5.6	5.6
Choline chloride	103.0	103.0	103.0	103.0	103.0	103.0
Manganese Sulphate	10.0	10.0	10.0	10.0	10.0	10.0
Niacin	1.25	1.25	1.25	1.25	1.25	1.25
Methonine	25.0	25.0	25.0	25.0	25.0	25.0
Vitamin B_{12} supplement****	25.0	25.0	25.0	25.0	25.0	25.0
Aurofac*****	22.0	22.0	22.0	22.0	22.0	22.0
Calculated Analysis	%	%	%	%	%	%
Protein	24.00	23.20	23.90	23.90	23.20	23.20
Fat	4.22	4.81	4.56	4.61	4.01	4.15
Fibre	5.53	5.54	5.37	5.37	5.88	5.88
Calcium	2.02	2.02	2.02	2.05	2.03	2.03
Phosphorous	0.95	0.93	0.95	0.95	0.98	0.98

* Dry vitamin A - 5,000 I.U. per pound

** Dry vitamin D_3 - 11,000,000 units per pound

*** Riboflavin premix - 1 ounce of premix contains 1 gram of pure riboflavin

**** Vitamin B_{12} supplement - 6 mgs. of B_{12} per pound

***** Aurofac - 10 grams of aureomycin per pound

C. Alfalfa and cereal grass in laying rations

Experiment I - Egg production and hatchability studies

In November, 1953, the first tests were initiated to ascertain what effect, if any, the inclusion of increasing levels of alfalfa and cereal grass in the diet of laying hens, would have on subsequent rate of production and hatchability. The experiment was conducted in a poultry house having thermostatically controlled steam heat. The heat was held constant at 50° F. The house was equipped with sixteen pens of equal dimensions, each pen containing identical accessories including feeders, waterers and a three-compartment trap nest but no roosts. Lighting arrangements were such that all pens were subjected to the same intensity of illumination. By random distribution each of the sixteen pens received nine White Leghorn pullets and one cockerel. All the birds were procured from the University poultry flock. Until the commencement of the trial they had been reared and fed under regular university supervision and conditions. As this experiment was designed to test the effect of different levels of both alfalfa and cereal grass with respect to rate of production and hatchability, it was deemed desirable to replicate each treatment once. As a means of eliminating infertility due to incompatability, all males were systematically introduced into a new pen of pullets three times per week. The duration of the experiment was 120 days. During this period the birds received all mash rations and water ad libitum. The eight replicated treatments or diets comprising the basis for this experiment were as follows:

Treatment A - Basal ration containing no dry forages

Treatment B - " " plus 0.50 per cent alfalfa

Treatment C - " " " 0.50 per cent cereal grass

Treatment D - " " " 2.00 per cent alfalfa

Treatment E - Basal ration plus 2.00 per cent cereal grass

Treatment F - " " " a mixture composed of 1.0 per cent alfalfa and 1.0 per cent cereal grass

Treatment G - Basal ration plus 4.00 per cent alfalfa

Treatment H - " " " 4.00 per cent cereal grass

The basal ration conformed in composition to the Required Nutrient Allowances of the National Research Council 1950 for breeding hens, with a protein content of 15 per cent. The alfalfa and cereal grass were incorporated into the various diets at the expense of ground wheat and soybean oil meal (see Table 6). To maintain a constant level of vitamin A in all the diets, the vitamin A activity supplied by the alfalfa and cereal grass was calculated and dry vitamin A was added to the various rations where required.

The birds were trap-nested 5 days per week. The eggs were marked, gathered and stored daily including Sundays in an egg room that was maintained at average temperature of 62± 7° F. At intervals of two weeks, the eggs were incubated in a 2940 Jamesway unit after being candled to remove cracks and double yolks.

On the eighteenth day of incubation the eggs were candled. Infertile and dead germs were removed from the machine, broken open and classified into 4 groups, namely, (a) infertile, (b) dead in shell first week, (c) dead in shell second week, (d) dead in shell 14th to 18th day. In all, 8 hatches were satisfactorily completed.

Experiment II - Egg production and hatchability studies extended

In October 1954 the second test using Leghorn pullets was undertaken. This experiment was designed to extend the results obtained from

TABLE 6

Composition of Diets used in Laying Experiments I and II

	Treatments							
Ingredients	A %	B %	C %	D %	E %	F %	G %	H %
Wheat	61.56	61.26	61.26	59.86	59.86	59.86	59.10	59.10
Oat groats	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Soybean oil meal (41% protein)	4.30	4.15	4.15	4.10	4.10	4.10	3.00	3.00
Meat meal (50% protein)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Bonemeal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Limestone	3.64	3.59	3.59	3.54	3.54	3.54	3.42	3.42
Salt (iodized)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Granite grit (insoluble)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Dehydrated alfalfa leaf meal	--	0.50	--	2.00	--	1.00	4.00	--
Dehydrated cereal grass	--	--	0.50	--	2.00	1.00	--	4.00
	gms/100 lbs	gms/100 lbs	gms/100 lbs	gms/100 lbs	gms/100 lbs	gms/100 lbs	gms/100 lbs	gms/100 lbs
Manganese sulphate	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Riboflavin premix*	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Dry vitamin D_3**	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74
Dry vitamin A ***	274.70	256.70	240.30	203.30	137.30	170.30	131.10	--
Calculated Analysis	%	%	%	%	%	%	%	%
Protein	15.00	15.05	15.04	15.19	15.16	15.15	15.05	15.05
Fat	2.75	2.75	2.76	2.75	2.74	2.74	2.76	2.76
Fibre	3.29	3.39	3.34	3.33	3.34	3.34	3.45	3.45
Calcium	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25
Phosphorous	0.75	0.75	0.75	0.75	0.75	0.76	0.77	0.77

* Riboflavin premix - 1 ounce of premix contains 1 gram of pure riboflavin
** Dry vitamin D_3 - 11,000,000 units per pound
*** Dry vitamin A - 5,000 I.U. per pound

the 1953 trials. The same experimental house and equipment were used as in the previous year. The pullets on this test were grown from day old chicks procured from the last hatch of Experiment I. These chicks were reared to maturity on rations containing identical levels of alfalfa and cereal grass as included in their respective maternal diets.

At six months of age 16 of the best pullets were selected from each lot. These pullets were randomly distributed into two pens of equal size. This made a total of 16 pens containing 8 pullets and one cockerel each. The same experimental procedure was followed as outlined in Experiment I with the exception that eggs were stored prior to incubation at a constant temperature of 50° F.

Attention is here drawn to one of the main differences between the birds used in Experiments I and II. Neither the birds used in Experiment I nor their parents had been subjected to specific levels of alfalfa or cereal grass in their diets prior to being placed on test. The maternal diets of birds on Experiment II and their own starting and growing rations contained exactly the same levels of alfalfa and cereal grass as they themselves were offered during the 98 day production and hatchability study here reported. Experiment II, furthermore, included a study of the effect of the two forage meals on interior egg quality as determined by candling in accordance with the official Canadian Government egg grading regulations* in so far as they relate to Grade A and B for yolk shadow and air cell size.

* Regulations respecting the grading, packing and marking of eggs. Canada Department of Agriculture, Ottawa, Canada, (1951).

RESULTS

A. Alfalfa and cereal grass in chick rations

Experiment I

The results of Experiment I are shown in Table 7. No statistical analyses were made as the data gathered did not lend themselves to this form of analysis. In all cases the chicks preferred alfalfa to cereal grass. In treatment B (cereal grass), the average consumption of cereal grass was 860 grams while in treatment C (alfalfa) the average consumption of alfalfa was 920 grams. In treatment D, where the chicks had access to both alfalfa and cereal grass as the vitamin A supplement, the average consumption of alfalfa by the two replicates was 627 grams, while the average consumption of cereal grass was only 454 grams, a difference of 173 grams.

Treatment C produced the greatest rate of gain and efficiency of feed conversion, while treatment A (the basal ration) produced the least, a difference of 36 grams in mean growth weight at 6 weeks and a difference of 0.66 grams of feed per gram of gain in feed efficiency. Treatment C and D show very little difference in growth weight and feed efficiency. The fact that in both of these treatments the chicks had access to alfalfa may have had some bearing on the results. The mortality that occurred in this experiment could not be attributed to the diets fed.

Experiment II

The results of this experiment (see Table 8) indicate that the inclusion of alfalfa and cereal grass in a chick ration at varying levels up to 10 per cent did not reduce the palatability of the diets. The chicks consumed as much of treatments F and G (the 10 per cent level of alfalfa and cereal grass) as they did of treatment A(the basal ration). Furthermore there did not appear to be any measurable difference in the palatability