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INTRODUCTION

The use of dehydrated sweet potato meal as a carbohydrate feedstuff for poultry and livestock has attracted considerable interest within recent years. The southern section of the United States is a "feed-deficient" area, particularly so in carbohydrate feedstuffs. Of such feeds, corn is the most widely used; but the soil, climatic conditions and types of farming make it impossible to produce locally an adequate supply of this grain. Many areas in the South are better adapted to the production of sweet potatoes than of corn. In Louisiana, for example, the average production of corn for the ten year period, 1929-1938 was 14.5 bushels per acre, while the average production of sweet potatoes for the same period was 70 bushels per acre. According to Morrison (1936), number 2 dent corn contains 87.2 per cent dry matter and sweet potatoes contain 31.5 per cent dry matter. On this basis one acre of corn will yield 708.06 pounds of dry matter and one acre of sweet potatoes will yield 1,102.5 pounds of dry matter.

Fresh sweet potatoes have been used to a limited extent in poultry and livestock feeding for many years; however, because of the bulkiness of sweet potatoes, most farm animals cannot consume a sufficient quantity to supply the energy needs of their bodies. This limitation has led to the development of sweet potato dehydrators, many of which are operating in the South at the present time.

The production of dehydrated sweet potatoes which is usually ground into a meal naturally raised questions concerning its use and place in the rations of farm animals. Since this is a relatively new feedstuff, there have been very few experimental studies reported concerning its nutritive value. Lease and Mitchell (1940) studied the influence of sweet potato meal in the ration of laying hens upon the vitamin A content of eggs. Egg yolks from hens on a vitamin A deficient diet contained eight blue units of vitamin A per gram of yolk. Thirty days after the hens were placed on a ration containing 25 per cent of sweet potato meal, the vitamin A content of the egg yolks increased to 42 blue

units per gram. Work is in progress at practically all of the Agricultural Experiment Stations in the South on the use of sweet potato meal, particularly in the rations of cattle and swine. The work reported in this publication summarizes the results of studies conducted to determine the relative value of dehydrated sweet potato meal compared to other carbohydrate feeds and the extent to which it can be used in chick rations.

EXPERIMENTS AND RESULTS

Because of the nature of this investigation, it was necessary to modify slightly the experimental procedure as the work progressed. For convenience in presenting and discussing the data, the experiments were divided into three groups which are designated as series A, B, and C. Each series will be discussed later in the order named.

A total of nine experiments were conducted which involved the use of 2,200 day-old chicks. The experiments in series A were conducted for a period of weeks. The experiments of series B and C were continued for only eight weeks, in order to complete as many experiments as possible during the time available for this project. Each experiment included 10 pens of 25 chicks each. The experimental rations were fed to duplicate or triplicate pens in each experiment. The sweet potato meal used in these tests was made from Puerto Rico potatoes and was dehydrated by the "lime process."

The chicks were weighed individually and the feed consumption determined at weekly intervals. Notations of abnormal symptoms were recorded at each weighing. All growth data were weighted for sex influence in computing the final summaries. This was done by adding the average weight of the males and the average weight of the females in each pen and dividing the total by two.

The term "index number" is used in these studies in comparing the growth of the chicks on the experimental rations to the reference of control ration. In computing "index numbers," the weighted average of the chicks in the control pen was given a relative value of 100. The weighted average of the chicks in the different experimental pens was divided by that of the control ration and the quotient multiplied by 100.

All growth data obtained in these experiments were analyzed statistically by the method of analysis of variance. The degree of significance of the difference between pens was determined by the "t" test. The feed ingredients used were analyzed for protein content and combined so that the protein content of each ration was 18 ± 0.1 per cent in the experiments of series A and 19 ± 0.1 per cent in the experiments of series B and C. In all of the experimental rations the calcium and phosphorous contents were adjusted to 1.5 ± 0.05 and 0.80 ± 0.05 per cent respectively.

Experiments of Series A

The experiments of series A were designed to determine the relative value of sweet potato meal as a substitute for yellow corn meal. The rations used in this series are shown in table 1. Ration 1 was the control or reference ration. The other rations contained varying amounts of sweet potato meal which was added in the place of a similar quantity of yellow corn meal. The three experiments in series A were conducted in the fall, winter, and spring of 1940-41. Single Comb Rhode Island Red chicks were used in experiment 1 and White Plymouth Rock chicks were used in experiments 2 and 3.

Statistical analysis of the results of these feeding trials showed that no significant difference existed between comparable pens in the different experiments; therefore, the results of the three experiments were combined as shown in table 2. The results as given in this table are based upon 150 chicks per ration.

From the data presented in table 2 it is obvious that the rations containing 10 and 20 per cent of sweet potato meal are not significantly different from the reference ration. The differences between the reference ration and the rations containing 30 and 40 per cent of sweet potato meal were statistically significant.

The efficiency of feed utilization followed about the same trend as the growth data. The rations containing the lower levels of potato meal were utilized about as efficiently as the reference ration, whereas the rations containing higher levels of potato meal were utilized somewhat less efficiently.

Mortality was relatively high in all pens. However, since most of the deaths occurred during the first two weeks of the experiments, it is doubtful that the mortality can be attributed to the rations used.

INGREDIENTS	Ration 1	Ration 2	Ration 3	Ration 4	Ration 5
	Reference	10% S. P. M.*	20% S. P. M.	30% S. P. M.	40% S. P. M.
	lbs.	lbs.	lbs.	lbs.	lbs.
Yellow corn meal.....	45.00	34.50	22.50	11.00	.....
Sweet potato meal.....	.....	10.00	20.00	30.00	40.00
Wheat bran.....	10.00	10.00	10.00	10.00	10.00
Wheat shorts.....	10.00	10.00	10.00	10.00	10.00
Pulverized oats.....	10.00	10.00	10.00	10.00	10.00
Dried skim milk.....	5.00	5.00	5.00	5.00	5.00
Shrimp meal.....	8.00	10.00	10.00	10.50	12.00
Soybean oil meal.....	8.00	7.00	9.00	10.00	9.75
Oyster shell flour.....	1.00	2.00	1.50	2.00	1.25
Steamed bone meal.....	2.00	0.50	1.00	0.50	1.00
Cod liver oil.....	0.50	0.50	0.50	0.50	0.50
Salt.....	0.50	0.50	0.50	0.50	0.50
TOTAL.....	100.00	100.00	100.00	100.00	100.00

*S. P. M. = Sweet potato meal.

TABLE 2. EXPERIMENTAL OUTLINE AND A COMBINED SUMMARY OF THE RESULTS OF EXPERIMENTS 1, 2, AND 3, SERIES A.

PENS AND RATIONS	Wted. Ave. at 10 weeks		Grams of feed per gram gain	Index No.	Per cent mortality
	Gms.	lbs.			
1 and 10—Reference.....	886.5	1.95	3.46	100	16
2 and 9—10% S. P. M.*.....	871.4	1.92	3.46	98	17
3 and 8—20% S. P. M.....	861.5	1.90	3.66	97	11
4 and 7—30% S. P. M.....	791.5	1.74	4.10	89	24
5 and 6—40% S. P. M.....	750.4	1.65	4.30	85	23

*S. P. M. = Sweet potato meal.

Experiments of Series B

The experiments of series B were conducted to compare the feeding value of dehydrated sweet potato meal to that of wheat bran, rice bran, and pulverized oats. The rations used in this series are shown in table 3. Ration 1 of table 3 is a practical chick ration and was used as the reference ration. Each of the experimental rations contained corn meal plus 25 per cent of one other carbohydrate feed in addition to the protein, mineral, and vitamin supplements. Series B included two experiments which were conducted in the late spring and early summer of 1941. White Plymouth Rock chicks were used in both experiments. TABLE 1. REFERENCE RATION AND METHOD OF ADDING SWEET POTATO MEAL (SERIES A)

An analysis of the results obtained from the duplicate experiments showed that the differences between comparable pens were not statistically significant; therefore, the results of the two experiments were com-

TABLE 3. RATIONS USED IN THE FEEDING TRIALS OF SERIES B

INGREDIENTS	Ration 1 Reference	Ration 2 S. P. M.*	Ration 3 Wheat bran	Ration 4 Pulv. oats	Ration 5 Rice bran
	lbs.	lbs.	lbs.	lbs.	lbs.
Yellow corn meal.....	20.00	35.50	44.50	41.00	41.00
Sweet potato meal.....	.....	25.00	.....	.....	.....
Wheat bran.....	20.00	.....	25.00	.....	.....
Wheat shorts.....	20.00	.....	.....	.....	.....
Pulverized oats.....	13.50	.....	.....	25.00	.....
Rice bran.....	.....	.....	.....	.....	25.00
Dried skim milk.....	5.00	5.00	5.00	5.00	5.00
Alfalfa leaf meal.....	5.00	5.00	5.00	5.00	5.00
Shrimp meal.....	6.625	13.00	8.625	10.25	10.375
Soybean oil meal.....	6.625	13.00	8.625	10.25	10.375
Oyster shell flour.....	2.00	0.50	0.75	0.50	1.00
Steamed bone meal.....	0.25	2.00	1.50	2.00	1.25
Cod liver oil.....	0.50	0.50	0.50	0.50	0.50
Salt.....	0.50	0.50	0.50	0.50	0.50
TOTAL.....	100.00	100.00	100.00	100.00	100.00

*S. P. M. = Sweet potato meal.

TABLE 4. EXPERIMENTAL OUTLINE AND A COMBINED SUMMARY OF THE RESULTS OF EXPERIMENTS 1 AND 2, SERIES B.

PENS AND RATIONS	Wted. Ave. at 8 weeks		Grams of feed per gram gain	Index No.	Per cent mortality
	Grms.	lbs.			
1 and 10—Reference.....	583.8	1.29	3.94	100	17
2 and 9—S. P. M.*.....	586.4	1.29	3.69	101	15
3 and 8—Wheat bran.....	665.0	1.47	3.30	114	7
4 and 7—Pulverized oats.....	653.8	1.44	3.18	112	11
5 and 6—Rice bran.....	628.6	1.39	3.24	108	11

*S. P. M. = Sweet potato meal.

bined and are summarized in table 4. The small difference between the average weight of the chicks receiving the reference ration and those receiving the potato meal ration was not significant. However, the pens of chicks receiving wheat bran, pulverized oats, and rice bran made significantly greater gains and utilized their feed more efficiently than those receiving the reference ration or the potato meal ration. The mortality which occurred could not be attributed to the conditions of the experiment.

Experiments of Series C

In the feeding trials of Series C, sweet potato meal and yellow corn meal were fed in combination with one other cereal feed in order to measure any supplementing effects that might result from the use of a wider variety of carbohydrate feedstuffs. The carbohydrates used, other than yellow corn meal and sweet potato meal, were wheat bran, wheat shorts, rice bran, rice polish, and pulverized oats. These rations are shown in table 5.

Two reference rations (rations 1 and 7 of table 5) were used in each experiment of this series. The practical chick ration used in series B was included as one reference ration and the other contained 40 per cent of sweet potato meal and 15 per cent of yellow corn meal. This latter ration was included in order to make it possible to measure more accurately any supplementing effects of the cereal feeds that were used in this series. Four experiments were conducted in series C. Experiments 1 and 2 were duplicates as were experiments 3 and 4; however, neither could be combined statistically because of the variations between the pairs of experiments. Rations 1, 2, 3, 4, and 7 of table 5 were used in experiments 1 and 2. Rations 1, 5, 6, and 7 of table 5 were used in experiments 3 and 4 of series C. These feeding trials were all conducted in the fall and winter of 1941-42. White Plymouth Rock chicks were used in each experiment.

The experimental outline and results of experiment 1 are summarized in table 6. The chicks in this experiment were grown in a warm room and an outbreak of colds occurred during the latter part of the experi-

TABLE 5. RATIONS USED IN THE FEEDING TRIALS OF SERIES C

INGREDIENTS	Ration 1	Ration 2	Ration 3	Ration 4	Ration 5	Ration 6	Ration 7
	Reference	S. P. M.* and Wheat bran	S. P. M. and Rice bran	S. P. M. and Pulv. oats	S. P. M. and Wheat shorts	S. P. M. & Rice polishings	40% S. P. M.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Yellow corn meal	20.00	22.50	21.00	20.00	24.50	20.50	15.00
Sweet potato meal . . . . .	.....	20.00	20.00	20.00	20.00	20.00	40.00
Wheat bran	20.00	20.00	.....	.....	.....	.....	.....
Wheat shorts	20.00	.....	.....	.....	20.00	.....	.....
Rice bran . . . . .	.....	.....	20.00	.....	.....	.....	.....
Rice polishings . . . . .	.....	.....	.....	.....	.....	20.00	.....
Pulverized oats	13.50	.....	.....	20.00	.....	.....	.....
Alfalfa leaf meal	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Dried skim milk	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Shrimp meal	6.625	12.00	13.00	13.50	11.00	13.25	15.75
Soybean oil meal	6.625	12.00	13.00	13.50	11.00	13.25	15.75
Oyster shell flour	2.00	1.00	1.00	.....	1.00	0.75	.....
Steamed bone meal	0.25	1.50	1.00	2.00	1.50	1.25	2.50
Cod liver oil	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00

*S. P. M. = Sweet potato meal.

TABLE 6. EXPERIMENTAL OUTLINE AND A SUMMARY OF THE RESULTS OF EXPERIMENT 1, SERIES C.

PENS AND RATIONS	Wted. Ave. at 8 weeks		Grams of feed per gram gain	Index No.	Per cent mortality
	Grms.	lbs.			
1 and 10—Reference.....	487.0	1.07	4.44	100	4
2 and 9—Wheat bran and S. P. M.*..	498.4	1.10	4.39	102	14
3 and 8—Rice bran and S. P. M.....	486.9	1.07	4.27	100	14
4 and 7—Pulv. oats and S. P. M.....	560.9	1.24	3.92	115	6
5 and 6—40% S. P. M.....	481.5	1.06	4.16	99	12

*S. P. M. = Sweet potato meal.

ment. These conditions resulted in slow growth. Only one ration in experiment 1 produced gains which differed significantly from the other rations. The chicks that were fed the pulverized oats and sweet potato meal ration utilized their feed more efficiently and made significantly greater gains than the chicks in any of the other pens. In view of the brooding difficulties experienced in this experiment the results should be accepted as tentative.

The outline and results of experiment 2 are summarized in table 7. Experiment 2 was conducted with the same rations and at the same time as experiment 1, but in a cold room brooder house. The chicks in experiment 2 grew better and utilized their feed more efficiently than the chicks of experiment 1 of this series. In the latter test, all of the experimental rations produced significantly greater gains than either of the reference rations. Mortality was reasonably low in each experiment.

Experiments 3 and 4 were duplicates and included only two experimental rations and the two reference rations. (See tables 8 and 9). Even though the average weights of experiments 3 and 4 differ appreciably in comparing one to the other, they agree fairly well when the rank of each pen within the experiments is compared. In both tests

TABLE 7. EXPERIMENTAL OUTLINE AND A SUMMARY OF THE RESULTS OF EXPERIMENT 2, SERIES C.

PENS AND RATIONS	Wted. Ave. at 8 weeks		Grams of feed per gram gain	Index No.	Per cent mortality
	Grms.	lbs.			
1 and 10—Reference.....	685.1	1.51	3.45	100	8
2 and 9—Wheat bran and S. P. M.*..	722.8	1.59	3.24	106	2
3 and 8—Rice bran and S. P. M.....	730.0	1.61	3.13	107	0
4 and 7—Pulv. oats and S. P. M.....	733.6	1.62	3.11	107	4
5 and 6—40% S. P. M.....	653.9	1.44	3.33	95	6

*S. P. M. = Sweet potato meal.

TABLE 8. EXPERIMENTAL OUTLINE AND A SUMMARY OF THE RESULTS OF EXPERIMENT 3, SERIES C.

PENS AND RATIONS	Wted. Ave. at 8 weeks		Grams of feed per gram gain	Index No.	Per cent mortality
	Grms.	lbs.			
1 and 10—Reference.....	452.0	1.00†	4.85	100	40
3, 8 and 5—Wheat shorts and S. P. M.*	543.0	1.20	4.15	120	22
4, 7 and 6—Rice polishings and S. P. M.	546.4	1.20	3.50	121	4
2 and 9—40% S. P. M.....	474.9	1.05	4.57	105	50

*S. P. M. = Sweet potato meal.

†The chicks in this trial were chilled early in the experiment which no doubt accounts for the high mortality and poor growth obtained.

the two experimental rations containing wheat shorts plus sweet potato meal and rice polishings plus sweet potato meal produced significantly greater gains than either of the reference rations. The differences between the two reference rations were not significant.

GENERAL DISCUSSION

This investigation was designed to determine to what extent sweet potato meal may be used in chick rations under practical conditions, and not to study quantitatively the different nutrients supplied by this feedstuff. It should be kept in mind that all of the sweet potato meal used in these studies was obtained from one dehydrating plant which used lime in the dehydrating process. While this product was quite uniform in color and composition, it is possible that sweet potato meal made by other processes or from other varieties of sweet potatoes may differ somewhat in its feeding value.

The rations which included sweet potato meal were eaten by the chicks as readily as the reference rations. The condition of the droppings from the chicks in all of the pens was normal. Therefore, it appears that sweet potato meal is palatable to chicks and has no undesirable physiological effects.

TABLE 9. EXPERIMENTAL OUTLINE AND A SUMMARY OF THE RESULTS OF EXPERIMENT 4, SERIES C.

PENS AND RATIONS	Wted. Ave. at 8 weeks		Grams of feed per gram gain	Index No.	Per cent mortality
	Grms.	lbs.			
1 and 8—Reference.....	533.8	1.18	3.79	100	10
3 and 6—Wheat shorts and S. P. M.*..	569.6	1.26	3.84	107	2
4 and 5—Rice polishings and S. P. M..	583.1	1.29	3.80	109	0
2 and 7—40% S. P. M.....	512.7	1.13	3.75	96	16

*S. P. M. = Sweet potato meal.

Some of the sweet potato meal used in these experiments was held in a feed room for as long as six months and did not show any signs of weevil infestation, mold, or other forms of decomposition. On the basis of this observation, it seems that the storing and keeping qualities of sweet potato meal are as good as any of the commonly used carbohydrate feedstuffs and considerably better than many of them.

The growth obtained from the practical chick ration that was used as one of the reference rations in the experiments of series B and C was poorer than had been expected. According to calculations based on average feedstuff composition figures this ration contained an adequate quantity of all the nutritive essentials known to be required by poultry. When other conditions are equal, rations containing a larger number of ingredients usually produce more rapid gains than do simple rations. This was not true of these experiments and there appears to be no satisfactory explanation for the discrepancy at the present time.

SUMMARY AND CONCLUSIONS

These studies were conducted to determine the feeding value of sweet potato meal in practical chick rations. Because of changes in the procedure, the experiments were divided into three series which were designated as series A, B, and C. The purpose of the experiments in series A was to determine to what extent sweet potato meal could replace yellow corn meal in practical chick rations. The experimental rations used contained 10, 20, 30, and 40 per cent of sweet potato meal in the place of a similar amount of yellow corn meal.

The experiments of series B were conducted to compare the feeding value of dehydrated sweet potato meal to that of wheat bran, rice bran, and pulverized oats when fed in combination with yellow corn meal as the only other carbohydrate feedstuff. A practical chick ration was used as the reference ration.

In series C two carbohydrate feeds were used in addition to sweet potato meal which made up 20 per cent of all the experimental rations. The carbohydrate feedstuffs were fed in various combinations in order to measure any supplementary effects that might result from using a larger number of feeds. Two reference rations were used in each experiment; one was a practical chick ration and the other contained 40 per cent of sweet potato meal and 15 per cent of yellow corn meal as the only carbohydrate feedstuffs.

From the data secured under the conditions of these experiments the following conclusions seem warranted:

1. When sweet potato meal was substituted for 10 and 20 per cent of the yellow corn meal in the experiments of series A, there were no differences between these two rations and the reference ration in the growth, mortality, or amount of feed required to produce one unit

of gain. Rations containing 30 and 40 per cent of sweet potato meal did not produce results as satisfactory as did the reference ration or the rations containing lower levels of potato meal.

2. The ration containing sweet potato meal in series B was as well utilized as the reference rations, but was slightly inferior to the rations containing wheat bran, rice bran, and pulverized oats.
3. Rations containing two cereal feeds in addition to sweet potato meal were as good as, and in some combinations significantly better than the reference rations, one of which was a practical chick ration.
4. Sweet potato meal was found to be palatable to chicks and did not have any undesirable physiological effects.
5. The storage and keeping qualities of sweet potato meal were equal to or better than that of the other carbohydrate feeds used.
6. Sweet potato meal was found to be a good carbohydrate feedstuff for practical chick rations and may be used to the extent of 20 or 25 per cent of the mash mixture in the place of other carbohydrate feeds.