THE VALUE OF IODINE FOR LIVESTOCK IN CENTRAL PENNSYLVANIA[1,2]

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INTRODUCTION

A series of feeding experiments was conducted at the Pennsylvania State College in cooperation between the college and the Mellon Institute of Industrial Research—the latter acting through the multiple industrial fellowship of the Iodine Educational Bureau—for the purpose of studying the value of iodine when fed to farm animals, in a manner supplementary to ordinary rations, under conditions present in central Pennsylvania.

In relation to the iodine content of feeding stuffs and waters, central Pennsylvania is sometimes spoken of as a border-line district, in the sense that the needs of domestic animals for iodine are ordinarily satisfied, while an occasional appearance of goiter or of hairlessness in young animals shows that the usual margin of safety in the supply of iodine is so small that a deficiency sometimes occurs.

The essential relation of iodine to the function of the thyroid gland being thoroughly established, and deficiency of iodine in food or water having been shown to be at least a major cause of disturbance of thyroid function, a special interest attaches to the iodine problem in regions such as central Pennsylvania in which there is no acute, general iodine deficiency, since it is not known that supplementary iodine is of value only in regions in which the iodine content of foodstuffs and waters is so deficient as to manifest itself through the prevalence of goiter and related disorders.

In other words it is at least logically possible that iodine might have a nutritive value in relations other than with the thyroid, and the special object of this study was to throw light on this possibility.

SCOPE OF INVESTIGATION

The scope of the investigation was as follows: (1) A feeding experiment was conducted with 25 Holstein-Friesian cows which were infected with *Brucella abortus,* and which were individually subjected to maximum dosage with iodine in an effort to learn the effects of such treatment on the course of the abortion disease; (2) a feeding experi-

[1] Received for publication Dec. 16, 1931; issued August, 1932.

[2] The general outline of this project was proposed by E. B. Forbes, who also maintained direct oversight of the experimental work and the preparation of the results for publication. Geo. M. Karns devised and prepared the iodine supplement employed, performed the iodine estimations on feedstuffs and drinking water, and cooperated in directing the experiment, through correspondence and personal visits. S. I. Bechdel and P. S. Williams conducted (1) a feeding experiment on cows infected with *Brucella abortus,* to determine the effect of the maximum dosage of iodine on the course of the disease, and (2) a feeding experiment with calves to determine the value of supplementary iodine for growth. T. B. Keith conducted experiments with swine, and also with lambs fed as matched pairs or in groups, to learn the value of supplementary iodine in their growth. E. W. Callenbach and R. R. Murphy conducted a feeding experiment with chickens to learn the effects of iodine on growth and early egg production.

ment with 42 Holstein-Friesian calves, fed as 21 matched pairs, to determine the value of supplementary iodine for growth; (3) a feeding experiment with 40 swine, fed as 10 lots of 4 individuals each; (4) a feeding experiment with 30 lambs fed as 15 matched pairs, and a feeding experiment with 171 lambs, fed as 6 lots of 28 or 29 individuals each, to learn the value of supplementary iodine in the growth of these animals; and (5) a feeding experiment with 701 chickens, fed in 4 groups of 160 to 187 each, to learn the effects of iodine in the growth and early egg production of this species.

In all, therefore, 1,009 animals were fed in this investigation.

The iodine was administered in nearly the whole of this work in the form of a new preparation—iodized linseed meal. This was elemental iodine so combined with linseed meal as to leave but a trace of free iodine.

In the preparation of this compound a certain quantity of old-process linseed meal is placed in a tumbling mill with a known quantity of iodine. The two are then intimately mixed for about 12 hours, by the end of which time the meal and the iodine have become uniformly mixed and a reaction between the two has begun. The preparation is then stored under such conditions that uncombined iodine will not be lost, and the reaction between the two components is completed within a few days. The meal is then standardized as to iodine content.

This preparation was made several times during the course of the experiments, the several lots being standardized to contain from 4 to about 10 per cent of iodine, and the iodine was fed in this form in all the experiments except during a very small portion of the work with calves.

The results of these experiments therefore apply with certainty only to the particular preparation of iodine which was employed, and the reaction of the animals to dosage with this preparation rendered perfectly clear the fact that their tolerance for iodine in this preparation is much less than for iodine as potassium iodide.

The dosage of iodine employed, expressed in milligrams of iodine per day, per 100 pounds live weight, was as follows: Calves, 20; sheep, 30; swine, 50; chickens, 50.

This dosage, which may properly be designated as therapeutic rather than nutritional, in view of the minuteness of the quantities of iodine involved in the functioning of the thyroid gland, was arrived at after a review of published reports on other feeding experiments in which iodine was administered in quantities greater than those required for the maintenance of thyroid function. It is not known that the liberality of the dosage was in any way prejudicial to the state of nutrition of the experimental subjects.

These experiments were conducted with a certain degree of consideration of the locality involved, since the geographic distribution of iodine is significant in relation to animal nutrition; but it was considered more desirable to feed the animals in a manner representative of prevailing custom in the section than to restrict them to locally grown feeds, since central Pennsylvania does not depend in the main on feeding stuffs produced within this section, and it was not practicable to feed these animals as they are normally fed and at the same time feed them exclusively on locally produced products.

The rations, therefore, were composed not only of local products but also, to a large extent, of feedstuffs purchased in the market and of unknown geographic origin. The experiments were all conducted in dry lots. Had they been conducted on pasture the local influence would have been much more pronounced.

The iodine content of the feeding stuffs employed is given in Table 1. In general the iodine content of this group of products does not vary greatly, but as exceptions to this statement the oyster shell was appreciably richer in iodine than were the feeds of agricultural origin; the poultry mashes were also rich in iodine, probably on account of the iodine content of the cod-liver oil contained; and the grain mixture fed to calves contained very much more iodine than is known to be characteristic of any of the feedstuffs of which they are composed. Unfortunately it was impracticable to determine whether some one of the constituent feeding stuffs was responsible for this surprisingly high iodine value, or whether it was due to some unaccountable contamination. In all cases the basal ration contained iodine in quantities sufficient for the maintenance of thyroid function, as estimated from observations by Marine and Kimball on dogs.[3]

TABLE 1.—*Iodine content and origin of feeding stuffs and water used in various feeding experiments with different kinds of farm animals*

Subjects of experiments	Feeding stuff	Origin	Iodine, parts per billion[a]
40 swine	Linseed meal	Market, unknown origin	90.3
	Digester tankage	do	118
	Corn (maize), grain	do	55.5
	Oats, grain	do	104
	Wheat middlings	Local mill	
	Salt	Scranton, Pa	130
	Water	Spring Creek	1.8
42 calves	Grain mixture	Part local, part market	27,300
	Timothy hay	Kylertown, Pa	115
	Alfalfa hay	New Jersey	78
	Mixed hay	Kylertown, Pa	60
	Clover hay	Ohio	61.8
	Skim milk	Local	70.7
	Salt	Scranton, Pa	130
	Water	College well	1.1
171 lambs	Corn (maize), grain	Market, unknown origin	55.5
	Linseed meal	do	90.3
	Mixed hay	Local	150
	Rock salt	Scranton, Pa	165
	Water	College well	1.1
30 lambs	Corn	Market, unknown origin	55.5
	Linseed meal	do	90.3
	Alfalfa hay	Local	78
	Salt	Scranton, Pa	130
	Water	Spring Creek	1.8
701 chickens	Mash Nos. 1 and 2	Market, Buffalo, N. Y	1,040
	Mash Nos. 3 and 4	do	1,090
	Scratch grains	do	19.4
	Semisolid buttermilk	Local	46
	Oyster shell	Local market	444
	Grit	do	44.5
	Water	College well	1.1

[a] Dry basis, except for waters.

[3] MARINE, D., and KIMBALL, O. P. THE PREVENTION OF SIMPLE GOITER IN MAN. A SURVEY OF THE INCIDENCE AND TYPES OF THYROID ENLARGEMENTS IN THE SCHOOLGIRLS OF AKRON (OHIO) FROM THE 5TH TO THE 12TH GRADES, INCLUSIVE—THE PLAN OF PREVENTION PROPOSED. Jour. Lab. and Clin. Med. 3: [40]–48, illus. 1917.

OBSERVATIONS ON THE EFFECTS OF ADMINISTERING IODINE TO COWS INFECTED WITH BRUCELLA ABORTUS

In the study to determine the reaction of cows affected with abortion disease to heavy dosages of iodine, the 25 cows used as subjects were from a herd of grade Holstein-Friesian cattle, maintained for experimental purposes on college farm No. 12, which is 2½ miles from the main dairy barn of the college.

Regular periodic blood tests revealed that this herd was free from abortion disease until the summer of 1929. At this time an outbreak of infectious abortion occurred, and vigorous steps were at once taken to prevent its spread. All reacting or suspected animals were removed to a quarantine barn about 2 miles away, but in spite of the fact that blood tests were made every two weeks, it seemed impossible to prevent a rapid spread of the disease throughout the herd. In fact 31 of the 40 cows reacted to the blood test before the spread of the disease was finally stopped.

As the plan of management included the holding of the reacting animals in quarantine for some time, an excellent opportunity was afforded for the experimental administration of iodine to infected cows and to some others which had been exposed but which had not reacted to the agglutination blood test.[4]

Iodized linseed meal was given, therefore, with the regular ration, in as large quantities as the animals would eat without going off feed. The heroic dosage employed was based on recommendations for the treatment of actinomycosis by administration of potassium iodide.

The rations of 11 of the cows (Nos. 5, 8, 12, 13, 16, 17, 18, 21, 32, 38, and 41) consisted of a grain mixture containing 17.5 per cent of protein, corn silage and alfalfa hay; while the ration of the remaining 14 cows consisted of a grain mixture containing 24 per cent of protein, corn silage and timothy hay.

Each of the cows was 3 years of age, and the greater number of them were in their second pregnancy.

NOTES ON INDIVIDUAL COWS RECEIVING IODINE

Cow No. 5 between December 4 and December 12 received 17 g of iodine; agglutination tests previous to July 17 were all negative; reaction was positive July 17, August 23, October 14, November 14, November 19, December 4, and December 13. The cow carried her calf until she was slaughtered December 13; she was due to freshen February 19. This cow received iodine eight days only.

Cow No. 8 between December 4 and January 1 received 51 g of iodine; agglutination tests were negative until April 1, when the test was doubtful; the reaction was positive April 15, negative May 1, doubtful July 17 and August 23, negative October 14 and 31, and November 14, and highly suspicious December 3. The cow calved on the date due, December 22; the calf was normal; the reaction was suspicious December 17, and slightly suspicious December 31. This cow reacted positively only once, on April 15, over seven months before iodine feeding was begun. Samples of the placenta and amniotic fluid were subjected to a test for Bang bacillus by injection into guinea pigs. The test showed that the organism was not present. This cow was heavily dosed with iodine for the 18 days just previous to a normal parturition.

Cow No. 10 between October 25 and November 12 received 16.47 g of iodine; agglutination tests previous to July 17 were all negative; the reaction was doubtful July 17, negative August 23, doubtful October 5, negative October 14, doubtful October 31, and negative November 14; cow aborted October 28; the calf lived a few hours only; the cow was sold for slaughter November 21. The reaction

[4] The writers are indebted to Dr. J. F. Shigley, associate professor of veterinary science, for veterinary service rendered; and to Dr. C. J. Marshall, State veterinarian, and to his associates in the Bureau of Animal Industry, for the performance of the agglutination tests on which this report is based.

of this cow was never positive. She aborted after having had iodine for three days, about four months after the first indication, by blood test, that she might have the disease. Three days after aborting the reaction was slightly suspicious, and two weeks later was negative. Because of the variable results of the blood tests prior to iodine feeding, the last change back to negative is of doubtful significance.

Cow No. 12 between October 30 and November 25 received 26.702 g of iodine; agglutination tests were negative throughout; the cow calved normally January 1; she tolerated 1 g of iodine a day and did not go off feed.

Cow No. 11 between October 30 and November 25 received 26.702 g of iodine; agglutination tests were negative throughout; the cow calved normally November 24; she tolerated 1 g of iodine a day for 26 days.

Cow No. 15 between October 30 and November 25 received 26.702 g of iodine; agglutination test were negative throughout; the cow calved normally January 1; she tolerated 1 g of iodine daily for 26 days.

Cow No. 16 between October 25 and December 12 received 49.662 g of iodine; agglutination tests were negative prior to October 14, and doubtful October 14 and 31. The reaction was highly suspicious November 14, positive November 19, and highly suspicious on December 13. The cow was sold for slaughter December 13, while carrying a calf, and was due to freshen February 10.

Cow No. 17 between October 19 and November 9 received 41.143 g of iodine; agglutination tests were negative prior to August 23, when the test was positive; the cow aborted August 27; the reaction was positive October 14 and November 14; the cow was sold for slaughter November 17. This cow tolerated about 2 g of iodine daily for 21 days with no apparent bad effects except that less than the usual amount of hay was consumed.

Cow No. 18 between October 19 and November 9 received 42.147 g of iodine; agglutination tests prior to August 23 were all negative; the cow aborted August 1; the reaction was positive August 23, October 14 and November 14; the cow was sold for slaughter November 17. Iodine feeding at the rate of 2 g a day for 21 days brought about no change in reaction to the agglutination test. The heavy dosage of iodine caused no apparent ill effects, except that the cow consumed less than the usual quantity of hay.

Cow No. 19 between October 10 and November 25 received 26.702 g of iodine; agglutination tests were all negative; the cow freshened normally April 19. One g of iodine daily for 26 days during the fifth month of pregnancy was tolerated with no ill effects.

Cow No. 21 between October 25 and November 12 received 17.88 g iodine; agglutination tests prior to October 14 were all negative; the reaction was slightly suspicious October 14, highly suspicious October 31, and positive November 14. The cow was due to calve November 24, but aborted October 31, when iodine feeding had been in progress 6 days, and was sold for slaughter November 17. The reaction changed from slightly suspicious to positive while the cow was receiving iodine at the rate of 1 g daily.

Cow No. 23 between October 30 and November 25 received 26.702 g of iodine; agglutination tests were all negative prior to November 19 when the reaction was highly suspicious. The cow aborted November 28, being due to calve February 10, and was sold for slaughter November 29. This animal was apparently infected and was incubating the disease before the iodine feeding was started. After being on the iodine (1 g daily) for 19 days she reacted in a manner designated highly suspicious, and aborted 9 days later, 3 days after the close of a 26-day iodine feeding period.

Cow No. 25 between October 30 and November 25 received 26.702 g of iodine; agglutination tests were all negative. The cow when examined on November 27 was found to be pregnant, and freshened normally on April 11. This cow (negative to abortion test) was fed 1 g of iodine daily for a 26-day period with no ill effects, in the fourth and fifth months of pregnancy.

Cow No. 26 between October 30 and November 25 received 26.702 g of iodine; agglutination tests were all negative; the cow aborted December 10; the calf was 6 weeks premature. This cow was sold for slaughter December 13. A blood sample taken on date of slaughter was found negative. The cow aborted 18 days after the close of a 26-day iodine feeding period. A positive blood reaction had not developed 3 days thereafter.

Cow No. 28 between October 19 and November 9 received 33.957 g of iodine; agglutination tests prior to July 17 were all negative, but were positive July 17 and August 23. The cow aborted September 12; the calf was born dead; the cow was due to calve in January. The reaction was positive October 14 and November 14; the cow was sold for slaughter November 17. She had aborted

about one month previous to a 21-day period of iodine feeding. Iodine feeding (1½ g daily) produced no change in reaction.

Cow No. 31 between October 19 and November 9 received 13.621 g of iodine; agglutination test August 23 was highly suspicious; and positive October 5, October 14 and November 14. The cow aborted October 4, the calf being dead, and was sold for slaughter November 15. This cow aborted two weeks previous to beginning of 21-day iodine feeding period and would tolerate only a small quantity of iodine.

Cow No. 32 between October 25 and January 1 received 48.662 g of iodine; agglutination tests were all negative until October 5 when the test was designated slightly suspicious; on October 14 it was highly suspicious, positive October 31, highly suspicious November 14, and positive November 19 and December 3. The cow aborted December 11, and had living calf weighing 45 pounds, one month premature, which lived until December 23. The reaction of the cow was positive December 17 and December 31. This cow was sold for slaughter January 7, 1930. The reaction changed from positive to highly suspicious about three weeks after iodine feeding was started, then changed to positive, and the cow aborted when the iodine feeding had been in progress 47 days. Iodine feeding was then continued 20 days longer with no change in the blood reaction.

Cow No. 34 between October 30 and November 25 received 26.702 g of iodine; agglutination tests were negative until November 19, when the cow reacted in a manner designated slightly suspicious; the reaction was positive December 3 and 13; cow aborted December 7, but the calf lived only 12 hours. The cow was due to calve December 27, and was sold for slaughter December 13. The blood test when iodine feeding was started was negative but changed to slightly suspicious when the cow had received iodine 20 days, and two weeks later the reaction was positive. Four days later the cow aborted, 12 days after the close of 26-day iodine feeding period.

Cow No. 35 between October 19 and November 25 received 40.303 g of iodine; agglutination tests were negative prior to May 1, on which date test was positive; they were also positive July 17, August 23, October 14, and November 14 and 19; the cow would not conceive and was sold for slaughter November 29. A 36-day iodine feeding period, in which a total of 40 g of iodine was fed, produced no change in the positive blood reaction.

Cow No. 37 between October 19 and November 9 received 42.639 g of iodine; agglutination tests were negative prior to July 17, on which date the reaction became positive. The cow was not pregnant. Tests were positive August 23, October 14, and November 14. The cow was sold for slaughter November 15. A daily dose of over 2 g of iodine for 20 days made no change in the blood reaction. The cow ate less than the normal quantity of hay.

Cow No. 38 between December 4 and December 12 received 18 g of iodine; agglutination tests were negative prior to April 15, on which date the test was positive; it was positive May 1, August 23, October 23, November 14 and 19, and December 13. The cow was due to calve January 8, but was sold for slaughter December 13. With eight days of iodine feeding, at the rate of 2¼ g a day, during the eighth month of pregnancy, there was no change in blood test.

Cow No. 39 between October 25 and November 25 received 31.662 g of iodine; agglutination tests were negative until October 5, on which date the test was slightly suspicious; it was negative October 14 and 31, and November 14, and slightly suspicious November 19. The cow was sold for slaughter November 29. This cow had an abscessed ovary and would not conceive. Her blood test was never more than slightly suspicious. Thirty-one days of iodine feeding (1 g daily) produced no change in reaction.

Cow No. 40 between October 29 and December 13 received 70.817 g of iodine; agglutination tests were negative until August 23, on which date the test was positive; it was also positive October 14 and November 14, highly suspicious November 19, and positive December 3 and 13. The cow was due to calve January 18, but was sold December 13. A 45-day iodine feeding period, in which a total of over 70 g of iodine were fed, produced no change of blood reaction.

Cow No. 41 between October 30 and November 25 received 26.702 g of iodine; agglutination tests were negative prior to November 14, on which date test was slightly suspicious, and again negative November 19. The cow was sold November 29 because of failure to conceive. Reaction was negative at the time iodine feeding was started, but slightly suspicious after the cow had received iodine for two weeks. Two weeks later the reaction changed back to negative.

Cow No. 44 between October 19 and January 1 received 82.755 g. of iodine; agglutination tests were negative until August 23, when the test was highly suspicious; tests were also highly suspicious October 5, 14, and 31, and November

14, positive November 19 and December 3, 17, and 31. The cow calved at full term December 19, and the calf was apparently healthy. The blood test on this cow was highly suspicious when iodine feeding was started, but changed to positive after the cow had been given iodine for one month, and continued positive until the cow was sold. Iodine was given, in doses of more than 1 g a day for 73 days including the last 60 days previous to a normal, full-time parturition.

DISCUSSION OF RESULTS

Iodine was first administered at the rate of 5 g of the element a day, in the form of iodized linseed meal. This quantity threw the cows off feed on the second day, but it was found that most individuals would tolerate from 2 to 3 g of iodine a day, at least for a limited period. Certain cows tolerated 2 g of iodine daily, as long as it was fed to them, while others would not tolerate more than 1 g a day. Some of the cows resented the presence of the iodized linseed meal in their ration from the beginning, while others paid little attention to it and appeared to eat their grain with the usual relish. After receiving a heavy dosage of iodine for several days, there was in all cases a decrease of appetite for hay. Possibly the iodine interfered with essential fermentations in the rumen.

After several days of heavy iodine feeding the cows became sluggish; the hair grew rough, and in certain individuals there was copious nasal discharge, and brownish discoloration of the skin about the eyes, nose, and tail.

The cream produced by the cows that received iodine was rejected by the inspector at the college creamery, because of its objectionable odor; and analysis of the cream, and also of the mixed milk of cows Nos. 5, 16, and 38, revealed the presence of iodine in very large quantities.

At the time this investigation was started it was the plan to continue the iodine feeding for several months, but conditions which developed thereafter rendered it desirable to dispose of all animals infected with abortion disease without delay. Two cows, Nos. 5 and 38, were fed iodine for only eight days. The average length of time during which the 23 others received iodine was 30½ days. Of these cows 6 received iodine for more than 30 days and the remaining 17 received iodine for an average of 23.6 days. The average total quantity of iodine fed these 17 cows was 31.7 g. Three cows, Nos. 16, 32, and 44, were fed for an average of 63 days, the average total of iodine given being 63.7 g.

THE EFFECTS OF IODINE ON THE GROWTH AND PHYSICAL CONDITION OF DAIRY CALVES

The object of this investigation was to learn whether iodine, especially in the form of iodized linseed oil meal, is of value in the rearing of dairy calves.

The calves which served as subjects were grade Holstein females which were purchased at ages of 1 to 5 days in groups of 4 to 12—as they were available—from dairy farmers in Bradford County. Great care was taken to select vigorous animals of uniform size, and they were reared in accordance with the usual practice on good dairy farms.

In the conduct of the experiment the identity of the groups of the calves as purchased was maintained, for convenience, each group being

divided into pairs, as evenly balanced as possible, one animal of each pair receiving iodine and the other serving as a control.

The calves received whole milk until they were 2 to 3 weeks of age. The ration was then gradually changed to skim milk, grain, and hay. The two calves of each pair were fed exactly the same quantities of feeds (with the exception of hay) throughout the experiment, the quantities allowed to each pair being determined by the calf with the smaller appetite.

The first four or five weeks' feeding constituted a preliminary period. During this time the calves were established on the experimental ration, and the feeding was carried out in the same systematic manner as during the later experimental feeding.

The grain mixture was made up of 75 pounds of oats, 75 pounds of wheat bran, 40 pounds of yellow hominy feed, 40 pounds of yellow corn meal, 50 pounds of linseed meal, and 1½ pounds of salt.

Four kinds of hay were fed, at different times during the experiment, viz, early cut timothy, high-grade New Jersey alfalfa, mixed hay of good quality, and high-grade red clover. The respective proportions of the total hay fed were 4, 15, 22, and 59 per cent. The timothy was fed during the preliminary period because of its usefulness in the prevention of digestive disturbances in young calves.

Each calf was given as much hay as it would eat. With each pair of calves, without exception, the one receiving iodine ate less hay than did the control.

The calves were weighed once each week, and a measurement of the height at the withers was taken once a month. The average daily intake of feeds and the total cod-liver oil and iodine fed are shown in Table 2.

TABLE 2.—*Average daily feeds and total cod-liver oil and iodine eaten by calves*

Group No., number of days on experiment, and subgroup	Average daily skim milk	Average daily grain	Average daily hay	Total cod-liver oil per calf	Total iodine per calf
Group 1, 139 days:	*Pounds*	*Pounds*	*Pounds*	*C c*	*Grams*
3 calves receiving iodine	16. 73	2. 04	1. 55	283. 3	2. 570
3 calves receiving no iodine	16. 73	2. 04	1. 83	283. 3	None.
Group 2, 131 days:					
6 calves receiving iodine	16. 49	2. 13	1. 79	265. 0	2. 409
6 calves receiving no iodine	16. 49	2. 13	1. 85	265. 0	None.
Group 3, 117 days:					
4 calves receiving iodine	16. 20	2. 34	1. 89	255. 0	2. 759
4 calves receiving no iodine	16. 20	2. 34	2. 16	255. 0	None.
Group 4, 110 days:					
3 calves receiving iodine	15. 07	1. 99	1. 14	190. 0	1. 788
3 calves receiving no iodine	15. 07	1. 99	1. 44	190. 0	None.
Group 5, 103 days:					
2 calves receiving iodine	15. 46	1. 68	1. 68	190. 0	1. 615
2 calves receiving no iodine	15. 46	1. 68	1. 51	190. 0	None.
Group 6, 75 days:					
3 calves receiving iodine	14. 48	2. 19	1. 35	260. 0	. 727
3 calves receiving no iodine	14. 48	2. 19	1. 31	260. 0	None.

The analysis of the ration indicated a normal iodine intake considerably greater than the 1 mg weekly which Marine [5] reported as adequate for thyroid maintenance in dogs. This estimate of the iodine content of the ration disregards the analysis of one grain mixture, a sample of which showed one hundred times the amount of iodine present in other foods of similar type. Unfortunately the

[5] MARINE, D., and KIMBALL, O. P. Op. cit.

analysis was made after the feeding with the questioned material had been completed, and it was impossible to determine whether the extremely high iodine content was continuously present or whether the sample was unaccountably contaminated at the time of taking.

The quantity of iodine fed was adjusted once a week, the standard allowance being 30 mg per hundred pounds live weight. The iodine was fed once a day in the skim milk. After they had received iodine for about four weeks, the calves displayed marked evidence of having had too much of it. Their coats became very rough, and they did not eat with the usual appetite. The feces were thin and of an abnormal reddish-brown color. There was considerable variation in the tolerance of the individuals for iodine, and the appetites of some were so much affected that they ate only a small proportion of the normal quantity of hay. The administration of iodine, therefore, was discontinued for intervals of from 17 to 44 days, in the several groups, after which it was resumed at a lower level of intake, namely, 10 mg per hundred pounds live weight a day.

Table 3 gives the intervals of time during which iodine was administered or was withheld.

TABLE 3.—*Schedule of iodine feeding*

Group	Interval during which iodine was fed from beginning of experiment	Interval during which iodine was not fed	Final interval during which iodine was fed at diminished rate to end of experiment	Group	Interval during which iodine was fed from beginning of experiment	Interval during which iodine was not fed	Final interval during which iodine was fed at diminished rate to end of experiment
	Days	*Days*	*Days*		*Days*	*Days*	*Days*
No. 1	43	44	50	No. 4	34	34	22
No. 2	43	44	43	No. 5	28	33	30
No. 3	48	17	65	No. 6	6	43	27

The iodine was omitted from the feed of four calves before the end of the investigation, as indicated by the next to the last column in Table 4.

The very poor physical condition of some of the calves that had received iodine suggested the desirability of special measures for restoring them to health. Cod-liver oil was therefore used, both calves of each pair receiving the same quantity—usually 10 c c a day. The cod-liver oil was continued, with each pair of calves, as long as it seemed to be needed by the calf that had received iodine. The average length of time during which the calves were given cod-liver oil was 31 days, although 2 received it for 72 days, 4 received it for 58 days, and 6 received it for 41 days.

During the final period of administering iodine the drug was given to 11 of the calves in the form of potassium iodide, instead of iodized linseed meal, in order to reveal possible differences in the response of the animals to iodine in the two combinations.

On the lower plane of iodine intake there was no definite evidence of iodine excess, and during the brief period of comparison of iodized linseed meal and potassium iodide no differences could be detected of their effect on the calves.

TABLE 4.—*Gains of calves in weight, and in height at withers*

Group and number of days on experiment	Controls, which received no iodine				Calves which received iodine					
	Calf No.	Initial weight	Gain in weight	Gain in height at withers	Calf No.	Initial weight	Gain in weight	Gain in height at withers	Period fed iodine	Total iodine fed
		Lbs.	*Lbs.*	*Centimeters*		*Lbs.*	*Lbs.*	*Centimeters*	*Days*	*Grams*
Group 1, 139 days	77	94	197	21.5	76	92	205	24.0	93	2.458
	78	100	219	23.0	80	96	190	24.5	93	2.665
	79	105	218	22.5	81	108	199	24.0	93	2.587
Average		99.6	211.3	22.3		98.6	198.0	24.1		
Group 2, 131 days	83	115	216	24.5	89	120	208	23.5	86	2.774
	85	100	193	17.0	95	93	156	21.0	83	1.982
	87	115	191	25.0	84	113	211	28.0	86	2.676
	86	90	189	24.0	91	89	217	24.0	86	2.323
	94	106	215	25.0	93	110	216	23.0	86	2.665
	88	88	177	20.0	82	87	164	21.0	86	2.037
Average		102.3	196.8	22.5		102.0	195.3	23.4		
Group 3, 117 days	101	101	183	17.0	100	104	176	19.0	99	3.052
	77	100	193	18.0	99	93	191	18.0	99	2.416
	96	113	178	18.5	102	105	165	19.0	99	2.551
	98	116	203	20.5	103	118	219	22.0	99	3.016
Average		107.5	189.2	18.5		105.0	187.7	19.5		
Group 4, 110 days	112	93	152	20.0	106	90	140	18.0	53	1.090
	108	110	132	18.0	111	102	141	19.0	76	2.111
	110	128	147	18.0	107	110	151	17.5	76	2.164
Average		110.3	143.6	18.6		100.6	144.0	18.1		
Group 5, 103 days	120	100	128	11.0	118	98	131	14.0	68	1.531
	117	110	161	18.0	114	112	160	17.0	60	1.700
Average		105.0	144.5	14.5		105.0	145.5	15.5		
Group 6, 75 days	122	111	126	15.0	121	119	130	15.0	32	.758
	127	100	117	14.0	125	109	116	15.0	32	.671
	126	105	107	12.0	123	105	111	18.0	32	.752
Average		105.3	116.6	13.6		111.0	119	16.0		

The gains in weight of the calves, as recorded in Table 4, do not indicate a significant difference in growth between those that received iodine and those that did not. Among the 21 pairs of calves, in 10 cases the calf receiving iodine made the greatest gain. The total increase in weight of the 21 calves receiving iodine was 45 pounds less than the total gain of the 21 calves that received no iodine. The mathematical interpretation of the differences in gains in weight, by Student's method, revealed odds of 2.8 to 1 indicating that the calves which did not receive iodine had made the greater average gain in weight. These odds are not statistically significant.

A similar interpretation of the gains in height at withers gives results favorable to iodine in five of the six groups. The separate consideration of the 13 pairs of Groups 1, 2, and 3, which received larger total quantities of iodine than did the remaining groups, gave odds of 65 to 1 in favor of the indication that the calves receiving iodine made the greater gains in height; while the consideration of the entire 21 pairs of calves gave odds of 77 to 1 in favor of the same possibility. These odds are statistically significant.

The cause of the apparent stimulation of skeletal growth, as a result of the administration of iodine, was not revealed. This response of the calves receiving iodine is especially puzzling because they ate appreciably less hay than did those that received no iodine—the hay containing a very considerable part of the calcium of the ration.

While there is ground for question as to the iodine intake of these calves, on account of the excessively high apparent iodine content of the grain mixture fed, it appears that the tolerance of calves for iodine is less than that of sheep, swine, and chickens.

It also seems that the iodine of iodized linseed meal, which was fed during the greater part of the experiment, produced a more marked reaction on the calves than does the iodine of iodides.

At the time of this writing, the calves now being about 1 year of age, the difference in height of the calves which received iodine, as compared with those that received none, is no longer apparent, and that is no apparent difference in health of the calves as a result of iodine feeding.

THE VALUE OF SUPPLEMENTAL IODINE IN THE GROWTH OF SWINE

Forty purebred pigs of the Berkshire, Chester White, Duroc-Jersey, and Poland China breeds were divided into 10 lots of four each, as nearly as possible of the same size, sex, age, and breed representation.

Five lots were given iodine in addition to the basal ration (Table 5), while the other five were used as controls or checks.

TABLE 5.—*Live weights, gains in weight, and feed consumption of 10 lots of 4 pigs each, alternate lots receiving supplemental iodine with the ration for 126 days*

Lot and treatment	Average initial weight	Average final weight	Average daily gain	Feed per 100-pound gain
	Pounds	*Pounds*	*Pounds*	*Pounds*
No. 1, iodine	50.6	223.0	[a] 1.4	495.7
No. 6, check	48.7	221.0	1.37	426.7
No. 2, iodine	54.7	234.7	1.43	417.9
No. 7, check	55.2	221.7	1.32	447.7
No. 3, iodine	42.2	194.7	1.21	412.0
No. 8, check	40.5	165.7	.99	498.0
No. 4, iodine	41.2	188.0	1.16	335.5
No. 9, check	41.0	179.0	1.09	347.3
No. 5, iodine	51.5	188.7	1.08	345.5
No. 10, check	52.8	209.0	1.23	320.0

[a] Adjusted on account of the removal of 1 pig in the course of the experiment.

The composition of the rations is shown in Table 6. The rations were hand fed, the feeds being dry, to the limit of the pigs' appetites. The iodine was fed in the form of iodized linseed meal thoroughly mixed into the ration, once each day, at a rate of 50 mg of the element per hundred pounds live weight.

TABLE 6.—*Composition of basal ration of pigs*

Constituent	Proportions in which feed was mixed		Constituent	Proportions in which feed was mixed	
	First 112 days	Last 14 days		First 112 days	Last 14 days
Ground yellow corn	160	180	Tankage	20	20
Ground oats	40	40	Linseed meal	10	10
Wheat middlings	40	40	Salt	1	1

The age of the pigs at the beginning of the trial ranged from 10 to 12 weeks, and their average initial weight, in the several lots (Table 5), ranged from 40.5 to 55.2 pounds.

The test was continued until the average live weight per lot, in each group of five lots, reached approximately 200 pounds, which required 126 days with each group.

The initial and final weights, recorded in Table 5, are each the average of three weights taken on consecutive days. In addition, intermediate, individual weights were taken at 2-week intervals.

This experiment was conducted between December 3, 1929, and April 8, 1930. The pigs were confined in dirt lots in which there was no vegetation and were sheltered by small movable houses. It was possible, therefore, for the pigs to supplement the inorganic nutrients of the rations to a limited extent by eating earth.

No effects of the iodine feeding were observable in the performance of the pigs.

The essential data of the experiment are given in Table 5.

THE VALUE OF SUPPLEMENTAL IODINE IN THE FATTENING OF LAMBS

Two feeding experiments, one with 30 lambs fed individually by the paired feeding method, and a second with 171 lambs fed in six approximately equal groups, were conducted to learn whether iodine, in the form of iodized linseed meal, is of value in the fattening of lambs.

LAMBS FED BY THE PAIRED-FEEDING METHOD

The lambs were raised in northern Pennsylvania and were divided into 15 pairs, of the same sex, and as nearly as possible of the same weight and of the same condition as to fatness.

Each lamb was fed in the same individual crate throughout the entire experiment, which was started December 31, 1929, and ended March 18, 1930, a period of 77 days. Both members of each pair were given the same quantity of feed; and if one of a pair refused a part of its feed, the ration of its mate was diminished in like proportion.

The ration was one which is commonly used for fattening lambs, and consisted of alfalfa hay and a grain mixture, the latter composed of 9 parts of coarsely ground corn, 1 part of linseed meal, and 0.5 per cent of salt. The analysis of this basic ration showed iodine to be present in amounts usually considered adequate for the maintenance of thyroid function. In addition one member of each pair was given 33 mg of iodine per hundred pounds of live weight, in the form of iodized linseed meal, the iodine being fed once each day thoroughly

mixed with the grain ration. An earlier effort to feed the same total quantity of iodine in two doses a week was unsuccessful, since it sickened the lambs. The daily feeding, however, produced no unfavorable effects.

The initial and final weights are averages of three weighings each, taken on as many consecutive days, and in addition the lambs were weighed each week. The initial weights of the lambs ranged from 56 to 72 pounds, and the final weights from 72 to 105 pounds.

The lambs were fed in a closed shed on a ground floor bedded with straw, some of which was eaten. During winter days, when the ground was covered with snow, the lambs were permitted to run outside for a few hours each day. The lambs were not treated for parasites. Several were slaughtered, and all of these, especially lamb No. 2, were found to be infested with the nodule parasite.

The numerical data of the experiment are presented in Table 7.

TABLE 7.—*Live weights, gains in weight, and feed consumption of 15 pairs of lambs, one individual of each pair receiving supplemental iodine with the ration for 77 days*

Pair and treatment	Initial weight	Final weight	Average daily gain in weight	Average daily ration	Feed consumed per pound of gain in weight
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
No. 1:					
Iodine	63	96	0.43	2.74	6.40
Check	65	99	.44	2.76	6.25
No. 2:					
Iodine	63	72	.12	2.16	18.51
Check	69	90	.27	2.16	7.92
No. 3:					
Iodine	72	104	.41	2.66	6.41
Check	72	105	.43	2.67	6.22
No. 4:					
Iodine	60	73	.16	1.75	10.37
Check	60	69	.12	1.78	15.23
No. 5:					
Iodine	60	89	.38	2.51	6.68
Check	56	85	.38	2.53	6.72
No. 6:					
Iodine	66	96	.39	2.54	6.53
Check	64	90	.34	2.54	7.55
No. 7:					
Iodine	61	83	.28	2.49	8.73
Check	66	90	.31	2.49	8.00
No. 8:					
Iodine	62	82	.26	2.46	9.49
Check	59	83	.31	2.48	7.97
No. 9:					
Iodine	69	89	.26	2.46	9.47
Check	68	90	.28	2.47	8.65
No. 10:					
Iodine	64	87	.30	2.10	7.06
Check	61	74	.16	2.10	12.42
No. 11:					
Iodine	68	90	.28	2.28	7.97
Check	61	81	.26	2.28	8.77
No. 12:					
Iodine	59	85	.34	2.33	6.91
Check	67	92	.32	2.33	7.10
No. 13:					
Iodine	57	80	.30	2.45	8.23
Check	56	78	.28	2.45	8.59
No. 14:					
Iodine	59	77	.23	2.23	9.55
Check	56	77	.27	2.25	8.28
No. 15:					
Iodine	69	99	.39	2.77	7.13
Check	63	96	.43	2.77	6.48

LAMBS FED IN GROUPS [6]

The group-feeding experiment was conducted between November 2, 1929, and February 14, 1930. The lambs used in this experiment included native fine wools grown in southwestern Pennsylvania, native muttons from northern Pennsylvania, and western lambs grown in the State of Washington. The lambs from each source were divided into 2 groups of 28 or 29 each, and 1 group from each of the 3 sources was fed, in addition to the regular ration, 33 mg of iodine per 100 pounds live weight daily for 104 days. The iodine was fed twice daily in the form of iodized linseed meal thoroughly mixed with the grain ration.

The average initial weights of the lambs in the lots ranged from 52.3 to 55.9 pounds. The average final weights ranged from 71.6 to 91.4. (Table 8.) The ration consisted of mixed hay, hand fed twice daily, and a grain mixture of 9 parts corn and 1 part linseed meal likewise fed twice each day.

TABLE 8.—*Live weights, gains in weight, and feed consumption of six groups of lambs, three of which received supplemental iodine with their ration for 104 days*

Type of lambs, group, and treatment	Lambs at start	Lambs at end [a]	Initial weight (average)	Final weight (average)	Daily gain (average)	Feed intake per 100 pounds of gain			
						Shelled corn	Oil cake	Hay	Total
Native fine wool:	*Number*	*Number*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
No. 1, iodine	29	27	55.9	73.0	0.16	530.4	59.7	738.3	1,328.4
No. 2, check	28	27	55.8	75.9	.19	461.9	50.7	631.3	1,143.9
Native mutton:									
No. 3, iodine	29	27	52.3	71.6	.18	500.8	52.3	648.7	1,201.8
No. 4, check	28	27	53.1	74.4	.21	450.2	49.9	565.3	1,065.4
Western:									
No. 5, iodine	29	27	54.1	86.6	[b].26	403.5	44.8	491.9	940.2
No. 6, check	28	27	55.6	91.4	[c].28	385.0	41.5	467.8	894.3

[a] 1 or 2 lambs in each group were slaughtered in the course of the experiment for carcass studies.
[b] Adjusted on account of the removal of 2 lambs in the course of the experiment.
[c] Adjusted on account of the removal of 1 lamb in the course of the experiment.

The lambs receiving iodine cleaned up their feed less promptly than did those receiving no iodine.

THE VALUE OF SUPPLEMENTAL IODINE FOR CHICKENS

In the experiment to determine the effects of the administration of supplemental iodine to chickens during growth and early egg production, four groups of single-comb white leghorn female chicks, containing 160, 170, 184, and 187 individuals, respectively, were fed the experimental rations from the time of hatching to the age of 32 weeks.

Groups 1 and 2 received the same varied mash ration, the animal-protein components of which were fish meal, meat scrap, and dried milk. Group 2 received in addition iodized linseed meal in a quantity sufficient to provide 50 mgs of iodine per 100 pounds of chicken a day.

The mash ration for Groups 1 and 2 consisted of 40 pounds of yellow corn meal, 15 pounds of wheat bran, 15 pounds of flour wheat middlings, 10 pounds of alfalfa-leaf meal, 10 pounds of dried milk, 5

[6] This report is based on an experiment conducted under the direction of Associate Prof. W. L. Henning, primarily as a comparison of types of lambs as feeders.

pounds of fish meal, 5 pounds of meat scrap, 2 pounds of steamed bone meal, 1 pound of salt, and 1 pound of cod-liver oil.

Groups 3 and 4 received a mash ration similar to that fed to Groups 1 and 2, except that the fish meal was replaced by meat scrap, Group 4 receiving this mash ration by itself, and Group 3 the same plus iodine, given at the same rate as to Group 2.

For the first 8-week period the iodized linseed meal was fed in accordance with predetermined standard live weights;[7] and thereafter in accordance with the experimental weighings which were taken individually every four weeks.

In addition to the mash rations all groups received a half-and-half cracked corn and wheat scratch mixture beginning with the fifth week and continuing to the end of the experiment.

The four groups of chicks used in the experiment were hatched at weekly intervals as follows: Group 1, March 20; Group 2, March 27; Group 3, April 3; Group 4, April 10, 1930. All males were removed at eight weeks of age, the data reported here being for females only. The chicks were placed in brooding quarters when 24 hours old and were fed the proper mash ration. The same mash mixture was fed, ad libitum, in hoppers, during the entire course of the experiment; and the scratch grain mixture, given after the fourth week, was also fed in hoppers.

During the first 16 weeks, the birds were housed in a long type of brooder house, each pen of which is 12 by 20 feet. Each group had access to a sun porch 8 by 10 feet in size. At the end of the 16-week period they were moved into laying quarters and remained there until the conclusion of the experiment. At no time in the course of the experiment were the birds allowed out on range.

Cannibalism was not manifest in an unusual degree in any of the groups during the experiment, the infrequent occurrence of this habit being approximately evenly distributed among the four groups.

No difference was noticeable in the behavior or the condition of the four groups of birds at any time during the experiment.

The average growth, the number of birds culled at the age of 16 weeks, the mortality, and the average number of eggs laid, for each group are given in Table 9.

TABLE 9.—*The effect of iodine on the growth, mortality, and early egg production of chickens*

Group and treatment	Age	Birds in groups	Average body weight	Mortality		Average number of eggs laid to age of 32 weeks
				Per period	Total	
	Weeks	*Number*	*Grams*	*Per cent*	*Per cent*	
No. 1, no iodine	0	160	38			
	4	160	232	0	0	
	8	160	508	0	0	
	12	159	817	0.6	0.6	
	16	155	1,039	2.5	3.1	31
	20	[a] 131	1,274	0	3.1	
	24	122	1,462	5.6	8.7	
	28	114	1,531	5.0	13.7	
	32	109	1,589	3.1	16.8	

[a] 24 culled at age of 16 weeks.

[7] CHARLES, T. B., and KNANDEL, H. C. REARING CHICKS IN CONFINEMENT. Penn. Agr. Expt. Sta. Bul. 218, p. 11, Table III. 1928.

TABLE 9.—*The effect of iodine on the growth, mortality, and early egg production of chickens*—Continued

Group and treatment	Age	Birds in group	Average body weight	Mortality		Average number of eggs laid to age of 32 weeks
				Per period	Total	
	Weeks	*Number*	*Grams*	*Per cent*	*Per cent*	
No. 2, iodine	0	170	40			
	4	170	235	0	0	
	8	169	523	0.6	0.6	
	12	167	796	1.2	1.8	
	16	[b] 142	1,124	1.2	3.0	35
	20	138	1,368	2.4	5.4	
	24	130	1,516	4.7	10.1	
	28	125	1,656	2.9	13.0	
	32	121	1,674	2.4	15.4	
No. 3, iodine	0	184	39			
	4	182	211	1.1	1.1	
	8	181	450	.5	1.6	
	12	174	711	3.8	5.4	
	16	[c] 146	983	1.6	7.0	24
	20	138	1,221	4.3	11.3	
	24	135	1,468	1.6	12.9	
	28	134	1,585	.5	13.4	
	32	130	1,764	2.2	15.6	
No. 4, no iodine	0	187	38			
	4	187	209	0	0	
	8	182	451	2.7	2.7	
	12	179	718	1.6	4.3	
	16	[d] 158	970	1.6	5.9	24
	20	148	1,220	5.3	11.2	
	24	133	1,451	8.0	19.2	
	28	132	1,531	.5	19.7	
	32	123	1,729	4.8	24.5	

[b] 23 culled at age of 16 weeks; also 2 died.
[c] 25 culled at age of 16 weeks; also 3 died.
[d] 18 culled at age of 16 weeks; also 3 died.

Attention is called to the fact that Group 2, which received iodine, excelled Group 1 in body weight, after the twelfth week; but doubt is thrown upon the significance of this observation by the fact that Group 3, which received iodine, was excelled by Group 4 in body weight.

SUMMARY

Twenty-five grade Holstein milking cows which were infected with, or had been exposed to, contagious abortion were subjected to liberal dosage with iodine in the form of iodized linseed meal. The length of time of feeding the different individuals varied from 8 to 73 days, the average being 28.7 days. The average total amount of elemental iodine fed was 34.32 g per cow. The average daily dose per cow was 1.2 g. Individual cows varied in their ability to tolerate iodine from 0.65 g to 2.13 g a day. The maximum total amount fed any individual was 82.8 g in a period of 73 days.

Agglutination blood tests for abortion disease were made at 2-week intervals during the iodine feeding, monthly tests having been conducted previous to that time.

The administration of iodine did not affect the condition of disease, as indicated by results of the agglutination blood test. The disease developed in the normal manner, in five cows, the tests progressing from suspicious to positive during the time iodine feeding was in progress. There were no clear-cut cases of change in reaction in the reverse direction. In the case of five cows of the six that aborted during the iodine treatment, the development of the disease was clearly indicated.

by the blood test. Six animals furnished rather conclusive evidence that intensive iodine feeding during the last six months of pregnance was not harmful. No cows were fed iodine during the first three months of pregnancy.

The milk and cream produced during heavy iodine feeding had an objectionable odor and contained very large quantities of iodine.

Forty-two calves were fed, by the paired system of feeding, in an effort to learn whether iodine, especially in the form of iodized linseed meal, is of value in the rearing of dairy calves.

The duration of the experimental feeding of the different pairs of calves ranged from 75 to 139 days. Twenty-six of the calves were fed for 117 days or longer.

The ration was made up of skim milk, grain, and hay, as in good average practice. Cod-liver oil was included in the ration of all calves during a part of the time.

Iodine was fed to one calf in each pair in quantities ranging from 10 mg to 23.5 mg a day. Thirteen individuals received 18.5 mg or more a day, as an average for the experiment.

Thirty milligrams of iodine per hundred pounds of live weight, in the form of iodized linseed meal, proved to be a heavier dosage than the calves could tolerate, as revealed by loss of appetite (particularly for hay), roughness of the hair, digestive disturbances, and an emaciated condition, after receiving iodine at this rate for from three to five weeks.

With few exceptions, the calves could tolerate 10 mg of iodine, in the form of iodized linseed meal, per hundred pounds live weight, with no harmful effect.

The calves that received iodine ate less hay and made appreciably less gain in weight, but greater gain in height, on an average, than did those receiving no iodine.

The addition of cod-liver oil to the ration of the calves, when they were in an emaciated condition as a result of excessive iodine intake, proved very helpful in bringing the calves back to a normal condition.

Among 10 experimental lots of growing swine, fed as matched pairs of lots, three lots receiving iodine made greater gains in weight than did their check lots, while two check lots made greater gains than did the paired lots receiving iodine. The differences in three cases were too small to be of possible significance.

The five groups that received iodine required an average of 401.3 pounds of feed to produce 100 pounds of gain in weight, while the five groups used as checks required 407.9 pounds of feed to produce 100 pounds of gain.

It is therefore evident that no certain beneficial results, either as to amount or cost of gain in weight, were derived from feeding iodine, in the form of iodized linseed meal, to growing swine.

Fifteen carefully selected pairs of native Pennsylvania lambs were fed for 77 days in a study of the value of supplemental iodine in the fattening of lambs.

One lamb of each pair received in addition to its ration 33 mg of iodine a day in the form of iodized linseed meal, while the other lamb constituted a control or check.

Among the 15 pairs of lambs, in 7 pairs the lamb receiving iodine gained in weight the more rapidly, while in the remaining 8 pairs the check lamb gained the more rapidly.

Of 165 comparisons between weekly gains in live weight of the pairs, 63 favored the lamb which received iodine; 69 favored the check lamb, and 33 comparisons were of neutral significance.

The average difference between the average daily gains of pair mates was 0.01 pound in favor of the check lamb.

These results show clearly that iodine as fed in this experiment produced no appreciable effect in the fattening of lambs.

The average daily gains in live weight of the lambs in the groups which received iodine were slightly less than those in the check or control groups, the difference ranging from 0.02 to 0.03 pound.

The feed required for 100 pounds of gain in live weight was greater for the lots that received iodine. The iodine fed groups of the native fine-wool lambs, the native mutton lambs, and the western lambs required 184.5, 136.4, and 46.9 pounds more feed, respectively, for each 100 pounds of gain than was required by the check lots.

There was, therefore, a slight deterimental effect from the feeding of iodine to these lambs, and this effect was greater with lambs from the State of Pennsylvania than with those from the State of Washington.

Four groups of single comb white leghorn female chicks, containing from 160 to 187 individuals each, were fed from hatching time to the age of 32 weeks to determine the value of supplemental iodine in relation to growth and early egg production.

Two of the groups received a normal mixed ration containing fish meal, while the others received a similar ration but with meat scrap replacing the fish meal.

The iodine was administered in the form of iodized linseed meal at a rate supplying 0.05 of iodine per 100 pounds of chicken a day.

No certain effect of the iodine on the growth, mortality, or egg laying of the birds was observed.

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