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FOR THE DEGREE OF

Doctor of Philosophy

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THE EFFECT OF THYROPROTEIN ON THE GROWTH, FATTENING AND CARCASS COMPOSITION OF SWINE

A Thesis

Submitted to the Faculty

of

Purdue University

by

Tilden Wayne Perry

In Partial Fulfillment of the

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of

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THE EFFECT OF THYROPROTEIN ON THE GROWTH, FATTENING, AND CARCASS COMPOSITION OF SWINE

ABSTRACT

Four experiments were conducted to determine the effect of feeding different levels of thyroprotein on growth, fattening, feed efficiency , carcass composition and certain hormone changes in swine.

Trial I was conducted during the summer of 1948. Forty Duroc pigs were divided into four lots of 10 pigs averaging 40 pounds live-weight, and were placed in adjacent pens on concrete. Lot I served as the control and received a basal ration of the following average composition: ground yellow corn, 63.75 percent; ground wheat, 20 percent; protein supplement, 15 percent; a simple mineral mixture, 1 percent; and a vitamin supplement, 0.25 percent. Lots II, III, and IV received, in addition to the basal ration, 4, 6, and 8 grams of thyroprotein, respectively, (0.0088%, 0.0132% and 0.0176%) per 100 pounds basal ration. The complete diet was fed ad libitum. The three respective thyroprotein-fed lots made average gains of 187, 195, and 186 pounds as compared to the control group which gained 154 pounds in the 119-day feeding trial. The groups receiving thyroprotein required from 4 to 8 percent less feed per unit of gain than was required by control animals.

The carcasses from the 10 hogs of the fastest gaining group (Lot III) and the carcasses from 9 of the 10 animals of the control group (Lot I - one animal was condemned because of an arthritic condition) were taken for chemical analysis. The animals from the control group

had the following average carcass chemical composition: moisture, 38.19 percent; protein, 9.48 percent; fat, 51.88 percent; ash, 0.52 percent. The carcasses of the animals from the 0.0132 percent thyroprotein-fed group had the following average chemical composition: moisture, 34.99 percent; protein, 8.85 percent; fat, 55.65 percent; ash, 0.46 percent. These differences between groups were statistically significant at the 5% level. However, when the data were analyzed for a method to compensate for the difference in average liveweight between the two groups (analysis by covariance), there was no significant difference between the two groups in moisture, protein, fat, or mineral matter content.

For the Winter Trial, 1948-49 (Trial II) fifty weanling Hampshire pigs were divided into five groups and housed in adjacent pens on concrete. The average individual weight for these animals was 54 pounds. In this trial the components of the ration were not mixed together, as in Trial I, but rather each component was placed in a separate compartment of a self-feeder. Lot I received the basal ration of shelled corn, a protein supplement, a simple mineral mixture, and a vitamin supplement blended with a protein supplement. Lot II received an average of 0.447 gm. thyroprotein per 100 pounds liveweight per day, in the protein supplement. An adjustment was made each two weeks in an attempt to keep the dosage level constant. Lot III received an average of 0.426 gm. thyroprotein per 100 pounds liveweight per day in the protein supplement. In this case only one adjustment was made - that was midway through the trial. Lots IV and V received the basal ration plus 60 and 80 grams, respectively, of thyroprotein per 100 pounds of protein supplement. The feeding of thyroprotein at the level of 80

grams per 100 pounds supplement (0.395 gm. per 100 pounds liveweight) resulted in a significantly increased growth rate of 24 pounds more than the controls. In the 138-day feeding trial control animals made an average gain of 179 pounds as compared to 203 pounds for the animals receiving 80 grams of thyroprotein per 100 pounds protein concentrate. At levels of 0.447, 0.289 and 0.426 gm. per 100 pounds liveweight, the feeding of thyroprotein depressed growth rate from 17 to 21 pounds less than control animals. Significantly greater thyrotropic hormone content was found in the anterior pituitaries of animals receiving 0.289 gm. thyroprotein per 100 pounds liveweight per day, and significantly less in the anterior pituitaries of the animals receiving 0.447 gm. thyroprotein per 100 pounds liveweight per day, when compared with the anterior pituitaries of the control animals.

Trial III was conducted during the summer of 1949 and all animals fed on Ladino clover-alfalfa pasture. Sixty pigs of Hampshire breeding and of an average weight of 79 pounds were divided into five lots of 12 pigs each. All components of the basal ration were fed free choice and included shelled corn, protein supplement, and mineral mixture. Each lot of 12 pigs was confined to a one-half acre pasture. Lot I received only the basal ration. Lot II was fed thyroprotein at a level of 0.363 gm. per 100 pounds liveweight per day in the protein concentrate. One adjustment was made midway through the feeding trial. Lot III was handled similarly to Lot II except the level of feeding thyroprotein was 0.644 gm. Lot IV received the basal ration only until the animals reached an average individual weight of 136 pounds at which time the feeding of thyroprotein at a level of 0,579 gm. per 100 pounds liveweight was started. The animals in Lot V received the basal ration

plus 120 gm. thyroprotein per 100 pounds protein concentrate (0.442 gm. per 100 pounds liveweight per day). In the 98 day feeding trial the control animals made an average gain of 154 pounds which was equaled by the animals receiving a daily intake of 0.363 gm. thyroprotein per 100 pounds liveweight (Lot II). At a level of 0.644 gm. (Lot III) the feeding of thyroprotein on pasture resulted in a significantly depressed growth rate of 35 pounds less than the control animals. At levels of 0.442 gm. (Lot V) and 0.579 gm. (Lot IV) the feeding of thyroprotein had little effect on growth rate. Animals receiving thyroprotein during this trial required from 5 to 15 percent more feed per unit of gain than control animals which received no thyroprotein.

The fourth trial was conducted during the fall and winter of 1949-1950. The trial was started on Ladino clover-alfalfa pasture, but two weeks later a killing frost reduced the plots to barren lots. Five groups of 12 pigs each were lotted in one-half acre adjacent lots. This trial consisted of two units. Lots I and II composed one unit in which a complete single ration was fed. Lot I served as the control and received the same basal ration fed in Trial I. Lot II received in addition to this basal ration, thyroprotein at a level of 0.0184 gm. per 100 pounds liveweight per day (8 grams per 100 pounds ration). Lot III served as a control group for the second part of the trial in which Lots III, IV and V received the components of their ration free choice. The hogs were given free access to a basal ration composed of ground shelled corn and ground wheat (70 - 20), protein supplement, and minerals. Lot IV was given the same ration as Lot III except that the animals in this group received thyroprotein at a level of 0.487 gm. per 100 pounds liveweight per day. Lot V was given the same ration

as Lot III plus thyroprotein adjusted every two weeks so that the ration contained 0.500 gm. per 100 pounds liveweight per day up to the time the animals weighed an average of 136 pounds; then the level was dropped to 0.400 gm. until the animals weighed 180 pounds; from that time on, the level was dropped to 0.300 gm., giving an overall average of 0.341 gm. per 100 pounds liveweight per day. The feeding of thyroprotein at decreasing levels as the animals grew larger (Lot V) resulted in a significantly increased growth rate of 17 pounds more than the control animals which received no thyroprotein. In no other case did the feeding of thyroprotein significantly affect growth rate in this trial.

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THE EFFECT OF THYROPROTEIN ON THE GROWTH, FATTENING, AND CARCASS COMPOSITION OF SWINE.

INTRODUCTION

The thyroid gland is primarily concerned with the regulation of metamorphosis, growth, and metabolism, and indirectly affects a wide variety of functions such as reproduction, milk secretion and the cardio-vascular, respiratory, and nervous systems. This regulatory action is accomplished through its secretion thyroglobulin, or the amino acid thyroxin which is contained in the thyroid gland and which is generally spoken of as the thyroid hormone. After total thyroidectomy the basal metabolic rate gradually falls to 45 or 50 percent of its normal value, oxidative processes in all tissues are depressed, and body temperature may decrease slightly. The administration of thyroid substance or thyroxin to such athyreotic animals or to normal subjects causes the basal metabolism to be elevated in proportion to the amounts received.

It might be assumed that the thyroid hormone, because of its action upon cellular metabolism, would exert important influences upon growth. Thyroidectomy of the young animal retards general growth. On the other hand, thyroid stimulation causes the resumption of growth in such animals and, according to the level of stimulation, may sometimes cause an acceleration in the developmental processes. However, this is true only up to a certain point. Hyperthyroidism may be accompanied by extreme weight loss and organic disturbances of varying degrees of severity, and sometimes death.

Research has shown that other hormones have an effect on growth. The endocrine regulation of growth is primarily a function of the growth

hormone of the anterior pituitary gland. The sex glands likewise have a marked effect on growth, especially on the regulation of skeletal development. In fact, all the hormones of the endocrine system are interrelated in the part played in the phenomena of growth. The role of a single hormone in growth and development is hard to evaluate.

Unlike many hormones which are relatively inefficient when administered orally, thyroprotein exhibits marked thyroid activity when fed. For this reason it could be readily adapted to livestock feeding practices if it were shown to produce desirable economic effects in the farm animals.

The objectives of these trials were, therefore, to study the effect of thyroprotein on growth rate, feed efficiency, and carcass composition of swine.

FORMATION OF THYROPROTEIN

Investigations on the iodination of proteins date back to the latter part of the nineteenth century following the discovery, at about that time, of iodine in organic combination in the thyroid gland. Further research indicated that the greater part of the iodine in the thyroid gland occurred in combination with thyroglobulin, thus establishing the fact that the active substance is actually an iodoprotein. This led to attempts to iodinate various proteins to bring about thyroid-like activity. Liebricht in 1897 combined iodine with casein by mixing the two substances together in the proportion of 20 grams of iodine to 80 grams of casein, and stirring at 100° C. This resulted in a rather crude form of material designated as periodocasein. It was learned shortly afterwards that hydriodic acid liberated as a side product prevented the reaction of iodine with protein from going to completion. To overcome this, the iodination was conducted in a solution buffered with sodium bicarbonate. By this means the liberated hydriodic acid was neutralized continuously, permitting the reaction to proceed. It is of considerable interest that more than fifty years later this method, with but slight modifications, has been found to provide optimal conditions for the formation of iodinated proteins with high thyroxine content and marked thyroidal properties.

In recent work the principal departures from earlier procedures has been, (a) limitation of the iodine to optimal level established for thyroxine formation, and (b) incubation of the iodinated proteins at 60° to 70° C. The general procedure is as follows:

Twenty grams of casein is placed in 700 ml. of distilled

water containing 5 grams of sodium bicarbonate, and is dissolved by stirring. The mixture is then placed in a water bath held at 38° to 40° C., and a total of 317 grams of finely powdered iodine is added in small portions over a period of 3 to 4 hours, the solution meanwhile being agitated vigorously with a mechanical mixer. When the requisite amount of iodine has been added, the solution is incubated at 70° C., with vigorous stirring, for 18 to 20 hours. After dialysis, the iodinated protein is recovered by isoelectric precipitation, dried, and ground to a fine powder.

In order that levels of administration can be controlled, a quantitative assay of thyroidal potency is necessary. The biological methods developed for assay are adaptable , with slight modifications in some cases, for estimation of thyroidal activity of iodinated proteins, The biological assays are based on the stimulation of metamorphosis in frog tadpoles, and on the elevation of the metabolic rate and decrease in body weight of the common laboratory animals. Also, chemical determination of the thyroxine content of thyroactive iodinated proteins has given results that checked well with biological assays.

By control of the factors now known to influence the formation of thyroxine in iodinated proteins it is possible to produce consistently, preparations containing from 3 to 4 percent thyroxine as indicated by either chemical or biological assay. Although further investigation is needed to establish unequivocally that all of the material indicated by these measurements is actually thyroxine, comparisons of results obtained by chemical and biological assays indicate a very close similarity to thyroxine in both chemical characteristics and biological activity.

REVIEW OF LITERATURE

Many functions have been attributed to the thyroid gland since Hippocrates and Plato declared its purpose to be that of lubrication of the pharynx, larynx, and trachea. At the present time not all investigators are agreed on the many causes of altered function of the thyroid gland or the results of such alteration, but there is agreement that normal thyroid function is essential for optimum physiologic activity of vertebrate organisms.

It has long been known that hypothyroidism of the new born, known as cretinism, is characterized by retarded physical and mental growth. Early investigators found that these symptoms could be prevented - or at least alleviated - by the oral administration of dessicated thyroid tissue. Moussu, as early as 1899, reasoned that if a small amount of thyroid is necessary for growth, larger doses might result in more rapid growth. Working on the hypothesis of Moussu, a great deal of work has been done since that time in attempts to bring about more rapid growth in both laboratory and common farm animals.

Koger and Turner, (1943) studied the effects of thyroprotein on mice, rats, rabbits, and guinea pigs. In mice the rate of growth was consistently accelerated by injecting 0.01 to 0.03 milligrams of crystalline thyroxine-sodium daily or by feeding 0.04 to 0.32 percent thyroactive iodocasein in the ration. Thyroprotein had little or no effect on growth in rats of the Missouri strain. The growth rate of male guinea pigs was accelerated by small amounts of thyroprotein for a short period of time but the same dosage was inhibitive in warm weather. The growth rate of male or female rabbits was unaffected by extremely small

doses of thyroprotein and larger amounts caused progressive depression of growth. Koger, Hurst, and Turner, (1942, 1943) reported stimulatory effects in albino mice when either crystalline thyroxin or thyroactive iodocasein was administered.

Growth stimulation in ruminants by the administration of thyroprotein has not been generally reported. Dinusson, Andrews, and Beeson, (1948) reported that Hereford calves weighing about 500 pounds which were fed iodocasein did not gain as rapidly as their controls which received no thyroprotein. Beeson and Mott, (1948) were not able to accelerate the growth rate of steers which were fed thyroprotein, starting at an average weight of 550 pounds. However, Millen, Nevens, and Gardner, (1948) reported that the feeding of thyroprotein at a level of 1.3 grams per 100 pounds body weight per day resulted in a slightly increased growth rate in dairy calves.

Considerable variation in the response of dairy cows to thyroprotein has been reported. Almost all investigators in the subject are in agreement that there is no response when the material is fed to a fresh cow. Likewise, very little response is evident during the last month or two of lactation; as a matter of fact, thyroprotein may tend to cause a cow to dry up late in the milking period. Most workers feel that it is in mid-lactation that a response occurs. Usually it is the good producers which give the best response in terms of increased production of milk and butterfat.

Although thyroprotein-feeding can raise the yields of milk and fat markedly, it can also create a condition of hyperthyroidism with higher heart rate, respiration rate, and body temperature, and a loss in body weight. (Blaxter, 1943, 1945, 1946; Booth, et al, 1947; Hibbs

and Krauss, 1947; Kemmerer, et al, 1946; Moore, 1946; Reece, 1944, 1946, 1947a, 1947b; Reed, 1947; Reineke, et al, 1942, 1943, 1944; Seath et al, 1944, 1945; Swanson and Knodt, 1949; Sykes et al, 1947; Thomas and Moore, 1947; Van Landingham et al, 1944, 1946, 1947a, 1947b)

It appears that larger chickens do not give much growth response to the administration of thyroprotein and that it is only in the younger chickens that response may be obtained. Parker, (1943) fed from 0.025 to 0.2 percent thyroactive iodocasein in the ration of Rhode Island Red Chicks. Chicks receiving the lower level made greater gains and required less feed per gram of gain than did the controls. Chicks receiving the higher levels gained more than the controls and were more fully feathered than those receiving the lower levels or the controls. Irwin, Reineke, and Turner (1943) also produced slightly heavier chicks at twelve weeks of age by feeding thyroactive iodocasein. However, they reached a point where growth was depressed. These results have been extended by Turner, Irwin, and Reineke (1944) who found some growth depression with 0.1 percent iodinated casein in the diet. The carcasses of these birds had less subcutaneous fat than their controls.

Wheeler, Hoffman, and Graham (1948) fed 10 grams of thyroprotein per 100 pounds feed to Rhode Island broilers and reported a significantly increased rate of growth in males but not in females up to 12 weeks of age. In this trial there was no observable difference in abdominal fat between birds which had received the treatment and those which had not. Similarly, Quisenberry and Krueger (1948) reported increased gains and feed efficiency with 800 chicks of the New Hampshire and White Plymouth Rock breeds fed iodinated casein to six weeks of age.

Glazener and Shaffner (1948) reported a difference in response between breeds of chickens. Rapid-growing strains of Barred Plymouth Rock and New Hampshire Red chickens were reported to have a higher thyroid activity than slower-growing strains. Conversely, the slow-growing Plymouth Rocks showed a greater response to iodinated casein than the rapid-growing strain.

In the case of swine almost all the work with thyroprotein has been directed toward studying its effect on growth rate. However, two groups of investigators have reported a study of the effect of thyroprotein on milk production in the lactating sow. Reineke and McMillen (1946) administered thyroprotein at the level of 0.005 percent of the ration to two sows that were deficient in milk production, as indicated by extreme thinness and emaciation of their pigs. Lactation improved markedly as judged by improvement in the pigs and external appearance of the sow's udder. Braude (1947) indicated there might have been some stimulation of milk production in sows. However, in both cases it was very difficult to get a very accurate estimate of the actual amount of milk produced. Based on the work with ruminants it is feasible to believe a stimulation of milk production could be brought about.

The effect of thyroidally-active substances on the growth rate of hogs has not been fully established. The findings of some investigators are in apparent opposition to those of others. Some of the known factors that undoubtedly affect the response of swine to thyroprotein are age of the animals at the time of treatment, environmental temperature, breed difference, and level of dosage. In English work, Braude (1947) reported seven trials with Large White Hogs to which he had given a

constant level of 1.5 gm. thyroprotein per day. He observed increased rate of respiration, hyperirritability, and retarded rate of growth. Muhrer, Warner, Palmer, and Hogan (1947) found no growth stimulation when pigs were fed iodinated casein for a short time during the fattening period.

Vander Noot, et al (1948) found that thyroprotein had little effect on growth at levels up to 0.225 gm. per 100 lb. body weight per day and that higher dosages reduced growth. However, thyroprotein feeding was discontinued when the pigs weighed 125 pounds.

In contrast to the above, several investigators have reported a stimulation of growth by feeding thyroprotein to hogs. Beeson, Andrews, Witz, and Perry (1947, 1949) were able to stimulate growth rate in weanling Duroc pigs by feeding thyroprotein at the level of 0.0088 percent, whereas the level of 0.0044 percent had no apparent effect. Pigs receiving the higher dosage gained 26 pounds more per pig and required ten percent less feed during an 84-day feeding trial. A significant increase in body length and weight of bellies and picnic shoulders was reported. Perry, Beeson, and Andrews (1948) continued this work and in a 104-day trial a ration containing 0.0088 percent was without effect whereas a ration containing 0.0132 percent thyroprotein caused a significant increase in gain and also resulted in significantly longer carcasses with heavier loins.

Wallach, McMillen, and Newland (1947) and Reineke, McMillen, and Bratzler (1948) found that while eight control Durocs averaged 1.42 pounds per day gain during a seventy nine day post-weaning period, two separate lots of seven Durocs receiving 1.4 and 2.8 gm. thyroprotein

per 100 pounds feed, respectively, gained 1.54 pounds per day. Similar results were obtained by these investigators with Yorkshire, Chester White, and Berkshire pigs. Using small dosages of iodinated casein (0.005 to 0.006 percent of the ration) Reineke and McMillen (1946) reported a significant increase in the rate of gain and a slight increase in efficiency of food utilization.

Experimental

Four feeding trials were conducted in these experiments. The design of these trials was based on information obtained in three previous trials in which alteration of the function of the thyroid gland had been brought about by the feeding of thiouracil and thyroprotein to pigs. The first of the four to be reported was conducted in the summer of 1948; the second during the winter of 1948-49; the third during the summer of 1949; and the fourth during the winter of 1949-50. In the first trial 40 purebred Duroc hogs were used. In the other three trials a total of 160 purebred Hampshire hogs were used. The pigs selected were apparently in good health and as nearly uniform in age, size, and appearance as possible. The first two trials were conducted in drylot on concrete floors, and the third trial was conducted on Ladino-alfalfa pasture. The fourth trial was started in the fall of 1949 on Ladino-alfalfa pasture, also. However, after the first two weeks a severe frost prevented further pasture growth and therefore this trial was actually conducted on soil with no green pasture. Water was available at all times from automatic water fountains. The feed was fed ad libitum from self-feeders. Duplicate individual weights were obtained at the beginning and end of each trial and single individual weights were taken at 14-day intervals during the experiment.

The feed consumption of each group of hogs was determined at 14-day intervals corresponding to the weigh periods. At the end of each trial the hogs were processed by Kingan and Company, Indianapolis, Indiana, where the carcass studies were made.

The data were treated statistically by the methods of analysis outlined by Snedecor.

Summer Feeding Trial - 1948

Forty Duroc pigs were divided into four groups of ten pigs averaging 40 pounds liveweight. This trial was started on June 28, 1948, and was completed October 25, 1948, a period of 119 days. The four lots were housed in adjacent pens with concrete floors in the Purdue Experimental Feeding Barn.

All components of the ration were blended into one feed which was fed ad libitum. This is designated as the basal ration and it was to this ration that various treatments were added for the lots receiving treatments.

Composition of the Basal Ration
(Summer Trial - 1948)

Ingredient	June 28 to July 26 (%)	July 26 to Sept. 6 (%)	Sept. 6 to Oct. 25 (%)
Ground yellow corn	58.75	63.75	69.00
Ground wheat	20.00	20.00	20.00
Supplement V_1	20.00	15.00	10.00
Mineral mixture$_2$	1.00	1.00	1.00
Vitamin Supplement$_3$	0.25	0.25	0.00

1. Purdue Supplement V has the following composition - 40% soybean oil meal, 20% meat and bone scrap, 20% fish meal, 10% alfalfa meal, 10% cottonseed meal.

2. Mineral mixture is composed of equal parts of steamed bone meal, ground limestone, and salt.

3. "NOPCO XX" - 3000 I.U. of A and 400 I.U. of D per gram, fortified cod liver oil. National Oil Products Company, Harrison, New Jersey.

Because of the relatively small amounts of thyroprotein to be mixed into the ration at any one time, the material was first mixed with the

salt by hand and then mixed with 75 pounds of soybean oil meal. This mixture was then placed in a mechanical mixer and blended with other constituents of the ration.

The basal ration, as listed in the preceding table, was fed to all animals with changes being made on the dates indicated to adjust for the decreasing protein requirements of growing hogs. As may be noted from this table this was accomplished by decreasing the amount of Purdue Supplement V and increasing the amount of ground yellow corn in the ration.

Lot I served as the control. Lots II, III, and IV received, in addition to the basal ration, 4, 6, and 8 grams (0.0088%, 0.0132%, and 0.0176%) of thyroprotein, respectively, per 100 pounds of basal ration. The trial was ended when the fastest gaining lot of animals weighed approximately 225 pounds each.

The carcasses from the 10 hogs of the fastest gaining group (Lot III), the carcasses from 9 of the 10 animals from the control group (Lot I - one animal was condemned because of an arthritic condition), and three animals from Lot II were taken for chemical analysis. In order to obtain representative samples from each carcass, one half of each carcass was skinned, boned out and thoroughly ground and mixed in a sausage grinder. Bones, skin, and edible carcass were weighed separately for each animal. A two pound sample was taken from each ground carcass and each sample was further mixed and chopped in a Hobart food cutter before aliquots were taken for chemical analysis. The chemical determinations made on these samples were for water, protein, fat, and mineral matter. The procedures followed were those outlined by the Association of Official Agricultural Chemists.

Winter Feeding Trial - 1948-49.

Sixty weanling Hampshire pigs were purchased from the Marsh Foundation, Van Wert, Ohio. From this group fifty pigs were separated into five lots of ten pigs on the basis of liveweight, thriftiness, and general appearance. This trial was started on December 23, 1948, and was concluded May 10, 1949, a total of 138 days. The five lots were housed in adjacent lots in the Purdue Experimental Feeding Barn. All pens had concrete floors. The average initial weight for the five groups was 54 pounds per pig. The trial was completed when the fastest gaining group (Lot V) reached an average liveweight of 257 pounds.

In previous trials the thyroprotein had been incorporated into a single complete ration for those animals receiving thyroprotein. In this trial it was desired to incorporate the thyroprotein into the protein supplement and let the pigs eat their ration cafeteria-style. The components of the ration consisted of shelled corn, Purdue Supplement V, and a mineral mixture containing equal parts of steamed bone meal, ground limestone, and salt. Lot I served as the control and received only the basal ration. Lot II received, in addition to the basal ration, 0.447 gm. of thyroprotein per 100 pounds liveweight per day. The thyroprotein was mixed into the protein supplement. An adjustment was made each two weeks in an attempt to keep the consumption of thyroprotein at the desired level. Lot III received the basal ration plus 0.426 gm. thyroprotein per 100 pounds liveweight per day, mixed in the protein concentrate. However, only was an adjustment made at the time the average individual liveweights in this lot was 125 pounds. That is, the level for the first half of the feeding trial was calculated from

the average of the starting liveweight and 125 pounds liveweight. Likewise, the level for the second period was based on the average of 125 pounds and the finish weight of 225 pounds. Lots IV and V received the basal ration plus 60 grams and 80 grams, respectively, of thyroprotein per 100 pounds of protein concentrate, mixed in the protein concentrate.

At the completion of the trial, the animals were marketed direct to Kingan and Company, Indianapolis, Indiana. Although some of the thyroid glands had been mutilated in the slaughtering process, weights were obtained on all intact thyroid glands. The hypophysis of each pig was recovered and the anterior lobe of each hypophysis was weighed on a chainomatic balance. The anterior lobes were then frozen until they were assayed for thyrotropic hormone content. For assay, all the anterior lobes from the hogs of each lot were macerated together with a mortar and pestle. Two ml. of water was added to each 100 mg. of tissue so that 1 ml. of the injected solution contained 50 mg. of tissue. The methods of Bergmann and Turner (1939), and of Elijah and Turner (1942) were followed carefully. Day-old male White Leghorn chicks were injected subcutaneously daily for four days with 0.1 ml. of the solution, containing 5 mg. of the anterior pituitary material. Thus, each chick received 0.4 ml. of a solution containing 20 mg. of the anterior pituitary tissue. The baby chicks were sacrificed on the fifth day and their thyroids were dissected and immediately weighed on a balance accurate to 0.1 mg. Each chick was inspected at post-mortem to be sure that only males were used.

Summer Feeding Trial - 1949.

Seventy weanling Hampshire pigs were purchased from L. L. Stewart,

Kirklin, Indiana, from which 60 were selected and divided into groups of twelve pigs each. The pigs were maintained on one-half acre plots of Ladino clover and alfalfa pasture. The trial was started June 29, 1949, and concluded October 5, 1949, a total of 98 days. The average starting weight was 79 pounds and the trial was concluded when the fastest gaining group (Lot II) averaged 233 pounds per animal.

As in the trial just previous, all components of the basal ration were fed as libitum. The basal ration consisted of - shelled corn; mineral mixture (mineral mixture consisted of equal parts of steamed bone meal, ground limestone, and salt); and protein supplement (protein supplement consisted of equal parts of soybean meal and meat scraps). Lot I received only the basal ration. Lot II was fed thyroprotein at a level of 0.363 gm. per 100 pounds liveweight per day in their protein concentrate. One adjustment was made when the animals averaged 135 pounds liveweight. Lot III was handled similarly to Lot II except that the level of thyroprotein in this lot was 0.644 gm. per 100 pounds liveweight per day. Lot IV received the basal ration only until the animals reached an average liveweight of 136 pounds at which time the feeding of thyroprotein at a level of 0.579 gm. per 100 pounds liveweight was started. Lot V received the basal ration plus 120 gm. thyroprotein per 100 pounds protein concentrate. No carcass studies were made in this trial.

Winter Trial - 1949-50.

Seventy weanling Hampshire pigs were purchased from L. L. Stewart, from which 60 pigs were selected and divided into five lots of twelve pigs each. The original plan of this trial was that it would be

conducted on pasture with each group being assigned to a one-half acre plot. However, after the second week a killing frost reduced the pastures to barren plots. The trial was started October 27, 1949, and was concluded February 2, 1950, a total of 98 days. The average initial weight of the pigs was 74 pounds and the trial was concluded when the fastest gaining group (Lot V) reached an average liveweight of 233 pounds.

Actually, this trial consisted of two separate comparisons. In one comparison thyroprotein was fed as a part of a single complete ration, while in the other comparison thyroprotein was incorporated in the protein supplement and all components of the ration were fed free choice. Lot I served as the control for one comparison and received only the basal ration of a single complete feed which contained Purdue Supplement V, ground corn, ground wheat and minerals. (Same basal as listed in Summer Trial - 1948). Lot II received the basal ration listed for Lot I with the exception that thyroprotein was incorporated into the ration at the level of 8 gm. per 100 pounds of feed (0.0176%). Lot III served as a second control and received an ad libitum ration of ground shelled corn and wheat (7 to 2), Purdue Supplement V, and minerals. Lot IV received the same ration as Lot III with the exception that thyroprotein was incorporated into the supplement so that the animals received 0.487 gm. thyroprotein per 100 pounds liveweight per day with adjustments being made each two weeks. Lot V received the ration listed for Lot III plus thyroprotein adjusted every two weeks so that the ration contained 0.500 gm. thyroprotein per 100 pounds liveweight per day up to the time the animals weighed 136 pounds; then the level was dropped to 0.400 gm. until the animals weighed 180

pounds; from that time on, the level of thyroprotein was dropped to 0.300 gm. per 100 pounds liveweight per day, giving an overall average of 0.341 gm. per 100 pounds liveweight per day.

No studies were made on the carcasses of the animals from this trial.

RESULTS - SUMMER TRIAL - 1948

(Growth Rate)

The data summarizing the effects of thyroprotein on growth are presented in Tables 1, 2, and 6. From these tables it may be observed that the animals receiving thyroprotein grew at about the same rate as the controls for approximately 42 days, after which time it became apparent that the animals receiving thyroprotein began to gain more rapidly. In this trial the difference became apparent when the animals were approaching 100 pounds in weight. Furthermore, at about the time the animals weighed 125 pounds (at the seventieth day of the experiment) the margin between the controls and the treated animals widened very rapidly. During the 119 day feeding trial the controls gained an average of 154 pounds per pig while the animals receiving thyroprotein at levels of 0.0088, 0.0132, and 0.0176 percent, gained 187, 195, and 186 pounds, respectively. The feeding of thyroprotein at these three levels resulted in gains that were significantly greater ($P < .05$) in each case than the gains made by the animals in the control group.

The animals in the control group made an average daily gain of 1.30 pounds as compared to daily gains of 1.57, 1.64, and 1.57 pounds, for the animals receiving, in addition to the basal ration, 0.0088, 0.0132, and 0.0176 percent thyroprotein, respectively.

One barrow from the lot receiving the highest level of thyroprotein (0.0176%) weighed 216 pounds at the completion of the trial, which compared very well to the lot average of 228 pounds, but developed inability to stand on the hind legs. Because this was the highest level of thyroprotein that had been fed to swine in experiments conducted at this

TABLE 1. Average Growth Rate of Animals by Weigh Periods. (Summer Trial - 1948)

Group Number	Treatment	Unit	Days on Feed									
			0	14	28	42	56	70	84	98	112	119
I	Control	lb.	42	57	74	88	110	125	145	164	185	196
II	0.0088% Thyroprotein (0.184 gm./100 lb. liveweight)	lb.	41	56	75	93	113	135	159	185	213	228
III	0.0132% Thyroprotein (0.289 gm./100 lb. liveweight)	lb.	41	56	77	96	118	143	167	191	222	236
IV	0.0176% Thyroprotein (0.373 gm./100 lb. liveweight)	lb.	42	58	78	98	121	147	166	190	215	228

TABLE 2. Average Daily gain of Animals by Weigh Periods. (Summer Trial - 1948).

Group Number	Treatment	Unit	Days on Feed									Ave.
			14	28	42	56	70	84	98	112	119	
I	Control Group	lb.	1.09	1.21	1.03	1.53	1.14	1.40	1.37	1.49	1.56	1.30
II (0.184	0.0088% Thyroprotein gm./100 lb. liveweight)	lb.	1.04	1.39	1.25	1.43	1.56	1.75	1.82	2.04	2.11	1.57
III (0.289	0.0132% Thyroprotein gm./100 lb. liveweight)	lb.	1.06	1.52	1.36	1.54	1.83	1.68	1.69	2.24	2.07	1.64
IV (0.373	0.0176% Thyroprotein gm./100 lb.liveweight)	lb.	1.16	1.42	1.44	1.65	1.88	1.35	1.74	1.79	1.81	1.57

Station it was felt there might be a possibility of bone or muscle damage. However, examination of the animal by Dr. L. M. Hutchings, of the Veterinary Science Department, failed to reveal any gross pathology of joints or muscles.

Also, one gilt from the same lot (Lot IV - 0.0176% thyroprotein) gained from the start very similarly to other animals in the same lot until the fifth weigh period (70 days on feed). After this time she barely maintained her weight and at the completion of the trial her weight was 138 pounds. She was retained for pathological studies. Dr. L. M. Hutchings examined this animal at the time of slaughter and was not able to detect any abnormalities. The glands examined included the pancreas, liver, lungs, heart, kidneys, and thyroid.

One female in Lot I developed an arthritic condition and was condemned at time of slaughter.

Feed Consumption

The pattern of feed consumption closely followed the growth pattern. For the 119 day period the control group had an average daily feed consumption of 5.4 pounds. This was approximately one pound less per day than was consumed by the three lots receiving thyroprotein in their ration. Daily feed consumption of 6.2, 6.7, and 6.3 pounds, were recorded for the respective treated lots which received thyroprotein at the levels of 0.0088, 0.0132, and 0.0176 percent. The animals in the four lots consumed approximately equal amounts until the fourth weigh period (56 days on feed) after which the control animals failed to consume as much as any of the animals receiving thyroprotein. (Table 3)

TABLE 3. Average Daily Feed Consumption by Animals by Weigh Periods. (Summer - 1948).

Group Number	Treatment	Unit	Days on Feed									
			14	28	42	56	70	84	98	112	119	Ave.
I	Control Group	lb.	3.2	3.6	4.4	4.6	5.3	6.1	7.1	7.8	7.9	5.4
II (0.184	0.0088% Thyroprotein gm./100 lb. liveweight)	lb.	3.4	3.7	4.5	5.8	5.8	7.1	8.4	9.4	9.1	6.2
III (0.289	0.0132% Thyroprotein gm./100 lb. liveweight)	lb.	3.6	3.9	5.0	6.0	6.0	7.4	8.9	10.3	10.9	6.7
IV (0.373	0.0176% Thyroprotein gm./100 lb. liveweight)	lb.	3.5	3.8	4.9	6.0	5.9	7.1	8.2	9.4	10.0	6.3

TABLE 4. Average Daily Consumption of Thyroprotein per 100 Pounds Liveweight. (Summer - 1948).

Group No.		Unit	Days on Feed									Ave.
			14	28	42	56	70	84	98	112	119	
II	Ave. Liveweight	lb.	49	66	84	103	124	147	172	199	221	135
	Ave. daily feed consumption	lb.	3.4	3.7	4.5	5.8	7.1	7.1	8.4	9.4	9.1	6.2
	Thyroprotein per pig per day	gm.	.136	.148	.180	.232	.282	.284	.336	.376	.364	.248
	Thyroprotein per 100# liveweight	gm.	.278	.224	.214	.225	.187	.193	.195	.189	.165	.184
III	Ave. Liveweight	lb.	49	68	87	107	131	155	179	207	229	139
	Ave. daily feed consumption	lb.	3.6	3.9	5.0	6.0	7.4	8.9	10.3	10.3	10.9	6.7
	Thyroprotein per pig per day	gm.	.216	.234	.300	.360	.360	.444	.534	.618	.654	.402
	Thyroprotein per 100# liveweight	gm.	.441	.344	.345	.336	.275	.286	.298	.299	.286	.289
IV	Ave. Liveweight	lb.	50	68	88	110	134	157	178	203	222	135
	Ave. daily feed consumption	lb.	3.5	3.8	4.9	6.0	5.9	7.1	8.2	9.4	10.0	6.3
	Thyroprotein per pig per day	gm.	.280	.304	.392	.480	.472	.568	.656	.752	.800	.504
	Thyroprotein per 100# liveweight	gm.	.560	.447	.445	.436	.352	.362	.369	.370	.360	.373

The feed was fed ad libitum and all ingredients were mixed into a complete feed. Since the thyroprotein was incorporated into the ration at a definite level for each lot receiving this treatment, the amount of thyroprotein consumed was fairly closely controlled. Animals in the group whose ration contained 0.0088 percent thyroprotein consumed an average of 0.248 gram per day or 0.148 gram per 100 pounds liveweight per day. The consumption for the other two groups on treatment was: - for the group receiving thyroprotein at the level of 0.0132 percent, 0.402 gram per day or 0.289 gram per 100 pounds liveweight per day; for the group receiving thyroprotein at the level of 0.0176 percent, 0.504 gram per day or 0.373 gram per 100 pounds liveweight per day. (Table 4). It should be noted from Table 4 that the animals in each lot receiving thyroprotein started at a certain level of consumption in relation to the average liveweight, and that this consumption of thyroprotein per unit of liveweight gradually grew less.

Feed Efficiency

The data presented in Tables 5 and 6 concerning the amount of feed required to produce 100 pounds gain indicate all groups receiving thyroprotein were more efficient than was the control group. Whereas the control animals required 417 pounds of ration to produce 100 pounds gain, the animals in the three groups receiving thyroprotein required 395, 406, and 405 pounds of feed, respectively, to produce 100 pounds gain. The animals receiving the treatments were, therefore, from three to five percent more efficient in producing gains.

It is of interest to note that the control animals were, on the average, more efficient in making gains than were the animals on

treatment up to the time the animals on treatment began to gain faster than the control animals - 70 days on feed. From this time forward, all the groups receiving thyroprotein gained more efficiently than the control animals.

Carcass Composition

As explained in the Experimental Procedure, 22 of the 37 carcasses from this feeding trial were selected for chemical analysis. One-half of each of these 22 carcasses was skinned, boned, and ground separately, in a sausage grinder. A two-pound sample was taken from the resulting portion of each carcass for chemical analysis by methods outlined by the Association of Official Agricultural Chemists, sixth edition, 1945. For the best comparison of the effect of thyroprotein on carcass composition it was decided to compare carcasses of the animals from the control group with those from the fastest-gaining group (Lot III). In addition, the carcasses of three animals whose liveweights were approximately the same as three animals from Lot I, and of which there was no similar weight in Lot III, were taken from Lot II. No Carcasses from the animals in Lot IV were taken for analysis.

The results of the chemical analysis are summarized in Table 7. One of the first things that may be noticed from reading this table is that the sum of moisture, protein, fat, and ash in each case does not always equal 100 percent. However, duplicate checks were made on each analysis indicating the analyses were not too far from the best result that could be obtained by our present methods of analysis.

The carcasses of the animals from Lot III (0.0132 percent thyroprotein) contained significantly more ($P < .05$) fat than the controls. The average fat content of the carcasses from the controls was 51.88

TABLE 5. Average Amount of Feed Required by Animals to Produce 100 Pounds Gain. (Summer - 1948)

Group Number	Treatment	Unit	Days on Feed									Ave.
			14	28	42	56	70	84	98	112	119	
I	Control	lb.	296	292	431	301	464	435	516	524	509	417
II (0.184	0.0088% Thyroprotein gm./100 lb. liveweight)	lb.	322	363	359	405	368	406	461	460	464	395
III (0.289	0.0132% Thyroprotein gm./100 lb. liveweight)	lb.	336	358	367	390	329	443	527	462	526	406
IV (0.373	0.0176% Thyroprotein gm./100 lb. liveweight)	lb.	304	267	344	369	316	528	474	525	549	405

TABLE 6. The Effect of Thyroprotein on Growth Rate, Feed Consumption, and Feed Efficiency of Swine. (Summer Trial - 1948. 119 days)

Item	Unit	Lot Number			
		I	II	III	IV
Number of pigs		10	10	10	10
Initial weight	lb.	42	41	41	42
Final weight	lb.	196	228	236	228
Gain per pig	lb.	154	187*	195*	186*
Daily gain per pig	lb.	1.30	1.57	1.64	1.57
Daily feed consumed per pig.					
Ground corn	lb.	3.57	4.08	4.40	4.18
Ground wheat	lb.	1.08	1.24	1.33	1.27
Protein supplement	lb.	.71	.79	.85	.82
Mineral mixture	lb.	.05	.06	.07	.06
Vitamin supplement	lb.	.01	.01	.01	.01
Thyroprotein	gm.	------	.248	.402	.504
Total	lb.	5.42	6.18	6.66	6.34
Feed Per 100 Pounds Gain					
Ground corn	lb.	274.8	261.1	268.3	266.9
Ground wheat	lb.	83.4	79.1	81.2	80.9
Protein Supplement	lb.	54.3	50.9	52.1	52.3
Mineral mixture	lb.	4.2	4.0	4.1	4.1
Vitamin supplement	lb.	.5	.4	.4	.5
Total	lb.	417.2	395.5	406.1	404.7

*Least significant difference for gain at the 5% level is 30 pounds.

Treatments:

Lot I - Control - received the basal ration only.
Lot II - 0.0088% thyroprotein in addition to the basal ration.
Lot III - 0.0132% thyroprotein in addition to the basal ration.
Lot IV - 0.0176% thyroprotein in addition to the basal ration.

TABLE 7. The Effect of Thyroprotein on Chemical Composition of Carcasses. (Summer Trial - 1948)

Hog Number	Live Weight	Moisture, percent	Protein, percent	Fat, percent	Ash, percent	Total
			Lot I, Controls			
1	264	37.26	9.56	52.17	.53	99.52
2	162	44.93	10.44	44.33	.57	100.27
3	245	36.88	9.50	52.58	.52	99.48
4	215	36.16	8.88	54.53	.60	100.17
5	184	41.43	11.13	47.38	.53	100.47
6	229	32.96	8.31	58.53	.42	100.22
7	165	38.91	9.50	51.22	.50	100.13
8	222	36.27	8.88	54.99	.45	100.59
9	136	38.95	9.13	51.15	.56	99.79
Average	202	38.19	9.48	51.88	.52	
			Lot II, 0.0088% Thyroprotein			
12	164	36.09	9.13	54.22	.47	99.91
16	303	33.14	8.63	57.74	.49	100.00
19	209	35.77	9.63	54.36	.48	100.24
			Lot III, 0.0132% Thyroprotein			
21	227	34.88	9.75	55.24	.49	100.36
22	172	38.87	9.69	50.81	.53	99.90
23	258	30.85	8.25	60.82	.35	100.27
24	240	36.63	9.56	53.45	.49	100.13
25	257	34.16	8.13	57.07	.42	99.78
26	251	35.06	9.38	54.76	.47	99.67
27	239	33.06	7.81	58.80	.39	100.06
28	225	37.69	9.31	52.07	.50	99.57
29	223	33.93	8.38	57.32	.46	100.09
30	272	34.78	8.25	56,11	.45	99.59
Average	236	34.99	8.58	55.65	.46	

percent while that of the animals from Lot III was 55.65 percent. However, the carcasses from the control animals contained significantly more (P .05) moisture, protein, and mineral matter than those of the animals from Lot III. The comparative average moisture, protein and mineral matter content in percent, for the two groups was as follows: Moisture - Lot I - 38.19, Lot III - 34.99; Protein - Lot I - 9.48, Lot III - 8.85; Mineral matter - Lot I - 0.52, Lot III - 0.46. (Table 7). It should be noted at this point that the average liveweight for the control animals was 202 pounds whereas the average liveweight for the animals in Lot III was 236 pounds. When the data was analyzed by covariance to adjust for the 34 pounds difference in average liveweight of the two groups, there was no significant difference between them in moisture, protein, fat, or mineral matter content.

Although there was a general trend for lighter animals to produce carcasses that contained more water and less fat than heavier animals, there were exceptions. Animal number 16, Lot II, weighed 303 pounds yet the carcass from that animal contained a lower percentage of fat than those carcasses from animals weighing much less (Hog 6, Hog 7).

RESULTS - WINTER TRIAL (1948 - 1949)

Growth Rate

The growth data in this trial are summarized in Tables 8, 9, and 13. With the exception of Lot V, which received thyroprotein at the rate of 80 grams per 100 pounds of protein supplement (0.395 gm. per 100 pounds liveweight), none of the thyroprotein-fed groups gained as rapidly as the controls. During the first 70 days of the experiment the animals in all lots gained at approximately the same rate, whereas after this time Lots I and V grew more rapidly. The animals in the control group finished the 138-day feeding trial at an average weight of 233 pounds while the average final weight of the animals in Lot V was 257 pounds. The increased gain of 24 pounds made by Lot V over Lot I was statistically significantly at the 5 percent level.

The average final weights of the hogs in Lots II, III, and IV were, 212 pounds, 217 pounds, and 220 pounds, respectively. The apparent depressed growth rate shown by thyroprotein-fed animals in Lots II, III, and IV, when compared with the growth rate of the control animals, was not statistically significant although the difference approached significance.

The daily growth rate of the Hampshire pigs in this trial in no case approached the gain of either control or thyroprotein-fed pigs in previous trials. The best average growth rate recorded was 1.48 pounds per day for the 138-day feeding period by Lot V which received thyroprotein at the level of 80 grams per 100 pounds protein supplement. The poorest average growth rate of 1.14 pounds per day was made by the animals in Lot II which consumed 0.447 gram thyroprotein per 100

TABLE 8. Average Growth Rate of Animals by Weigh Periods. (Winter Trial - 1948 - 1949).

Lot Number	Treatment	Unit	Days on Feed										
			0	14	28	42	56	70	84	98	112	126	138
I	Control	lb.	54	67	79	95	112	129	150	172	194	217	233
II	0.447 gm. thyroprotein per 100# liveweight. Adjust each 2 weeks	lb.	54	70	81	93	109	124	141	157	175	196	212
III	0.426 gm. thyroprotein per 100# liveweight. Adjust once	lb.	56	70	84	98	114	130	146	164	182	203	217
IV (0.289 gm./100 lb. liveweight)	60 gm. thyroprotein per 100# protein supplement.	lb.	58	71	85	100	114	130	148	166	186	204	220
V (0.395 gm./100# liveweight)	80 gm. thyroprotein per 100# protein supplement.	lb.	54	69	83	99	116	138	159	186	211	238	257

TABLE 9. Average Daily Gain of Animals by Weigh Periods. (Winter Trial - 1948 - 1949).

Lot Number	Treatment	Unit	Days on Feed										Ave.
			14	28	42	56	70	84	98	112	126	138	
I	Control	lb.	0.92	0.84	1.21	1.21	1.19	1.49	1.56	1.61	1.61	1.33	1.30
II	0.447 gm. thyroprotein per 100# liveweight. Adjust each 2 weeks	lb.	1.11	0.83	0.82	1.16	1.06	1.20	1.14	1.30	1.49	1.32	1.14
III	0.426 gm. thyroprotein per 100# liveweight. Adjust only once	lb.	1.05	0.97	0.96	1.19	1.12	1.14	1.31	1.28	1.51	1.18	1.17
IV (0.289	60 gm. thyroprotein per 100# protein supplement. gm./100# liveweight)	lb.	0.95	0.99	1.06	1.02	1.14	1.24	1.29	1.43	1.31	1.37	1.18
V (0.395	80 gm. thyroprotein per 100# protein supplement. gm./100# liveweight)	lb.	1.06	1.01	1.18	1.20	1.54	1.51	1.94	1.80	1.90	1.62	1.48

pounds liveweight per day with only one adjustment being made, made an average daily gain of 1.17 pounds. The animals in Lot IV were fed 60 grams of thyroprotein per 100 pounds protein supplement. Their average daily gain was 1.18 pounds. The animals of the control group made an average daily gain of 1.30 pounds. (Table 9)

Feed Consumption

Average daily feed consumption tended to follow the growth curve with the fastest-gaining group (Lot V) consuming an average of 6.2 pounds of feed while the slower-gaining groups - Lots II, III, and IV, consumed 5.3, 5.5, and 5.1 pounds, respectively, per day. Since the animals in the various groups were not individually fed it was not possible to analyze the difference in feed consumption between groups for statistical significance. (Table 10).

As in previous trials, thyroprotein intake was controlled as closely as possible. For Lots II and III it was planned that all animals would be fed 0.500 gm. thyroprotein per 100 pounds liveweight per day. This necessitated estimations of the average liveweight for the next period as well as daily feed intake in order to incorporate the proper amount of thyroprotein in the ration. The average daily consumption for the animals in Lot II was 0.447 gm. per 100 pounds liveweight per day, while for Lot III it was 0.426 gm.

Thyroprotein was added at the level of 60 grams per 100 pounds protein concentrate in the ration for Lot IV. Since the average daily consumption of protein supplement was 0.67 pounds, the daily thyroprotein consumption was 0.289 gm. per 100 pounds liveweight. The protein concentrate of the ration for Lot V contained 80 grams

TABLE 10. Average Daily Feed Consumption by Animals at Weigh Periods. (Winter Trial - 1948-49)

Lot Number	Treatment	Unit	Days on Feed										Ave.
			14	28	42	56	70	84	98	112	126	138	
I	Control	lb.	2.9	2.9	3.9	4.4	5.7	6.6	6.2	7.7	7.6	7.1	5.5
II	0.447 gm. thyroprotein per 100# liveweight. Adjust each 2 weeks	lb.	3.2	3.2	3.2	3.8	5.0	5.6	6.0	7.4	7.9	8.1	5.3
III	0.426 gm. thyroprotein per 100# liveweight. Adjust only once	lb.	3.4	3.7	4.0	4.7	5.5	6.5	6.8	6.8	7.4	7.2	5.5
IV (0.289	60 gm. thyroprotein per 100# protein supplement. gm./100 lb. liveweight)	lb.	3.1	3.5	4.0	4.3	4.9	5.7	5.8	6.7	6.8	6.8	5.1
V (0.395	80 gm. thyroprotein per 100# protein supplement. gm./100lb. liveweight)	lb.	3.3	3.8	4.6	4.6	5.7	7.2	7.9	8.4	8.8	8.2	6.2

TABLE 11. Average Daily Consumption of Thyroprotein Per 100 Pounds Liveweight. (Winter - 1948-49).

Lot No.		Unit	Days on Feed 14	28	42	56	70	84	98	112	126	138	Ave.
	Ave. liveweight	lb.	62	76	87	101	117	133	149	166	186	204	133
II	Daily protein Suppl. consumption	lb.	.75	.83	.89	.90	.69	.71	.63	.63	.63	.35	.71
	Thyroprotein per pig per day	gm.	.310	.417	.515	.560	.475	.564	.794	.865	.915	.514	.594
	Thyroprotein per 100# liveweight	gm.	.500	.549	.592	.554	.406	.424	.533	.521	.492.	.252	.447
	Ave liveweight	lb.	63	77	91	106	122	138	155	173	193	210	137
III	Daily protein Suppl. consumption	lb.	.64	.74	.66	.93	.84	.64	.66	.60	.47	.31	.65
	Thyroprotein per pig per day	gm.	.356	.412	.372	.520	.472	.696	.970	.876	.689	.450	.583
	Thyroprotein per 100# liveweight	gm.	.565	.535	.409	.491	.387	.504	.625	.506	.357	.214	.426
	Ave. liveweight	lb.	65	78	93	107	122	139	157	176	195	212	139
IV	Daily protein Suppl. consumption	lb.	.47	.87	.91	.90	.73	.73	.74	.59	.44	.20	.67
	Thyroprotein per pig per day	gm.	.282	.522	.546	.540	.438	.438	.444	.354	.264	.120	.402
	Thyroprotein per 100# liveweight	gm.	.434	.669	.587	.505	.359	.315	.283	.201	.135	.566	.289
	Ave liveweight	lb.	62	76	93	107	127	149	173	199	225	248	156
V	Daily protein Suppl. consumption	lb.	.80	.82	.90	1.18	.96	.77	.72	.79	.40	.27	.77
	Thyroprotein per pig per day	gm.	.640	.656	.720	.944	.768	.616	.576	.632	.320	.216	.616
	Thyroprotein per 100# liveweight	gm.	1.032	.863	.791	.874	.605	.413	.333	.318	.142	.087	.395

TABLE 12. Average Amount of Feed Required by Animals to Produce 100 Pounds Gain.
(Winter Trial - 1948 - 1949)

Lot Number	Treatment	Unit	Days on Feed										Ave.
			14	28	42	56	70	84	98	112	126	138	
I	Control	lb.	310	348	322	358	483	444	400	471	529	477	422
II	0.477 gm. thyroprotein per 100# liveweight. Adjust each 2 weeks	lb.	288	381	396	326	469	466	528	572	529	608	464
III	0.426 gm. thyroproetin per 100# liveweight. Adjust once.	lb.	319	375	413	393	493	570	482	539	487	613	470
IV (0.289	60 gm. thyroprotein per 100# protein supplement. gm./100# liveweight	lb.	320	349	373	416	424	458	453	471	520	495	434
V (0.395	80 gm. thyroprotein per 100# protein supplement. gm./100# liveweight)	lb.	306	370	393	382	367	477	407	468	463	507	421

TABLE 13. The Effect of Thyroprotein on Growth Rate, Feed Consumption, and Feed Efficiency of Swine. (Winter Trial - 1948-49. 138 Days)

Item	Unit	Lot Number				
		I	II	III	IV	V
Number of pigs		10	9	10	9	10
Initial weight	lb.	54	54	56	58	54
Final weight	lb.	233	212	217	220	257
Gain per pig	lb.	179	158	161	162	203*
Daily gain per pig	lb.	1.30	1.14	1.17	1.18	1.48
DAILY FEED CONSUMED						
Shelled corn	lb.	4.74	4.54	4.83	4.43	5.43
Protein supplement	lb.	.70	.71	.65	.67	.77
Mineral mixture	lb.	.02	.04	.02	.02	.01
Vitamin supplement	lb.	.01	.01	.01	.01	.01
Thyroprotein	gm.	-----	.59	.58	.29	.40
Total	lb.	5.47	5.30	5.51	5.13	6.22
Feed Per 100 Pounds Gain						
Shelled corn	lb.	365.9	398.2	412.4	375.9	367.8
Protein supplement	lb.	54.0	63.0	55.8	56.5	52.1
Mineral mixture	lb.	1.6	3.5	1.7	1.4	1.0
Vitamin supplement	lb.	.4	.5	.4	.5	.3
Total	lb.	421.9	464.2	470.3	434.3	421.2

* Least significant difference for gain at the 5% level is 23 pounds.

Treatments:

Lot I - Control - received only the basal ration.

Lot II - 0.447 gm. thyroprotein per 100 pounds liveweight per day, adjusting each two weeks.

Lot III - 0.426 gm. thyroprotein per 100 pounds liveweight per day, adjusting once.

Lot IV - 60 gm. thyroprotein per 100 pounds protein concentrate. (0.289 gm. per 100 pounds liveweight per day)

Lot V - 80 grams thyroprotein per 100 pounds protein concentrate. (0.395 gm. per 100 pounds liveweight per day)

thyroprotein per 100 pounds. The consumption of protein supplement per day for this lot was 0.77 pound with a resulting average daily intake of 0.395 gm. thyroprotein per 100 pounds liveweight. (Table 11)

Feed Efficiency

The animals of the control group (Lot I) and the animals of the group receiving 80 grams thyroprotein per 100 pounds protein supplement (Lot V) were the most efficient groups from the standpoint of pounds of feed required to produce 100 pounds of gain. Thèse two groups required an average of 422 and 421 pounds of feed, respectively, to produce 100 pounds of gain. Lots II, III, and IV were less efficient, requiring 464, 470, and 434 pounds of feed per 100 pounds of gain.

Thyrotropic hormone content of Anterior Pituitary Gland

In the normal animal the activity of the thyroid gland is regulated by the thyrotropic hormone of the anterior pituitary gland. It is known that there are species, age, sex, seasonal, breed, and strain differences in thyrotropic hormone production and that the level of secretion can be altered by numerous environmental factors such as temperature, iodine, and goitrogens. When exogenous thyroxine or thyroidally-active substances are administered the thyroid gland ordinarily reduces its activity and the production of the anterior pituitary thyrotropic hormone may be affected.

In an attempt to study some of the above effects, an assay of the thyrotropic hormone content of the anterior pituitary glands of the swine in this trial was made. (The procedure as outlined by Elijah and Turner (1942)) Day-old Leghorn cockerels were injected with suspensions

of pituitary materials from the five lots of swine. An assay showed highly significant differences in thyrotropic hormone content between lots of animals which had been subjected to the differing treatments.

The anterior pituitaries of the animals which received the largest amounts of thyroprotein per 100 lb. liveweight - Lots II and III - contained the smallest amounts of thyrotropin. The pigs in Lots IV and V, which received an average of 0.289 and 0.395 grams of thyroprotein per 100 pounds of liveweight had anterior pituitaries with the largest amounts of thyrotropin. (Table 14).

TABLE 14. Thyrotropic Hormone Assay of Anterior Pituitaries.

(Winter Trial - 1948 - 1949)
Weights of Thyroid Glands of Injected Chicks

Lot I (mg.)	Lot II (mg.)	Lot III (mg.)	Lot IV (mg.)	Lot V (mg.)
10.0	3.8	10.0	10.0	11.8
5.0	8.0	5.8	5.0	5.2
9.0	6.4	4.2	7.8	8.6
6.2	5.4	4.2	7.4	5.4
6.6	6.4	4.4	7.2	8.2
7.0	6.8	4.4	9.6	6.8
9.6	7.0	5.4	7.8	9.0
7.0	5.0	5.4	7.8	4.0
6.4	5.6	5.6	6.6	5.8
5.9	5.0	7.8	7.0	6.8
6.3	5.2	7.8	9.8	6.8
9.2	7.0	7.4	8.6	6.2
6.8	4.2	8.0	6.8	8.0
3.6	3.4	6.0	6.8	8.0
5.6	5.8	7.8	6.6	7.4
5.2	5.0	7.4	7.8	7.4
6.4	5.0	5.0	7.8	7.4
6.0	6.0	7.0	7.8	7.4
6.0	3.8	4.8	7.8	
5.6	3.6	6.6	9.8	
6.68	5.42	6.28	7.81	7.22

Actual differences from averages:

Lots -	I and II	- 1.26*	III and IV	- 1.53**
	I and III	- 0.40	V and I	- 0.54
	I and IV	- 1.13*	V and II	- 1.80**
	II and III	- 0.86	V and III	- 0.94
	II and IV	- 2.39**	V and IV	- 0.59

Treatments:

Lot I - Control - received only the basal ration
Lot II - 0.447 gm. thyroprotein per 100 lb. liveweight per day. Adjust each 2 weeks.
Lot III - 0.426 gm. thyroprotein per 100 lb. liveweight per day. Adjust only once.
Lot IV - 60 grams thyroprotein per 100 lb. protein supplement. (0.289 gm./100 lb. liveweight per day).
Lot V - 80 grams thyroprotein per 100 lb. protein supplement. (0.395 gm./100 lb. liveweight per day).

RESULTS - SUMMER TRIAL - 1949

Growth Rate

In this experiment the addition of thyroprotein to the ration had no effect on growth rate in Lots II, IV and V, but significantly reduced the rate of growth in Lot III. The animals in this lot received thyroprotein at the level of 0.644 gm. per 100 lb. body weight. The effects on growth rate were observed as early as 42 days and the reduction in rate of gain became more evident as the trial progressed.

The average daily gains of the animals in this trial compared favorably with those of other trials. The group receiving thyroprotein at the level of 0.367 gm. per 100 lb. liveweight (Lot II) and the animals of the control group (Lot I) made the best gains with average daily gains of 1.57 and 1.56 pounds, respectively. These were followed by Lot V (0.442 gm./100 lb. liveweight) with a daily gain of 1.48 pounds, then Lot IV (0.579 gm./100 lb. liveweight) with 1.41 pounds per day. It is apparent in the case of Lots IV and V that the feeding of thyroprotein to hogs on pasture depressed growth rate. Statistically significant growth depression was brought about by the feeding of thyroprotein to the animals in Lot III which averaged a growth rate of 1.22 pounds per day. (Table 16)

Three of the animals in Lot III developed bent and deformed front legs quite similar to that which may be observed in the case of rickets. The front legs of these animals curved inward at the knee joint, and it became difficult for them to walk.

Feed Consumption

No marked difference in feed consumption was observed between the

TABLE 15. Average Growth Rate of Animals by Weigh Periods. (Summer Trial - 1949).

Lot Number	Treatment	Unit	Days on Feed							
			0	14	28	42	56	70	84	98
I	Control	lb.	76	93	114	135	160	170	210	230
II	0.363 gm. thyroprotein per 100# liveweight per day.	lb.	79	94	113	136	159	178	206	233
III	0.644 gm. thyroprotein per 100# liveweight per day.	lb.	77	90	111	127	145	152	174	196
IV	0.579 gm. thyroprotein per 100# liveweight per day starting at 130#	lb.	81	98	116	139	158	174	200	220
V	120 gm. thyroprotein per 100# protein supplement. (0.442 gm./100# liveweight)	lb.	80	94	112	136	157	175	204	225

TABLE 16. Average Daily Gain of Animals by Weigh Periods. (Summer Trial - 1949).

Lot Number	Treatment	Unit	14	28	42	56	70	84	98	Ave.
I	Control	lb.	1.21	1.50	1.49	1.77	1.38	2.17	1.43	1.56
II	0.363 gm. thyroprotein per 100# liveweight per day	lb.	1.11	1.35	1.62	1.62	1.41	1.99	1.91	1.57
III	0.644 gm. thyroprotein per 100# liveweight per day	lb.	0.99	1.44	1.15	1.31	0.47	1.58	1.59	1.22
IV	0.579 gm. thyroprotein per 100# liveweight per day starting at 130#	lb.	1.21	1.30	1.61	1.38	1.13	1.88	1.40	1.41
V	120 gm. thyroprotein per 100# protein supplement. (0.442 gm./100# liveweight)	lb.	1.04	1.27	1.70	1.52	1.25	2.10	1.46	1.48

TABLE 17. Average Daily Feed Consumed by Animals at Weigh Periods. (Summer Trial - 1949).

Lot Number	Treatment	Unit	14	28	42	56	70	84	98	Ave.
I	Control	lb.	3.8	4.6	5.2	6.2	6.6	7.7	7.5	5.9
II	0.363 gm. thyroprotein per 100# liveweight per day.	lb.	3.8	4.9	4.7	6.4	6.7	8.7	8.4	6.2
III	0.644 gm. thyroprotein per 100# liveweight per day.	lb.	3.8	4.8	4.6	6.7	5.1	6.4	7.4	5.6
IV	0.579 gm. thyroprotein per 100# liveweight per day starting at 130#	lb.	4.0	5.2	4.9	6.6	6.7	7.7	8.4	6.2
V	(0.442 gm./100# liveweight) 120 gm. thyroprotein per 100# protein supplement.	lb.	4.0	5.6	5.3	6.3	6.8	8.4	8.5	6.4

TABLE 18. Average Daily Consumption of Thyroprotein per 100 Pounds Liveweight. (Summer - 1949).

Lot Number		Unit	Days on Feed 14	28	42	56	70	84	98	Ave.
II	Ave. liveweight	lb.	87	103	125	147	169	192	220	156
	Daily protein suppl. consumption	lb.	.40	.61	.29	.74	.78	.90	.61	.62
	Thyroprotein per pig per day	gm.	.227	.345	.162	.790	.835	.962	.650	.567
	Thyroprotein per 100 lb. liveweight	gm.	.261	.335	.130	.537	.494	.501	.295	.363
III	Ave. liveweight	lb.	84	100	119	136	149	163	185	137
	Daily protein suppl. consumption	lb.	.45	.57	.30	.61	.54	.71	.89	.58
	Thyroprotein per pig per day	gm.	.443	.560	.292	1.081	.964	1.271	1.579	.884
	Thyroprotein per 100 lb. liveweight	gm.	.527	.560	.245	.795	.647	.780	.854	.644
IV	Ave. liveweight	lb.				148	166	187	210	179
	Daily protein suppl. consumption	lb.				.63	.60	.51	.60	.59
	Thyroprotein per pig per day	gm.				1.112	1.060	.911	1.060	1.036
	Thyroprotein per 100 lb.liveweight	gm.				.751	.639	.487	.505	.579
V	Ave. liveweight	lb.	87	103	124	146	166	190	215	153
	Daily protein suppl consumption	lb.	.45	.52	.38	.54	.61	.59	.73	.55
	Thyroprotein per pig per day	gm.	.542	.622	.457	.643	.736	.707	.871	.677
	Thyroprotein per 100 lb.liveweight	gm.	.643	.604	.368	.440	.443	.372	.405	.442

four lots which gained at approximately the same rate (Lots I, II, IV, and V). The animals of Lot III, probably because they did not grow as rapidly, consumed 5.6 pounds per day as compared with 5.9 pounds for the animals in Lot I, 6.2 for Lot II, 6.2 for Lot IV, and 6.4 for Lot V. (Table 18)

Thyroprotein consumption was not well governed, probably due to the fact the thyroprotein was mixed into the protein supplement and the calculation of the level of the drug to blend into each unit of supplement was based on the observation of many feeding trials that pigs on pasture will consume about three-fourths of a pound of protein supplement per day. Very recent results have indicated, however, that pigs on Ladino clover pasture will consume less protein supplement than they will when on alfalfa pasture. It had been planned that thyroprotein would be fed to the animals in Lot II at the level of 0.300 gm. per 100 lb. liveweight per day. They actually consumed an average of 0.363 gm. which amounts to twenty percent more. Furthermore, Lot III was to get 0.500 gm. thyroprotein per 100 lb. liveweight per day but they actually received 0.644 gm. Lot IV was to get 0.500 gm. and they received 0.579.

Feed Efficiency

The control animals (Lot I) in this trial required less feed than any of the other four lots to produce 100 pounds gain. Their average requirement was 380 pounds of feed per 100 pounds gain. Lot II was next most efficient with a requirement of 396 pounds, then Lot V with 434 pounds, then Lot IV with 439 pounds, and finally, Lot III which required 455 pounds of feed to produce 100 pounds gain. (Tables 19 and 20).

TABLE 19. Average Amount of Feed Required by Animals to Produce 100 Pounds of Gain.
(Summer - 1949)

Lot Number	Treatment	Unit	Days on Feed							Ave.
			14	28	42	56	79	84	98	
I	Control	lb.	317	304	347	350	479	354	527	380
II	0.363 gm. thyroprotein per 100# liveweight	lb.	345	360	292	395	477	434	437	396
III	0.644 gm. thyroprotein per 100# liveweight	lb.	380	334	398	513	1080	407	468	455
IV	0.579 gm. thyroprotein per 100# liveweight starting at 130#	lb.	329	402	304	482	595	410	598	439
V	120 gm. thyroprotein per 100# protein suppl. (0.442 gm./100# liveweight)	lb.	382	443	313	413	545	399	582	434

TABLE 20. The Effect of Thyroprotein on the Growth Rate, Feed Consumption, and Feed Efficiency of Swine. (Summer Trial - 1949. 98 Days)

Item	Unit	Lot Number				
		I	II	III	IV	V
Number of pigs		12	12	12	12	12
Initial weight	lb.	76	79	77	81	80
Final weight	lb.	230	233	196	220	225
Gain per pig	lb.	154	154	119*	139	145
Daily gain per pig	lb.	1.56	1.57	1.22	1.41	1.48
	DAILY FEED CONSUMED					
Shelled corn	lb.	5.35	5.58	4.95	5.71	5.48
Mineral mixture	lb.	.02	.02	.02	.03	.02
Protein supplement	lb.	.57	.62	.58	.48	.55
Thyroprotein	gm.	----	.57	.88	1.04	.68
Total	lb.	5.94	6.22	5.55	6.22	6.41
	Feed Per 100 Pounds Gain					
Shelled corn	lb.	342.3	355.1	405.7	403.7	395.5
Mineral mixture	lb.	1.3	1.2	1.5	1.9	1.5
Protein supplement	lb.	36.2	39.2	47.7	33.8	36.9
Total	lb.	379.8	395.5	454.9	439.4	433.9

*Least significant difference for gain in weight at the 5% level is 30 pounds.

Treatments -

Lot I - Control, received basal ration, only.
Lot II - 0.363 gm. thyroprotein per 100 lb. liveweight per day.
Lot III - 0.644 gm. thyroprotein per 100 lb. liveweight per day.
Lot IV - 0.579 gm. thyroprotein per 100 lb. liveweight per day.
Lot V - 120 grams thyroprotein per 100 lb. 100 lb. protein supplement (0.442 gm. per 100 lb. liveweight per day).

RESULTS - WINTER TRIAL - 1949 - 1950

Growth Rate

Because of the differences obtained between growth rate of pigs receiving thyroprotein in a complete ration in dry lot and those which were fed thyroprotein in a protein supplement free choice on pasture, this trial was designed to compare the effects of thyroprotein in both systems of feeding.

Lot I (control) received a complete basal ration and Lot II received the same ration plus 0.0176 percent thyroprotein. The pigs in Lot II gained approximately five pounds more per head than those in the control group but this difference was not statistically significant.

The second phase of this trial included Lots III, IV, and V. Lot III was fed the second basal ration in which all components were fed free choice. In the 98 days of this feeding trial the animals in Lot III reached an average weight of 216 pounds. Animals in Lot IV, which received 0.487 gm. thyroprotein per 100 pounds liveweight per day reached an average weight of 213 pounds in the same period. The animals in Lot V gained significantly more (P .05) than their controls (Lot III) and grew to a weight of 233 pounds during the trial. Lot V was given the same ration as Lot III plus decreasing amounts of thyroprotein, as the animals became larger, starting with 0.500 gm. thyroprotein per 100 pounds liveweight per day and ending with 0.3 gm. (Tables 21, 22, 26)

Feed Consumption

Very little difference in feed consumption between Lots I and II was recorded. The average daily feed consumption for the animals of these two groups was 7.3 and 7.1 pounds respectively. However, in the

TABLE 21. Average Growth Rate of Animals by Weigh Periods. (Winter Trial - 1949 - 1950).

Lot Number	Treatment	Unit	Days on Feed						
			0	14	28	42	72	84	98
I	Control	lb.	74	97	126	148	187	206	224
II	0.0176% thyroprotein. (0.374 gm. thyroprotein/100# liveweight)	lb.	74	90	123	142	192	207	229
III	Control #2	lb.	74	88	120	140	184	199	216
IV	0.487 gm. thyroprotein per 100# liveweight	lb.	74	91	118	130	178	192	213
V	Decreasing amounts of thyroprotein. (0341 gm./100# liveweight)	lb.	74	95	121	141	190	211	233

TABLE 22. Average Daily Gain of Animals by Weigh Periods. (Winter Trial - 1949 - 1950).

Lot Number	Treatment	Unit	Days on Feed						Ave.
			14	28	42	72	84	98	
I	Control	lb.	1.67	2.06	1.54	1.32	1.59	1.29	1.53
II	0.0176% thyroprotein (0.374 gm./100# liveweight)	lb.	1.15	2.36	1.38	1.66	1.29	1.59	1.59
III	Control #2	lb.	1.05	2.21	1.43	1.48	1.29	1.19	1.45
IV	0.487 gm. thyroprotein per 100# liveweight	lb.	1.26	1.94	0.83	1.58	1.25	1.45	1.42
V	Decreasing amounts of thyroprotein (0.341 gm./100# liveweight)	lb.	1.54	1.85	1.42	1.65	1.73	1.58	1.63

TABLE 23. Average Daily Feed Consumption by Animals by Weigh Periods (Winter Trial 1949-50).

Lot Number	Treatment	Unit	Days on Feed						Ave.
			14	28	42	72	84	98	
I	Control	lb.	5.0	7.1	7.0	7.2	8.2	9.1	7.3
II	0.0176% thyroprotein (0.374 gm./100# liveweight)	lb.	4.3	6.4	6.9	7.7	8.3	8.5	7.1
III	Control # 2	lb.	3.6	6.1	6.7	6.9	6.2	7.1	6.2
IV	0.487 gm. thyroprotein per 100# liveweight.	lb.	4.6	6.9	6.8	7.9	9.2	9.0	7.4
V	Decreasing amounts of thyroprotein. (0.341 gm./100# liveweight	lb.	4.4	6.9	6.8	8.1	9.5	9.8	7.6

TABLE 24. Average Daily Consumption of Thyroprotein per 100 Pounds Liveweight.

(Winter Trial - 1949 - 1950)

Lot Number		Unit	14	28	42	72	84	98	Ave.
II	Ave. liveweight	lb.	82	107	133	167	200	218	152
	Daily protein suppl. consumption	lb.	.87	1.27	1.37	.77	.83	.85	.96
	Thyroprotein per pig per day	gm.	.347	.511	.549	.616	.666	.680	.568
	Thyroprotein per 100# liveweight	gm.	.423	.478	.413	.369	.333	.312	.374
IV	Ave. liveweight	lb.	83	105	124	154	185	203	139
	Daily protein suppl. consumption	lb.	.42	.24	.30	.46	.48	.48	.41
	Thyroprotein per pig pig per day	gm.	.211	.250	.853	.749	.728	1.214	.677
	Thyroprotein per 100# liveweight	gm.	.254	.238	.688	.486	.393	.595	.487
V	Ave. liveweight	lb.	85	108	131	166	201	222	154
	Daily protein suppl. consumption	lb.	.30	.22	.32	.46	.49	.54	.40
	Thyroprotein per pig per day	gm.	.149	.231	.730	.636	.490	.780	.525
	Thyroprotein pwe 100# liveweight	gm.	.175	.214	.557	.393	.244	.351	.341

other phase of the trial there was a difference. Lot III, the second control group, had an average daily feed consumption of 6.2 pounds as compared to 7.4 and 7.6 pounds, for Lots IV and V. This difference became evident after 72 days on feed. (Table 23).

Thyroprotein consumption by the animals of Lot II was 0.374 gm., for Lot IV it was 0.487 gm., and for Lot V it was 0.341 gm. per 100 pounds liveweight. (Table 24).

Feed Efficiency

Lot II which received 0.0176 percent of thyroprotein required but 447 pounds of feed to produce 100 pounds of gain while the control group (Lot I) required 473 pounds. In the second phase of this trial the control group (Lot III) required 429 pounds of feed per 100 pounds gain which was lower than the figure of 466 pounds required by the animals in Lot V, and almost 100 pounds less than the 521 pounds required by the animals in Lot IV.

TABLE 25. Average Amount of Feed Required by Animals to Produce 100 Pounds Gain by Weigh Periods.

(Winter Trial 1949 - 1950)

Lot Number	Treatment	Unit	14	28	42	72	84	98	Ave.
I	Control	lb.	302	343	456	549	517	706	473
II	0.0176% thyroprotein (0.374 gm./100# liveweight)	lb.	378	271	497	465	644	535	447
III	Control #2	lb.	341	274	468	468	477	600	429
IV	0.487 gm. thyroprotein per 100# liveweight	lb.	364	339	827	498	733	621	521
V	Decreasing amounts of thyroprotein. (0.341 gm./100# liveweight)	lb.	284	371	477	490	551	616	466

TABLE 26. The Effect of Thyroprotein on Growth Rate, Feed Consumption, and Feed Efficiency of Swine.

(Winter Trial - 1949 - 1950)
98 days

Item	Unit	Lot number				
		I	II	III	IV	V
Number of pigs		12	12	12	12	12
Initial weight	lb.	74	74	74	74	74
Final weight	lb.	224	229	216	213	233
Gain per pig	lb.	150	155	142	139	159*
Daily gain per pig	lb.	1.53	1.59	1.45	1.42	1.63
DAILY FEED CONSUMED						
Ground corn	lb.	4.73	4.65	4.37	5.28	5.44
Ground wheat	lb.	1.45	1.42	1.44	1.66	1.71
Protein supplement	lb.	1.00	.96	.37	.41	.40
Mineral mixture	lb.	.07	.07	.04	.05	.05
Thyroprotein	gm.	----	.568	----	.677	.525
Total	lb.	7.25	7.10	6.22	7.40	7.60
FEED PER 100 POUNDS GAIN						
Ground corn	lb.	308.3	292.3	301.4	372.0	334.1
Ground wheat	lb.	94.6	89.4	99.5	117.1	105.1
Protein supplement	lb.	65.1	60.4	25.2	28.7	24.4
Mineral mixture	lb.	4.8	4.5	2.9	3.2	2.9
Total	lb.	472.8	446.6	429.0	521.0	466.5

* The least significant difference for gain in weight at the 5% level is 16 pounds.

Treatments:

Lot I - First control - one complete ration.
Lot II - Basal ration number 1 plus 0.0176% thyroprotein.
Lot III - Second control - components of ration fed free choice.
Lot IV - Basal ration number 2 plus 0.487 gm. thyroprotein per 100 pounds liveweight per day.
Lot V - Basal ration number 2 plus 0.341 gm. thyroprotein per 100 pounds liveweight per day.

DISCUSSION

In summarizing the data from the four feeding trials reported here and the data from current research it appears that the course of growth and development of swine can be increased by properly controlled administration of thyroprotein. However, the period in the life of the animal at which the administration of thyroprotein is made, the length of time it is administered, the level of treatment, and other items, including environmental temperature, have an important bearing on results obtained. In other words, it appears that the administration of thyroprotein, within narrow limits of conditions, may be conducive to increased growth. When administration does not fall within these narrow and rather definite limits there may be either no effect or a detrimental effect on growth rate.

In all experiments conducted at this Station with Duroc pigs stimulated growth rate was brought about by the incorporation of from 0.088 to 0.0176 percent thyroprotein in their ration. (Beeson, et al 1947, 1949; Perry, et al 1948, 1950). Reineke, et al (1948) and Wallagh, et al (1947) reported that growing Duroc pigs showed a growth response when slightly lower levels of thyroprotein were incorporated in the ration. In a preliminary report, Hale, et al (1948) reported that Duroc pigs which received thyroprotein in their ration were more efficient gainers than their controls. The data in this paper indicates a response in growing Hampshire pigs when thyroprotein was included in their ration. However, the response was not nearly as uniform as was that with Durocs. In fact, in the Summer Trial of 1949, no growth stimulation was brought about by the feeding

of thyroprotein and in the case of one group (Lot III) a significantly depressed growth rate was recorded. (Table 15) Similarly, in the Winter Trial of 1948-49, and in the Winter Trial of 1949-50, one lot of animals in each trial which received thyroprotein gained significantly more than their respective controls. However, the other three lots of animals in each trial which received thyroprotein in their rations gained no more than their controls and in most cases, gained less than their controls. (Tables 8 and 21) Perhaps there is a breed difference in response to thyroprotein. Reineke et al (1948) reported a breed difference in response to thyroprotein. These Michigan workers reported that when thyroprotein was fed at the level of 2.8 grams per 100 pounds of feed to Berkshire, Yorkshire and Duroc pigs, increased growth rates of 13.7, 15.1, and 11.3 pounds, were made by the three respective breeds. When Chester White pigs were fed this same level, no increased growth was shown and more feed was required per unit of gain by the animals receiving thyroprotein, indicating that a level conducive to increased growth in one breed of hogs may not be the optimum level for another breed. Elijah and Turner (1942) indicated there is a difference in level of thyroxine secretion between slow and fast-gaining hogs of the same breed. Glazener and Shaffner (1948) reported differing thyroid activity between differing strains of growing chickens.

In all of the thyroprotein research with swine conducted at the Indiana Station prior to this trial, thyroprotein was blended into the ration as a definite percent of the ration - 0.0044, 0.0088, 0.0132, or 0.0176 percent. Since the growing pig consumes decreasing amounts of feed, in proportion to body weight, as it increases

in size, it follows that where thyroprotein comprised a definite percent of the ration, the heavier the animal became, the less thyroprotein it received per unit liveweight. In trials with the Hampshire pigs some of the levels of thyroprotein did not decrease, in proportion to liveweight, as the pigs grew larger. In these trials it was observed that the only instances where thyroprotein-fed Hampshire pigs significantly outgained their controls was when the level of thyroprotein decreased in proportion to liveweight as the pigs grew in size. Reineke et al (1948) with pigs, and Hurst and Turner (1947) with mice, indicate that it is necessary to reduce the thyroprotein dosage per unit body weight as growth progresses if growth stimulation is to be maintained. Braude (1947) administered thyroprotein to growing pigs at constant levels, regardless of body weight, and reported that lower levels were of no effect whereas higher levels affected the animals adversely.

Vander Noot et al (1948) were unable to show a growth response by the feeding of 0.075 to 0.225 gm. thyroprotein per 100 pounds body weight per day. Higher levels of 0.5 to 4.0 gm. per 100 pounds body weight resulted in growth depression. One feature of this trial that may partially explain the results was that the animals were fed to a liveweight of but 125 pounds when the trial was concluded. In all of the work with swine at the Indiana Station it has been observed that very little difference in growth rate was noticeable between animals receiving thyroprotein and their controls until the animals reached an average liveweight of 130 pounds. Another point concerning the New Jersey work was that the level of thyroprotein per unit of liveweight remained constant and did not decrease as the animals

became larger.

Two of the trials with Hampshire pigs, which did not show too uniform response, were conducted on soil - one of them during the summer of 1949 was conducted on Ladino clover-alfalfa pastures. There is a possibility that a greater response would be obtained with animals in dry lot than with animals on pasture. However, this does not seem like an explanation as the response reported by Reineke et al (1948) and Wallach et al (1947) was from trials conducted on rape pasture. there is a possibility legume pasture may contain some unidentified factor(s) which may be antagonistic to thyroprotein action. Beeson and Bloss (1950) were unable to increase growth rate by the addition of thyroprotein to an all plant ration which had been fortified with Animal Protein Factor supplement. However, in adjacent pens, the addition of thyroprotein to an all-plant ration that did not contain APF resulted in significantly increased growth.

Half-carcasses from thyroprotein-fed animals had a greater percentage of fat and lower percentages of moisture, protein, and mineral matter than did those from the control group. (Table 7) When adjustment was made for the difference in liveweight of the two groups by use of regression coefficient there was no significant difference in composition between the two groups. This would indicate that as an animal grows, under normal conditions, the ratio of these constituents changes. In other words, these differences in carcass composition between the two groups are due to the difference in liveweight of the animals from which the carcasses were taken. The control animals had an average liveweight of 202 pounds at time

of slaughter whereas the thyroprotein-fed animals selected for carcass analysis had an average liveweight of 236 pounds at the time of slaughter. In one sense it might be said that thyroprotein had an effect on carcass composition in that in a given time the feeding of thyroprotein resulted in a more rapid growth rate with a resulting carcass which is characteristic of the weight attained. This is borne out by investigations of Blunn and Baker (1947) and Willman and Krider (1943) who reported there was a highly significant correlation between liveweight and such physical characteristics as thickness of back fat, area of loin-eye muscle, and area of lean in the end cut of ham.

Thyrotropic hormone content of the anterior pituitary glands from the hogs of the Winter Trial of 1948 - 1949 was assayed by the chick assay method outlined by Elijah and Turner (1942). The general trend of the analysis indicated that the faster growing hogs had anterior pituitaries with higher levels of thyrotropic hormone. The level of thyrotropic hormone in the various anterior pituitaries bore a relation to the level of consumption of thyroprotein. Animals which consumed the highest levels of thyroprotein, per unit of body weight, had the lowest level of thyrotropic hormone in their anterior pituitaries.

In reporting the results of the Summer Trial 1949, mention was made that in the lot receiving the highest level of thyroprotein (Lot III - 0.644 gm. thyroprotein per 100 pounds liveweight per day) there were at least three animals with apparent malformation of the front legs. If this level of thyroprotein was high enough to cause a rather marked degree of hyperthyroidism the results would be in line with other research in the field of induced hyperthyroidism. Drill (1943) reported that calcium balance during hyperthyroidism may be-

come negative due to a large increase in fecal calcium. Silberberg and Silberberg (1940) were able to alter the pattern of calcium metabolism in growing mice by the administration of thyroxin.

Feed Efficiency usually followed the pattern of growth stimulation. In other words, even though the metabolic rate of thyroprotein-fed animals was accelerated, in the case of those animals in which thyroprotein caused increased growth there was a smaller percentage of the daily intake used for maintenance. This usually resulted in a requirement of less total feed per unit of gain.

RESULTS

1. The feeding of thyroprotein at the levels of 0.0088, 0.0132, and 0.0176 percent of the ration, respectively (0.184, 0.289, and 0.373 gm. per 100 pounds liveweight per day) to weanling Duroc pigs for a 119 day feeding trial in dry lot (Summer Trial 1948) resulted in a significantly increased growth rate of from 32 to 41 pounds more than control animals which received no thyroprotein.
2. Animals receiving thyroprotein in their ration required from 11 to 22 pounds less feed than control animals to produce 100 pounds gain during the Summer Trial of 1948.
3. Half-carcasses from the control animals (202 pounds liveweight) contained a significantly smaller percentage of fat and significantly greater percentages of protein, moisture, and ash, than carcasses from animals which had received 0.0132 percent thyroprotein in their ration (232 pounds liveweight).
4. The feeding of thyroprotein at the level of 80 grams per 100 pounds of protein supplement (0.395 gm. per 100 lb. liveweight) to weanling Hampshire pigs in a 138 day feeding period in dry lot resulted in significantly increased growth rate of 24 pounds more than the controls which received no thyroprotein. (Winter Trial 1948-1949)
5. The feeding of thyroprotein at levels of 0.447 gm., 0.289 gm., and 0.426 gm. per 100 pounds liveweight per day resulted in a depressed growth rate of from 17 to 21 pounds less than control animals. (Winter Trial - 1948-1949)

6. Significantly greater thyrotropic hormone content was found in the anterior pituitaries of animals receiving 0.289 gm. thyroprotein per 100 pounds liveweight per day, and significantly less in in the anterior pituitaries of animals receiving 0.447 gm., when compared with anterior pituitaries from control animals. (Winter Trial - 1948-1949)
7. When thyroprotein was fed at the level of 0.644 gm. per 100 pounds liveweight per day to weanling Hampshire pigs for a 98-day feeding trial on pasture (Summer Trial - 1949) a significantly depressed growth rate of 35 pounds less than control animals resulted.
8. All animals receiving thyroprotein during the Summer Trial of 1949 required more feed to produce 100 pounds of gain than did the control animals. This increased requirement ranged from 16 to 75 pounds more.
9. Thyroprotein fed at decreasing levels, starting at 0.5 gm. at the beginning of the trial and finishing with 0.3 gm. per 100 pounds liveweight per day (average - 0.341) resulted in a significantly increased growth rate of 17 pounds more than control animals in a 98 day post weaning feeding trial with Hampshire pigs. (Winter Trial - 1949-1950)
10. In all cases in which the feeding of thyroprotein resulted in a more rapid rate of growth the level of feeding started at a predetermined height per unit of liveweight and gradually decreased in proportion to the liveweight of the animal.

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