GESTATION, LACTATION AND CREEP-FEEDING STUDIES WITH SWINE

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Bachelor of Science

Oklahoma Agricultural and Mechanical College

Stillwater, Oklahoma

1951

Submitted to the faculty of the Graduate School of
the Oklahoma Agricultural and Mechanical College
in partial fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
May, 1957

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ACKNOWLEDGMENT

The author wishes to express his appreciation to Dr. J. C. Hillier of the Animal Husbandry Department for his assistance in the planning and executing of these studies.

He also wishes to acknowledge the help of Dr. W. R. Kirkham of the Department of Agricultural Chemistry for directing the chemical analyses.

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INTRODUCTION

In practical swine production, the critical phases and the ones in which there are many unsolved problems are the periods of gestation and the early life of the pigs (up to fifty pounds). With our present knowledge of swine nutrition, disease control, and management, losses among pigs weighing fifty pounds or more can be cut to a minimum. However, heavy losses still occur during the gestation period and during the early life of pigs. These losses involve fertility of the breeding animals, embryonic death losses, deaths at farrowing and the first few days after farrowing, losses due to inadequate nutrition of the young pig and losses due to contagious diseases among baby pigs. It has been shown that inadequate nutrition during critical periods may influence adversely the fertility of breeding stock, embryonic death losses, and losses of pigs after farrowing.

Specifically, vitamins of the B-complex, when fed in purified diets, have been shown to have a definite influence on fertility, embryonic losses, and survival of those farrowed alive. There is a large volume of information indicating that additions of B-complex vitamins improve rations composed of natural feeds for growing pigs. However, there is only limited information available on the addition of B-vitamins to natural rations for sows during gestation. It is known that natural rations commonly fed to growing pigs may be low

in B-complex vitamins. It has also been shown that purified diets low in B-complex vitamins have a marked influence on reproduction. Thus, it was felt that studies concerning the addition of B-complex vitamins to gestation rations composed of natural feeds would give additional information on the influence of these vitamins on reproduction under practical conditions.

It has also been shown that creep rations should be nutritionally adequate with respect to protein, minerals, vitamins, and energy, and that they should be very palatable. The pelleted form has been shown to be preferred to meal form. Since the capacity of the young pig to consume feed is limited, it was thought that increasing the energy content of the ration by the addition of fat might be of value in producing more rapid and efficient gains of nursing pigs. Replacing the alfalfa meal commonly used with a vitamin A concentrate and a B-vitamin concentrate would have the effect of reducing the fiber content of the ration and thus improving the energy content of the ration.

LITERATURE REVIEW

Physiological Causes of Sterility and Reduced Fertility in Swine

Since we are going to use such measures as litter size, weight of pigs at farrowing, and percentage of pigs raised as measures of the nutritional adequacy of rations, it seems desirable to review briefly the literature on causes of reproduction failure of an anatomical or physiological nature.

It was felt that such a review would give one a better appreciation of the possible variations in reproductive performance among gilts being fed and handled alike.

Warnick et al. (1947) investigated some of the conditions associated with lowered fertility in sows. Thirty-one sows that had failed to conceive from breeding at two to four consecutive heat periods were used. Structural abnormalities of the genital tract, embryonic deaths, pathology of the oviducts, and cystic follicles were apparent causes of lowered fertility.

Hutchings (1948) stated that reproductive failure may result from (1) inability or reduced ability to produce ova, (2) lack of sexual desire, (3) death of ova or spermatoza prior to fertilization, (4) lack of implantation of fertilized ova in the uterus, (5) arrested or abnormal fetal development, abortion or fetal resorption, and (6) stillborn pigs at normal term. He stated that about five per cent of all pigs are stillborn.

Warnick et al. (1949) observed sixty-three females that had been bred at two to four different heat periods without conceiving. In this study the major cause of repeat breeding in gilts appeared to be a failure of fertilization due to genital abnormalities. The major abnormalities were bilateral tubal abnormalities, bilateral missing segments, and bilateral cystic follicles. Embryonic death was the primary cause of repeat breedings in sows, being responsible for 61.4 per cent of the repeat breeding in sows and 23.9 per cent in gilts.

Ninety-five gilts and sows which had shown impaired fertility were used by Wilson et al. (1949) to determine some of the causes of impaired fertility in swine. Of these, sixteen were not used in the summary for various reasons. Of the remaining seventy-nine females, fifty-three conceived during the study, but they were regarded as being hard to settle. The rest showed various abnormalities which were responsible for their sterility or low fertility. The most important abnormalities were tubal aberrations, cystic follicles, and blind or missing portions of the reproductive system.

Wiggins et al. (1950) examined the genital organs of 2,967 open (non-parous) gilts at a packing plant. The presence of corpora lutea was taken as evidence of sexual maturity. The gilts were of unknown ages and were slaughtered at four seasons of the year. Highly significant seasonal differences in the percentage of prepuberal animals were found with the highest percentage being found in October and the lowest in April.

Phillips and Zeller (1941) stated that approximately one-fifth of the females in a swine herd fail to conceive during a breeding season, and about one-third of all matings are infertile.

From these reports it can be seen that complete failure to conceive, incomplete fertilization of the ova produced, and early fetal mortality results in a marked reduction of breeding efficiency in swine. These facts should not be overlooked in considering nutritional effects on sows and gilts during the gestation period.

Effect of Ration on Gestation and Lactation Performance

Energy

Hanson et al. (1953) conducted an experiment to determine the effect of limited feeding (limited energy primarily) on the growth and reproductive performance of gilts. Sixteen pairs of litter-mate gilts were placed in two groups at an average weight of approximately 120 pounds. Group one was self-fed a corn, oats, soybean meal-type ration at the rate recommended by that station for normal reproduction. Group two was hand-fed at a rate which permitted a steady but limited increase in weight. Both groups were fed the same feed mixture. The limited-fed group was permitted to consume about fifty-eight per cent as much feed as the self-fed group from the start of the experiment until one week after farrowing. The average weight of the gilts at farrowing was 342 pounds for the self-fed lot and 241 pounds for the limited-fed lot. Much of the saving in feed was lost during the lactation period when both groups were self-fed. During this period, gilts that were limited in feed intake during

gestation ate 200 pounds more than the gilts self-fed during gestation. Gilts self-fed during gestation farrowed 1.23 more pigs per litter than the gilts on the limited ration. These pigs weighed 0.22 pound more per pig at birth and 4.2 pounds more at weaning than the pigs from the limited-fed gilts. The weaning weights of the pigs indicate that limiting the feed intake of the mother during growth and gestation had a detrimental effect on the milk-producing ability of the gilts thus fed.

Self et al. (1955) conducted an experiment to study the effects of full-feeding on reproductive phenomena. They concluded that continuous full-feeding was superior to continuous limited-feeding for ovulation rate but was inferior for embryo survival and number of embryos at twenty-five days after service. They also concluded that only a short period of full feeding was necessary to stimulate maximum ovulation. Their work indicated that the limited-fed gilts would have had the largest litters if they had been allowed to go to the full term of gestation.

The National Research Council (1953) recommended the energy level of 0.75 pound of total digestible nutrients per pound of total ration for pregnant and lactating swine.

Protein

Thompson (1922) conducted an experiment to determine the effect of mineral or protein or both mineral and protein on the size, strength, and vigor of the pigs farrowed. He fed the rations listed below in his experiment:

Ration Number	1	2	3	4
Kafir %	100	50	50	49.5
Oats		20		
Wheat Shorts		25	50	49.5
Tankage		5		
Mineral[1]				1.0

[1]Equal parts of calcium carbonate and precipitated bone meal.

Sows fed these rations farrowed an average of five, nine, eleven, and eight pigs for rations one to four, respectively. At farrowing, the pigs averaged 1.94, 2.94, 2.12, and 2.25 pounds for rations one to four. Thompson concluded that the addition of protein to a low-protein gestation ration produced stronger, larger, taller, and heavier pigs. He also concluded that the addition of minerals to a ration high in protein but low in minerals seems to increase to a very slight degree the size, length, and strength of pigs farrowed but definitely increased the circumference of the bone (rear cannon).

Work et al. (1942) fed corn-soybean meal rations containing ten per cent and fourteen per cent crude protein to lactating sows in dry lot. At eight weeks of age, pigs from sows on the ten per cent ration averaged 23.1 pounds while pigs nursing sows fed the fourteen per cent ration averaged 34.6 pounds.

Terril et al. (1952) investigated the protein requirement of gilts that were allowed bromegrass pasture. Corn-soybean meal-type rations containing ten, twelve, and fourteen per cent crude protein were fed. No significant differences were found in the average number of pigs farrowed per litter, average birth weight per pig, or in the percentage of total pigs farrowed that were alive seven days after birth.

The National Research Council (1953) recommended a fifteen per cent crude protein ration for breeding gilts and a fourteen per cent crude protein ration for sows.

Calcium and Phosphorus

Evans (1929) stated that the ration for the pregnant sow or gilt should contain 0.50 to 0.75 per cent lime.

Hogan (1932) estimated that the rations of brood sows should contain not less than 0.4 per cent calcium for the most successful reproduction as judged by the offspring produced and a study of the bones of the sows.

Dunlop (1935) stated that the requirement of swine for calcium was 0.45 per cent of the complete rations.

Mitchell and McClure (1937) gave the daily requirement for calcium and phosphorus as follows:

	Calcium Per cent of Dry Ration	Grams Calcium Daily	Phosphorus Per cent of Dry Ration	Grams Phosphorus Daily
Pregnant Gilt				
250# Early Gestation	0.25	4.0	0.2	3.5
250# Late Gestation	0.4	7.0	0.3	5.0
Lactating Sow 400#	0.45	10.0	0.35	8.0

Hutton (1938) found the desirable level of calcium in swine rations to be from 0.64 to 1.5 per cent of the ration and the phosphorus level from 0.30 to 0.51 per cent with a calcium-phosphorus ratio of less than 2:1.

The National Research Council (1953) recommended 0.6 per cent calcium and 0.4 per cent phosphorus per pound of total ration in a gestation or lactation ration for swine.

Vitamin A

Hughes et al. (1928) showed that swine fed on a white corn tankage ration developed symptoms of vitamin A deficiency. This was corrected by the addition of ten per cent of good alfalfa meal.

Guilbert et al. (1937) conducted experiments on cattle, sheep, and swine. They found the carotene requirement for all species to be twenty five to thirty micrograms daily per kilogram of body weight.

Hale and Fraps (1941) stated that the ration of sows should contain 200 micrograms of carotene per 100 grams of feed. They based this recommendation on the fact that the pigs from both the first and second litters showed no symptoms of a vitamin A deficiency at birth.

The National Research Council (1944) set the requirement for vitamin A at ninety micrograms per kilogram of body weight or four milligrams for a 100-pound growing pig per head daily. Five times this amount or twenty milligrams per head daily was recommended for pregnant gilts and sows and ten times this amount or forty milligrams per head daily for brood sows nursing litters.

Morrison (1948) stated that rations for brood sows should contain three milligrams of carotene per pound of air-dry feed.

B-Complex Vitamins and Unknown Factors

Evidence that some natural diets may not support normal reproduction was shown by Ross et al. (1942a) in a series of experiments with swine and rats. They fed a basal ration of 76.35 per cent ground yellow corn, 17.5 per cent soybean meal, 5.0 per cent alfalfa meal, 0.5 per cent iodized salt, and 0.65 calcium carbonate. They concluded that the ration was inadequate for normal reproduction and lactation. Gilts raised in dry lot on this ration failed to suckle their litters well enough to allow normal growth. Many pigs died before weaning, while others became emaciated. These findings were also substantiated in rat experiments. Normal reproduction and lactation could be obtained with swine and rats if ten per cent alfalfa meal was added to the basal ration.

Ross et al. (1942b) stated that alfalfa supplies two vitamins of the B-complex, inositol and para-aminobenzoic acid, which some rations do not furnish in large enough amounts. It is likely that at least one more dietary factor may also be involved. Other feed stuffs that were found to supply the missing dietary factor are tankage, fish meal, dried brewers' yeast, and liver extract.

Fairbanks et al. (1945) fed a basal ration composed of yellow corn 83.0, expeller soybean meal 8.0, tankage 5.0, menhaden fish meal 2.0 per cent, fortified cod liver oil, and minerals. This ration proved to be nutritionally inadequate for gestation and lactation under dry lot conditions. An addition of six per cent or twelve per cent dried corn distillers solubles or a combination of six per cent solubles and four per cent alfalfa meal, or ten per cent alfalfa meal

improved breeding efficiency, fertility, and the strength of the pigs farrowed. The value of the alfalfa meal and distillers solubles was attributed to the known or unknown water soluble vitamins contained in these products. The two lots of sows which were fed the basal ration during gestation and lactation weaned thirteen per cent and seven per cent of their pigs, while eighty-two per cent and eighty-three per cent of the pigs were weaned by the two lots of sows fed alfalfa meal during gestation and the basal ration during lactation. The importance of adequate nutrition during gestation and the value of alfalfa meal as a B-complex vitamin supplement was clearly demonstrated.

Krider et al. (1946a) supplemented a ration for brood sows with folic acid, alfalfa meal, or liver extract. Gestation and lactation results were significantly improved by the addition of either alfalfa meal or liver extract to the basal ration containing the known required B-vitamins. These results suggest that known factors were being supplied by these products. Although the addition of the folic acid concentrate did not improve weaning weights significantly, the pigs from sows so fed were thriftier and more vigorous than were pigs from sows fed the basal ration.

Krider et al. (1946b) investigated the value of the addition of condensed fish solubles (Sardine) and rye pasture for sows during gestation and lactation. A seventeen per cent protein ration composed of ground yellow corn, expeller processed soybean meal, five per cent dehydrated alfalfa meal, fortified cod liver oil and mineral was found to be nutritionally inadequate for gestation and lactation under dry

lot conditions. Only twenty-six per cent of the pigs were weaned by sows fed this ration with an average weaning weight of only 17.1 pounds. Three or six per cent condensed sardine fish solubles (fresh basis) was added to the basal ration. The sows fed the three per cent added solubles weaned ninety-two per cent of the pigs farrowed alive with an average weaning weight of 31.1 pounds. The sows fed the six per cent added solubles weaned seventy-one per cent of the pigs farrowed alive with an average weaning weight of 33.7 pounds. The pigs in both groups were very growthy and thrifty. The fish solubles were apparently providing supplemental nutrients, probably vitamin-like, which were necessary for satisfactory growth, gestation, and lactation. Fall-seeded rye pasture also proved to be an excellent source of the supplementary nutrients required to correct the inadequacies of the basal ration. Gilts receiving rye pasture weaned seventy-four per cent of their pigs with a weaning weight of 31.9 pounds each.

Krider et al. (1946c) supplemented the seventeen per cent protein ration, previously mentioned, with rye pasture, ten per cent alfalfa meal, and either two or four per cent of condensed fish solubles (fresh basis). The menhaden solubles were almost as effective as the sardine product in supplementing the basal ration. When the basal ration plus the supplement was fed in dry lot during lactation, the deficiency (or deficiencies) was (were) corrected, and the residual effect of rye pasture feeding during gestation was manifested.

Krider et al. (1948) used the previously described basal ration that was inadequate for gilts during gestation and lactation in dry lot. In this experiment the addition of one per cent condensed sardine

fish solubles supplied the nutrients needed to correct the first limiting deficiency (or deficiencies) of the basal ration. The pigs fed this ration were thrifty, but lacked the growthiness, sleekness, and uniformity observed when one per cent fermentation solubles were added to the one per cent condensed sardine fish soluble ration. The addition of one per cent fermentation solubles increased weaning weights significantly when added to one per cent condensed sardine fish solubles ration.

Ensminger et al. (1947) fed sows a purified ration containing the fat soluble vitamins A, D, E, and K and six B-complex vitamins (thiamine, riboflavin, niacin, pyridoxine, pantothenic acid, and choline). Sows fed on the purified diet for the last fifty-two days of gestation and forty-two days during lactation weaned pigs comparing favorably to the college herd, whereas complete failure in lactation resulted when the same ration was fed 140 days prior to farrowing. The use of rations devoid of thiamine, riboflavin, or choline resulted in unsatisfactory reproduction and lactation. A thiamine deficiency in the ration resulted in a loss of appetite of the sow, high mortality in the pigs, and a weak condition of the legs of the pigs at birth. A riboflavin deficiency resulted in loss of appetite and poor gains on the gilts. The pigs were either dead at birth or died within forty-eight hours after birth. The gilts fed choline-deficient rations had good appetites throughout the gestation period. However, there was a high mortality among the pigs from this group of sows. Weak legs at birth, subnormal weaning weights, and fatty livers were common findings in this group.

Cunha et al. (1948) indicated that the rate of gain was lowered slightly when the alfalfa content of the ration was increased from five to fifteen per cent during the growing and fattening period. However, it was shown that pigs fed fifteen per cent of alfalfa as compared to five per cent alfalfa, during growth, stored a factor or factors which later influences conception, reproduction, and lactation. The gilts fed only five per cent of alfalfa during growth were slow to conceive. Most of the gilts required three to four matings and some of them became sterile. This group weaned only four per cent of the pigs which were farrowed. When fifteen per cent of alfalfa meal was fed during growth, less time was required for the gilts to conceive. No sterility was encountered and approximately sixty per cent of the pigs were weaned.

Anderson and Hogan (1950) fed a basal ration of corn, tankage, soybean meal, alfalfa meal, cod liver oil, and a complex mineral mixture to eighteen gilts weighing 150 pounds at the start of the test. At 200 pounds they were divided into three groups. One group was left on the basal ration, another group was fed the basal ration plus Merck A.P.F. number three (to supply ten micrograms of B_{12} per pound of feed). The third group was fed the basal ration plus fifteen per cent fish meal and two per cent fish solubles. Sows on the basal ration weaned eighty-six per cent of the pigs farrowed alive, while sows on the other two rations weaned 100 per cent of the pigs they farrowed. The average weaning weights of the pigs were 28.0, 36.2, and 32.5 pounds for the basal ration, the A.P.F., and the fish meal rations, respectively.

Hodgskiss et al. (1950) observed that gilts fed rations deficient in pantothenic acid showed characteristic goose-stepping in the hind legs, loss of appetite, reduced water intake, and an exudate on the skin. All these gilts conceived, but they did not farrow or show external signs of pregnancy. Autopsy revealed partially resorbed, macerating fetuses in the uterine horns of these animals.

Miller et al. (1952) stated that a level of 1.25 milligrams of riboflavin per pound of feed was indicated as the practical minimum recommended allowance for breeding gilts and sows. This recommendation was based on farrowing and weaning results of an experiment with sows fed four different levels (0.55, 0.83, 1.25, and 1.65 milligrams per pound of feed) of riboflavin.

Bowland and Owen (1952) fed Yorkshire females for two generations on a ration in which barley was the only grain used. This ration contained 2.7 milligrams of pantothenic acid per pound of feed as determined by microbiological assay. The addition of three to twelve milligrams of calcium pantothenate per pound of ration gave no marked improvement in rate of growth. In fact the addition of calcium pantothenate may have had a detrimental effect. The level of pantothenic acid in the sows' milk was found to be directly related to the pantothenic acid content of the ration fed.

Ullrey et al. (1954) fed thirty-two gilts on a pantothenic acid-deficient ration for one month before dividing them into eight groups. Two groups were fed on each level of pantothenic acid. These levels were 0.5, 2.5, 5.5, and 8.5 milligrams per pound of ration. After one month on these diets, the gilts were bred. Gilts on the 0.5 milligram

level showed infantile reproductive organs, including inactive and atrophied ovaries, and farrowed no pigs. The gilts receiving the 2.5 milligram level produced some pigs with diarrhea, locomotor incoordination, and persistent tremors that were irreversible. Goose-stepping was observed at three days in several pigs from gilts fed this level of pantothenic acid. The average weaning weight of the litters farrowed was used as the measurement which reflected most completely the adequacy of the pantothenic acid levels to support total gestation and lactation performance. No significant differences were observed between the two higher levels or between replicates.

Teague (1955) investigated the comparative reproductive performance of gilts fed a diet containing 18.0 per cent sun-cured alfalfa as compared to those fed a well supplemented legume-free diet prior to breeding and during gestation. The inclusion of alfalfa did not noticeably affect breeding performance but significantly increased the number of live pigs farrowed and the number of pigs surviving to weaning age. When examined early in gestation, animals which had received the alfalfa diet possessed a greater number of corpora lutea than those fed the legume-free diet. The data suggests that the diet which contained alfalfa furnished a factor or factors which favorably influence ovulation rate and the post-natal survival of the litter, and that this factor (factors) was (were) absent or was supplied in insufficient quantity by the legume-free diet.

The National Research Council (1953) recommended that 0.5, 1.2, 5.0, and 4.5 milligrams of thiamine, riboflavin, niacin, and pantothenic

acid, respectively, be fed per pound of total ration to pregnant and lactating swine.

Antibiotic Feeding

Lasley (1952a) stated that antibiotics fed to sows at the level of five milligrams per pound of ration do not pass through the milk to the pigs in sufficient quantities to be effective in improving either the weaning weight or the survival rate of pigs.

Carpenter and Larson (1953) fed two groups of gilts in dry lot. One group received two grams of aureomycin per 100 pounds of feed until they weighed 180 pounds. The level of aureomycin was reduced to one gram per 100 pounds of feed for the remainder of the experiment. It was concluded that feeding the antibiotic, aureomycin, to swine from weaning through two gestation and lactation periods had no harmful or beneficial effect on reproduction. They stated that aureomycin can be detected in the milk of sows given the antibiotic orally, but the amount is small and variable and was observed to have no influence on growth rate of the suckling pigs.

De Pape et al. (1953) added 0.5 per cent A.P.F. antibiotic supplement to a basal ration of barley, soybean meal, ground sun cured alfalfa hay and meat meal for brood sows during pre-breeding, gestation, and lactation. They obtained no significant improvement in number of pigs farrowed, number of pigs farrowed alive, average birth weight, or number of pigs weaned per sow.

Hanson et al. (1953) conducted an experiment to determine the effects of feeding aureomycin during gestation on litter size and on

health and survival of the pigs. The gilts fed aureomycin during the gestation period farrowed slightly larger litters and their pigs were slightly heavier at weaning. The differences were of doubtful significance because of the limited number of litters and the variability within lots. Hence, the results were inconclusive.

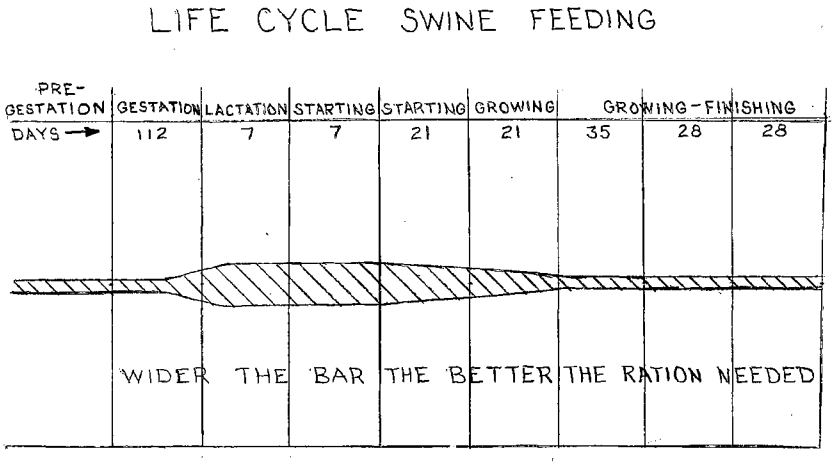
Beeson et al. (1954) conducted three experiments to study the effects of different levels of aureomycin on the birth weight, livability, and weaning weight of pigs. These experiments were conducted in 1953 and 1954. It was concluded from these experiments that the higher levels of aureomycin feeding (20 to 45 grams per ton) increased the birth weights of pigs. The average increase in birth weight varied from 0.09 to 0.31 pound for these tests. Aureomycin in the gestation ration did not improve the number of pigs farrowed per litter, livability of the pigs, per cent of pigs weaned, or the weaning weights of the pigs.

Davey et al. (1955) conducted reproduction studies on successive generations of swine fed levels of 10, 50, and 100 milligrams of aureomycin per pound of feed. These studies were conducted primarily in an attempt to study any possible toxic or undesirable effects of the high levels on reproduction. They concluded that neither the feeding of aureomycin continuously during the growth and reproduction periods nor the use of high levels of aureomycin had a deleterious effect on reproduction. They stated that no significant differences were found in total fertility, average birth weight, or average number of pigs weaned per litter among the three treatments.

Creep Rations

The purpose of creep-feeding is to furnish the young pig with as great an amount of nutrients as possible during the period when he is very efficient in his growth. The sow is unable to furnish enough milk to meet the nutritional needs of the pigs; therefore another source of nutrition should be supplied. A creep ration should contain adequate amounts of the required nutrients. It should also be very palatable for maximum consumption.

Catron (1954) stated that the nutritional needs of the young pig are very great from the time of birth to weaning (eight weeks). During this time the sow will not furnish enough milk to supply all of the nutrients required by the pig. Therefore, it is desirable during this time that a creep ration be fed in a well-located creep. Higher livability in young pigs, lower per cent of young pig trouble, thriftier pigs, and faster and more economical gains during their growing phase resulted from feeding a creep ration to supplement the milk produced by the sow.



Krider et al. (1950) recommended creep-feeding of nursing pigs under most conditions. They stated it was particularly beneficial under the following: (a) when sows are hand-fed in groups; (b) when large numbers of sows and litters are running together, increasing hazards to the pigs; (c) when sows are fed limited rations which would prevent the pigs from having an adequate supply of supplementary feed; and (d) when sows are self-fed balanced rations and most uniform rapid and economical performance of the pigs is desired. They also stated that palatability of the creep ration was important. These recommendations were based on six experiments with 134 sows and their litters on pasture.

Terrill et al. (1952) investigated the value of creep-feeding a palatable pig starter ration when small groups of sows and their litters were self-fed shelled corn and supplement on rye pasture. The daily gains of creep and non-creep fed pigs were 0.61 and 0.50 pound, respectively.

Terrill et al. (1952) investigated the response of suckling pigs to four levels of crude protein in the creep ration when sows were fed a 12.5 per cent crude protein ration on pasture. The performance was quite satisfactory in all lots. The daily gains of pigs receiving creep rations containing seventeen, twenty, and twenty-three per cent crude protein were almost the same. The gains of the pigs receiving the fourteen per cent crude protein creep ration were eleven per cent slower than those in the other lots, but the difference was not statistically significant because of variations among litters within treatments. The average daily gain was 0.55, 0.62, 0.62, and

0.61 pound for fourteen, seventeen, twenty, and twenty-three per cent protein, respectively. They recommended that mixed pig starter rations for suckling pigs raised on good pasture contain seventeen per cent or more crude protein.

Easley (1952) conducted an experiment to determine the value of a special creep ration for suckling pigs. Three weeks after farrowing, the sows and litters were divided as evenly as possible into two groups according to the age of the pigs and the sire of each litter. One group of pigs had access to the same ration as the sows in a self-feeder. The second group also had access to the same ration as the sows and in addition had access to a special creep ration. Pigs which were fed the special creep ration between three and eight weeks of age averaged 3.1 pounds heavier at weaning than pigs not receiving the ration. Pigs on the special creep ration cost slightly more per pound to produce than those on the sow ration.

Hanson and Ferrin (1953) conducted an experiment to determine the value of adding aureomycin, procaine penicillin, or arsanilic acid to a pig starter for suckling pigs. The pigs on all treatments were self-fed in a creep in the barn. All pigs and their dams were confined on concrete floors throughout the trials. Two separate trials were conducted. The total number of litters per treatment was eight. It was clearly shown that aureomycin, procaine penicillin, or arsanilic acid was effective in increasing the feed consumption of the pigs, their rate of gain, and their efficiency of gain. A weighted average of the results of both trials showed that aureomycin and procaine penicillin at a level of five milligrams per pound of

starter and arsanilic acid at a level of thirty milligrams per pound of starter produced essentially the same results.

Teague (1954) investigated the feeding value of certain creep-feeds and the importance of certain management practices. One of the tests made was a comparison of oat groats versus clipped oats in pelleted form. A total of twenty-five gilt and sow litters was used. All tests were started when the pigs were an average of four weeks of age and continued for twenty-four days. The pigs that consumed the greater quantity of either creep-feed in all cases gained most rapidly.

In the second test, to evaluate the feeding value of an all-plant pelleted creep-feed, a simplified all-plant diet, including corn, clipped oats, and soybean meal was pelleted. This ration gave satisfactory results as compared to diets in which six per cent dried skim milk or dried skim milk and fish meal were included. In another trial, a creep ration was tested that was composed of yellow corn middlings, soybean oil meal, fish meal (menhaden), alfalfa (ground), and sugar plus minerals and vitamins. This ration was shown to be unpalatable and not readily eaten in either meal or pellet form. In another test, the addition of 7.5 per cent cane sugar to a creep ration gave no beneficial effect.

Conrad and Beeson (1954) stated that the importance of creep feeding suckling pigs cannot be overemphasized. In a study conducted by these men, an attempt was made to develop a new creep ration largely of home-grown feeds which would be palatable, high in protein, and well fortified with vitamins and antibiotics. This study also included

feeding shelled corn or whole wheat to suckling pigs along with a protein supplement. The creep treatments were as follows: Lot 1 - an eighteen per cent crude protein mixed creep ration containing ten per cent cane sugar; Lot 2 - free-choice shelled corn and protein supplement; Lot 3 - free-choice whole wheat and protein supplement. The eighteen per cent creep ration produced pigs weighing thirty-seven pounds each at weaning, while the pigs on the corn plus supplement free-choice ration weaned at twenty-nine pounds, and those on wheat plus supplement free-choice averaged thirty-three pounds at weaning. In addition, the pigs on the eighteen per cent protein creep ration produced their gain on sixteen per cent less feed than those on the ration composed of corn and supplement free-choice.

McMillan and Wallace (1954) conducted an experiment to test the palatability of eight different creep rations. The first mixture was composed of yellow corn, oats, soybean meal, dried skim milk and appropriate vitamin-mineral-antibiotic fortifications. In the second mixture the corn was replaced by partially dextrinized, partially gelatinized yellow corn, and in the third mixture similarly treated corn with the germ and bran removed was used. The fourth through the eighth rations were similar to the first mixture except that special ingredients replaced an equal weight of the corn. The fourth and fifth mixture contained ten per cent of prime beef tallow (stabilized). The sixth mixture contained ten per cent citrus molasses. The seventh mixture was composed of ten per cent blackstrap molasses, and the eighth mixture contained ten per cent cane sugar. All mixed rations were fed in the pelleted form except ration five.

The comparative consumption for the various mixtures was .90, .67, 2.32, 33.42, 11.84, .52, 1.59, and 48.73 per cent for rations one to eight, respectively.

Lewis et al. (1955) conducted three experiments involving 328 baby pigs to study the influence of cane sugar and form of pig starter on palatability, feed conversion, rate of gain, and early starter consumption. Sugar in starters in either the meal or pelleted form significantly improved feed efficiency. The addition of sugar within the pelleted starter significantly increased early gains and early consumption of the starter.

Summary of Review

It has been pointed out in this review of literature that the diet of the sow during gestation has a marked effect on the litter she will produce. The amount of energy the sow is allowed to consume, the kind and quantity of protein, and the mineral composition of the ration have been shown to be of importance. Also, the needs for vitamin A and certain B-complex vitamins have been demonstrated. It is also pointed out that certain anatomical and physiological conditions may exist which have a marked influence on the reproductive performance of the sow.

Yet, at present, rations compounded to meet all the known requirements for gestating and lactating sows do not produce entirely satisfactory results. Even under the best feeding and management conditions, approximately thirty per cent of the pigs farrowed alive do not reach market. A large part of the losses appear to be due to

inadequate nutrition during the gestation and lactation periods. Much of the loss from "overlaying" may actually be due to inadequate nutrition, the pig becoming so weak and listless that he does not move out of the way.

The ability of a healthy pig to grow is so great that his demands for additional nutrients soon exceed the supply provided by the mother's milk alone. The supplying of additional high quality nutrients during this period has been shown to be a desirable practice.

The experimental work that follows is an attempt to study further the effects of adding additional B-complex vitamins to a commonly used gestation ration for sows. These investigations also include feeding trials on creep rations for pigs nursing sows.

EXPERIMENTAL

Section 1--Gestation-Lactation Studies

General

The first section of this study was designed to test the value of adding B-complex vitamins (riboflavin, pantothenic acid, niacin, and choline) to a gestation ration composed of natural feeds. The performance of the sows at farrowing time and per cent of pigs farrowed alive that were living at fifty-six days were used as a measure of the nutritional adequacy of the rations. This trial was conducted from November 26, 1954, to May 28, 1955.

Twenty Hampshire gilts and four Hampshire sows were paired into two groups according to weight, breeding, and date of service. The average initial weight of the females was 294.8 pounds for those in lot 1 and 293.1 pounds for those in lot 2.

Each group had access to a shed (12 x 12) during the winter season. They also had access to rye and wheat pasture, which provided some green feed during most of the test.

Each lot was hand-fed one of the mixed rations shown in table 1 in relation to their condition during the gestation period. Except for a short period at farrowing, the sows were self-fed during lactation on the same ration they received during gestation. The chemical composition of the feeds is given in table 2. The calculated chemical composition is given in table 3.

Table 1

Percentage Composition of Sow Rations

(Spring 1955)

Ration Number	1	2
Milo	60%	60%
Alfalfa hay (leafy)	20	20
Soybean meal	10	10
Tankage	8	8
Bone meal	1	1
Salt	1	1
2-49-C Fortafeed[1]	-	.2
Total	100.0	100.2
Cost per cwt.$	2.67	2.77

[1]Supplied 4 mg. riboflavin, 8 mg. pantothenic acid, 18 mg. niacin and 180 mg. of choline per pound of feed.

Table 2

Chemical Composition of Feeds

(Spring 1955)

%	Red Milo	Alfalfa Meal	Soybean Meal	Tankage
Moisture	10.25	6.49	7.13	5.22
Ash	1.55	11.25	6.74	16.31
Protein	9.31	23.81	50.87	61.94
Fat	3.82	3.46	2.57	11.68
Calcium	.12	1.23	.34	3.79
Phosphorus	.64	.84	.40	.12
Crude Fiber	2.10	18.61	6.60	4.50
Nitrogen Free Extract	72.97	36.38	26.09	.35

Table 3

Calculated Chemical Composition of the Gestation-Lactation Rations

Ration Number	1	2
	%	%
Protein	20.93	20.93
Calcium	.91	.91
Phosphorus	.73	.73
Vitamins	Mg/lb.	Mg/lb.
Choline	318.00	498.00
Niacin	27.20	45.20
Pantothenic Acid	5.20	13.28
Riboflavin	1.63	5.63

The rations were prepared in the following manner. Red milo purchased on the open market, was ground to medium fineness and mixed with the other components. A commercial B-complex vitamin supplement was added to form ration two as indicated in table 1. High quality alfalfa hay was ground moderately fine for use in this ration. Each ration was thought to be adequate with respect to the level of protein, mineral, and energy content. The level of B-complex vitamins was also believed to be adequate, except possibly in the case of pantothenic acid and riboflavin in ration one.

Individual liveweights were recorded as the females entered the test, at the time of farrowing, and again at weaning. Pigs were weighed within twelve hours of birth, at eight weeks, and at ten weeks of age.

The number of services per conception, number of live pigs produced, condition of the pigs, and percentage of pigs farrowed alive and weaned were noted. Each sow was observed daily for signs of changes in condition. The young pigs were also observed daily.

Results and Discussion

The results of the gestation section are summarized in table 4. The number of sows bred in each lot was twelve. The one female

Table 4

Summary of Results
Gestation Period

(Spring 1955)

Lot Number	1	2
Number of sows bred	12	12
Number of sows farrowed	11	9
Av. weight of sows at start (lbs.)	294.8	293.1
Av. weight of sows--110 days of gestation (lbs.)	385.3	404.3
Av. sow gain to farrowing (lbs.)	90.5	111.2
Av. daily gain on sow farrowing (lbs.)	.958	1.13
Av. daily ration (lbs.)	8.17	8.17
Av. number pigs farrowed alive per litter	8.7	8.4
Av. number pigs farrowed dead per litter	.3	.1
Dead at birth (total)	3	1
Av. total pigs farrowed	9.0	8.5
Av. farrowing weight of pigs (lbs.)	2.82	2.75
Condition of pigs at birth (%)		
Strong	89.6	90.8
Medium	6.2	7.9
Weak	4.2	1.3
Pig losses (number)		
Overlaid	4	0
Starved (weak)	4	4
Chilled	0	0
Infected joints	1	1
Pneumonia	1	0
Deformed pig	1	0

in lot 1 that did not farrow normally was a gilt that went past her farrowing date. She was slaughtered, and upon autopsy it was found that she had a fibrous condition of the cervix which inhibited delivery

and probably had hindered conception. There was one apparently normal pig in the uterus, but it could not have been delivered due to the condition of the cervix. Nine gilts farrowed in lot 2. One gilt was removed at the start of the trial because of passing blood in the urine. Upon autopsy it was found that she had an infected kidney. Early in the trial one of the sows was sold for breeding purposes. The other gilt had difficulty farrowing and was taken to the veterinary clinic where a caesarean operation was performed. She died while the operation was in progress. She was then autopsied and it was found that she had fluid around the heart, which probably caused her death. Seven pigs that appeared normal from outward appearance were removed from the uterus of the sow; however, none of the pigs was living at the time of removal. The average initial weight for the lot 1 gilts was 294.8 pounds and for the lot 2 gilts was 293.1 pounds. The average weight of the sows at farrowing time was 385.3 and 404.3 for lot 1 and lot 2, respectively. The sows in lot 2 gained an average of 20.7 pounds more per sow than the sows in lot 1 up to the time of farrowing. Both lots were receiving the same amount of feed, which was an average of 8.17 pounds of the mixed ration per head daily. The greater gain in weight of the sows in lot 2 is believed to be due to the effect of the supplemented B-complex vitamins. However, this added gain did not show up in the farrowing weight of the pigs. The average farrowing weight of the pigs was 2.82 and 2.75 pounds for lots 1 and 2, respectively. The average number of pigs farrowed per litter was 8.7 for lot 1 and 8.4 for lot 2. Apparently litter size and birth weight were not adversely affected

by feeding the supplemented ration during gestation. The condition of the pigs at birth was approximately the same, with the lot 1 sows giving birth to 89.6 per cent strong, 6.2 per cent medium, and 4.2 per cent weak pigs of those farrowed alive. The condition of the lot 2 pigs was 90.8 per cent strong, 7.9 per cent medium, and 1.3 per cent weak pigs of those farrowed alive. The number of pigs farrowed dead was three and one for lots 1 and 2, respectively. Pig losses during the nursing period were eleven in lot 1 and five in lot 2. Each lot had four pigs that were starved (weak) and one pig that died from infected joints. Four pigs in lot 1 were overlaid. The other two deaths in lot 1 resulted from pneumonia. Also one pig was born deformed.

The lactation results are given in table 5. The average weight of the sows after fifty-six days of nursing was 291.1 and 326.1 pounds for lots 1 and 2, respectively. The average weight loss during nursing was lot 1, 94.2 and lot 2, 78.2 pounds. The sows in lot 1 lost an average of sixteen pounds more than did those in lot 2 during the eight-week nursing period. The average feed consumption per sow during the nursing period was 714.3 and 771.7 pounds for lots 1 and 2, respectively. During the lactation phase the lot 1 sows consumed on the average 12.7 pounds per day, while the lot 2 sows consumed 13.7 pounds per day. As stated, there was a marked difference in the weight loss per sow on the two rations. The smaller weight loss in the B-complex vitamin supplemented group is believed to have been due to the stimulation of appetite by the B-vitamins. This seems to be verified by the fact that the lot 2 sows consumed approximately one more pound of feed per day than did the lot 1 sows.

The percentage of the pigs born alive that were weaned was high for both lots. The lot 1 sows weaned 88.5 per cent and the lot 2 sows weaned 93.4 per cent. When these percentages are considered, it seems to indicate that the pigs whose dams had been fed on the vitamin-fortified ration were slightly stronger and healthier than the pigs from the sows that had been fed the non-fortified ration.

Table 5

Summary of Results
Lactation Period

(Spring 1955)

Lot Number		1	2
Av. sow weight after 56 days nursing	(lbs.)	291.1	326.1
Av. weight loss during nursing	(lbs.)	94.2	78.2
Av. feed consumption per sow during nursing	(lbs.)	714.3	771.7
Av. daily feed consumption during nursing	(lbs.)	12.7	13.7
Per cent pigs farrowed alive weaned	(%)	88.5	93.4
Av. 56 day weight of pigs	(lbs.)	36.4	36.7
Av. 56 day litter weight	(lbs.)	315.6	311.9
Av. 70 day pig weight	(lbs.)	49.9	50.4
Av. 70 day litter weight	(lbs.)	432.7	428.6

The following data was computed from the seventeen litters that were used on the creep-feeding study.

The average weaning weight (fifty-six days) of the pigs was approximately the same for lots 1 and 2, being 36.4 and 36.70 pounds, respectively. The average litter weaning weight (fifty-six days) was 315.61 for lot 1 and 311.9 pounds for lot 2. The added litter weight in lot 1 was due to the slightly larger number of pigs raised

per litter. The average seventy-day weight of the pigs followed the same trend, with the lot 2 pigs weighing one-half pound more per pig than did the lot 1 pigs. The average seventy-day litter weight was also slightly higher for the lot 1 pigs, due to the slightly larger number of pigs raised per litter.

The feed costs for this section of the experiment are summarized in table 6. The average daily feed cost for the gestation period (110 days) was twenty-two and twenty-three cents per sow per day for lots 1 and 2, respectively. The feed cost was approximately one cent

Table 6

Feed Costs--Gestation-Lactation Period

Lot Number	Days	1	2
Av. daily feed cost	110	$ .22	$ .23
Feed cost per sow			
Gestation	110	24.20	25.30
Lactation	56	19.07	21.37
Total	166	$43.27	$46.67
Feed cost per pound of pig at 56 days		$ .177	$ .167

more per day for the sows in lot 2. In terms of a 110 day gestation period, this additional cost would amount to $1.10 per sow. The sows in lot 2 gained 20.7 pounds more but required $1.10 more in feed cost; therefore, the cost of the extra weight was approximately $5 per hundred pounds. During the lactation phase the lot 1 sows consumed an average of 12.7 pounds per day, while the lot 2 sows consumed 13.7 pounds of the mixed ration per day. The feed cost

per sow during lactation was $2.30 more for the lot 2 sows than for those in lot 1. The feed cost per pound of pig at fifty-six days was $0.177 and $0.167 for lot 1 and 2, respectively. The cost per pound of pig in lot 1 was approximately one cent higher because the pigs were one-half pound lighter and they had consumed more feed than had the lot 2 pigs. The lot 1 sows were thirty-five pounds lighter at weaning time than the lot 2 sows. The difference in the value of the sow at the start and at the end of the experiment was also another factor in the higher pig cost per pound in lot 1. The lot 1 sows finished the trial at approximately the same weight at which they had started, while the lot 2 sows gained about thirty-five pounds during the trial.

The feed prices used in the calculation of the cost of the gestation and lactation rations are given in table 7.

Table 7

Feed Prices for Gestation and Lactation Rations

(Spring 1955)

	Dollars per 100 lbs.
Milo	2.48
Alfalfa hay	1.50
Soybean meal	4.15
Tankage	5.00
Bone meal	5.00
Trace Mineralized Salt	2.00
Fortafeed	51.00

Summary

Reproduction studies were conducted with Hampshire gilts to determine the effect of adding riboflavin, pantothenic acid, niacin, and choline to a ration that was believed to be adequate for normal reproduction. The gilts were fed the ration throughout one gestation and lactation period. The performance of the gilts at farrowing time and the per cent of the pigs farrowed alive that were weaned at fifty-six days were used to determine the nutritional adequacy of the ration. The vitamin-fortified ration supported normal gestation and lactation. Sows fed this ration weaned a higher per cent of the pigs farrowed alive than did the non-fortified ration. The respective weaning percentages were 88.5 per cent for the non-fortified and 93.4 per cent for the fortified ration. The pigs farrowed by the sows on the vitamin-fortified ration were more vigorous at birth and weighed slightly more per pig at weaning. The feed cost per pound of pig at fifty-six days was slightly lower for the vitamin-fortified ration. It would seem from the results obtained from this one trial that feeding the fortified ration was beneficial in producing greater livability of the pigs, slightly heavier pigs, and heavier sows at weaning. The extra weight on the lot 2 sows at the time the pigs were weaned actually had the effect of lowering the cost per pound of weaned pig by about one cent. However, other trials using the vitamin-fortified ration will be conducted before definite conclusions are reached on the effect of the added B-vitamins.

Section 2--Creep-Feeding Studies

General

Most standard creep rations for pigs contain a small percentage (five-ten per cent) of alfalfa. The alfalfa is added to the creep ration primarily as a source of carotene and B-vitamins. However, it seems feasible that the addition of alfalfa to the creep ration might adversely affect the palatability since it increases the fiber content of the ration. Thus, it would appear that a vitamin A concentrate might favorably replace the alfalfa in a creep ration fortified with B-vitamins. With the current low price for tallow, it would seem possible to utilize some fat in creep rations for pigs.

The objectives of this creep-feeding study with pigs were (1) to determine if a vitamin A concentrate could replace the alfalfa in a B-vitamin fortified standard creep ration for pigs; (2) to determine if added fat would increase the efficiency of the creep ration when fed to pigs.

Rate of gain and feed efficiency were used as criteria for measuring the relative value of the different creep rations.

Seventeen of the litters of pigs discussed in section one were allotted to the three different rations on the basis of age and the ration their mother was receiving. The average initial age of the pigs on the three experimental rations was four weeks.

The sows and pigs were housed in wooden sheds (7 x 8 feet). The creeps in which the special rations were fed were located just outside the shelter, on the south side for protection from the north wind. Both feed and water were available in the creep. The pigs also had access to the regular ration fed to their dam in individual self-feeders and to the water supplied the sows from fifty gallon barrels equipped with automatic watering cups.

Each litter of pigs was self-fed the assigned creep ration shown in table 8. The complete creep ration was mixed and pelleted by the Stillwater Milling Company. The antibiotic, vitamin supplement, and trace mineralized salt were mixed as a premix with soybean meal and then added to the other ingredients. The fat was melted and mixed with the other components in the mixer. A commercial B-complex vitamin supplement and an antibiotic supplement were used as indicated in table 8. Each ration was thought to be adequate with respect to the mineral and vitamin requirements of the animals. The calculated chemical composition is given in table 9.

The pigs were weighed at eight and ten weeks of age. Feed efficiency was based on the feed consumed at these ages.

Results and Discussion

The results of the creep feeding study are summarized in table 10. The average fifty-six day weights of the pigs were 36.89, 34.43, and 39.00 pounds for lots 1, 2, and 3, respectively. An analysis of covariance (Snedecor, 1946) to remove the effect due to litter size, indicated these differences in weaning weight were not statistically significant. The pigs consuming ration three (vitamin A concentrate

Table 8

Percentage Composition of the Creep Rations

(Spring 1955)

Ration Number	1	2	3
Milo	66.80	62.30	52.30
Soybean meal	18.50	18.00	23.00
Fish meal	3.00	3.00	3.00
Buttermilk (dry)	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00
Trace mineral salt	1.00	1.00	1.00
Fortafeed[1]	.20	.20	.20
Aurofac[2]	.50	.50	.50
Molasses	5.00	5.00	5.00
Vitamin A concentrate	2 gms.	———	2 gms.
Alfalfa meal (dehydrated)	———	5.00	———
Fat	———	———	10.00
Total lbs.	100.00	100.00	100.00
Cost of ration per cwt.$	3.67	3.67	4.36

[1]Supplied 4.0 mg. riboflavin, 8.0 mg. pantothenic acid, 18.0 mg. niacin, and 180.0 mg. choline per pound of feed.

[2]Supplied .009 gm. of aureomycin and .009 mg. of B_{12} per pound of feed.

Table 9

Calculated Chemical Composition of the Creep Rations

Ration Number	1	2	3
Net energy (Therms)	71.10	69.54	83.13
Protein (%)	18.67	18.62	18.84
Calcium (%)	.91	.99	.92
Phosphorus (%)	.79	.78	.77
Vitamins mg/lb			
Choline	680.00	677.00	687.50
Niacin	38.87	38.59	36.68
Pantothenic acid	14.46	14.80	14.00
Riboflavin	5.01	5.24	5.01
Amino acids (% of ration)			
Lysine	.8409	.8514	.9159
Tryptophan	.2026	.2055	.2111
Cystine	.2802	.2821	.2779
Methionine	.2681	.2706	.2691
Leucine	1.3214	1.2754	1.3174
Isoleucine	.8049	.8139	.8314
Phenylalanine	.8008	.7978	.8068
Threonine	.5624	.5684	.5869
Valine	.6930	.7000	.7440
Histidine	.3326	.3431	.3531

Table 10

Summary of Results

Creep-Feeding Studies

(Spring 1955)

Ration Number	1 Vit. A	2 Alfalfa	3 Vit. A + Fat
Litters	6	6	5
Av. number pigs per litter	8.33	8.66	8.80
Av. 56 day weight (lbs.)	36.59	34.43	39.00
Av. daily gain 56 days (lbs.)	.600	.564	.645
Av. 70 day weight (lbs.)	50.87	48.85	50.90
Av. daily gain to 70 days (lbs.)	.684	.657	.686
Feed consumption per pig 56 days (lbs.)	21.29	21.61	20.57
Feed consumption per pig 70 days (lbs.)	37.31	36.17	37.41
Feed per pound of gain 56 days (lbs.)	.633	.685	.569
Feed per pound of gain 70 days (lbs.)	.779	.787	.779
Feed cost per pound of pig 70 days $	.0269	.0272	.0320
Feed cost of sow $	43.85	45.42	45.43
Loss or gain of weight on sow (lbs.)[1]	+26.00	+18.00	- 8.00
Loss in value of sows during trial $	.08	1.24	4.01
Total feed cost per pound of pig raised to 70 days $[2]	.1305	.1373	.1424

[1]Figured on basis of original and final weight of sows. Gilts figured at $18.00 per hundred at start of the trial and weaned sows figured at $16.50 per cwt.

[2]Including the feed cost of sow and loss in value of sow.

with fat added) had a slight weight advantage over the pigs in the other two groups at eight weeks of age. The pigs fed ration one (vitamin A concentrate) were slightly heavier than the alfalfa-fed pigs at eight weeks of age. The average daily gain of the pigs was also in the favor of the ration containing fat. The alfalfa-fed pigs had the lowest average daily gain per pig up to eight weeks of age. Their average daily gain was .564 pounds while the vitamin A concentrate fed pigs had an average daily gain of .600 pounds, and the pigs consuming the ration containing vitamin A concentrate plus fat gained .645 pounds per pig per day. A slightly greater amount of the creep ration was consumed by the pigs on the alfalfa creep ration. This would indicate that apparently there was no adverse effect obtained from feeding the alfalfa in regard to the palatability of the ration. This was probably due to the fact that all rations were pelleted. Another factor that might be present is that the pigs may have eaten more of the lower energy (alfalfa) ration in order to satisfy their need for energy. The feed required per pound of gain up to fifty-six days was .633, .685, and .569 pounds per pig for lots 1, 2, and 3, respectively. It appears from this data that the most efficient feed utilization was made by the pigs fed creep ration three (vitamin A with fat added) up to eight weeks of age.

The average weight per pig at ten weeks was almost identical for those fed the vitamin A and the vitamin A with added fat rations, while the pigs receiving the ration containing alfalfa weighed 48.85 pounds, and the other two weighed 50.87 and 50.90 pounds per pig,

respectively. The average daily gains for each group were .684, .657, and .686 pounds per day per pig for lots 1, 2, and 3, respectively. The feed consumed per pig up to ten weeks of age was 37.3, 36.2, and 37.4 pounds for creep rations one to three, respectively.

Feed prices for the feeds used during the creep feeding phase are shown in table 11. When feed cost was considered on the different creep rations, the pigs that had consumed creep ration one cost $2.69 per one hundred pounds of pig produced to seventy days. The pigs that had consumed creep ration two cost $2.72, and those consuming creep ration three cost $3.20 per one hundred pounds of pig produced. However, one should remember that the cost of the creep ration is small in regard to the overall cost per pound of pig produced to ten weeks of age.

Table 11

Feed Prices for Creep Rations

(Spring 1955)

	Dollars per 100 lbs.
Milo (Ground)	2.85
Soybean meal	4.60
Fish meal	7.50
Buttermilk dry	7.50
Bone meal	4.50
Trace mineralized salt	2.50
Fortafeed	51.00
Aurofac	34.00
Molasses	2.00
Vitamin A concentrate	165.00
Alfalfa hay dehydrated	3.25
Fat (animal)	9.00

The total feed cost per sow nursing the pigs on creep ration one, two, and three was $43.85, $45.42, and $45.43, respectively. The reason for the lower feed cost per sow for those nursing the pigs that were consuming creep ration one was that they consumed sixty-five and 72.5 pounds less feed than did the sows nursing pigs on creep ration two and three, respectively. The average difference in the weight of the sows at the end of the trial as compared to their average initial weight was as stated below. The sows nursing pigs consuming creep rations one and two gained twenty-six and eighteen pounds, respectively, while the sows nursing pigs consuming creep ration three lost eight pounds. Sows nursing pigs consuming creep rations one, two, and three were valued at $0.08, $1.24, and $4.01 less at the end of the trial as compared to their value at the start of the trial. The difference in the beginning value and the final value was a combination of both price and condition of the sow.

The total cost per pound of pig raised to seventy days was 13.1, 13.7, and 14.2 cents per pound, respectively, for pigs fed the three creep rations.

Summary

Seventeen litters of Hampshire pigs were fed three different milo-soybean type creep rations. The variables were (1) vitamin A concentrate, (2) dehydrated alfalfa leaf meal and (3) vitamin A concentrate with ten per cent fat added. Each of these rations was fortified with a B-complex and antibiotic supplement.

The vitamin A concentrate satisfactorily replaced the alfalfa with respect to the vitamin A requirement of the pigs. On a calculated basis the vitamin A concentrate supplied the same amount of vitamin A as was supplied by five per cent dehydrated alfalfa leaf meal. The pigs that had consumed the vitamin A concentrate in the creep ration gained slightly more weight than did the pigs that had consumed the alfalfa. A possible explanation was that the vitamin A concentrate ration had a slightly higher energy value.

The ration containing the fat and vitamin A concentrate increased the average weight of the pigs over the pigs from the other lots up to fifty-six days. However, this advantage was lost from the fifty-sixth day to the seventieth day. A possible explanation of this could be that the pigs were being supplied adequate protein from their mother's milk in order for them to make efficient use of the high energy ration up to eight weeks of age. Then, when the milk supply was removed, the high energy ration lacked the protein that was necessary for efficient utilization of the higher energy ration. Also, from an economical viewpoint the ration containing the added fat was more expensive and raised the cost per pound of pig at seventy days of age approximately 1.0 cent per pound of pig over the vitamin A concentrate ration and approximately 0.5 cent per pound of pig over the alfalfa ration.

It would appear from the results obtained in this one study that the ration containing the vitamin A concentrate was the most practical. The feed cost per pound of liveweight gain was considerably lower for those pigs fed the vitamin A concentrate ration than those fed the ration containing the alfalfa.

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