ABSTRACTS OF PAPERS TO BE PRESENTED AT THE
THIRTY-NINTH ANNUAL MEETING OF
THE AMERICAN SOCIETY OF
ANIMAL PRODUCTION

The meetings are scheduled to be held at the Hotel Sherman in Chicago on November 28 and 29, 1947, with a dinner for the honor guest on November 30.

Breeding and Genetics Section
J. L. Lush, Chairman

HERITABILITY ESTIMATES OF SOW PRODUCTIVITY AND LITTER PERFORMANCE. Cecil T. Blunn and Marvel L. Baker, University of Nebraska.

Criteria used to evaluate sow performance were total number of pigs farrowed, born alive, alive at 21, 56, and 168 days of age, as well as litter weight at 56 and 168 days. These factors were adjusted for age of sow, inbreeding of sow and inbreeding of litter before heritability estimates were determined. A total of 561 litters farrowed in the Nebraska swine breeding project from 1937 to 1943, inclusive, were used. Heritability estimates were obtained by doubling the intra-sire regression of daughter's performance on sow's performance (based on 478 daughter-dam pairs). These were compared with intra-line estimates of heritability based on paternal half-sib and full-sib correlations. Estimates of heritability based on full-sib correlations varied from 0.05 for litter weight at 168 days to 0.15 for number of pigs alive at weaning. For paternal half-sib correlations, estimates varied from 0.08 for number of pigs alive at 21 days to 0.17 for litter weight at 168 days. Based on intra-sire regressions, heritabilities varied from 0.02 for number of pigs alive at 56 days to 0.39 for number of pigs born alive. Sow productivity is a combination of a progeny test of the sow and a measure of her direct environmental influence on the litter. The more important a pig's own genes are for a given character, the more litter performance becomes a progeny test for the dam. Litter weight at 168 days, therefore, is more a progeny test than a measure of sow performance.

PERFORMANCE TESTS OF MORGAN HORSES UNDER SADDLE. W. M. Dawson, Ralph W. Phillips, and E. B. Krantz, United States Department of Agriculture.

One-mile tests at the walk and at the trot on an exercise track and an eleven-and-a-half-mile cross-country ride (each horse walked 4.7, trotted 5.7, and cantered 1.1 miles) have been conducted since 1941 on three-year-old Morgan horses raised and trained at the U. S. Morgan Horse Farm, Middlebury, Vermont. Horses carried 20 percent of their weight and were tested at their “normal” gait. Eleven which tended to pace were omitted. Analyses of variance of 68 horses that trotted naturally showed significant differences in time required for the cross-country ride, time required to walk a mile and length of stride at the trot for the offspring of eight sires. Significantly less time was required on both the cross-country ride and the mile test by horses with the longest stride at the trot. Correlations between the time required for the cross-country ride and the time required for the mile test at the walk and the trot were 0.42 and 0.35, respectively. Horses given the best scores by the riders for performance of the walk were ones with the fastest time and longest stride. Those given high scores on ease of walk to rider also tended to have a long stride. Effects of numerous body measurements and scores of conformation, as well as scores of temperament, condition, quality and style, on performance, are discussed.

The effect of inbreeding on performance was estimated from comparison of inbred and linecross litters in four projects of the Regional Swine Breeding Laboratory. Litter inbreeding was studied using differences between inbreds and 2-line crosses, within season and line of dam. Durocs included 396 inbred and 167 line cross litters of 14 lines and 33 crosses; Poland Chinas comprised 440 inbred and 158 line cross litters of 17 lines and 66 crosses. Average inbreeding of lines varied from 23 to 42 percent in four projects. For each 10 percent rise in litter inbreeding, independent of age and inbreeding of dam, the decline averaged in litter size, 0.2 pigs* at birth, 0.4 pigs** at 21 days and 0.5 pigs** at 56 and 154 days; in pig weight no decline to 56 days but 3.6 pounds** at 154 days. Rate of decline was similar for the same breed in different projects, but was faster for Durocs than for Polands, especially in litter size. For Poland Chinas at one station, comparison of 2-line and 3-line crosses indicated that for each 10 percent rise in inbreeding of dam, litter size declined 0.16 pigs at birth and 0.21 to 0.25 pigs* at 21 to 154 days of age, pig weight declined 0.05 pounds at birth, 0.17 pounds* at 21 days with no effect at later ages. Time trend in performance of inbreds indicated linear inbreeding decline as large or larger than that based on inbred line cross comparisons, with small and nonsignificant line differences in rate of decline. (* P<.05; ** P<.01)

SELECTION OF YOUNG DAIRY BULLS BY METHODS USING MAXIMUM INFORMATION IN THE PEDIGREE. Franklin Eldridge and G. W. Salisbury, Cornell University.

Several investigators have determined the correlations between the average butterfat production of the offspring of a dairy bull and the average production of different groups of his relatives. However, no study has been previously reported in which these correlations derived from information on the same groups of relatives in each of the pedigrees of a large number of dairy bulls, have been combined into one analysis. In the New York State herd analysis program and U.S.D.A. proofs on Holstein sires, there were a large number of bulls having five or more daughters with production records as well as butterfat production records on: (1) the dam of the bull, (2) the maternal half-sisters of the bull, (3) the paternal half-sisters of the bull, (4) the dams of the paternal half-sisters of the bull, (5) the paternal half-sisters of the dam of the bull and (6) the mates of the bull. These data were used to determine how much each of the items should be weighted in one regression equation to give the most reliable estimate of the actual production of the daughters of a bull. It was found that the regression equation accounted for about 48 percent of the variability in the average butterfat production of the daughters of these bulls. The most important variate affecting the average production of the daughters was the average production of their respective dams (r equal approximately to +0.67). After the deletion of this variate, the equation still accounted for 14 percent of the variability, a highly significant portion.

THE EFFECTS OF ENVIRONMENTAL AND HEREDITARY FACTORS ON TRICHOSTRONGYLID WORM INFECTION ON SHEEP. L. Otis Emik and Paul W. Gregory, University of California.

Statistical measures of environmental influences and estimates of heritability for resistance of sheep to trichostrongyliids were sought. Counts of parasites' eggs were made on fecal samples taken at weekly intervals for 12 weeks. The lambs (10 Southdown, 12 Shropshire, 36 Hampshire, 20 Merino, and 25 Rambouillet) constituted the major portion of the lamb crop at University of California, Davis, in 1939. Age of the lambs was not correlated to infestation level (as measured by mean square root of counts). Environmental effects were estimated by analysis of variance of the square roots of the counts. The main effects were adjusted for unequal subclass numbers. Sex, breed, day, sire, twin, type and sheep were all significant. The presence of interaction between days and the other factors indicated that days largely represented independent sampling rather than any time trend. The highly significant Sex X Type
interaction points to a definite sex difference between the mutton and wool types in relation to infestation. The females were responsible for most of the difference. The Breed X Sex interaction was still significant when corrected for type, but largely due to type differences. Heritability as estimated by full-sib correlation was $0.56 \pm 0.04$ and by half-sib correlation in Hampshires it was $0.25 \pm 0.04$. The high standard errors offset the otherwise encouragingly high estimates of heritability. Studies of inherited resistance are exceedingly complex under these circumstances and proper design of experiment will be necessary to insure the success of future research.

COMPARISON OF CORRIEDALE X NAVAJO AND ROMNEY X NAVAJO CROSSES. James O. Grandstaff, United States Departments of Interior and Agriculture, cooperating.

At the Southwestern Range and Sheep Breeding Laboratory, Fort Wingate, N. Mex., old-type Navajo ewes were mated to purebred Corriedale and Romney rams, and some $\frac{1}{2}$ and $\frac{3}{4}$ Navajo ewes were backcrossed to Romney rams. From 1937 to 1942 inclusive a total of 905 matings were made, using six rams of the Corriedale breed and six of the Romney breed. These matings resulted in an average of 89 percent of pregnant ewes for each cross. The Corriedale cross was superior to the Romney cross in percentages of lambs born and reared and in rate of growth of lambs from birth to weaning age. Mean differences in weaning weights of lambs and in the poundage of lamb produced per ewe bred, of 3.9 pounds and 15.4 pounds respectively, were highly significant. A total of 283 ewe lambs were saved as breeding prospects, the percentage of culled lambs being significantly greater for the Romney than for the Corriedale cross. At yearling age there was no significant difference between the Corriedale and Romney crossbred ewes, in body weight or length of staple. The ewes sired by Romney rams had coarser fleeces containing more kemp and other medullated fibers, but the fleeces of the Corriedale F1 ewes were heavier and yielded a greater amount of clean wool. Differences between crosses with respect to fleece, weight, yield of clean wool, fiber-diameter, and percentages of kemp and other medullated fibers were highly significant.

SELECTION IN AN INBRED LINE OF DUROC SWINE. R. C. Laben and J. A. Whatley, Jr., Oklahoma A. & M. College.

The intensity of selection for certain traits was determined in Line 3 of the Oklahoma swine breeding project. This was a closed line, bred for 6 generations from a foundation of 3 boars and 10 sows. From 1938 through 1946, 33 boars and 85 sows produced 147 litters. The average inbreeding of the 816 pigs raised to 180 days was 16 percent. There was a uniform increase in inbreeding to 24 percent in the fourth generation, followed by a decline to 19 percent in the sixth generation. Selected individuals averaged 22 pounds heavier than their generation at 180 days, but the weight decreased from 187 pounds in the first to 153 pounds in the fifth generation. The conformation score of selected individuals was 2.3 points above their generation averages. Generation average scores did not change noticeably. Size of litter weaned decreased from 6.7 pigs in the first generation to 6.0 pigs in the fifth and 4.3 pigs (only 6 litters) in the sixth generation. This decline occurred in spite of selecting breeding stock from litters 1.2 pigs larger than the average. Dams of selected individuals were 2.5 points superior in production index to the 45.5 point average of dams of all pigs. Approximately 50 percent of the selected sows had descendants in the line at the close of the study. These “effective” sows were superior to the selected sows in 180 day weight and productivity.

THE FERTILITY OF BOVINE SPERMATOZOA TREATED WITH IMMUNE SERA FOR THE CONTROL OF TRICHOMEONIASIS. Banner Bill Morgan, University of Wisconsin.

One hundred and one cows and heifers were artificially inseminated with semen from a trichomonad infected bull and semen from a normal bull to which Trichomonas foetus had been added. The semen was diluted with raw or hyperimmune bovine sera for the purpose of inactivating or destroying the trichomonads. Twenty cows became pregnant and calved normally (19.8%). Artificial insemination of twenty control animals with normal undiluted
semen resulted in 17 pregnancies. Twenty control cows bred artificially with semen from an infected bull resulted in 4 normal calvings; 16 cows contracted trichomoniasis. This method cannot be placed on a practical basis until the spermatocidal effects of bovine sera can be removed.

REACTIONS OF SOUTHDOWN SHEEP TO TWO ENVIRONMENTS. Ralph W. Phillips and Damon A. Spencer, Food and Agriculture Organization of the United Nations and United States Department of Agriculture.

Comparisons were made of reactions of Southdown sheep to environments at Beltsville, Maryland and Middlebury, Vermont. In one comparison the flock was transferred from Beltsville to Middlebury and returned to Beltsville after failing to thrive in Vermont. In another, lambs were transferred from Middlebury to Beltsville, and their performance compared with that of animals born and raised at Middlebury. In the first comparison, ewes of all ages were lighter at Middlebury than at Beltsville before leaving and after their return. Lambing percentages were also generally lower at Middlebury. There were no important differences in birth weights at the two locations but weaning weights were generally lower at Middlebury, the average difference being about 10 pounds. Fleece lengths and weights were lower in all age groups at Middlebury. In the second set of comparisons weaning weights were not available but there were no consistent indications of differences in performance at Middlebury and Beltsville with the exception that ewes at Middlebury were heavier in all age groups for which data were available. The animals used in the second set of comparisons were of a larger, more rugged type than those used in the first set, and may have been better adapted to conditions at Middlebury. Other possible factors affecting the results are discussed. The findings indicate the importance in livestock production of variations in adaptability to environment and point to the need for greater attention to such problems in animal husbandry research.

THE RELATION OF FACE COVERING TO LAMB PRODUCTION IN RANGE RAMBOUILLET EWES. Clair E. Terrill, United States Department of Agriculture.

Previous work has shown that Rambouillet ewes with open faces produce more pounds of lamb than those with covered faces. Because these results indicated a significant economic importance for face covering, this study was extended using the lifetime lamb production of 798 Rambouillet ewes born during the years from 1938 to 1940 at the Western Sheep Breeding Laboratory, Dubois, Idaho. Ewes with open faces produced 11.2 more pounds of lamb per year during their lifetime than those with covered faces. Ewes with partially covered faces produced 7.7 more pounds of lamb per year than those with covered faces. These differences occurred in spite of three periodic clippings around the eyes of all ewes subject to wool blindness. The advantage of open-faced ewes in lamb production was apportioned to specific phases of reproduction. About 46 percent of the advantage of open-faced ewes was due to a greater number of lambs born per ewe lambing; 26 percent was due to higher weaning weights; 19 percent was attributed to a higher proportion of the open-faced ewes becoming pregnant; and 9 percent was due to greater viability to weaning of offspring from the open-faced ewes as compared to those with covered faces. The greatest advantage for open-faced ewes was found at 3 years of age followed in order by 2, 4, 6, and 5 years. These results confirm previous work and emphasize the economic importance of open face in range sheep.

THE HERITABILITY OF MILK AND BUTTERFAT PRODUCTION AND PERCENTAGE OF BUTTERFAT IN AYRSHIRE CATTLE. W. J. Tyler and George Hyatt, Jr., West Virginia University.

Data on the production of 6888 daughters and mates of 374 Ayrshire sires were used in this study. All milk and butterfat records were converted to a 305-day mature equivalent twice-a-day milking basis. Twice the intra-sire regression of daughter’s production performance on dam’s performance was used to estimate the heritability of differences in single unselected records of milk and butterfat and the percentage of butterfat. The estimates were 31.28 and 55 percent respectively. The observed phenotypic relationships between these vari-
ables for the same cow were 0.93 between milk and butterfat production, −0.14 between milk production and percentage of butterfat, and 0.23 between percentage of butterfat and butterfat production. The corresponding genetic correlations between these variables were 0.85, −0.20 and 0.26. The results of this study indicate that butterfat test is about twice as heritable as milk and butterfat production. Approximately 20 percent of the heredity that influences milk and butterfat production also affects the percentage of butterfat in the milk. On the other hand, about 85 percent of the animal's genotype that influences milk production also influences the production of butterfat.


The birth records and autopsy reports were analyzed from a flock of sheep for the three years 1945 through 1947. The flock contained the six breeds, Shropshire, Hampshire, Oxford, Rambouillet, Southdown, and Cotswold. During the period studied there were 312 pregnancies resulting in the birth of 483 lambs (including stillbirths). Of these 483 lambs, 136 died during the first two months for a mortality rate of 28.2%. No significant difference in mortality rate between years was found. The sex ratio at birth showed a larger percentage of males than females. Differences in mortality rate between sexes were studied and the percentage for ram lambs was found to be higher than that for ewe lambs. Mortality of twin lambs was 35% as compared to 20% of lambs from single births. A study of the post-mortem reports showed that unknown factors, pneumonia, overlaying and patent foramen ovale (open heart valve) were the most important causes of death. Over causes included injuries, bacteraemia, navel infection, coccidiosis, over-eating and freaks. The records indicate a difference in mortality rate between breeds and between offspring from different sires within breeds.

Extension Section

L. K. Bear, Chairman


The large roundworm of swine presents a serious problem in swine raising which is not always handled through sanitation alone. A very efficient method of removing this parasite of swine, through the inclusion of sodium fluoride or other soluble fluorides in the feed has been perfected and the development of this method is described. Data are presented on the effectiveness and safety for this purpose of various soluble fluorides. The use of a saline laxative in conjunction with a soluble fluoride has been found to increase the efficiency and also the safety of the treatment. The use of calcium-containing minerals or of milk in the pigs' ration during the treatment has been found to decrease the efficiency. Permission access to certain types of pasture has also been shown to lower the effectiveness to some extent.

A COMPREHENSIVE STUDY OF BRUISE LOSSES IN SWINE. Harold A. Henneman and Ralph May, Wilson & Co.

From March, 1946 to September, 1947, weekly tests were made on good and choice butcher hogs selected at random to determine, (1) the monetary loss per head slaughtered; (2) the age, location and cause of bruises; and (3) variation in bruising by seasons, weight of hogs and distance hauled. Both truck and rail lots were used in securing data on 1082 carcasses. Bruise trim was weighed and monetary discount recorded on trim and degraded cuts. Thirty-nine percent of the test hogs were bruised. Of the wholesale cuts, 25.5 percent of the hams were bruised; 15 percent of the fatbacks; 2 percent of the loins; 6.8 percent of the bellies, and 6.8 percent of the shoulders. Bruise causes were, 40.4 percent by cane, whip or club; 18.7 percent by kicking or prodding; 18.4 percent by crowding and trampling; 10.1 percent by fork, nail or puncture; 1.6 percent spreaders and 10.8 percent due to other causes; 48.6 percent of the bruises occurred on the farm before loading. Average monetary loss per head slaughtered due to bruising was 19 cents, of which 9 cents was trim and 10 cents degrading loss. Loss per
head bruised was 48 cents. Average losses on rail hogs was 19.4 cents per head and truck hogs, 18.6 cents per head. Hogs weighing 200 to 250 pounds had an average loss per head of 16.2 cents; 250 to 300 pounds hogs 20.4 cents; and 300 to 350 pounds hogs 23.8 cents. Hogs hauled 50–100 miles had an average loss of 11.2 cents per head; 100–150 miles, 17.3 cents and 150–200 miles, 21.6 cents per head.


The Michigan Sow Testing Program is in its third year. Over 800 litters have been weighed at weaning time. Each year it has been observed that the 10 high litters weigh about the same as the 30 low litters.

The Sow Testing Program has been a means of extension contacts to improve feeding and management in counties and communities where weaning weights have been low. There is an increasing interest in litter data in sale catalogs and a noticeable increase in sale value of good gilts with production data. A summary of the sow testing data for the three years and some of the effects it is having on swine production and extension methods is to be presented.

The Michigan Swine Breeders’ Association and Animal Husbandry Extension sponsor a Michigan Winter Swine Feeding Contest and Show. Pigs must be farrowed after August 1 and weighed in under 90 pounds of weight before November 15. Feed records must be kept on the group of pigs fed and the pigs must gain an average of 1.4 pounds daily to qualify for the show. The prize winning barrows are slaughtered and awards are also made in the Carcass Show. Having feeding records, placing on foot and in the carcass make this program very educational from production and marketing standpoints. The average feed-lot data and the effectiveness of this program from an extension standpoint are to be discussed.

Meats Section
D. E. Brady, Chairman

AN INDEX FOR ESTIMATING PORK CARCASS YIELDS. L. J. Bratzler, E. D. Farwell, and W. N. McMillen, Michigan State College.

In cooperation with The Detroit Packing Company individual weights and measurements were taken on 478 hogs from 17 breeds and crossbred groups. Slaughtering and cutting was done by packing company personnel and represented their normal methods. Through development of a specialized technique, it was possible to secure the data at five different two-hour cutting periods. The following data were tabulated on each hog: live weight; cold carcass weight; carcass length from aitch bone to first rib; weight of each of the primal cuts, trimmed loin, belly, skinned ham, and New York style skinned shoulder; and the weight of the fat back. A highly significant correlation coefficient of +0.820 was found between the yield of primal cuts from the carcass and the relationship of trimmed loin to fat back. Also a highly significant, although somewhat lower, correlation coefficient of +0.561 was found between the yield of primal cuts on a live weight basis and the relationship of trimmed loin to fat back. These results indicate that the trimmed loin—fat back ratio is a reliable index for estimating the yield of primal cuts from a hog carcass.

BACTERIOLOGICAL STUDIES RELATING TO THERMAL PROCESSING OF CANNED MEATS. C. E. Gross, John Morrell & Company.

Thermal resistance of putrefactive anaerobic spores in meat has been studied. Studies include determination of thermal resistance for spores: formed in laboratory media; formed in raw, pasteurized and sterilized meat; and normally occurring in meat. Curing agents in amounts permitted for use in federally inspected plants did not affect the level of heat processes required for sterilization. The thermal process for destruction varied directly as the concentration of spores. Salt inhibited germination of spores surviving thermal processes and was quite effective at a level of 3.33 percent. Spores surviving the thermal processes were shown
head bruised was 48 cents. Average losses on rail hogs was 19.4 cents per head and truck hogs, 18.6 cents per head. Hogs weighing 200 to 250 pounds had an average loss per head of 16.2 cents; 250 to 300 pounds hogs 20.4 cents; and 300 to 350 pounds hogs 23.8 cents. Hogs hauled 50–100 miles had an average loss of 11.2 cents per head; 100–150 miles, 17.3 cents and 150–200 miles, 21.6 cents per head.


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to be viable two and a half years later. The thermal resistance of spores is less when grown in raw meat or organs and increases when grown in either pasteurized or sterilized meats and organs. The average increase amounts to approximately three times. The effect was shown to be related to the substrate itself through repeated raising and lowering of resistance by transfer from media to media. These data correlate with studies on the processing levels necessary for sterilization of spores normally occurring in commercial meat and organs. The hazard of drawing conclusions of commercial significance from laboratory experiments is emphasized. These studies permit drawing conclusions of practical commercial significance.

SANITATION FROM THE SLAUGHTERING FLOOR TO THE CONSUMER.
C. H. Pals, United States Department of Agriculture.

Sanitary handling of meat involves attention to a wide variety of factors. Such a program should include provision for preventing contamination with harmful bacteria, molds and yeasts, insects, rodents, excreta from insects, rodents and other animals, harmful chemicals, hair, dust and other filth. Buildings and equipment should be so constructed to as permit them to be readily cleaned and maintained in a sanitary condition. Facilities should be provided which will include an adequate supply of hot and cold water under pressure, well distributed throughout all operating departments, adequate lighting which is well distributed and of good quality, and proper ventilation. The recent increase in the amount of meat and meat food products being packed in consumer-sized packages will decrease the contamination which results from the repeated handling of products. More attention should be given to using suitable protective coverings on all meat and product during the time it is being transported. Separate equipment of proper design for eviscerating and handling poultry and fish should be provided in retail stores. Persons handling meat should be free from communicable diseases and from conditions such as boils and infected wounds which might contaminate meat.

Nutrition Section

T. S. Hamilton, Chairman

THE ADEQUACY OF SYNTHETIC RATIONS FOR SWINE. G. C. Anderson and A. G. Hogan, University of Missouri.

Three Chester White pigs were allowed to nurse their mother for three days, and were then transferred to an artificial milk prepared by adding water to a synthetic diet. The synthetic diet contained all of the vitamins now recognized, including pteroylglutamic acid, but it contained no crude vitamin carriers. The pigs were subject to diarrhea at first, and grew at a moderate rate. During the last four weeks the pigs grew at a tremendous rate and the average weight at 8 weeks was 35.8 lbs. This trial was repeated, with some modifications, but with a lesser degree of success. The pigs were Spotted Poland Chinas and they were kept continuously on wide mesh screen floors. The average weight of the three pigs at 8 weeks was only 21.9 lbs., but they seemed reasonably healthy and thrifty. The difference in response of the two groups may have been due to differences in genetic makeup, or in the environment, or it may be the diet is not entirely adequate.

One of the Chester White pigs, a female, was retained and was carried through a reproductive cycle. She farrowed 11 living pigs, but became severely anemic, stopped lactating and died on the 55th day after farrowing. The 5 surviving pigs were reared on the synthetic diet with no difficulty and when 8 weeks old their average weight was 24 lbs. So far as can be determined now they are normal.

THE EFFECT OF THYROPROTEIN AND THIOURACIL ON THE GROWTH AND FATTENING OF SWINE. W. M. Beeson, F. N. Andrews, H. L. Witz and T. W. Perry, Purdue Agricultural Experiment Station.

In a preliminary investigation to determine the effect of thyroprotein and thioracil on swine, purebred Duroc pigs averaging 53 pounds were fed for 84 days on a basal ration composed of 69 percent corn, 20 percent wheat, 10 percent Purdue supplement 5 and 1 percent
to be viable two and a half years later. The thermal resistance of spores is less when grown in raw meat or organs and increases when grown in either pasteurized or sterilized meats and organs. The average increase amounts to approximately three times. The effect was shown to be related to the substrate itself through repeated raising and lowering of resistance by transfer from media to media. These data correlate with studies on the processing levels necessary for sterilization of spores normally occurring in commercial meat and organs. The hazard of drawing conclusions of commercial significance from laboratory experiments is emphasized. These studies permit drawing conclusions of practical commercial significance.

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THE EFFECT OF THYROPROTEIN AND THIOURACIL ON THE GROWTH AND FATTENING OF SWINE. W. M. Beeson, F. N. Andrews, H. L. Witz and T. W. Perry, Purdue Agricultural Experiment Station.

In a preliminary investigation to determine the effect of thyroprotein and thioruracil on swine, purebred Duroc pigs averaging 53 pounds were fed for 84 days on a basal ration composed of 69 percent corn, 20 percent wheat, 10 percent Purdue supplement 5 and 1 percent
minerals. Thyroprotein was mixed in the basal ration at levels of 0.0044 percent and 0.0088 percent and thiouracil was fed at a rate of 0.1 percent for six weeks and then changed to 0.0088 percent thyroprotein. Thyroprotein fed at the 0.0044 percent level had no significant effect on the rate of growth. The pigs receiving 0.0088 percent thyroprotein gained 26 pounds (P < 0.05) more in 84 days and required 10 percent less feed per pound of gain than the control group. Carcass measurements and weights of primal cuts were not significantly affected by thyroprotein when fed at the 0.0044 percent level; but when fed at the 0.0088 percent level, thyroprotein produced significantly longer carcasses, heavier bellies and heavier picnic shoulders. Feeding of thiouracil at 0.1 percent of the diet markedly retarded growth, reduced feed intake and caused the pigs to become very short and chuffy, sluggish, and to develop severe myxedema. Symptoms of myxedema were characterized by thickened skin, brittle and coarse hair, loss of hair in abdominal region, puffy legs, slow gait and asthmatic breathing. Due to the severity of the myxedema at the end of the sixth week, the thiouracil was replaced with 0.0088 percent thyroprotein. After one week on thyroprotein the symptoms of myxedema began to disappear and the hogs became more active and showed a marked increase in gain and appetite.


The metabolic nitrogen of the feces, consisting of body constituents excreted with indigestible constituents of the feed in the feces, has heretofore been used merely in correcting apparent digestion coefficients to true digestibility. However, the materials containing this fraction of the fecal nitrogen must be replaced in the animal body if its integrity is to be preserved. Furthermore, its replacement from the food supply cannot be presumed to be 100 percent efficient. Hence, the metabolic fecal nitrogen becomes an item in the nitrogen requirement of the animal, an item that has not previously been considered. Since the metabolic fecal nitrogen varies with the dry matter consumed, and hence is greater the greater the fiber content of the ration for a given net energy requirement, this item in the total protein requirement is largest for rations high in fiber, such as those derived from poor quality roughage. In the immature ruminant in which the growth of new tissue is at its highest rate, some 20 percent of the requirement of truly digestible (metabolizable) protein is used in the replacement of the metabolic fecal loss, while at maturity over 60 percent of the total requirement is determined by this factor. This revision of the estimate of the protein requirement of ruminants by the factorization method brings the estimate into close agreement with experimental results obtained by feeding trials designed to determine absolute protein requirements for maximum growth.


A prairie hay meadow was divided into four series of plots and the series have been harvested the third week in June, July, August and September each year for three years. Hay cut in June had an average yield of 0.91 tons per acre while the areas cut in July averaged 1.17 tons and the August and September areas averaged 1.07 tons. The distribution of rainfall had an influence on the annual yield and composition. The crude protein content of the hay and its apparent digestibility tended to decrease as the season advanced. The July hay was found to have the highest total digestible nutrient value per acre when fed to yearling steers. The August hay ranked second in total feeding value per acre while June hay was the most valuable per pound. Prairie hay that was put up without getting wet lost approximately one-half its carotene the first month of storage but still contained an appreciable amount after being stored six months. The chemical composition of second-growth grass exhibited the same characteristic changes with age that were shown by first-growth grass.

Pigs removed from the mother at birth and placed on a synthetic milk containing all known vitamins and with plasma or serum as colostrum substitutes failed to survive longer than 22 days. It was found that pigs fed no colostrum substitutes such as serum or plasma died very shortly after birth. This finding indicates that colostrum and serum or plasma contain something which is necessary for the survival of the pig. Indications were that plasma was superior to serum as a colostrum substitute for the newborn pig. A severe diarrhea developed with all pigs fed synthetic milk. The pigs gradually became unthrifty in condition and developed a dark exudate around the eyes which often cemented the lids together. The results obtained indicated that the ration used was inadequate. The addition to the ration of crude casein, lactose, 1-20 liver powder, or an anti-pernicious anemia liver extract was of no apparent benefit in prolonging life or improving the appearance of the pigs. The use of the following therapeutic agents was of no benefit in controlling the diarrhea that developed or in prolonging life: Penicillin, sulfathalidine, sulfamethazine and kapectate.

The Need and Interrelationship of Pteroylglutamic Acid, Erythrocyte Maturation Factor, Biotin, and Other Vitamins for the Young Pig. T. J. Cunha, R. W. Colby, L. K. Bustad and C. E. Lindley, State College of Washington.

A basal purified ration containing sucrose, casein, lard, minerals, A, D, E, K, C, and the 6 B-complex vitamins (thiamine, riboflavin, niacin, pyridoxine, pantothenic acid, and choline) was used. The following rations were fed: Basal, Basal+sulfasuxidine, Basal+sulfasuxidine+folic acid, Basal+sulfasuxidine+E.M.F., Basal+sulfasuxidine+folic acid+biotin, Basal+10% alfalfa, Basal minus pantothenic acid, and Basal minus pantothenic acid+biotin. After 86 days on experiment a folic acid antagonist was added to half the pigs fed sulfasuxidine. The addition of sulfasuxidine to the basal ration for 86 days was unsuccessful in producing a folic acid deficiency. The effect of adding a folic acid antagonist to the ration will be reported on. The addition of folic acid or an anti-pernicious anemia liver extract (E.M.F.) to the basal ration+sulfasuxidine resulted in biotin deficiency symptoms showing up much sooner and developing more severely than where the Basal+sulfasuxidine alone was fed. The addition of biotin to a pantothenic acid deficient ration resulted in pantothenic acid deficiency symptoms showing up sooner. Data will be reported on weight gains, efficiency of feed utilization, deficiency symptoms, and hemoglobin and other blood components observed in all lots of pigs.

Copper Metabolism with Relation to Alkaline Blood Phosphatase and Blood Ascorbic Acid. George K. Davis and Harry Hannan, Jr., Florida Agricultural Experiment Station.

In studies with copper deficient Devon cattle, it was observed that the alkaline blood phosphatase values increased as copper values decreased. Paralleling the increased phosphatase values, the blood inorganic phosphorous values rose from below 6.0 mg. percent to over 12.0 mg. percent. Accompanying this rise, the bones became brittle and in young animals many symptoms of ascorbic acid deficiency were present. Blood ascorbic acid changes have not been sufficiently marked to relate them to the changes observed in the animals. Copper administration quickly restored the phosphatase and blood inorganic phosphorous values to normal.


Fifteen gilts were used in this trial. The effects of adding folic acid alone and folic acid, biotin, p-aminobenzoic acid and inositol to a basal purified ration were studied. Alfalfa and
fish meal were used as a source of an unknown factor or factors. The purified basal ration used was composed of sucrose, casein, lard, minerals, A, D, E, K, C, and the 6 B-complex vitamins thiamine, riboflavin, niacin, pyridoxine, pantothenic acid and choline. The rations fed were as follows: Lot I, Basal; Lot II, Basal+pteroylglutamic acid; Lot III, Basal+pteroylglutamic acid, biotin, inositol and PABA; Lot IV, Basal+15% dehydrated alfalfa meal; and Lot V, Basal+5% fish meal. In lots IV and V the amount of casein used was decreased to compensate for the protein content of the alfalfa meal and fish meal added, thus equalizing the total protein content in all rations. Data will be reported on litter size, death losses, weaning weights, loss of weight by sows during lactation, and other pertinent information obtained.


Four groups of dairy cows, 8 to a group, were fed: (I) herd ration; (II) herd ration+10 gms commercial soya lecithin; (III) herd ration+one million I.U. of vitamin A, and (IV) herd ration+one million I.U. of vitamin A+10 gms. of commercial soya lecithin daily for a period beginning 4 weeks before and continuing until one week postpartum. Assays of blood plasma vitamin A and carotene; vitamin A, carotene and lecithin in milk were made at intervals up to 21 days postpartum. Liver vitamin A of 10 new-born calves from differently treated dams was also determined. The plasma-vitamin A level in the group I cows fell almost to the half of the normal level postpartum, while the level in groups III and IV remained fairly high, group IV being the highest. At 21 days postpartum the vitamin A levels in the blood of group IV was also the highest. The vitamin A in the colostrum of group III was almost double that of the control group and in group IV almost 4 times that of the control group. Lecithin also was highest in the milk of group IV cows. The highest level of vitamin and lecithin was maintained in the milk of group IV 21 days postpartum. The total liver storage vitamin A in the new-born calves from the control group was negligible; about 6000 micrograms in vitamin A supplemented group and about 12,000 in the calves from the vitamin A+lecithin supplemented cows. Three groups of 6 calves each were fed from birth to 7 days of age as follows: (I) colostrum, (II) skimmilk+25,000-35,000 I.U. vitamin A, (III) skimmilk+25,000-35,000 I.U. vitamin A+3-4 gms of lecithin. Every calf in group II developed scours from the 3rd day and died on the 7th day, while all the calves in groups I and III grew well with slight evidence of digestive disturbance.


Two years of sulphur feeding are reported as a control of death loss from enterotoxemia. In 1945-46, four lots of 500 lambs were fed. Two lots were self-fed and two lots hand-fed grain with alfalfa hay fed through panels. One self-fed and one hand-fed lot were fed inorganic sulphur in the amount of 2 per cent of the grain ration. The second year, eight lots of 135 lambs were self-fed to determine desirable levels of sulphur. The levels fed were 1/2 oz., 1 oz., and 1/2 oz. sulphur per lamb per day and were replicated. The death loss from this disease was 1 percent or less for self-fed and hand-fed lambs when sulphur made up 2% of the grain ration compared to 8% for self-fed and 6% for hand-fed lots when sulphur was not fed. Grain consumption and gains were considerably less when this amount of sulphur was fed. The death loss was less than 1%, 3%, and 6% when sulphur was fed 1/2 oz., 1/2 oz., and 1/2 oz. per lamb per day respectively compared to 11% when sulphur was not fed. The feeding of sulphur slightly lowered the grain consumption, the rate of gain, and the efficiency of the gain but did not influence carcass grade, or flavor of the meat. It is suggested that sulphur be fed in the amount of 1/2 oz. per lamb per day when self-fed with a grain ration. There is no explanation offered as to the manner in which the sulphur acts.


Plasma vitamin A and C determinations were made on a herd of 94 suckling pigs that
were suffering from a severe digestive disturbance. The pigs were divided into three groups according to their condition and the severity of their symptoms. The three groups were classified thrifty, unthrifty, and moribund. The respective average vitamin values were 0.277, 0.187, and 0.077 vitamin A per 100 cc. of blood plasma, and 0.85 mg., 0.66 mg., and 0.48 mg. vitamin C per 100 cc. of blood plasma. To measure the influence of the plane of nutrition on the vitamin A and C plasma levels two groups of weanling pigs were fed two different rations. The one ration contained a large amount of yellow corn with a limited amount of plant protein and no animal protein. The other ration was a well balanced ration containing both animal and plant protein. The blood plasma from the pigs fed the well balanced ration contained 0.1 mg. more vitamin C but no more vitamin A than the pigs receiving the poorer ration. The addition of 20 percent lactose and chlorobutanol (10 gr./100 lbs. feed) to a basal ration of corn, soybean oil meal, and ground alfalfa hay increased the vitamin A and C plasma levels. Feeding 100 mg. of crystalline vitamin C to newborn pigs immediately after birth increased the vitamin C plasma level more than 0.5 mg. Taking the pigs away from the mother and feeding them heated cow's milk produced an average decrease of 0.15 mg. in the plasma vitamin C level.

THE PROTEIN REQUIREMENTS OF GROWING FOXES. Lorin E. Harris, Charles F. Bassett, Leonard M. Llewellyn and John K. Loosli, United States Department of Agriculture and Cornell University, cooperating.

Diets as adequate as knowledge permits were fed to growing foxes at the following percentage levels of protein on a dry basis: 13, 16, 19, 22, 25, 28, 34, and 40. Fox pups were fed in such a way as to evaluate the protein requirements from 50 days of age (weaning time) to 161 days of age (end of fastest growing period) and from 161 days of age to 262 days of age (pelt ing time). Carcass analyses and balance studies were conducted during the above period. The animals were small in size on the lower protein diets. The minimum protein requirement (dry basis) for fox pups 50 to 161 days of age lies between 22% and 25%, and for 161 to 259 days of age it lies between 19% and 22%. In practice one should feed diets containing 25% to 34%, and 19% to 25% respectively.

RAISING NEW-BORN Pigs TO WEANING AGE ON A “SYNTHETIC” DIET, WITH ATTEMPT TO PRODUCE A PTEROYLGLUTAMIC ACID DEFICIENCY. B. Connor Johnson, Marian F. James and J. L. Krider, University of Illinois.

Two groups of ten baby Duroc-Jersey pigs have been raised to weaning age on a “synthetic” diet composed of casein, cerelose, lard, salts and vitamin. This ration was made up in water with the lard homogenized in to simulate milk. In order to inhibit intestinal synthesis of pteroylglutamic acid or unknown factors all animals received 3 gms. (2% dry basis) of sulfathalididine per liter of milk. The first group was started on the synthetic milk at 2 weeks of age and was carried for 6 weeks. These pigs averaged 2981 gms. at the beginning of the experiment and 14,830 at the end. This is a gain of 200 gms. per day. The second group was started on experiment at 4 days of age and was kept on for 7 weeks. Their weight averaged 1986 gms. at the start and 16,120 gms. at the close of the experiment. This is a gain of 288.4 gms. per day. Pteroylglutamic acid was omitted from the diet of 5 of the pigs in each of these groups in attempt to produce a deficiency of PGA in the baby pig. However, there was practically no difference in growth of the PGA free group as compared to the animals receiving PGA. The deficient groups showed no blood pathology of any kind, however, they did show definitely lighter colored hair coats.


Weanling pigs from sows kept in drylot were fed to weights of 75 pounds. In test A, the basal ration was 63.5% ground yellow corn, 34% expeller soybean meal, 0.5% fortified vitamin A and D oil, and 2% complex mineral mixture. In tests B and C, 15% of wheat flour
middlings replaced part of the corn and soybean meal. All rations contained 20% crude protein. The supplements fed and the average daily gains in pounds were as follows: test A (1) basal (0.30); (2) basal +6 crystalline B-vitamins (B₁, B₂, niacin, pantothenic acid, and choline) (0.94); (3) same as (2) +10% dehydrated alfalfa meal (0.80); and (4) same as (2) +0.5 mg. folic acid per pound of ration (0.89); test B (1) basal +6 crystalline B-vitamins (0.98); (2) same as (1) +10% dehydrated alfalfa meal (0.90); (3) same as (1) +1.5% liver extract (1.08); and (4) same as (1) +0.34 crystalline folic acid per pound of ration (1.05); test C (1) basal +6 crystalline B-vitamins (1.12); (2) same as (1) +pyracin, PAB, inositol, biotin, alpha tocopherol and vitamin K (1.06); (3) same as (1) +10% dehydrated alfalfa meal (1.00); (4) same as (1) +1.5% liver extract (1.23); (5) same as (1) +folic acid concentrate to supply 0.24 mg. of folic acid per pound of diet (1.09); and (6) same as (1) +5% Cerogras (1.11). Most of the basal pigs in test A became emaciated, listless, unthrifty, had rough coats, and severe diarrhea and 27% died. Blood of survivors averaged 7.0 grams of hemoglobin per 100 cc. and 5.1 million red blood corpuscles per ccm. Blood from the other groups had hemoglobin values of 10.0, 9.8, and 9.8 grams, and red blood corpuscle counts of 6.9, 6.7, and 7.1 million, respectively. The liver extract apparently supplied a growth factor(s) essential for optimum gains of pigs.


Two tests were made of the supplementary value of dehydrated alfalfa meal, condensed sardine fish solubles, and of combinations of alfalfa meal, fish solubles, menhaden fish meal, and dried corn distillers' solubles for pigs from weaning to 100 pounds in drylot. The basal diet was composed of 67% ground yellow corn, 6% meat scraps, 20.5% expeller soybean meal and 0.5% each of limestone, iodized salt and fortified vitamin A and D oil. All rations contained 20% crude protein. Pigs fed 4% alfalfa meal grew faster and required 13% less feed per 100 pounds gain than those fed the basal diet. With 10% alfalfa meal, gains were more rapid and economical than with 4% alfalfa meal. The combination of 4% alfalfa meal and 6% distillers' solubles was not improved by adding 3% menhaden fish meal. Two percent of fish solubles produced as well as 4% of this product and results at both levels equaled those from the addition of 10% alfalfa meal. Four percent of fish solubles produced as rapid gains as the combination of 6% alfalfa meal and 4% fish solubles. In the third test, five lots of weanling pigs were fed in drylot to 75 pounds to evaluate semi-solid fish and fish solubles. The basal ration (20% crude protein) was composed of 60% ground yellow corn, 33% expeller soybean meal, 5% dehydrated alfalfa meal, 2% of minerals, and irradiated yeast. The addition of 5% or 6% of semi-solid fish from Cod and Haddock, 3% of semi-solid Red Fish, or 2% sardine fish solubles to the basal ration increased gains slightly. The results with various fish by-products were similar.

MAGNESIUM DEFICIENCY IN RABBITS. H. O. Kunkel and P. B. Pearson, Agricultural and Mechanical College of Texas.

A purified basal diet has been developed for rabbits which is adequate in all known factors except magnesium. Feeding New Zealand White rabbits diets containing insufficient magnesium results in a symptom complex of hyperirritability, hypomagnesaemia, retardation or early cessation of growth, convulsive seizures, and death. Vasodilatation was not observed. Convulsive seizures induced by artificial auditory stimulus did not terminate fatally. Death occurred only after spontaneous convulsive seizures which generally were not preceded by the incoordinated running about which always preceded the induced seizures. When the diet contained 60 p.p.m. magnesium, retardation of growth occurred between the second and eighth week of experiment. Extreme emaciation was apparent in all animals maintained for an extended period on the deficient diet. In the later stages of deficiency rabbits became lethargic with little response to physical or auditory stimulus. The magnesium content of the blood, as determined by an improved method, continued to decrease throughout the entire experimental period reaching levels less than half of those of rabbits fed 450 p.p.m. magnesium in
the diet. Minimal levels in plasma (1.0 mg. of magnesium per 100 ml. as compared with control levels of 1.3 to 2.2 mg. per 100 ml.) were reached by the sixth week and remained at this level during the rest of the period. Data are available on the quantitative requirement of rabbits for magnesium and the effect of the calcium content of the diet upon this requirement.


Previous studies have shown that good growth resulted when tryptophane was added as a supplement to a low protein corn ration. However, all symptoms of niacin deficiency were not prevented with daily supplements of 200 mg. of d, l tryptophane per pig. In the present experiments a basal ration containing 14 percent protein made up of corn, 87; casein, 5.5; soybean meal, 5.5; mineral, 2; and liberal amounts of thiamine, riboflavin, pantothenic acid and pyridoxine were fed to a group of weanling pigs whose average weight was 22 pounds. In addition each pig received daily supplements of 1 gm. of d, l tryptophane. The growth of the pigs in this lot was not superior to that of the pigs which received the lower levels of tryptophane, but no symptoms of niacin deficiency were observed with the higher levels fed. The average daily gain for the pigs in this lot was 0.86 pounds per pig. When the casein content of the above ration was increased to 25 percent at the expense of the corn the animals grew very well and showed no symptoms of niacin deficiency. The pigs in this lot averaged 1.10 pounds gain in body weight per pig per day. The incorporation of 10 percent distillers' dried solubles in the above ration gave good growth and prevented symptoms of niacin deficiency from appearing. The average daily gain for the pigs in this lot was 0.71 pounds per pig. The feeding of 800 mg. of d, l tryptophane to niacin deficient pigs was not as effective as 100 mg. doses of niacin in the cure of the deficiency.


Phosphate fertilization of soybean hays grown on a Bladen type soil extremely low in phosphorus produced no significant change in composition as measured by standard feeding-stuffs analysis, which included calcium and phosphorus. This was also true of the Bull grass contaminant. Fattening trials and digestibility studies with lambs using soybean hay for roughage and raw soybeans for concentrate gave no significant differences either in weight gains or apparent digestibilities between feeds fertilized with phosphate and those not fertilized with phosphate. When cerelose replaced soybeans as the concentrate, lambs which received soybean hay fertilized with phosphate gained an average of 0.28 lb. daily per lamb as compared to 0.19 lb. for the non-phosphate group. This difference approached significance at the 5% level. Digestibility studies using soybean hay alone as well as with cerealse as the concentrate gave slightly higher digestibilities of all standard feed nutrients for phosphate-fertilized hays as compared to hays not fertilized with phosphate. Only ether extract, however, approached significance at the 5% level. Serum phosphate values of lambs fed phosphate-fertilized hay plus sugar were higher than those of lambs receiving non-phosphated hay plus sugar. Generalizations on the influence of fertilization on the nutritive value of plants for animals are not warranted at this stage of the investigations.

RAT AND PIG FEEDING TRIALS WITH GRAINS OF DIFFERENT PROTEIN CONTENT. L. W. McElroy and W. Lobay, University of Alberta.

Feeding trials were conducted to study the effect that variations in the protein content of grains may have upon growth when rations composed mainly of cereal grains are fed to weanling rats and pigs. Samples of grain containing less than 10% protein were arbitrarily classified as "low," those containing 12% to 13% as "medium" and those containing 16% or more as "high" protein grains. When such grains were fed to rats in rations in which
grain constituted the only source of protein, marked differences in growth response were observed. The results of a pig feeding trial showed that when a mixture of oats and barley constituted the only source of protein during the period from 30 lbs. to 200 lbs. live weight, the group fed high protein grains made an average daily gain of 1.07 lbs. and required 380 lbs. of feed per 100 lbs. gain. The corresponding figures for groups fed medium and low protein grains were 0.97, 405 and 0.87, 486 lbs., respectively. Comparison of these results with those obtained with groups supplemented with an arbitrary level of a mixed protein supplement without regard to the protein content of the grain in the basal ration, showed that protein supplementation resulted in increased rates of gain in all cases and that the reduction in total feed required per 100 lbs. gain, attributable to the use of protein supplement, was 129 lbs., 66 lbs., or 31 lbs. depending upon whether low, medium or high protein grains were used.


The results of three years' (1944, 1945, and 1946) work are reported comparing the feeding value of barn-dried hay, field-cured hay stored loose, and field-cured windrow-baled hay cut from the same field. The hay was fed as the only roughage, and concentrates were fed at the same rate to each group of cows. Thirty-six Holstein cows have been used in these trials. The average daily consumption of the various kinds of hay per cow was: barn-dried, 32.2 lbs.; field-cured loose, 32.3 lbs.; and windrow-baled, 31.3 lbs. The average daily 4% fat-corrected milk production on the barn-dried was 31.6 lbs.; field-cured loose, 31.4 lbs.; and windrow-baled, 32.0 lbs. The hays were sampled at regular intervals for carotene determination and federal grading. At the time of feeding the barn-dried hay has averaged approximately one grade higher than the other two types of hay. However, the carotene content of the barn-dried hay at the time of feeding was not enough greater than either the windrow-baled or field-cured loose hays to be of much practical significance. The carotene contents of the various hays expressed as micrograms per gram of dry matter were: barn-dried, 11.6; field-cured loose, 7.4; and windrow-baled, 7.1. The barn-dried hay had no more protein than the other two types of hay. The live weights of the cows were equally well maintained on the three kinds of hay.

BLOOD CALCIUM AND PHOSPHORUS LEVELS IN RANGE CATTLE. A. L. Moxon, Twila M. Paulsen and L. E. Johnson, South Dakota Agricultural Experiment Station.

Blood samples were taken from 88 head of range cattle over a period of 5 years for plasma calcium and plasma inorganic phosphorus determinations. These cattle were on controller summer grazing and wintering experiments. Forty head were on an Experimental ranch in Lyman Co. and 48 head were on the Range Field Station at Cottonwood in Jackson Co. The cattle at Cottonwood were bled in early spring, midsummer and late fall in 1942, '43, '45, and '46. The cattle in Lyman Co. were bled on seventeen occasions between Apr. 1, 1942 and Jan. 24, 1945. Phosphorus showed a range of 1.19 to 9.57 mg. per 100 ml. plasma with a mean value of 4.77 mg./100 ml. in samples from cattle in Lyman Co. Calcium values ranged from 4.8 to 19.8 mg. per 100 ml. plasma with a mean value of 9.9 mg./100 ml. Levels for Cottonwood cattle were similar. Calcium and phosphorus levels as related to season and management practices will be discussed.

EFFECT OF THIOURACIL AND PROTAMONE ON GROWING SWINE. M. E. Muhrer, D. R. Warner, Z. Palmer and A. G. Hogan, University of Missouri.

Four crossbred pigs received the basal ration and eight similar pigs received the same ration with the addition of 0.05 and 0.1% of thioracil. In a 28 day period of ad libitum feeding the pigs that received 0.1% thioracil required 24.4% less feed per unit gain in weight than did the controls. Six of the pigs were slaughtered, and analyzed for water, fat, protein and ash. The thioracil-fed pigs contained about 3% more water and about 3% less fat than did the controls. The appearance of the live animals indicated that the thioracil-fed pigs contained the larger percentage of fat but that was not the case. They actually contained
about 3% less fat and 3% more water than did the controls. Samples of fatty tissue (leaf lard) and of muscle (lean of loin) from the thiouracil-fed pigs, both contained a lower percentage of fat than did the controls. The lean of loin from the thiouracil-fed pigs contained 71.9% water, 5.7% fat, 21.8% protein and 1.09% ash. The lean of loin from the controls contained 69.1% water, 8.5% fat, 21.9% protein and 1.11% ash. The dressing percentage of the two groups was the same, 73%. In preliminary trials protamone-fed pigs did not gain as rapidly or as economically as either the control or thiouracil-fed pigs.


In an attempt to determine if ewes on pasture during the summer could successfully complete gestation and lactation on a very low carotene ration, a group of ewes were fed the following ration for two successive winters: Oat straw, oats, soybean oil meal, and CaCO₃. A control group was fed alfalfa hay and oats. During the second season additional ewes were added to the low carotene group and given 25,000 I.U. of vitamin A weekly. Blood plasma vitamins A and C and hemoglobin were determined periodically on the ewes and their lambs, and vitamins A and C on ewes' milk. Part of the ewes and their lambs were sacrificed at 8 weeks after lambing, and the remainder after 1 month on pasture, to determine liver vitamin A reserves. The results show that the straw ewes did not maintain their weight as well as the hay ewes. There was no appreciable difference in the growth of single lambs, but in the twins the hay group was markedly superior. Although there was no significant difference in the vitamin A concentration of the milk, the blood plasma level of both ewes and lambs was higher in the hay group. Vitamin A administration did not increase the blood plasma of the ewes or their lambs over the straw group. However, liver analyses of the ewes show the straw ewe reserves were much lower than those of the hay ewes, with the ewes receiving vitamin A, intermediate. Hemoglobin at birth in all lambs was high and decreased sharply the following week.

EFFECT OF VARYING THE ENERGY SOURCE ON ACID PRODUCTION BY SOME MIXED CULTURES OF SILAGE ORGANISMS. R. L. Salsbury and C. B. Bender, Rutgers University.

Water extracts obtained from two molasses silages at various stages of fermentation were inoculated into media each of which contained a different carbohydrate as energy source. Production of acid was measured by titration of the cultures after four days incubation at thirty degrees Centigrade. Over the period of the experiment, differences were obtained in the average production of acid on the different media. Generally, arabinose gave greater acid production than xylose, sucrose greater than lactose, and levulose and dextrose greater than galactose. The alcohols, glycerol, mannitol and sorbitol showed lower acid production than the foregoing, and mannitol and sorbitol generally produced more acid than did glycerol. The polysaccharides inulin, dextrin, and soluble starch were fermented to produce approximately similar amounts of acid, no definite preference of carbohydrate being apparent here.

A STATISTICAL STUDY OF DATA ON APPARENT DIGESTIBILITY OF HAYS BY CATTLE. Burch H. Schneider, Helen M. Pavlech and Henry L. Lucas, West Virginia University and North Carolina State College.

Data from 382 digestion trials with cattle on 13 kinds of hay and published by 64 authors were analyzed statistically. There were significant differences between the different hays in digestibility of all nutrients. There were significant differences between protein and N.F.E. composition of the hays studied, but the variation within each kind of hay was so great that the differences in percentages of crude fiber and fat between the different kinds of hay were not significant. Co-variance adjustments of the digestion coefficients and of T.D.N. for chemical composition did not remove the significant differences for digestibility that exist between hays or between investigators. Multiple regression studies showed that there were significant relationships between the chemical analysis and the digestion coefficients of nu-
erts. Thus the proximate composition can be used to predict the digestibilities of nutrients. These predictions are more accurate than fixed average coefficients when applied to a sample or to an average composition of a feed. A different prediction equation is needed for each kind of hay, as follows:

\[ K = C_K - 1.81 \times J_0 + 3.38 \times P_0 \]

\[ R = C_R - 1.13 \times J_0 + 0.58 \times N_0 \]

in which \( K \) and \( R \) are the predicted values and \( C_K \) and \( C_R \) the constants for the digestion coefficient of crude protein and the T.D.N., respectively. \( J_0 \), \( N_0 \), and \( P_0 \) are the percentages of protein, N.F.E., and fat in a sample or average. The constants \( C_K \) and \( C_R \), for a few of the hays are as follows: alfalfa 34, 14; alfalfa clover timothy mixed 26, 13; red clover 24, 17; clover grass mixed 28, 17; soybean 30, 15; timothy 24, 17.

**THE VALUE OF DEHYDRATED SWEET POTATOES AS A CARBOHYDRATE FEED FOR FATTENING STEERS.** B. L. Southwell and W. H. Black, Georgia Coastal Plain Experiment Station and United States Department of Agriculture.

Sweet potatoes grow well in the lower southeast, are relatively more productive than corn and offer possibilities as an abundant and cheap source of carbohydrate feed. The mature sweet potatoes are shredded for drying. They are dried either by spreading in a thin layer on a hard surface for two days or in artificial dehydraters. The dried product stores easier in the lower Southeast than shelled corn. In dry lot steer feeding tests of 140 days length dehydrated sweet potatoes proved less palatable and more laxative than corn when it replaced all the corn in a grain mixture of 6 parts cracked shelled corn and 1 part cottonseed meal. A grain mixture of 3 parts dehydrated sweet potatoes, 3 parts cracked shelled corn and 1 part cotton seed meal gave slightly higher daily gains than corn and cottonseed meal. The steers fed the mixture of potatoes and corn ate somewhat more feed, showed a little better finish and sold for a little higher price than those on the other grain mixtures. Ground snapped corn proved somewhat superior to dehydrated sweet potatoes as a steer feed when used as the only carbohydrate. The sweet potatoes used in these tests (Porto Rico variety) produced a slightly yellow fat in the beef carcasses.

**STUDIES ON THE VALUE OF WHEY PRODUCTS IN EARLY CALF NUTRITION.** R. F. Van Poucke, F. W. Hill, R. A. Zuercher and N. E. Rodgers, Western Condensing Company.

Experiments were conducted over a two year period to determine the feasibility of substituting a whey product for whole milk in early calf nutrition. Holstein calves, 3-4 days of age, were compared on the following treatments during a 112 day period: I. Whey product plus commercial calf meal and, II. Whole milk plus commercial calf meal. Mixed hay and salt were fed ad libitum throughout the trials. The average daily gains were 1.84 and 1.81 pounds, with 2.53 and 2.21 pounds of milk solids plus calf meal required per pound of gain, respectively. During the trial 84.5 and 147.3 pounds of milk solids were consumed per calf. These observations indicated that whey product can successfully supplant whole milk in early calf nutrition and promoted trials comparing the value of a 30% vegetable protein calf meal with a 20% protein meal containing 5% animal protein when fed in combination with the whey product. Average daily gains were 1.49 and 1.45 pounds respectively, with 2.41 pounds of milk solids plus calf meal required per pound of gain. Amounts of 114.8 and 119.9 pounds of milk solids were consumed per calf. Combined results of all tests indicate that milk solids are associated with the efficiency of utilization of feed for early growth of calves. Whey product in combination with vegetable protein calf meal produced gains as efficiently as in combination with animal protein meal. Mortality in all experiments was less than 2%.

**THE EFFECT OF THE PLANE OF NUTRITION AND ASSOCIATION ON THE DIGESTIBILITY OF FOOD STUFFS BY RUMINANTS.** Cyril J. Watson, Canadian Dept. of Agriculture.

The effects of the plane of nutrition and association on the digestibility of feedstuffs by ruminants have been studied over a period of fifteen years. For both factors the investigation included roughages, succulent feeds, grains and concentrates. They were fed singly and in various combinations. It was concluded that for most feedstuffs these two factors either had no effect upon digestibility or, where differences existed, they were of small magnitude.

Four lots of grade Shropshire ewes (3 ewes per lot 1946, 8 per lot 1947) were fed as follows: Lot I—Basal of 4 lb. fair to poor mixed legume and grass hay, 0.25 lb. corn, and iodized salt; Lot II—Basal plus 1% bone meal in the grain, and mineralized salt; Lot III—Basal plus 0.25 lb. soybean oil meal; and Lot IV—Basal plus 0.25 lb. soybean oil meal, 1% bone meal in the grain, and mineralized salt. The mineralized salt contained CoSO₄, CuSO₄, MnSO₄, Fe₂O₃, and KI. The corn ration was increased to 0.7 lb. for Lots I and II, and to 0.75 lb. for Lots III and IV on May 24, 1946, and immediately after lambing in 1947. Lambs were creep fed the ewe grain mixture ad lib. April born lambs from these ewes were given a drench of 4,000 larvae of the common stomach worm (Hemonchus contortus) on June 20, 1946, and July 14, 1947. About 6 weeks later a larger drench (40,000 in 1946; 15,000 to 20,000 in 1947) was given. Data will be presented showing the effect of the ration and the worm infections on growth, feed consumption, fecal egg count, post-mortem worm count, hemoglobin, blood plasma vitamins A and C, plasma protein, and inorganic phosphorus of these lambs. Results of 1946 experiment and preliminary observations for 1947 indicate that lambs receiving these minerals passed worm eggs earlier and had larger numbers of worms at autopsy. The higher protein level seems to exert a protective effect.

NUTRITION STUDIES WITH SWINE. I. SUPPLEMENTED MILK DIETS FOR YOUNG PIGS IN CAGES. J. A. Weybrew, H. A. Stewart, W. J. Peterson and Gennard Matrone, N. C. Agricultural Experiment Station and U. S. Plant, Soil, and Nutr. Laboratory.

Baby pigs have been successfully raised in screen-floored cages from 1 day of age to normal weaning age of 8 weeks on milk diets supplemented with minerals and cod-liver oil. Three essentially whole milk diets were compared: Diet A, evaporated milk; Diet B, reconstituted non-fat milk solids plus butter; and Diet C, reconstituted whole milk powder. Creamery butter supplemented the skim milk diet in the ratio of 1 part butter to 3 parts skim milk solids. The solids content of the milk slurries ranged from approximately 17 wt.-vol. percent at the start to 40 percent (except for Diet A, which never exceeded the solids content of the evaporated milk) for the last three weeks of the trial. In general, the pigs made excellent gains on all diets during the first 5 weeks. At 8 weeks, the mean weights were 35.1 ± 3.0, 45.8 ± 2.1, and 48.6 ± 1.4 pounds for the three diets, respectively. On diets permitting more rapid gains, the pigs performed more uniformly; the respective coefficients of variation at 8 weeks were 23.8 percent, 10.1 percent, and 8.2 percent. At weaning age, the hand-fed pigs on an average weighed 9.6 pounds more than a comparable number of similar pigs that had been suckled by their dams on good pasture with access to a self-feeder. Mortality during the experiment was 12.2 percent.


Previous experiments have shown the value of using small grains such as oats and wheat in place of corn for young pigs suffering from chronic symptoms of digestive disturbances or enteritis. Further work on this problem indicates that at least part of the growth promoting ability of the small grains for this condition in contrast to corn is due to the low amounts of the amino acids, tryptophane and lysine in corn. The average daily gain for pigs affected with chronic symptoms of enteritis on a corn basal ration supplemented with soybean oil meal was 0.13 lb. for a 4-week growth period. Pigs showing the same clinical symptoms as the controls gained at the rate of 0.44 lb. daily on an oats-wheat basal ration also supplemented with soybean oil meal. When the corn basal ration was supplemented with tryptophane and lysine, the daily growth rate was 0.40 lb. daily or almost equal to that on the oats-wheat ration. A 2 percent salt mixture containing all the minerals needed in animal nutrition was added to the corn basal ration and produced a daily gain rate of 0.22 lb. or some improvement over the controls. All 4 rations contained about the same amount of protein on a percentage basis. Growth rates, tryptophane and nicotinic acid values are given.
EFFECT OF WINTER SUPPLEMENTATION ON SUBSEQUENT GAINS OF BEEF STEERS ON GRASS AND IN THE FATTENING LOT. W. E. Connell, S. S. Wheeler and R. C. Tom, Colorado A. & M. College and Experiment Station.

Three years experiments were conducted in Northeastern Colorado to determine the effect of adding one pound of cottonseed meal or soybean meal to the basal wintering ration of sorghum roughage for steer calves on their current and subsequent gains. A comparison was also made between cane silage and chopped cane fodder for wintering calves. The addition of the protein supplement to the wintering ration stimulated appetite and added 85 pounds per head to the gains. The extra feed required to produce this gain cost $6.65 or 7.8 cents per pound added gain. At the end of the six months summer grazing, the spread in gains was reduced to 37 pounds, increasing its cost per pound to 18.1 cents, while by the end of the following fattening period the extra gain was narrowed to 30 pounds and cost 22.3 cents per pound. Based on Morrison's energy tables and expressed in terms of feed replacement, the value of the protein supplement fed during the winter was increased seven times. However, this replacement value was lost by the end of the summer grazing period. From a practical feeding standpoint, it would pay to add a protein supplement to the wintering ration if the calves were sold at the end of this period, but its value is questionable if the calves are carried on through the grazing and fattening periods. Cane silage and chopped cane fodder, considered on a dry matter basis, were equal in feed value.

PRODUCING MEAT ON WHEAT PASTURE WITH AND WITHOUT SUPPLEMENTAL FEEDING. Rufus F. Cox, Kansas Agricultural Experiment Station.

Repeated tests show little advantage for feeding grain, roughage, protein supplement or ground limestone to lambs on wheat pasture, unless digestive trouble is being experienced. Dry roughage helps to prevent digestive disorders among lambs on wheat pasture. Lambs given access to a Milo stalk field (combined) while on wheat pasture gained more than those receiving wheat pasture alone. Lambs were grazed on wheat which had 125 pounds per acre of treble superphosphate applied at the time of sowing. A very slight increase in gain accompanied the grazing of the fertilized wheat. In this case, however, the soil was not deficient in phosphorus in the first place. The blood of the lambs grazed on phosphated wheat pasture was nearly 20% higher in phosphorus but virtually no different in calcium and potassium content from the blood of lambs grazing unfertilized wheat. When lambs have access to good wheat pasture furnishing all the forage they will eat, all nutrients apparently are sufficient in amount to meet their needs, and in case of certain mineral elements, the supply is often three times the requirements.

USING PASTURE AND ROUGHAGE IN PRODUCING BEEF. A. J. Dyer, University of Missouri.

By making maximum use of good roughage in winter and good pasture in summer, less than 10 bushels of grain were required to develop choice weanling calves to 1190 pound 2-year-old steers carrying sufficient finish to top the St. Louis market on the date they were sold. In three successive trials, very similar results have been obtained. The three things essential for the success of this system of management are (1) well bred cattle, (2) an abundance of good roughage in winter, and (3) an abundance of good pasture in summer. Producing beef with very little grain fits well into pasture farming practiced in Missouri.


Six grade Hereford steers and fifteen wethers out of western ewes and by Southdown rams were used in these experiments. Four series of experiments were conducted with the
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By making maximum use of good roughage in winter and good pasture in summer, less than 10 bushels of grain were required to develop choice weanling calves to 1150 pound 2-year-old steers carrying sufficient finish to top the St. Louis market on the date they were sold. In three successive trials, very similar results have been obtained. The three things essential for the success of this system of management are (1) well bred cattle, (2) an abundance of good roughage in winter, and (3) an abundance of good pasture in summer. Producing beef with very little grain fits well into pasture farming practiced in Missouri.


Six grade Hereford steers and fifteen wethers out of western ewes and by Southdown rams were used in these experiments. Four series of experiments were conducted with the
steers, each series consisting of a digestion trial run on one group of three steers at the same
time that the remaining steers were on pasture and harnessed for fecal collection. The steers
on digestion trial received fresh bluegrass clipped daily and similar in stage of maturity to blue-
grass consumed by the group on pasture. The groups of steers were reversed in each succeed-
ing series. Three additional digestion trials were conducted with the steers without com-
parable pasture trials. The wethers in groups of three were placed on different forages, and
several alternating digestion and pasture trials were conducted with each group. Digestion
coefficients were determined both by the usual method and by the lignin ratio technique of
Ellis, Matrone and Maynard. Satisfactory agreement was obtained between coefficients de-
termined by the two methods when experimental conditions were carefully controlled. The
coefficient of digestibility of dry matter by the steers varied in a straight line relationship
from 80.0% to 74.0% as the maturity of the forage increased, as indicated by progressive change
in: (a) lignin content from 3.9% to 9.1% (dry basis), (b) crude fiber content from 22.1% to
36.0%, and (c) protein content from 18.8% to 12.9%. The digestibility of all feed constitu-
ents followed the pattern of dry matter digestibility. Comparison of dry-matter digestibility by
all lambs on all forages with the composition of the forage resulted in high negative correlation
with lignin content, but lower correlation with protein and crude fiber content.

AGE, WINTER GAIN AND GRAZING METHODS AS FACTORS IN STEER PRO-
DUCTION FROM PASTURE. C. M. Kincaid, George W. Litton and R. E. Hunt, Virginia
Agricultural Experiment Station.

Two ages (yearling and two-year old feeders), three winter feeding levels (maintenance:
7/2 pound and 1 pound per day liveweight gain, approximately) and different methods of
grazing were compared in a factorial arrangement. On the average the older steers had 3/4 of a
grade better carcasses and one percent higher dressing percent. Annual gain, carcass grade
and dressing percent improved as winter gain increased. The regression of summer gain on
winter gain from differences among feeding levels and from differences within subclasses
were -0.69 and -0.42, respectively. The regression of fill during the first 24 hours on pasture
on winter gain, estimated in 1946, yielded a regression coefficient of -0.19. When adjustment
was made for differences in fill among feeding levels, the two estimates of regression of sum-
mer gain on winter gain were not greatly different. As acres of pasture per steer increased
from 1.78 to 3.92 acres, average gains per acre of pasture decreased and average gains per steer
increased. Because heavy grazing reduced the gains per steer and also reduced the length of the
grazing season, an intermediate grazing rate (approximately 2.5 acres per steer) seemed to be
the optimum when rainfall was about equal to or above the long time average. In one year
(1944) with deficient rainfall in July and August, light grazing (3.67 acres per steer) produced
significantly greater gains per steer than the intermediate rate.

A COMPARISON OF THE PRODUCTION FROM RANGE COWS AND YEAR-
LING STEERS. J. H. Knox and Marvin Koger, New Mexico Agricultural Experiment Station.

For eleven years records of gains made by nearly 450 steers for 12 months after weaning
have been kept along with records of the annual production of breeding cows on similar
range. The average gain per head made by the steers equalled 85 percent of the average calf
production from cows with a 90 percent calf crop. Since it was impractical to measure forage
consumption directly in the extensive semi-desert pastures used, the amount of feed eaten
was calculated from the estimated maintenance requirement and the energy content of the gain
produced. By this method the forage consumption of yearling steers which weighed 429 pounds
at weaning and 745 pounds a year later was calculated to be 65 percent of that of 950-pound
breeding cows producing a 90 percent calf crop with calves weighing 424 pounds at weaning.
The production by the steers per unit of feed consumed was calculated to be 152 percent of
that of breeding cows under similar conditions. A drought of one year reduced the production
from steers slightly more than cows during the current year, but the net result was favorable
to the steers because of the lowered calf crop in the year following the drought.
COMPARISON OF VARIOUS METHODS OF USING IMPROVED PERMANENT PASTURES FOR FATTENING STEERS. J. I. Miller, F. B. Morrison and J. E. Briggs, Cornell University.

Two series of trials were conducted during the pasture seasons of 1944, 1945, and 1946. The pastures used had been plowed and seeded with proper fertilization in 1940 and at the time of the trials had a ground cover consisting of approximately 66 percent Kentucky bluegrass, 7 percent other grasses (mostly timothy and reedtop) and 13 percent clovers (wild white and Ladino). In one series of trials yearling steers purchased in the spring, grazed on pasture alone, and sold in early October made an average daily gain of 1.32 lbs. They had the lowest cost per cwt. gain, the lowest selling price per cwt., and the lowest net return of the methods of feeding studied. Similar steers hand-fed a total of approximately 1200 lbs. ground corn per head while on pasture made an average daily gain of 2.15 lbs., sold for $3.89 more per cwt. and were decidedly more profitable. Other steers were grazed on pasture alone until mid-August or until October 30 and then short fed in dry lot. Each method of feeding was more profitable than fattening on pasture alone but less profitable than grain feeding on pasture. In the second series of trials calves were purchased in the fall, wintered with and without grain, then pastured without grain until mid-August and finished in dry lot. These steers were more profitable than the yearling steers purchased in the spring that were similarly fed during the grazing and finishing periods.

COMPARING SYSTEMS OF EARLY LAMB PRODUCTION INCLUDING PASTURE VERSUS ROUGHAGE FOR WINTERING EWES AND CREEP FEEDING VERSUS NO GRAIN FOR LAMBS. C. V. Ross and A. J. Dyer, University of Missouri.

Strong lambs were produced by 26 Northwestern ewes, which during pregnancy had only bluegrass pasture except during periods when weather conditions made it impossible for them to graze. Twenty-six similar ewes fed solely on legume hay and oat straw in dry lot produced lambs slightly smaller than those produced by ewes on pasture. The difference in weight was not statistically significant. Neither was there a significant difference in the gains made by the two lots of ewes during pregnancy nor in the fleece weights. A few abnormalities occurred among ewes wintered in dry lot: one lamb was born without a lower jaw and three ewes aborted. Of those aborting, one died. Analysis for vitamin A revealed an adequate amount stored in the liver. Thirty-four percent of the creep fed lambs and thirty-five percent of those not receiving grain were marketed by June 19. By August 13, ninety-six percent of the creep fed lambs had been marketed while only fifty-eight percent of those not creep fed had been marketed.

METHODS OF SUPPLYING PHOSPHORUS TO CATTLE. L. H. Tash, J. M. Jones, and W. H. Black, Experiment Station, Texas A. & M. College, and United States Department of Agriculture.

A test to determine methods of supplying phosphorus to range cattle proved that the use of bonemeal in self-feeders; the use of a soluble phosphate in the water supply; and pasture fertilization, provided ample moisture is received, will prevent aphosphorosis. Weaning weights of calves from cows that received supplement, or that were grazed on a pasture fertilized with superphosphate, averaged from 50 to 60 pounds more than of calves from cows that received no additional phosphorus. Cows at the time the calves were weaned averaged over 200 pounds more for the groups receiving additional phosphorus. The history of the control group was characterized by numerous cases of extreme aphosphorosis among the lactating cows, low inorganic phosphorus content of the blood, failure to attain maximum development, and reduced fertility. Of the supplement-fed groups there was some advantage in favor of the group receiving a soluble phosphate compound through their water supply over the group receiving bonemeal. The pasture fertilized with 200 pounds of triple superphosphate per acre was stocked at a 50 percent higher rate than the pasture utilized by the other groups. This
group initially made the best record, then, as grazing conditions became progressively worse, the inorganic phosphorus content of the blood of the lactating cows dropped to about the same low level as that in the blood of the lactating cows of the control group. The cattle lost weight rapidly and numerous symptoms of phosphorosis appeared.

BALANCED NUTRITION FOR RANGE LIVESTOCK—EMPHASIZING VITAMIN A. R. C. Tom,Ralston Purina Company.

For many years the need of vitamin A for range livestock has been recognized. Repeated experiments under controlled conditions, accompanied by numerous field demonstrations under practical ranching conditions have given uniformly satisfactory results with a practical vitamin A carrier during more than three years. One group of experiments conducted under practical range conditions during the wintering period of 1946-1947 resulted in 41 lbs. more for each cow and 17 lbs. more for her calf (approximately six weeks old) when a supplement fortified with vitamin A was fed and compared with a standard high-protein supplement. In the Rocky Mountain region early spring calves were produced satisfactorily when a supplement fortified with vitamin A was fed during the last two months of pregnancy and for thirty days after calving.

Physiology Section

F. N. Andrews, Chairman

IODINE DEFICIENCY IN NEWBORN SHEEP AND SWINE. F. N. Andrews, C. L. Shrewsbury, C. Harper, C. M. Vestal and L. P. Doyle, Purdue University Agricultural Experiment Station.

Considerable difference of opinion exists in the literature as to whether domestic animals in Indiana and neighboring states should receive supplementary dietary iodine. The gross and microscopic anatomy and iodine content of the thyroid glands of over 300 newborn lambs and more than 400 newborn pigs in three central Indiana sheep flocks and two swine herds were studied. Pregnant ewes and sows were fed commonly-used rations with and without iodized salt and observations were made over a three-year period. The normal thyroid of the newborn lamb is reported to weigh between one and two grams and to contain between 0.2 and 0.3 percent iodine on a dry weight basis. Of 334 lamb thyroids from ewes fed commonly-used rations not supplemented with iodine, 55 percent weighed more than two grams and only three percent contained more than 0.2 percent iodine. Only 12 percent of the glands appeared normal histologically. Similar increases in thyroid size, reductions in iodine content, and histological changes were observed in newborn swine. The use of stabilized iodized salt reduced the occurrence of these changes. The commonly recognizable clinical evidences of iodine deficiency such as hairlessness and scanty wool were not common. Correlations of 0.321 and 0.350 between iodine content and thyroid weight were found in lambs and pigs respectively. The correlations between iodine content and height of the thyroid epithelium were 0.646 and 0.525 in lambs and pigs respectively.

EFFECTS OF DILUTION ON MOTILITY OF BULL SPERMATOZOA. P. L. Cheng, L. E. Casida and G. R. Barrett, University of Wisconsin.

Visual estimates at 450 magnifications have been made of the percentage of spermatozoa showing forward motion in a dilution of 1:10 and in eight successive dilutions from 1:100 to 1:12800. Six semen samples from each of five bulls have been studied and two different diluents, 0.08M sodium citrate and 0.9% sodium chloride have been compared throughout. Average differences were shown in the motility of the spermatozoa from different bulls and in the different samples from the same bull. The percentage of motility decreased markedly in the higher dilutions but this decrease seemed fairly uniform for the different samples both within and between bulls and in the two different diluents. There was an average difference between the diluents, the motility being greater in the sodium chloride. The difference between the diluents, however, was more marked for some bulls and for same samples than for
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others. Possible correlations have been sought between different indices of motility and the fertility of these samples of sperm when used in artificial insemination. No correlation was found between any index of motility when studied between samples within bulls. There was slight evidence for a correlation, however, between motility at a dilution of 1:10 and fertility and also between highest dilution in which motility was shown and fertility when studied between bulls.

EXPERIMENTAL USE OF COMMERCIAL HORMONE PREPARATIONS IN TREATING SHY-BREEDING DAIRY COWS. H. P. Davis, J. A. McCrory and A. B. Schulze, University of Nebraska.

Cows in the University herd requiring more than three services for conception and free of genital disease or infection were treated with Gonadin or Follutein. Similar shy-breeders were not treated and served as controls. The conception rate of the untreated cows was 33 percent for 79 services over three. Cows for which the cause of shy-breeding could not be diagnosed from their breeding history or by examination of the genitalia were treated indiscriminately with Gonadin or Follutein. Neither preparation was effective in increasing the conception rate in such females (32 services). Cows and heifers found to have abnormally small and apparently underactive ovaries, although having fairly regular estrous cycles were treated with Gonadin. Seven of eleven treated services resulted in conception. This treatment was apparently more effective in heifers than in cows. Seven females diagnosed as having follicular cysts from the frequency of estrus and the presence of large follicular cysts were injected with 10,000 units of Follutein. All returned to regular estrous cycles but only five became pregnant. Eight females diagnosed as having greater than normal follicular development at estrus but not large enough to be classified as cystic and having normal estrous cycles were injected with 5,000 units of Follutein three days after service. Five of the eight conceived on the treated service. Of the 26 services in which abnormal function was indicated by examination, 17 conceptions resulted or a conception rate of 64 percent was obtained.


Forty head of yearling heifers grading good are being used in feeding trials designed to determine the effects of two stimulants, namely: Lot II—Fowler’s Solution (arsenious acid); Lot III—Nux Vomica (a strychnine compound); and Lot IV—Thiouracil. Two bulls are being used to breed the heifers, each bull breeding five heifers in each lot. The effects from the use of the stimulants is being measured by the following criteria: gains; estrous cycle; services per conception; density, length, and luster of hair; physiological and pathological effects on the reproductive organs, heart, liver, kidneys, and thyroid glands; and carcass grade. The following average daily gains were made during the first 44 days of the trial: Lot I (control), 2.92 pounds; Lot II, 2.97 pounds; Lot III, 3.34 pounds; and Lot IV, 3.24 pounds. However, at the end of 156 days on trial the gains in all lots of heifers were about the same. The heifers will be continued on feed for another 42 days. Results to date on two years work indicate that the use of thiouracil, Fowler’s solution, and Nux Vomica may be effective in increasing rapidity of gains only for a short feeding period. No harmful effects were noted in rat growth trials last year when the meat and internal organs of heifers fed thiouracil and the two drugs (after a 40 day depletion period) were fed at a 30 and 80 percent level of their diet. Rat trials will be conducted this fall with the meat and internal organs of heifers, but with no drug depletion period prior to slaughter.

INFERTILITY (STERILITY) OF BEEF AND DAIRY COWS AND OUTLINE OF TREATMENT. A. H. Frank, United States Department of Agriculture.

Work on relative infertility in beef and dairy cows has been in progress for about one year. During this time records have been kept on more than 1000 cows. Over 50 percent of these cows have needed treatment for breeding troubles. Preliminary to treatment the cows were examined for known conditions such as improper development, abnormal growth, brucellosis, trichomoniasis and other pathogenic conditions of the genitalia that may interfere
with fertility. After elimination of the above maladies, the cows were classified according to their breeding behavior. The treatment was directed toward glandular dysfunction. Each class was treated by three different methods, mechanical (removal of corpora lutea and cysts and massage of ovaries), mechanical in combination with hormone (pregnant mare’s serum), and p.m.s. alone. A fourth animal was kept as a control. This work has not been carried on long enough to evaluate the effectiveness of the different methods of treatment.


The following experiment was undertaken to determine by a biological method the thionauracil level in muscular tissue after prolonged feeding and the rate at which it disappears from the tissue following removal of the supplement. Weanling Chester White pigs were used. The diet was supplemented with 0.2% thionauracil for a period of 34 days, and then it was removed from the ration. Some animals were sacrificed at the time the supplement was removed, and others one and three days later. Pooled, dried muscular tissue was thus obtained for three groups of animals. The thionauricil content of the dried tissue preparations was then determined by feeding it at a 50% level to rats and measuring the degree of depression of thyroid function as indicated by the thyroidal uptake of radioactive iodine. A standard response curve for rats was established by adding thionauricil to a similar diet. Without thionauricil the gland could accumulate about 1.5% of an administered dose of radioactive iodine per mg. thyroid weight per 100 gm. body weight; however when 5 to 10 mg. of thionauricil was added per 100 gm. diet this value decreased approximately 50% and at a level of 100 mg. per 100 gm. diet a depression of 80% was observed. By similar measurements with rats fed tissue from pigs which had received thionauricil it was found that the thionauricil level of the muscle meat of pigs after prolonged feeding of 0.2% thionauricil was 6 ± 3 mg. per 100 gm. but that after the removal of the thionauricil from the ration for one day the level dropped to 2 ± 1 mg. per 100 gm., and no detectable amount was present after 3 days.

GROWTH STIMULATION WITH REGARD TO THE ANIMAL’S OWN THYROID SECRETION RATE. Victor Hurst and C. W. Turner, Missouri Agricultural Experiment Station.

Earlier work from this station indicated the favorable influence of exogenous thyroxine or thyroprotein on the growth rate of mice. With the development of an assay for the rate of thyroid hormone secretion, we have observed that the thyroid secretion rate declines with age. Recently our work has indicated that in order to accelerate growth to the maximum it is necessary not only to administer thyroxine at the proper level above the animal’s own thyroid secretion level, but also that this level must decline in proportion to the normal decline of the thyroid secretion rate with age. Young Rockland female mice were divided into eight groups; one control, one on 0.1% thionauricil, and the other six on 0.1% thionauricil plus levels of injected OL-thyroxine varying from dosages less than the animal’s own thyroid secretion rate to those causing extreme hyperthyroidism. After a twelve week period, high levels of thyroxine retarded skeletal growth and body weight as compared to controls. In one group, animals continued on a high level for an additional seven weeks either died, failed to breed, or dropped dead young in all but two out of seventeen cases. With the thyroid secretion rate declining with age, a stimulating dosage level at one stage of growth later reduced body weight to normal when hyperthyroidism began to occur. Growth of animals on thyroxine dosages approximating the normal thyroid secretion rate did not differ from that of controls.

THE DEVELOPMENT OF HYALURONIDASE IN BULL SEMEN. James E. Johnston and John P. Mixner, Rutgers University.

The concentration of the enzyme hyaluronidase found in bull semen may be a factor in fertility since it has been shown that this enzyme can disperse the corona radiata cells which surround the ovulated mammalian ovum. Thus the transport (or secretion) of hyaluronidase by semen and the subsequent denudation of the ovum may be an important function of semen
immediately preceding the penetration of the ovum by a spermatozoon. As a preliminary to
the study of the relationship of hyaluronidase concentration in semen to its fertility, it was
necessary to determine the effects of both the length and the temperature of semen storage upon
the hyaluronidase concentration of seminal plasma. In this connection it was found (1) that
hyaluronidase is found in seminal plasma immediately following ejaculation; (2) that seminal
plasma which was centrifuged and filtered to remove all spermatozoa showed no increase in
hyaluronidase concentration when stored at either 37°C or 5°C; (3) that upon storing semen
after ejaculation at 5°C, there was a gradual and considerable increase in concentration of
hyaluronidase (as much as 400% increase in concentration in 144 hours) coincident with a
drop from a semen motility rating of 3 to 1; and (4) that upon storing semen after ejaculation
at 37°C there was an extremely rapid and large increase in the concentration of hyaluronidase
(as much as 645% increase in concentration in 72 hours) coincident with a drop from a semen
motility rating of 3 to 0.

AN INVESTIGATION OF THE STAINING PRINCIPLE AND THE BACKGROUND
STAIN IN THE DIFFERENTIATION OF LIVE FROM DEAD SPERMATOZOA.

Dennis T. Mayer, Dale Squiers and Ralph Bogart, Missouri Agricultural Experiment Station.

In the majority of semen specimens from the bull, ram, stallion and boar varying per-
centages of the spermatozoa are dead. In addition in each specimen some of the live cells are
physiologically abnormal and die during the early stages of storage. Previous publications from
this laboratory have suggested the use of live-dead staining technique alone and in combina-
tion with the cold shock method for the quantitative determination of dead and physiologically
abnormal spermatozoa. In the original staining method for the differentiation of live and dead
spermatozoa, eosin was the staining principle and opal blue (Breslau) was the background
stain. Since the opal blue has been unobtainable, this laboratory, after a thorough investiga-
tion, found that fast green FCF is a better background stain than the original opal blue. Eosin
B (bluish) was originally used as the staining principle, but results of this investigation show
that all of the halogen derivatives of fluorescein including eosin Y, erythrocin, and rose bengal
will stain the dead spermatozoa. It was also shown that staining of the dead cells may not occur
if the pH, osmotic pressure, and stain concentration vary from a relatively narrow range.
Staining of dead spermatozoa does not occur if the stains are not in a solution containing
highly ionizable salts. The new staining mixture is described and details of the method are
given. The accuracy and repeatability of the staining technique are attested by the results of
a series of quantitative determinations.

THE EXPERIMENTAL INDUCTION AND MAINTENANCE OF LACTATION
IN GOATS WITH ESTROGEN-THYROID COMBINATIONS. Joseph Meites and
C. W. Turner, Missouri Agricultural Experiment Station.

Estrogens have been employed successfully in initiating lactation in goats and cows, but
have been considered ineffective for augmenting established lactation. Thyroid preparations
can increase established production, but cannot initiate it. Since estrogens can stimulate
pituitary lactogen secretion and mammary growth, while thyroid can speed up metabolic proc-
eses favorable to lactation, these together should be superior to either alone. Two grade Tog-
genburg goats which were nearing the end of lactation, were given diethylstilbestrol and thy-
roxine for ten-day periods at monthly intervals. Initially, these goats were producing 1.1 and
1.8 pounds of milk daily, respectively. Six months later, after four ten-day treatments, daily
milk production had increased over 100 percent (to about four pounds each). This represented
as much milk as these goats had produced a year previously, a few months after kidding. Two
dry, multiparous goats, weighing about 120 pounds each, were fed three grams of dimethyl
ether of diethylstilbestrol and 75 grams of thyroprotein (Protamone) per 100 pounds of grain.
The daily intake of each goat was estimated at about 60 mgs. of estrogen and 1.5 grams of
thyroprotein. Milking was begun after four months. An upward trend in production occurred
for over eight weeks reaching between three and four pounds daily per goat, and persisting
at this level for six more weeks. No loss in body weight occurred, despite continuous hormone
feeding throughout the experiment.
PROCEEDINGS OF THE SOCIETY

STUDIES OF SOME BLOOD CONSTITUENTS AT TIME OF PARTURITION IN MASTECTOMIZED COWS. R. P. Niedermeier, Veerl R. Smith and C. K. Whitehair, University of Wisconsin.

Studies were initiated to ascertain whether the changes in certain blood constituents at time of parturition were the result of the initiation of lactation or physiological factors accompanying parturition. The mammary glands were totally ablated from five Jersey cows, of which one was a two-year-old. The two-year-old and a nine-year-old cow have calved since mastectomy. The blood levels prior and subsequent to parturition for total serum calcium, plasma carotene and vitamin A and fat were studied. In the aged cow at parturition there was a drop in total serum calcium, carotenoids, and plasma fat. There was no appreciable change in the plasma vitamin A level. In the two-year-old there was no appreciable change in the total serum calcium at parturition, but a drop occurred in the plasma carotene and vitamin A levels.


A study was made of the levels of acid and alkaline phosphatase in a series of semen ejaculates obtained consecutively as long as libido persisted and within a 30 minute period from 10 young bulls. The 10 bulls composed 2 feed groups. Group I received a simple concentrate mixture consisting largely of corn while Group II was fed a complex mixture containing supplementary vitamins and minerals. Both groups received the same hay. In 56 ejaculates the mean levels of acid and alkaline phosphatase were 170 (range 46 to 338) and 393 (range 97 to 3,459) units per 100 ml. of bull semen, respectively. The semen from Group II bulls contained markedly higher levels of both phosphatases than that from Group I. A high degree of correlation existed between the acid phosphatase level and the spermatozoa concentration of the semen produced by both groups (Group I, 0.902; Group II, 0.876). The following significant coefficients of correlation were found between the semen acid phosphatase level and some characteristics of Group II semen: initial motility, 0.675; initial pH, -0.606; decrease in pH upon incubation, 0.688 and volume, 0.458. No significant relationship existed between the enzyme and these characteristics of Group I semen. The level of alkaline phosphatase was not related to the characteristics of semen studied. However, as previously suggested, the results of this study further indicated that the blood is the immediate origin of semen alkaline phosphatase.


The action of gonadotrophins when administered at two different stages of the estrous cycle was studied in 18 Chester White and Poland China sows. Treatment of the two groups was initiated either on the 4th day (luteal phase) or 15th day (follicular phase) of the estrous cycle, respectively. A single injection of 2000 I.U. of pregnant mare serum gonadotrophin was given for follicular stimulation on the 4th or 15th day, depending on the group, followed five days later by an intravenous injection of 1 gm.-equiv. of unfractionated sheep pituitary extract for ovulation. All sows were mated or inseminated at the time of the intravenous injection and slaughtered 48-56 hours later. Sows in the follicular phase showed a greater ovarian reaction to the standard treatment than did luteal sows. This was indicated both by the average number of ovulation points (25.3 vs. 14.0) and by the number of intact follicles (5.4 vs. 10.8). Fertilized ova were not found in any of the luteal sows although an average of 10.6 ova was recovered per sow. In the follicular group 19.6 ova per sow were recovered and of these 5.3 were fertilized. The results were variable, however, in that five of the nine sows had no fertilized ova. Treatment failed to incite estrus in the luteal sows, and it delayed the onset of estrus in eight of the nine follicular sows beyond the 21st day (four beyond the 23rd day).
INTERRELATION OF THE PITUITARY AND THE SEX HORMONES IN MAMMARY GLAND GROWTH. J. J. Trentin and C. W. Turner, Missouri Agricultural Experiment Station.

The nature of the pituitary factor responsible for mammary duct growth was investigated by the extraction and assay of cattle anterior pituitary tissue. The active factor was found to be associated with the protein fraction rather than the lipid soluble fraction. The possible identity of the mammary duct stimulating and mammary alveolar stimulating factors was investigated by comparison of the duct stimulating and alveolar stimulating activity of a series of anterior pituitary preparations and extracts. The ratio of the mammary duct unit to the mammary alveolar unit varied from 0.5 to 1.8 for a series of eight preparations ranging from fresh anterior pituitary tissue of pregnant and non-pregnant cows to highly purified extracts. Under the conditions of these experiments the relatively small variation in this ratio is taken as indicating no significant separation of duct stimulating and alveolar stimulating activity of anterior pituitary. Until such time as the two activities are separated it would appear logical to regard them as the result of the same pituitary factor or combination of factors. The response of the male mouse mammary gland to estrogen, progesterone, and combined estrogen and progesterone was investigated to determine if it would be possible to stimulate alveolar growth to the exclusion of duct growth. In no case was it possible to induce alveolar growth without first inducing duct growth. In the hypophysectomized male mouse estrogen was found to produce insignificant or no mammary stimulation while combined estrogen and progesterone caused a slight amount of duct growth.

FEEDING THYROPROTEIN (PROTAMONE) TO LIVESTOCK IN RELATION TO THYROID SECRETION RATE. C. W. Turner, Missouri Agricultural Experiment Station.

The availability of thyroprotein, a synthetic hormone preparation permits the study by livestock physiologists of the possible beneficial effect of mild hyperthyroidism upon the rapidity of growth, reproduction, lactation and related economic factors in various breeds and classes of livestock. Where possible it is helpful to determine the average thyroid hormone secretion rate of each class of animals, then administer amounts of thyroprotein slightly in excess of the normal to determine the value of the hormone when present in increasing amounts. When thyroprotein, in excess of the normal amount secreted, is fed it has been observed to cause the animal's own thyroid to cease secretion. It is important, therefore, to withdraw the thyroprotein-feeding gradually so that the animal's own thyroid can gradually take over secretory activity again. However, if rapid fattening is desired, then abrupt withdrawal should be practiced. In the light of work conducted today the following comments may be made. For growing animals the incorporation of the thyroprotein as a percentage of the feed is better than feeding a definite amount per day. Requirements of both feed and thyroprotein increase with body weight. For lactating animals, the thyroprotein should be fed in relation to body weight rather than to milk production. To date no experimental evidence is available which suggests that increased productivity induced by mild hyperthyroidism is not compatible with long life. In our laboratory, White Leghorn hens have finished their sixth laying year. Each year their egg production has far exceeded the controls with a smaller mortality rate. The average production of the hens fed thyroprotein continuously for the past three years is actually greater this year than of the two previous years.


In continuation of the work reported last year, thyroprotein was fed to four breeds of growing pigs allotted against suitable controls, and its effect on growth and feed consumption were recorded. The pigs were self fed a growing ration and had access to rape pasture. While eight control Duroc Jersey pigs averaged 1.42 lbs. daily gain on 3.63 lbs. of feed per lb. of gain during a 79 day post-weaning period, two separate lots of seven Durocs receiving 1.4 and 2.8 gms. of thyroprotein per 100 lbs. of feed respectively, gained 1.54 lbs. daily on an average of
3.4 lbs. of feed per pound of gain. Lots of Yorkshires and Chester Whites receiving thyroprotein at the 2.8 gm. level were slightly more efficient and gained more rapidly than their controls. Berkshire pigs receiving 5.6 gm. of thyroprotein per 100 lbs. of feed made 0.28 lbs. more gain daily on 0.94 lbs. less feed per pound of gain than their controls. Improvement in quality of hair coat was noted in all groups receiving thyroprotein. A corollary study on the weight and histology of thyroids from Berkshires, Duroc Jerseys, Yorkshires, and Duroc X Yorkshire Crossbreeds was made, and revealed significant differences between the different breeds both in gross histology and mean acinar cell height. The possible correlation between thyroid histology and market type will be discussed. It has been demonstrated that thyroprotein administration produces a histologically inactive gland, and thiouracil produces extreme hypertrophy and hyperplasia.

OCCURRENCE OF POSTPARTUM ESTRUS AND OVULATION IN SOWS. A. C. Warnick, L. E. Casida and R. H. Grummer, University of Wisconsin.

Sows were checked daily for heat beginning 1 day postpartum. Sows that came into estrus were bred and killed 1 to 2 days postestrus; sows that did not show heat were killed 10 days postpartum. Twenty-one sows were studied during the interval from April, 1946 to February 1947. Six of 19 suckled sows came into heat and were bred within 4 days postpartum. None of these sows ovulated and none had follicles above 5 mm. in diameter. Thirteen suckled sows did not come into heat by the tenth day and none ovulated. Two nonsuckled sows (pigs dead at birth in one case and immediately after birth in the other), came into heat by the seventh day and 6-cell embryos were flushed from the oviducts. A second experiment was run during the interval from May to July, 1947 to study the effects of suckling. Eight suckled and 7 nonsuckled sows were checked for heat by the same method as in the first experiment. The young were removed at birth from the 7 nonsuckled sows. Five of the suckled and 5 of the nonsuckled sows came into heat and were bred within 3 days postpartum but none ovulated. The remaining sows in each group which failed to come into heat also failed to ovulate by 10 days postpartum.

SOME GENITAL CONDITIONS ASSOCIATED WITH LOWERED FERTILITY IN SOWS. A. C. Warnick, R. H. Grummer and L. E. Casida, University of Wisconsin.

Thirty-one sows that had failed to conceive from breedings at 2 to 4 consecutive heat periods were obtained from Wisconsin swine growers for a study of causes of low fertility. All sows were mated to fertile boars at the first estrus after being obtained from the farmers. Sixteen sows were killed 1 to 2 days after the end of heat and are referred to as Group I; 15 sows killed approximately 25 days after breeding comprised Group II. Ten of the 16 sows of Group I showed normal pregnancy at 2 days; only 4 of the 15 of Group II showed normal pregnancy at 25 days. Structural abnormalities of the genital tract, embryonic death, pathology of the oviducts and cystic follicles were apparent causes of lowered fertility.


Postpartum studies of vitamin A and of carotenoids in the blood serum of dairy cows included 12 animals that retained fetal membranes and 20 that eliminated them within 6 hours after parturition. During the 28 days preceding the scheduled calving date, the experimental subjects were divided into 2 dietary groups, those restricted to a typical barn ration (concentrate mixture, alfalfa hay and Atlas Sorgo silage) and those receiving a similar ration supplemented with a vitamin A concentrate. The latter group received 500,000 U.S.P. units of vitamin A daily from 28 to 14 days preceding the expected day of parturition and 1,000,000 units daily during the remainder of the prepartal term. The postpartum ration was the same for all cows. As previously noted, the concentration of vitamin A in the blood serum of the cows continued to decrease several days following parturition, but after the first day, the rate