SYNOPSIS. The Ca:P ratio of the bone of albino rats was altered by feeding corn and soybean grain from soil fertilized with relatively large amounts of lime, P, and K. Weight gain and N digestibility were not related to soil treatments. The chemical composition of the grain was not appreciably changed by soil treatment, except for a substantial increase in P content with P fertilization.

NUMEROUS investigators have studied the effect of soil nutrient levels on the chemical composition and subsequent feeding value of crops. Results of such work are necessarily variable for a number of reasons, including the type and number of nutrients studied, the soil treatments used, crops employed, species of animals fed, and a host of environmental factors.

Studies were conducted in Michigan over a ten year period to compare the effects of feeding fertilized and unfertilized crops to dairy cows on the growth, vigor, production and composition of milk, and the reproductive ability of these animals (5). The results of these intensive investigations failed to show any differences in the health and vigor of matched herds of dairy cows, their progeny, or milk produced, that could be attributed to changes in the nutritive value of the feed as a result of fertilizer and lime applications (4, 8). Chemical analyses of the crops revealed only minor differences in composition that could be attributed to fertilization (7). According to Shear et al. (13, 14) this may have occurred because lime and fertilizer applications only increased the intensity of nutrient supply without altering the balance of nutrients in the soil. The result was larger plants with essentially the same chemical composition. However, studies on the same soil in the greenhouse indicated that unbalanced nutrient levels could substantially alter the composition of oats, soybeans, and alfalfa (12).

It is possible that a feeding trial with ruminants would not be sensitive enough to detect small differences in nutritional quality of a food, and certainly the direct effect on human nutrition could not be interpreted from experiments of this kind.

The present study involved feeding diets containing corn and soybeans grown on fertile and infertile soil to albino rats, with the belief that this experimental animal could detect small differences in the nutritive value of the crops.

EXPERIMENTAL PROCEDURE

In 1955, treble superphosphate (0-45-0) and muriate of potash (0-0-60) were applied at the rates of 1250 lbs. per acre, respectively, on plots designated to reagents. Calcitic lime was applied at four tons CaCO₃ per acre.

In 1956, 200 lbs. per acre of treble superphosphate and 200 lbs. per acre of muriate of potash were applied. Calcitic lime was applied at the rate of 1000 pounds per acre.

The initial nutrient levels in the experimental plots were considerably lower and the rates of fertilizer application were higher than normal for soils in most farming areas. Consequently, the soil treatments established wide ranges in nutrient availability so that the effects of unbalanced soil fertility on plant content and animal growth could be studied. This is in contrast to previous studies in which nutrient availability was balanced at the low levels.

Samples of mature corn and soybean grain were taken from each plot, ground, composited, and used for subsequent vitamin and feeding trials.

The grain samples were wet-ashed by the method of Bethke et al. (11) and analyzed for total calcium, potassium, magnesium, phosphorus, nitrogen and crude ash. Calcium and phosphorus were determined with a Beckman D.U. flame photometer. Concentrations were determined by the thiazole yellow of Drosdoff and Nearnass (6), while total phosphorus was determined as the molybdenum-blue complex. Kjehldahl nitrogen was determined by the A.O.A.C. method (1).

Ground corn and ground soybeans which had been stored for 30 minutes at 250° F. were supplemented with a vitamin mix, and common salt to give diets as shown in Table 1.

Each of the 16 diets was fed to 8 albino rats, each of whose initial weight was approximately 500 grams. The rats were assigned at random to individual wire-bottomed cages. The food and water were allowed ad libitum for the entire seven-week period. Live-weight changes and feed consumption were recorded weekly. Apparent digestibility of the dietary nitrogen was determined by the time collection method during the last two weeks of the feeding trial.

At the end of the seven-week period the animals were killed. The leg bones (scapula, radius, ulna, humerus, and femur) were removed from each animal, composited, and extracted with alcohol and ether as described by Bell. Calcium and phosphorus contents of the bones were determined by the A.O.A.C. (1) and Fiske and Subbarow (9) methods, respectively.

RESULTS AND DISCUSSION

Data for the chemical composition of the corn grain as influenced by soil treatment are presented in Table 2. These data suggest that, with the exception of the phosphorus content of both grains and the iron content of the corn grain, the amount of plant protein was not influenced by lime and fertilizer applications.

The increase in the phosphorus concentration of the corn and soybean grains averaged approximately 8% and 6%, respectively. Increased levels of magnesium and calcium in the grain appeared to be associated with phosphorus.