Microbiological Assays of Hays for Their Amino Acids According to Soil Types and Treatments Including Trace Elements

Wm. G. Blue, Victor L. Sheldon, and Wm. A. Albrecht

The plant is composed of carbohydrates, fats, nitrogenous compounds including proteins and vitamins, inorganic elements, and other substances possibly not classified in the above categories. The carbohydrates are produced by photosynthesis with the aid of a few inorganic elements such as magnesium in the chlorophyll, potassium for conversion of sugar to starch, and some of the minor elements, like manganese, for the transformation of sugar and starch to fats. The production of amino acids and protein is, however, not a photosynthetic but a biosynthetic process. This process probably depends on both the presence of, and the balance of, the supplies of inorganic elements in the plant as well as on the supply of carbohydrate. The quantities of these elements present are probably not the most important criterion of their service. Rather, the activities of the cationic and anionic constituents should probably be taken into account. It appears as if the role of these elements is mainly a catalytic one with only some of the elements actually becoming components of the protein molecule.

The primary objective of crop breeding has been that of increasing yields as measured by the quantity of material produced. Very little thought has gone to the quality of the crop in relation to the purposes it serves. This objective has resulted, in many cases, in the adoption of crops that give increased yields in carbohydrates. Yet, the provision of the carbohydrate content of rations for farm animals is a relatively simple matter. The serious problem in feeding farm animals is one of getting sufficient protein of proper quality even when we resort to the purchase of protein concentrates to balance the carbohydrates as energy in the diet.

Proteins are not commonly measured directly but only indirectly. This is done by oxidizing the organic substances slowly in the presence of sulfuric acid to retain the nitrogen. The total nitrogen in the ignited remains is determined and then multiplied by a numerical factor with the result considered as the protein. The inadequacy of such a generalized method of measuring the protein is readily evident. When it is now known that certain of the constituents of protein, namely, the essential amino acids, must be present in the animal’s diet, and when there must be a definite ratio between those essential ones in the diet for maximum efficiency in the utilization of foods, such general measures of protein by ignition and simple factor multiplication are of no specificity.

Chemical studies which make use of the construction of the organic parts of the plant from the nitrogenous compounds including proteins and vitamins, have some value in the qualitative analysis of the plant, but they have not enabled us to determine the nature of these inorganics with the organic products of synthesis. We obtain the concentration of inorganics instead of their activity and function in the plant in terms of organic output.

Biological assays have been used more recently in the evaluation of feeds in relation to the fertility of soils growing them. Little correlation has been established between the results as animal growth, ash analyses or the protein contents as measured by the total nitrogen method. However, sufficient work has been done in feeding experiments to show that good soils generally result in good healthy animals, while crops from poor and diseased animals, while those from good soils generally result in good healthy, has frequently been shown that differences between fertile and nonfertile soils may be greatly magnified when measured in terms of animal growth.

This biochemical method of evaluation, when along with the ash analyses of the crops, tells us about different combinations of the inorganic and nitrogenous, nor about the nature of the plant composition when any particular element in the soil is in sufficient concentration. Therefore, we may well consider the synthetic nitrogenous compounds as good indicators of the plant processes involving cation metabolism thereby indicating the services by the fertility of the soil. In the following study the vegetative parts of crops were microbiologically assayed for their content of amino acids in order to correlate, if possible, the concentration of these with the soil treatments, and some trace elements.

EXPERIMENTAL PROCEDURES

Crops, Soil Types, and Treatments

Korean lespedeza and alfalfa were the two crops whose amino acids were assayed by a microbiological method according to Stokes, Gunness, Dwyer, and Caswell (4, 5) with modifications.