

Annual Report - 1981

Infrared Analysis of Forages:

Factors which cause variation in quality and analysis of forages

I. Cooperating Agencies and Principal Investigators:

Agricultural Research Service, U. S. Department of Agriculture
Utah Agricultural Experiment Station
Dept. of Animal, Dairy & Veterinary Science
Utah State University, UMC 48
Logan, Utah 84322

M. J. Anderson - Project Leader
K. H. Asay
M. D. Rumbaugh

II. Progress or Work and Principal Findings:

Samples of hays (predominately alfalfa) submitted to the Utah State testing laboratory by farmers and hay dealers were tested for crude protein and acid detergent fiber (ADF). Total digestible nutrients (TDN) were estimated from crude protein and ADF. Prediction equations were developed and tested using infrared spectroscopy (IR). Correlations between IR predictions and chemical values were generally about .91, .95, and .94 for protein, ADF and TDN. Corresponding standard errors of difference (SED) between the two methods were 1.1, 1.5, and 1.5.

Samples from alfalfa variety trials collected in 1980 include several varieties, three locations, three cuttings, and replication. Chemical analyses are not completed on these samples but preliminary investigation indicates that IR correlations and SED will be similar to those from the U.S.U. testing lab.

Samples from Dr. Asay's grass breeding project were tested for crude protein, soluble nitrogen, acid and neutral detergent fiber and lignin. Prediction equations were developed with the IR. Correlations between IR predictions and chemical values were .96, .91, .85, .91, and .74, respectively for crested wheat grass (*Agropyron*) cultivars. Corresponding SED's were .30, .03, 1.42, 1.18, and .57.

Four species of grass were grown in pots in a greenhouse with three levels of light intensity, two levels of nitrogen fertilization and two levels of soil moisture. These grasses were sampled and tested for nitrate. There were significant differences in nitrate because of species, light, fertilization, moisture and light x moisture and moisture x species interactions. Prediction equations with IR were not satisfactory with IR. This may be partly because the chemical procedure for nitrate was not satisfactory. Fresh alfalfa was dried using several different methods. These samples plus the Reed Canary grass samples were analyzed for carotene. Prediction equations were developed with the IR. Correlations in excess of .95 were found between the IR predictions and the chemical values. However, the SED's were in excess of 10 milligrams per kilogram dry matter. These high SED values indicate need for further refinements of the equations

if they are useful. Large losses of carotene were found when forage was freeze-dried. Prediction equations for carotene were developed with the IR on 40 alfalfa hay samples. Correlations and SED for these hay samples were similar to the fresh alfalfa and grass studies.

A digestion study using 9 forages (includes grasses and legumes) fed to elk was conducted. Results from the digestion studies were used to develop prediction equations with the IR. Correlations and SED between the chemical and in vivo values and an IR prediction of a duplicated sample of forage were for organic matter .81 and 5.74, dry matter .63 and 2.00, crude protein .99 and 1.10, NDF .30 and 42.8, ADF .94 and 2.5, ADL .93 and .86, organic matter digestibility in vitro .98 and 4.00, organic matter digestibility in vivo .95 and 16.03 and digestible organic matter intake .75 and 19.75. Increasing the number of forages tested would add validity to the results of this study.

Four to six cultivars of three cuttings of alfalfa with two stages of maturity were sampled from 7 locations in Utah in 1981. These samples will be tested for IR predictions.

Forty seven hays from geographical areas which covered a wide range of climatic conditions were collected in 1981. Two or three cuttings with up to 3 stages of maturity were collected from 5 locations. These hays will be fed to sheep in digestion trials and results subjected to IR testing.

III. Usefulness of Findings:

A reliable rapid method of determining the nutritional value of forages would be a valuable tool for scientists interested in forages. Research results could be accelerated and be more valuable. Forage producers could be encouraged to produce a higher quality forage because they could be justly compensated. Dairymen and other livestock producers could demand high quality forage because of higher production. The infrared is a fast method and has potential for accuracy.

IV. Work Planned, for Next Year:

Chemical analysis will be completed on the alfalfa samples collected in 1980 and 1981. Prediction equations for estimating forage quality indicators will be developed and tested on these samples. Results of IR predictions will be examined to determine if years, cultivars, cuttings, source of samples, or stage of maturity influences the precision of the prediction.

Further work is in progress to determine if the prediction equation for carotene for alfalfa can be improved.

Digestion trials using four sheep per hay will be conducted on the 47 alfalfa hays collected this year. Upon completion of the digestion trials,

correlations between digestion coefficients and in vitro digestibility will be determined. Prediction equations for determining the digestion coefficients will be developed and tested with IR.

V. Publications during the past year:

Young Woo Park. 1981. A Study on Predicting Carotene, Nitrate, Soluble N and Fibrous Fractions in Forages and Vegetables with Near-Infrared-Reflectance Spectroscopy, and Effects of Processing Methods on Carotene Contents. PhD Dissertation. Utah State University, Logan.

Y. W. Park, M. J. Anderson and J. L. Walters. 1981. Carotene in Forages and its Prediction with Infrared Spectroscopy. Program, American Dairy Science Association Annual Meeting, Baton Rouge, LA. p. 104 (abstract)