Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 2 *Dairy Research (1984-2014)*

Article 142

1986

Forage analysis using near-infrared spectroscopy (NIRS)

L.H. Harbers

FORAGE ANALYSIS USING NEAR-INFRARED SPECTROSCOPY (NIRS)

L.H. Harbers

Introduction

It has been over 15 years since an analytical instrument was developed that could rapidly determine the concentration of organic compounds from the spectra produced by the bonding between carbon and certain molecules. The instrument is based on the principle that those molecules absorb energy in the infrared region and produce harmonics seen at lower wavelengths, namely the near-infrared region. Compounds may be quantitized by a computer that rapidly analyzes the absorption bands in the near-infrared compared to a standard. Peaks from compounds such as water, protein, fat, and carbohydrate may be detected. Those can be translated into components such as moisture, crude protein, crude fat, acid detergent fiber, etc. All this can be accomplished in minutes rather than hours or days required for the normal routine analyses presently available.

The Instrument

The instrument consists of several parts with associated equipment. The major part includes near-infrared scanning sensor with either a scanning monochrometer (research equipment) or rotating filters (routine unit). A computer, complementary software, and printer are also needed. The associated equipment would consist of a grinder and sample cups. A chemical laboratory would be necessary to analyze reference standards used as a learning set for the instrument.

The advantages of such an instrument are several. The analyses are rapid - one person can pack, scan, and empty 400 samples daily. It would take several technicians 3 or 4 months to make these determinations. Dr. Frank Barton III, USDA labs in Athens, Georgia, predicts that near-infrared spectroscopy (NIRS) will be the instrument of choice for forage analyses in the 21st century. It is a nondestructive method that can analyze for any organic compound at concentrations of about 1% or more of the dry matter of forage. It is valuable for analyzing the small samples generated by plant breeders, and regression equations useful for feed formulation can be generated by the computer.

There are several disadvantages to such a system. The initial cost of a research instrument would be between $75-100,000, although an instrument for routine analyses would cost much less. A minimum of 30 reference standards with data obtained by routine means would be necessary as a learning set. Other disadvantages are that each forage would need its own set of standards, and equations in the computer would need to be updated.

Forage Testing Programs Using NIRS

Several states use NIRS units for testing forage samples. Wisconsin has mobile and stationary units plus one commercial unit. A farm-industry- university program was mandated through their state legislature under the hay making task force that pioneered auctions of quality-tested hay on a statewide basis. Virginia has a centralized unit testing 13-16,000 samples yearly. Florida has a centralized unit calibrated for each forage. It tests alfalfa, some grasses and clovers, corn and sorghum silage, but not pastures, grains, and NH_3-treated silages. Kansas has NIRS units in the Grain Science department, where extensive testing of wheat has been underway for several years under the direction of Dr. Dave Wetzel.

A National Forage Research Project Network has already been established with the following objectives concerning NIRS:

1) Test and validate NIRS for determining forage quality.
2) Test and validate NIRS for other ingredients.
3) Define infrared spectral properties for feed utilization in ruminants.
4) Facilitate transfer of NIRS technology.
5) Establish and maintain a reference of feedstuffs for calibration.
6) Establish standards for conducting NIRS analyses.

The advantages of such a modern system outweigh the disadvantages. The usefulness of such a system for Kansas agriculture seems straightforward. Its initiation, execution, and ultimate success would appear to require a joint effort among farmers, industry, the universities, and the state legislature.

Neil Wallace prepares buffers in the rumen microbiology laboratory