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Feed-Composition Project in Latin America

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INTRODUCTION

Developments in the field of animal nutrition in recent years indicate that some systems of feed analysis and methods of computing livestock diets should be modified. Expanded knowledge of feed composition and nutrient requirements of animals has emphasized the importance of adopting more precise methods of balancing animal diets. Two factors contributing to more precise balancing of animal diets are the use of the calorie system for expressing energy requirements and a systematic nomenclature of feeds. The calorie system utilizes digestible, metabolizable, and net energy values for stating nutrient requirements and for characterizing feeds. The nomenclature system used for feeds describes precisely the origin and nature of the product so that the analytical data become more meaningful. These systems are adapted to natural feedstuffs and by-products from the processing of human and animal feeds.

Knowledge of feed composition is essential for proper feeding of livestock. Little is known concerning the composition of many feeds throughout the world. North American and European feed-composition data have been applied in balancing livestock rations; therefore, more local data are needed. Although information is available in many parts

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of the world, much of it is not widely published or distributed. Composition tables derived from representative world feeds are not generally available. The Latin-American feed-composition project was initiated to gather data from which local tables can be developed. These data, supplemented with National Research Council data, will provide more meaningful information for balancing livestock diets. Collaborating laboratories will receive composition tables and computer summaries of the analyzed data.

OBJECTIVES

The objectives of the project are (1) to collect accumulated data on the composition of feeds, (2) to devise a record system that can be used in nutrition laboratories to describe and record chemical and biological data on feeds, and (3) to publish feed-composition tables. The system described by Harris *et al* (1968) has been followed for data retrieval.

International Feed Nomenclature

More than 7,000 feedstuffs have been given international names. When "common names" were examined, more than 20 percent of them were found to be duplicate names for products used in different parts of the world. This duplication complicated identification of feedstuffs. The nomenclature system now in widespread use in North America was designed to minimize identification problems by assigning descriptive names to feedstuffs and to offer a system with the potential for international standardization. The international name should describe the feed, genotypically and morphologically; define the quality or grade, if applicable; and indicate the nutritional composition class into which the feed falls.

There are eight name components, each contributing specific information in describing the feedstuff (Harris *et al.*, 1968). These components are named below:

- Scientific name. Both genus and species are given with reference to the parent substance from which the material originates. The feed name begins with the scientific term and can be listed alphabetically for official definitions and in tabulating analytical data.
- Origin, species, and variety. This component lists the common feed names that correspond to a given scientific name. When the variety or kind has a marked nutritional influence (e.g., high-lysine corn or hard

versus soft wheat), this information is included in the name. When differences due to variety are not significant, the variety term is omitted.

- Part eaten. This component refers to the part of the parent material that is consumed. Thus, with a cereal grain, an animal can eat the grain, the straw, or the chaff. In today's technology, fractionation of plant and animal by-products provides innumerable products useful as animal feeds.
- Processes and treatments. When feedstuffs have been processed (by heating, grinding, sifting, extracting, digesting, pelleting. etc.), their nutritive value and means of identification may have changed substantially. This component reflects changes that processed feeds may have undergone before being fed to animals.
- Stage of maturity. Because of the presence of lignin and cellulosic materials, the nutritive values of roughages are affected by the stage of maturity. Stages of maturity are defined in terms of vegetative phases or by the number of days of growth.
- Cutting or crop. This refers to the number of harvests per year.
- Official grade or number. Nutritive quality of a feedstuff is often reflected by assigning a grade or number. When one of these is applicable, it becomes a name component.
- Classification. All feedstuffs have been grouped into eight classes: dry forage or roughage, succulent forage or roughage, silages, energy feeds, protein supplements, mineral supplements, vitamin supplements, and additives. The classes are based on nutritional composition of the feeds.

Here is an example of a feed name: *Medicago sativa*, alfalfa, ranger, leaves, dehy grnd pelleted, early bloom, cut 1, gr 1, (1). All eight components are represented. In some feeds—e.g., *Zea mays*, corn, grain, grnd, (4)—some components do not apply.

International Record System

The international record system provides a unified system of handling laboratory data. It allows for direct transfer to an electronic computer system and for maintenance of a master file. The system assigns an arbitrary number to each project and to each experiment within a project. It is recommended that the project or experiment number be a two-part number, the first part indicating the year and the second part indicating the project. A master listing of the project number, title, and project director should be maintained in a bound book. Laboratory samples should be labeled and identified as they are collected. The

identifying project, experiment, and laboratory sample numbers should be carried with the data for identification in the master record file and in the computer data bank.

Collecting Feed-Composition Data

The project is gathering analytical data for feeds grown in different parts of the world. Present efforts are focused in Latin America. An instructional booklet has been written that outlines research procedures for organizing a project or experiment and for collecting and labeling samples for analysis. A data source form for recording analytical feed data and a glossary of feed terms are included. The calorie system for balancing livestock diets is outlined. Several chemical and biological methods used in determining feed analyses are presented.

An international data source form has been devised for collecting feed-composition data and is available to laboratories wishing to collaborate in the project. The form includes space to record information about the sample, information about digestibility trials if conducted on the sample, and data from the chemical and biological analyses of the feed. These forms are prepared to allow a control file of analyses and to provide a duplicate copy of the analyses for the project center at the University of Florida. At the project center, the information will be put into an IBM data bank and, periodically, electronic computer summaries will be completed.

Summarizing Feed-Composition Data

For ease of electronic computer identification, feeds are assigned an international reference number and cataloged in an international name file. The assigned numbers, identifiable by computers, provide positive and continued identification for feeds.

The feed sample data are punched into four computer card forms. Forms 1 and 2 refer to the origin and description of the sample. Form 3 refers to the digestibility trial data, if applicable. Form 4 refers to the chemical and biological data, the digestion coefficients, energy values, and dry-matter basis.

The raw data are converted to a uniform system—i.e., metric units standard terminology—and values are expressed on a 100 percent dry-matter basis. Values for each nutrient in a given feed are totaled, means calculated, and coefficients of variation determined. Nitrogen-free extract (NFE) is calculated from the average proximate composition. Digestible protein and energy may be calculated from given digestion

coefficients or estimated by equations programmed into the computer system. Equations for estimating metabolizable and net energy, for TDN (total digestible nutrients), and for vitamin A equivalents are available in the summarization system if the values are not reported. The summarized data are dovetailed with the name file to print feed-composition tables, including the international feed name, and all available chemical and biological feed data for that feed. All data are reported on an as-fed and a 100 percent dry-matter basis.

Tables of Feed Composition

To ensure proper identification, the scientific name of the feed, the international name and reference number, and other common names are used in the tables of feed composition. A coding system is being developed to show the ecological region in which the feed sample originated. With sufficient information, the following data for each feed sample can be listed in the tables: dry matter, ash, crude fiber, ether extract, NFE, crude protein, digestible protein, cellulose, lignin, gross energy, digestible energy, metabolizable energy, net energy, total digestible nutrients, minerals, vitamins, and amino acids. Digestible protein, metabolizable energy, net energy, and total digestible nutrient values are given for the appropriate animal species, and net energy values are partitioned for maintenance and production (gain, pregnancy, milk, eggs, and work) when applicable.

When at least four sample analyses for a given feed have been included, the coefficient of variability is given in the tables.

CLASSIFICATION OF ECOLOGICAL ORIGINS OF FEEDSTUFFS

The source form used to record composition data is also designed to locate the origin of the feedstuff. If the origin is recorded only as the country of origin, the data may be of limited use because of the environmental variations found in tropical countries. If certain of the major environmental factors could be recorded, the statement would be more meaningful because it would indicate differences in composition due to ecological influences. It would also provide a more accurate means of comparing the nutrient properties of feedstuffs from different parts of the world.

Therefore, in addition to stating the origin of the feed by country, state, and county, the source form incorporates four environmental factors: latitude, altitude, mean annual precipitation, and biotempera-

ture. These four factors are the same as those used by Holdridge (1967) for classifying ecological life zones.

Latitude, rainfall, and biotemperature are each assigned a single numerical character in a factorial manner according to their values in the appropriate range of the continuum. Since the ranges of the continuum for altitude are not constant in the Holdridge system, altitudinal values are maintained in meters. This enables the life zone to be identified by a two-part seven-digit number. The first part is composed of the three digits corresponding to the coded numerical characters for latitude, biotemperature, and rainfall. The second part is the four-digit value for altitude in meters. Since each feedstuff is precisely identified by the assigned reference number, a step linear regression equation will allow comparison of samples of the same feedstuff grown under similar environmental conditions but in different geographical areas and an evaluation of the same feedstuff grown in different ecological life zones. This same technique will be used to determine the effects of latitude, altitude, rainfall, and biotemperature.

SUMMARY

The feed-composition project is designed to standardize feed-evaluation systems, to provide more precise data, and to provide systematic compatability for computer summarization and linear programming. A descriptive nomenclature system, an international reference number, and a name file are used for identifying feeds. A booklet of instructions amd a data-source form for recording analytical feed data are used in collecting feed-composition information. The collected data are coded, cataloged, and summarized for use in developing feed-composition tables. The summarized data, showing the applicable feed components, are used to construct tables for use in calculating diets and mixtures of feeds for livestock consumption.

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