Oct. 23, 1981

SUMMARY CRIS WORK UNITS (FY 1982)

I. Research Unit: Field Crops Research Unit

USDA, ARS
Field Crops Research Unit
R. B. Russell Agricultural Research Center
P. 0. Box 5677
Athens, GA 30613

II. Program Mission Statement:

Fundamental and applied research is conducted on the chemical composition and nutritive value of Southern field crops including forages and oilseeds. Emphasis is placed on identifying and modifying the anatomical, chemical, and biochemical factors limiting animal performance and to develop low cost feeds of improved nutritive value to support economical expansion of the region's livestock and poultry industry. Procedures are developed for converting forages and other feedstuffs into high energy products for more efficient utilization alone or in balanced or complete rations. Development and application of improved analytical techniques such as near infrared-reflectance spectroscopy to rapidly predict the nutritive value of forages and feeds are investigated. Procedures are developed for terminally processing feeds to significantly reduce salmonella contamination. New and improved methods are developed for determining total oil and moisture of sunflower seed. Information on the origin, composition, and elimination of waxes in sunflower oil from new hybrids are developed. The effects of variable temperature and moisture storage condition on microbial and chemical changes in sunflower are investigated.

III. Research Unit Leader:

James A. Robertson
Supervisory Research Chemist
FTS 250-3318

IV. Program Identification:

20521 - Technologies for food and feed uses - field crops

CRIS Work Unit No.: 7712-20521-001

Title: Develop improved technology for production of low cost quality feed products from Southern forages

Project Leaders: D. Burdick and R. R. Spencer (Mr. Spencer's efforts have been redirected to CRIS 7712-20521-014)

Date Initiated: February 10, 1977

Scheduled Termination Date: February 10, 1982

Reason for Doing the Research:

The value of forage crops (grass and legumes) produced each year exceeds the value of any other farm crop. It has been estimated that under favorable hay drying conditions, 21-24% of these crops (dry matter) are lost in harvesting. Field losses can be reduced to 8-12% by preserving the forages as silage. Direct cutting and dehydration can reduce dry matter losses to ~5%. Nutrient losses also vary depending on the harvesting and processing methods employed. Southern forages, i.e., Coastal bermudagrass, can be processed using these three basic harvesting methods. Harvesting losses such as dry matter, protein, carotene, xanthophyll, have not been determined for most Southern forages. In this period of rising fuel costs, the conservation of fuel is also a major concern of Southern forage producers and users. Both alfalfa and Coastal bermudagrass are commercially dehydrated for use in poultry feeds as xanthophyll sources for pigmenting broilers and egg yolks. Although harvesting and processing conditions have been known to affect the amount of xanthophyll in these products, only recently have data been obtained indicating that biological availability also may be affected. Preliminary studies have shown differences in the biological availability of xanthoohyll in dehydrated Coastal bermudagrass that may be related to the age of the crop at harvest and to harvesting conditions. This difference in biological availability is important as both the alfalfa and Coastal bermudagrass dehydration industries are currently resorting to partial field drying (sun curing) to conserve energy. While partial field drying (six hours) results in about a 50% savings in the amount of fossil fuel needed for complete dehydration, there is only about a 15% loss in xanthophyll. Information, however, is needed on the biological availability of the xanthophyll in these field dried-dehydrated products.

Objectives:

To develop practical methods of processing Southern forages, i.e., sun curing for hay, wilting for silage, partial field drying and dehydration, to conserve energy and increase nutritive value and feed efficiency. To study quality losses, i.e., dry matter, protein, carotene, and xanthophyll, in the processing of Southern forages.

Most Significant Results to Date:

Studies on the dehydration of Coastal bermudagrass have shown that 35-40% of the fuel required can be saved by wilting for 4-6 hours before dehydration.

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Wilting has minimum effect on the quality of the dehydrated product. Haying studies have shown that dry matter and quality losses are related to the moisture content of the hay at the time of baling. Very little losses occurred when the hay was baled at moisture contents above 15%. No mold was observed in hay baled up to 25% moisture. The rate and extent of rumen digestion of Coastal bemrudagrass can be improved by 10-20 percentage units by treatment with alkali either before or during the pelleting process. Samples of pelleted alfalfa and Coastal bermudaqrass, fresh, direct dehydrated and wilted and dehydrated, have been obtained. Both the fresh harvested forage and pellets are currently being analyzed for carotene and xanthophyll. The biological availability trial with laying hens is to commence in a few days.

Publications:

1. Spencer, R. R. Field wilting and field losses of Coastal bermudagrass during hay production. Proc. Eighth Research Industry Conference Coastal Bermudagrass Processors' Association, pp. 80-86. 1978.

2. Albrecht, W. J. Evaluation of a simple low cost solar collector for drying forages. Proc. Eiqhth Research Industry Conference Coastal Bermudagrass Processors' Association, pp. 87-94. 1978.

3. Spencer, R. R. and D. E. Akin. Rumen microbial degradation of potassium hydroxide treated CBG leaf blades examined by electron microscopy. J. Animal Science 51:1186. 1980.

4. Spencer, R. R. and J. K. Thomas. Effects of field curing on quality and yield of CBG hay, Proc. Tenth Research Industry Conference Coastal Bermudagrass Processors' Association, pp. 12-18. 1980.

5. Burdick, D., R. R. Spencer, and G. 0. Kohler. Processing and Utilization of Forage Crops. Chapter in Volume II. Plant Products, ed. by I. A. Wolff. Chemical Rubber Company Handbook. 1981.

CRIS Work Unit No.: 7712-20521-002

Title: Conversion of Southern forages into feedstuffs of improved nutritive value by controlled fermentation

Project Leader: Frank McHan

Date Initiated: March 17, 1977
Scheduled Termination Date: March 17, 1982
Reason for Doing the Research:
Reliable estimates indicate that total annual production of silage in the U. S. is currently in excess of 150 million tons; also this silage currently provides over $2 billion dollars worth of feed for our livestock industry. At present, average annual production of silage in the 13 Southern states is estimated at about 30 million tons. The ensiling process as carried out under practical farm operations is still more an "art" than a "science". This is because we still do not know all the factors influencing the processes involved in forage fermentation. Oftentimes, poor quality silage is produced and the reason(s) are unknown. As the quality of silage often determines the success or failure of the entire feeding program, it is important that conditions for consistently producing quality silage be identified. In addition, the average farmer that makes silage is unable to experiment on better ways to get better silage. This work must be done by the USDA since no industry will invest the time and resources necessary to answer the vital questions of good silage production.

Objectives:

To develop new or improved microbial and chemical techniques for improving or retaining the nutritive value of harvested southern forage. Also, the development of new or improved techniques for measuring nutrients and analyzing for various chemical constituents that may be present in forage and silage being studied.

Most Significant Results to Date:

Pretreatment of forage by formic acid-formaldehyde before ensiling have been shown to produce an additive effect on preservation of proteins in silage, and these proteins thus can be utilized at a later time by the ruminant. This can result in an energy savings for the ruminant. Forage, with a low soluble carbohydrate content and pretreated before ensiling with an enzyme like cellulase, caused the soluble sugar content of the silage to be raised. Raising the soluble sugar content of the forage helps insure a more favorable fermentation of the ensiled material. Silage acids, which lower the pH and preserve the forage, are produced from soluble sugars. A technique has been developed for extracting and measuring all the major silage acids by use of gas chromatography. Another GLC technique has been developed to more accurately measure the moisture content (or determine dry matter) of forage silage. Time to determine moisture (or dry matter) was reduced from 2-10 hours to approximately 15 minutes per sample.

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Publications:

McHan, Frank. Fermentation of Coastal bermudagrass silage in the laboratory. Proceedings of the Eighth Research-Industry Conference of the Coastal Bermuda-grass Processors' Association. 8:1. 1978.

McHan, Frank, Roland Spencer, John Evans, and Donald Burdick. Composition of high and low moisture Coastal bermudagrass ensiled under laboratory conditions. Journal of Dairy Science 62:1606. 1979.

McHan, Frank and Donald Burdick. Effects of cellulolytic microorganisms on fermentation of Coastal bermudagrass silage. Proceedings of the Tenth Research-Industry Conference of the Coastal Bermudagrass Processors' Association 10:52. 1980.

Fishman, M. L., Frank McHan, and Donald Burdick. The effects of formic acid/formaldehyde treatment on the nitrogenous constituents in annual ryegrass. Proceedings XIV International Grassland Congress, Lexington, Kentucky, June 15-24, 1981. (Accepted for publication).

Personnel Assigned:

Microbiologist	1.0 SY
Biological Aid	1.0 MY

CRIS Work Unit No.: 7712-20521-004

Title: Ultrastructure of Southern forages as related to nutritive value

Project Leaders: F. E. Barton, II, D. E. Akin, and D. Burdick

Date Initiated: March 2, 1977

Scheduled Termination Date: March 2, 1982. (Work on this project has been terminated and redirected to 7712-20521-014).

Reason for Doing the Research:

For more than a century, the Weende procedures have been used to assess the quality of forages and have not provided agronomists, plant breeders, or nutritionists with the necessary data to optimize the forage-livestock system. The differences in animal performance on different species and cultivars cannot be answered by the differences in crude protein and fiber. New methods of looking at forages and assessing quality are needed. This project combines chemistry, microbiology, and animal nutrition to determine what and how the structural fractures of the plant cell wall affect digestibility. To accomplish this, the techniques of electron microscopy, NMR-spectroscopy, NIR-reflectance spectroscopy, and HPLC and GC-chromatography as well as gravimetric techniques are used to examine the plant cell wall for amount, site, and structure of lignin, constituent sugars, and the digestion of various plant cell wall components by rumen microorganisms. This will be a survey of bermudaqrass and representative cool-season species.

Objectives:

1. Determine site of lignification.

2. Rate and extent of digestion

3. ^{13}C-NMR of lignin

4. Make-up of the constituent sugars in the "hemicellulose" fraction.

Most Significant Results to Date:

Specific interrelationships between fiber-digesting rumen bacteria and forage cell walls of various nutritive qualities were identified and related to fiber digestion using anaerobic culturing methods and electron microscopy. For the lower quality warm-season forage (bermudagrass) cell walls were rigid, slowly degraded, and often required direct bacterial attachment prior to degradation. Also, these warm season forages elicited fewer total bacteria and fiber-digesting bacteria than cool season grasses. Structural studies at the molecular level have shown that a five-carbon sugar and the lignin aromatic moiety to which it was bound have been identified from the carbon-13 nuclear magnetic resonance (^{13}C-NMR) spectrum of an isolated lignin carbo-hydrate complex following ozonalysis. Currently, near-infrared reflectance spectroscopy is being used to determine structural differences as related to quality and

to predict composition and quality. When the instrument is properly calibrated, 19 different feeds and forage types and six different constituents can be determined in about 20 sec for each set of 6 values.

Publications:

Twenty-two to date (list may be obtained from Field Crops Research Unit, RRC).

CRIS Work Unit Mo.: 7712-20521-005

Title: Improved forage protein utilization in ruminants as affected by digestible energy

Project Leader: W. R. Windham

Date Initiated: October 6, 1978

Scheduled Termination Date: October 6, 1981

Reason for Doing the Research:

Earlier research had indicated that treatment of Coastal bermudagrass (CBG) with formaldehyde (1% dry matter basis) would increase the quantity of forage protein reaching the abomasum for digestion and absorption as amino acids in the small intestine dramatically (approximate increase 1.7 fold relative to untreated CBG). However, when such a treated CBG diet was fed to growing ruminants, no increase in protein retention occurred. This latter observation suggests that energy or glucose per se may have been limiting amino acid utilization in the growing ruminant. The present studies were undertaken to determine the influence of glucose infusion on amino acid utilization after absorption. Base treatment of the forage is known to increase organic matter digestibility (hence, increased energy availability). Formaldehyde and base treatment were combined in an attempt to provide energy from the forage. Results, from a protein viewpoint, were not encouraging because passage rates were increased by the base and protein digestibility was decreased. Glucose infusions were quite positive in that protein retention and plasma amino acid concentration were decreased and accompanied by significant decreases in urinary nitrogen. Overall results from the research point out a need for continued research in this area to identify suitable energy sources which will increase protein utilization and not affect digestibility of the forage fiber or forage protein.

Objectives:

Maximize the use of protein in Southern forages by increasing the amount of digestible energy available to the ruminant for tissue protein synthesis.
(1) Determine the effects of increasing the metabolizable energy supply in ruminant diet on the efficiency of utilization of forage protein from formaldehyde-treated and untreated Coastal bermudagrass hay.
(2) Increase the efficiency of conversion of forage protein and gross energy to edible animal products by maximizing protein and energy available and utilized from CBG by combining formaldehyde and alkali treatments.

Most Significant Results to Date:

The efficiency of converting Coastal bermudagrass protein to animal protein can be increased when the intake of metabolizable energy is increased. The data suggest an insulin-glucose interaction at the tissue level when the increased energy is provided by glucose per se. Glucose resulted in large decreases in

plasma amino acids and urinary nitrogen with a concomitant increase in protein retention by growing ruminants. Digestible energy and presumably metabolizable energy can be increased by base treating (NaOH) the forage before feeding; however, level of base treatment appears to be critical to avoid decreasing crude protein digestibility and subsequent protein balance.

Publications:

1. Moore, C. K., H. E. Amos, J. J. Evans, R. S. Lowrey, and D. Burdick. Nitrogen balance, abomasal amino acids, abomasal crude protein, and amino acids in wethers fed formaldehyde-treated Coastal bermudagrass and infused with methionine, glucose, and monensin. J. Anim. Sci. 50:1145-1159. 1980.

2. Moore, C. K., H. E. Amos, R. S. Lowrey, J. J. Evans, and D. Burdick. Influence of abomasal infusions of glucose and methionine on nitrogen balance in wethers. Abstr. An. Mtg., Southern Section, American Society of Animal Science, p. 45. 1979.

3. Amos, H. E. and J. J. Evans. Influence of glucose addition and formaldehyde treatment of forage diets on nitrogen metabolism and fiber digestion in wethers. J. Anim. Sci. 48:354. (Supplement 1, Abstract). 1979.

4. Amos, H. E. and J. J. Evans. Nitrogen metabolism of growing lambs fed Coastal bermudagrass as influenced by formaldehyde or glucose. J. Anim. Sci. 51:712-721; 1980.

5. Amos, H. E., J. J. Evans, D. S. Himmelsbach, and F. E. Barton, II. In vitro stability, in vivo hydrolysis and absorption of lysine and methionine from polymerized amino acid preparations. J. Ag. and Fd. Chem. 28:1250-1254. 1980,

6. Amos, H. E., J. J. Evans, and D. Burdick. Influence of added energy on Coastal bermudagrass utilization by ruminants. Proc. Tenth Research Industry Conference, Coastal Bermudagrass Processors' Association, pp. 34-44. 1980.

CRIS Work Unit No.: 7712-20521-007

Title: Application of near-infrared reflectance spectroscopy to predict forage quality

Project Leader: F. E. Barton, II

Date Initiated: July 30, 1981

Scheduled Termination Date: July 30, 1986 Reason

for Doing the Research:

The measurement or determination of forage quality has traditionally been an "after the fact" analysis. That is, by the time all the analyses were finished, the forage had already been fed or the selection of a cultivar from a plant breeding trial had already been made. There has not been an accurate rapid means of analyzing large numbers of samples. Near infrared reflectance (NIR) and linear regression analysis techniques can now be used to predict 6-10 constituents in as little as 40 seconds per sample. This means hundreds of samples can be run in a day's time. Research is being conducted to evaluate the technique and state of the art equipment as well as elucidate the structural features of the plants spectrum which are related to forage quality.

Objectives:

1. Identify chemical and physical characteristics of forages which determine their spectral properties.

2. Evaluate the near-infrared method on forages of widely different quality, species, and environments.

3. Use the near-infrared method to assist in the interpretation of animal data based upon collection trials and the feed materials.

Most Significant Results to Date:

Calibrations have been obtained from a filter-NIR reflectance spectrometer which are adequate to give good predicted values for freeze-dried and hay samples of bermudagrass. Preliminary studies are underway with a new monochrometer NIR reflectance spectrometer. Previous cooperative work with USDA, El Reno, OK, has shown good results for Old World Bluestem and a current project between the two labs is investigating Eastern gamma grass. From a theoretical viewpoint, results have shown that the optimal width of the derivative treatment can be preselected by examination of the log 1/R spectrum.

Publications:

1. Barton, F. E., II and D. Burdick. J. Agric. and Food Chem. 27:1248. 1979.

2. Burdick, D., Barton, F. E., II, and Nelson, B. D. Agron. J. 73:399. 1981.

3. Barton, F. E., II and Burdick, D. Proc. 8th Res. Ind. Conf., Coastal Bermuda-grass Processors Association. 1978.

Barton, F. E., II and Burdick, D. Proc. 10th Res. Ind. Conf., Coastal Bermudagrass Processors Assoc. 1980.

5. Barton, F. E. and Coleman, S. W. Okla. Agric. Exp. Stn. Res. Rep. 1981.

Personnel Assigned:

Research Chemist	0.5 SY
Animal Physiologist	0.2 SY

CRIS Work Unit No.: 7712-20521-008

Title: Enzymatic and Chemical Control of Lignification to Increase Forage Digestibility for Ruminants

Project Leader: John J. Evans

Date Initiated: May 9, 1980

Scheduled Termination Date: May 9, 1983

Reason for Doing the Research:

Numerous research studies show that lignification reduces digestibility of forages by the ruminant animal. Although it is known that lignification increases with plant maturity (senescence), a paucity of information exists on the control of lignification in plants. In general, lignification reduces plant size and increases toughness (rigidity) of plant tissues. As a result, harvesting is difficult, and greater energy is required than with less lignified forages. Lignin also makes the forage more difficult to masticate and reduces digestibility and intake. The endogenous plant enzyme, peroxidase, mediates the lignification of cell walls in plants. This lignification is dependent on the presence of peroxidase and lignin precursors. Peroxidase also destroys the plant hormone indole-3-acetic acid (IAA). IAA is responsible for cell elongation and endogenous destruction of this hormone by peroxidase results in inhibition of plant growth. Inhibition or control of peroxidase and/or the lignin precursors would result in decreased lignification. Beneficial effects of decreased lignification would include increased plant mass and production of more digestible forage material.

Objectives:

1. Determine the effects of plant growth hormones and lignin precursors on the morphology and growth of warm and cool season grasses.

2. Determine the relationship between peroxidase activity in these forages with the degree of lignification.

3. Modify lignin deposition in the forage cell walls and relate these changes to *in vitro* digestibi1ity.

Most Significant Results to Date:

Three warm-season and three cool-season grasses were treated with the plant hormones indole-3-acetic acid (IAA), gibberillic acid (GA), and kinetin (K). Gibberillic acid produced the greatest growth response in the grasses resulting in plants 2-4 times as tall as the controls. Application of lignin precursors (coumaric, sinapic, and ferulic acids) resulted in no increase in growth rate and in some cases resulted in a decreased growth rate.

Publications: None

Personnel Assigned:

Research chemist 1.0 SY; Biological aid 1.0 MY

CRIS Work Unit No.: 7712-20521-009

Title: New or improved methods for determination of total oil and moisture in sunflower seed

Project Leader: J. A. Robertson

Date Initiated: March 2, 1977

Scheduled Termination Date: March 2, 1982

Reason for Doing the Research:

There are no federal standards for sunflower seed and oil, and when the project was initiated, there were no official methods for sunflower seed. Thus, the Oilseed Crops Research Unit cooperated with the Federal Grain Inspection Service, the Sunflower Association of America's Grades and Standards Technical Committee, and the AOCS Smalley Committee to develop an official oil method for domestic trading of sunflower seed and to certify laboratories performing oil analyses. New and rapid instrumental methods such as wide-line nuclear magnetic resonance (NMR) and near-infrared reflectance spectroscopy (NIR) needed to be evaluated to determine their applicability for use in sunflower seed analysis. Studies needed to be conducted to determine the optimum instrumental parameters for oil analysis and to compare NMR and NIR with the standard extraction method.

Objectives:

Develop new or improved methods to determine total oil and moisture in sunflower seed utilizing instrumental and extraction-gravimetric methods to provide methodology urgently required for domestic and export trading of sunflowers and to promote expanded production of the crop.

Most Significant Results to Date:

The AOCS Sunflower Seed and Meal Analysis Subcommittee, J. A. Robertson, Chairman, was responsible for the development of the following AOCS Official Methods for sunflower seed: Sampling, moisture and volatile matter, oil content and protein content. In addition, a NMR procedure prepared by J. A. Robertson is now being used to determine oil content of sunflower seed in domestic trading. Studies have shown that wide-line NMR can be used to rapidly and accurately determine oil content of sunflower seed.

Publications:

1. Robertson, J. A., W. H. Morrison, and D. C. Zimmerman. USDA Utilization Research on Sunflower. Proc. Sunflower Forum, Fargo, N.D. January 23, 1979. pp. 23-25.

2. Robertson, J. A. and W. H. Morrison. Analysis of Oil Content of Sunflower Seed by Wide-line NMR. JAOCS 56:961-964. 1979.

3. Robertson, J. A. and W. R. Windham. Comparative Study of Methods of Determining Oil Content of Sunflower Seed. JAOCS 58: In press. November, 1981.

Personnel Assigned:

Research Chemist 0.4 SY

CRIS Work Unit No.: 7712-20521-011

Title: Identify and characterize sunflower seed waxes and their effects on oil quality

Project Leader: W. H. Morrison, III

Date Initiated; June 17, 1980

Scheduled Termination Date: June 17, 1983

Reason for Doing the Research:

With the introduction of newly developed high-oil hybrid sunflower seed, there have been reports of an increased wax content in the oil from hybrid seed as compared to the wax content in the oil from open pollinated varieties. Although not harmful to health, waxes form a cloudy haze in the oil which is unacceptable to the American consumer. In addition, there is no rapid method of determining the wax content which is applicable to both crude and processed oil. Information gained from these studies will aid plant breeders in developing hybrids with reduced wax content. The development of a rapid method for determining wax content will greatly facilitate on line quality control of processed oil as well as aiding the newly developing area of sunflower oil as a fuel where wax can affect fuel efficiency.

Objectives:

To isolate and identify the wax components of new sunflower hybrids and to develop a rapid, accurate method for determining wax content of sunflower oil in order to determine the wax level associated with cloud formation in liquid salad oil.

Most Significant Results to Date:

Samples of hybrid and open pollinated sunflower seed have been separated into kernel, seed coat or testa, and hull. Wax content was run on the extract from each fraction and the hull was found to be the exclusive source of wax in the sunflower seed. Wax was found to be on the surface of the hull since abrasive surface polishing or washing the seed with a solvent removed a large percentage of these waxes. Wax content was inversely proportional to the hull content. Microscopic examination revealed structural differences which could account for the reported increase in wax content of oil from hybrid seed. Three genetically different hybrid seed grown at six different locations were analyzed to determine if hull and wax content is related to genetic factors within the seed and/or variations in growing conditions. A rapid method for determining wax has been developed using a 50/50 mixture of oil and acetone which is cooled in an ice bath for five minutes then evaluated turbidimetrically for wax content. This method appears quite suitable for both crude and processed oil.

Publications:

Morrison, W. H., III, D. Akin, and J. A. Robertson. Open pollinated and hybrid sunflower seed structures that may affect processing for oil. JAOCS 58: . 1981.

Morrison, W. H., III. Sunflower lecithin. JAOCS: in press.

Personnel Assigned:
Research chemists 1.1 SY; Physical science technician 0.5 MY

CRIS Work Unit No.: 7712-20521-013

Title: Effect of storage conditions on chemical and microbial deterioration of hybrid sunflower seed

Project Leader: J. A. Robertson

Date Initiated: July 30, 1981

Scheduled Termination Date: July 30, 1985

Reason for Doing the Research:

The record 1979 U. S. oilseed sunflower crop produced 3.18 million metric tons of seed, and for the first time in the short history of the crop, there was a carry over of 1 million metric tons of seed into the 1980 crop year. Because of late harvest in 1979, a substantial portion of the crop went into storage at high moisture. As a result, heat damage, high free fatty acids, presence of visible molds, and one incidence of aflatoxin contamination were reported.

Conflicting information exists in the literature and for industry on the optimum and safe storage conditions for sunflowers and no research has been reported on hybrid seed. A wide range of "safe" moisture levels are currently recommended (6-10%) which supposedly minimizes microflora invasion and maintains good seed quality during storage. More information is needed on the different kinds of fungi that invade and grow in stored sunflower seed. Dr. S. A. Watson, Coordinator of the NC-151 national project on improvement of quality of marketed cereals and grains states, "Identification of the mold species invading sunflower seeds under various conditions and their effect on oil quality is a major research area yet to be addressed." The degree of heat damage is a major index of seed quality and is based on visual observation of seed discoloration. Information needs to be developed on the relationship between heat damage and free fatty acids.

Objectives:

(a) To develop information on the effect of storage conditions on hybrid sunflower seed in relation to the growth of fungi and changes in seed germination, composition, and quality,
(b) To determine the relationship between heat damage and free fatty acids to aid in the establishment of realistic standards for sunflower seeds, and
(c) To determine the minimum storage conditions for the elaboration of aflatoxin in stored seed.

Most Significant Results to Date: None

Publications: None

Personnel Assigned:

Research Chemists	1.4 SY
Physical Science Technician	0.5 MY

CRIS Work Unit No.: 7712-20521-014

Title: Investigations of chemical and biological structure, in forages as related to quality

Project Leaders: F. E. Barton, II, D. E. Akin, and R. R. Spencer

Date Initiated: July 30, 1981

Scheduled Termination Date: July 30, 1986

Reason for Doing the Research:

Despite grassland resources of about 600 million acres and annual hay production (excluding alfalfa) of about 50 million tons, many of our forage grasses, especially those in the warmer, southern states, while being productive, are low in quality primarily due to poor cell wall digestibility. Research proposed herein would provide basic information into the inherent limitations of cell wall digestibility and provide insight into potential applied research to improve fiber quality.

Current technology has reached a high degree of sophistication such that spectroscopic and microscopic methodologies are available to analyze chemical and biological structure in situ to gain understanding of the role of specific factors in the structurally intact cell wall that influence quality. Specifically, samples will be analyzed by nuclear magnetic resonance (NMR) spectroscopy, gas liquid chromatography (GLC), high pressure liquid chromatography (HPLC), light and electron microscopy with complementary x-ray analysis for structural factors that limit forage quality.

Objectives:

1. Investigate forages, especially warm-season species, to determine basic information concerning influence of species, maturity, and environmental stress (drought and temperature) on chemical and biological structures of the plant cell wall and how these structures are affected by rumen microorganisms.

2. Investigate modifications to forage structure brought about by chemical, biochemical, and genetic means for improved quality.

Most Significant Results to Date:

Results of a preliminary study of environmental stress on Old World Bluestem and lovegrass indicate the high temperature alone does not adversely affect quality for these grasses. Evidence from Texas A & M on Kleingrass supports this. Each species can cope with drought and temperature differently and thus the effect on quality is not always the same. Preliminary results from solid phase 13C-NMR studies of forages and forage fractions indicate that it may be possible to use this new technique to measure forage quality. The ratio of integrated intensities from the solid phase ^{13}c-NMR spectra of Coastal bermudagrass and Kentucky-31 tall fescue

compare favorably with the ratio of compositional analysis results by gravimetric procedures (i.e., ADF, NDF, lignin, CP) and NIR-predicted results.

Publications:

This is a revision of CRIS 7712-20521-004 (see attached).

1. Barton, F. E., II, Akin, D. E., and Windham, W. R. Scanning electron microscopy of acid detergent fiber digestion by rumen microorganisms. (Accepted by J. Agric. Food Chem. on February 27, 1981).

2. Barton, F. E., II, Himmelsbach, D. S. and Amos, H. E. Nitrogen-15 NMR of the amorphous polymer of lysine-formaldehyde urea. J. Agric. Food Chem. 29:669-671. 1981.

Personnel Assigned:

Research Chemist	1.3 SY
Microbiologist	1.0 SY
Animal Physiologist	0.3 SY
Support Chemist	1.0 SY
Technician	1.0 MY
Physical Science Aids (S/S)	1.0 MY

CRIS Work Unit No.: 7008-20521-012A (Coop. Agreement)

Title: Studies of plant structure related to forage quality and quantity

Project Leaders: D. E. Akin and R. H. Brown (Agronomy Department, University of Georgia)

Date Initiated: June 11, 1981

Scheduled Termination Date: September 30, 1982

Reason for Doing the Research:

There is a current and urgent need for basic research on plant structure as related to forage quality and quantity with the ultimate objective of improving plant yield and quality for improved forages to more efficiently produce meat and dairy products. In addition, there is a need to conduct studies on anatomical and ultrastructural factors that potentially could be modified to improve forage yield and quality. The cooperative research to be conducted under this Cooperative Agreement will be for the mutual benefit of the forage research at the University of Georgia and the Russell Research Center.

Objectives:

To determine the relationship of plant anatomy and ultrastructure in leaf blades of species of C_3, C_4 and intermediate forages related to physiological processes involved in photosynthesis and to forage quality. Studies will include: (a) growth and care of species that have widely different leaf anatomies to have an adequate supply of material at specified maturities; (b) evaluate species for processes, e.g., photorespiration, and relate these processes to plant anatomy; and (c) identify the characteristics in forage species that reduce agronomic quality, especially factors that affect rumen microbial population and growth and digestibility of specific tissue types.

Most Significant Results to Date: None

Publications: None

Personnel Assigned:

Professional:	0.2 SY
Technical	1.0 TY

CRIS Work Unit No.: 7712-01011-001

Title: Eliminate salmonella from poultry feeds by pelleting and other process modifications and treatments

Project Leaders: D. Burdick and R. R. Spencer

Date Initiated: September 30, 1980

Scheduled Termination Date: September 30, 1983

Reason for Doing the Research:

Salmonella infection of poultry causes reduced production efficiency and increased production costs to the poultry producers. Meat products produced from infected poultry can also be infected with salmonella causing a public health problem. USDA Livestock and Veterinary scientists are particularly concerned with the related production problems. Both ARS and FSIS are concerned with problems and potential problems that salmonella contamination of poultry meat products can cause to the health of the general public. An in-house cooperative project between the following research units has been formed to address these problems: Field Crops Research Unit, Meat Processing Research Unit, Meat Quality Research Unit, and the Southeast Poultry Research Laboratory»

Objectives:

To investigate factors which contribute to salmonella contamination of poultry feed in commercial feed mills, during transport, and at the farm. To determine the relationship of time, temperature, water activity, and use of antimicrobial chemicals to destroy salmonellae in various practical feed formulations during laboratory, pilot plant, or commercial pelleting using artificially or naturally contaminated feeds. Lastly, to have feed trials run to determine effects of treatments on nutritional values of the processed feeds.

Most Significant Results to Date:

The Field Crops Research Unit's assignment in this cooperative project is the pelleting of poultry feeds in our pilot plant mill to eliminate salmonella in the pelleted feed. A pellet temperature of 82°C (180°F) was selected as the initial goal of our pelleting. In the initial phase of this work, an unpelleted broiler starter ration was pelleted using various dies that were on hand. The maximum pellet temperature obtained ranged from 50-70°C. The latter temperature was obtained using an old die which gave a poor rate of production (~0.5 tons/hr). The mill itself was studied to develop means of increasing the temperature of the meal entering the pellet die. Modifications were made to the conditioner and to the feeder which increased meal temperature from 40-60°C. Using this temperature, meal at maximum feed rate and a new 1 1/2" thick die containing 3/16" holes yielded a maximum pellet temperature of 71°C at 2.0 tons of pellets per hour. The maximum amperes obtained (related to mill load) was 28-32. The mill at capacity will take a load of 40-45 amperes. The mill feeder will have to be modified to increase the rate of feed to the mill. Work was also undertaken to determine the effect of varying steam in the pellet mill conditioner on the moisture content and the temperature of the resulting pellets. A non-medicated broiler-starter ration

containing 60 lbs fat/ton and 11% moisture was pelleted under actual production conditions at the University of Georgia Feed Mill. A 40 h.p. California Pellet Mill with 2 1/2" x 3/16" die was used. Steam entering the conditioner was varied to reflect differences in amperage of the pellet mill motor ranging from 40 to 90 amps. Moisture content of the pellets varied from 15% (40 amps) to 12% (80 amps). Moisture content of the cooled pellets was 11%. Pellet temperature was taken using a mercury thermometer, thermistor, and Infrared "Heat Spy", Temperatures ranged from about 195^{o}F (40 amps) to 150°F (80 amps). These data show that a range in temperature and moisture content of the pellets can be obtained by varying the steam in the pellet mill conditioner. Also, that the amount of steam in the conditioner influences, to a large extent, the temperature of the pellets and that pellet temperatures in excess of 180°F (in this case 195°F) can be obtained.

Publications: None