

0247 34  
T-ADIC-0000-2433

1. TITLE  
Cereals—grain processing—India

2. SUBJECT TERMS  
Grain utilization in India; annual report, 1972/1973

3. AUTHOR  
(101) Ind. State Univ. Dept. of Grain Science and Industry

4. REPORT DATE  
1973

5. NUMBER OF PAGES  
39p.

6. AND UNDER  
ARC

IN633.1.K16a

7. AUTHOR ORGANIZATION NAME AND ADDRESS  
Ind. State

8. SUPPLEMENTARY NOTES (Including Organization, Publishers, Availability)  
(Activity summary)

9. ABSTRACT

10. CONTROL NUMBER  
73-448-001

11. PRICE OF DOCUMENT

12. SUBJECT TERMS  
Food crops  
Grain crops  
India

13. PROJECT NUMBER

14. CONTRACT NUMBER  
GPO-1031 311(1)  
15. TYPE OF DOCUMENT

OSU 7-13-1974  
115 00 1000 1000  
Date 7-13-1974  
IN 633 1. K16

Title: Grain Utilization in India

Grantee: Kansas State University  
Department of Grain Science & Industry  
Food and Feed Grain Institute

Director: Dr. David R. Linbeck

A. Statistical Summary:

Period of Grant: July 1968 to June 1973 (extended without additional funding through June 1974)

Amount of Grant: \$200,000.  
Accumulated: \$153,696.  
Expenditures for Report Year: \$26,289.  
Anticipated for Next Year: \$46,104.

B. Narrative Summary

Two students completed their Ph.D. programs involving research conducted at the Central Food Technological Research Institute, Mysore, India. Scientific papers concerning the results of both investigations were presented at the national meeting of the American Association of Cereal Chemists (Miami Beach, Florida, Oct. 29 - Nov. 2, 1972). Manuscripts from both investigations are currently in preparation or submitted for publication in scientific journals. Contact has been maintained with CFTRI through its director, Dr. H.A.B. Paryia, with emphasis on cooperative interactions between the two institutions, which can continue if methods for necessary funding can be discovered.

A third student initiated the research phase of his Ph.D. program at the Institute for Food Research and Product Development, Kasetsart University, Bangkok, Thailand. The research project involves studies on the preparation, acceptability, and nutritional evaluation of cereal-based foods for children. Formulations for a dehydrated rice noodle supplemented with soy flour and methionine have been prepared and are being tested for acceptability at two child nutrition centers in northern Thailand. A fortified rice snack has also been formulated and subjected to preliminary acceptance testing with adults and children in Bangkok.

The most significant accomplishments of the grant continue to be the relationships formed between personnel of Kansas State University and institutions in the two countries, Thailand and India, where students have conducted research under the provisions of the grant. This has increased the competency of Kansas State University to render assistance to India and other developing countries in food grain utilization and to train graduate students in food grain utilization in such nations. The relationship has been maintained by visits of a limited number of faculty to these two countries in the past several years and more visits are planned for the future. This has stimulated and maintained

## **2. Detailed Report**

### **1. General Background and Summary of the Grant**

Kansas State University has a long history of international involvement. The University has been involved in India on a university-wide basis since 1956 when it finalized a contract with the International Cooperation Administration (now USAID) to staff and operate a program to aid in the development of Andhra Pradesh Agricultural University at Hyderabad. A large number of KSU faculty have served abroad under the provisions of this program. This program was concluded in 1973. In 1963 Kansas State University signed a contract with AID for developing Ahmadu Bello University in Nigeria. This program involves assistance in broad areas of agriculture and veterinary medicine.

As soon as the 211(d) program was announced, the Council of U.S. universities for Rural Development in India (of which Kansas State University was a member) expressed a keen interest in involving its member universities in the program. In view of the heavy demands being made on university resources by their programs in India, CUSURDI and AID felt that the prime need was to use 211(d) funds to build strength around selected fields where there was interest, a potential for exceptional competence, and a need for application in India.

Kansas State University has the only Department of Grain Science and Industry in the world. The University, therefore, finds itself in a unique position: that of being able to provide services, training and research competence of a highly specialized nature which other universities cannot provide. This department has an excellent international

reputation for its research and training functions in the field of grain science. The graduate student body of this department is currently about 50-60% international students. The staff and faculty of the department of Grain Science and Industry are in almost daily contact with foreign students and visitors.

With the very heavy dependence of developing nations, such as India, on cereal grains to provide the major portion of the per capita daily intake of calories, Kansas State University with its Department of Grain Science and Industry was a logical choice for the awarding of a grant involving the area of Grain Utilization. The experience, knowledge, research and training functions of this organization could be focused on the important problem of improving grain utilization in India and other developing nations, particularly increasing the capability of Kansas State University to effectively serve this area of vast need. During the period of the grant, a broad approach to several areas of grain utilization has been involved. The need for such an approach not only continues but has intensified during the period since the grant was made in 1968. Continuation of such efforts, sponsored by modest grants from AID for continuing and expanding these programs, should be of first-order priority.

#### Objectives of the Grant

##### A. Objectives Restated

The basic objectives, as stated in the contract, are as follows: "The basic objectives are to train graduate students in food grain utilization in India and other developing countries and to further

develop the competency of Kansas State University in these areas. The University considers international activities of this nature a legitimate concern and function. Training and research activities in this area are under way but assistance, as requested in this grant, will enable the University to engage in new endeavors and expand its research and graduate instruction program so as:

1. To increase the capability of Kansas State University to render assistance to India and other developing nations in food grain utilization.
2. To enlarge the pool of scientists trained in grain handling, processing, storage and marketing interested in and capable of assisting India and other developing nations.
3. To increase professional awareness of the increasing importance of grain storage, handling, processing and marketing in developing countries.
4. To encourage college students to seek careers in international service in the broad area of grain utilization.
5. To provide an opportunity for graduate students to obtain research experience on problems of particular relevance to India and other developing countries by assisting with research activities carried out fully or in part in India.
6. To stimulate and encourage faculty and other professional staff to consider careers in international service and to increase faculty interest in and university commitment to agricultural problems of India and other developing countries by drawing upon their special relevant competences in training and research."

### **B. Review of Objectives**

The basic objectives "to train graduate students in food grain utilization in India and other developing countries and to further develop the competency of Kansas State University in these areas" have received about equal emphasis during the period of the grant and have not been significantly modified. One major means for increasing the competence of a university is by training graduate students in the designated area. A second is by involvement of faculty members in programs in an area such as grain utilization in developing nations. Both approaches have formed the basic framework for administration of this grant. The six sub-objectives listed are interrelated and have received about equal emphasis. It was decided at the initiation of the grant that sub-objective B "to enlarge the pool of scientists . . ." would be done on the basis of quality rather than quantity. For this reason, the number of students selected were limited rather severely and those chosen were promised support to the completion of their programs if progress was satisfactory. This has subsequently turned out to be one of the strong points of the program, since it was discovered that maximum benefits can be obtained from having one or two students at a time working in developing nations. The objectives and sub-objectives are still very consistent with needs in the area of grain utilization in developing nations and do not require further modification.

### **III. Accomplishments**

A. The general criteria that have been used to determine satisfactory accomplishment of grant objectives are listed below as they are applicable to the two basic objectives of the grant.

1. Training graduate students in food grain utilization in India and other developing countries.

a. Progress of students in the 211(d) program towards meeting the Kansas State University Graduate School requirements for the Ph.D. degree.

b. Formulation and progress of a research problem in an area of grain utilization with the research being accomplished in a developing country.

c. Progress in the ability of the student to understand and articulate problems of developing nations, particularly those involving grain utilization.

2. Further developing the competence of Kansas State University to render assistance to India and other nations in food grain utilization.

a. An increased number of faculty with interests in problems of international development.

b. An increased number of faculty with knowledge of agricultural problems in India and other developing countries, particularly as evidenced by application to their special competencies in training and research.

c. An increased effectiveness of faculty to work with international students based on knowledge, understanding, and interest of the student's country and its problems, particularly those related to grain utilization.

**B. Accomplishments of the report year**

The work plan outlined in annual Technical Report No. 4 was followed and realized. A one-year extension to the grant without additional funding was requested from AID and approved.

Mr. Patrick L. Finney completed the requirements for the Ph.D. degree and was granted the degree. His dissertation, entitled "Milling, Chemical, Rheological and Breadmaking Properties of Indian Wheats," resulted from research carried out at the Central Food Technological Research Institute, Mysore, India in collaboration with Mr. G. S. Bains of the Discipline of Flour Milling and Baking Technology. An abstract of the thesis is enclosed as Item A in the Appendix. This abstract summarizes the findings of the research and further details will not be given here, other than to say that the work was of mutual satisfaction to both institutions. Dr. Finney presented a paper concerning the results of the investigation at the annual meeting of the American Association of Cereal Chemists in Miami Beach, Florida (Oct. 29 - Nov. 2, 1972). An abstract of this presentation is enclosed as Item B in the Appendix. A manuscript covering the major results of Dr. Finney's research has been prepared and submitted for publication in a scientific journal. Dr. Finney is currently employed as a postdoctoral fellow in the Department of Grain Science and Industry in order to obtain additional training in interests arising from his research experiences in India. A paper by K. A. Tara, P. L. Finney and G. S. Gains, "Damaged Starch and Protein Contents in Relation to Water Absorption of Flours of Indian Wheats," (*Die Stärke*, 24, 342 (1972)) was published as a result

of work done by Indian colleagues at CFTRI in collaboration with Dr. Finney using the straight-grade flours from a number of varieties of Indian wheats resulting from Dr. Finney's work. A copy of the abstract of this paper is enclosed as Item C, Appendix. Dr. Finney also furnished samples of flours, milled by him from Indian wheats, to his Indian colleagues which resulted in the publication of another paper by his co-director Mr. Bains (K. A. Tara and G. S. Bains, "Determination of Damaged Starch Content of Flours of Indian Wheats," *Die Stärke*, 24, 159 (1972)).

Mr. L. Merrick Lockwood and his family returned from India where he had been conducting research at the Central Food Technological Research Institute, Mysore under the co-direction of Dr. S. K. Majumder in the Infestation Control and Pesticides Discipline. Mr. Lockwood wrote a Ph.D. dissertation entitled "Organophosphate Pesticides for Use as Grain Protectants in India: Degradation of Their Residues during Milling and Cooking of Cereal Grains.: An abstract of the thesis is enclosed as Item D, Appendix. This abstract summarizes the findings of the research and further details will not be give here. The work has aroused considerable interest in India. A request was received and approved from Cyanamid India Limited, Bombay, to reproduce the abstract of Dr. Lockwood's dissertation "for free distribution among various scientists and grain technologists in India with the compliments of Cyanamid India Limited." A request was also received and approved from an Indian entomologist to forward several copies of the abstract to Government of India officials involved in decision-making concerning the use of grain protectants. Dr. Lockwood presented a paper covering

the results of the investigation at the annual meeting of the American Association of Cereal Chemists in Miami Beach, Florida (Oct. 29 - Nov. 2, 1972). An abstract of this presentation is enclosed as Item B, Appendix. Dr. Lockwood has recently accepted an assignment in Bangladesh with the International Voluntary Services, Inc. The position will involve development of grain storage and handling methods for use at the local village level, an area directly related to his training under the 211(d) program.

Mr. Alvin Siegel went to Bangkok, Thailand in July, 1972 to initiate the research phase of his Ph.D. program. He was originally scheduled and approved to go to CFTRI, Mysore, India, where a project had been formulated with Indian scientists at the Institute. However, at the last minute, a directive from AID necessitated a change of country and, after telephone discussions with Dr. Irwin Hornstein, Thailand was chosen. Mr. Siegel is conducting research at the Institute for Food Research and Product Development, Kasetsart University, Bangkok under the co-direction of Mr. Amara Bhumiratana, Director of the Institute. A project involving studies on the preparation, acceptability and nutritional evaluation of cereal-based foods for children was planned and initiated. The 211(d) professor traveled to Bangkok in September, 1972 to complete the planning phase of the project with Mr. Siegel and Mr. Amara and to make necessary arrangements for accomplishing the research. The itinerary for the trip included:

Sept. 14 National Food Research Institute, Ministry of Agriculture and Forestry, Tokyo, Japan (The 211(d) professor presented a seminar and consulted with Japanese scientists and colleagues on research related to the 211(d) program).

**Sept. 16-22 Institute for Food Research and Product Development, Bangkok.**

A soy flour-fortified dehydrated rice noodle has been formulated for use with children. Fortification has been done with 20% and 30% soy flour with methionine added to some formulations. A soy flour-fortified rice snack has also been formulated and used to prepare a deep-fried snack. Acceptability studies have been conducted with adults and school children using this product. Initial studies concerning preparation and drying of the rice noodles have been completed. Soy-fortified rice noodles were prepared by a local noodle factory in Bangkok, air dried and packaged for shipment to northern Thailand where feeding studies have been initiated in child nutrition centers in two villages. Acceptability studies are currently in progress in child nutrition centers in Ban Yang Village (60 children, aged 2-7, average age 4) and Ban Mai Village (55 children, aged 2-7, average age 4). Samples of the products currently being evaluated in Thailand have also been submitted to the Wisconsin Alumni Research Foundation for nutritional testing and analysis. The 211(d) professor, accompanied by Dr. Paul Seib of the Department of Grain Science and Industry, made a second trip to Thailand in May-June, 1973, to consult with Mr. Siegel concerning progress of the research, to evaluate data collection and results to that point, to observe the acceptability studies in progress, and to plan the final stages of the research program. The itinerary for the trip included:

**May 22 Food and Agricultural Organization, United Nations, Rome, Italy (to consult with Dr. H.A.B. Parpia, Director, CFTRI, Mysore, India, concerning work done at Mysore by two 211(d) students, publication of the**

work, and possibilities for future collaboration).

May 25-June 4 Institute for Food Research and Product Development, Bangkok and Chiangmai (to observe acceptability testing at Ban Mai Village).

C. A summary of the accumulated accomplishments during the period of the grant can best be done as follows:

1. Relationships have been established with Central Food Technological Research Institute (CFTRI), Mysore, India and with the Institute for Food Research and Product Development (IFRPD), Bangkok, Thailand. Collaborative research of interest to the above two institutions and to Kansas State University has been accomplished at CFTRI and IFRPD by 211(d) students. Personal relationships have been established between personnel of CFTRI and IFRPD and faculty of Kansas State University.
2. Two students have completed their Ph.D. degrees under the 211(d) program in areas related to grain utilization in India.
3. A third student is conducting research in Thailand concerning the preparation, acceptability and nutritional evaluation of a cereal-based food for children. Initial results from this research look most promising for the development of a potentially useful product.
4. Increased faculty interest at Kansas State University in agricultural problems of India and other developing nations has occurred due to direct involvement of faculty from the Department of Grain Science and Industry in the 211(d) program.

D. The proportion of each year's expenditures that was used for each objective or area of activity is estimated as follows:

<u>Activity</u>	<u>Proportion of expenditures</u>
Research and training of graduate students	64%
Teaching	12%
Consultation	24%

#### IV. Impact of Grant Supported Activities in Developing Institutional Capabilities.

The capabilities of an academic institution may best be evaluated in terms of its areas of responsibility. These include teaching, research and consultation.

##### A. Development of Teaching Competence

The 211(d) program has been used to enrich the teaching program of this department and the services of those involved in the 211(d) program have been made available to other departments of Kansas State University for use in their teaching programs. It is strongly believed that this approach is of more value to this University and its students than the creation of new courses specifically dealing with international agriculture. This is due to the heavy international commitment that Kansas State University has had for many years. As the experiences of students and staff involved in the 211(d) program are incorporated into their various teaching assignments, many more students will benefit from these experiences than would the few enrolling in any one new course.

The 211(d) professor has incorporated experiences from the 211(d) program into the two courses he teaches related to food science and into his involvement in the food science interdepartmental program at Kansas State University. The two graduate students returning from India last year presented seminars concerning their research and experiences in India. These were attended by interested students and faculty from this and other departments within the University. The 211(d) professor presented a discussion of his experiences in India to a group of College of Agriculture sophomore honors students in one of their colloquia and answered questions from the group. The teaching competency of the two staff members who have accompanied the 211(d) professor on trips to India or Thailand have definitely been increased as a result of their involvement in the 211(d) program. One of the professors indicated that he had heard of some of the problems faced by developing nations, but lacked real understanding of them until he was exposed to the experiences of his trip with the 211(d) professor. He called this the "realization aspect" and this sentiment was echoed by the second professor. Such understanding and realization has definitely increased the interests of both professors in international agriculture, has increased their ability to advise and work with international students, and has increased their teaching competency as a result of their increased understanding of international students and agricultural problems.

Development and improvement of teaching competence occurs as the experiences and competence of teaching faculty are increased. As noted above, this is certainly being accomplished via the 211(d) grant.

This is being done through the 211(d) program by exposing more persons to the problems of grain utilization, production, storage and distribution in developing nations.

#### B. Development of Research Competence

Relationships between Kansas State University and both the Central Food Technological Research Institute, Mysore, India, and the Institute for Food Research and Product Development, Bangkok, have been strengthened and developed. Considerable exchange of technical information and experience has occurred between individuals in the institutions via the 211(d) program. New areas of mutual research interests are becoming apparent which are increasing the research competence of scientists at Kansas State University by opening new or expanded areas of research. Dr. E. Carl Hosney accompanied the 211(d) professor to India during 1972 to evaluate the wheat quality evaluation being conducted by Mr. Patrick L. Finney at CFTRI. Dr. Hosney's research speciality is cereal chemistry, including cereal grain quality evaluation and functionality. As a result of his experiences in India, he was interested in the proposal of an African student who wanted to study utilization of milo, a food grain widely used in parts of Africa. Dr. Hosney told the 211(d) professor that he probably would not have been so interested in this proposal if it had not been for his experiences during the trip with the 211(d) professor. A study of milo utilization in food products was initiated and has resulted in the completion of an M.S. thesis, with the distinct possibility that the research may be continued at Kansas State University and similar work will definitely be continued by the student following her return to Africa. This was a direct result of the 211(d) program and the involvement of a faculty member, even though 211(d) funds were not used in the African student's program.

Investigations into starch structure and functionality, in progress in the 211(d) professor's laboratory, are being enlarged to include isolation of starches from some of the wheats studied in India under the 211(d) program. This is being done to determine whether there are differences between the starches of Indian wheats and U.S. wheats since some of the former had unusual baking properties. This interest is a direct result of the 211(d) program and the involvement of the 211(d) professor.

The research competency of a university is increased as the interests, knowledge and experiences of the faculty are increased. Such enrichment enables new applications, new problems and different views to be formulated by research personnel of the University. Scientists from Kansas State University and the two institutions at which 211(d) students have been situated have exchanged information and ideas on potential areas for collaborative research, for information exchange and for consultation. If the relationship between Kansas State University and these institutions and their staff is allowed to continue to develop, significant areas of mutual cooperation are bound to emerge. During discussions with Dr. Parpia, Director of C.F.T.R.I., in Rome this year, the mutual benefits of the associations initiated during the 211(d) grant were mentioned many times and the great need for such associations to continue was emphasized by both Dr. Parpia and the 211(d) professor. (During the tenure of the present grant, these associations and relationships have just been initiated and now need time, management and direction to reach fruition. Many of the areas of

mutual interest may be incorporated into existing research programs at K.S.U. such as the development of protein-enriched cereal-based foods and problems of grain storage, while others will require initiation of new research programs, enriching the efforts of Kansas State University. All of these will increase the research competence of the scientists involved, particularly in areas of food grain production, storage and utilization in developing nations.

#### C. Development of Competence for Consultation and Service

As indicated in the last two annual technical reports and again reemphasized in this report, experiences gained in India and Thailand by students and staff participating in the 211(d) program increase their competence for consultation and service in the following ways:

1. Information and knowledge gained from these experiences constitute a pool of knowledge and information concerning international agriculture, particularly grain utilization in developing nations, and food problems which can be made available to the university community and other interested individuals.

During the trip to Bangkok this year, the 211(d) professor and Dr. Seib met and consulted with Dr. Narudom Boon-long, Head, Department of Food Science and Technology, Kasetsart University concerning the development of the department at Kasetsart and problems of mutual interest. As a result of this, possibilities for establishing a mutually beneficial relationship between the two departments is being explored. Some students from Kasetsart University are currently studying for advanced degrees at Kansas State University. Information concerning

possible consultants in the area of food processing is also being solicited as a result of the contact with Dr. Marudom.

2. The most unique concept of the 211(d) program is the ability to formulate a research project in an area of mutual interests through direct cooperation with colleagues in developing countries. This observation has been voiced on several occasions by Dr. Parpia, again reiterated in Rome this year, and cannot be stressed enough. The experiences gained through such a venture are not available in the University other than through the 211(d) program. The 211(d) program as administered by this university has been based on personal contact by scientists, devoid of political overtones. This fact was emphasized to Mrs. Gandhi, Prime Minister of India, by Dr. Parpia when explaining the strengths of such a program and why its approval should not enter the realm of political considerations. As a result, the visa application of Mr. Siegel was approved for India after AID had indicated such visas were not being considered favorably. Further it has been indicated that we can continue to place students in India under the provisions of the 211(d) grant because of the mutual benefits derived from personal associations between scientists. It will be most regretful if these efforts and programs are lost through lack of foresight in arranging the low level of funding required for their continuation and expansion. It is still firmly believed that the 211(d) concept will, in the long run, prove to be the most viable, least expensive vehicle to foster establishment of significant long term relationships between institutions and scientists in developing nations and their counter-

parts in the U.S., without the political implications of technical assistance teams. It has been shown that such programs can operate on the local economy without the need for large support organizations other than the sister institution in the developing nation.

3. Experiences of those involved in the 211(d) program are daily utilized through lectures, seminars, contact with international students and discussions with other faculty members having interests in India and other developing nations.

The 211(d) professor presented a talk to a group of farm families in Indiana concerning the 211(d) program at Kansas State University and its involvement in Thailand. This was the third year that he has done so, with India being emphasized the previous two years. This presents an excellent opportunity to discuss agricultural problems in developing countries utilizing experiences derived from the 211(d) program and to answer questions from a group who often question American involvement in such programs. The group has shown considerable interest as indicated by three invitations to speak.

As a result of the visit by the 211(d) professor and Dr. Hosney at the Bread Research Institute of Australia and C.S.I.R.O. Wheat Research Unit, North Ryde as they returned from India last year, Dr. David Simmonds of the Wheat Research Unit visited Kansas State University in May, 1973 under non-211(d) sponsorship. He presented a seminar concerning his research on cereal proteins which was attended by students and staff with interests in this area of grain science. This is an excellent example of the relationships that can be formed from

activities occurring during the 211(d) program which hold promise for mutual benefits to both institutions in years to come.

Dr. Paul Seib accompanied the 211(d) professor to Thailand in May-June, 1973. Dr. Seib is a cereal chemist with particular interests in extrusion processing of grains. This is an area in which the Institute for Food Research and Product Development is acquiring capability due to provision of a Wenger Extruder by AID. The experiences that Dr. Seib had in Thailand enabled him to become more familiar with the agriculture of Thailand... This was his first involvement in international agriculture and he returned much better qualified to work in this area and with more interests in doing so. This is again one of the finest examples of the use of the 211(d) program to increase the teaching, research and consulting competence of Kansas State University by increasing these capabilities of individual faculty members, already involved in teaching and advising international students. Dr. Seib greatly benefitted from the trip, his discussions with personnel in Thailand, and the experiences he had involving cereal production and utilization in a developing country with the food problems attendant to such an area. This has increased the competency of Kansas State University to assist with food grain utilization in developing nations by more effectively equipping one of its younger faculty members to work in this area. This is one aspect of the 211(d) program which should be encouraged and used, for it truly achieves the objectives of the grant and will have a lasting impact.

## V. ILLUSTRATION OF INTERNATIONAL ACTIVITIES IN AGRICULTURE

There is no way that all of the contributions in the area of grain utilization made by Kansas State University to developmental activities and programs in less developed countries can be adequately cited in the scope of this report. The Department of Grain Science and Industry has a long history of international involvement. This department has an excellent international reputation for its research and training functions in the field of grain science. Foreign students have selected Kansas State University for many years for training in grain science and utilization, often leading to advanced degrees in these areas. No figure is known to the 211(d) professor to reflect the actual numbers of foreign students trained here in grain science. Currently, approximately 50-60% of the graduate student enrollment in the Department of Grain Science and Industry is international, i.e. 35-40 international students. International wheat teams visit this department regularly throughout the year to learn of grain utilization and research concerning cereal grains. During the report period, individuals, milling groups and wheat teams visited the Department of Grain Science and Industry for one-day briefings from Norway, Turkey, Japan, China (Taiwan), Israel, W. Germany, Korea, Guatemala, Peru, England, Italy, Brazil, and Latin America. These briefings are sponsored by Great Plains Wheat Inc. and Foreign Agricultural Service of the U.S.A.

Kansas State University is committed to the concept that international activities are a legitimate concern and function of the University. It has a long history of involvement in international agriculture and

continues its high degree of interest and involvement in international programs of this nature. These programs are diverse in nature and it must be realized that a commitment to teaching and training foreign graduate students represents a major commitment of the resources of a university. Kansas State University has been a center for such activity and it has only recently become necessary to place limitations upon the number of foreign students enrolled in the graduate programs of this University. This was necessitated by current economic conditions in the United States as reflected by decreasing financial support for graduate education and research.

The University has been involved in India on a university-wide basis since 1956. The University has staffed and operated a program to aid in the development of Andhra Pradesh Agricultural University at Hyderabad. A large number of KSU faculty have served abroad under the provisions of this program. The program was concluded in September, 1972, after approximately 61 man years of involvement.

In 1963 Kansas State University signed a contract with AID for aid in developing Ahmadu Bello University in Nigeria. This program involves assistance in broad areas of agriculture and veterinary medicine. The program has been in operation since that time with numerous KSU faculty members having served there on two-year or short-time assignments. Approximately 22 families are currently on assignment in Nigeria.

Training and research programs in grain handling and processing have been continued on an international basis by the Department of Grain, Science and Industry under contracts with AID. For the fourth

consecutive year a short course in Grain Storage and Marketing was planned under the provisions of Contract AID/csd-1588. The short course was to be held in Columbia and had to be cancelled at the last minute. Under this same contract, programs involving grain storage, transportation and processing were continued and staff members from this department and the Department of Economics travelled to Panama, Indonesia and Thailand to consult on problems pertinent to these areas. During this same period, the Department of Grain Science and Industry has continued its extensive research program concerning nutritional improvement of cereal-based foods under the provisions of Contract AID/csd-1588. One faculty member went to Morocco in relation to protein-enriched cereal-based food products developed from this research.

Professor Arlin Ward, Department of Grain Science and Industry, made an extensive visit to Europe during June, 1973, sponsored by Great Plains Wheat Inc. During his trip he consulted with 36 different mill organizations in six countries concerning problems of cereal grain processing.

#### VI. Other Resources for Grant-Related Activities

Many divisions of Kansas State University provide either direct or indirect support to the 211(d) program. The university contributes the salary of the 211(d) professor. Administrative services and advice are provided by the various international programs offices that have extensive overseas projects. In addition, the overall staff of the Department of Grain Science and Industry contributes in innumerable ways to the support of the 211(d) project, by providing office space

and library facilities, as well as giving advice and encouragement to the 211(d) students. Table I reflects the distribution of 211(d) grant funds.

#### VII. Next Year's Plan of Work and Anticipated Expenditures

During 1973-74, a one-year extension to the grant approved without additional funding, Mr. Siegel will complete the requirements for his Ph.D. degree and be terminated from the program. Acceptability testing, storage studies (physical, chemical and organoleptic tests) and nutritional evaluation of the soy-enriched rice noodles and rice snacks will be completed in Thailand during September, 1973. Mr. Siegel will then return to Kansas State University and write a dissertation based on the results of his research in Thailand. The 211(d) professor will travel to Thailand to complete the evaluation of data collection, to consult with Mr. Amara concerning future plans for any product developed by Mr. Siegel, including any need for further development research, and to discuss the possibility of future collaboration between Kansas State University and the Institute for Food Research and Product Development. This trip is considered a necessity to arrive at decisions concerning the future of any product developed by Mr. Siegel and any further collaboration between the two institutions.

As indicated in the proposed budget for 1973-74 (Table II), major expenditures for equipment will be made. Approximately \$19,000. will be spent on major items of equipment which will be used at Kansas State University to continue and initiate new research in areas related to the subject matter of the grant. The purchase of this equipment was

made possible by the contribution of the 211(d) professor's salary by Kansas State University making available that portion of the 211(d) budget for purchase of equipment. This is an excellent example of the involvement of non-211(d) funding enabling uses to be made for 211(d) funds which will have impact far beyond the expiration of the current grant. This will directly increase the research competency of Kansas State University in areas related to grain utilization in developing nations by enabling the purchase of equipment which can be used to continue present research and to initiate new research in these areas at Kansas State University.

#### VIII. Other

Experiences gained by Kansas State University during the tenure of the present grant indicate that programs of this type deserve very high priority for continuation and expansion. It has been found that these programs can be effectively administered with a modest level of funding in such a way that the University is able to continually expand its capability to serve developing nations in the area of grain utilization and to increase the effectiveness and interests of faculty members in international agriculture, particularly in the area cited which represents a vast problem on a world-wide basis. It is our opinion that a program such as the current 211(d) program at Kansas State University can be effectively continued at the present level of funding, i.e. 240,000 per year, and could be expanded to include developing nations other than India. This latter facet would be most desirable to allow maximum benefits to be realized from such involvement. The program

should continue to be centered around the training of one to three graduate students at any one time and the involvement of a limited number of faculty members from the university. Such a program would allow maximum benefit to be derived from the grant. AID is strongly urged to give priority consideration to the continuation of this program so that the relationships now initiated can be strengthened and enlarged. The strength and desirability of this type of program has been underlined by those involved both at Kansas State University and in the institutions in the developing countries.

**IX. Report of Expenditures**

See Tables I and II.

**Table I**

**Distribution of 211(d) Grant Funds and Contributions From Other Sources of Funding \***

**Review Period July 1, 1972 to June 30, 1973**

(List all grant related activities)	211(d) Expenditures			Non 211(d) Funding Amount
	Period Under Review	Cumulative Total	Projected Next Year	
e.g. Research	\$16,773	\$ 98,493	\$29,507	\$128,000
Teaching	3,128	18,468	5,532	24,000
Consultation	6,388	36,935	11,065	48,000
<b>TOTAL</b>	<b>\$26,289</b>	<b>\$153,896</b>	<b>\$46,104</b>	<b>\$200,000</b>

1. Salary of 211(d) professor (\$19,479 including benefits) by Kansas State University.

2. There is no way to estimate in any reasonable accuracy the remaining contribution of non-211(d) funding.

Table XI

**Expenditure Report  
(Actual and Projected)**

Under Institutional Grant AID/csd-1931

Review Period: July 1, 1972 to June 30, 1973

(Line Items to Conform to Budget in Grant Document)	Expenditures to date		Projected Expenditures	Total
	Period Under Review	Cumulative Total	Year 6 <sup>1</sup>	
e.g. Salaries	\$ 5,273	\$ 57,093	\$ 6,000	\$ 63,093
Graduate stipends	9,575 <sup>2</sup>	49,747	5,370	55,117
Exchange professor	-0-	1,068	-0-	1,068
Travel	6,274 <sup>3</sup> 2,645 <sup>4</sup>	24,794	8,500	33,294
Equipment, supplies and other	2,522 <sup>5</sup>	21,194	26,234	47,428
	\$26,289	\$153,896	\$46,104	\$200,000

<sup>1</sup> One-year extension of grant without additional funding approved.

<sup>2</sup> Graduate stipends include the following:

Patrick L. Finney	\$ 350
L. Merrick Lockwood	2,685
Alvin Siegel	6,540
	<u>\$9,575</u>

<sup>3</sup> 1972-73 Travel includes expenses of:

- Dr. Lineback's, Dr. Finney's and Dr. Lockwood's travel to 57th Annual Meeting American Association of Cereal Chemists (Miami Beach, Florida) to present scientific papers resulting from 211(d) research.
- Mr. Siegel's travel to Bangkok.
- Dr. Lineback's trip to Bangkok.
- Mr. Siegel's trips in Thailand on grant-related business.
- Per diem for Dr. Lineback's and Dr. Seib's trip to Bangkok. Air fare to be paid in 1973-74.

<sup>4</sup> Mission payments reflect the official costs received from AID for return of Mr. Lockwood and Mr. Finney with their families from India.

<sup>5</sup> No items of equipment costing more than \$100 are included.

**APPENDIX**

## Appendix

### Item A

Abstract of a dissertation entitled "Milling, Chemical, Rheological and Breading Properties of Indian Wheats" submitted by Patrick L. Finney to the Graduate School, Kansas State University in partial fulfillment of requirements for the Ph.D. degree, 1972 (research done at Central Food Technological Institute, Mysore, India under 211(d) grant).

Physical and chemical tests were conducted on 33 Indian varieties of wheat (54 samples). Wheats were tempered according to hardness and protein content and milled on a Buhler experimental mill. Flours from the wheats were evaluated by the following tests: protein, moisture, and ash, Zeleny sedimentation, Hagberg falling number, gassing power, mixograph and farinograph studies, and three experimental baking formulae.

Results of those studies indicate that presently grown Indian wheat varieties vary greatly in their physical, chemical, rheological, and baking characteristics. Varieties may be conveniently divided into two groups: (1) those which were introduced in 1966 and are of Mexican stock along with crosses made with the Mexican varieties, and (2) varieties unrelated to the newly introduced, high-yielding Mexican varieties.

Varieties from both groups were found to have exceptionally high water absorption capacities, with values approaching 80 percent, in spite of some medium and low flour protein contents. The high water absorption results agree with previous studies on Indian wheats conducted in 1940 and 1965. These results concerning high water absorption capacities also agree with recently published data on the Mexican wheat varieties from CIMMYT,

India.

A number of recently introduced high-yielding Mexican varieties and a few of other Indian varieties were found to have exceptionally high loaf volume potentials, when measured on a constant protein basis. Kalyan Sona (S-227), known as Rista Corona in Mexico, which is presently the most important high-yielding wheat variety of commercial significance in India, was found to be an above average breaking wheat variety with excellent bread characteristics and loaf volume potential greater than the Regional Baking Standard (RBS-70A), a composite of above-average United States-grown hard red winter and hard red spring bread wheats. The RBS-70A was used in the study as a standard flour in order to simultaneously compare Indian varieties with known United States varieties and to standardize all work on a daily basis.

It was found that a number of Indian wheat varieties responded from moderately to greatly to potassium bromate. This fact was discovered by comparing the results of the AACC lean formula baking test with those of the AACC test including 1 mg. potassium bromate. Kalyan Sona was found to respond to potassium bromate from medium to greatly. It may be assumed that present day bakers might profit by supplementing their present baking formulae with potassium bromate or another equally acceptable oxidizer in cases when lack of volume due to low protein content in the flour prevails.

Other promising varieties with excellent to good baking characteristics include normal and high-yielding varieties. Since India is necessarily concerned with food quantity, the most important of those varieties are the high-yielding ones. These include WG-357 and WL-212, two varieties which had trial yields even greater than Kalyan Sona, but have not yet been released to the farmers. Both varieties had high water absorption capacities and medium high loaf volume potential.

Since the milling and baking industries are steadily enlarging in India, and along with them the white, leavened bread industry, the significance of Kalyan Sona's high water absorbing capacity and high loaf volume potential is evident. And, if the other varieties mentioned prove to be commercially equal to Kalyan Sona, the Indian wheat developments realized and projected into the near future will continue to be encouragement to the rest of the world.

## Appendix

### Item B

P. L. Finney, G. S. Bains, R. C. Hoseney and D. R. Linebeck "Milling and Baking Evaluation of Indian Wheats," 57th Annual Meeting of the American Association of Cereal Chemists, Abstract 116, Miami Beach, Florida (Oct. 29 - Nov. 2, 1972).

During recent years India has experienced revolutionary changes in all areas related to wheat production. New varieties were introduced to plant breeders and agronomists in the mid-sixties. New crosses were made with indigenous varieties. Increased utilization of sub-soil water occurred. Improved farming practices increased. Greater cooperation was established between scientists in related fields, extension agents, and farmers. A greater demand for wheat developed and production of wheat increased from approximately 15 to nearly 25 million metric tons between 1965 and 1971. An increased awareness and interest in wheat quality and its evaluation has resulted. Recently a two crop-year study on the milling and baking quality of Indian wheats was completed during an 18-month period at C.F.T.R.I., Mysore, India. Studies were made on 35 varieties (54 samples in all) from three breeding stations. All varieties of commercial significance were included, along with other promising varieties not yet released to the farmer. Milling, chemical, physical-dough, and baking tests (100 g., three formulas) were made. All bakes were conducted with optimum water absorption and optimum mixing requirements. Some of the newly developed varieties had medium-high to high loaf-volume potentials. The major wheat presently grown in the Punjab and distributed throughout India (Kalyan Sona or P-227) proved to be comparable with good-quality hard

winter wheats grown in the Great Plains of the U.S. Earlier workers in India questioned the response of the Indian varieties to potassium bromate ( $\text{KBrO}_3$ ). Present results indicate that approximately 30 to 40% of the varieties tested responded significantly to 1 mg. of  $\text{KBrO}_3$ .

Mixing times and tolerance varied greatly among varieties, ranging from mixing times of 1 min. to extremes approaching 30 min. In addition, optimum water absorptions varied from 56 to 84% with all three of the experimental baking formulae used. Flour protein varied from 8 to 13.3%.

**Appendix**

**Item C**

**K. A. Tara, P. L. Finney and G. S. Bains, "Damaged Starch and Protein Contents in Relation to Water Absorption of Flours of Indian Wheats," Die Stärke, 24, 342 (1972). (A portion of this work was supported by 211(d) Grant AID/csd-1931 "Grain Utilization in India" administered by the Department of Grain Science and Industry, Kansas State University).**

**Abstract:**

**The investigation has shown damaged starch to be a significant factor in the high water absorption by 63 straight-run flours of a number of varieties of Indian wheats. A significantly high positive correlation ( $r = +0.81$  to  $+0.87$ ) was obtained between water absorption and damaged starch contents compared to a value of  $+0.50$  for water absorption and protein content. The prediction of water absorption from damaged starch and protein contents is discussed.**

## Appendix

### Item D

Abstract of a dissertation entitled "Organophosphate Pesticides for Use as Grain Protectants in India: Degradation of Their Residues during Milling and Cooking of Cereal Grains," submitted by L. Merrick Lockwood to the Graduate School, Kansas State University in partial fulfillment of the requirements for the Ph.D. degree, 1973 (research done at Central Food Technological Research Institute, Mysore, India under 211(d) grant).

Samples of paddy (rough rice), wheat and sorghum were treated with different concentrations of malathion, gardona and sumithion as protection against insect infestation during storage.

Bioassay tests, using Sitophilus oryzae (rice weevil) and Tribolium castaneum (red flour beetle), were conducted to determine the effectiveness of the treatments in protecting the grain against insect attack. Results of the bioassay tests indicated that the lowest levels of treatments used (10 ppm of malathion or gardona; 2 ppm of sumithion) were sufficient to eliminate any existing infestation of these insects. In the case of malathion and gardona, protection was afforded for 6 to 8 weeks. For sumithion to provide equivalent protection it would be necessary to apply concentrations higher than 2 ppm. The intermediate levels of treatment (40 ppm for malathion or gardona; 8 ppm for sumithion) and the high levels of treatment (80 ppm of malathion or gardona, 16 ppm of sumithion) protected the grain over the full test period of two months.

The amount of residues in the treated grain were analyzed by means of gas-liquid chromatography before and after milling. There was a significant loss of residues from wheat and sorghum during machine milling.

On the average, machine milling resulted in 30% to 70% loss in residues for all three protectants. Less heating of the flour took place when sorghum was milled, as compared to wheat. This might explain the observation that less residue was lost during machine grinding of sorghum as compared to machine grinding of wheat. Wheat ground by hand showed up to 40% less breakdown of insecticides as compared to machine grinding. This also may be the result of less heating during hand grinding.

With paddy there is a tendency for residues to be concentrated in the hull and bran fractions. As a result, polished rice retained relatively little residue from protectants applied to the whole grain. Even with treatments of paddy at 80 ppm of malathion, residues on the polished rice were never above 4 ppm.

Samples of milled products were cooked by traditional Indian methods. Rice was boiled and iddies were prepared by grinding rice with water, fermenting the paste and steaming it. Wheat and sorghum flour were made into chapaties. In the case of sorghum a second preparation was made in which balls of dough were boiled in water. In chapati preparation the amount of residue breakdown was closely related to the amount of cooking. Average losses during the preparation of chapaties ranged from 43% to 75% though individual samples varied over a wider range. Preparations involving boiling or steaming resulted in complete degradation of the residues of all three insecticides, so far as detectable with the methods used (less than 0.1 ppm).

Most of India's grain harvest is retained at the farm and village level. Any program aimed at reducing waste due to insect damage during storage must provide methods which can be used for small scale storage. Unfortunately, the most effective methods involving fumigation are not

easily applicable at this level and the health regulations of the Indian Government prohibit the admixture of any insecticide with grain in storage. Recommendations have been made to amend the existing regulations to allow the use of malathion as a grain protectant to be admixed with stored grain up to a limit of 8 ppm. The results of this investigation indicate that the breakdown of residues during milling and during cooking by typical Indian methods are comparable to the breakdown observed in the cooking and milling processes studied in the United States and Europe. It would appear that there is considerable justification for the recommendation to allow the use of malathion as a protectant for stored grain in India. In this investigation it would seem advisable to consider other alternatives in addition to malathion, such as gardona and sumithion. These protectants would be useful in cases where insects begin to develop resistance to the toxicity of malathion.

## Appendix

### Item B

L. M. Lockwood, S. K. Majumder and D. E. Lineback, "Application of Insect-Control Chemicals to Cereal Grains and Analysis for Residues after Processing," 57th Annual Meeting of the American Association of Cereal Chemists, Abstract 13, Miami Beach, Florida (Oct. 29 - Nov. 2, 1972).

In recent years, application of chemical agents to harvested grains to reduce losses from insect infestation has increased greatly in India. This has resulted in significant economic benefits by reducing the amount of grain lost subsequent to harvest, thus increasing that available for human consumption. At the same time has come the realization that consumption of residues of these agents may have significant adverse effects on human health. Thus it is of increasing importance to ascertain whether residues of chemical agents, even those of low mammalian toxicity, used to control insect infestation of cereal grains appear in the processed grain in foods prepared from these grains. A 2-year study has just been completed at C.F.T.R.I., concerning the application of three commonly used insect-control agents to three widely used cereal grains, and the presence of residues in foods prepared from the processed grains. Initial studies established the lowest effective concentrations of malathion, gardona, or sumithion required for wheat, sorghum, or rice. Two insects commonly infecting cereal grains were used in the bioassay procedures. The three grains were then treated with multiples of the lowest effective concentration for each control agent. At various times, samples of the treated grains were removed and processed by methods common to India. These methods ranged from hand milling to power milling. The milled products were

investigated for chemical residues by gas-liquid chromatographic techniques. Common Indian foods were prepared in normal fashion from each of the three milled grains. Samples were then investigated for the presence of chemical residues resulting from treatment with the three insect-control agents. These techniques facilitated evaluation of relationships between the method of milling and the amount of residue present in the final product.