

ANNUAL REPORT
WESTERN REGIONAL RESEARCH CENTER, ARS, USDA
COMPREHENSIVE RESEARCH ON RICE
January 1, 1993 - December 31, 1993

PROJECT TITLE: Rice Utilization and Product Development

PROJECT LEADER: R. N. Sayre
Research Leader
Cereal Product Utilization Research Unit
Western Regional Research Center, ARS, USDA
Albany, California 94710
(510) 559-5664 FAX (510) 559-5626

WRRC INVESTIGATORS: M. M. Bean
R. Becker
R. H. Edwards
T. S. Kahlon
W. Yokoyama
M. M. Chiu
F. I. Chow
C. A. Hudson
R. E. Miller
A. P. Mossman
C. Nihaniv
L. Zaragoza

LEVEL OF 1992 FUNDING: \$25,000

PROPOSAL OBJECTIVES: To carry out research on California rices that ultimately will lead to new products for domestic and foreign markets.

RESEARCH OBJECTIVES:

1. Stabilized Rice Bran
2. Rice Technology
3. Extrusion Technology
4. Rice Quality Assessment

SUMMARY OF 1993 RESEARCH (MAJOR ACCOMPLISHMENTS) BY OBJECTIVE:**1. Stabilized Rice Bran**Storage Stability

Stabilized rice bran may develop "off" flavors due to oxidation of the oil. This seems to be a particular problem when the bran is heated for the second time. If this change could be prevented, the usefulness of full fat rice bran as a food ingredient could be expanded. Hexenal was used as a measure of oxidative development in stabilized rice bran. Rice bran was heated in an autoclave at 240° or 260° F for 1 or 15 min. then stored at -4°, 77°, or 122° F for various periods. Lower stabilization temperature and shorter treatment time reduced hexenal values and preliminary results indicate that storage at room temperature causes more oxidation than storage at either high or low temperatures. A combination of moderate stabilization temperature and controlled storage temperatures may prevent oxidation problems in finished products containing rice bran.

Nutrition

We have looked at the various components of rice bran in an attempt to identify the factors which reduce plasma and liver cholesterol. A recently completed nutritional study using hamsters as a model indicated that part of the cholesterol lowering properties of rice bran is due to the unsaponifiable matter in rice bran oil which had a dose response effect. This effect is more pronounced when the unsaponifiable material was fed in the form of intact, full-fat rice bran. The feeding portion of a study with hamsters to test the effects of various levels of oryzanol and tocopherol from rice bran oil on cholesterol status has just been concluded. Analyses of plasma and liver cholesterol levels are in progress as well as evaluation of plaque formation in the aorta. These studies are aimed at confirming claims for gamma oryzanol.

Methods

New techniques and methodology have been developed for nutritional studies. Lipoproteins can be determined from one drop of blood which allows repeated sampling from the same small animal. An image analysis method for measuring plaque formation and regression in the hamster aorta has been developed.

2. Rice Technology

Seventy-five samples of rice representing several varieties grown at different geographical locations and under different environmental conditions were analyzed for starch properties. Differential scanning calorimetry (DSC) measurements have been completed. DSC measures starch gelatinization temperature, a property of the intact starch granule. We have recently acquired an instrument that will measure molecular properties of starch such as molecular weight, shape, and branching characteristics. These observations are being made on the same samples that were used for the NIR rice quality assessment work in order to better understand the effects of both variety and environment upon rice quality.

3. Extrusion Technology

The quality of rice pasta products was further improved using fractional factorial experimental design to identify optimum processing parameters. Extruder processing temperature, screw speed, screw configuration, and the amount of added moisture were studied. Pasta with improved taste, texture and reduced cooking losses was produced and evaluated by taste panels. A rapid procedure to measure cooking loss is being developed for correlation with Instron texture profile analyses. Substantial quality improvements have been achieved over commercially available rice based pasta products.

4. Rice Quality Assessment

Using rice samples prepared for near-infrared reflectance spectroscopy (NIR) at the Western Regional Research Center (WRRC), two collaborating laboratories demonstrated successful application of NIR technology for predicting amylose and protein in the same rice samples with different NIR instruments. To test the procedure whereby both grinding and scanning steps were performed in each laboratory, fifty rice varieties from the 1992 crop were obtained from five state breeders. The samples were sent as milled rice to WRRC, Albany; to the USDA Instrumentation and Sensing Laboratory at Beltsville, MD. (Steve Delwiche and Karl Norris); and to the Grain Research Laboratory in Winnipeg, Manitoba, Canada (Philip Williams). Amylose data by chemical analysis were supplied by the USDA Rice Quality Research Laboratory, Beaumont, TX (Bill Webb) and protein data were obtained at USDA, Beltsville. Amylose prediction equations had correlations of $R^2 = 0.94-0.96$ with standard errors of $\sim 1\%$ amylose. Protein predictions had correlations of $R^2 = 0.99$ with standard errors of $\sim 0.1\%$. This successful demonstration of results at both USDA laboratories has convinced the USDA facility at Beaumont to purchase an NIRSystems instrument similar to those used in the collaborative study. Other breeders and rice companies are also considering such purchases.

NIR and differential scanning calorimetry (DSC) data were obtained on 15 rice varieties grown in four states in support of the project by Kent McKenzie at the California Rice Research Foundation to compile an integrated evaluation of rice grain quality to characterize genetic (varietal) and environmental (regional) differences among the important U.S. rice varieties.

PUBLICATIONS AND REPORTS:

Bean, M. M., Miller, R. E., and Chiu, M. M. 1993. NIR and DSC - New tools for rice quality evaluations. Rice Field Day at Biggs, CA (Poster and Abstract)

Same submitted for Rice Technical Working Group (RTWG), New Orleans, March, 1994.

Bean, M. M. and Miller, R. E. 1993. Rice properties important for baked and other processed food products. Temperate Rice Conference, Yanco Agricultural Institute, Yanco, NSW, Australia. February, 1994. (Abstract)

Same submitted for Rice Technical Working Group (RTWG), New Orleans, March, 1994.

Kahlon, T. S., Chow, F. I., Knuckles, B. E., and Chiu, M. M. 1993. Cholesterol-lowering effects in hamsters of β -glucan-enriched by barley fractions, dehulled whole barley, rice bran, and oat bran, and their combinations. *Cereal Chem.* 70:435-440.

Kahlon, T. S., Chow, F.I., Chiu, M. M., and Hudson, C. A. 1993. A mechanism for cholesterol-lowering in hamsters by rice bran and its unsaponifiable components. *Cereal Foods World* 38:601 (Abstract)

Kahlon, T. S., Chow F. I., and Sayre R. N. 1993. Cholesterol-lowering by rice bran oil unsaponifiable matter. Rice Field Day, Biggs, CA (Abstract)

CONCISE GENERAL SUMMARY OF CURRENT YEAR'S RESULTS:

1. Rice bran has been stabilized at two different temperatures for two time periods and stored at three temperatures. Oxidation was measured by hexenal production. Lower stabilization temperature for a shorter treatment time reduced hexenal formation. Preliminary results indicate that room temperature storage produces more oxidation than either low or high temperature storage. The unsaponifiable matter in rice bran oil has been shown to reduce plasma and liver cholesterol on a dose response basis. Increased fecal fat excretion appears to be associated with reduced cholesterol levels. An image analysis methods has been developed to measure plaque formation and regression in hamster aorta.
2. Seventy-five rice samples representing different varieties grown at different locations have been analyzed for gelatinization temperature. These same samples will be analyzed for molecular size and shape with a newly acquired instrument to establish an information base for rice starch from differing sources. This information will be related to processing characteristics.
3. The different parameters of extrusion processing were tested using a fractional factorial experimental design. Rice pasta with improved taste, texture, and reduced cooking loss was produced which is superior to commercially available rice based pastas.
4. The Western Regional Research Center, USDA has collaborated with the USDA Instrumentation and Sensing Laboratory and the Canadian Grain Research Laboratory to establish that repeatable results can be obtained for amylose content and protein content in rice by NIR spectroscopy produced on different instruments. This successful demonstration of results by a rapid, non-destructive technology will expand the use of this equipment to other rice quality research facilities, plant breeders, and millers.