COMPREHENSIVE RESEARCH ON RICE

Annual Report

January 1, 1976 - December 31, 1976

Program Area:	Rice Utilization
Title: RU-2	Rice Utilization and Product Development
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1976 Funding:	$25,000 ($12,500 each to UC Davis, and WRRC)
Objective:	To carry out research work on California short and medium grain rices that ultimately will lead to new products for domestic and foreign markets.

Research Objectives

1. Reduced stickiness. Develop methods of reducing stickiness of California rices to improve their general acceptance as Table Rices in the United States. (WRRC).

2. Frozen rice. Develop frozen rice products from California short, medium, and long grain rices (WRRC).

3. Storage stability of modified rices. Carry out storage studies and nutritional evaluation of modified California rices (UCD and WRRC).

4. Rice flour. Fundamental studies on rice flour baking properties (UCD and WRRC).

Summary of Current Year's Work

1. Reduced stickiness. An objective method of measuring rice stickiness was developed utilizing the Instron Tensile Tester. Cooked rice is placed between two plates which are slowly brought together to slightly compress it. The force necessary to separate the plates is then determined. Long grain rices ranged in the area of 35 to 70 force units whereas short and medium grain rices ranged from 175 to 360. Fluidizing milled Calrose in hot air at 400°F for 15 seconds reduced the stickiness from 310 to 160 force units. Hot air treatments are partially successful in reducing stickiness but other problems such as loss of gloss and decreased storage stability are created.

2. Frozen rice. Preliminary precooking and freezing conditions were explored using California Long Grain 3764, and compared with Arkansas Starbonnet. The 3764 tends to absorb more water than Starbonnet, using standardized cooking procedure, and is more pasty when freshly cooked. However, after storage in flexible boil-in-the-bag type packages for 3-4 weeks at 10°F, and -30°F, all samples of 3764 were significantly less pasty, had good separation of kernels and were equivalent in taste quality to Starbonnet.

3. Storage stability of modified rices. No work has been started on storage stability of rice treated with hot air to reduce stickiness. However, to establish a cooperative research atmosphere between UC Davis and WRRC (as desired by the Rice Research Board), UC Davis agreed to carry out a minor storage statility study on the quick-cooking rice developed at WRRC (see Publication 1 Special Report). Although not funded directly by the Board, it is advantageous in that this quick-cooking process is particularly adapted to California short and medium grain rices. The actual storage conditions studied will be exactly analogous to those contemplated for the more extensive storage stability studies on the hot-air modified rices.

4. Rice flour. Great publicity has been achieved on the WRRC-developed rice bread; newspapers throughout the country, and trade journals have carried stories, and a commercial food manufacturer has indicated he plans to market the rice mix developed. The best breads obtained are those incorporating

short and medium grain rices (WRRC).

5. Rice Flour Utilization (UCD)

a. Rice Bread. Various factors affecting rice bread quality were investigated. These include the moisture level, Methocel-K4M, oil, gluten, honey and skim milk solid content. Addition of Methocel at 3%, and low-fat milk solids at 3.0-4.5% of the weight of rice flour resulted in rice bread of better texture and flavor acceptance. Breads of different rice/wheat flour ratios were also tried. The best texture and volume was obtained by mixing 90% rice flour and 10% wheat flour. The specific volume of 100% rice bread was 5.50 (ml/gm) while that made with 90% rice and 10% wheat flour was 6.00.

b. Rice Vermicelli. Rice Vermicelli were made from medium grain rice flour. After rehydration in water, the product was pressed to remove excess water, cooked with steam, and then threaded. The product was cooled, rolled between cylinders into flat slabs, extruded with a hydraulic press into threads, cooked in water or steam, and then dried under the sun or in a hot air drier.

The physical and chemical properties of rice vermicelli differing in cooking behaviors were investigated. These include moisture, amylose, amylopectin, protein, fat, fat, water-uptake, cooking loss and texture changes after rehydration in boiling water for 1-5 min.

Water-uptake was directly correlated with cooking time. Rice vermicelli of higher protein content (6.15%) was lower in water-absorption capacity and lower in cooking loss than those of low protein content (4.47%). Volume change showed a similar pattern as the water-uptake behavior, except that it increases with an increase in amylopectin content. Cooking loss was positively correlated with cooking time. The rate of cooking-loss in water was faster when amylopectin content in the vermicelli was increased.

Texture value was inversely correlated with cooking time. Rice vermicelli of higher protein content was more resistant to softening during cooking. Water-uptake is a predominant factor affecting texture of rice vermicelli at certain critical levels of water absorption. Before reaching this level, the protein content plays a more important role.

c. Rice Cookies. The feasibility of substituting rice for wheat flour in popular American cookies was studied. The rice flour cookies had a greater

spread. This is probably due to several reasons. First, rice flour is lower in protein. Soft wheat, with its lower protein content is preferred over hard wheat flour for cookies because it gives a greater spread. Second, rice flour doesn't have gluten like wheat flour, which when mixed with water forms an elastic structure resulting in less spread. Third, rice flour appears to be less hydrophilic, allowing more water for the sugar. With more sugar dissolved, there is a greater spread. This was shown by the rice flour cookies having less moisture and being more crisp.

Thiamine loss during baking was 35% both in the rice and wheat flour cookies. Riboflavin loss during baking was 10%

The rice oat-meal cookies were more crisp at the lower flour level of 16.4% No textural difference was noted when the flour level was increased to 26 to 28%. The rice flour cookies were rated as more acceptable than the wheat flour cookies. Although definite conclusions can't be drawn on flavor acceptability judgements of the panel, it does give an indication of how rice flour cookies will be accepted.

In evaluating the overall comparison of the cookies, substituting rice for wheat flour looks very promising.

Publications or Reports

1. Monsman, A. P. and Fellers, D. A. Reduction of stickiness in rice. A talk presented at the 61st Annual Meeting of the American Assoc. of Cereal Chemists, New Orleans, Louisiana, October, 1976.
2. Nishita, K. D., Roberts, R. L., Bean, M. M., and Kennedy, B. M. Development of a yeast-levened rice-bread formula. Cereal Chem. 53:626 (1976).
3. Saunders, R. M. Rice Research at the Western Regional Research Center. 16th Rice Technical Working Group Meeting, Lake Charles, Louisiana, March, 1976.
4. Altares, R. A., and Luh, B. S. Thermoprocessing of canned Calrose rice enriched with beans and textured vegetable proteins. Proc. Sixteenth Rice Technical Working Group Meeting. p 71. Lake Charles, Louisiana, March 2-4, 1976.
5. Chen, S. Y. Physical and chemical properties of rice vermicelli. M.S. thesis. 1976. University of Calif., Dept. of Food Science and Technology, Davis, CA 95616.

Concise Summaries

Rice stickiness can be reduced by hot-air treatment. An objective method to measure stickiness has been developed (WRRC).

California long-grain rice can be converted into frozen rice products comparable

in properties to Starbonnet frozen rices (WRRC).

Experimental parameters have been established for stability of modified California rices. A model system using California quick-cooking rice is being studied cooperatively between UC Davis and WRRC.

Excellent national publicity has been afforded (California) rice bread.

Various factors affecting quality and specific volume of rice bread have been explored. Among these, moisture level, methocel, and skim milk powder are important parameters for successful rice bread baking.

The physical and chemical properties of rice vermicelli made from medium grain rice were studied. Rice vermicelli takes only 1 to 5 minutes for rehydration in boiling water as compared to 25 to 30 min for macaroni.

Factors affecting texture and nutritive value of rice-oatmeal cookies have been studied. It was shown that rice cookies have a greater spread. They are more crisp and attractive than the wheat flour cookies. Vitamin B retention in the cookies were determined. Thiamine retention was 65% after baking, while riboflavin retention was 90%.

SPECIAL REPORT ON WRRC RICE RESEARCH
NOT CURRENTLY SUPPORTED BY
THE RICE RESEARCH BOARD

A new process using a centrifugal fluidized bed for the critical drying step was developed to produce dry, quick-cooking rice products using a minimum number of treatment steps. The process conditions are very flexible and applicable to short, medium and long grain white rice to yield products similar to "Minute Rice". Brown rice and wild rice have been satisfactorily processed as well. High heat transfer rates used in the CFB drier (air flow 3000 fpm; 295°F; drier rotation 300-400 rpm), resulted in a short 4-7 minute drying cycle with good control of texture and rehydration characteristics. The rotation of the dries produces a centrifugal force of about 10 times gravity, thus permitting an air drying velocity about 10 times that used in previously developed techniques.

Because of the reduction in drying temperature and time and precooking conditions, it is estimated that energy requirements, water usage and effluent water treatment and disposal should be significantly less than in existing commercial plants.

The new California Long Grain selection 3764 handles very well in this process to yield a flavorful, non-pasty quick-cooking product.

Three major food processing companies have shown serious interest in commercializing this process.

Publications

1. Carlson, R. A., Roberts, R. L. and Farkas, D. F. Preparation of quick-cooking rice products using a centrifugal fluidized bed. Journal of Food Science 41:1177 (1976).