

COMPREHENSIVE RESEARCH ON RICE
Annual Report
January 1, 1975 - December 31, 1975

I. Project Number: RU-2 Rice Utilization and Product Development

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III. Level of 1975 Funding: \$17,000

IV. Objectives According to 1975 Proposals and Experiments:

To do research and development work on California grown medium and short-grained rice that will lead to the improvement in new methods of processing and to expand the utilization of rice in processed form, and fundamental work related to the development and commercialization of such products. The research will develop further understanding of the market potential for processed rice products. A budget for accelerated research on rice utilization was awarded to speed up the program. These included:

1. Fermented Rice
2. Rice Cookies and Crackers
3. Precooked Frozen Rice
4. Precooked Instant Rice.

V. Summary of Current Year's Work:

During the period January 1 to December 1975, research work on rice utilization concerning fermentation, baking, freezing, freeze-drying, and hot-air drying of precooked Calrose rice was carried out. Calrose rice was successfully made into a number of rice products attractive in color, flavor, texture, and palatability.

1. Fermented Rice. Experiments were carried out to study rice fermentation. A very

attractive fermented rice called "Lao-chao" was obtained. We used a mixture of rice containing 2/3 Calrose and 1/3 sweet rice. The sweet rice is more viscous after cooking, and helps to keep the system away from atmospheric oxygen.

The "starter" used in the investigation contains several members of Mucoraceous fungi, including Rhizopus oryzae, Rhizopus chinesis, and Chlamydomucor oryzae, and a yeast species called Endomycopsis. By following the traditional method, we have made an excellent fermented rice from a mixture of Calrose (65%) and sweet rice (33%).

The fermented rice has a taste of sweet tartness, and a distinctive fragrance of fruit aroma. The juice from the fermented rice contains about 15% sugars and 2.6% alcohol. The pH value of the product is at 3.7-3.9. During fermentation, lactic acid was formed by the organism bringing the titratable acidity to 0.46%. A mixture of esters formed during fermentation contributed to the fruit aroma. Rhizopus chinensis excretes amylases to convert the rice starch into maltose and glucose which were then fermented by the yeast Endomycopsis to alcohol, and carbon dioxide. R. chinensis also produces a very pleasant fruit aroma. The lactic acid-producing strains of Rhizopus organism yield equal molar ratio of lactic acid, alcohol, and carbon dioxide under anaerobic conditions. The fermented rice can be kept at 40°F in a refrigerator for 2 to 3 months without deterioration in quality. The fermented rice can be consumed as such, or cooked with eggs, or used as a flavor booster in cooking various fish and vegetable dishes. We will study the optimum conditions for better yield, more attractive flavor, the chemical composition, and better keeping quality of the fermented product.

2. Rice Cookies and Crackers. The rice research project was extended in 1975 to include rice cookies and crackers. We have developed various recipes for making rice cookies and crackers. Up to 35 to 40% of the ingredients was Calrose rice flour.

The rice flour was incorporated with sugar, shortening, salt, baking powder, eggs, non-fat milk powder, soy protein and other ingredients such as oatmeal, peanut butter, rye, raisin, walnuts, etc. There were 23 recipes developed. The better ones are rice cookies with oatmeal, rice cookies with peanut butter, and several others. They have an appealing aroma, texture, and flavor.

The chemical, physical, sensory, and nutritive quality of rice cookies and crackers are being investigated.

3. Precooked Frozen Rice. Various factors affecting texture of precooked frozen Calrose rice were investigated. It was observed that addition of 5% hydrogenated vegetable oil to the cooking water in the presence of 0.5% Tween 60 as an emulsifier can help to keep the cooked rice from sticking together. "Tween 60" is a surfactant or emulsifier made by ICI America Inc. It is permitted by FDA for food use. The rice was first soaked in water at room temperature for 30-40 minutes to reach a moisture

content of 30%. This was followed by cooking 1 part of soaked rice with 1.1 parts of cooking water containing 5% hydrogenated vegetable oil and 0.5% "Tween 60". An electrical automatic rice cooker was used. The texture and flavor of the frozen rice was very good after thawing. It was also observed that addition of 1% by weight of salt (sodium chloride) to the cooking water would improve the flavor acceptance of the frozen rice.

Addition of calcium chloride (0.25-0.75%) did not improve the texture of the frozen rice. Various factors affecting crystallization, retrogradation, and texture of frozen cooked rice at various storage temperatures (0°C, -12°C, -25°C), are being investigated. A scanning electronmicroscope is used to study the degree of crystallization of starch as related to retrogradation and moisture level in the frozen rice.

4. Precooked Instant Rice. Experiments were carried out to study the methods for preparation of precooked Calrose instant rice which were dehydrated by hot air. Freezing of the cooked rice prior to dehydration greatly facilitates the dehydration process. Furthermore, the dehydrated rice kernels will not stick together in lumps if the freezing process was applied.

Storage stability of precooked Calrose rice dehydrated by the hot-air drying process at 100°C is being investigated. The products were sealed in cans under vacuum, and stored at 1°, 20°, and 37°C for various periods. We are investigating the changes in color, rehydration capability, nutritive value and sensory quality of the instant rice. The changes in color, rehydration, amino acids, fatty acids, and peroxide value of the rice as related to the sensory quality of the product is being continued.

VI. Publications or Reports:

1. Yan, M.T., and Luh, B. S. 1975. Effect of Processing Conditions on Quality and Nutrient Retention in Frozen Precooked Calrose Rice.
2. Altares, R.A., and Luh, B.S. 1975. Thermo Processing of Mixture of Rice, Beans, and Textured Vegetable Protein.

VII. Concise General Summary of Current Year's Results.

1. Calrose rice can be fermented with a starter in the presence of 1/3 its weight of sweet rice to produce a ready-to-eat product which is very attractive in aroma, flavor, and texture. The product can also be used in cooking to make more tasty dishes.
2. Various recipes for making rice cookies and crackers have been developed. Rice cookies with oat-meal, rice cookies with peanut butter, rice crackers, etc. are made from Calrose rice flour. The products have good future for home-baking as well as for industrial use. This is a new outlet for broken-rice obtained in the milling process.
3. Various factors affecting texture of precooked frozen Calrose rice were investi-

gated. It was observed that addition of 5% hydrogenated vegetable oil to the cooking water in the presence of 0.5% Tween 60 as emulsifier can help to keep the cooked rice from sticking together. Careful control of cooking water/soaked rice ratio : between 1.25/1.00 and 1.10/1.00 can yeild a cooked rice of excellent texture and flavor acceptance. Addition of 1.0% by weight of salt to the cooking water also improves the flavor acceptance of the frozen rice. Crystallization of rice starch is related to retrogradation and textured quality of cooked rice.

4. Precooked Instant Rice.

Freezing of cooked rice prior to dehydration in a hot-air tunnel greatly facilitates the dehydration process. Furthermore, the dehydrated rice kernels will not stick together in lumps if the freezing process is applied prior to dehydration.