December 17, 1974

I. ANNUAL REPORT

COMPREHENSIVE RESEARCH ON RICE

PROJECT NUMBER & TITLE RU - 1 Rice Utilization and Product Development

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OBJECTIVES To do research and development work on California grown medium and short grain rice that will lead to improvement in methods of processing to more utilization of rice in various processed form. Equally important is to evaluate the chemical, physical and nutritional properties and storage stability of the rice products.

WORK IN PROGRESS Research work on canning, freezing and dehydration of precooked Calrose rice under various processing conditions is in progress. The approaches are (a) to improve the protein content of the processed rice with dry beans and textured vegetable proteins; (b) to improve the color, texture and flavor of processed rice by controlling the processing conditions; (c) to evaluate the nutritive value, chemical and physical characteristics, palatability, and storage stability of the precooked rice products; and (d) to develop new rice products for human consumption.

EXPERIMENTS COMPLETED 1. Canning of Calrose Rice. A series of experiments was carried out to study the quality of canned Calrose rice fortified with dark red kidney beans, garbanzo beans, and textured soy proteins. Calrose rice was the major component (more than 40%) in the formulation. The canned product contained more than 12% protein as compared with 6-7% in Calrose rice. The proximate composition of the rice, dry beans, and textured soy proteins are presented in Table 1.

Table 1. Proximate Analyses of Calrose Rice, Red Kidney Beans, and Textured Soy Protein.

	Calrose rice	Red Kidney dry beans	Texture soy protein
Water,%	12	10	6
Protein, % (N X 5.95)	6-7	20-22	50-52
Carbohydrates, %	80.4	62	32
Fats,%	0.4	1.5	1

The chemical analysis of Calrose rice enriched with the B vitamins (niacin and thiamine) are presented in Table 2.

Table 2. Chemical Analysis of Calrose Rice, Enriched with Niacin and Thiamine

Sample	Water %	Total Starch %	Protein % (NX 5.95)	Iron mg/100g	Vitamins niacin mg/100gm	Thiamin (Vit. B_1) mg/100gm
1	12.10	80.12	6.80	2.78	0.41	3.54
2	12.23	80.17	6.91	2.86	0.43	3.47
3	11.87	79.69	6.93	2.92	0.42	3.52

The rice sample contained 6.80 - 6.93% protein and 11.87 - 12.23% moisture. The amino acid profile was improved due to the higher lysine content in beans (6.2% of total protein) and higher methionine content in milled rice (2.0% of total protein). Table 3 illustrates the benefits of combining rice and dry beans

Table 3. Amino Acid Composition of Rice, Beans and Textured Soy Protein

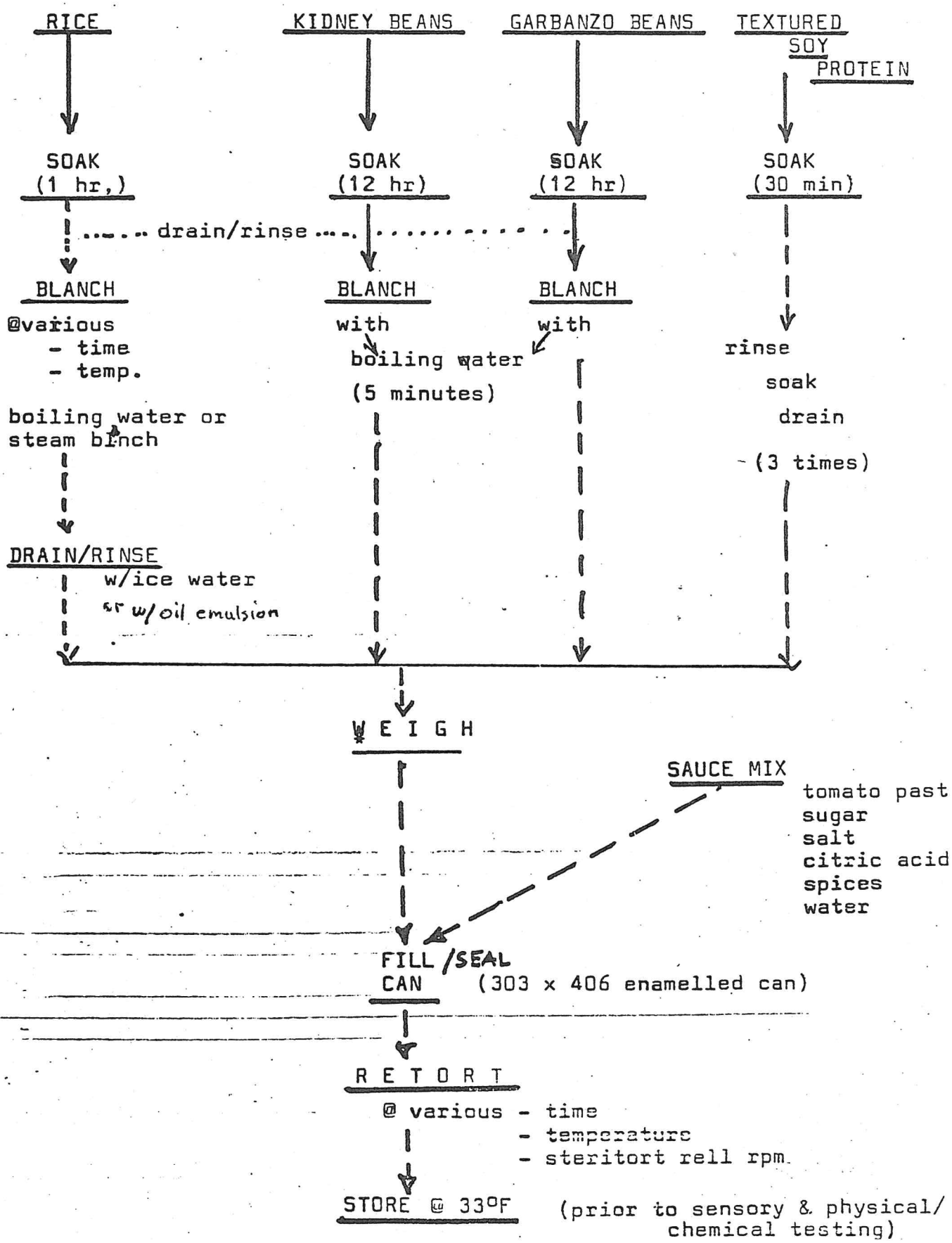
Essential Amino Acid (% of Total Protein)	Rice	Beans	Textured Soy Protein	Amino Acid Limited in:
% Protein	9.8	20.	50	
Valine	6.2	5.6	4.6	
Leucine	9.5	7.2	7.7	
Isoleucine	4.7	5.4	4.6	
Threonine	4.0	3.4	4.0	
Lysine	4.0	6.2	5.7	Rice
Methionine	2.0	0.7	1.3	Beans, and textured soy protein
Cystine + Methionine	3.0	1.5	2.8	
Phenylalanine	6.1	4.4	5.1	
Tyrosine	2.2	2.6	2.1	
Tryptophane	1.1	0.9	1.3	Rice

in improving the amino acid profile, and the nutritive value of the canned product.

The flow diagram for rice canning is presented in Figure 1.

2. Product Formulation. Polished Calrose rice contains 6.8% protein. To increase the protein content in the canned product, dark red kidney beans (20-22% protein), garbanzo beans (20-22% protein), and textured soy protein (50-52% protein) were used in the formulation. The rice was first soaked in cold water at room temperature for one hour, and then blanched in either boiling water or steam at 212°F for 1, 2, and 3 minutes respectively. The blanched products were drained, rinsed, and combined with prepared dry beans and textured protein in 303 x 406 enameled cans. The dark red kidney and garganzo dry beans

FIG. 1. RICE CANNING FLOW DIAGRAM



were first soaked in water at room temperature for 12 hours, washed, blanched in water at 212°F for 12 hours, drained and cooled in water, sorted, and then ready for canning with the blanched Calrose rice. The textured soy protein was soaked in water for 30 minutes, and then rinsed and drained. One typical example of the formula is as follows: 45% blanched rice (53% moisture), 15% red kidney beans (60% moisture), 15% garbanzo beans (58% moisture), and 25% textured soy protein (78% moisture). The sauce was made of 4% sugar, 2% salt, 0.1% monosodium glutamate, 0.2% onion powder, 0.1% garlic powder, 11% tomato paste (26% solids), 0.3% citric acid, 0.06% black pepper, and 0.12% paprika. Three hundred ml of sauce is added to 190 gm mixture of the rice, beans, and textured protein.

The heat treatment required to get a sterilized canned product in the steritort was 30 minutes at 245°F for 303 x 406 cans.

3. Results in Rice Canning. The following results were obtained:

a. The rice product canned with plain water was less acceptable to that with sauce and condiments as shown above.

b. Unsoaked rice tends to show more break down of the kernels during processing. Unblanched rice kernels tend to have a poor texture after canning.

c. Steam blanching the soaked rice for 3 min at 212°F produced a canned product of better texture than that blanched in boiling water for 3 min. The optimum blanching time in boiling water was 2 minutes.

d. The conventional still retort in which the cans were not rotating, produced a non-uniform product. The rice and beans sank to the bottom of the can. The steritort in which the cans were rapidly rotating produced a more uniform and attractive canned product as compared with the still retort.

e. Shorter pre-cooking time results in a more rapid heat transfer during processing.

f. An attractive canned rice can be obtained with 12% protein through fortification with dry beans and soy proteins.

4. Freezing Preservation of Precooked Rice. The cooking and processing characteristics of long grain (Texas rice) differ significantly from the short (Pearl) and medium grain (Calrose) varieties. The long grain varieties have a relatively high amylose content (23-27%), an intermediate gelatinization temperature range (70° to 75°C), and a moderate water-uptake capacity at 77°C (110 - 150 ml per 100 gm), and a relatively high viscosity (750 to 950 Brabender Units, B.U.) of the cooked paste on cooling to 50°C.

The short and medium -grain varieties of rice have a lower amylose content (15-21%), a relatively lower gelatinizing temperature range (60-69°C), and higher water-uptake values at 77°C (300-400 ml per 100 gm). Amylograms of the typical

short- and medium-grain varieties usually show low cooled-paste viscosities (650-750 Brabender Units) at 50°C.

Results obtained during the paste year indicate that precooked Calrose rice can be frozen. It yields a convenience product which needs only to be heated before serving. Fortification of the rice with niacin and thiamine (B_1), was done by mixing 1 part of premix to 199 parts of milled rice. The rice was washed and soaked in water at room temperature for 30-40 minutes, rinsed with cold water to remove loose starch, cooked with various amounts of water (1+0.75; 1+1; 1+1.25; 1+1.5; 1+1.75 respectively) in an electrical rice cooker. The cooked rice was cooled, packaged in 12 oz boil-in-the-bag pouches or in 12 oz carton pouches, and then frozen at 0°F.

The optimum rice to water ratio seems to be in the range of 1 part of rice to 1.25 parts of water. The loss of thiamin and niacin during washing was about 13%. The frozen product appears to be quite good in quality. Work is being continued to study the Shear Press values, objective color test, and sensory evaluation for color, texture and flavor of the product after thawing and preheating. The texture of the rice is a more important problem to be studied. Work on retrogradation of starch at various temperature, loss of texture during thawing, and keeping quality of frozen precooked Calrose rice is being continued.

5. Freeze-dried Precooked Rice. An instant rice made by freeze-drying the precooked Calrose frozen rice was made. The product rehydrates readily in boiling water in a few minutes, and has a very attractive color, flavor and texture after rehydration. The products were packaged under vacuum in #2 1/2 cans. Work is being continued to study the storage stability of the freeze-dried product.

Freeze-dried rice is an excellent product as a convenience food. It rehydrates readily to yield a very attractive rice as good as freshly cooked. It should be protected from moisture and air by packaging in aluminum -foil pouches. Slow absorption of moisture by the product from the air can lead to slow chemical reactions, development of off flavor , and toughening of texture. Even though the oil content of rice is low, there is a possibility of rancidity development on long storage unless the package is good enough to protect the rice oil from oxidation. The use of aluminum-foil pouches also prevents deteriorative changes caused by light and microorganism contamination.

WORK PLANNED. Research work will be continued on canning of medium and short grain rice, chemical and physical properties of rice products, precooked frozen rice, and utilization of broken rice. The details of the plan has been presented in the research proposal for 1975.

MAJOR ACCOMPLISHMENTS. During the 1974 fiscal year, good results have been obtained on canned high protein rice, frozen rice in boil-in-the-bag type containers, and freeze-dried rice. It was shown that the medium grain rice can be used for processing if the processing conditions were properly controlled. The work is being continued on the chemical and physical properties of the processed rice, and nutritive and sensory quality of the products.

IMMEDIATELY APPLICABLE RESEARCH RESULTS. It has been shown that Calrose rice can be processed into canned, frozen and dehydrated products. The industry should make good use of the results to promote more utilization of medium grain rice for processing. Canning, freezing, and freeze-drying are the major outlets for processing.

EVALUATION OF PROJECT. The rice utilization project was started in 1974. It is a little too early to make a critical evaluation of the accomplishments. From the results obtained, it appears that California grown medium grain rice should have good prospects for promotion into rice products for human consumption.

PUBLICATIONS OR REPORTS. More work will be needed to have the scientific and technical results of the research published.