



Shelf-life Extension of Brown Rice

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2013
National Year
of
RICE

**SAPAT NA BIGAS
KAYA NG PINAS**

❖ National Year of Rice

- **Presidential Proclamation No. 494**
- **Aims to encourage everybody to join in the government's efforts towards rice self-sufficiency**
- **One of the key messages for the public is to “Eat brown rice for better health”**





- Filipinos love to eat rice
- It is our staple food
- Average consumption is 307g/capita/day (7th National Nutrition Survey, FNRI 2008)



❖ The rice importation

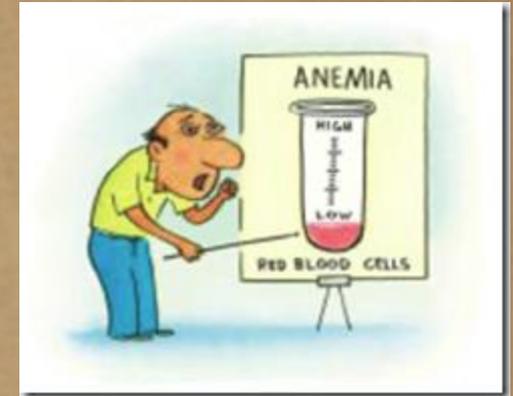
- Based on the data from the Bureau of Agricultural Statistics, our top agricultural import in 2010 was well-polished rice
- According to the National Food Authority, the Philippines imported 2 Million metric tons of rice in 2010 but in 2013, this went down to 350,000 metric tons
- Our rice production in 2010 was 10.32 million metric tons which went up to 17.97 million metric tons in 2013





❖ The micronutrient deficiencies

- Iron deficiency anemia was highest (55.7%) among infants 6 to 11 months old based on the 2008 National Nutrition Survey
- Over all anemia prevalence was 42.5% among pregnant women, classified as high public health significance
- Zinc deficiency was noted in 21.6% of infants & pre-schoolers, 20.6% in female adolescents, 33.6% in male adults and 21.5% among pregnant women



❖ Effects of micronutrient deficiencies

- The presence of anemia is an indication of an individual's iron status
- Iron deficiency anemia causes long-term cognitive impairment, poor-school performance, risk of low birthweight for infants and increased maternal mortality
- Zinc deficiency causes growth retardation and stunting, impaired reproduction and immune disorder

❖ The emerging health problems

- Prevalence of high FBS (≥ 126 mg/dL) increased from 3.4% to 4.8%, peaking at age 50-69 years old
- No. of overweight individuals had almost doubled since 1993
- Overweight and obesity affected 27 in every 100 adults

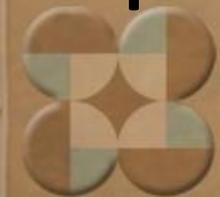


Our solution



If we take a closer look on brown rice

- ✓ we will know that production of brown rice has 10% higher recovery than white rice = economics
- ✓ we will realize that our rice importation in 2010 was 13% of our national consumption = savings
- ✓ we may be able to reduce the risk factors associated with certain life style diseases = health
- ✓ we may be able to feed more with our current rice production = food security



Facts on brown rice

- **Brown rice is more nutritious than white rice**
- **Bran layer is rich in fiber, minerals and B- vitamins**
- **Brown rice has low to moderate glycemic index**
- **There is shorter milling time and higher output volume when brown rice is produced**



❖ The problem with brown rice

- **Shelf-life of brown rice is short**
- **Consumers are not aware of the health benefits of brown rice**
- **Brown rice is expensive and not readily available**
- **These had to be addressed to increase utilization of brown rice**



❖ What has been done?



❖ “R&D Program for the Optimization, Utilization and Promotion of Brown Rice in the Philippines”

(Dec 2010 – Apr 2012)



○ **Proj. 1 Optimization studies for the improvement of shelf-life of brown rice**

○ **Proj. 2 Mineral availability, dietary fiber and fermentability characteristics of optimized brown rice**



Objectives

General:

- **To improve the shelf-life of brown rice through process optimization**

Specific:

- **to determine optimum processing parameters**



Objectives

- to determine the retention of nutrients, microbiological safety, and sensory properties of brown rice after processing and during storage and
- to estimate shelf-life of optimized brown rice



Methodology

- **Screening experiments**
- **Optimization experiments using Response Surface Methodology**
- **Standardization runs**
- **Chemical, microbiological and sensory evaluation of optimized brown rice**
- **Verification experiment**



7 variables / 8 run screening design

Run	Lag time	Variety	Microwave	Steaming & drying	Drying	Packaging	Storage
1	24 hrs	mixed	no	yes	yes	vacuum	open
2	6 hrs	mixed	no	no	no	vacuum	shaded
3	24 hrs	pure	no	no	yes	no vacuum	shaded
4	6 hrs	pure	no	yes	no	no vacuum	open
5	24 hrs	mixed	yes	yes	no	no vacuum	shaded
6	6 hrs	pure	yes	no	yes	no vacuum	open
7	24 hrs	mix	yes	no	no	vacuum	open
8	6 hrs	mix	yes	yes	yes	vacuum	shaded

Sample collection in commercial rice mill



❖ Screening experiment



❖ Results of screening experiments:

- Among the three heat treatments the combination of steaming and drying has the largest reducing effect on the FFA
- Steaming and drying contributes to the reduction of off odor
- Steaming and drying contributes to the increase in the over-all liking of the product
- Variety affects the over-all acceptability

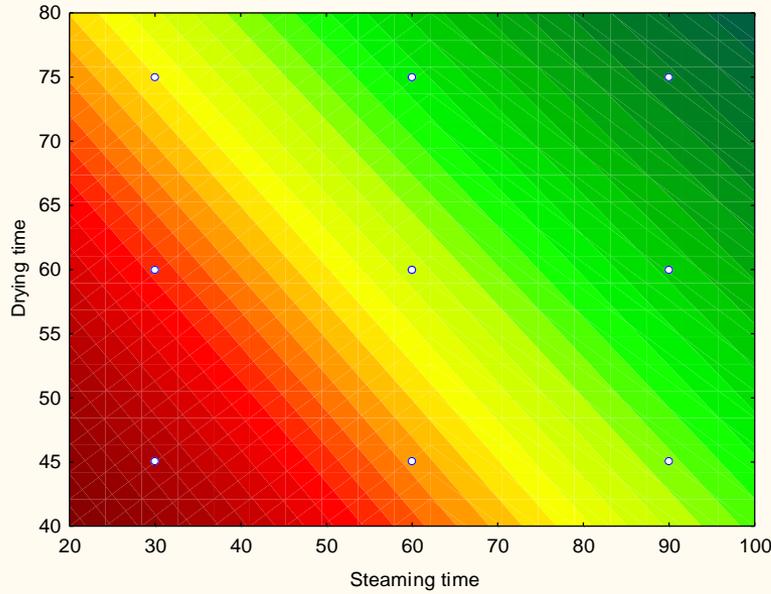
3 Factor Box-Behnken Design

Standard Run	Steaming Time	Drying Temp	Drying Time
1	30	55	60
2	90	55	60
3	30	75	60
4	90	75	60
5	30	65	45
6	90	65	45
7	30	65	75
8	90	65	75
9	60	55	45
10	60	75	45
11	60	55	75
12	60	75	75
13	60	65	60
14	60	65	60
15	60	65	60

Fitted Surface; Variable: FF_F

3 3-level factors, 1 Blocks, 15 Runs; MS Residual=3.367215

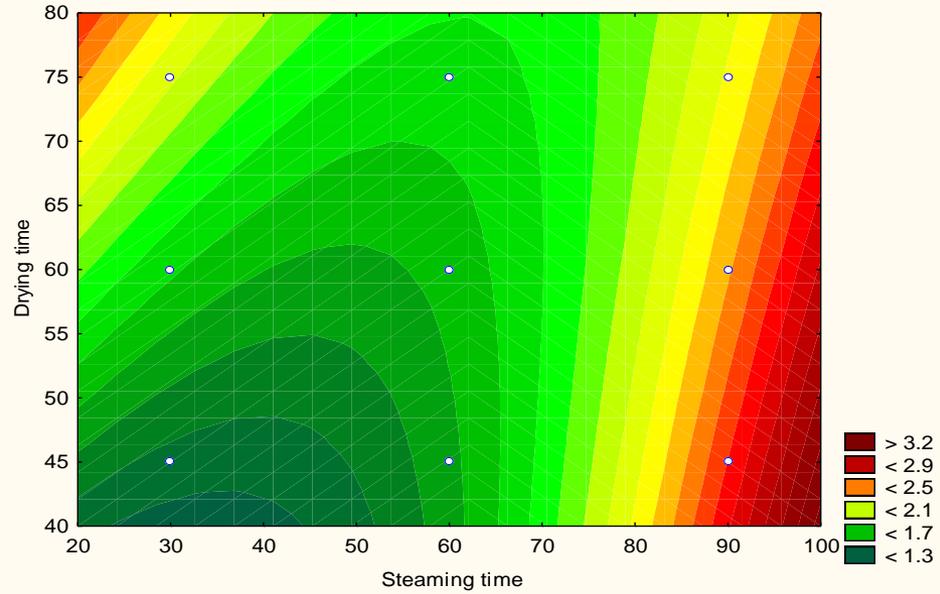
DV: FF_A



Fitted Surface; Variable: P_V

3 3-level factors, 1 Blocks, 15 Runs; MS Residual=.0173716

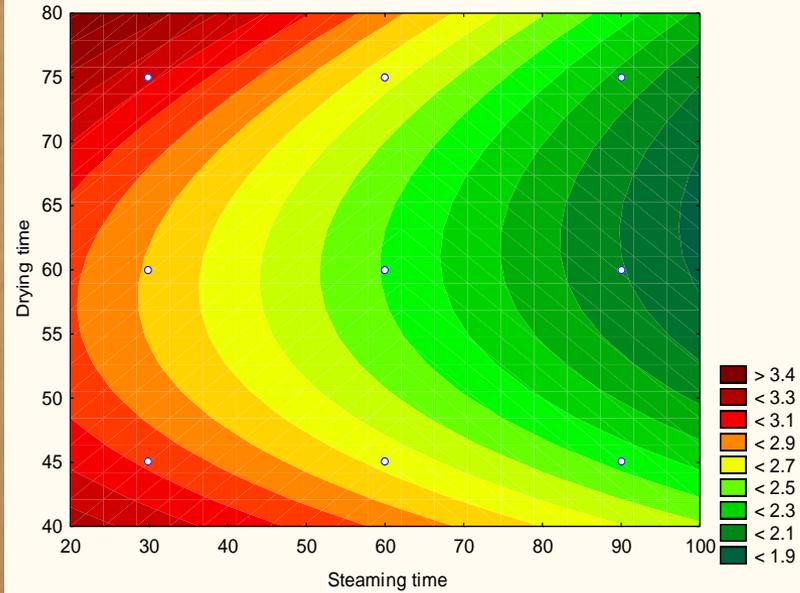
DV: P_V



Fitted Surface; Variable: QDA-R Off-odor

3 3-level factors, 1 Blocks, 15 Runs; MS Residual=.1478976

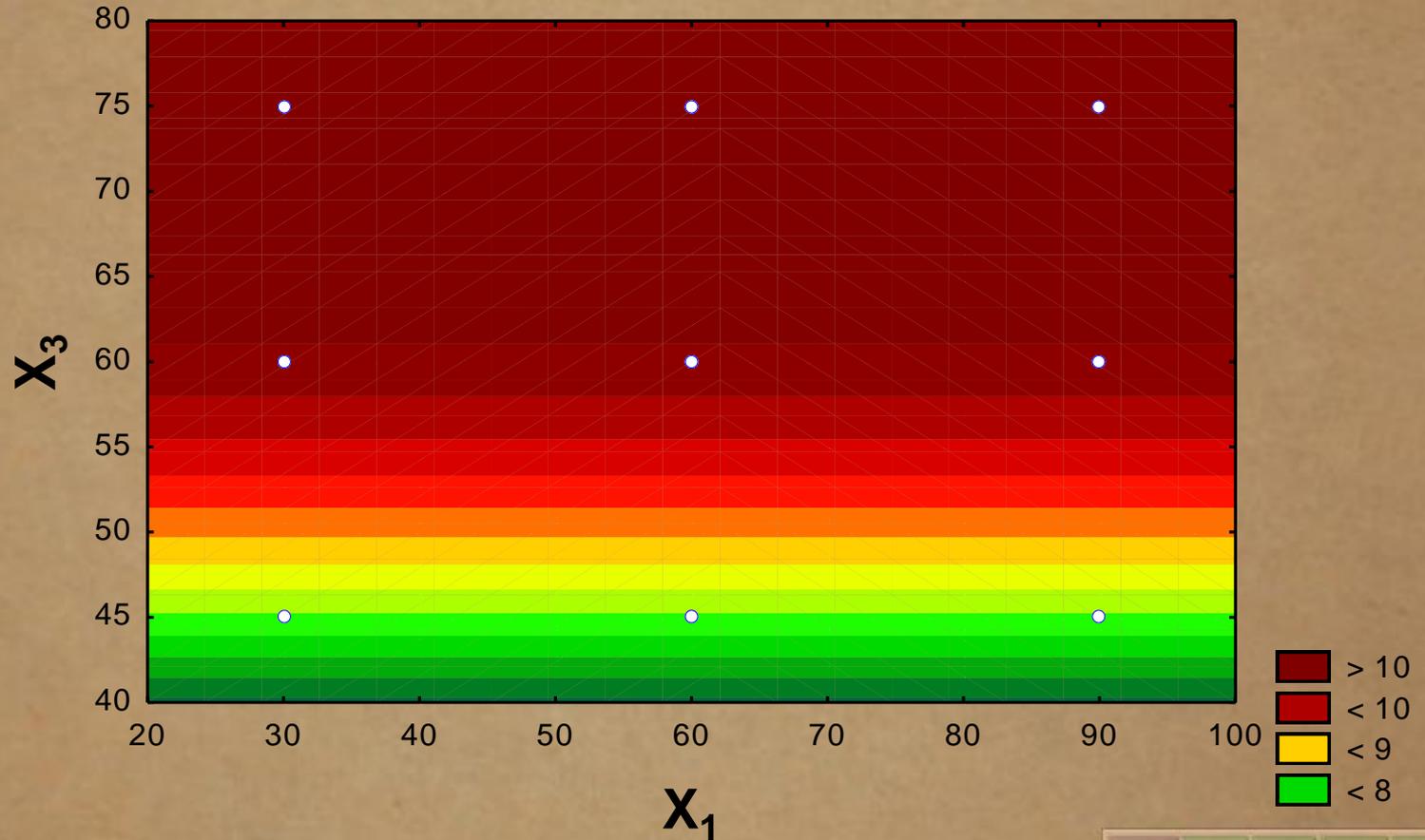
DV: QDA-R Off-odor



Fitted Surface; Variable: QDA-C OA

3 3-level factors, 1 Blocks, 15 Runs; MS Residual=.6385166

DV: QDA-C OA

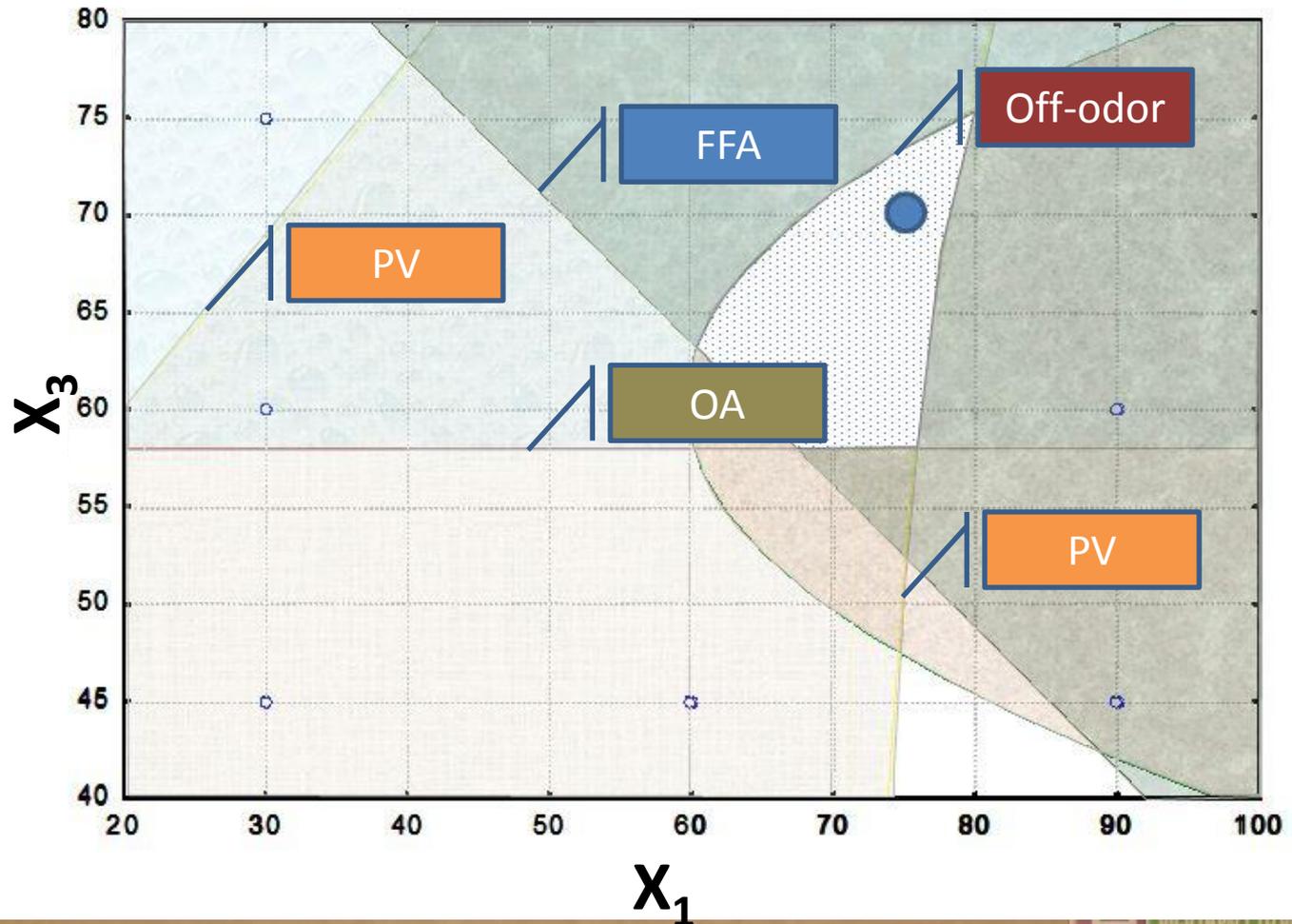


Responses considered in optimization

- **The FFA should be as low as possible**
- **The peroxide value should be as low as possible**
- **The off odor should be as low as possible**
- **The over-all liking should be as high as possible**



❖ Overlaid plots of dependent variables showing the optimum region





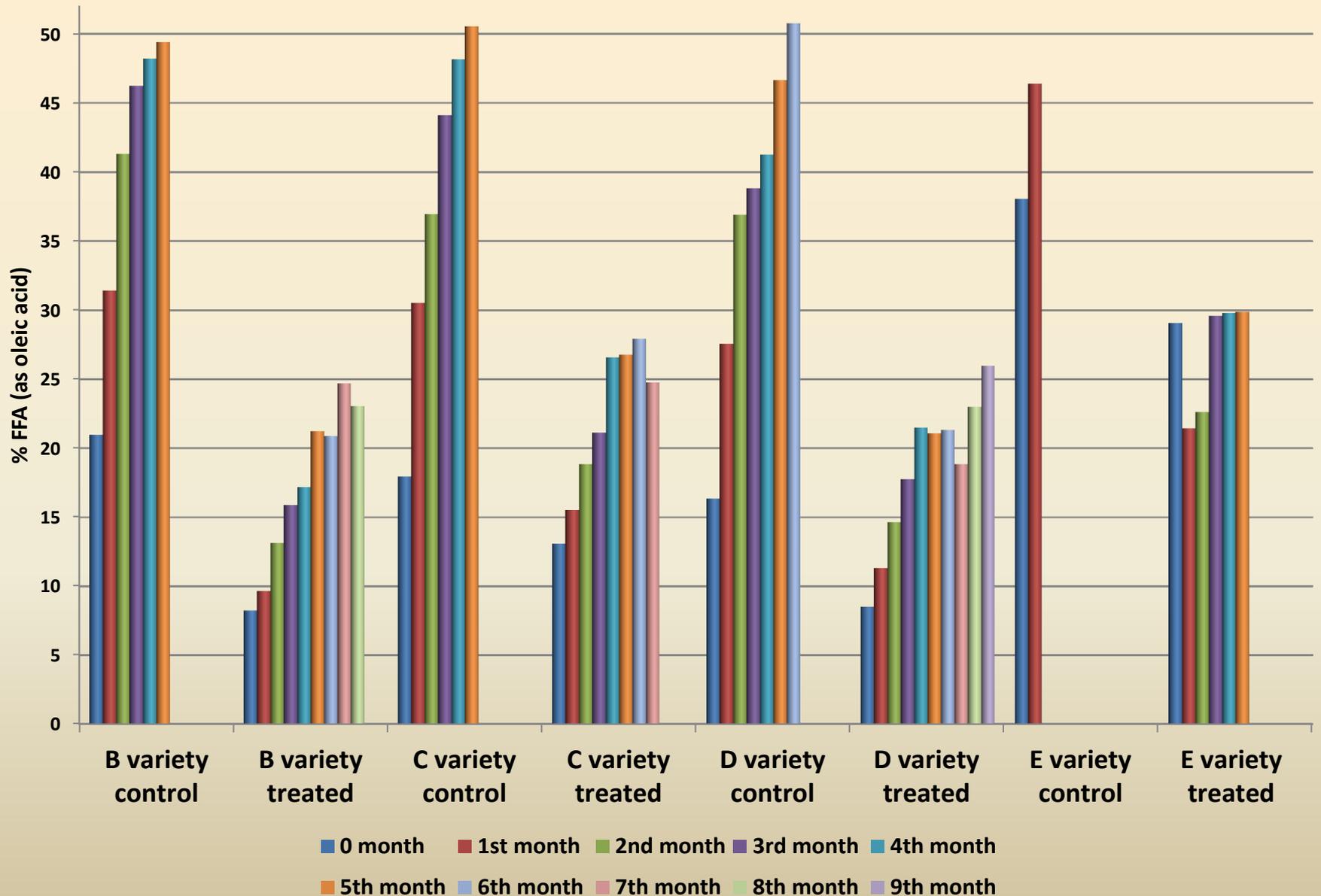
Verification runs (storage studies)

❖ Actual storage in commercial mill

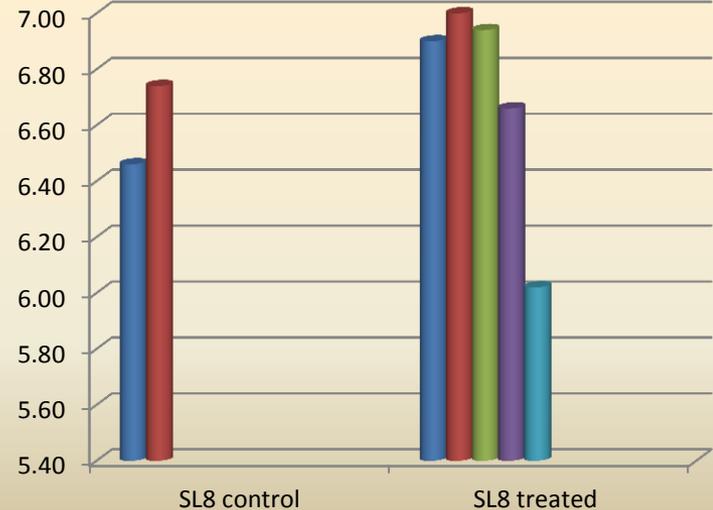
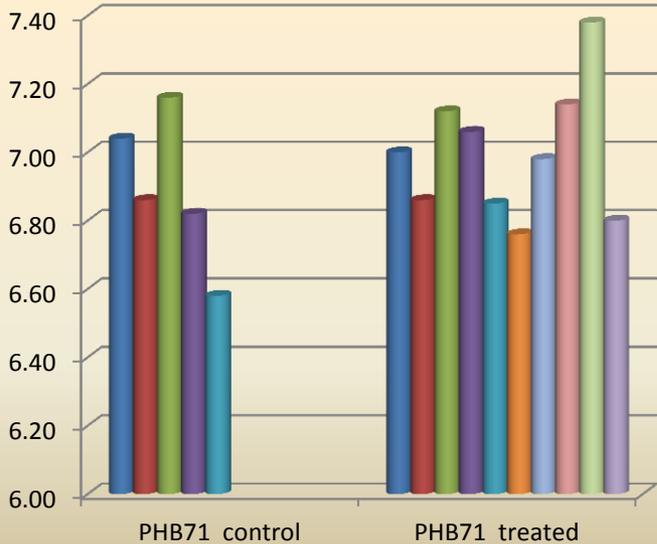
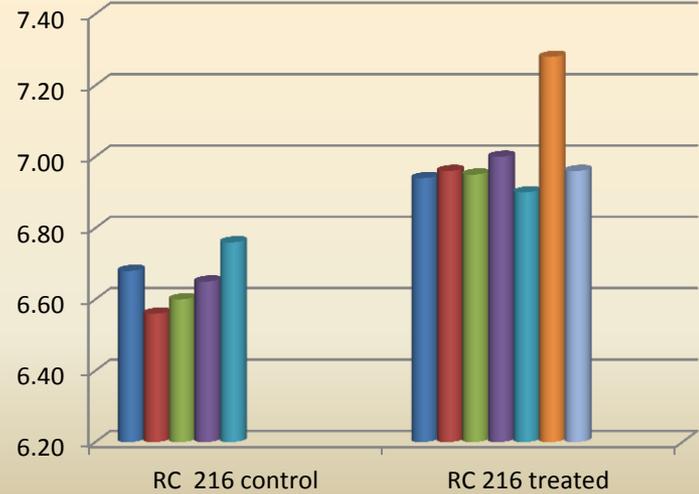
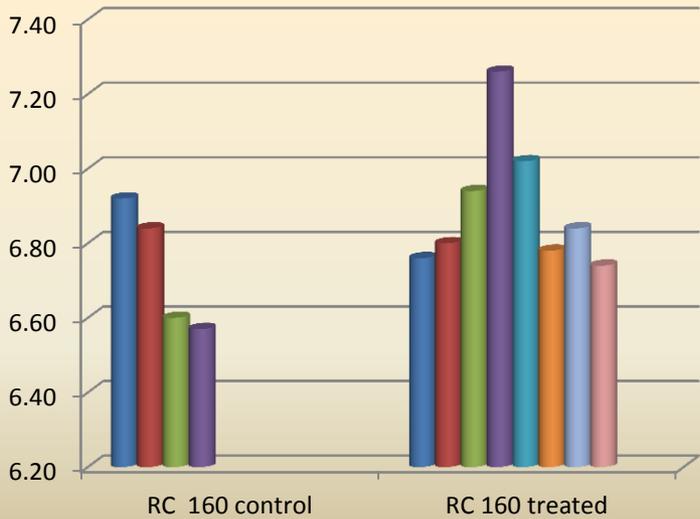
- Optimized parameters were applied to four (4) rice varieties
- Samples were stored in actual storage facility of a commercial rice mill in San Leonardo, Nueva Ecija



% FFA of brown rice during the storage period



❖ Acceptability rating of odor of raw brown rice during storage



❖ Shelf-life of control and treated brown rice

Variety	Treatment	Observations during storage	Shelf-life (months)
B Variety	Control	Presence of rice weevils, and rancid odor on the fourth month of storage	3
	Treated	Presence of rice weevils and rancid odor on the eighth month of storage	7
C Variety	Control	Presence of rice weevils, and rancid odor on the 4 th month of storage	3
	Treated	Presence of rice weevils and rancid odor on the seventh month of storage	6
D Variety	Control	Presence of rice weevils and drop of hedonic rating to 6.5 on odor on the fifth month of storage	4
	Treated	Rancid odor perceived by the panelists on the tenth month of storage	9
E variety	Control	Presence of molds on the second month of storage	1
	Treated	Rancid odor and drop of hedonic score to 6.0 on raw samples on the fifth month of storage	4

❖ Continuation....

- The heat treatment did not affect the acceptability in terms of sensory qualities; the texture was even improved
- Nutrients such as vitamin B1 & B3, including phosphorus were retained after the heat treatment
- There were no significant changes in the color of brown rice due to treatment done



❖ Nutrition facts

NUTRITION INFORMATION

Serving Size 67 g

Servings per pack 7

	Amount per Serving	Amount per 100 g
Energy (Calories)	250	370
Total Fat (g)	2	3
Total Carbohydrates (g)	53	79
Total Dietary Fiber (g)	2	3
Total Protein (g)	5	8
Sodium (g)	0	5
	Amount per Serving	% RENI
Calcium (mg)	19	3
Iron (mg)	1	5
Zinc (mg)	1	18

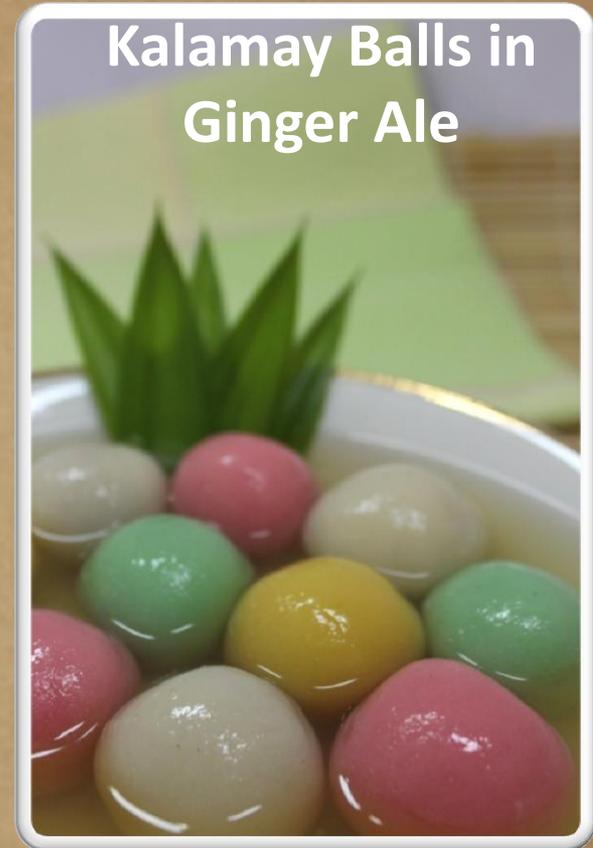
Base on RENI for Male 19 years old and above



❖ Brown rice recipes developed



Arroz con Leche



**Kalamay Balls in
Ginger Ale**



Everlasting Turon



Suman Duo in Dulce de Leche Dip



Pahiyas Fried Rice

Rice Adobo Wrap





First adoptor of the FNRI brown rice technology with DOST Sec. Mario G. Montejo, FNRI Director- Dr. Mario V. Capanzana and brown rice study project leader