EFFECT OF PARBOILING ON THE FORTIFICATION OF RICE WITH IRON AND ZINC

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OVERVIEW
- FOOD FORTIFICATION
  - deliberately increasing the content of an essential micronutrient (vitamin or mineral) in a food, so as to improve its nutritional quality and provide health benefit with minimal risk

FOOD FORTIFICATION
- a strategy adapted by the WHO (World Health Organization) and FAO (Food and Agriculture Org) to eliminate micronutrient malnutrition
- more than 2 billion people in the world today suffer from micronutrient deficiencies

Iodine, iron, vitamin A, and zinc deficiencies
- identified by World Health Report as among the world’s most serious health risk factors.
  - Iodine – goiter/cretinism
  - Vitamin A – blindness
  - Iron – anemia
  - Zinc – growth retardation

WHY FORTIFY RICE?
- a valuable vehicle for micronutrient fortification programs:
  - staple food of more than 3.5 billion people worldwide (Asia-Pacific, Latin America, Africa, and Caribbean)
  - Asian countries consume nearly 90% of the world’s rice
  - populations that subsist on rice are at high risk of vitamin and mineral deficiencies
  - the milling process depletes the grains of micronutrients, resulting in a nutrient-deficient staple food.

Examples of mineral-fortified rice products

Iron and zinc-fortified (Panama)
Iron-fortified (Philippines)
Calcium, iron and zinc-fortified (China)
Calcium and iron-fortified artificial rice (Philippines)

RECOMMENDED DIETARY ALLOWANCE (RDA)
- set by the Institute of Medicine of the National Academy of Sciences

IRON
- Children: 7-15 milligrams per day
- Adult (female): 18 milligrams per day
- Adult (male): 8 milligrams per day
- Pregnant female: 27 milligrams per day

ZINC
- Children: 3-9 milligrams per day
- Adult (female): 8 milligrams per day
- Adult (male): 11 milligrams per day

CONTENTS in NATURAL MILLED RICE (12% MC)
- Iron: 3-55 milligrams per kilogram
- Zinc: 7-55 milligrams per kilogram
- ~5 lbs (16 cups) of cooked rice to meet RDA
FORTIFICATION by EXTRUSION

- COLD EXTRUSION
  - 1 part
  - 100-200 parts

- HOT EXTRUSION
  - 1 part
  - 100-200 parts

HYPOTHESIS

- Movement of micronutrients into the starchy endosperm of the rice kernel may be enhanced by using brown rice as feedstock in the parboiling-fortification process

ROUGH RICE VS BROWN RICE

CLXL745 Head Rice Samples (feedstock: brown rice)

- Non-Parboiled
- Parboiled, Unfortified (0 mg/L)
- Parboiled, Fortified (100 mg/L)
- Parboiled, Fortified (200 mg/L)

FORTIFICATION by PARBOILING

- Advantageous to use in countries where parboiled rice is the staple food (e.g., parts of Asia and Africa)
- Basic hurdle: fortificant molecules should be able to move into the starchy endosperm of the rice kernel and should be retained upon milling

SAMPLES (Rough Rice and Brown Rice)

- Pureline: RoyJ
- Hybrid: CLXL745

SOAKING (0, 100, 200 mg/L Fe and Zn)
- Ratio: 1 part rice/2 parts fortificant
- Duration: 3 hours
- Temperature: 158°F

STEAMING (Autoclave)
- Temperature: 240°F
- Pressure: 12 psi
- Duration: 10 min

DRYING
- Ambient air
- Temperature
- 60 seconds

MILLING
- Pureline: RoyJ
- Hybrid: CLXL745

- Ratio: 1 part rice/2 parts fortificant
- Duration: 3 hours
- Temperature: 158°F
- Pressure: 12 psi
- Duration: 10 min
- 60 seconds

SAMPLES

- CLXL745 Rough Rice
- CLXL745 Brown Rice
- RoyJ Rough Rice
- RoyJ Brown Rice

Head rice iron content as affected by micronutrient fortification through parboiling

- CLXL745 Rough Rice
- CLXL745 Brown Rice
- RoyJ Rough Rice
- RoyJ Brown Rice

1 cup of cooked rice will meet RDA for iron

Iron Content (mg/kg)

0 mg/L 100 mg/L 200 mg/L

0 10 20 30 40 50 60 70 80

0 mg/L 100 mg/L 200 mg/L

CLXL745-Rough Rice
CLXL745-Brown Rice
RoyJ-Rough Rice
RoyJ-Brown Rice

Undetectable
**SUMMARY**

*With brown rice as feedstock in parboiling-fortification:*
- Better retention of iron and zinc in milled rice
- High head rice yield is maintained
- Minimal color change
- Slight decrease in paste viscosity (softer texture?)

*Thank You!!!*