Making rice more nutritious through extrusion

Technology, trends and opportunities

Anthony Hehir
Director Nutrition Improvement, DSM Nutritional Products

Americas Rice Convention, Punta Cana, June 2018
Presentation roadmap

- Brief introduction to DSM
- The case for rice fortification
- Hot extrusion to fortify rice
DSM: A global Life Sciences and Material Sciences company active in health, nutrition and materials

OUR PURPOSE IS TO CREATE BRIGHTER LIVES FOR PEOPLE TODAY AND GENERATIONS TO COME.

We connect our unique competences in Life Sciences and Materials Sciences to create solutions that nourish, protect and improve performance.
DSM Human Nutrition & Health

WIDEST PORTFOLIO OF NUTRITIONAL PRODUCTS
- Vitamins
- Carotenoids
- Omega 3 & 6 Nutritional Lipids
- Nutraceuticals
- Premixes

Health Benefit Solutions

ALL STAGES IN LIFE
- Pregnancy
- Senior years

ALL MAJOR SEGMENTS
- Nutrition Improvement
- Early Life Nutrition
- Food & Beverages
- OTC+Rx
- Dietary Supplements
- Worldwide Production
- Scientific Research & Innovation
- Global Sales and Regulatory Expertise

Quality for Life

Inspired

We can help you get to market faster with solutions that take you further.
Nutrition Improvement - a specialized focus at DSM

Through its Nutrition Improvement team, DSM is your partner of choice in the provision of high quality, affordable and accessible nutritional solutions that have a proven public health impact on populations at risk of malnutrition.

- **Nutrition Solutions**
  - Fortification of products intended to improve nutrition at public health level

- **Expertise**
  - World leader in food fortification technology, application expertise, nutrition science

- **Partnerships**
  - DSM proudly engages in partnerships (both public and private) to ensure maximum impact on public health nutrition.

We fight malnutrition. Every day.
The case for rice fortification
2 billion people suffer from vitamin and mineral deficiencies

Hidden hunger

- Mainly caused by limited or no access to a variety of foods
- A poor diet results in micronutrient deficiencies, also called hidden hunger, because people do not show the typical symptoms of hunger.

1/3 of the world's population is affected by hidden hunger. They might never reach full physical cognitive potential.
“Probably no other technology available today offers as large an opportunity to improve lives and accelerate development at such low cost and in such a short time.”

Food fortification to fight malnutrition
Source: Enriching Lives, The World Bank
Hot extrusion to fortify rice
Why Fortify Rice with Vitamins and Minerals

- Rice is the main staple for 3 billion people, concentrated in developing countries. Rice fortification enables consumers to improve their micronutrient intake without changing behavior.

- Rice fortification is a proven and cost effective strategy to address micronutrient deficiencies; comparable to salt, flour and oil fortification.

- Time is right: fortifying rice to address deficiencies is gaining momentum and supported by governments, captains of industry and key global aid organizations.

- 48% industrially milled maize flour is fortified
- 30% industrially milled wheat flour is fortified
- 1% ‘industrially’ milled rice is fortified
Rice Fortification can put back what’s lost post-harvesting and add what’s needed by the population

Nutrients lost from rice in the milling process

Fortifying rice via extrusion

1. Addition of vitamins and minerals
2. Blending (0.5 – 2% ratio)

Paddy rice → Rice milled → Broken rice grains → Whole rice grains → Turned into flour → Extruded rice kernels → Fortified rice
Plant Set Up - Hot Extrusion

- Grinding
- Extruder with gravimetric feeding and pre-conditioning
- Fluid bed pre-drying and belt final drying
- Screening
Advantages of Extrusion Technology

- **Robustness:**
  Micronutrients are embedded in the rice matrix and remain so even if the rice is washed before cooking, steamed or cooked in excess water.

- **Acceptance:**
  Fortified extruded kernels have been tested worldwide and can be made to look like rice grains, thus no need to change consumer dietary habits.

- **Flexibility:**
  Any variety of rice can be fortified. Size, shape and colour of fortified kernels can be adapted. Micronutrient blend and recipe can be adapted to match target consumer.

- **Scientific backing:**
  Using hot extrusion technology to produce fortified kernels is supported globally by a wide range of evidence.

**Fortified kernel:**
- 92 - 97% rice flour
- 3 - 8% premix
- Moisture content max. 13 - 14%
- Emulsifier, additives

Dispersed protein coagulates
Cohesiveness through partially gelatinized starch

DSM
BRIGHT SCIENCE. BRIGHTER LIVING.
Extrusion Comparison

**Warm extrusion**

Preconditioner + pasta press 60-80°C  
Or gluten free pasta press 60 - 90°C

- Opaque
- Slightly edged
- Suited for opaque rice species (e.g. white rice)

Warm extruded fortified rice kernels blended with non-fortified white rice from Laos

**Hot extrusion**

Preconditioner + double screw extruder 80 - 110°C

- Translucent
- Rounded edge
- Suited for translucent rice species (e.g. parboiled)

Hot extruded fortified rice kernels blended with non-fortified parboiled rice
Which Micronutrients can we add via extrusion?

Similar to maize and wheat flour fortification WHO guidelines:
- Iron
- Folic Acid
- Vitamin B12
- Vitamin A
- Zinc

Micronutrients lost during milling can be added back:
- Thiamin (B1)
- Vitamin B6
- Niacin (B3)

Many others are also possible in case of public health need or interest:
Vitamin E, Vitamin D, Selenium, Lysine, Calcium (limited quantities) etc.

Possible, but cause coloring of the fortified kernels:
Riboflavin (B2), Vitamin C, beta-carotene

Effective nutrient forms: factors for consideration
- Bioavailability of nutrient form
- Interaction with rice matrix & other nutrients
- Legal status
- Sensory attributes
- Visual effects
- Cost-effectiveness
- Stability; shelf life & handling requirements
Vitamin stability in extruded fortified kernels

Process & storage stability
- Losses in process are 0-20%
- Most sensitive vitamins are A & B1
- Kernels stored at 30°C, Monthly losses 4-10% with kernels stored at 30°C
- Shelf-life of 1 year is common with overages to compensate for losses

Washing stability
- Very low with hot extruded kernels
- For cold extruded kernels, losses depend on intensity of the washing and on the binder matrix.

Cooking stability
- Impacted by excess water that is removed after cooking, or soaking/extensive cooking for over two hours

Iron bioavailability
DSM as your B2B partner in rice fortification

- **Global market leader** in vitamins & mineral premixes
- **Custom-made** rice premix solutions & extruded fortified kernels
- **Regulatory support** services, incl. export & import
- **Extensive technology know-how** & patent portfolio to produce fortified kernels
- **Extensive research** on optimal acceptability, stability & nutrient retention in fortified rice
- Broad global **network & customer base**
- **Consumer insights & concept design capabilities** to drive brand success
Thank You!

Fortified kernels
Making rice more nutritious