

FAQS

RICE FORTIFICATION



Consumer Questions

1. What is rice fortification?

Rice fortification is a practical and cost-effective way to ensure a sufficient supply of essential vitamins and minerals in rice, to improve the health and productivity of rice-eating populations worldwide.

2. Is rice a natural source of vitamins and minerals?

Yes, rice is a natural source of vitamins and minerals. Brown rice (un-milled rice) contains more nutrients, mainly in its bran and germ layers. These layers are mostly lost during the milling process that produces white rice. Both white and brown rice contain small amounts of the B vitamins, particularly thiamin and niacin, zinc, phosphorus, calcium, iron and folic acid (1). Brown rice, in addition, has trace amounts of vitamin E, manganese and magnesium. However, neither milled (white) rice nor brown rice provides a significant quantity of essential vitamins and minerals.

3. *What are the benefits of rice fortification?*

Consumption of fortified rice offers populations the benefit of achieving their full cognitive, physical and productive potential, especially malnourished populations whose staple food is rice. For example, the addition of folic acid to rice reduces the risk of neural tube defects in newborns and that of iron helps to improve cognitive performance in children, reduce anaemia levels, maternal deaths and poor productivity (2). One of the primary benefits of rice fortification is that populations can receive a steady supply of their required vitamins and minerals without having to change their dietary habits or behavior.



4. *Who should eat fortified rice?*

Fortified rice can be eaten by anyone who either does not eat or does not have access to a nutritious, balanced daily diet. Women of child bearing age and children tend to be the most affected by vitamin and mineral deficiency and should, therefore, eat fortified rice. In countries that have a significant burden of vitamin and mineral deficiency, entire populations can benefit from consuming fortified rice.

5. *Can I choose whether or not to eat fortified rice?*

Yes, you can. If your country has a national requirement to fortify its rice, only fortified rice will be available. It is important to bear in mind that fortified rice will provide you sufficient amounts of vitamins and minerals, essential for good health and nutrition, which may not be supplied in one's daily diet. If you prefer unfortified rice, choose brown rice.

6. *Why not just take vitamin and mineral supplements?*

Supplements are particularly effective in treating individuals with moderate to severe vitamin and mineral deficiency. However, it is a lot more expensive than fortification and people either forget to take their supplements or avoid taking supplements because of its undesirable side effects (3). There is also the chance of toxicity if supplements are consumed at the wrong dosage. In comparison, fortification does

not rely on changes in dietary behaviour and it is highly unlikely that a person would consume an excess of vitamins and minerals from fortified rice (2).

7. *Why not just eat more nutrient rich foods?*

A varied and balanced diet consisting of adequate levels of all vitamins and minerals is the ideal way to achieve good health and nutrition. Unfortunately, this is not a realistic option for many people in the world today, as it requires people to follow appropriate dietary patterns and behaviors at all times. Fortified food can provide a steady supply of all the required micronutrients to entire populations without them having to change their food habits or dietary behaviour (2).

8. *Why not just eat brown rice or parboiled rice?*



Although brown and parboiled rice contain more micronutrients than regular white rice, they do not meet the daily vitamin and mineral requirements for humans. They are also unable to provide the variety and level of micronutrients available through fortification.

9. *Why are some people negative toward rice fortification?*

Some people want food that is “natural” without any additives. What is often not fully appreciated is that milled rice is not natural because vitamins and minerals and other healthy elements have been removed during processing. The negativity surrounding rice fortification is likely due to a lack of understanding of the potential benefits that fortified rice can offer countries battling vitamin and mineral deficiency, and due to a notion that rice is difficult to fortify. Rice fortification is still a relatively new idea, so there needs to be more technical consultations which could provide an opportunity for these concerns to be raised and addressed.

10. How is fortified rice produced?

There are a number of ways by which rice can be fortified (4). These include:

Powder enrichment method

Vitamins and minerals are applied to rice kernel, followed by coatings of water insoluble substance to avoid rinsing off of the nutrients.

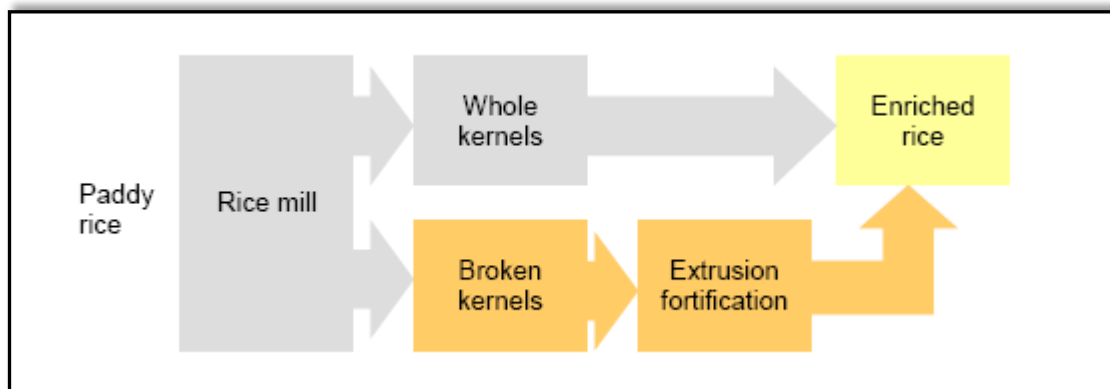
Coating techniques

This involves the coating of ordinary rice in layers with an alcoholic solution of the micronutrient compound and insoluble substances.

Cold and hot extrusion methods

This involves the extrusion of a mixture of rice flour & mineral-vitamin-powder through either a cold or hot extruder to produce a rice-like kernel

For both the coating and extrusion approaches, the resulting fortified grain premix is blended into traditional rice at a specified ratio, usually between 1:50 and 1:200.



11. Can any variety of rice be fortified?

Yes, any variety of rice can be fortified using any one of the fortification methods described in the question above. When using the extrusion method for fortification, the appearance, shape, size and texture of fortified rice can be adapted to all rice varieties as it is custom made.

12. *Will fortification change the appearance or taste of rice?*

Fortified rice, regardless of the fortification technique used, resembles natural rice grains and has been scientifically shown to be indistinguishable from natural rice in appearance, taste and texture (5).

13. *Will there be nutrient losses when fortified rice is rinsed before cooking?*

Fortified rice made using coating and extrusion technologies can be rinsed prior to cooking in the same way as regular rice. This can, however, still result in small nutrient losses, depending on the types of nutrients added. However, fortified rice using dusting methods can have significant losses of nutrients during rinsing.

The vitamins and minerals added to hot and cold extruded fortified rice, are evenly distributed in the rice kernel and adequately sealed, resulting in high retention of most of the nutrients. However, roughly 25% of the B vitamins are lost due to their water soluble properties (unpublished data). There are reports of greater losses with coating and powder techniques on which limited data is available.



14. *Can fortified rice be cooked in the same way as regular rice?*

Yes, fortified rice can be cooked in exactly the same way as regular rice.

15. *Will cooking change the appearance, texture or taste of the fortified rice?*

The effects of cooking on fortified rice are the same as the effects of cooking on regular rice. Therefore, it has the same appearance texture and taste as regular cooked rice (5).

16. How about the nutrient losses when fortified rice is cooked in excess water (as per local practice in some countries) and that water is drained?

Current fortification technologies available such as extrusion allow for rice to be cooked in excess water, without significant nutrient losses. However, in the case of water soluble B-vitamins, losses of up to 30% losses have been reported when extruded rice grains are cooked in excess water (unpublished data).

17. How successful are other foods that have been fortified in improving health?

There are a number of different foods, which for years have successfully been fortified to improve the nutritional status of populations. For example:

- Flour has been used as a vehicle for vitamins and minerals for nearly a century and has been very successful in reducing vitamin and mineral deficiency. Currently over 30% of the worlds wheat flour produced in large mills is fortified with either/or iron and folic acid and over 60 countries have legislative requirements and standards requiring all flour produced in large mills be fortified. For more information: <http://www.sph.emory.edu/wheatflour/>
- Since the 1700's, salt has been used as a vehicle for iodine supplementation of populations and during the last two decades ,governments around the world (over 180 countries) have adopted “universal salt iodization” to virtually eliminate iodine deficiency. Currently about 75% of the worlds household salt is iodized. The challenge for the future as countries attempt to reduce salt intake for health benefit is to ensure all salt added during food processing (where feasible) is iodized at an adequate level to continue to protect populations from deficiency. Other foods which have been fortified include sugar, sauces, infant foods, condiments and oil. For more information: <http://www.iodinenetwork.net/>



18. *Is fortified rice available in the market? If yes, where is it available?*

Yes, fortified rice is available in the market in Brazil, China, Columbia, Costa Rica, Nicaragua, Papua New Guinea, the Philippines and the United States. While fortified rice is available only in specialty markets in China, retail markets in Brazil and Columbia, all of the rice in Papua New Guinea is fortified. Fortification in Costa Rica is being carried out at the national level in all rice mills. In 2009, Nicaragua passed a government resolution that all rice consumed in country should be fortified.



Health/Nutrition Sector Questions

1. What vitamins and minerals can be added to rice?

In principle, almost any combination of vitamins and mineral can be added to rice. At the moment, technologies exist for rice to be fortified with the iron, zinc, calcium, vitamin A, folic acid, thiamin, niacin and vitamin B₁₂ (4). Depending on the deficiencies present in the general population or in a specific target population (e.g. young children, school children, pregnant and lactating women), rice can be fortified accordingly.



2. Should rice fortification be made a national requirement?

Experience with other staple food fortification (salt, wheat flour, maize flour and oil) has shown that the most successful national scale programs, with high population consumption have all be associated with an enforceable food standard requirement for fortification. Even though the costs of fortification are small compared with the benefits, it is hard for companies to bear these additional costs if cheaper unfortified

rice predominates in the market. There is a high and ongoing investment in education and marketing by governments and companies to encourage consumers to change behavior and purchasing habits. When food fortification is dependent on the market then often poorer people from lower socio-economic sectors tend to miss out. Fortified products are often positioned as more expensive value added products and not for the masses. At the moment, a few countries (e.g. Philippines, Papua New Guinea) have national rice fortification requirements in place. To facilitate fortified rice reaching the whole population, national rice fortification requirements should be considered. This is especially feasible in countries where most of the rice is being imported through a few external traders or in countries that grow their own rice where fortification is routed through a few centralized rice mills so as to reach large segments of its population.

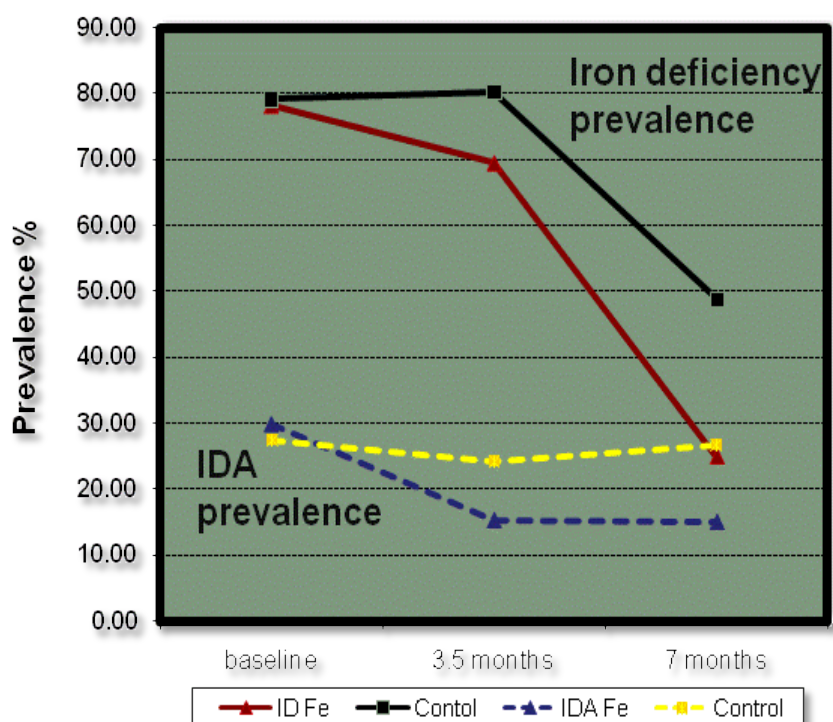
3. Are there recommended standards for rice fortification?

Countries (listed above) that have adopted rice fortification have developed national standards for rice fortification and these will be developed by the Food Standards organizations in each country. To help countries with this, the World Health Organization and other normative organizations are currently working towards developing technical guidelines for countries considering rice fortification. The fortification of wheat flour recently underwent a thorough process of developing guidelines that have been endorsed by the World Health Organization, Food and Agriculture Organizations and other global bodies. These will be useful, in the mean time, for countries that are considering rice fortification. These can be accessed at: http://www.who.int/nutrition/publications/micronutrients/wheat_maize_fort.pdf.

4. Is rice fortification found to be efficacious in reducing micronutrient deficiencies?

Yes, several controlled research studies conducted in children and young women have demonstrated that regular consumption of rice fortified with adequate levels of bio-available forms of micronutrients results in a significant reduction in the prevalence of micronutrient deficiencies (5-7).

Biological efficacy of iron fortified rice in Indian school children (5)



5. Will Governments subsidize the costs of rice fortification?

It will depend on the country and its public distribution system and other targeted food programs that are operational. However, fortification in general is a very cost-effective strategy.

6. Will fortified rice be able to reach vulnerable groups?

There are different ways through which fortified rice can reach vulnerable groups in populations: a) if all the rice in a country is fortified on a national requirement basis; b) if special programs such as public distribution networks, school feeding programs and programs that target pregnant mothers and young children supported by the Government or by international organisations adopt fortified rice in their distribution.

7. What are the safe limits for addition of vitamins and minerals to rice?

Safe limits for the addition of each of the vitamins and minerals to rice would be different. Similar to any fortification program, each nutrient being considered for rice

fortification would have to be well within the upper limits set by relevant international health bodies and would most likely account for only $\frac{1}{4}$ – $\frac{1}{2}$ of the recommended daily intake.

8. Is it safe for children and pregnant women to eat fortified foods every day?

Children, pregnant and lactating women, would especially benefit from consuming fortified foods every day as their daily requirements for vitamins and minerals are higher, to be able to support physical growth and the development of new tissues. Decades of experience in the use of fortified foods shows that it is safe for children and pregnant women to eat fortified foods every day. When many foods are being fortified in a country reaching the same population, it is recommended that the Government department responsible for health and nutrition in that country conducts a comprehensive analysis to make any required corrections to the fortification standards.

9. Are there any known side effects to consuming fortified rice?

No side effects on health have been reported in the studies published on fortified rice. Published sensory studies comparing fortified rice to normal rice have reported no taste or smell differences (5).

10. Is it possible that a person might consume an excess of nutrients from fortified rice?

The nutrient composition of fortified rice is set based on the average per capita rice consumption of the population intended to consume fortified rice. This ensures that excess of nutrients in the fortified rice is not a possibility. Since the amount of vitamins and minerals added to the rice is low ($\frac{1}{4}$ - $\frac{1}{2}$ of the recommended intake) and the excess limit of most nutrients is often many times the recommended intake, it is almost physically impossible (e.g. eating more than 20 kg of rice/day) to consume an excess of nutrients with fortified rice. In addition, quality control procedures should be enforced at the point of blending the micronutrient premix with rice.

12. How fast can one expect health effects of consuming fortified rice?

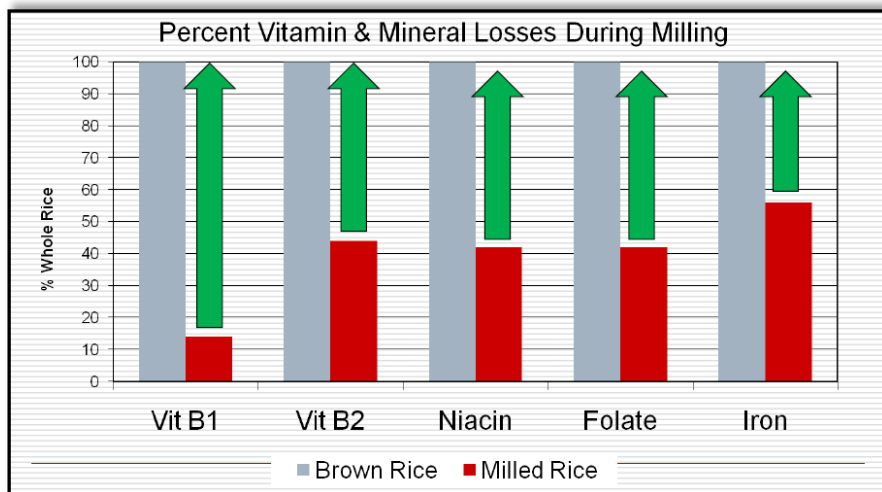
Micronutrient deficiency occurs when the micronutrient stores in the body have been depleted, a process which usually takes months. Building up new stores also takes time, and one cannot expect to see health effects within days or a few weeks. For example, formation of new red blood cells to counteract anemia takes at least 2 weeks. Daily consumption of fortified rice will allow new stores to be built, and will demonstrate biological efficacy starting from about 4 months since the start of consumption (5).



Agriculture/ Trade Sector Questions

1. *What are the milling losses of vitamins and minerals present in rice?*

The rice milling process removes the hull, bran, and germ layers from rough, paddy rice. During this process, a significant amount of the vitamins and minerals are lost. The chart below illustrates the milling losses for several important micronutrients.



2. *What is a premix?*

Premix refers to the rice kernels that have the added vitamins and minerals, using the coating or extrusion techniques, which are subsequently blended into traditional rice to make fortified rice (5).

3. *Who produces premixes?*

Several companies currently offer fortified rice premixes:

1) Extruded grain premix

- DSM-Buhler, China
- Adorella Alimentos, Brazil
- Food and Nutrition Research Institute, Philippines
- Superlative Snacks Incorporated, Philippines
- J.D. Aguilar Commercial Inc, Bataan, Philippines)
- Swagat Foods, India
- Christy Friedgram, India
- Vigui, Costa Rica
- Group NTQ, Costa Rica

2) Coated grain premix

- Wright Enrichment, USA
- SunRice, Australia
- Research Products Company (RPC), Kansas, USA
- CLG Health Food Products, Philippines

4. How will the premixes be procured by the Government and Industry?

Fortified grain premixes can be procured directly from regional premix facilities available to countries in each geographical region.

5. How stable are these micronutrients added to the premix? Are there losses during cooking?

Sensory tests conducted on fortified rice, in both the natural and cooked forms, have shown no changes in colour, taste or appearance between fortified and natural rice, suggesting that the vitamins and the minerals added to the premix are reasonably stable (5). Cooking losses have been shown to be minimal (unpublished data).

6. What is the shelf life of the premix?

The reported shelf life of premixes is between 3 months and 2 years, for it to be free of rancidity and microbial growth and maintain stability of nutrients (4).

7. What is the shelf life of fortified rice?

Studies have shown that the shelf life of fortified rice is at least 6 months. Additional storage studies are required to establish exactly how long fortified rice can stay free of rancidity and microbial growth.

8. At what point can the premix blended into regular rice? Will there be segregation?

Blending of the premix with the regular rice can be done at various stages in the supply chain. It can be done during the milling process in large centralized mills that are well equipped for blending operations, where rice is bagged or in large warehouses where rice is stored prior to distribution. Point-of-use fortification is another method for blending the fortified grain premix with traditional rice, currently being done in large school feeding programs.

The optimal blending method will vary based on the type of fortification program or strategy – whether it is a mass fortification program at a national level, select public feeding programs, or commercial retail distribution in supermarkets.

Because the fortified premix is so similar to traditional rice in size, shape and density, little segregation occurs. A 2008 pilot project in India evaluated the issue of segregation during transport and storage of blended, fortified rice and found that the homogeneity of the blend remained constant, even after transporting to long distances (unpublished data).

9. How will it be ensured that uniform blending is achieved?

Mechanical dosifiers equipped with a variable flow mechanism and a mixing system that guarantees uniform blending of premix with natural rice are now available. In addition to this, improved premixes with greater stability and better adherence of fortificant compounds also aid in the blending process. Continuous quality assurance by producers, periodic government inspections, and regular analyses of the concentration of micronutrients in random batches of the fortified rice will also ensure uniform blending. Protocols are currently available to carry out reliable analytical tests.

10. What are the quality control and quality assurance procedures needed for rice fortification?

There are several guidance documents available to set up appropriate quality assurance and quality control (QA/QC) procedures, to ensure that the fortified food meets the standards of quality required for its intended use at the consumer level. These guidelines can be applied for rice fortification also. Once the flow of the fortification process is identified, the purpose of QA/QC procedures is to establish criteria for each component of the process, monitor the criteria at all critical points and take timely corrective action.

11. What are the experiences from countries currently practicing rice fortification?



Costa Rica:

Regulations for a national requirement on rice fortification were issued by the government in 2001. The primary agency responsible for monitoring fortification is the Costa Rican Institute for Research and Education on Nutrition and Health (INCIENSA), Ministry of Health. Authorities reported that most of the rice sold in the country follows the national standard and compliance is ensured through random sampling of fortified rice blends in the market place. Fortification is being carried out at the national level in all the rice mills.

USA:

Although rice enrichment is a requirement for only six states in the U.S., enriched rice is readily available in all states. The U.S. Food and Drug has established a standard (CFR 137.350) that specifies the minimum levels of the micronutrients to be included in all enriched rice. Nearly all the fortified rice in the U.S. is fortified using the powder enrichment method.

Philippines:

Philippino Government regulations stipulated a national requirement for rice fortification in November 2004. Most of the fortified rice is handled by the National Food Authority (NFA), a quasi-governmental institution with the mandate for food

security and rice stabilization and regulatory powers over grain business. The NFA distributes approximately 15% of all rice consumed in the Philippines.

Nicaragua:

On July 29, 2009, the Minister of Health for Nicaragua, enacted a Ministerial Resolution No. 235 which states that it is the responsibility of the producer, importer, distributor and processor of rice to make sure that the rice is fortified with the specified levels of micronutrients. However, implementation of this mandate has not been comprehensive, although plans are underway to begin fortifying rice that is milled by several of the country's largest rice mills.

Papua New Guinea:

In 2007, the Head of State of Papua New Guinea issued a Food Sanitation Regulation that mandates the addition of iron, thiamin and niacin to rice and has been importing rice from Australia which is fortified with iron and the B vitamins.

12. How will rice fortification impact on trade?

While considering rice fortification, a country should address its unique international and regional trade obligations, while at the same time enabling trade of fortified rice with other countries. For instance, Pacific Island countries have to respect World Trade Organization (WTO) Agreements, Pacific Island Countries Trade Agreement (PICTA), the Pacific Agreement on Closer Economic Relations (PACER), the Cotonou Agreement, and various Compacts of Free Association with the United States of America.

Since fortification specifications are considered technical specifications, they are most impacted by the Agreement on Technical Barriers to Trade (TBT Agreement) of the WTO. According to article 2.4 of the TBT Agreement, countries should use relevant international standards (such as the World Health Organization (WHO), when available.

In general, the WTO requires non-discrimination between trading partners as well as non-discrimination between imported and locally-produced goods. This means that regulations should apply equally to nationally produced and imported products.



Finance Sector Questions

1. Is rice fortification cost-effective?

There is data to show that the benefits of any fortification measure far outweigh its associated costs. These benefits would apply to fortification of rice as well.

In 2008, a panel of eight of the world's most distinguished economists ranked fortifying food with iron as one of the most cost-effective ways to address malnutrition.

The estimated benefit: cost ratios for iron fortification is approximately 6:1 for effects on physical productivity. When cognitive benefits are included, this ratio increases to 36:1. Sue Horton's article on *The Economics of Food Fortification* (2006) has more information on country-specific cost-effectiveness and cost-benefit analyses (8).

2. Who will bear the costs of rice fortification?

Costs associated with fortification of staple products such as rice are often shared by the public and private sectors. In most cases, rice millers are responsible for capital investment in machinery, testing supplies for mill quality control, and staff training while the State pays for national quality assurance (Food Control), monitoring, and evaluation. Determining who is responsible for these various costs requires dialogue between government and industry.

Costs will ultimately be passed on to the consumer if the industry is unable to absorb them. In most countries, the cost of fortification at the mill is paid by the consumer,

either directly through the market price of rice or indirectly through any government subsidies

3. *Will fortified rice cost more than the regular rice? If yes, how much more?*

The processes involved in fortification, do add extra costs to rice. However these costs are minimal when compared to the health and economic costs associated with populations experiencing high levels of micronutrient deficiencies. The additional costs to fortify rice with vitamins and minerals using the various technologies in select rice- eating countries are provided in the table below (4):

| Country | Retail rice price (US\$/kg) | Technology | Estimated Rice-premix cost (US\$/kg) | Estimated cost of rice fortification (US\$/MT) | Retail price increase (%) |
|-----------------|-----------------------------|----------------|--------------------------------------|--|---------------------------|
| China | 0.50 | Hot extrusion | 2.00 | 15.0 | 2 - 4% |
| The Philippines | 0.55 | Coating | 2.00 * | 10.0* | 1.8% * |
| Costa Rica | 0.63 | Cold extrusion | 2.11 | 10.5 | 1.7% |
| India | .52 | Cold Extrusion | 1.50 | 14.7 | 1.5 - 2.5% |

* Cost for rice fortified with iron only

Overall, the incremental increase in retail cost of 1 kilogram of fortified rice, however, is negligible and has been calculated to be around 1.5 - 3% of current retail price (between 8 and 16 US cents per 10 kg of rice).

Further, costs to fortify 1 MT (metric ton) of rice is only about US\$ 15 and the cost of providing a child a school lunch meal of fortified rice daily for an entire year is about 40 US cents, as shown in the table below.

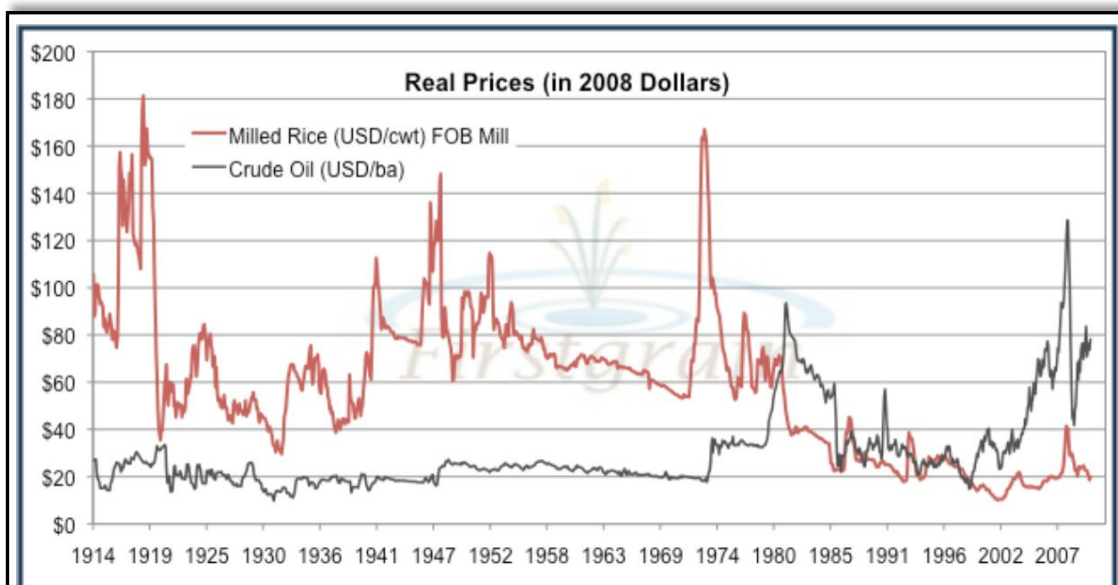
| | |
|---|-------------------|
| Incremental annual cost for fortified rice meal daily | USD \$0.40 |
| Incremental Cost to fortify 1 Metric Ton of rice | USD \$15 |

Cost of fortified rice may be further reduced if:

- Millers order pre-mix (a recurring cost) in bulk or may place their pre-mix order with other states in the region when standards are the same across countries.
- Governments facilitate cost savings by eliminating import taxes on pre-mix or fortified products, providing tax incentives for investment in new equipment, or subsidizing fortification start-up costs.

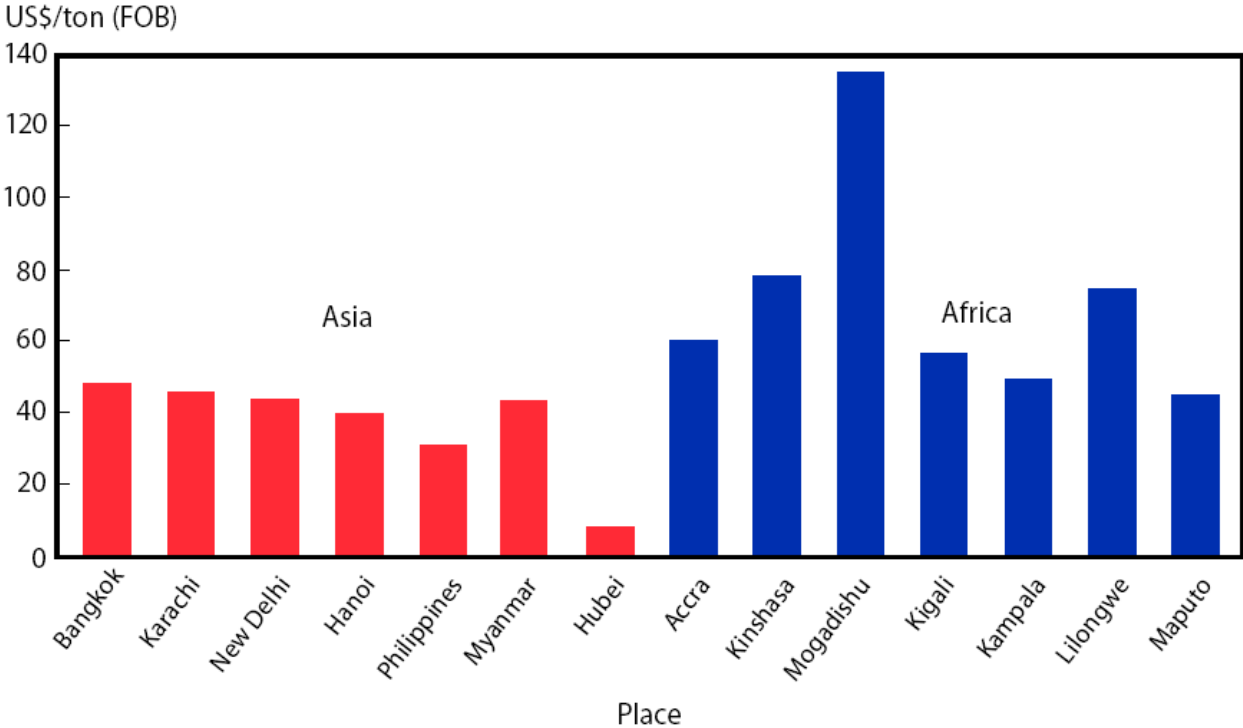
19. Is fortified rice too expensive for people of low socioeconomic status?

In recent years, rice price has fluctuated roughly between US\$ 12 and US\$ 40 per cwt (between 30 –78 US cents per kg of rice) as seen in the graph below.



Across retail markets in Asia, except the Hubei market in China, rice prices are now around 40% higher than what they were before the global financial crisis. In Africa,

retail price increased by 40–80% in most countries, except in Mogadishu, Somalia, where it has exceeded 100%. The figure here shows the change in retail rice price in December 2009 from two years before in 2007.



Data source: FAO Rice Monitor (12-2009)

Compared to these fluctuations in the commodity price of rice, the marginally higher cost of fortified rice (1.5-3%) is negligible and would be affordable even to the poorer segments of the populations for whom the health benefits of fortified rice is expected to be substantial.

Note: The FAQs and answers are a result of the joint effort of several partners of the Rice Fortification Resource Group (RiFoRG).

For further information, please visit the RiFoRG website:
www.gainhealth.org/RiFoRG

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