Addressing Myths and Misconceptions about Rice Fortification

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Key Messages

- Rice fortification is safe.
- Rice fortification cannot eliminate all micronutrient deficiencies; it complements other strategies such as biofortification and dietary diversification. Supplements will continue to be important for the most vulnerable groups such as pregnant and lactating women and preschool children.
- Rice fortification benefits consumers with access to commercial markets where fortified rice is sold as well as beneficiaries of social safety net programs that include fortified rice. In both cases, this can include rural and urban populations.
- When fortified with multiple micronutrients, fortified rice is more micronutrient-rich than brown, parboiled or non-fortified white rice.
- Any variety or type of rice can be fortified.
- Current technologies can produce fortified rice that tastes, smells and looks the same as non-fortified rice.

Introduction

This paper addresses concerns, myths and misconceptions in West Africa about the benefits and safety of rice fortification by presenting information from the global experience.

Is rice fortification safe?

The type and levels of micronutrients added to rice are calculated so that the lowest possible proportion of consumers **(1)** have unacceptably low levels of nutrient intakes and **(2)**

Jollof is a common rice dish throughout West Africa where nations debate which serves the best version of this dish.

The Gatsibo Rice Mill in Rwanda buys rice from local farmers and processes it for local consumption

exceed the tolerable upper intake level of any nutrient.[1] The recommended daily intake for individuals varies based on a person's age and gender.[1] The highest level of intake that is likely to pose no risk of adverse effects is considered the tolerable upper intake level.[1] Rice fortification standards also consider the micronutrients consumed and the daily or regular quantity of rice consumed by the target population.[1] In other words, fortified rice fills the micronutrient gap, without promoting excess intake.

Specific population groups have higher micronutrient needs than others.[1] For example, pregnant women are recommended to take iron/folate or multiple micronutrient supplements to meet their micronutrient requirements. Young children may also take vitamin A or other micronutrient supplements. Providing supplements to these vulnerable groups remains safe and may need to continue even when they are consuming fortified foods because their micronutrient requirements are much higher than those of the average population.

Is fortified rice made with plastic or non-edible ingredients?

In recent years, a rumor has spread through West Africa that some rice being sold in local markets was made of plastic.[2] To date no cases of plastic rice have been identified despite investigations and analyses of rice available for sale.[3] With fortified rice, all ingredients are edible.

Fortified rice is produced using one of two technologies (see Milani et al, p. 48 of this supplement):

1. Coating covers the surface of the rice with a layer of vitamins and minerals.
2. Extrusion involves production of fortified kernels made from water, rice flour and a mix of vitamins and minerals.

In both techniques, the non-rice-based components are the edible vitamins and minerals needed to impact the nutritional status of consumers. Additionally, with coating, edible gums and waxes are used to make the nutrients adhere to the rice.

Is rice fortification necessary, alongside other programs, such as dietary diversity?

Currently multiple interventions contribute to reducing malnutrition in West African countries, including vitamin and mineral supplementation, food fortification, promotion of dietary diversification, homestead food production, biofortification and public health measures such as immunizations and malaria and parasite control.[4] Rice fortification is meant to complement, not replace, these existing programs to improve the nutritional status of the target population. Fortification of staple foods, including rice fortification, is one of the most important, safe, cost-effective, scalable and evidence-based tools to help address widespread micronutrient deficiency.[5] It has also been repeatedly highlighted as one of the best development returns on investment.[6] WFP recently conducted Fill the Nutrient Gap (FNG) analyses in Niger.[7] FNG combines a review of secondary data information with linear programming analysis, using the Cost of the Diet software developed by Save the Children UK.

Fortification, when combined with other nutrition interventions, contributes to reducing costs to meet nutrient requirements for the household as well as for specific target groups, in particular pregnant and lactating women and adolescent girls.

Will fortified rice benefit rural consumers?

Mass fortification is the "addition of micronutrients to foods commonly consumed by the general public."[1] Mass-fortified food reaches consumers who have access to commercial markets. This is one of its benefits: new distribution channels do not need to be created because they already exist. In different countries, different regions will have varying access to commercial markets and hence to fortified rice. For example, in Guinea-Bissau, because rural farmers trade locally grown cashews for imported rice, fortified rice could have greater reach in rural Guinea-Bissau than in rural Nigeria, where local farmers are less likely to buy rice in the commercial marketplace.[8] In comparison, the rural reach of fortified rice in social safety net programs will depend on the intended target population for that program – if a school feeding program targets rural school children, then rural children will benefit. On the other hand, if urban poor are the targeted recipients of a food distribution program, then rural coverage will be limited. Depending on which distribution mode of fortified rice is chosen, a varying proportion of rural consumers may benefit.

What is the difference between fortified and biofortified rice?

Rice fortification and biofortification are different ways to make rice more nutritious. They can safely coexist as part of a strategy to improve micronutrient health. The difference lies in when and how micronutrients are added, and the type, number and level of micronutrients that can be incorporated.[9]

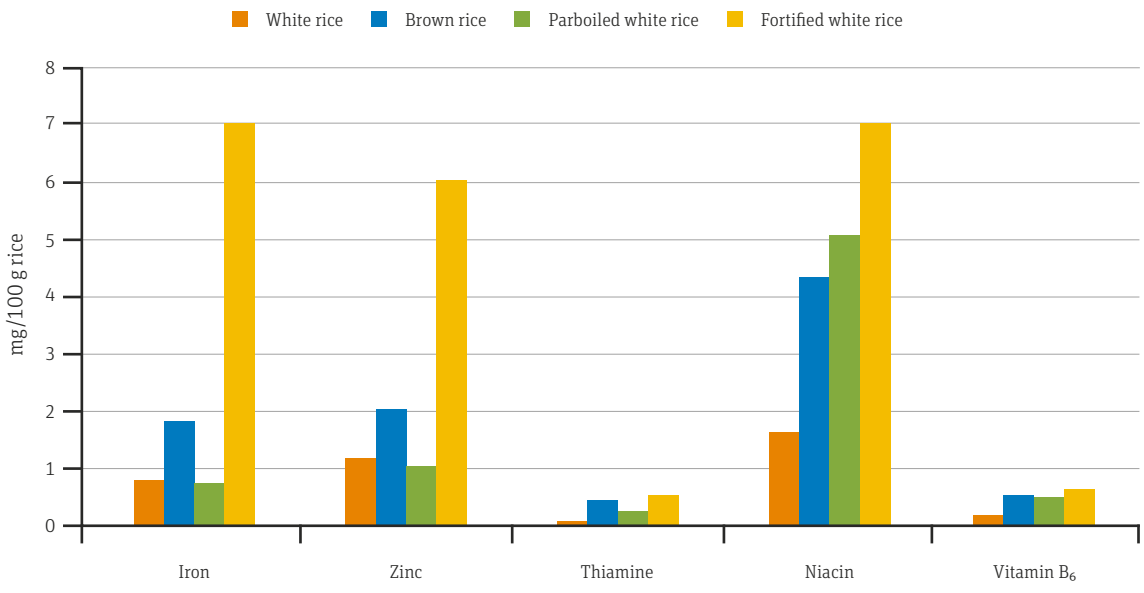
In rice fortification, micronutrients are added after the rice has been harvested. Many nutrients such as vitamins B_1 (thiamine), B_3 (niacin), B_6 (pyridoxine), B_9 (folate), B_{12} (cobalamin), A (retinol), D (cholecalciferol), E (tocopherol), iron, zinc and selenium can be added without changing the appearance of the rice. The number and levels of nutrients that are added to rice can be much higher with fortification than with biofortification. For additional information on rice fortification nutrients and levels, please refer to the contributions by de Pee et al (p. 63), Milani et al (p. 48), and Rudert et al (p. 87) in this supplement.

Biofortification increases the micronutrient content before the crop is harvested. The process is through conventional plant breeding or genetic modification (GM). An example of GM biofortification is Golden Rice, which expresses β-carotene.[10] In practice, a limited number of nutrients are increased in biofortified rice varieties at any one time and research is ongoing to increase their levels. Currently, only non-GM rice cultivars with higher iron or zinc levels are available. Genetically modified Golden Rice containing provitamin A has not been released on the market.

Why not encourage consumption of brown rice or parboiled rice instead of fortified white rice?

White rice is widely consumed and, when fortified, it can have a significantly higher micronutrient content than non-fortified rice, including brown or parboiled rice. Therefore, there is a

FIGURE 1: Profile of select micronutrients in white rice, brown rice, parboiled white rice, and fortified white rice[11]



greater potential to improve micronutrient health by fortifying white rice than from increasing consumption of brown or parboiled rice. If brown or parboiled rice is the preferred rice, these can also be fortified.

> "When fortified, white rice can have a significantly higher micronutrient content than non-fortified brown or parboiled rice"

Figure 1 shows the micronutrient content (iron, zinc, thiamine, niacin and vitamin B_6) for non-fortified rice (white, brown, and parboiled) and fortified white rice.[11] The content of folate and vitamins A and B_{12} are not shown because they are absent or negligible in all types of rice except fortified rice. The data demonstrate three points:

1. Milling removes much of rice's naturally occurring nutrients.
2. Parboiling retains a significant level of some nutrients.
3. Brown rice is relatively iron- and zinc-rich compared to non-fortified white rice.

While the nutrient content of fortified rice is dependent on the amounts added, fortified rice has the potential to offer much higher levels of key nutrients such as iron, zinc, vitamin A, folic acid and vitamin B_{12}.

In addition, the consumption of fortified white rice does not require a change in existing behaviors as would be the case if consumption of brown rice were to be promoted. While there is little data on brown rice consumption in West Africa countries, the 2009 US National Health and Nutrition Examination Survey found that, after years of promotion, only 2.9% of children and 7.7% of adults consumed the recommended daily level of at least three whole grain ounce equivalents (which includes brown rice).[12]

Local customs for preparing rice, such as sorting and rinsing, must be considered when choosing the best technology for rice fortification

Can any variety of rice be fortified?

With coating and extrusion, all varieties of rice can be fortified. For more information on rice fortification technology, please refer to the contribution by Milani et al (p. 48).

Can broken rice be fortified?

Yes, broken rice can easily be fortified. The same technologies used to fortify non-broken rice (e.g., extrusion, coating) can also be used to create fortified kernels to blend with broken rice.

Is fortified rice acceptable to consumers?

The acceptability of fortified rice depends on the quality of the fortification technology, the type and levels of nutrients added,

TABLE 1: Summary of sensory studies comparing fortified rice developed through extrusion or coating technology, with unfortified rice[13]

Study	Sensory evaluation outcome(s)
Shrestha 2003[14] (coated, folic acid)	No difference between fortified and unfortified rice.
Moretti 2005[15] (extruded, iron)	Tested multiple kinds of micronized iron compounds. No difference between fortified and unfortified rice.
Beinner 2010[19] (extruded, iron)	No difference between fortified and unfortified rice.
Radhika 2011[20] (extruded, iron)	No difference between fortified and unfortified rice.
Khan Van 2014[16] (extruded, multivitamin)	*Able to identify fortified rice but were neutral or favored fortified rice more than unfortified rice.*
Hussain 2014[18] (extruded, multivitamin)	*Able to identify fortified rice but had similar preference for fortified and unfortified rice.*
Wieringa 2016[17] (coated, extruded, multivitamin)	Children: No difference between fortified and unfortified rice. *Women: Preferred a coated fortified rice; liked the other fortified rice the same as unfortified rice.*

and consumer preferences. All rice fortification technologies aim to make fortified rice taste, smell and look the same as non-fortified rice. We reviewed studies that assessed the sensory qualities of extruded or coated fortified rice compared with non-fortified rice.[13] In **Table 1**, the first column lists the study and in parentheses the fortification technology used and the nutrients added to the rice. For example, for the second row, Shrestha and colleagues tested coated rice fortified with folic acid only.[14] In the case of the Moretti 2005 study, multiple kinds of micronized iron compounds were tested.[15] For the Khan Van 2014[16] and Wieringa 2016[17] studies, fortified rice made with multiple technologies was tested. The second column has the main results observed. Text not in italics represents studies where the participants did not note any sensory differences between the fortified and unfortified rice. The first two studies with italicized text had similar findings: participants were able to identify fortified rice but they had a similar preference for fortified and unfortified rice, or favored the fortified rice (Khan Van 2014,[16] Hussain 2014[18]). The last study with italicized text had two key findings: women preferred a specific manufacturer's coated fortified rice compared to non-fortified rice but liked the rest of the extruded and coated fortified rice samples the same as non-fortified rice (Wieringa 2016[17]). Taken together, all of these studies suggest that consumers will not reject fortified rice based on sensory qualities.

Conclusion

Fortified rice is safe and acceptable to consumers. Fortification levels add micronutrients without causing excessive intake. Fortified rice is acceptable to consumers as virtually any type of rice can be fortified and, if properly produced, can taste, smell and look the same as non-fortified rice. Among consumers who predominantly eat white rice, fortified white rice may be more readily acceptable to consumers than less micronutrient-rich types of non-fortified rice such as brown or parboiled rice. Rice fortification benefits consumers who have access to commercial markets where fortified rice is sold and those who are beneficiaries of social safety net programs; in both cases, rural dwellers can benefit from rice fortification. However, fortified rice should be part of a larger micronutrient intervention strategy as population groups with higher nutrient needs, such as pregnant and lactating women and children, may require additional interventions to meet their micronutrient needs. The broader strategy can include complementary interventions such as biofortification and dietary diversification.

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Women sell rice in Benin, where three large importers comprise 74% of the rice market

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