Addressing Myths and Misconceptions about Rice Fortification

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Key Messages

- Rice fortification is safe.
- Where rice is the staple food and micronutrient deficiencies are widespread, rice fortification has great potential to significantly contribute to the reduction of micronutrient deficiencies. However, on its own it cannot eliminate all micronutrient deficiencies in a population: in the most vulnerable groups, e.g., pregnant and lactating women and preschool children, additional interventions such as supplementation are required.
- Micronutrient deficiencies affect all socioeconomic groups. Therefore, where micronutrient deficiencies are widespread, rice fortification benefits all socioeconomic strata of society.
- Rice fortification and biofortification differ as to the type, number and levels of micronutrients in rice, and as to when they are included in rice. In biofortification, the process of fortifying occurs during the crop production phase, or prior to the harvest. In rice fortification, the fortification is done post-harvest and can add more types and higher levels of micronutrients.
- When fortified with multiple micronutrients, white rice is more micronutrient-rich than brown, parboiled, or non-fortified white rice.
- With a few exceptions, any variety of rice can be fortified.
- Current technologies can produce fortified rice that tastes, smells and looks the same as non-fortified rice, and retains its nutrients when prepared using various cooking methods.

Introduction

Concerns, myths, and misconceptions exist regarding the benefits and safety of rice fortification. This paper addresses these concerns by presenting information from the global experience as well as evidence based on rice and wheat flour fortification.

> "The fortification of staple foods and condiments has been safely used for more than 90 years to help reduce micronutrient deficiencies"

Is rice fortification safe?

The fortification of staple foods and condiments – a strategy used for more than 90 years – has been proven safe and effective in significantly contributing to the reduction of micronutrient deficiencies. As with other food fortification, rice fortification is safe because the type and levels of micronutrients added are calculated based on the following:

- The recommended daily intake of specific micronutrients by age group and gender, as a person's age, gender and physiological status influences their daily nutrient requirements for healthy body functions
- The highest level of intake that is likely to pose no risks of adverse effects in an age and gender group, which is referred to as the tolerable upper intake level (UL). The fortification levels are chosen so that the UL is not exceeded when fortified food is consumed
- The level of specific micronutrients typically consumed by the target population
- The daily/regular quantity of rice consumed by the target population

This information is used to calculate the gap between the micronutrients consumed and the micronutrients required by specific groups. This gap is used to determine which micronutrients, and how much of the specific micronutrient, will be included in fortified rice. In other words, the level of micronutrients added is calculated such that the additional micronutrients provided in fortified rice will provide the greatest number of individuals in the target population with adequate intake, without causing intake above the UL by those who consume large quantities of the fortified rice. Fortified rice fills the micronutrient gap, without promoting excess intake.

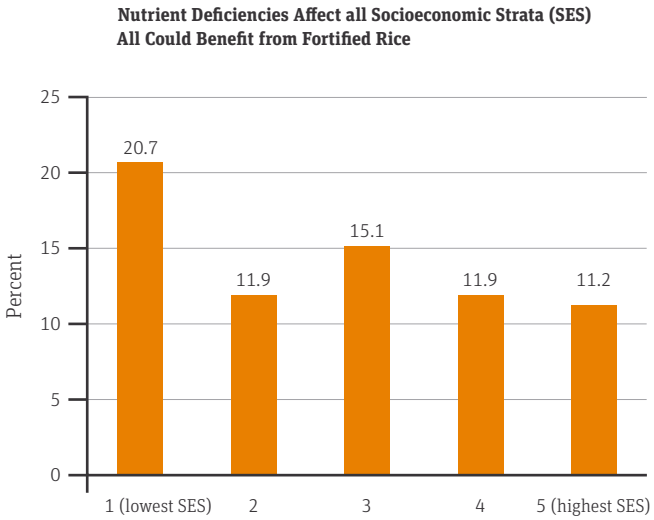
It is important to remember that:

- The type and levels of micronutrients are set in such a manner that even groups consuming large quantities of fortified rice will not exceed the UL. For example, in some countries, the typical adult consumes up to 400 or 500 g of rice per day. In this case, the micronutrients are added at a level that ensures that micronutrient intakes from all dietary sources are below the UL, taking a daily rice consumption of 400–500 g into consideration. Thus, the micronutrients consumed in fortified rice will be at a safe level.
- Specific population groups have higher micronutrient needs than others. For example, pregnant women are recommended to take iron/folate or multiple micronutrient supplements to meet their micronutrient requirements. This remains safe, and is recommended even when they are consuming fortified foods. This is because their micronutrient requirements are much higher than those of the average population. The same holds true for young children who also may be taking vitamin A or other micronutrient supplements. A young child also consumes much smaller quantities of rice than healthy adults in the same population. This, combined with their relatively high micronutrient needs, means that young children are not at risk of exceeding their UL with fortified rice.

Can rice fortification eliminate micronutrient deficiencies in the entire population?

Rice fortification can significantly contribute to the reduction of micronutrient deficiencies. For safety reasons, the fortification levels are calculated such that the additional micronutrients provided in fortified rice will provide the greatest number of individuals in the target population with adequate intake, without causing excessive intake. On its own, this level of fortification cannot eliminate all micronutrient deficiencies among all segments of the population. For example, a pregnant woman has significantly higher micronutrient needs than a man of the same age. Fortified rice can contribute to meeting the needs of pregnant women, but cannot fully meet their needs. Children under the age of two years also have relatively high micronutrient needs to support their growth and development. However, they can only consume small quantities of food in comparison to adults, so the additional micronutrients received by eating fortified rice will not be sufficient to fill their gap in micronutrient intake. Therefore other simultaneous micronutrient interventions are necessary to increase the micronutrient intake of these target populations. For more information on addressing nutrition objectives, please refer to the contribution by Rudert et al (p. 193).

FIGURE 1: Percentage of non-pregnant Vietnamese women (15–49 years) with iron deficiency, by socioeconomic group.



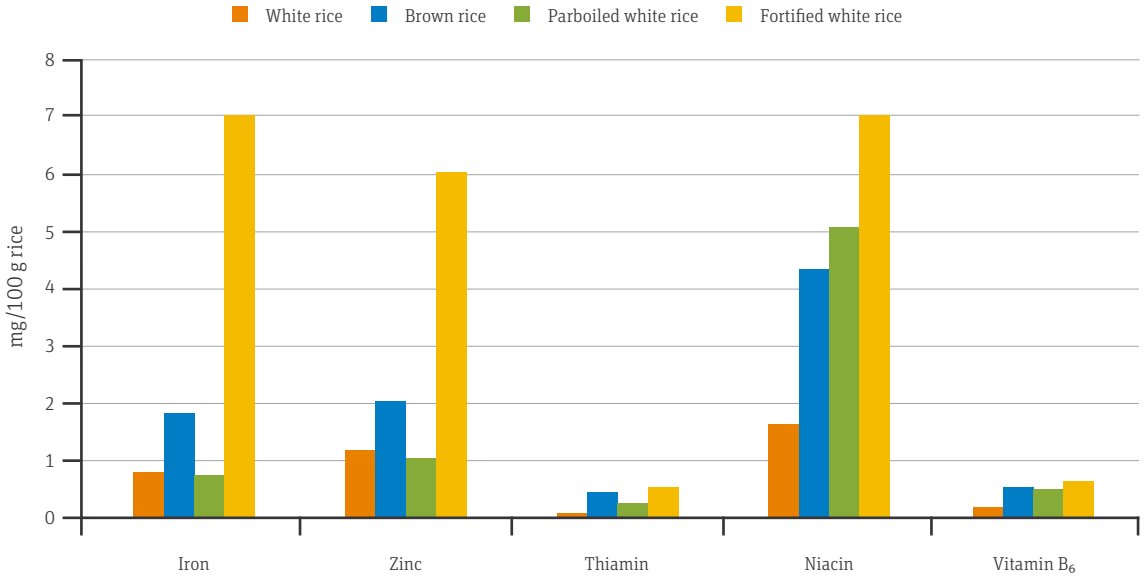
Adapted from[1]

> "Fortified rice can help meet the needs of pregnant women and of young children, but cannot fully meet their needs"

Is fortified rice only needed by low-income groups?

Although micronutrient deficiencies are more prevalent among lower socioeconomic groups, deficiencies also occur in higher-income groups, urban populations, obese individuals, and individuals with higher-than-average education. For example, as shown in the 2000 Vietnamese National Nutrition Survey (see **Figure 1**), iron deficiency was highest among women from the lowest socioeconomic group (20.7%). However, at least 11% of women from higher socioeconomic groups were also iron deficient, even in the highest income group.[1] This demonstrates that fortifying rice with iron can benefit all strata of society who consume rice.

FIGURE 2: Profile of select micronutrients in white rice, brown rice, parboiled white rice, and fortified white rice.[4]



What is the difference between fortified and biofortified rice?

Rice fortification and biofortification are two different approaches 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.[2]

In rice fortification, micronutrients are added after the rice has been harvested. For example, folic acid, niacin, vitamins B_1 (thiamin), B_6 (pyridoxine) B_{12} (cobalamin), A (retinol), D (cholecalciferol), E (tocopherol), iron, zinc and selenium can be added without changing the appearance of the rice. For additional information, please refer to the contributions by de Pee et al (p. 143), Montgomery et al (p. 159) and Rudert et al (p. 193).

Biofortification increases the micronutrient content through breeding or genetic modification (GM). Therefore it occurs *before* harvesting the crop. An example of biofortification is Golden Rice, which expresses β-carotene.[3] 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.

In addition, the levels of nutrients that are added to rice can be much higher with fortification than with biofortification. However, once a rice variety is biofortified, no additional processes are needed after harvesting to increase nutrient levels.

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

White rice is widely consumed, and when fortified, can have a significantly higher micronutrient content than non-fortified rice, including brown or parboiled rice. Therefore, there is a greater potential to improve micronutrient health by fortifying white rice than from increasing consumption of brown or parboiled rice.

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

Figure 2 shows the micronutrient content (iron, zinc, thiamin, niacin and vitamin B_6) for non-fortified rice (white, brown and parboiled) and fortified white rice.[4] 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 demonstrates 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 or parboiled rice were to be increased. While there is little data on brown rice consumption in Asian countries, the 2009 US National Health and Nutrition Survey[5] 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). This finding is in line with lessons learned from wheat flour and salt fortification to the effect that communication alone without additional behavior change activities does not increase consumption of a specific food.

"The acceptability of fortified rice depends on the fortification technology, the type and level of nutrients, and consumer preferences"

Can any variety of rice be fortified?

The rice fortification technology of dusting can be used to fortify all varieties of rice, although this technology is not recommended. For coating and extrusion, most varieties of rice can be fortified; however, this will require tailoring of fortified kernels accordingly. For more information on rice fortification technology, please refer to the contribution by Montgomery et al (p. 159).

Is fortified rice acceptable to consumers?

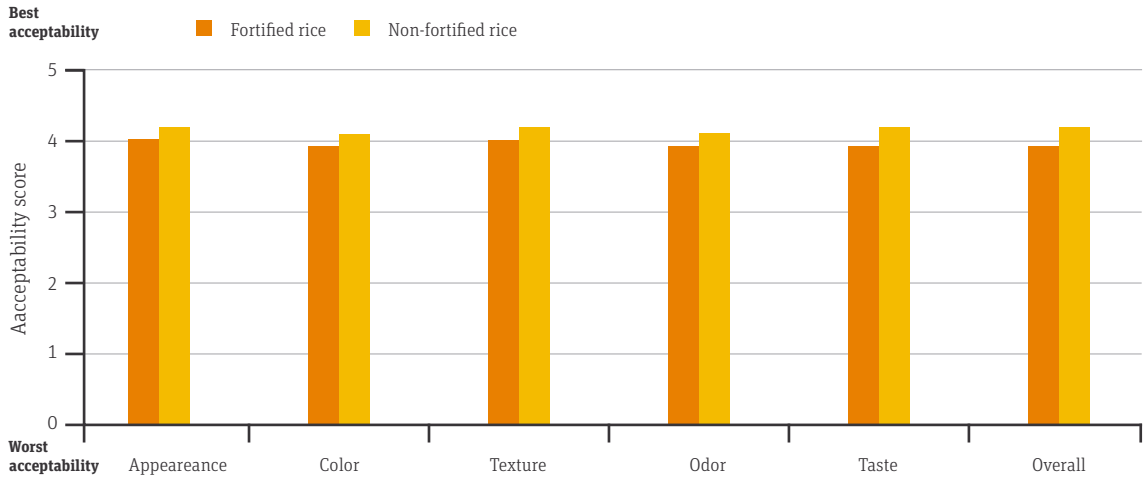
The acceptability of fortified rice depends on the fortification technology, the type and levels of nutrients added, and consumer preferences. All rice fortification technologies aim to make fortified rice taste, smell, and look the same as non-fortified rice.

A recent study that compared rice fortified using extrusion technology with non-fortified rice evaluated six sensory parameters (appearance, color, texture, odor, taste, and overall acceptability) among Indian children 8–11 years of age.[6] The children ranked each sample with a score of 1 (worst) to 5 (best). As shown in **Figure 3**, the fortified and non-fortified rice were statistically indistinguishable on all six sensory parameters. In addition, all sensory parameters were rated over 4 points, suggesting strong acceptability for both types of rice. This study shows that consumers perceive fortified rice to taste, look, and smell similar to non-fortified rice.

Are the nutrients in fortified rice retained after preparation and cooking?

When produced using extrusion or rinse-resistant coating technologies, fortified rice will retain nutrients through various preparation and cooking conditions, including washing and cooking in excessive water that is later discarded. The micronutrients in the fortified kernels produced with extrusion technology are evenly distributed throughout the kernels. Therefore, the nutrients are adequately sealed and adequately retained through preparation and cooking. However, when fortified rice is produced using dusting or coating that is not rinse-resistant, nutrients will be lost if the rice is washed prior to cooking. There is ongoing additional research in this area to further identify potential differences in nutrient retention between different rice preparation and cooking methods and fortification technologies.

FIGURE 3: Acceptability scores for fortified and non-fortified rice among Indian children aged 8–11 years.



Adapted from[6]

An indigenous mother carrying her baby, Guatemala 2012

"Fortified rice is acceptable to consumers, as virtually any variety of rice can be fortified"

Conclusion

Fortified rice is safe and acceptable to consumers. Fortification levels are set such that the additional micronutrients consumed will provide the greatest number of individuals in the target population with adequate intake, without causing excessive intake. Fortified rice is acceptable to consumers, as virtually any variety of rice can be fortified and, if properly produced, will taste, smell and look the same as non-fortified 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. 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, will require additional interventions to meet their micronutrient needs.

References

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