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How does thiamine-fortified salt taste?

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Abstract

Everyone needs vitamins and minerals to stay healthy. But it's not always easy to get all you need. Health organizations can help people by fortifying common foods with vitamins or minerals. Adding them to food means you can get the micronutrients you need without taking a vitamin pill. In rural Cambodia, many people struggle to eat enough thiamine. Thiamine – aka vitamin B1 – is important. It helps brain development in infants and is needed by the muscles and heart. Infants often get the vitamins they need from their mother's milk. If the mother doesn't have enough thiamine in her diet, then the baby won't either.

We wanted to know whether fortified salt would be a good way to help people get enough thiamine. We recruited hundreds of Cambodian families to taste-test thiamine-fortified salt. Most people liked the new salt, especially when they cooked with it. Thiamine-fortified salt could help lots of people!

Introduction

Your body needs a lot of different nutrients. We need a lot of some **nutrients**, like carbohydrates, fat, and **protein**. These **macronutrients** give you energy and help you grow. Vitamins and minerals are **micronutrients**. They are also essential, but you only need tiny amounts each day. **Thiamine** is a vitamin. It is present in whole wheat bread, brown rice, and beans. You only need about 1 milligram of thiamine in a day. That's the weight of a single grain of sand! Thiamine **deficiency** is dangerous, especially for growing babies. It can impact brain development, or cause the potentially deadly disease beriberi. Babies under 6 months get all of their nutrients, including thiamine, from their mother's milk. Unlike other nutrients, there are no storage depots for thiamine in the body, so breastfeeding mothers need to eat thiamine every day to make milk containing thiamine.

In traditional Cambodian cuisine, people eat rice every day. They usually eat white rice instead of brown rice (Fig. 1). Milling brown rice to make white rice means it loses many vitamins, including thiamine. Brown rice is healthier, but

Figure 1: A Cambodian woman washing white rice. **Photo**: Kyly C. Whitfield

it goes bad more quickly. It also takes more fuel, water, and time to cook. So what can help people, especially breastfeeding mothers, get enough thiamine?

There's a good chance you have some **iodized salt** in your house. **Iodine** is an essential mineral, naturally present in seaweed, fish, and dairy products. In many countries, iodine is sprayed on salt to make iodized salt. This is not expensive and it already helps millions of people get enough iodine in their diet. Could the same method work to help people get enough thiamine? First, we needed to know if people in Cambodia liked the taste of thiamine-**fortified** salt!

Methods

We worked with a factory to produce thiamine-fortified salt. Our new fortified salt also has iodine because the Cambodian government requires salt to be iodized. We calculated the amount of thiamine needed by breastfeeding mothers. Then, we added extra to account for **degradation** over time.

Food testing studies normally use trained taste-testers. But we needed to know if the fortified salt tastes good in traditional Cambodian dishes! So, we worked with village leaders in Kampong Thom (Fig. 2) to recruit 405 participants. All were at least 18 years old and were **heads of household** for their families.

Trained **Khmer**-speaking research staff visited families (Fig. 3) over three days. We **randomized** the order that families got to taste each salt. Neither the researcher nor the participants knew which salt was which. This is called a **double-blind** design. Families made a meal with one of the salts. The next day, we gave them a bag of the other type of salt, and the families made the same meal again. The day after each meal the family rated the taste, smell, and texture of each salt on a 5-point scale. We had them rate the salt by itself and cooked in a meal.

To see if the salt changed after time in storage, we returned 4 months later to repeat data collection. We reconnected with 341 households and recruited 64 new participants. Just like any other food, the quality can get worse over time, especially when it is hot and humid. So we also checked the nutrient quality of the salt after the 4 months of storage.

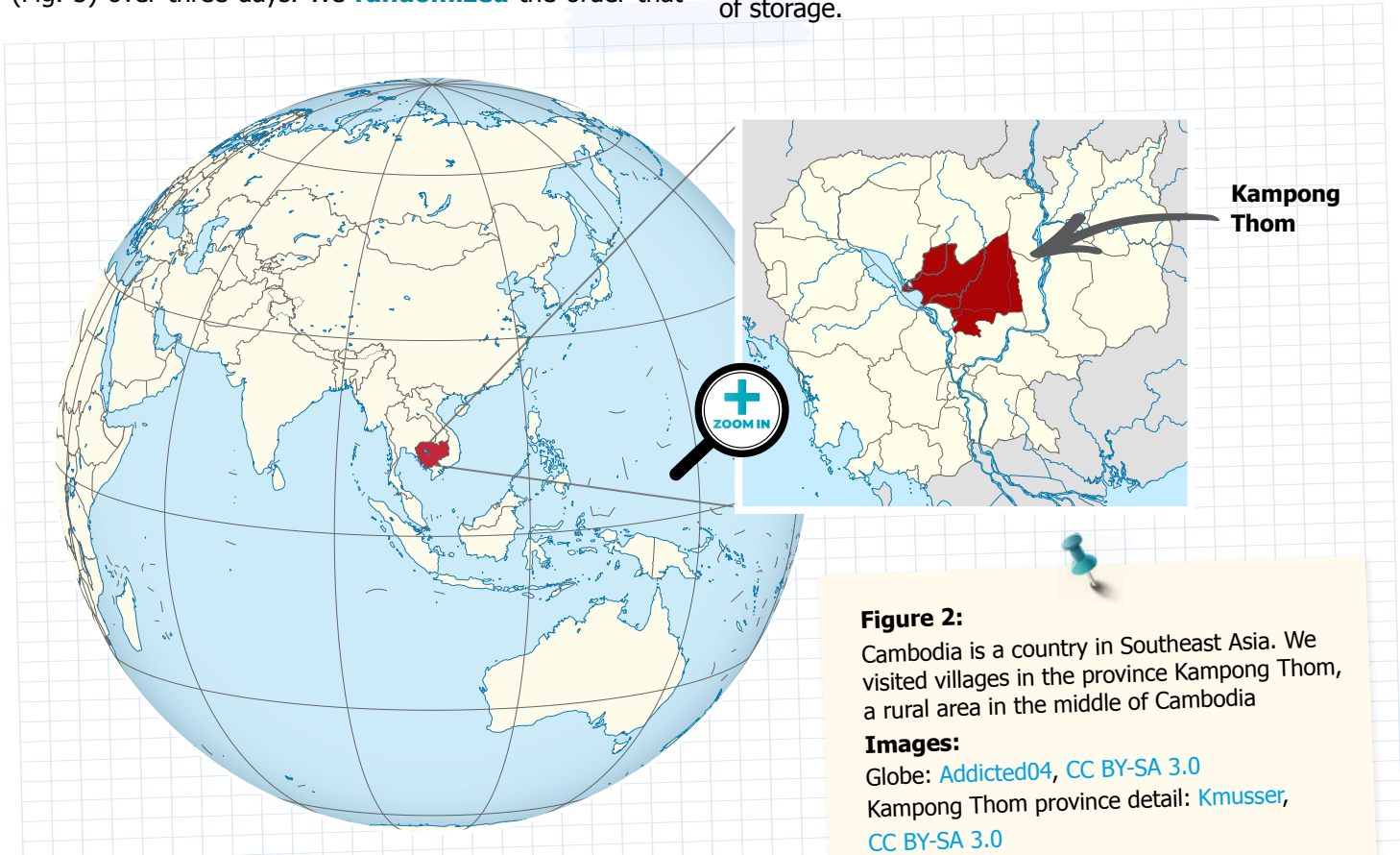


Figure 2:
Cambodia is a country in Southeast Asia. We visited villages in the province Kampong Thom, a rural area in the middle of Cambodia

Images:
Globe: Addicted04, CC BY-SA 3.0
Kampong Thom province detail: Kmusser, CC BY-SA 3.0

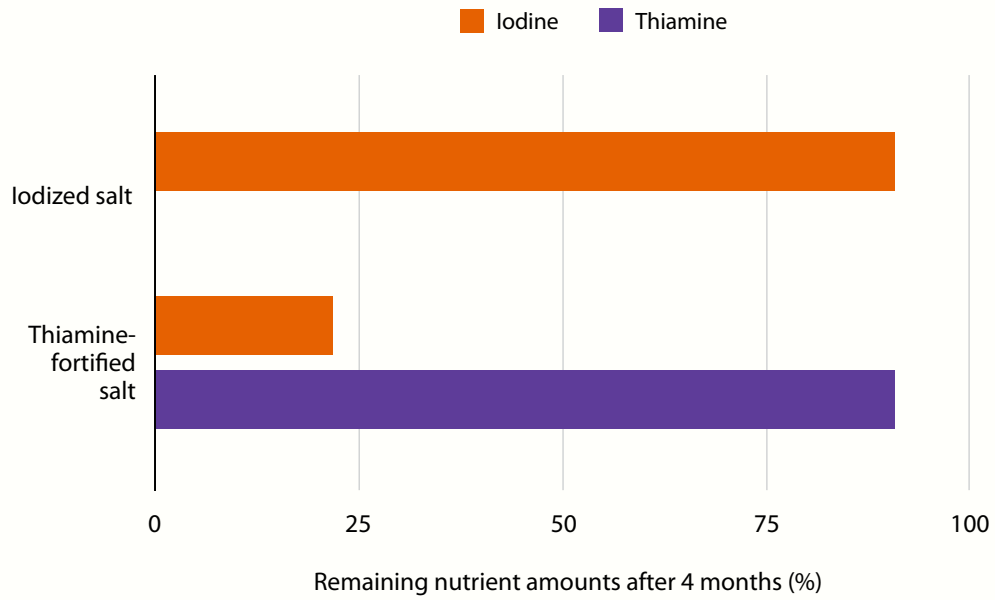
Figure 3:
We collected data from Cambodian families who had used our salt in their cooking
Photo: Emily Meier

Results

Both the iodized salt and the thiamine-fortified salt got high scores on the taste tests.

On its own, people liked the iodized salt a little better than the thiamine-fortified salt. When cooked into meals, they couldn't taste the difference between the salts!

When we checked the nutrient quality we found that 9% of the iodine in the iodized salt was lost after 4 months. The thiamine-fortified salt included both thiamine and iodine. The amount of thiamine decreased by 9% after 4 months. But, as you can see in Figure 4, the amount of iodine in the thiamine-fortified salt decreased by 78%!



The amount of micronutrients in fortified salts goes down as the salt gets older. What difference do you see in the decrease in iodine?

Figure 4:
We measured the amount of each micronutrient remaining in the salt after being stored for four months in typical Cambodian environmental conditions.

Discussion

The goal of fortifying foods with vitamins is to help everyone get the nutrition that they need. This only works if the fortified foods taste the same as conventional foods. We were happy that people liked the taste of both the regular iodized salt and the thiamine-fortified salt. We did detect a statistical difference in a few comparisons. These differences were very small, and the families liked both salts. This means that the salt tastes, looks, and feels good enough to use. We wouldn't want to introduce a new salt that made food worse!

We were surprised to see so much iodine degradation in the thiamine-fortified salt. This means that the thiamine-fortified salt did not have enough iodine in it by the end of the study. It would not meet Cambodian government requirements for iodization. This was put in place to prevent important iodine deficiency outcomes like goiter. We did more tests and found that adding thiamine makes the iodized salt more alkaline. This makes the iodine in the salt less stable. Before selling the fortified salt in stores, we need to solve this problem. Adding stabilizers to the fortified salt mixture is a likely solution.

Conclusion

People all over the world get the vitamins and minerals they need from fortified foods. Chances are, there are even some fortified foods in your house! Take a moment to be a food fortification detective. Look for clues on the labels of the foods in your house. Words like "fortified" and "enriched" are a signal that vitamins and minerals have been added. You might see a list of vitamins and minerals on the side. How many can you find?

Glossary of Key Terms

Degradation - going down in value or quality.

Double-blind - a study where neither the researchers or the participant know which treatment they are getting until the study is over. This helps prevent bias by the researcher when they are interacting with the participants. This is a common design for medical and clinical testing.

Fortified - with added vitamins and minerals.

Head of household - an adult who makes decisions for a family.

Iodine - an element that is needed in small amounts for human health.

Iodized salt - salt that has been mixed with iodine-containing compounds.

Khmer - the official language of Cambodia. Khmer is also the name of the majority ethnic group of Cambodia.

Macronutrient - nutrients that living things need in large quantities.

Micronutrient - nutrients that living things need in small quantities.

Nutrient - a substance that a living thing needs to live and grow.

Randomized - put into a new order without a pattern, like shuffling a deck of cards.

Thiamine - also known as vitamin B1, a molecule that people and animals need to stay healthy.

Vitamin - a molecule needed for your body to keep working.

Check your understanding

1. What reason was given in the article to explain why thiamine deficiency is common in Southeast Asia?

2. Why were the researchers glad to see such small differences in how much people liked the two salts?

3. Fortification is done to staple foods like bread, milk, and salt. Why is this?

4. As you can see from this research, a lot of thoughtful testing goes into creating fortified foods. But it's not just fortified foods that are tested this way. A lot of food preferences are tested using a double-blind design. Let's say that you are attending the family reunion of your very large family. The previous year there was a big argument about how good gluten-free cake tastes. This year you want the data! Working with a bakery, design a double-blind experiment to figure out if your family prefers cake made with gluten-free flour or regular flour.

5. Create a presentation on the fortified foods in your own home. Check your cupboards – can you find any fortified foods? What foods are they? Research the vitamins and minerals that were added and why they are important.

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