Question: What are the possible microbiological concerns associated with rice starch?

Response:

While many papers discuss the functional properties of rice starch, I was unable to find any studies that specifically addressed potential microbiological concerns of rice starch.

According to Appendix 1 of FDA's Draft Guidance for Industry: Hazard Analysis and Risk-based Preventive Controls for Human Food, the hazards associated with starches (although it doesn't specifically call out rice starch) are *Bacillus cereus* and *Salmonella*. The appendix also states hazards associated with rice products:

Rice Product	Hazards
Raw grains	*Bacillus cereus,* pathogenic *E. coli*
White or brown rice, sticky/sweet rice, basmati rice, jasmine rice, arborio rice, rice-based noodles	*Bacillus cereus, Salmonella* spp.

Rice consists of about 80% starch He et al. (2020). How is rice starch, which constitutes about 80% of rice according to He et al. (2020), made from rice? Is there a step in its processing that will inactivate pathogens present in the raw materials?

Rice starch can be made by several different ways, both of which most commonly start with broken rice (the rice that remains after dehulling and milling)(Mitchell, 2009). The traditional rice starch production method involves soaking white (milled rice) in 0.2 to 0.5% NaOH to extract proteins, then grinding, sieving, washing, airdrying, and final sieving (Juliano, 1984; Mitchell, 2009; Kim et al., 2010). Alternatively, rice starch can be made using a mechanical process (Mitchell, 2009).

The alkali process used to make rice starch will likely result in the death of Gram-negative bacteria such as *E. coli* and *Salmonella*, as the pH of the extraction solution will be >12, and Gram-negative organisms die quickly at such pHs (Mendonca et al., 1994). However, spores of *Bacillus cereus* are resistant to alkaline conditions, and some *Bacillus* spp. can survive after 1 hour incubation at 1M (4%) NaOH (Setlow et al., 2002).

Rice starch is often further modified to improve its physical properties. This modification can be done chemically or via hydrothermal processes. This hydrothermal modification involves heating the starch at low moisture levels (<35%) to temperatures of 80 to 120°C for >30 minutes to modify the physicochemical properties of starch (swelling power, solubility, crystalline stability) (Jacobs and Delcour, 1998; Sui et al., 2017).

One paper states the following: "Recently, hydrothermal modification is of great interest to produce "clean label" food products as an alternative approach to the chemical modification in the modern health-conscious food industry" (Sui et al., 2017), and these "clean label starches" do not need to be labeled as "modified food starch" but maintain functional qualities associated with modified food starches (Park and Kim, 2021). Several "clean label" rice starches that are currently marketed by several companies. It is unclear how this processing affects the microbiological properties of the rice starch.

In comparison to other starches, rice starch has similar chemical and molecular properties (Juliano, 1984), although some differences between rice starch and other starches do exist. Rice starch has smaller starch granules of <10 μm (vs. >80 μm for potato) (Jacobs and Delcour, 1998), stronger links between starch granule-associated proteins and the starch granules (which could lead to more protein in the rice starch (Zhan et al.,

2020), and different amylose:amylopectin ratios (Mitchell, 2009). It might be expected that similar hazards are associated with rice starch and other types of starches.

If a food product includes rice starch as an ingredient and there is no subsequent "kill" step, other preventive controls should be in place to control pathogens. For *Salmonella*, a preventive control might be requiring the supplier to state on the C of A that there is no *Salmonella* spp. present. Alternatively, you could do your own "kill step" on the rice starch ingredient before you use it in your product.

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Compiled by W. Bedale, Food Research Institute, University of Wisconsin-Madison; bedale@wisc.edu