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Title: Accelerated shelf life studies: testing micronutrient stability of new and upgraded food aid products.

Reference

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Background and Objectives:

Food aid products can be exposed to conditions throughout the humanitarian supply chain (e.g., sustained exposure to high levels of heat and humidity) that can potentially affect or degrade products, including nutritional properties, taste, odor and packaging integrity and appearance. For these reasons, understanding how products behave through the supply chain is critical to ensure that optimum nutrition and quality are delivered to food aid consumers. Shelf life trials are a vital part of product research and development and introduction of new/upgraded food aid products, to determine how product nutrients and characteristics are maintained throughout the supply chain. They can also be used to determine the shelf life implications of new or modified packaging or combinations of ingredient and packaging parameters. Studying product and packaging performance in real time would require a 2-3 year period of observation under storage conditions. Accelerated shelf life studies are designed to mimic real time conditions found in the humanitarian supply chain in a fraction of the time for a cost-effective, efficient alternative to real time studies.

Objective: determine the vitamin and mineral stability and integrity of U.S. products included in the Food Aid Quality Review (FAQR) Phase II food aid effectiveness trials. Tests were carried out on three Fortified Blended Foods (FBFs) [Corn Soy Whey Blend (CSWB), Super Cereal Plus (SC Plus), Corn Soy Blend Plus (CSBP)] and on Ready-to-Use Supplementary Food (RUSF).

Methods:

Samples were analyzed for vitamin A and mineral (iron, calcium and phosphorus) content, and organoleptic properties (appearance, odor, taste, packaging appearance). Testing followed certified methods of the Association of Official Analytical Chemists (now AOAC International). Products were stored at 40 degrees Centigrade (104 degrees Fahrenheit) and 75 percent relative humidity for 26 weeks to mimic 26 months in real time. Products were sampled/tested seven times.

Results:

Vitamin A and Minerals: As expected, Vitamin A levels degraded substantially in all FBFs and remained stable in the lipid-based RUSF. Iron levels varied among the FBFs, mostly as expected, due partially to differing intrinsic micronutrient levels in the raw ingredients. Peroxide levels remained below the maximum permitted in all products.

Organoleptic characteristics: FBFs all developed a slight grainy odor over time. Three of the four showed sparse black flecks at various times, likely due to dark germ color and heat processing of the corn. These changes did not compromise taste or fitness for consumption. RUSF odor, appearance, texture remained stable and normal.

Packaging: There were no changes in packaging for any of the products.

Conclusions:

Vitamin A deficiency is a common public health issue around the world and among humanitarian assistance target populations. Fat-soluble Vitamin A degrades in FBFs over time and, therefore, is more effectively delivered in lipid-based products such as RUSF, but the higher cost of these products can be prohibitive for programming.

Shelf life studies are crucial to verify the stability and integrity of food aid products. These findings highlight the role that intrinsic values of raw ingredients play in establishing FBF specifications. Advances in ingredients and micronutrient technology can have a significant impact on shelf life duration and organoleptic properties through the supply chain. Packaging advances that better protect food aid products and, in particular, micronutrient content, will ensure consumers receive food aid products that deliver micronutrients.

For these reasons, innovations to optimize Vitamin A delivery and other food aid product characteristics are essential, e.g., 1) protective packaging to improve shelf life stability and product integrity; 2) micronutrient chemical forms more suitable to improve bioavailability; 3) determining the most appropriate Vitamin A delivery mechanism to optimize shelf life in the humanitarian supply chain.

Accelerated shelf life studies are industry standard for new product development and should be adopted and become standard for all new or upgraded food aid products. Shelf life protocols and conditions should be harmonized among aid organizations working on product development for comparable data and results. In particular, heat and humidity levels should be increased to more accurately reflect the conditions in the humanitarian supply chain. Industry should be engaged in packaging material and ingredient form innovation for food aid products. Humanitarian supply chain optimization models, which typically consider speed and cost of delivery, should also consider including measures of food product exposure to damaging conditions. This work, with USAID, is part of the Tufts University Food Aid Quality Review (FAQR) Project.

Keywords: food aid, product, stability, micronutrient, shelf life

Further Collaborators:

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Conflict of Interest: None

Packaging of Products Tested



Corn Soy Whey Blend
25 kg

Corn Soy Blend Plus
25 kg

RUSF
92 g



Super Cereal Plus
1.22 kg

Vitamin A Targets and Permitted Ranges: Fortified Blended Foods

Parameters	CSWB	SC Plus	CSBP
Vitamin A Target	1039	1038	1038
(mcg/100g) [Range]	[935-1143]	[880-1300]	[880-1300]

Vitamin A Performance in Fortified Blended Foods

