space food packaging facts

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Shelf-life Requirements

- Space food shelf life depends mainly on packaging. Shuttle foods are required to have a nine month shelf life minimum.
- International Space Station foods require a one year shelf life. All rehydratable and bite-sized foods destined for ISS are overwrapped with an aluminum foil laminate and vacuum sealed to improve the barrier properties, increasing the shelf life.
- The food system for planetary outpost will require a five year shelf life because of the planned mission lengths.

Rehydratable and Bite-sized Packaging Material

- NASA uses Combitherm® Paxx packaging material for its rehydratable and bite-sized packages. They are made by Wolff Walsrode of Burr Ridge, Illinois, a division of Bayer Corporation.
- Used for Shuttle and the International Space Station, these packages are made from a five layer co-extrusion of nylon/ethylene vinyl alcohol/tie layer of polyethylene/ linear low density polyethylene.
- Bite-sized packages are procured from the vendor sealed on three sides. NASA adds the product and seals the 4th side.
- Rehydratable and bite-sized packaging materials are packaged using modified atmosphere techniques.
- Each package is flushed with nitrogen three times before the final seal at 21 to 29 inches of Hg vacuum.
- Amount of vacuum varies depending upon the product; a hard vacuum will destroy the texture on some products.

Bite-sized package

Rehydratable Package

- Procured from the vendor in the shape of a cup and a lid and is made of a flexible material to aid in trash compression.
- The vendor forms the cup by thermoforming the five layer co-extruded film over a mold to make the flexible cup.
- The thermoforming process decreases the barrier properties of the original film as the material is stretched thinner to form the cup.
- NASA places the food product in the cup, places the lid on top of the cup, and seals the lid to the cup.
- The septum adapter is an injected molded device for holding the septum. The septum adapter is inserted, flushed three times with nitrogen, and the septum adapter is sealed into the package during closure.
- The septum is molded from silicon rubber and provides an entry for the needle used to inject water and then seals off when the needle is withdrawn.
- A special tool is used to insert the septum into the adapter and then sealed with a foil laminate. The foil laminate is pierced by the galley needle when rehydration takes place.

Above: Side and top view of a rehydratable food package that includes (left) a septum adaptor with foil laminate seal

Beverage Package

- The beverage package is a modified Capri Sun® package made from a foil laminate.
- The NASA version is longer than the commercial version.
- Dry beverage powder is placed in the package, the package is flushed three times with nitrogen, and the package is sealed with the septum adapter in the package.

Foil laminate beverage packet

Other Packaging Materials

- Pouches used for thermostabilized and irradiated foods are commercial pouches, using United States Army specifications for the Meals Ready to Eat program.
- A small amount of commercial plastic pudding containers, commercial full-panel pullout aluminum cans, and commercial condiment single serving pouches are also used for Shuttle and ISS.

Packaging Weight

- The food package weight for Shuttle is about 0.5 lbs per person, per day.
- Food package weight for the International Space Station is slightly higher as a result of the overwrap film and the additional thermostabilized pouches used.

Packaging Case Study: Eggs

Rehydratable, freeze-dried eggs are a common breakfast item on both Shuttle and ISS. To ensure that the eggs are readily rehydratable, they are freeze dried twice (i.e., freeze dried, rehydrated, and freeze dried again). As with all freeze-dried foods, eggs are stored in metal cans or foil packages prior to packaging for flight. NASA has used eggs stored in metal cans under nitrogen at 40° F that were well over two years old. The major astronaut complaint about freeze-dried scrambled eggs is that they are too crumbly and difficult to eat in microgravity. Some of this may be a result of the packaging process (vacuum packing), but the freeze-drying process is mostly to blame.

Retortable pouch

Dr. Charles Bourland is a former Subsytem Manager for International Space Station food in the Flight Crew Support Division at Johnson Space Center. His responsibilities included food and package development and advanced planning for the International Space Station and Advanced Life Support involving conversion of chamber-grown crops to edible food. Among other activities, Dr. Bourland is currently a consultant for NASA FTCSC.

Commercial plastic container

Drinking straw with clamp

Commercial condiment single serving pouch

Commercial full-panel pullout aluminum can

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