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FACT SHEET

FOOD PACKAGING | ©Perennia 2021

FINDING THE RIGHT FIT

Selecting the best package for your unique product is an important component of the food product development challenge. There are many considerations, including **functionality, food safety and quality, cost, appearance, tamper-evidence, efficiency of filling, marketability and environmental sustainability**. With so many variables to consider, it is tough to know where to start!

The properties of a package vary based on the material(s) it is made of, thickness, additives (e.g. blocking light or scavenging oxygen) and the techniques used to make it. When choosing the right material for your package, you will need to consider the barrier properties required for your particular type of food as well as the transportation and storage environments. For example, paper-based products may require waxing if used in a refrigerated environment, while some types of plastics become brittle in the freezer, and hot filling requires heat-resistant closures.

THE FUNCTIONS OF A PACKAGE INCLUDE THE FOLLOWING:

Containment, Protection, Preservation, Convenience, Communication

IMPORTANT CONSIDERATIONS WHEN CHOOSING YOUR FOOD PACKAGING

Barrier properties

Barrier properties refer to how much gas, moisture, light or volatiles (compounds that can affect the flavour and aroma of foods) can pass through a material. For example, aluminum and glass are excellent barriers to oxygen, moisture and light. Different types of plastics have different properties and ability to protect food products.

The role of pH

Liquid products with a pH <4.6 (consistent, uniform and proven) can be safely hot-filled into a suitable container and will be microbiologically stable indefinitely. In this case, the shelf life is limited by physical and chemical changes such as oxidation, separation, colour changes, etc. At this low pH of less than 4.6, harmful microbial organisms (food pathogens) will not grow or are easily destroyed by heat.

Hot filling (liquid foods)

During the hot fill process, the food is heated up to between 85 and 100°C and filled into containers at a minimum of 85°C, which sterilizes the package. The lidding material is sterilized by inverting the package for a specified time or other means such as steam injection. Alternatively, this type of product can also be pasteurized after filling in a heat tunnel, water bath or other cooker if a heat resistant package is used.

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Aseptic filling

Aseptic filling requires specific equipment that can bring the product up to a very high temperature for a short time, for example, 135°C for 1-2 seconds. It is a closed-loop system with tightly engineered conditions that allow for the food product and package to be sterilized. It also allows for the filling of the product into the package while maintaining sterile conditions. Examples include Tetra-Pak™ type packaging, aseptic PET blown on-site (Sidel) - both for very large volumes - or bag-in-box technology, which can be implemented for smaller volumes.

Water activity (a_w)

For dried foods to be safe at room temperature storage, it is recommended that they have a water activity of ≤0.85. Bacterial foodborne pathogens are inhibited at this level. However, water activity in many food products should be <0.60 to prevent food spoilage by inhibiting the growth of yeasts and moulds. Note that moisture content and water activity are not the same thing since different foods bind moisture differently. Water activity represents the "free water" in the food available for microbial growth, while moisture content represents the product's total water, including bound water.

Affordability

If your volumes are small, you may be limited by cost-effectiveness. Most suppliers have some stock packaging that they order in bulk, available in smaller quantities than the special order packaging options. It's important to find a supplier that fits your needs, so before contacting packaging suppliers, be sure to estimate your annual volumes. For larger volumes, you will be able to approach larger packaging companies with a variety of packaging options and save on bulk orders. For smaller volumes, you may be able to find a smaller producer with smaller minimum order quantities but likely less variety.

Your package's role in shelf life

Packaging plays an important role in reducing food loss and food waste. To extend your shelf life, you will need to maximize the effectiveness of your package. For oxygen-sensitive foods, this means eliminating as much oxygen from the product as possible (headspace, the food itself and that entering the package and/or closure). Vacuum packaging, nitrogen flushing, improvement of barrier properties and use of oxygen scavenging packaging or sachets are potential solutions.

For a fresh produce item that is still respiring, to maximize quality, you can create the best possible environment for your product by aligning the permeation of moisture, O_2 and CO_2 of the package to that of your produce. A modified atmosphere package (MAP) may elevate CO_2 and reduce O_2 inside the headspace, slowing down respiration and extending shelf life for some products. You may also need to control the amount of moisture inside the headspace so that the product does not dry out (too much venting) or experience pooling of moisture (not enough venting), which can create opportunities for food spoilage organisms.

For a dry product, you will need to keep moisture out to prevent caking and avoid increasing the water activity and moisture level of your product in high humidity situations.

Food Safety and Quality

Packaging companies have safety and quality programs just like food companies - ensure that you find out about your supplier's program. Ask your supplier for specification sheets so you are aware of instructions and limitations that may apply to your package. As part of your food quality program, you may have integrity tests to do on your packages, such as seam inspections (cans), torque tests (containers with lids), or perforation inspections (perforated flexible packaging).

ADDITIONAL READING

- Preferred plastics guide Canadian Produce Marketing Association: **https://www.cpma.ca/docs/default-source/industry/2020/CPMA_Preferred_Plastics_Guide_English.pdf**
- Plastics recycling guide: **https://plastics.americanchemistry.com/Plastic-Resin-Codes-PDF/**
- Designing for compostability in Canada: **http://www.nzwc.ca/focus/design/Documents/NZWC_DesignforCompostability.pdf**
- Principles of thermal processing (USDA): **https://www.fsis.usda.gov/shared/PDF/FSRE_SS_3PrinciplesThermal.pdf?redirecthttp=true**
- Smart packaging list (PAC): **https://www.pac.ca/wp-content/uploads/2020/06/pac-checklisten-smart-1.pdf**

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PACKAGING OPTIONS BASED ON PRODUCT TYPE

Food Type	Examples	Typical Package Type	Considerations / Requirements
Chilled (liquid)	Milk, some juices	HDPE (milk); PET (juice); bags or containers with film for HPP	Pasteurization (e.g. milk 72°C for 15 sec), HTST (high-temperature short time) or ESL (extended shelf-life, e.g. between pasteurization and UHT). Alternatively, HPP (high-pressure processing) for certain products. Requires refrigeration after processing throughout shelf-life.
Chilled (solid, raw)	Meat - raw or cooked, entrées	Form/fill/seal trays, Styrofoam™ with wrap (meat);	Filling/Seal equipment or Form/Fill/Seal for larger volumes. Requires refrigeration after processing throughout shelf-life.
Chilled (solid, ready-to-eat)	Lunch meats, cheese	Form/fill/seal trays, sealed bags, barrier shrink films (cheese)	Filling/Seal equipment or Form/Fill/Seal for larger volumes. Requires refrigeration after processing throughout shelf-life.
Frozen	Vegetables, fruits, ice cream, pizzas, etc.	HDPE, Flexible multi-layer, shrink films/box	Package must provide a barrier to oxygen and moisture. Also must withstand -18°C without becoming brittle.
Shelf-stable (wet, high-acid pH <4.6)	High acid foods - jams, juices, tomato-based sauces, etc.	Glass, hot-fill PET, aluminum, bag-in-box, pouch	Product can be "hot-filled" (e.g. 90°C with inversion to sterilize closure and headspace) or aseptically filled (e.g. bag-in-box).
Shelf stable (wet, low-acid pH >4.6 / a_w >0.85)	Low-acid foods - canned vegetables, alfredo sauce	Glass, aluminum, retortable pouch, aseptic brick, e.g. Tetra-Pak™, aseptic PET, e.g. Sidel, aseptic pouch	Product must reach commercial sterility[1] to eliminate risk of Clostridium botulinum.
Shelf-stable (dry, aw < 0.85 and in some cases <0.60 for food quality)	Nuts, powders, spices, lentils, dried fruit, nut butters, teas	Pouches, bags, canisters, tins, jars	Must provide suitable barrier to moisture to prevent caking, increase in a_w. Also usually require barrier to oxygen. Depending on product may require barrier to light as well, e.g. products with high oil content.

[1]*Commercial sterility is defined in Canada as "..processed by the application of heat, alone or in combination with other treatments, to render the food free from viable forms of microorganisms, including spores, capable of growing in the food at temperatures at which the food is designed normally to be held during distribution and storage". Sterilizing targets spores of C. botulinum, which, if not destroyed, can produce the deadly botulism toxin.* **https://laws-lois.justice.gc.ca/eng/regulations/c.r.c., c. 870/page-91.html?wbdisable=true**

FURTHER INFORMATION FROM PERENNIA

- Assessing and understanding your product's shelf life in its intended package is an important tool. This can be done in-house or with a third-party such as Perennia. For more information, see our Shelf Life Fact Sheet or get in touch.
- Making sustainable packaging choices is critical in today's world. Reduction of CO_2 emissions and energy usage and working towards a circular economy to reduce and recycle materials is an industry focus worldwide. See our Sustainable Packaging Fact Sheet for more information.
- Perennia's food and beverage analytical lab has the capabilities to test the factors defined above: pH, water activity and moisture content.
- For assistance with packaging choices, food analytical services and shelf life, get in touch with our innovation team **innovation@perennia.ca**.