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## A Brief History of Packaging<sup>1</sup>

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### Introduction

From the very earliest times, humans consumed food where it was found. Families and villages made or caught what they used. They were also self-sufficient, so there was little need for packaging of goods, either for storage or transportation. When containers were needed, nature provided gourds, shells, and leaves. Later, containers were fashioned from natural materials, such as hollowed logs, woven grasses and animal organs. As ores and chemical compounds were discovered, metals and pottery were developed, leading to other packaging forms.

Packaging is used for several purposes:

- Contain products, defining the amount the consumer will purchase.
- Protects products from contamination, from environmental damage and from theft.
- Facilitate transportation and storing of products.
- Carry information and colorful designs that make attractive displays.

For each product's needs, there are good packaging solutions. Though packages are often taken for granted, they are the result of many years of innovation -- in some cases accidental. A brief review of the more popular packaging developments are included in this fact sheet.

### Paper and Paper Products

One way of placing packages into categories is to describe them as flexible, semi-flexible, or rigid. Flexible packaging includes the paper sacks that dog food comes in, the plastic bags that hold potato chips, and the paper or plastic sacks in which we carry home our purchases. An example of semi-flexible packaging is the paperboard boxes that cereal, many other food products, small household items, and many toys are packaged in. For many non-food items, the packaging is made more rigid by formed packing materials that slip inside the box and hold the product and its accessories or components in place. Forms of rigid packaging include crates, glass bottles, and metal cans.

Cloth or paper may be the oldest forms of flexible packaging. Flexible packaging is the most "source-reduced" form of packaging, that means that

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a flexible package has the least amount of material compared to other forms of packages that would hold the product. This also means that flexible packaging adds very little weight to the overall product, and there is very little to discard when the package is empty.

The use of flexible packaging materials began with the Chinese. They used sheets of treated mulberry bark to wrap foods as early as the first or second century B.C. During the following centuries, the Chinese also developed and refined the techniques of paper making. Knowledge of how to make paper gradually moved west across Asia and into Europe. In 1310, paper making was introduced to England. The technique arrived in America in Germantown, Pennsylvania, in 1690.

Paper is basically a thin sheet of cellulose. Cellulose is a fibrous material derived from plants. Early paper was made from cellulose fibers derived from flax, the plant that also gives fibers for linen cloth. As demand for paper grew, old linen rags were sought as a source of fiber.

In 1867, the process for deriving useful cellulose fiber from wood pulp was developed. Because wood was so cheap and plentiful, this fiber source rapidly replaced cloth fibers as the primary source of paper fiber. Today, virtually all paper has wood pulp as the source of cellulose fiber.

An important step for the use of paper in packaging came with the development of paper bags. Commercial paper bags were first manufactured in Bristol, England, in 1844. Shortly thereafter, in 1852, Francis Wolle invented the bag-making machine in the United States. Further advancements during the 1870s included glued paper sacks and the gusset design, producing the types of paper bags used today. In 1905, machinery was invented to automatically produce in-line printed paper bags.

With the development of the glued paper sack, the more expensive cotton flour sacks could be replaced. But a sturdier multiwalled paper sack for larger quantities did not replace cloth until 1925, when a means of sewing the ends was finally invented.

Another important use of paper in packaging came with the development of paperboard -- the kind of paper that packages a box of cereal. The first paperboard carton -- often called a cardboard box -- was produced in England in 1817, more than two hundred years after the Chinese invented cardboard or paperboard.

Another common form of "cardboard" based on corrugated paper appeared in the 1850s. Basically, this form of cardboard is made from thin sheets of paperboard that are molded into a wavy shape and then "faced" or sandwiched between two flat sheets of paperboard. The strength, lightness, and cheapness of this material make it very useful for shipping and storing. However, replacing wooden crates with the new paper alternative would prove to be something of a battle. Nevertheless, about 1910, after much litigation between manufacturers and the railroads, shipping cartons of faced corrugated paperboard began to replace self-made wooden crates and boxes used for trade. Today, cardboard boxes -- more accurately called "C-flute corrugated paperboard cartons" -- are used almost universally for product shipping.

As with many innovations, the development of the carton was accidental. Robert Gair was a Brooklyn printer and paper-bag maker during the 1870s. While he was printing an order of seed bags, a metal rule normally used to crease bags shifted in position and cut the bag. Gair concluded that cutting and creasing paperboard in one operation would have advantages; the first automatically made carton, now referred to as "semi-flexible packaging," was created. Such folding cartons or "tubular cartons" dominate the dried, processed food market.

The development of flaked cereals advanced the use of paperboard cartons. The Kellogg brothers were first to use cereal cartons. The Kelloggs operated a sanatorium at Battle Creek, Michigan. They developed flaked cereals as a health food for their patients, but soon began marketing this new food product on a mass scale. Their original packaging was a waxed, heat-sealed bag of Waxtite wrapped around the outside of a plain box. The outer wrapper was printed with the brand name and advertising copy. Today, of course, a plastic liner protects cereals and

other products within the printed carton. Some cereal manufacturers have attempted to sell cereal in flexible pouches, like snack foods. However, U.S. consumers have only marginally accepted cereals in a pouch only, so we continue to see a bag-in-box format for cereals.

Paper and paperboard packaging increased in popularity throughout much of the 20th century. Then with the advent of plastics as a significant player in packaging (late 1970s and early 1980s), paper and its related products were replaced in many uses. Lately that trend has slowed as designers have tried to respond to the perception that plastic is environmentally unfriendly. The fact is that decreasing that amount of material in packaging is usually more important than the composition of the package to get the most environmentally friendly form of packaging.

## Glass

Although glass-making began in 7000 B.C. as an offshoot of pottery, it was first industrialized in Egypt in 1500 B.C. Made from base materials (limestone, soda, sand and silica), which were in plentiful supply, all ingredients were simply melted together and molded while hot. Since that early discovery, the mixing process and the ingredients have changed very little, but the molding techniques have progressed dramatically.

At first, ropes of molten glass were coiled into shapes and fused together. By 1200 B.C., glass was pressed into molds to make cups and bowls. When the blowpipe was invented by the Phoenicians in 300 B.C., it not only speeded production but allowed for round containers. Colors were available from the beginning, but clear, transparent glass was not discovered until the start of the Christian Era. During the next 1000 years, the process spread steadily, but slowly, across Europe.

The split mold, which was developed in the 17th and 18th centuries, further provided for irregular shapes and raised decorations. The identification of the maker and the product name could then be molded into the glass container as it was manufactured. As techniques were further refined in the 18th and 19th centuries, prices of glass containers

continued to decrease. Owens invented the first automatic rotary bottle-making machine, patented in 1889. Suddenly, glass containers of all shapes and sizes became economically attractive for consumer products, and from the early 1900s until the late 1960s glass containers dominated the market for liquid products. A typical modern bottle-making machine automatically produces 20,000 bottles per day.

While other packaging products, such as metals and plastics, were gaining popularity in the 1970s, packaging in glass tended to be reserved for high-value products. As a type of "rigid packaging," glass has many uses today. High weight, fragility and cost have reduced the glass markets in favor of metal and plastic containers. Still, for products that have a high quality image and a desire for high flavor or aroma protection, glass is an effective packaging material. The packaging glass used today is the only type of glass accepted in US recycling programs.

## Metals

Ancient boxes and cups, made from silver and gold, were much too valuable for common use. Metal did not become a common packaging material until other metals, stronger alloys, thinner gauges and coatings were eventually developed.

One of the "new metals" that allowed metal to be used in packaging was tin. Tin is a corrosion-resistant metal, and ounce-for-ounce, its value is comparable to silver. However, tin can be "plated" in very thin layers over cheaper metals, and this process made it economical for containers.

The process of tin plating was discovered in Bohemia in 1200 A.D., and cans of iron coated with tin were known in Bavaria as early as the 14th century. However, the plating process was a closely guarded secret until the 1600s. Thanks to the Duke of Saxony, who stole the technique, it progressed across Europe to France and the United Kingdom by the early 19th century. After William Underwood transferred the process to the United States via Boston, steel replaced iron, which improved both output and quality. The term 'tin can' referred to a tin-plated iron or steel can and was considered a cheap item. Tin foil also was made long before

aluminum foil. Today many still refer to metal cans as 'tin cans' and aluminum foil as 'tin foil', a carryover from times well past.

In 1764, London tobacconists began selling snuff in metal canisters, another type of today's "rigid packaging." But no one was willing to use metal for food since it was considered poisonous.

The safe preservation of foods in metal containers was finally realized in France in the early 1800s. In 1809, General Napoleon Bonaparte offered 12,000 francs to anyone who could preserve food for his army. Nicholas Appert, a Parisian chef and confectioner, found that food sealed in tin containers and sterilized by boiling could be preserved for long periods. A year later (1810), Peter Durand of Britain received a patent for tinplate after devising the sealed cylindrical can.

Since food was now safe within metal packaging, other products were made available in metal boxes. In the 1830s, cookies and matches were sold in tins and by 1866 the first printed metal boxes were made in the United States for cakes of Dr. Lyon's tooth powder.

The first cans produced were lead-soldered by hand, leaving a 1 1/2-inch hole in the top to force in the food. A patch was then soldered in place but a small air hole remained during the cooking process. Another small drop of solder then closed the air hole. At this rate, only 60 cans per day could be manufactured.

In 1868, interior enamels for cans were developed, but double seam closures using a sealing compound were not available until 1888.

Aluminum particles were first extracted from bauxite ore in 1825 at the high price of \$545 per pound. When the development of better processes began in 1852, the prices steadily declined until 1942, when the price of a pound of aluminum was \$14. Although commercial foils entered the market in 1910, the first aluminum foil containers were designed in the early 1950s while the aluminum can appeared in 1959.

The invention of cans also required the invention of the can opener! Initially, a hammer and chisel was the only method of opening cans. Then in 1866, the keywind metal tear-strip was developed. Nine years later (1875), the can opener was invented. Further developments modernized the mechanism and added electricity, but the can opener has remained, for more than 100 years, the most efficient method of retrieving the contents of a can. In the 1950s, the pop top/tear tab can lid appeared and now tear tapes that open and reseal are popular.

Collapsible, soft metal tubes, today known as "flexible packaging," were first used for artists paints in 1841. Toothpaste was invented in the 1890s and started to appear in collapsible metal tubes. But food products really did not make use of this packaging form until the 1960s. Later, aluminum was changed to plastic for such food items as sandwich pastes, cake icings and pudding toppings.

## Plastics

Plastic is the newest packaging material in comparison with metal, glass, and paper. Although discovered in the 19th century, most plastics were reserved for military and wartime use. Plastics have become very important materials and a wide variety of plastics have been developed over the past 170 years.

Several plastics were discovered in the nineteenth century: styrene in 1831, vinyl chloride in 1835, and celluloid in the late 1860s. However, none of these materials became practical for packaging until the twentieth century.

Styrene was first distilled from a balsam tree in 1831, but the early products were brittle and shattered easily. Germany refined the process in 1933 and by the 1950s styrofoam was available worldwide. Insulation and cushioning materials as well as foam boxes, cups and meat trays for the food industry became popular.

Vinyl chloride, discovered in 1835, provided for the further development of rubber chemistry. For packaging, molded deodorant squeeze bottles were introduced in 1947 and in 1958, heat shrinkable films were developed from blending styrene with synthetic

rubber. Today some water and vegetable oil containers are made from vinyl chloride.

Celluloid was invented during the American Civil War. Due to a shortage of ivory, a United States manufacturer of billiard balls offered a \$10,000 reward for an ivory substitute. A New York engineer, John Wesley Hyatt, with his brother Isaiah Smith Hyatt, experimented several years before creating the new material. Patented in 1870, "celluloid" could not be molded, but rather carved and shaped, just like ivory.

Cellulose acetate was first derived from wood pulp in 1900 and developed for photographic uses in 1909. Although DuPont manufactured cellophane in New York in 1924, it wasn't commercially used for packaging until the late 1950s and early 1960s. In the interim, polyethylene film wraps were reserved for the military. In 1933, films protected submarine telephone cables and later were important for World War II radar cables and drug tablet packaging.

Other cellophanes and transparent films have been refined as outer wrappings that maintain their shape when folded. Originally clear, such films can now be made opaque, colored or embossed with patterns.

One of the most commonly used plastics is polyethylene terephthalate (PETE). This material only became available for containers during the last two decades with its use for beverages entering the market in 1977. By 1980, foods and other hot-fill products such as jams could also be packaged in PETE.

Current packaging designs are beginning to incorporate recyclable and recycled plastics but the search for reuse functions continues.

## Labels and Trademarks

It now seems obvious that product containers will bear the identification of the maker alongside pictures, nutritional information, ingredients, etc. However, this seemingly obvious feature of packaging has its own history.

In the 1660s, imports into England often cheated the public and the phrase "let the buyer beware" became popular. Inferior quality and impure products were disguised and sold to uninformed customers. Honest merchants, unhappy with this deception, began to mark their wares with their identification to alert potential buyers.

Official trademarks were pioneered in 1866 by Smith Brothers for their cough drops marketed in large glass jars. This was a new idea - using the package to "brand" a product for the benefit of the consumer.

In 1870, the first registered U.S. trademark was awarded to the Eagle-Arwill Chemical Paint Company. Today, there are nearly three-quarters of a million (750,000) registered trademarks in the United States alone. Labels now contain a great deal of information intended to protect and instruct the public.

## A Review

From containers provided by nature to the use of complex materials and processes, packaging has certainly changed. Various factors contributed to this growth: the needs and concerns of people, competition in the marketplace, unusual events (such as wars), shifting lifestyles, as well as discoveries and inventions. Just as no single cause influenced past development, a variety of forces will be required to create the packages of the future, but a very important factor will always be consumer choice. Ultimately, only the packaging that our society demands is produced. We choose by the products we purchase.

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