MEAT PACKAGING AND PACKAGING TECHNIQUES*

PAUL E. GRINDROD
Oscar Meyer and Company

In discussing current packaging and packaging techniques for meats, it is useful to classify the proliferating types of meat packages into some sort of logical order. For this reason an outline entitled "Academic Overview of Meat Packages" was prepared as a guide as shown below:

ACADEMIC OVERVIEW OF MEAT PACKAGES

I. Anaerobic packages

1. Hermetic seals

2. Oxygen and water vapor impermeable materials

3. Minimum residual oxygen

a. Vacuum

b. Vacuum and inert gas flush

c. Inert gas flush only

d. Oxygen scavenger

Examples: Tin can, Institutional Fresh/Frozen, Processed Meats Packaged in Plastics

II. Non Hermetic Aerobic Packages

1. Marginal seals, if any

2. Oxygen permeable materials

3. Water vapor permeable and impermeable materials

Examples: Paper Wraps, Paper Cartons, Fresh Meats Wrapped in Supermarkets with Plastic Films

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* Presented at the 26th Annual Reciprocal Meat Conference of the American Meat Science Association, 1973.

III. Hermetic Aerobic Packages

1. Hermetic seals

2. Materials permeable to oxygen but impermeable to water vapor

3. Elimination of void space by vacuum

Examples: Fresh/frozen retail packages; some institutional

This classification of packages shows Anaerobic Packages, Non-Hermetic Aerobic Packages and Hermetic Aerobic Packages.

An Anaerobic package is just what its name implies--it is hermetically sealed and composed of materials which are both oxygen and water vapor impermeable. It minimizes the residual oxygen in the package through vacuum, vacuum plus an inert gas flush to produce a typical gas-packed package, an inert gas flush alone which also produces a gas-packed package only usually with a higher residual oxygen content, or through an oxygen scavenger which can be the meat itself, bacterial, biochemical or chemical action.

Examples of Anaerobic packages include the typical tin can, the familiar impermeable plastic refrigerated processed meat package and institutional fresh or fresh/frozen packages.

A Non-Hermetic Aerobic package, permits air and oxygen to enter the package and react with the product either through non-hermetic seals, oxygen-permeable materials or both. It similarly permits water to evaporate from the product and penetrate the package to the exterior environment either through non-hermetic seals or through packaging materials which are permeable to water vapor.

Examples of this classification of packages include the old fashioned meat paper wrap which does little more than keep the flies off the product and soak up the juice. The numerous paper cartons and paper shipping containers used for pork sausage and institutional fresh/frozen meats also belong in this classification. Many of these are wax or polyethylene coated to reduce moisture loss but at best are only partial barriers.

Similarly the vast array of consumer-sized fresh meat packages found in supermarkets today belong in this category. These packages, usually wrapped in polyethylene, modified polyethylene (EVA) or plasticized PVC with a tray of paperboard, foamed plastic or transparent plastic, are characterized by marginal leaking seals and oxygen permeable materials. Gross moisture vapor loss is minimized in these packages through non-hermetic heat seals and packaging materials with low moisture vapor transmission rates.

The third category, Hermetic Aerobic Packages, is characterized by hermetic seals and materials which are permeable to oxygen but not to water vapor. These packages are usually vacuumized to reduce the void space between the product and the package.

Examples of this type of package are fewer. Polyolefin pouches such as polyethylene, Surlyn (DuPont's Ionomer), irradiated, cross linked, oriented polyethylene are frequently used to package frozen consumer cuts. They are heat sealed with vacuum or clipped and vacuumized and subsequently heated to provide greater conformance of the pouch to the product.

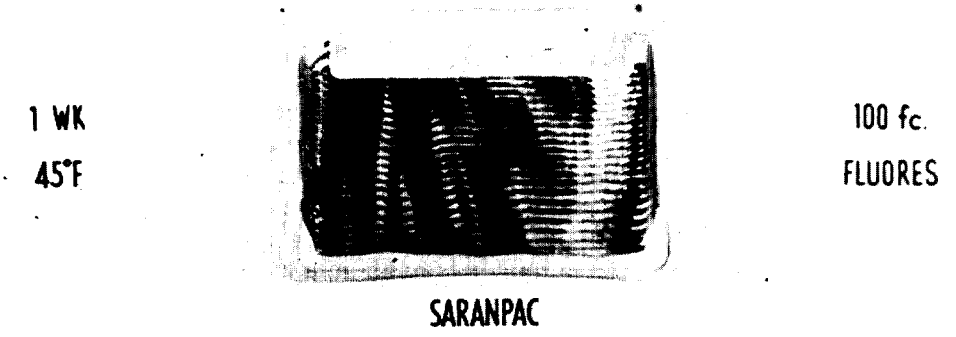
A more sophisticated package of this type is possible on the DuPont Bivac machine where oxygen-permeable Surlyn film is thermoformed in a vacuumized chamber to provide a glove-tight package with substantially no void space. This package is widely used for consumer sized frozen fresh meat cuts.

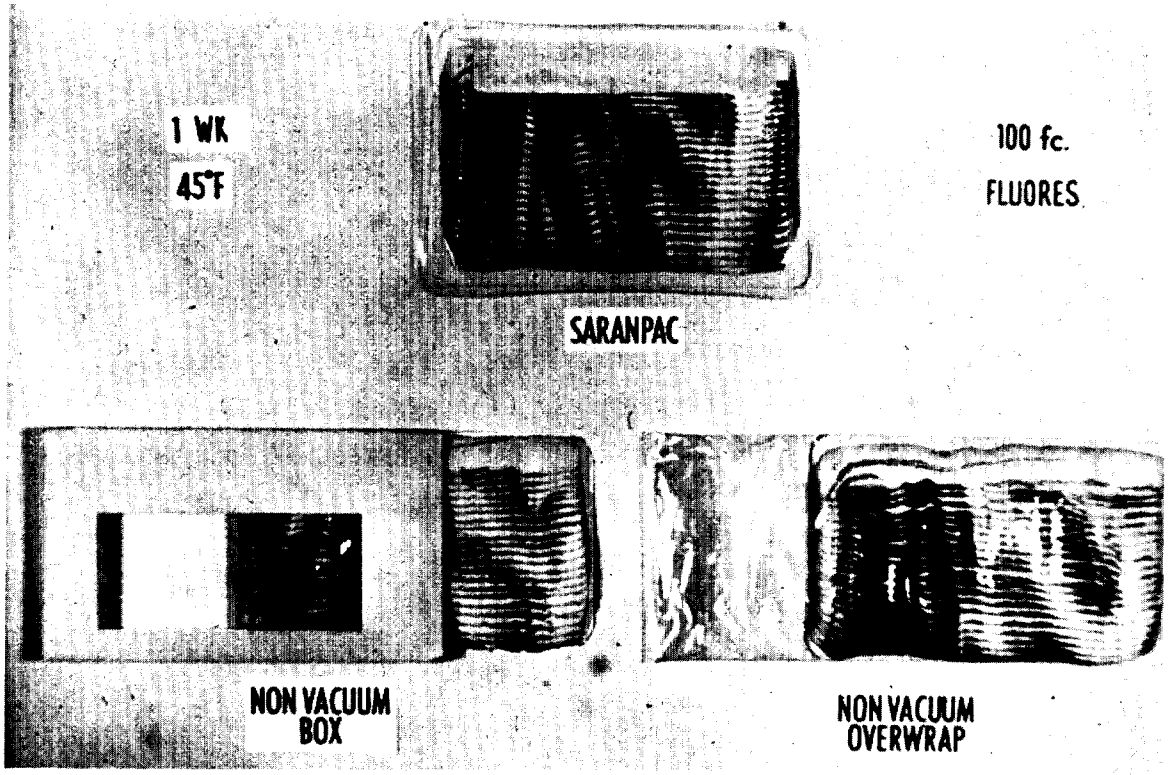
ANAEROBIC PACKAGES

The Anaerobic package group includes metal cans, processed meats packaged in plastics with vacuum or gas flush and institutional fresh or frozen sub primal cuts. The familiarity of meats packaged in metal cans to the general public precludes a discussion of this important packaging method in this paper. Instead, the plastic packaged processed meats and institutional fresh meat systems will be emphasized.

Plastic Packaged Processed Meats

One of the primary objectives of processed meat packaging is the elimination of oxygen and fading of the meat pigment nitrosomyoglobin. A dramatic example of the fading characteristics of bacon is shown below:



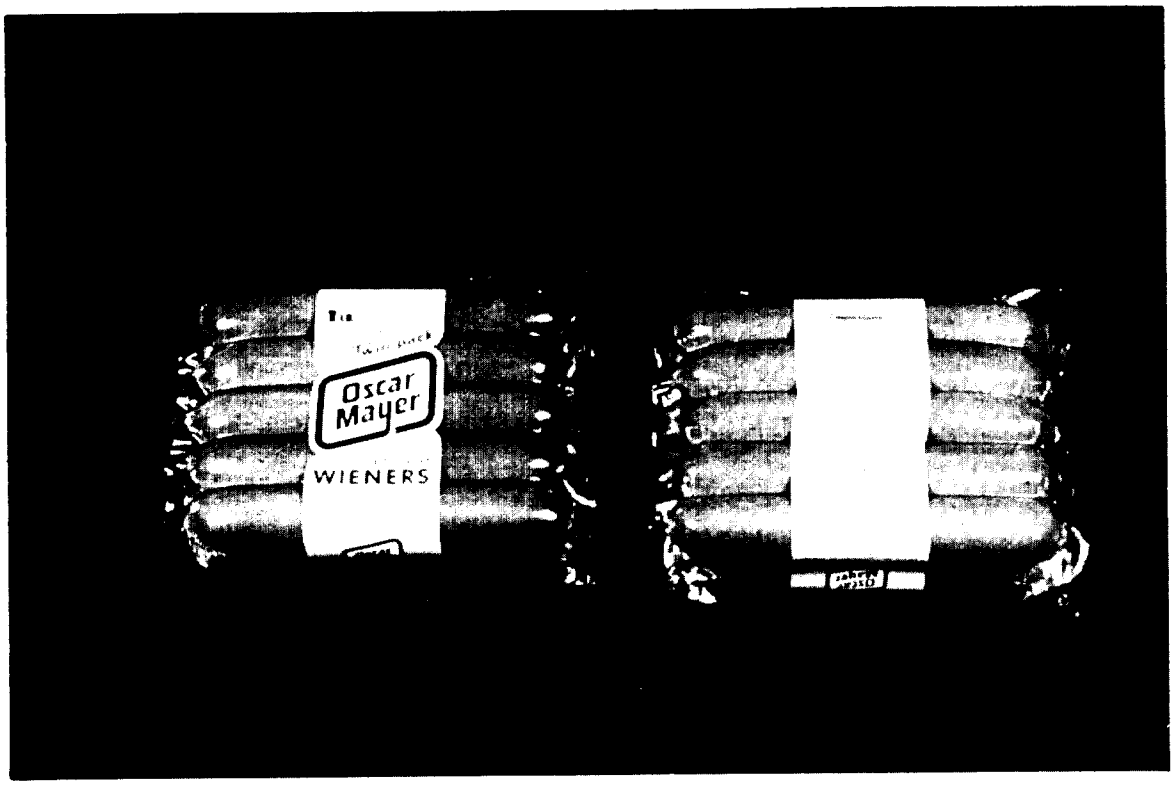


The first photo shows the color of bacon packaged in an oxygen barrier wrap (saran) versus two permeable packages. At zero time all packages show the bright red color of bacon. After 1 week of exposure to 100 footcandles @ 45° F, the low barrier packages permitted extensive and irreversible fading to occur.

These pictures of bacon packages dramatically illustrate the prime necessity in packaging processed meats--the elimination of oxygen. The balance of the processed meat packages discussed herein employ the same principle to lengthen color life.

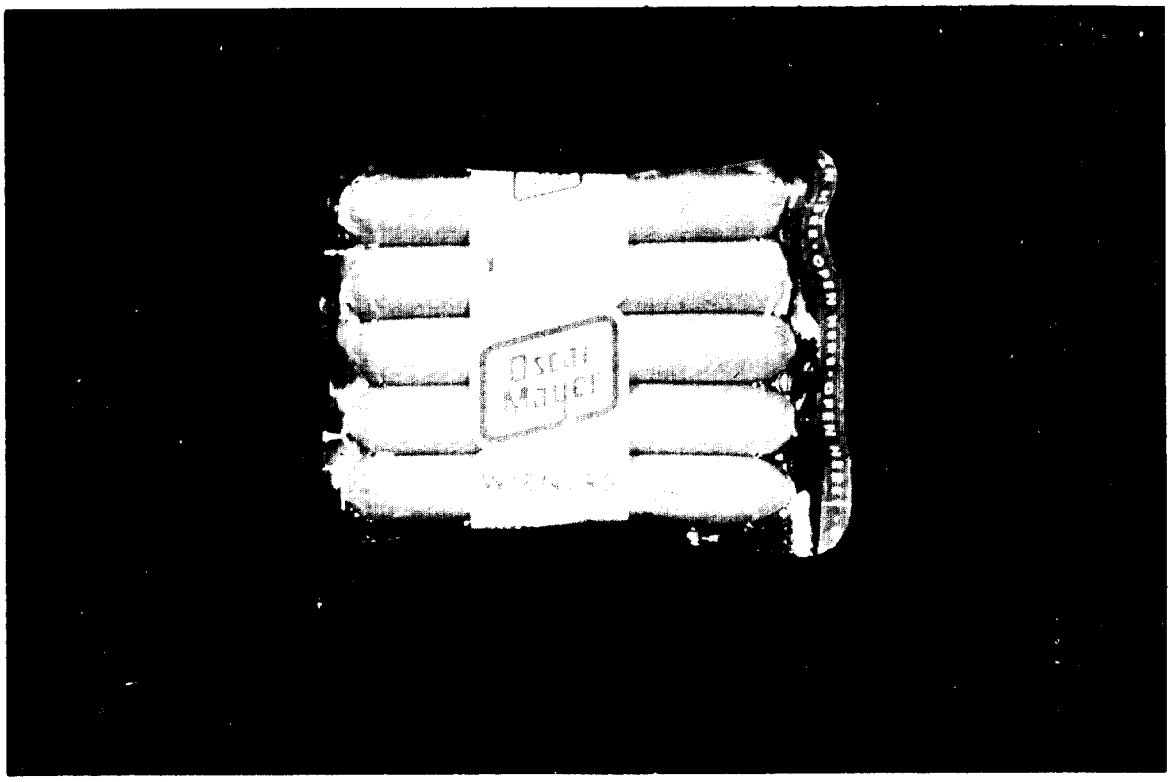
Wiener packages have evolved from bulk cartons of unprotected wieners, though non-hermetic cellophane packages to vacuumized barrier film packages which preserve color well. A typical example of a vacuum-packed wiener package is shown in the following photo.

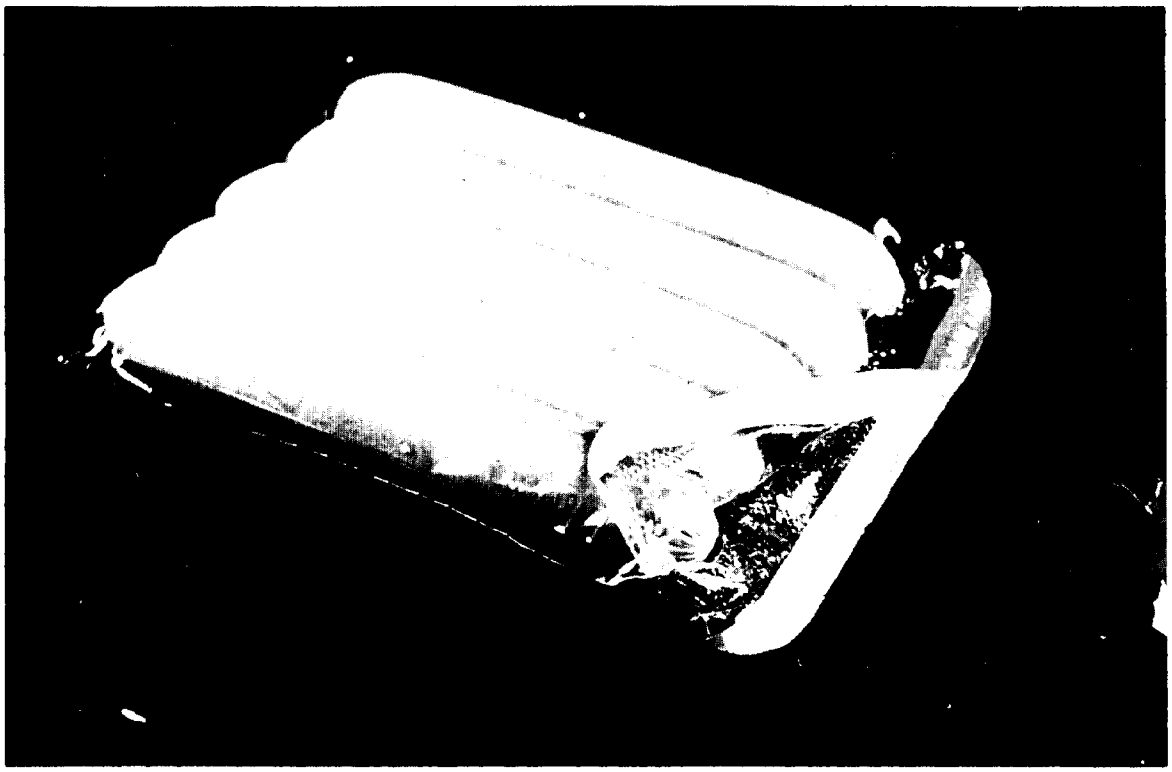
This particular package is composed of a cold-formed, saran laminate film which forms over the product providing a glove-tight fit with substantially no void space and maximum elimination of air. The seal on this particular package is fused which does not permit the package to be opened easily. It must be opened with a sharp instrument.



A further development in wiener packages is shown in the two following photos.

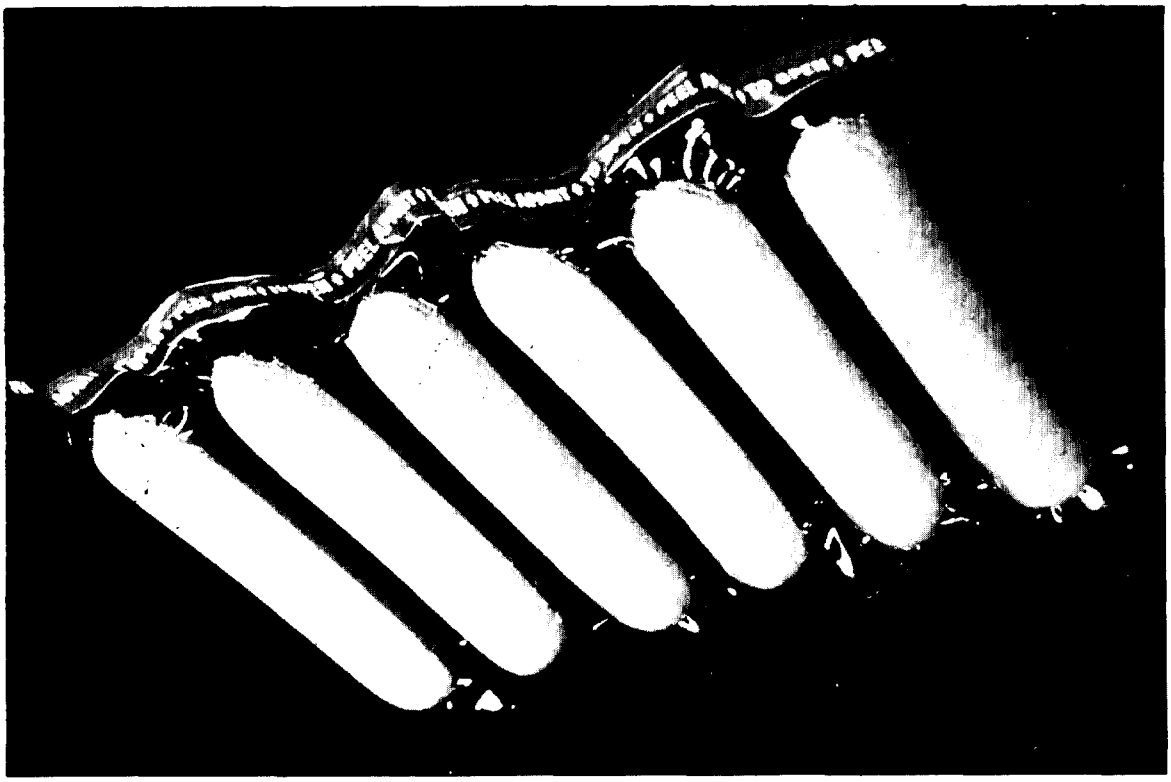
Package development largely follows the dictates of the consumer as interpreted by market research and one of the features for which the public expressed a desire was an easy open package.





These photos show a similar type wiener package with added easy open feature which is made possible by peelable films. The seal made between the upper and lower halves of the package is of sufficient strength to maintain the integrity of the package throughout the merchandising cycle but sufficiently weak to permit peeling. The control of this seal strength is sometimes difficult but does provide the consumer with easy access to the contents and a fairly good non-hermetic restorage feature. However, whenever a processed meat package is opened and air is admitted, significant color changes in the remaining product held in the refrigerator can be noted in 1 to 2 days. To provide even greater protection, individually sealed wieners are shown in the photo below. This wiener package maintains the hermeticity of each link until it is opened for use and each link can be separated from the package by tearing along the perforation.

The extent to which subdivision of consumer meat packages is truly desired is difficult to ascertain by market research, however there does seem to be an increasing market for smaller hermetically enclosed increments as the number of smaller families increases.



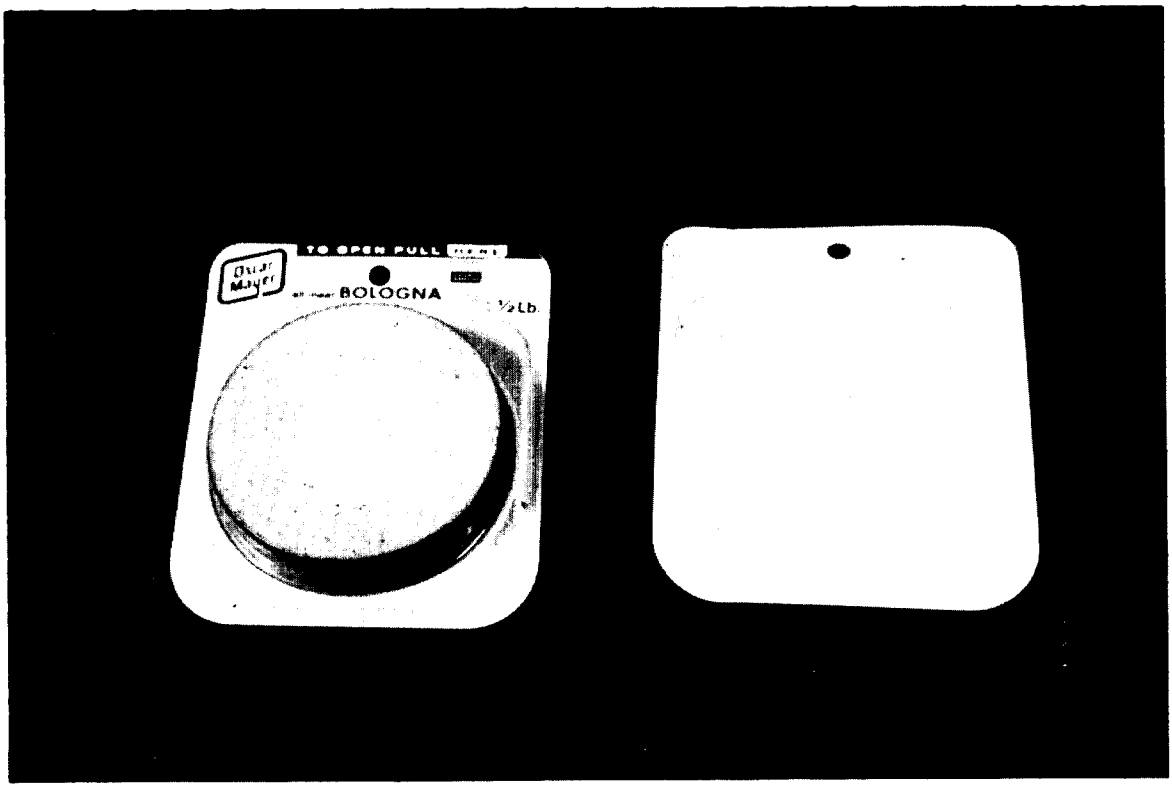
In the area of luncheon meat packages, there has been an interesting trend from flexible to semi rigid to rigid packages.

The above photo shows a vacuum luncheon meat package made from a thermoformed heat-sealed saran coated laminate.

The film thickness in this package is about 2 1/2 to 3 one thousandths of an inch which provides little rigidity to the package. The upper film web is thermoformed into a cavity and then collapsed by vacuum upon the meat. The fit of the package is imperfect with wrinkles and voids. It is also difficult to open and requires a sharp instrument.

The second generation improvement upon this package is shown in the next photo. This picture shows a semi-rigid vacuum package composed of a ten-thousandths of an inch thick plastic, thermoformed base and a cold formed saran laminate enclosing the product. The cold-formed film permits a glove-tight fit around the product. The film is adhered to the yellow base with a hot melt adhesive. The adhesive permits easy opening and hermetic reclosure.

A third generation luncheon meat package is shown next.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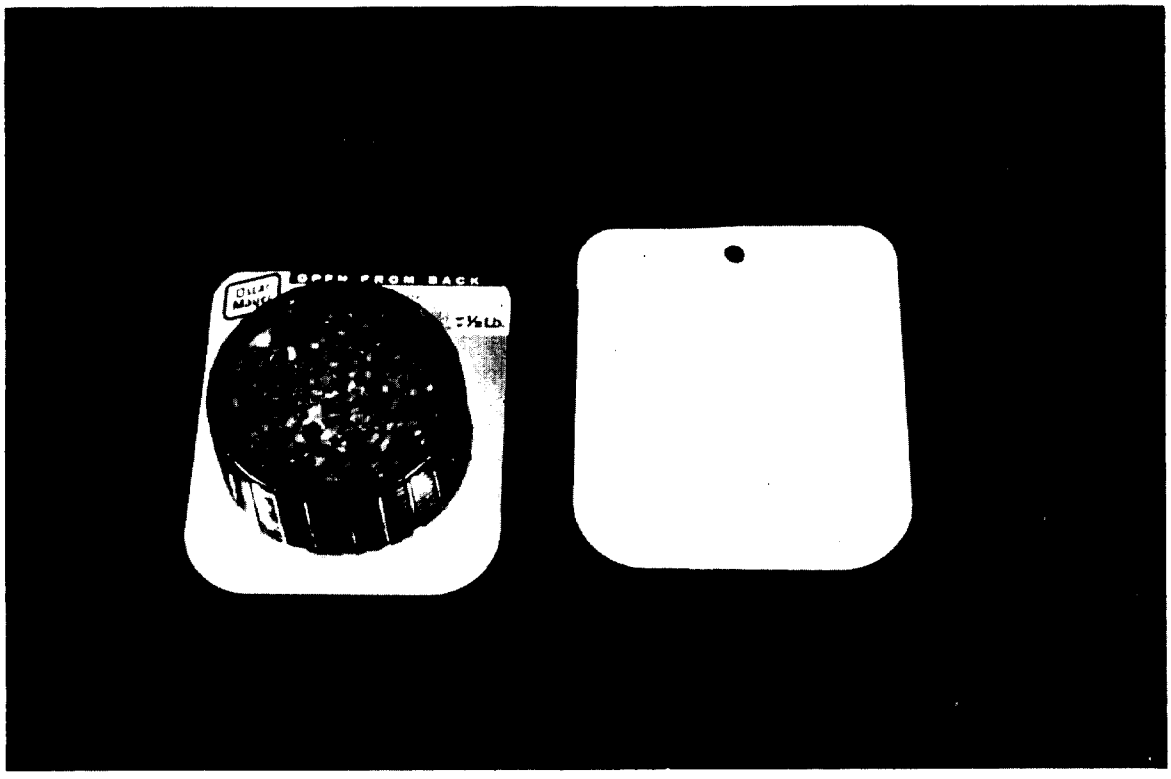
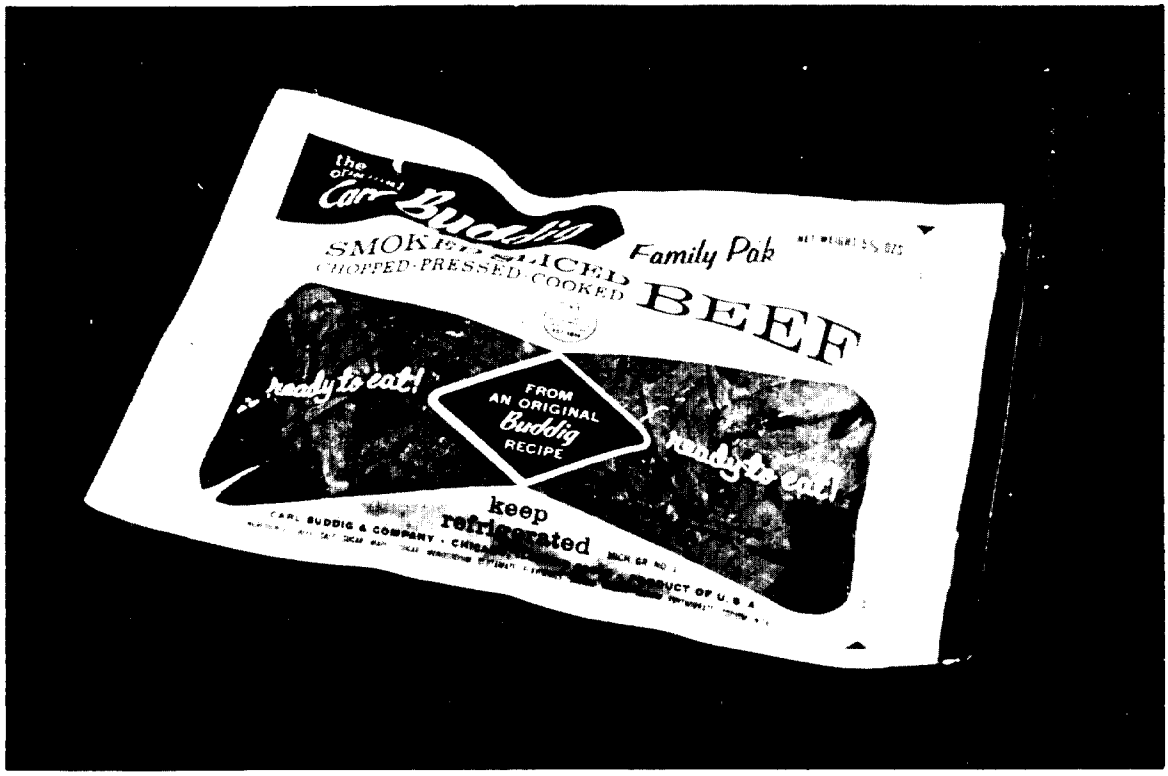

OPEN FROM BACK

This is a rigid package composed of 10 to 20 thousandths thick PVC plastic, both top and bottom, which imparts both rigidity and oxygen impermeability to the package. The upper molded cup again is adhered to the lower base with a hot melt adhesive permitting easy access and good reclosure features.

The rigid type luncheon meat package, while slightly more expensive than the semi rigid or flexible, imparts desirable aesthetics to soft products which may otherwise tend to deform in a flexible film package.

The previous packages were vacuumized to minimize void space between the package and the product. With some products it is not desirable to crush and compress the product through the use of vacuum. A typical example of a non-vacuum or gas-packed, product-package is semi-dried sliced beef as shown below:



The pouch is composed of a saran coated, heat sealable laminate and is first vacuumized to eliminate a significant proportion of the air and then flushed with an inert gas--usually nitrogen. It then is heat sealed in a ballooned condition which prevents the thin slices from being compressed during distribution.

One problem connected with gas packed packages is condensation. A typical situation encountered in the use of gas packed bags occurs in the lighted retail showcase where the lights frequently heat the shelves upon which the product rests. This causes a fractional temperature differential between the bottom and the top of the package and in effect sets up a miniature still where the moisture migrates from the bottom of the product, condenses on the upper film and drips on the upper surface of the product. This situation detracts from the aesthetics of product-package appearance and may accelerate bacteriological growth and fading in localized area.

Another interesting new meat package is the plastic ham can shown in the photo below. It is a substitute for the familiar all metal can and is thermally processed after closing to provide no less than one year of shelf life at 45° F.

Plastic ham cans have evolved in response to the consumer's desire for a corrosion-free interior and an easy open feature.

The plastic can circumvents mottling usually found in most metal ham cans and permits the use of an easy-open aluminum lid without corrosion complications associated with dissimilar metals.

The rigid plastic package shown here is composed of an oxygen-barrier laminate which is thermoformed to shape. The ham is placed inside and the all aluminum easy-open top is crimped on a canning machine under vacuum to provide a hermetic mechanical seal.

A package of this kind which is heat processed, requires an exceptionally good oxygen barrier because of its near sterility. Without the oxygen-scavenging action of limited bacterial growth, fading of processed meat color is much more likely.

Another meat package which is thermally-processed after packaging is shown in the photo below:

This familiar chub package, composed of oriented saran film, provides excellent oxygen barrier characteristics with a shelf life in excess of one year at 45° F.

The electronic longitudinal seal in combination with the metal clip and seal provides the hermeticity of a tin can. The metal clip end seals are hermetic through the "plugging" action of the viscous product in the capillary channels of the constricted film. Without a viscous flowable product, metal clip seals are non-hermetic.

A rather interesting package for pork sausage has also been included in the Anaerobic package group. Most pork sausage is packaged aerobically to insure a bright red appearance for the consumer at the point of purchase.

The following photo, however, shows an anaerobic pork sausage package where the product is marketed in the reduced state.

The packaging film is an oxygen barrier which is mechanically sealed with a metal clip at either end. A unique aspect of this package is the manner in which an anaerobic environment is achieved. Neither vacuum nor gas flush are used but rather the product itself is utilized as an oxygen scavenger by holding it in the sealed package for a time interval above freezing. During this period the very active pre-rigor muscle tissue scavenges all the oxygen. The package and its contents are subsequently frozen in a self-generated atmosphere completely free from oxygen.

Plastic Packaged Institutional Fresh Meats

Other anaerobic packages include institutional fresh or fresh frozen cuts packaged in heavy duty oxygen-impervious bags with vacuum and hermetic sealing.

The following photo shows a typical sub-primal cut enclosed in a pouch sealed under high vacuum. The anaerobic environment inhibits bacteriological growth with consequent advantages in meat quality for the ultimate consumer.

NON-HERMETIC AEROBIC PACKAGES

Shifting to the Non-Hermetic, Aerobic packaging area three package types are found--the ordinary brown paper wrap, the paper merchandising carton and the vast variety of supermarket wraps for fresh consumer-size meat cuts.

Little comment is required for the brown paper wrap. The opacity and porosity of this package to oxygen, moisture vapor and liquids precludes its extensive use in today's market.

Paper cartons provide one additional function, that of displaying the product in an attractive manner for sale in the merchandising case. An example of a non-hermetic, aerobic paper carton is shown in the following photo:

This package is a polyethylene coated solid bleached sulfite paperboard with a polystyrene window. Its polyethylene coating slows moisture vapor loss somewhat, however the package must still be regarded as extremely aerobic and non-hermetic.

While this type of package permits full bloom of oxymyoglobin to develop, the bloom is transient and short-lived and the total life of the package may be only 3-5 days at 45° F.

The vast variety of supermarket fresh meat packages are nearly all hand wraps of oxygen permeable transparent thin plastic film, usually plasticized PVC, polyethylene, polyethylene copolymers, ionomers, and to a decreasing extent non-barrier cellophanes. All of these films have a high rate of oxygen permeability and a low rate of water vapor transmission. All films are heat sealable and many of the films are oriented to provide shrink characteristics which lend a taut aesthetically pleasing appearance to the packages.

Packages may be fabricated from film alone or with a paper, foamed plastic or clear plastic tray.

The following photo shows a typical supermarket wrap utilizing a permeable film only:

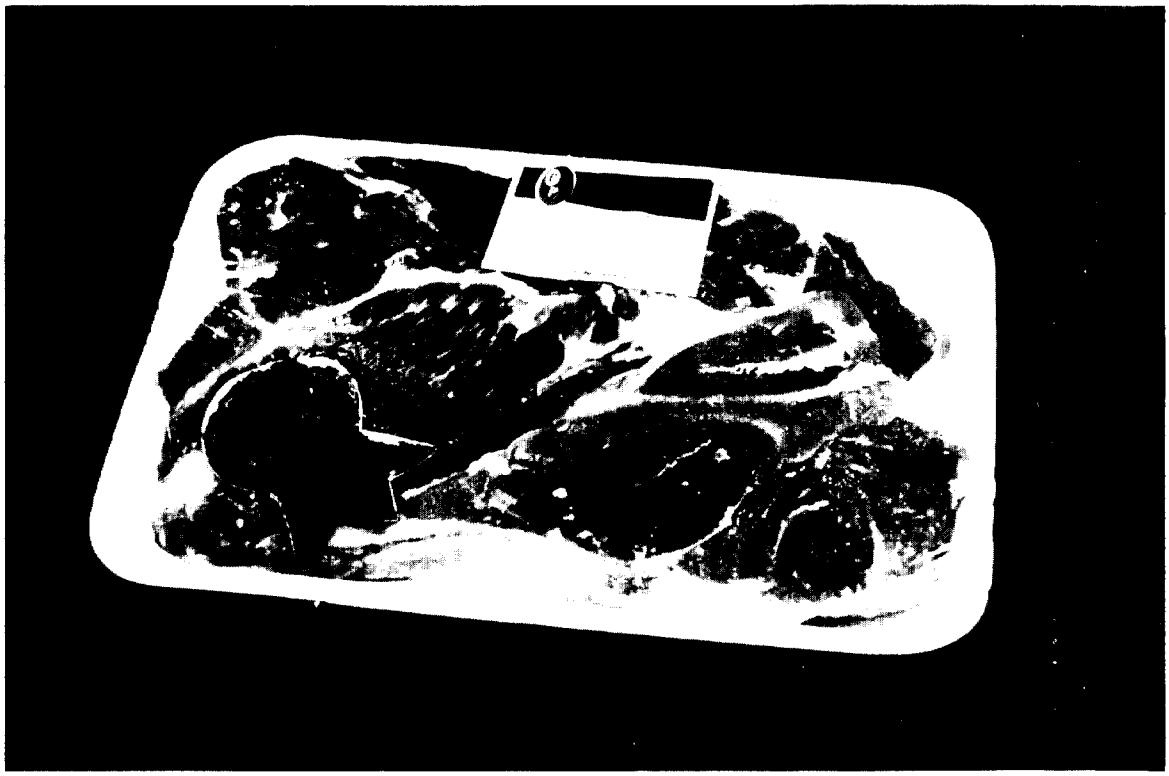
The fresh meat supermarket package sometimes includes a paper board tray as is shown above.

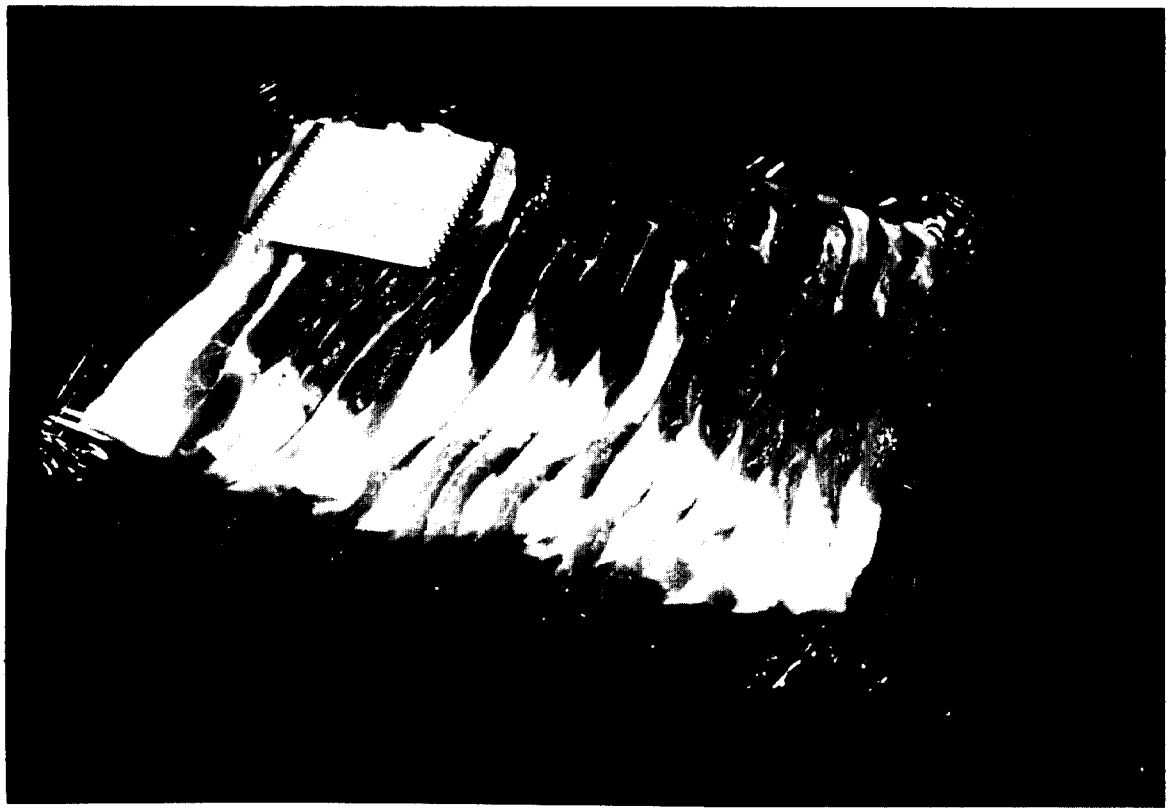
A somewhat more sophisticated version of this package substitutes a foamed polystyrene tray shown in the following photo.

The use of clear plastic trays is gaining momentum with the trend, augmented by local legislation in New York and Chicago, toward greater visibility for consumer evaluation.

The next photo shows the visual impact of the transparent tray.

Packaging trends brought about by legislative action usually stem from an honest desire to provide the consumer with accurate and ample information at the point of purchase. However, the elimination of lower cost alternatives by legislation may not always be in the public interest because it circumvents democracy in the market place.





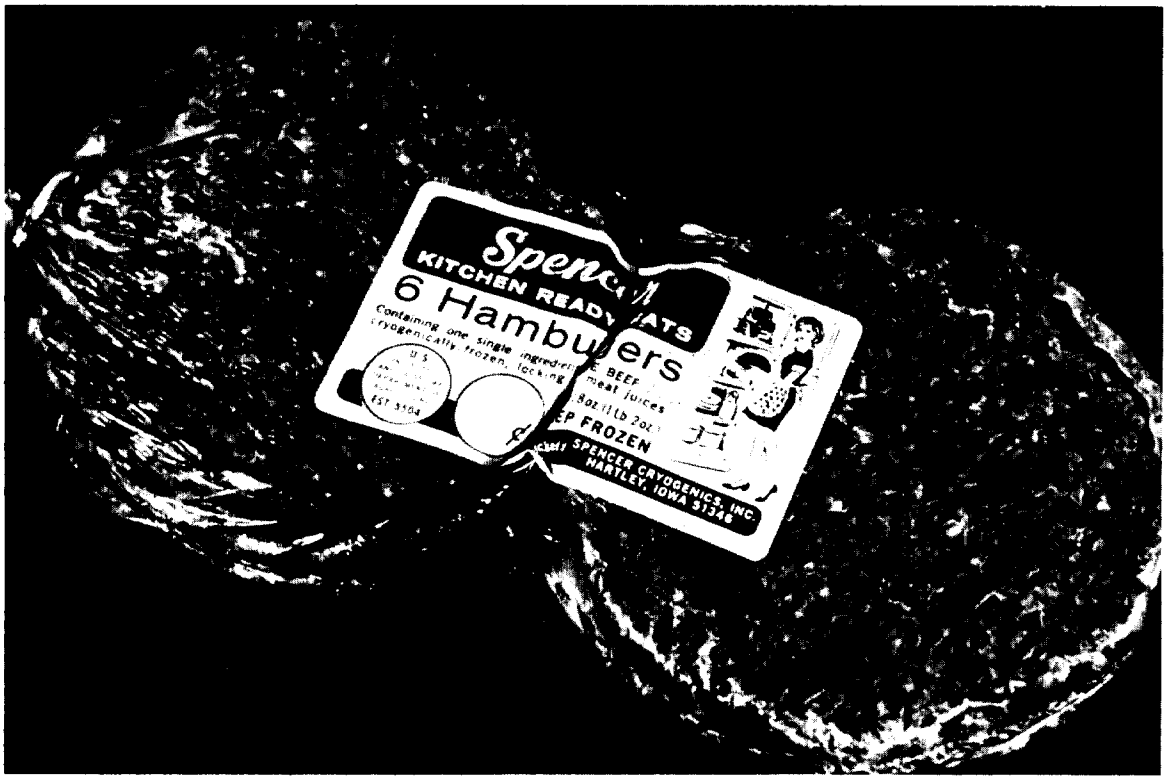
HERMETIC AEROBIC PACKAGES

The third category, Hermetic Aerobic packages, comprise some interesting new developments aimed primarily toward the growing fresh/frozen, consumer-sized cuts.

Many studies have shown reluctance on the part of the retail consumer to accept fresh or fresh/frozen meats cuts with the deep purple color characteristic of reduced myoglobin. For this reason, there has been an effort to produce aerobic but hermetically sealed packages for fresh and fresh/frozen meat cuts with high rates of oxygen transmission and low rates of water vapor transmission.

Current merchandising trends elect the bright appearance of oxymyglobin as an index of freshness which will attract the consumer. The use of polyethylene and ionomers with high oxygen permeability has given rise to several package designs.

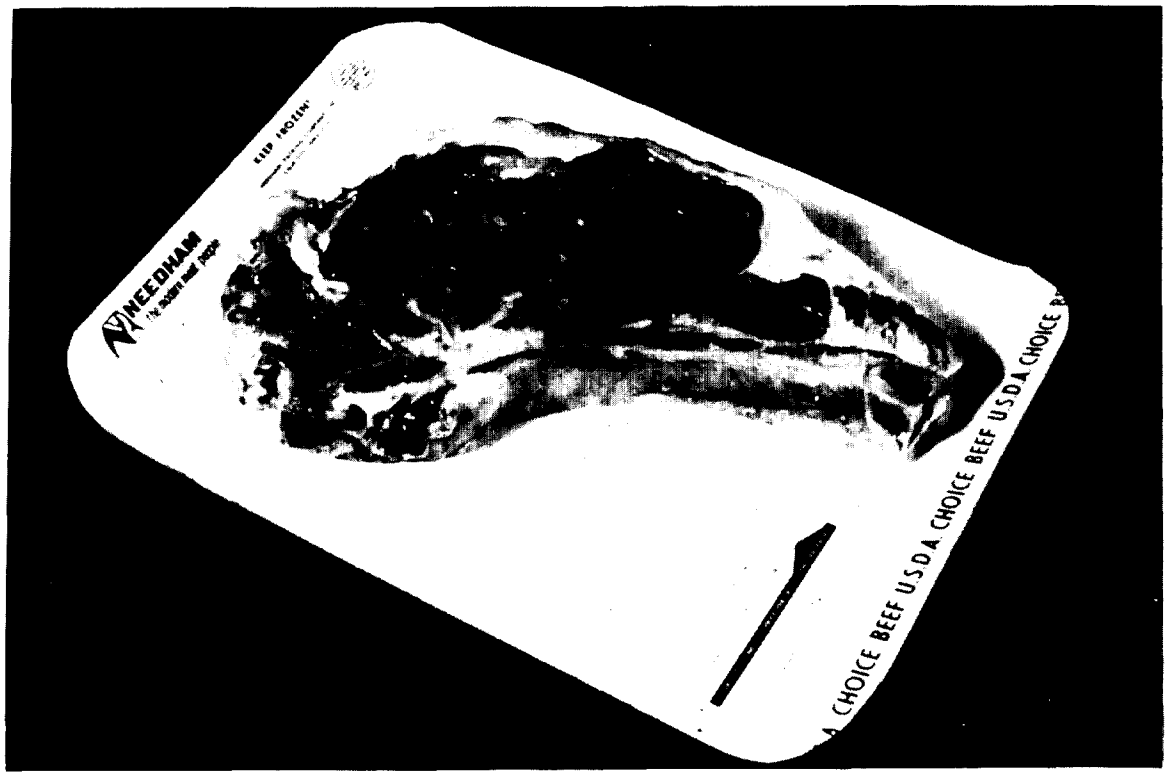
The photo below shows one of the early contenders for the fresh/frozen retail market:



This package is a biaxially oriented, irradiated polyolefin capable of a high degree of heat shrink. The frozen beef patties are placed in the pouch, evacuated and mechanically clipped. The pouch is then heated in a shrink tunnel to conform more closely to the product and to minimize void space. It is, at best, functionally inefficient. The mechanical clip does not provide a truly hermetic seal. This type of clip used in connection with a soft and amorphous product, which will fill the capillary openings through the seal, does, provide a good seal. But with frozen patties there is a constant, if small, leakage of water vapor through the seal.

This type of package, further, invariably suffers from internal frosting because of its numerous void spaces inside the package. This produces an aesthetically unsightly package and permits a minor degree of localized dessication.

The photo below shows a package of fresh frozen meat with a glove-tight fit made by thermoforming an ionomer film directly over a vacuumized chop. This results in substantially no void space and eliminates internal frosting. This semi rigid package depends upon a polymer coated paper-board as its base.



An even more effective hermetic aerobic package is the Bivac package shown in the photo above.

This package is made on the DuPont Bivac machine by thermoforming an upper ionomer film in a vacuum chamber over the product itself and sealing the upper ionomer film to the lower ionomer film in the vacuum environment. This produces a truly hermetically sealed package with a high oxygen transmission rate and zero void space.

The extreme adherence of the film to the product prevents the development of void space even if the package is punctured by a sharp point in the bone.

Color retention in the meat cut is adequate for merchandising if the product is held at -15 to -20° F under lights of moderate intensity.

CONCLUSION

Future changes in meat packaging will probably include the following trends:

1. Improved oxygen barrier plastics giving rise to better processed meat color life and less packaging mass.

2. Better color life will make the use of thermal processing more attractive as a means of minimizing bacteriological spoilage.

3. Increased consumer convenience through easy-open and hermetically-reclosable packaging designs.

4. Plastics with a wider temperature tolerance permitting functionality at both freezer and oven temperatures in the same package.

5. Increasing hermetic subdivision of packages to provide unopened freshness for the growing number of smaller families.

6. Centralization of fresh and fresh frozen meat packaging through increasing technological sophistication and the subsequent extension of shelf life.

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WAYNE BUSCH: Thank you, Paul, for a very comprehensive report on current developments. Our next speaker, Mr. William Young, is also an engineer. He received his degree in Mechanical Engineering from Stevens Institute of Technology. Active positions with several different firms including Director of Engineering Research for Standard Brands. Mr. Young founded his own company, the William E. Young and Company, of which he is currently President. Mr. Young has been recipient of several awards and holds over 30 patents. Today Mr. Young will review new developments and what he feels the future holds for developments in the packaging and merchandising areas. Bill.