Title: VACUUM SKIN PACKAGING

Abstract: Disclosed are packages and methods for packaging perishable foods such as meat, fish, poultry, vegetables or other food products. The packaging comprises a vacuum skin package comprising a film having specific package gas permeability requirements and a framing element within which the packaged goods are held.
VACUUM SKIN PACKAGING

The invention relates to packaging, to packaging for containing meat, fish, poultry, vegetables or other food products, and to method for packaging goods using this improved packaging.

BACKGROUND OF THE INVENTION

Perishable goods are subject to exposure to and contamination by microbial organisms such as bacteria, molds and the like by contact with airborne organisms or by contact with organisms on surfaces. The contamination can result in accelerated spoilage, toxin formation and other harmful effects. Thus it is desirable to protect the goods from contact with microbial organisms. Packaging such perishable goods in gas impermeable materials such as foil, paperboard and oxygen barrier films can provide a barrier to microbial contamination.

However, an anaerobic organism such as Clostridium botulinum produces a potent toxin that is the causative agent of botulism, an extremely virulent, dangerous, food poisoning. Since C. botulinum is an anaerobe, gas impermeable materials such as foil, paperboard and oxygen barrier films may not be suitable to package goods highly susceptible to botulin toxin formation. Spores of C. botulinum are heat resistant; it is impossible to kill the spores by merely heating the food. It is necessary to provide a package that allows oxygen to contact the surface of perishable goods to minimize the growth of C. botulinum. Thus, packages for fresh fish must provide a physical barrier to microbial and other contamination, yet provide for oxygen permeability.

C. botulinum contamination is particularly problematic in fresh fish. Traditionally, fresh fish has been sold in ice-chilled containers open to the atmosphere to minimize the growth of C. botulinum and consequent toxin formation. Such sales methods previously have been limited to relatively small geographic areas near the bodies of water where the fish were caught. For broader distribution, fish has traditionally been frozen.
With modern distribution methods, the desire of consumers in inland regions to consume fresh rather than frozen fish has increased. However, packaging of fresh fish to minimize the dangers of botulism is difficult. *C. botulinum* growth and toxin formation can occur as a result of time/temperature abuse during processing, storage, and distribution. Potentially hazardous conditions can occur in as little as two hours at temperatures >70°F, 11 hours at 50-70°F, two days at 42-50°F, and 7 days at 37.9-41°F.

Typical vacuum packaging inhibits the growth of common spoilage organisms, but does so under conditions that exclude oxygen and therefore does not inhibit the growth of *C. botulinum*. Therefore, vacuum packaging under conditions that exclude oxygen increases the likelihood that botulin toxin may be produced is unacceptable to consumers.

In packaging meat, fish, poultry, vegetables or other food products, it is also desirable to provide for relatively long shelf life of the packaged goods in a package that does not affect the appearance or keeping qualities of the packaged goods, is relatively simple and inexpensive to manufacture, yet sufficiently robust to protect the packaged goods from damage.

Vacuum skin packaging is a common method of packaging many goods where goods are tightly packaged within a wrapping material and where substantially all of the atmospheric air is excluded. Often the goods are placed in a tray or on a board background to increase the rigidity of the package to allow for better merchandising. In some cases, such as frozen fish, the packaged goods themselves are sufficiently rigid that additional rigid packaging elements are not needed.

Packaging has also been known to include certain gases to enhance the keeping qualities and the shelf life of the contents. Typically these packages are made from a plastic material that provides at least a partial barrier to the ingress of unwanted gases. The plastic material may be such that it allows gases that may be generated within the package to escape. Other known plastic materials allow certain gases to permeate to enhance the keeping qualities of the packaged goods. See, e.g.,
US Patents 4,685,274; 4,840,271; 5,025,611; 5,103,618 and 5,115,624. However, the packages disclosed therein can retain only a limited volume of the gas in the headspace.

Some products, such as fresh fish, must be packaged in a film with specific gas permeability properties to ensure food safety to prevent the growth of anaerobic bacteria. In the case of fresh fish, use of a backing, such as a board, base or tray, is not acceptable because the backing blocks the oxygen from contacting the fish.

U.S. Food and Drug Administration (FDA) guidance defines that packaging with “OTR greater than or equal to 10,000 cc/m²/24 hr can be regarded as oxygen permeable”. Such an OTR is unattainable with typical foam trays used in packaging foodstuffs such as fresh meats.

The FDA guidelines also note that “use of an oxygen permeable package will not compensate for the restriction to oxygen exchange created by practices such as packing . . . in deep containers from which the air is expressed.” If FDA guidelines regarding oxygen permeability are not met, a Hazard Analysis of Critical Control Points (HACCP) plan, a quality assurance protocol widely used in the food industry, must be established. Temperature monitoring is required and time/temperature indicators (TTI’s) must be provided on shipping containers. While temperature controls and monitoring can be accomplished during the distribution chain, it is impractical to do so after the packaged fresh fish has been sold to the consumer. The combinations of time and temperature that could provide hazardous levels of botulin toxin could easily occur during post-sale consumer handling of the packaged fresh fish.

It is therefore desirable to develop a vacuum skin package that has specific gas permeability and a framing element within which the packaged goods are held thereby providing sufficient rigidity to the package but does not contact the contents (i.e. the packaged goods). The goods are in contact only with the gas permeable film, which allows for adequate oxygen to contact the surface of the goods. Packages can be made with gas impermeable materials if oxygen is available in the headspace of the
package to inhibit growth of anaerobic organisms. However, it is difficult to provide sufficient oxygen in the headspace of such a package to provide extended protection against growth of anaerobes.

**SUMMARY OF THE INVENTION**

The invention includes a vacuum skin package that can contain perishable goods in which the package comprises or is produced from (a) a first flexible web of gas permeable skin wrapping plastic material; (b) one or more rigid or semi-rigid framing elements to surround but not contact the perishable goods; and (c) a second flexible web of gas permeable skin wrapping plastic material wherein the first flexible web and the second flexible web are sealed to each other to contain the perishable goods. The packages can comprise or be produced from a gas permeable plastic materials having an oxygen transmission rate (OTR) greater than or equal to 10,000 cc/m²/24 hr.

The invention also include a method of packaging goods comprising (a) placing perishable goods on a first flexible web of gas permeable skin wrapping plastic material in contact with the inside face of the first flexible web; (b) placing one or more rigid or semi-rigid framing elements in contact with the inside face of the first flexible web to surround but not contact the perishable goods; (c) placing a second flexible web of gas permeable skin wrapping plastic material over the perishable goods and one or more framing elements such that the inside face of the second flexible web is in contact with the perishable goods, the one or more rigid or semi-rigid framing elements and the inside face of the first flexible web; and (d) sealing the first flexible web and the second flexible web to each other to contain the one or more framing elements and the perishable goods.

Alternatively, the method can comprise (a) placing perishable goods on a first flexible web of gas permeable skin wrapping plastic material in contact with the inside face of the first flexible web; (b) placing a second flexible web of gas permeable skin wrapping plastic material over the perishable goods such that the inside face of the second flexible web is in contact with the perishable goods, and the inside face of the first flexible
web; (c) placing one or more rigid or semi-rigid framing elements in
contact with the outside face of the first flexible web and optionally in
contact with the outside face of the second flexible web to surround but
not contact the perishable goods; and (d) sealing the first flexible web and
the second flexible web to each other to contain the perishable goods.

DETAILED DESCRIPTION OF THE INVENTION

The term micron (μ) equals to 1/1000 of a millimeter (mm). A
micron is sometimes referred to as micrometer (μm). The term mil equals
to 1/1000 of an inch or to 25.4 microns.

The phrase "inside face" refers to the face of a film or packaging
web that is in contact with the packaged goods and is contained within the
package after it is formed. The inside face of the packaging web serves
as both the food-contact face and the sealant face, because portions of
the surface of that face are in contact with the food and other portions of
the surface of that face are in the area where seals are made.

The phrase "outside face" refers to the face of a film or packaging
web that is not in contact with the packaged goods and provides the
exterior surface of the package after it is formed.

The perishable goods can be meat, fish, poultry, fresh vegetables,
or combinations of two or more thereof although other types of goods such
as other foodstuffs can be packaged if desired.

The packaging webs can be prepared from films of thermoplastic
compositions with OTR preferably greater than or equal to 10,000
cc/m²/24 hr.

OTR of films are dependent on the thickness of the film and the
inherent permeability of its composition. Permeability is dependent on
such factors as temperature, relative humidity and pressure of the gas
impinging on the film. Typically OTR is calculated using standard
conditions normalized to 23°C, 50% relative humidity and 1 atmosphere.

For good appearance of the package for retail display, it may also
be desirable to use films that are not stretched by the weight of the
packaged goods (i.e. resists creep).
In a first embodiment of this aspect of the invention, the one or more framing elements are interposed between the first flexible web and the second flexible web such that the one or more framing elements are in contact with the inside face of the first flexible web and in contact with the inside face of the second flexible web to surround but not contact the perishable goods; and the first flexible web and the second flexible web are sealed to each other to contain the one or more framing elements and the perishable goods.

In a second embodiment of this aspect of the invention, the one or more framing elements are in contact with the outside face of the first flexible web and optionally in contact with the outside face of the second flexible web to surround but not contact the perishable goods; and the first flexible web and the second flexible web are sealed to each other to contain the perishable goods.

Films suitable for the packaging webs can comprise metallocene polyethylene (mPE) (especially grades with densities less than 0.91 g/cc, and more especially grades with densities less than 0.89 g/cc,), which have high OTR.

The metallocene polyethylene (mPE) employed in the present invention can be any such polyethylene as generally known in the art provided the oxygen permeability is sufficiently high to afford the requisite permeability necessary for the packaging web. More specifically, the metallocene polyethylene should have a density less than 0.91 g/cc, preferably less than 0.89 g/cc, at which densities the normalized OTR, at 23°C and 50% relative humidity will be greater than about 12,400 cc-mil/m²-day-atm, preferably greater than about 20,000 cc-mil/m²-day-atm. These mPEs can optionally be blended with other low crystalline polyolefin or amorphous polyethylenes (such as low density polyethylene, LDPE; linear low density polyethylene, LLDPE; other mPE and the like) provided the blend retains significantly high permeability. The composition may further comprise ethylene copolymers such as ethylene/vinyl acetate copolymers or ethylene/alkyl (meth)acrylate copolymers for improved processing. Also, the composition may further comprise ethylene/acid
copolymers at least partially neutralized with inorganic cations (i.e. ionomers).

For example, a 2-mil thick film of mPE with a density of less than 0.89 g/cc and OTR,<sub>n</sub>) greater than about 20,000 cc-mil/m<sup>2</sup>-day-atm will have an OTR of 10,000 cc-mil/m<sup>2</sup>/24h.

Compositions comprising ethylene copolymers at least partially neutralized with cations (ionomers) and modified with organic acids are also suitable for preparing films having high oxygen permeability. These compositions are described in greater detail in PCT Patent Application Publication WO03/089240. This publication also describes multi-layer films having high oxygen permeability, which can comprise at least one layer of modified ionomer and at least one layer of mPE.

An ethylene copolymer is a polymer that can comprise repeat units derived from about 5 to about 50%, or about 10 to about 19%, or 12 to 15%, by weight (wt %) of a polar monomer such as acrylic acid, alkyl acrylic acid, or alkyl acrylate, or combinations of two or more thereof, based on the total weight of the ethylene copolymer. The alkyl group may contain up to about 20 carbon atoms such as methyl, ethyl, butyl, isobutyl, pentyl, hexyl, and combinations of two or more thereof.

An ethylene copolymer may comprise up to 35 wt % of an optional comonomer such as carbon monoxide, sulfur dioxide, acrylonitrile; maleic anhydride, maleic acid diesters, (meth)acrylic acid, maleic acid, maleic acid monoesters, itaconic acid, fumaric acid, fumaric acid monoester, a salt of these acids, glycidyl acrylate, glycidyl methacrylate, and glycidyl vinyl ether, and combinations of two or more thereof.

The acid moiety of an ethylene copolymer may be neutralized with a cation to produce an ionomer. The neutralization, for example, can range from about 0.1 to about 100, or about 10 to about 90, or about 20 to about 80, or about 20 to about 40 percent, based on the total carboxylic acid content, with a metallic ion. The metallic ions can be monovalent, divalent, trivalent, multivalent, or combinations of two or more thereof.
The ionomer can also be a blend of an ionomer having a greater than 20% neutralization and, for example, an ethylene (meth)acrylic acid copolymer to achieve the desired degree of neutralization.

Examples of ethylene copolymers include, but are not limited to, ethylene/methyl acrylate (EMA), ethylene/ethyl acrylate (EEA), ethyl acrylate (EA), ethylene/butyl acrylate (EBA), ethylene/isobutyl acrylate/methacrylic acid, ethylene/methyl acrylate/maleic anhydride, ethylene/butyl acrylate/glycidyl methacrylate (EBAGMA) and ethylene/butyl acrylate/carbon monoxide (EBACO), and butylacrylate (BA).

Examples of commercially available ethylene copolymers include those available from E. I. du Pont de Nemours and Company (DuPont), Wilmington, Delaware, carrying the trademarks of Surlyn®, Nucrel®, Appeel®, Bynel®, and Elvaloy®, and Elvax®

The making of the film, multi-layer film, and corresponding film structures can be by any such method as practiced in the art. As such, the film and film structures can be typically cast, extruded, co-extruded and the like including orientation (either axially or biaxially) by various methodologies (e.g., blown film, bubble techniques, mechanical stretching or the like, or lamination). Various additives as generally practiced in the art can be present in the respective film layers including the presence of tie layers and the like, provided their presence does not substantially alter the properties of the permeable film or film structure. Such additives can comprise antioxidants and thermal stabilizers, ultraviolet (UV) light stabilizers, pigments and dyes, fillers, anti-slip agents, plasticizers, other processing aids, and the like.

The packages comprise two gas permeable film webs. The two film webs are typically two individual sheets of film. The webs may consist of identical compositions and appearance. Alternatively, one web may be different than the other web. For example, one web may be clear, allowing visualization of the packaged goods and the other may be opaque and/or colored to provide a background. One or both of the webs may also be printed with designs, logos, alphanumeric text and/or the like to provide a pleasing appearance for the package and/or to provide information to the
consumer. One skilled in the art can appreciate that a single web of film may be folded onto itself to provide two overlying webs, or a tube of film may be formed such that two overlying portions of the tube provide the equivalent of two webs of film.

Packages can be prepared from two webs of gas permeable packaging film. After placing the contents of the package between the film webs and applying a vacuum, the package is formed by adhering, preferably by heat sealing, the perimeters of the two webs to each other. The heat sealed perimeter of the package can be achieved by superimposing the first and second webs of polymeric film and then heat sealing each directly to the other or heat sealing them indirectly through the use of an intervening third polymeric film, again as generally known and practiced in the art.

The rigid or semi-rigid framing elements may be prepared from paperboard or thermoplastic compositions, such as polyester.

The framing elements are sized so that they surround the goods to be packaged, but do not contact the goods. For example, but not limitation, the framing elements may define a packaging area from about 10 to about 30 cm in length and from about 10 to about 30 cm in width, in which the goods to be packaged are placed. Although generally described herein in terms of rectangular areas, other shapes may be envisioned.

The framing elements may be shaped, embossed, textured and the like to provide a pleasing appearance for the package. The framing elements may also be printed with designs, logos, alphanumeric text and/or the like to provide a pleasing appearance for the package and/or to provide information to the consumer.

One embodiment of the framing element comprises a generally flat, single piece of paperboard or thermoplastic composition formed so that it provides a shaped perimeter margin with a concentric opening therein. This embodiment can contact the flexible packaging web in a generally coplanar manner, and resembles a mat used in picture framing. The shaped perimeter may be, for example, rectangular. The corners of the perimeter may be square or rounded off. The concentric opening may be
of similar shape of smaller dimensions to provide a margin of equal
dimension around the shape of the framing element. Alternatively, the
opening may be of different shape than the perimeter shape to provide a
margin that has different dimensions depending on the orientation of the
opening relative to the perimeter. Shapes other than rectangular may be
used for the perimeter and/or concentric opening. The thickness of this
embodiment of the framing element may be from about 0.5 mm to about 3
mm. The dimensions of the margin may be from about 1 cm to about 3
cm, or greater, depending on the shapes and sizes envisioned for the
perimeter and the concentric opening.

An alternative embodiment of the framing element comprises one or
more generally flat strips of paperboard or thermoplastic composition
shaped so that they form portions of a shaped perimeter margin. The
strips of this embodiment will contact the flexible packaging web in a
generally coplanar manner. For example, two strips with a space between
them may be used to define two sides of a rectangle (e.g. the sides along
the longer dimension of the rectangle), with the distance of the space
between the strips providing the dimension of the other two sides (e.g. the
sides along the shorter dimension of the rectangle). Alternatively, the
strips may define other portions of the perimeter of the packaging area.
For example, a strip may form a portion of a shaped perimeter comprising
a corner and portions of two adjacent sides. A strip may form a portion of
a shaped perimeter comprising a side, two corners and portions of two
adjacent sides. The strips may also be formed so that they provide
shapes other than rectangular. For example, the strips may be shaped as
arcs, providing curved shapes. The strips may be from about 1 cm to
about 3 cm wide, or greater, depending on the shapes and sizes
envisioned for the packaging area.

An alternative embodiment of the framing element comprises a strip
of paperboard or thermoplastic composition formed so that it defines a
packaging area that is generally coplanar with the packaging web but also
has a significant dimension in a direction perpendicular to the plane of the
packaging web to define a packaging volume.
As disclosed above, the framing elements can be located or placed between the two flexible packaging webs to define a packaging area and are sealed within the package. Packages according to this embodiment can be prepared by (a) placing perishable goods on a first flexible web of gas permeable skin wrapping plastic material in contact with the inside face of the first flexible web; (b) placing one or more rigid or semi-rigid framing elements in contact with the inside face of the first flexible web to surround but not contact the perishable goods; (c) placing a second flexible web of gas permeable skin wrapping plastic material over the perishable goods and the one or more framing elements such that the inside face of the second flexible web is in contact with the perishable goods, the one or more rigid or semi-rigid framing elements and the inside face of the first flexible web; and (d) sealing the first flexible web and the second flexible web to each other to contain the one or more framing elements and the perishable goods.

The steps (a) and (b) can be conducted so that (a) occurs before (b), (b) occurs before (a), or simultaneously.

In a second embodiment of the package of this invention, the framing elements are located or placed in contact with the outside face of one or both of the packaging webs and are on the outside of the package.

An example of this second embodiment comprises a package wherein the framing element comprising a generally flat, single piece of paperboard or thermoplastic composition having a shaped perimeter margin with a concentric opening therein is adhered to the outside face of one of the gas permeable webs. The framing element may be adhered by means including, for example, hot-melt adhesive or heat sealing.

Alternatively, the framing element comprises a generally flat, single piece of paperboard or thermoplastic composition that can be folded around the gas permeable packaging webs to provide a shaped perimeter with an opening. In this example, a portion of the framing element is adhered to the outside face of the first packaging web and a second portion of the framing element is adhered to the outside face of the second packaging web.
Packages according to this embodiment can be prepared by (a) placing perishable goods on a first flexible web of gas permeable skin wrapping plastic material in contact with the inside face of the first flexible web; (b) placing a second flexible web of gas permeable skin wrapping plastic material over the perishable goods such that the inside face of the second flexible web is in contact with the perishable goods, and the inside face of the first flexible web; (c) placing one or more rigid or semi-rigid framing elements in contact with the outside face of the first flexible web and optionally in contact with the outside face of the second flexible web to surround but not contact the perishable goods; and (d) sealing the first flexible web and the second flexible web to each other to contain the perishable goods.

Because the framing element is outside the package, step (c) relating to placing the framing elements may occur prior to step (a), prior to step (b) prior to step (d), or after step (d); or simultaneously with one of steps (a) or (b).
CLAMS

1. A vacuum skin package to contain perishable goods comprising (a) a first flexible web of gas permeable skin wrapping plastic material; (b) one or more rigid or semi-rigid framing elements to surround but not contact the perishable goods; and (c) a second flexible web of gas permeable skin wrapping plastic material; wherein the first flexible web and the second flexible web are sealed to each other to contain the perishable goods.

2. The package of claim 1 wherein the gas permeable plastic materials have an OTR greater than or equal to 10,000 cc/m²/24 hr.

3. The package of claim 2 wherein the gas permeable plastic materials comprise metallocene polyethylene.

4. The package of claim 2 wherein the gas permeable plastic materials comprise ethylene/acid copolymers at least partially neutralized with at least one cation, modified with at least one organic acid, or both.

5. The package of claim 2 wherein the one or more framing elements are interposed between the first flexible web and the second flexible web such that the one or more framing elements are in contact with the inside face of the first flexible web and in contact with the inside face of the second flexible web to surround but not contact the perishable goods; and the first flexible web and the second flexible web are sealed to each other to contain the one or more framing elements and the perishable goods.

6. The package of claim 2 wherein the one or more framing elements are in contact with the outside face of the first flexible web and optionally in contact with the outside face of the second flexible web to surround but not contact the perishable goods; and the first flexible web and the second flexible web are sealed to each other to contain the perishable goods.

7. A method of packaging goods comprising (a) placing perishable goods on a first flexible web of gas permeable skin wrapping plastic material in contact with the inside face of the first flexible web; (b) placing one or more rigid or semi-rigid framing elements in contact with the inside face of the first flexible web to surround but not contact the perishable goods.
goods; (c) placing a second flexible web of gas permeable skin wrapping plastic material over the perishable goods and the one or more framing elements such that the inside face of the second flexible web is in contact with the perishable goods, the one or more rigid or semi-rigid framing elements and the inside face of the first flexible web; and (d) sealing the first flexible web and the second flexible web to each other to contain the one or more framing elements and the perishable goods.

8. A method of packaging goods comprising (a) placing perishable goods on a first flexible web of gas permeable skin wrapping plastic material in contact with the inside face of the first flexible web; (b) placing a second flexible web of gas permeable skin wrapping plastic material over the perishable goods such that the inside face of the second flexible web is in contact with the perishable goods, and the inside face of the first flexible web; (c) placing one or more rigid or semi-rigid framing elements in contact with the outside face of the first flexible web and optionally in contact with the outside face of the second flexible web to surround but not contact the perishable goods; and (d) sealing the first flexible web and the second flexible web to each other to contain the perishable goods.
A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B65D81/20  B65D75/52  B65B25/06  B65B31/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B65D B65B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of box C. Patent family members are listed in annex.

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Date of the actual completion of the international search

13 June 2005

Date of mailing of the international search report

20/06/2005

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