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(54) **PACKAGING TO ENHANCE SHELF LIFE OF FOODS**

VERPACKUNG ZUM VERLÄNGERN DER HALTBARKEIT VON NAHRUNGSMITTELN

EMBALLAGE POUR AUGMENTER LA DUREE DE STOCKAGE D'ALIMENTS

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(73) Proprietors:
• **E.I. DU PONT DE NEMOURS AND COMPANY**
Wilmington,
Delaware 19898 (US)
• **Plásticos Dise S.A.**
Los Boulevares,
Cordoba 5147 (AR)

(72) Inventors:
• **DI TELLA, Carlos Alberto**
Cordoba,
Provincia de Cordoba (AR)

• **SEIDEL, Gerardo Carlos**
Villa Belgrano Cordoba,
Prov. de Cordoba (AR)
• **MARCANTONELLI, Ricardo Hugo**
Cordoba,
Provincia de Cordoba (AR)

(74) Representative: **Morf, Jan Stefan**
Patentanwälte Abitz und Partner
Postfach 86 01 09
81628 München (DE)

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• **Wiley's Encyclopedia of Packaging Technology,**
2nd Ed., (19/97), p. 527-529

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Description**FIELD OF THE INVENTION**

5 **[0001]** This invention relates to packaging of food products, specifically food products containing protein, and more specifically fresh red meat, that enhances the refrigerated shelf life of such foods.

BACKGROUND OF THE INVENTION

10 **[0002]** In the modern distribution and marketing of food products, many different packaging materials are used. One type of food packaging material is plastic film. Many different kinds of plastic film are used, varying both in composition and structure, and depending on the specific application.

15 **[0003]** Polyvinyl chloride (PVC) film is a predominant plastic film used to wrap retail-cut red meat and other products like fresh fish or poultry. PVC is low-cost relative to other plastic films and has many desirable properties such as clarity, oxygen transmission, flexibility, toughness, heat sealability, elastic recovery and processability. Traditionally, PVC films are used in a polystyrene foam tray/overwrap application which has several drawbacks. The packages wrapped in this fashion have both poor seal integrity, i.e., they often leak, and poor abuse resistance, i.e., they often become punctured or tear. The poor seal integrity of PVC overwrap films arises because the PVC is tack welded rather than hermetically sealed. Thus, the liquid purge or juices which exude from the meat products will leak through a tack sealed PVC overwrapped tray and result in a package that is unsightly and messy from a consumer viewpoint, and has limited shelf life. Further, the packages require absorption pads to absorb purge.

20 **[0004]** Furthermore, the shelf life for fresh red meat, wrapped in PVC is at best only a few days. Freshly-cut red meat has a purple-red color which relatively few ultimate consumers would associate with freshness. This color quickly changes to the generally-acceptable bright red color when the fresh meat is oxygenated by exposure to air, which changes myoglobins in the meat to oxymyoglobins. This change is generally referred to as "blooming." Once red meat has "bloomed", however, the refrigerated shelf life of such meat packaged in conventional polystyrene foam trays with PVC overwrap is relatively short, lasting at best about 2-3 days. Thus, better alternatives to PVC are sought.

25 **[0005]** In the search for alternatives to PVC film, various monolayer olefin films, particularly polyethylene (PE) films have been considered, but most are not as commercially acceptable and do not provide better performance. High-density polyethylene (HDPE) is much too inelastic and lacking in heat sealability to be useful as a commercial wrap, while the various low density polyethylenes, e.g. low-density polyethylene (LDPE), linear low-density polyethylene (LLDPE), ultra low-density polyethylene (ULDPE), etc., do not possess sufficient elastic recovery, and the film retains impressions or dents caused by handling of packaged goods by potential purchasers while inspecting the contents, thereby reducing the sale value of the food products. The use of non-toxic plasticizers, such as corn oil, has not proven satisfactory, particularly with respect to temperature stability.

30 **[0006]** Besides freshness, the packages must have integrity and shelf-appeal. The packaging of food articles such as poultry, fresh red meat, and processed meat products requires tough, puncture resistant, yet flexible, film materials. The film materials should be suitable for use in fabricating bags or pouches for packaging such food articles by the shrink-wrap method. Generally, the shrink-wrap method is predicated upon the heat-shrinking property of the bag. Food products are placed in the bag and thereafter exposed to heat, such as a flow of hot air, infra-red radiation, hot water and the like, thereby causing the bag to shrink and come into intimate contact with the contours of the food article. Packages prepared by this method have desirable shelf-appeal, which adds to sale value of the wrapped article. The package contents are kept in a hygienic condition, and shoppers can examine the quality of the food article from all angles.

35 **[0007]** For such shrink-wrap applications, the film material must be stretchable in order to provide a shrinkable film that will heat-shrink within a specified range of percentages, e.g. from about 30 to 60 percent at 90°C in both the machine and transverse directions. Further, the film must be heat sealable in order to be able to fabricate bags from the film, and the heat sealed seams must not pull apart during the heat shrinking operation. In addition, the film must resist puncturing by sharp edges, such as bone edges, during the heat-shrinking operation.

40 **[0008]** Various packaging methods are described in the art. Lustig et al., U.S. Pat. No. 4,963,419 discloses a multi-layer film for use in packaging primal and subprimal meat cuts. The films disclosed in Lustig aim to minimize the transmission of oxygen to prevent spoilage. The multi-layer film comprises a first outer layer containing a heat-sealable thermoplastic polymer; a core layer comprising an oxygen barrier film; and a second outer layer comprising an ethylene polymer having siloxane cross-linking bonds. In another embodiment, the multi-layer film contains a second core layer containing an ethylene vinyl acetate copolymer, located between the barrier core layer and the second outer layer.

45 **[0009]** In the mid-1970's, DuPont introduced their "Bivac®" packaging system for packaging frozen fresh meats. The Bivac® method involved packaging freshly-cut red meat in ionomerfilm, vacuum sealing and immediately flash-freezing the package. This method captured the red color and freshness of the freshly-cut red meat and maintained it in this state when stored at 0°F (-17.8°C) and not exposed to light for six months or more. The ionomer film used in the Bivac® was

mono-layer with essentially no shrinkage. Skin-packaging apparatus and methods covering the Bivac® process are disclosed in U.S. Patents 3,491,504, 3,706,174 and 4,069,643, the latter two aimed at packaging large items such as subprimals of meat.

[0010] A need still exists for improved packaging materials and methods to prolong the refrigerated shelf life of fresh foods, particularly fresh red meat, while maintaining package integrity and shelf-appeal, and overcoming the known drawbacks of conventional PVC packaging methods.

SUMMARY OF THE INVENTION

[0011] The invention herein provides a method for packaging fresh food to enhance the refrigerated shelf life of such food comprising:

- a. enclosing the food within a film structure having one or more layers, wherein one layer is a food contact layer that comprises a polymer selected from the group consisting of ionomers, acid copolymers, and blends or copolymers comprising ionomers and/or acid copolymers;
- b. vacuum sealing the film structure on its perimeter to achieve a sealed pouch encasing the food;
- c. applying minimal heat for a minimal time necessary to shrink the sealed pouch and/or effect a secondary seal, as the case may be, such that the food surface is placed in intimate contact with the food contact layer and any purge is contained; and
- d. maintaining a cold chain throughout steps a through c. and thereafter, save for the minimum time required to heat in step c, wherein the film structure was made by an extrusion blown process employing a blowing ratio (BUR) in the range of about 3 to about 7.

[0012] The invention also provides a package for fresh red meat or poultry to enhance the refrigerated shelf life of such food comprising:

- a. fresh red meat or poultry;
- b. a vacuum-sealed film pouch encasing the raw meat or poultry, said pouch having one or more layers, wherein one layer is a food contact layer that comprises a film comprising a polymer selected from the group consisting of ionomers, acid copolymers, blends or copolymers comprising ionomers and/or acid copolymers and the food contact layer is in intimate contact with the fresh red meat or poultry wherein the film pouch was made by an extrusion blown process employing a blow-up ratio (BUR) in the range of 3 to 7.

BRIEF DESCRIPTION OF THE FIGURE

[0013] FIG. 1 is a graph of off-odor scores for inside round beef steaks (semimembranosus muscle) held under simulated retail display conditions at 2-3°C. The presence and degree of off-odor characteristics is evaluated using the following scale: 1 = no off odor, 2 = slight off odor, 3 = small off odor, 4 = moderate off odor, 5 = extreme off odor.

DETAILED DESCRIPTION

Definitions

[0014] In this disclosure, the word "copolymer" means a polymer polymerized from two or more monomers, and includes terpolymers. The more specific descriptions, e.g. 'ethylene carboxylic acid copolymer', and the like, are meant to include copolymers which may also have a third monomer present. The term "direct copolymer" means a copolymer made by polymerization of monomers together, at the same time, as distinct from a graft copolymer where a monomer is polymerized on an existing polymer chain.

[0015] Ethylene/acid copolymers and their corresponding ionomers are well known in the art to be copolymers of ethylene with an olefinically unsaturated organic mono- or di-acid such as acrylic or methacrylic acid, or maleic acid or fumaric acid or their anhydrides, the acid (or anhydride) comprising 0.5 to 50 mole percent of the total polymeric material. The ethylene/acid copolymers and their methods of preparation are well known in the art and are disclosed in, for example, U.S. Pat. Numbers 3,264,272, 3,404,134, 3,355,319 and 4,321,337. The copolymers are termed ionomers when the acid is neutralized in whole or in part to produce a salt. The cations for said salts are usually metal ions such as sodium, potassium, zinc or the like. Suitable acid copolymer and ionomers are available from the DuPont Company under the trade names Nucrel® and Surlyn®, respectively.

[0016] As disclosed in U.S. Pat. No. 3,264,272 to Rees, an ionomer may be defined as a direct copolymer of alphaolefins having the general formula $RCH=CH_2$ wherein R is a radical selected from the class consisting of hydrogen and alkyl

radicals having from 1 to 8 carbon atoms, the olefin content of said copolymer being at least 50 mole percent based upon said copolymer, and an α , β -ethylenically unsaturated mono-carboxylic acid, the acid monomer content of said copolymer being from 0.6 to 50 weight percent (0.2 to 25 mole percent), preferably 8 to 20 weight percent, and more preferably 10 to 19 weight percent, based upon the copolymer, said copolymer having a melt index (by ASTM 1238, condition e) within the range of 0.1 to 15, said monocarboxylic acid copolymer containing uniformly distributed throughout the copolymer a metal ion having an ionized valence of 1 to 3 inclusive, wherein at least 10 percent of the carboxylic acid groups of said monovalent carboxylic acid copolymer are neutralized by said metal ions and exist in an ionic state.

[0017] The term ionomer is also meant to include terionomers in which a third unsaturated monomer has been copolymerized with ethylene and unsaturated acid. Examples of these monomers are vinyl acetate and (meth)acrylate esters such as methyl acrylate, ethyl acrylate and isobutyl acrylate. For instance, Surlyn® 1855 is a zinc-neutralized terionomer containing 10 wt. % copolymerized isobutyl acrylate. Blends of these terionomers with dipolymer ethylene-unsaturated acid ionomers are also included within the definition, such as blends of Surlyn® 1855 (terionomer) with Surlyn® 1707 (dipolymer ionomer).

[0018] By "blow-up ratio" is meant the ratio of the diameter of a film tube in blown film manufacturing after expansion to the diameter of the film prior to expansion, wherein the expansion is typically effected by air under pressure.

[0019] By "purge" is meant any liquid, juices, blood, etc. that are expelled from meat or poultry over time.

[0020] By "high shrinkage" is meant film shrinkage greater than 30% in each of the machine and transverse direction.

[0021] By "cold chain" is meant maintaining the environmental temperature of the food product and/or resulting package in the range of 0°C to 8°C, preferably 0°C to 6°C, and more preferably 0°C to 4°C.

[0022] By "vacuum sealing" is meant any method of sealing films in an evacuated chamber, typically achieved by a heated sealing bar or wire to seal two layers of film, but also including applying mechanical seals, such as a metal or plastic clip, to effect hermetic closure of the films. The resulting product is packaged and held under vacuum.

[0023] The use of "consisting essentially of" is meant to encompass recited elements and additional unspecified ingredients that would not affect the basic and novel characteristics of the composition defined in the balance of the claim.

Description

[0024] The invention herein provides a method for packaging fresh food to enhance the refrigerated shelf life of such foods. Of particular interest is the packaging of protein-containing foods such as fresh meat and poultry. Present methods of packaging fresh meat in retail stores usually allow a maximum shelf life of 2-3 days.

[0025] The "shelf life" of food products varies and is limited. In a retail environment, food shelf life is that finite time that a product remains of satisfactory sale quality before retail purchase. The shelf life of a food product depends on its chemical nature and the way it has been processed, packaged, distributed and stored. Processed foods (canned, dried, frozen) have limited shelf life in terms of food quality. They may lose some nutritive value and undergo subtle chemical and physical changes on long-term storage even though they may not be spoiled. Fresh foods, being more fragile, spoil primarily by bacterial deterioration (usually evidenced by off-odor) which reduces their quality.

[0026] The shelf life of pre-packaged fresh meats is influenced by microbial growth and environmental temperature. Microorganisms decrease shelf life by causing discoloration due to the oxidation of the meat pigment myoglobin to metmyoglobin. The environmental temperature affects the microbial growth rate, and hence the degradation of the meat itself. A foul-smelling odor may be detected at the first signs of degradation of the meat. The microorganisms primarily responsible for bacterial degradation in packaged meats include: homo and heterofermentative lactobacilli, aeromonas, psychrotrophic enterobacteriaceae, yeasts, molds, listeria, facultative anaerobes, clostridium bacillus, and lactobacillus. The microorganisms most likely to flourish under refrigerated conditions, are primarily the psychrophilics, chiefly of the genus pseudomonas.

[0027] As well, the practical shelf life is affected by consumer preferences, one of which is the preference for the bright red color of meat that has bloomed. Four parameters are known to influence meat color: surface dehydration, temperature, oxygen requirements of the meat and bacterial contamination. Slight dehydration may be considered helpful for desirable fresh meat color, but is deleterious when it occurs to any great extent. Color changes are effected in a number of ways. Sanitation in the packaging operation is of paramount importance in maintaining satisfactory color. A close relationship between the number of *Pseudomonas sp.* present on beef cuts and the rate of discoloration has been observed. The choice of lighting will also affect the meat color. Incandescent light in close proximity can cause rapid discoloration because the heat generated by the lights increase the surface temperature of the meat. Ultraviolet light can cause rapid discoloration, even though it can control microbial growth on the meat surface. See, N.G. Marriott et al., "Color Stability of Prepackaged Fresh Beef as Influenced by Pre-Display Environments", Food Technology, Vol. 21, No. 11, pp. 104-106 (1967).

[0028] The number of *Pseudomonas sp.* are also known to influence the development of foul smelling odors, an indication to the consumer of meat deterioration. Eliminating the growth of the pseudomonas should delay the development of unpleasant odors and hence-extend the shelf life for such meats.

[0029] Applicants have found a method for packaging fresh food, particularly fresh red meat, and a package related thereto, wherein a combination of optimal features can prolong the refrigerated shelf life of the packaged food. The method provides a film structure having one or more layers, wherein one layer is a food contact layer, the food contact layer ensures good contact and adhesion between the packaging film layer and the fresh food (most likely due to both the composition of the food contact layer and high shrinkage of the film structure), the film structure has an optimal rate of oxygen transmission to the fresh food, while heating to shrink and/or seal the packaging film structure is minimized and the packaged food is maintained in a "cold chain" under normal sanitation procedures. The refrigerated shelf life, typically in a retail environment, is prolonged or enhanced because, e.g., in the case of red meat, fresh odor, color and appearance of the meat is retained for a longer time period than is possible with conventional packaging methods. Conventional packaging, e.g. plasticized PVC, generally provides a refrigerated shelf life for red meat of - about 2-3 days. The technology of the invention herein can be expected to extend the refrigerated shelf life for red meat to about 4-6 days, or perhaps even longer.

[0030] While not bound by any particular theory or explanation, Applicants believe that the various features of their invention combine to achieve the result of enhanced refrigerated shelf life for packaged foods. For instance, given that the film structure comprises ionomers or acid copolymers (discussed more below), Applicants believe that there is a corresponding optimum window for the oxygen transmission rate for such films that allows red meat to maintain a red bloom yet also minimizes degradation of the meat under refrigeration.

[0031] The rate of oxygen transmission to the fresh food is achieved by the use of a film structure having one or more layers wherein one layer is a food-contact layer comprising an ionomer or acid copolymer film, provided the other layers in a multi-layer film have the same or higher oxygen transmission. The ionomer or acid copolymer film, and thereby the film structure, preferably has an oxygen transmission rate ranging from 1500 to 9000 cc/m²-day-atm, more preferably 2000 to 6000, and most preferably 2500 to 5500 cc/m²-day-atm for a 40-55 micron thick film tested at 23°C and 50% relative humidity per ASTM D-3985. Examples of such films are films made from DuPont Surlyn® ionomer resin, particularly Surlyn® 1707 ionomer resin, and DuPont Nucrel® acid copolymer resin, both commercially available from DuPont, Wilmington, DE. A monolayer film made from a blend of Surlyn® 1707 and terionomer Surlyn®. 1855 is also suitable. Typically the ionomer or acid copolymer film ranges from 40-70 microns in thickness.

[0032] Further, the use of ionomer or acid copolymer film is advantageous for packaging protein-containing food products since these films adhere well to the food, and can thereby help to minimize purge and extend shelf life. So long as the heating used to seal and/or shrink the film in packaging the food is minimized (both in duration and temperature), the method of packaging fresh food, particularly fresh red meat claimed herein can extend the refrigerated shelf life of such meats. This is especially useful for packaging meats for retail sale, though this method would be equally useful for packaging subprimal and primal meat cuts, which are often then enclosed in oxygen-impermeable "mother bags", for transport from slaughter houses to retail markets. Similarly, the invention herein may also be used to package retail cuts of meat that may then be enclosed in oxygen-impermeable "mother bags", preferably flushed with CO₂ or other inert gas. This would facilitate meat preparation at regional locations and subsequent transport to retail markets. In this way, the packaged retail cuts of meat prepared at the regional locations can be considered "case ready".

[0033] The film structure is preferably a monolayer film, though multilayer films are contemplated. Additional layers of films comprising polyethylenes, ethylene vinyl acetate, and/or polyethylenes made with metallocene catalysts may be used, often to impart bulk or mechanical integrity. If a coextrusion is employed, the innermost layer contacting the food ("food contact layer") should be made of acid copolymer or ionomer, and the oxygen transmission rate of the other layers must be the same or more than that of the food contact layer, such that the oxygen transmission rate ("OTR") of the total film must be in the range specified above. The food contact layer is preferably an acid copolymer film or ionomer film, more preferably an ionomer film, and most preferably a high-shrinkable ionomer film. The ionomer resin used in the preferred films preferably has a melt index ranging from 0.7 to 3.0 dg/min (by ASTM 1238, condition e) and density ranging from 0.94 to 0.96 g/cc.

[0034] In addition to acid copolymers or ionomers, the food contact layer may optionally comprise additional polymers or additives (e.g., color concentrates, UV stabilizers, anti-stat agents or other processing aids) so long as they do not affect the basic and novel characteristics of the food contact layer as explained herein. For example, it is anticipated that polyolefins or olefin copolymers containing a copolymerized unsaturated ester or higher olefin comonomer could be blended with the acid copolymers or ionomers, so long as the key characteristics of the acid copolymer or ionomers were not affected. It is expected that up to 30% by weight of polyolefin, based on the total weight of the food contact layer, could be added without adverse consequences.

[0035] The films may be fabricated using blown film technology, typically covering blow-up ratios (BURs) from 3: 1 to 4:1, as well as technology using high BURs, e.g., greater than 4:1, and biaxial-orientation techniques, wherein the higher BUR's are preferred. These are well-known in the art, including the "double bubble process" described in U.S. Pat. No. 3,456,044 (Pahlke), incorporated by reference herein, among others, though such methods have not ordinarily been applied to ionomer or acid copolymer films. Biaxially-oriented films may also be made by a tenter-frame technique, such as that used for oriented polypropylene.

[0036] In the method of the invention, the fresh food product is enclosed within the film structure, the film structure being multilayer or preferably monolayer. Typically this is accomplished by using two rolls of film structure which are draped around the food and sealed along the longitudinal ends to form a tube, and subsequently cut between food items to separate them, or by using bags or pouches of the film structure having an opening to introduce the food product, among other methods. Certainly, the same could also be accomplished by methods employing a single roll of film which is folded to form a tube surrounding the food items, sealed along the longitudinal end, and subsequently cut between food items.

[0037] Once the food is placed in the bag or pouch or between two rolls of film structure, the film structure is vacuum sealed on the perimeter to achieve a sealed pouch encasing the food. This is typically accomplished by sealing with a heated bar or wire in a vacuum chamber. Alternatively, a metal or plastic clip can be used to effect the hermetic closure of a pouch or tube. The vacuum is thereby applied during sealing, and after removing the sealed pouch from the vacuum chamber, atmospheric pressure causes the sealed pouch to collapse around the food and remains in intimate contact with the food.

[0038] In the case of shrinkable films, heat is applied after the vacuum-sealing to shrink the sealed pouch, e.g., by passing the sealed pouch through a hot air tunnel. This ensures intimate contact between the food product and the sealed pouch, in addition to that provided from the vacuum sealing. The shrinkable film preferably has a shrinkage of at least 25% in each of the machine and transverse directions, and more preferably has a shrinkage ranging from 30% to 70% in each of the machine and transverse directions.

[0039] In the case of non-shrinkable films, or films having a shrinkage of less than 15-25% in each direction, a secondary seal is effected by application of heat to the sealed pouch, which causes the two layers of the bag or pouch that are not in contact with the fresh food product to seal, i.e. a "secondary seal" In addition to the seal on the perimeter. Such methods are well-known and are disclosed in e.g., U.S. Pat. No. 3,491,504 to Young et al., which describes a method and apparatus for vacuum skin packaging.

[0040] Typically the heat application will be conducted by using a heated tunnel or bath, though any suitable method of heating is contemplated, e.g., infra-red heating. In either case of heat application for the final sealing, the amount of heat is minimal and is applied for a minimal amount of time. The heat is applied only for a time sufficient to shrink shrinkable film or to effect a secondary seal for non-shrinkable film. Immediately following, the package is returned to the cold chain. The time for heating is minimized to minimize the heat experienced by the food and any potential bacteria growth. As known to the skilled artisan, the required temperature and time will depend on many factors, e.g., the thickness and composition of the film structure itself, the types of heating apparatus used, as well as the meat cut selected.

[0041] Whether the film structure comprises high-shrinkage film or not, the resulting package has high integrity and effectively contains the purge (i.e. juices that exude from meat over time) within the meat. This is also believed to help maintain the freshness and maximize the refrigerated shelf life of the meat. Further, in the case of the preferred ionomer or acid copolymer film layers, it is well-known that ionomer films adhere well to food products containing proteins. The intimate contact between the meat surface and the film, plus superior adherence due to the shrinking force or the secondary sealing, also serve to contain purge and further enhance the refrigerated shelf life. To optimize the adherence, the cations used in the ionomer film are preferably sodium or zinc, or mixtures thereof.

[0042] The present invention also provides a package for fresh red meat or poultry. The foregoing description and various embodiments apply equally well to such claimed package. The package comprises the meat or poultry encased in a sealed film pouch having one or more layers. One layer is a food contact layer comprising an acid copolymer or ionomer film, preferably ionomer film, wherein the film pouch has an oxygen transmission rate of 1500 to 9000 cc/m²-day atm (preferably 2000-6000 cc/m²-day-atm) for a 40-55 micron thick film tested at 23°C and 50% relative humidity per ASTM D-3985, and preferably high shrinkage. The film pouch is made by an extrusion blown process employing a blow-up ratio (BUR) in the range of 3 to 7. The food pouch preferably comprises a biaxially-oriented heat-shrinkable film. The shrinkage is preferably in the range of 25% to 70% in each of the machine and transverse directions.

EXAMPLES

Examples 1-3 and Comparative Examples A-C

[0043] A six day test was run to compare the freshness of meats wrapped per the invention herein to meats wrapped by conventional means. The cuts of red meat used were the following: ground beef, rib eye (Delmonico cut) and round steak. Samples were taken from the same animal for each comparison. For each cut of meat, one sample was wrapped in a film bag made from highly shrinkable 55 micron thick film made from DuPont Surlyn® 1707 ionomer resin (Examples 1-3) and one sample was wrapped in a standard, commercially available plasticized PVC film (Resinite), wherein the meat lays in a polystyrene tray with an absorption pad (Examples A-C). Surlyn® is a registered trademark of DuPont. Surlyn® ionomer resin is available from DuPont, Wilmington, DE.

[0044] The meat was cut in a refrigerated area. Vacuum sealing and thermal shrinking of the packages was conducted

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outside of the refrigerated area, though the time was kept to a minimum, i.e., no more than a few minutes. The shrinkage time and temperature was selected to minimize thermal damage to the meat samples.

[0045] The samples were then kept at 4°C for the length of the test inside a lighted, refrigerated area within a commercial supermarket. Special lighting that reduces light-induced damage to meat was used. The refrigerated chambers got two de-icing cycles per day in which warm air at 15°C was released for 10 minutes.

[0046] Four supermarket meat managers judged the relative color and odor of all samples every day starting one day after the test started through the fifth day after the test started. The color was rated as either equivalent (=) or ranked 1 and 2, with 1 being the better of the two samples. Odor was rated as simply yes (Y) when a foul odor was detected and no (N) when no foul odor was detected. The testers also judged whether the meat could be: (1) sold as-is; (2) must be downgraded to a "bonus buy" for quick sale; (3) must be remixed and ground for quick sale; or (4) could no longer be sold. These results are listed in the "Sale Call" rows. The judgments of the four testers are compiled in the results shown in Table I.

TABLE I

	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
	CO	CO	CO	CO	CO
Ex. 1 <i>Ground beef</i>	= N	= N	1 N	1 N	1 N
Ex. A <i>Ground beef</i>	= N	= N	2 Y	2 Y	2 Y
SALE CALL	both (1)	both (1)	Both (2)	2-(3); A -(4)	2-(3); A -(4)
Ex.2 <i>Rib eye</i>	= N	= N	1 N	1 N	1 N
Ex.B <i>Rib eye</i>	= N	= N	2 Y	2 Y	2 Y
SALE CALL	both (1)	both (1)	3 -(1); B-(2)	3-(1); B-(2)	3-(1); B -(2)
Ex.3 <i>Top round</i>	= N	= N	1 N	1 N	1 N
Ex. C <i>Top round</i>	= N	= N	2 Y	2 Y	2 Y
SALE CALL	both(1)	both(1)	Both (1)	4-(1);C-(2)	4-(1);C-(4)
C = Color O = Odor					

[0047] The results in Table I show that through Day 2 (48 hours), the meat samples in either package were essentially equivalent in color and lacked any noticeable foul odor. By Day 3 (72 hours) the results changed. All of the comparative examples (A-C), in which the meat was wrapped in conventional PVC, emitted noticeable foul odors on Day 3 and through the remainder of the test, evidence of degradation of the meat. None of Examples 1-3 emitted any detectable foul odor through Day 5 (120 hours). Further, Examples 1-3 also ranked higher in color (i.e. retained the bright red color of freshly-cut meat) than the comparative examples. These factors show that the packaging per the invention herein helps to extend the refrigerated shelf life, and hence saleability, of the freshly-cut meat.

[0048] Applicants note that these refrigerated chamber tests for shelf life are less severe than if the packaged meat had been placed on actual retail display shelves. Retail shelf storage allows the meat packages to be exposed to slightly higher temperatures, particularly on their top surfaces. Such higher temperature exposure, even if only by a few degrees, is detrimental to freshness retention and even more dramatic differences in odor and color would be expected between the PVC wrapped packages and those of the invention.

Example 4 and Comparative Example D

[0049] Comparison of shrinkable crosslinked EVA bags (50 microns thick; commercially available from Cryovac and other converters), Comparative Example D, and highly shrinkable monolayer bags made from DuPont Surlyn® 1707 ionomer resin (55 micron thick), Example 4.

[0050] Meat cut selected: top round. Testing was done in triplicate samples and run for a total of six days. Meat samples were maintained in refrigerated shelves for a period of 6 days. The temperature of the meat in these shelves was controlled at 4-5°C. Cold chain was well maintained during the whole process, from the cutting of the meat slices to the storage. Special lighting (low UV) used.

[0051] The two types of packages were compared in terms of color and general appearance of the meat, as well as odor, after opening the package, by each judge. After 36 hours, the EVA package showed a significant presence of

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liquid purge (blood) and a much more loose (less shrinking force left) appearance than the Surlyn® ionomer package. The meat color was similar in both sets and considered acceptable by two supermarket meat managers. All the EVA packages showed a very poor film to meat adhesion, in contrast with the excellent adhesion observed in the Surlyn® ionomer bags.

[0052] After 3 days, the amount of purge in the EVA packages increased substantially. Both packages were similar in outside meat color, but the inner color of the meat packaged in EVA was darker. Excess high shrinking force of the crosslinked EVA, and lack of adhesion to the meat, tended to accentuate the amount of purge produced. The slight natural contraction of the meat and the poor adhesion of the EVA to the meat made the presence of purge more visible.

[0053] Both packages showed slightly darker red color on the fourth day but when the meat slices were cut, the ones packaged in Surlyn® were bright red in the interior while those from EVA packages were dark red. Differences in odor were noticed on day 4, with the meat in the Surlyn® ionomer bags smelling like fresh meat and the others showing an acid odor.

[0054] Finally on day 6 all the samples packaged in EVA bags were discarded by the meat managers due to unacceptable color and odor. The Surlyn® set although slightly dark on the outside, showed still natural red color on the inside of the cut and smelled like fresh meat. The judges for these tests were three meat managers from a supermarket and two marketing people from converter.

Examples 5-7 and Comparative Examples E-G

[0055] Test to compare bags made with 50-55 micron thick films of EVA (Elvax® 3120-7.5% VA, Comp. Ex. E; Elvax® 560-18% VA, Comp. Ex. F); Acid Copolymers (Nucel® 3990, Ex. 5), metallocene (Affinity® 1881, Comp. Ex. G), and Ionomer (Surlyn® 1707, Example 7; Surlyn® 1707/Surlyn® 1855 blends, Example 6) resins.

[0056] Meat cuts selected: Sirloin steaks, ground beef, eye of round and rump.

[0057] Meat packaged in plastic bags made from monolayer blown films (all at blown up ratios of 7:1). Meat slices were placed inside the bags and vacuum-sealed on an Audionvac vacuum packaging machine (made by Audion Elektro, Holland). Thermal shrinkage done in a hot air tunnel at temperatures in the 165-175°C range with residence times inside the tunnel of 6-8 seconds.

[0058] The meat packages were stored in a refrigerated area at 5+/-1 °C with special low UV lighting. Package evaluation was done after 5 and 8 days in storage. A veterinarian, several meat managers from a supermarket and three marketing people from the converter participated in the evaluation of the packages. Rating was done on color, odor, texture and general appearance of the meat. The ranking criteria was selected along the following guidelines:

- COLOR: 1 — As good as when packaged.
 2 — Slight discoloration
 3 — Larger color change but still acceptable for sales
 4 — Unacceptable for sale (dark faded red)
 5 — Significant color change (dark greenish red)

- ODOR: 1 — Good as fresh, just packaged meat
 2 — Very slight smell but still good
 3 — Slight acid smell
 4 — Stronger acid smell
 5 — Very strong, noticeable smell

Results:

Day 5:

[0059] All packages were evaluated on color. All Surlyn® packages presented the best color characteristics. The packages of the rump cut appeared to be the most sensitive and color degradation for all sets of bags was more pronounced. The two EVA sets and the metallocene resin set were judged questionable for sales. The sirloin packages in Surlyn® had an almost original color without any liquid purge visible in the packages.

[0060] Packages containing ground beef were also opened and judged on meat consistency, color and odor. The meat in the two DuPont Surlyn® sets was considered equivalent to fresh ground meat. The other packages showed significant darkening of the meat inside the package.

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[0061] Only the Surlyn® packages maintained good meat adhesion and high shrinking force during this period, despite the contraction of the meat.

Day 8:

[0062]

A) Sirloin

Sample - Resin	Odor - Ranking	Color - Ranking
E	3	4
F	3.5	3.5
5	4	4.5
G	5	5
6	2	2
7	1	2

B) Ground Beef

Sample-Resin	Odor - Ranking	Color - Ranking
E	4.5	4
F	5	3
5	3	2.5
G	3	5
6	2	2
7	2	2

C) Eye of round

Sample - Resin	Odor - Ranking	Color - Ranking
E	3	3.5
F	3	3
5	2	3.5
G	4	5
6	1	2
7	1	1

D) Rump

Sample - Resin	Odor - Ranking	Color - Ranking
E	5	5
F	5	3.5
5	2.5	3
G	4.5	5
6	2	3

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Table continued

Sample - Resin	Odor - Ranking	Color - Ranking
7	1	3

The Oxygen Transmission Rates (23°C, 50% relative humidity) for these 50 micron films were measured as:

7.5% EVA, 6500 cc/m²/day
 18% EVA, 8200 cc/m²/day
 Metallocene polyethylene (0.902 g/cc density), 6500 cc/m²/day
 Acid copolymer resin (7% AA), 2500 cc/m²/day
 Surlyn® 1707, 2800-3000 cc/m²/day
 (no available data for the Surlyn® blend).

Examples 8-10 and Comparative Examples H-I

[0063] Oxygen transmission rates (OTR) were measured for various ionomer films. A film of 19% ethylene vinyl acetate (EVA) was also tested as Comparative Example H. PVC film obtained from a commercial supermarket, used to wrap meats for retail sale, was also tested as Comparative Example I. The conditions were 23 degrees Celsius and 50% relative humidity. The films were 50-55 microns thick, except the PVC film which was 12 microns. Ranges are reported for each and the results are as follows:

TABLE II

Example/FILM	OTR (cc/m ² -day-atm)
8. Surlyn® 1707 ionomer film (BUR=3)	2400-2600
9. Surlyn® 1707 ionomer film bag (BUR=7)	3500-6000
10. Example 8 after shrinking	2800-5500
H. 19% EVA blown film	8100-8500
1. Commercial PVC meat wrap	21000-24000

Examples 11-12 and Comparative Examples J-K

[0064] Sensory characteristics (odor, smell) and microbial counts were compared for ground beef and sliced top round each wrapped in standard, commercial PVC wrap and vacuum, shrink-wrapped film made from Du Pont Surlyn® ionomer resin.

[0065] A total of 56 meat samples were assayed over 7 days. This included 14 ground beef samples wrapped in PVC film, 14 ground beef samples wrapped in Surlyn® ionomer film, 14 top round samples wrapped in PVC film, and 14 top round samples wrapped in Surlyn® ionomer film. The packaged meat was stored under standard refrigeration conditions (approximately 2°C) at a local supermarket. Daily, two duplicate packages of each food and wrap were retrieved from the supermarket and transported back to the lab under refrigerated conditions for immediate testing.

[0066] Organoleptic characteristics were noted. Approximately 10 grams (-/+ 2g) samples were aseptically removed then diluted 1:10(w/w) in buffered peptone water, stomached for two minutes. The mixtures were serially diluted in peptone water and plated onto BHI [Brain Heart Infusion] agar (total mesophile) and VRBA [Violet Red Bile Agar] petrifilm (E.coli and coliforms). BHI plates were incubated for 24 hours at 35°C. VRBA plates were incubated for 24 hours at 42°C. Plate counts were calculated per gram of meat. On day 4 and day 7, a second replicate of the BHI dilutions (psychrophilic counts) were plated, then incubated for 8 days at 4°C.

[0067] Ground beef packaged in both PVC and Surlyn® ionomer film yielded similar mesophilic microbial profiles over the course of seven days. Top round results were similar through the first five days; day six and seven results were variable.

Package type	Day	Ground Beef Results mesophilic			psychrophilic
		Total cfu/g	coliform cfu/g	Ecoli cfu/g	Total cfu/g
PVC Comp. Ex. J	1	1.30E+05	45	45	

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Table continued

Package type	Day	Ground Beef Results mesophilic			psychrophilic
		Total cfu/g	coliform cfu/g	Ecoli cfu/g	Total cfu/g
Surlyn® Ex. 11	2	1.90E+05	35	35	1.30E+05
	3	4.00 E+05	45	45	
	4	5.60E+05	45	45	
	5	8.90E+05	45	55	1.30E+06
	6	2.60E+06	25	25	
	7	1.40E+06	25	25	
	1	1.10E+05	20	20	3.50E+04
PVC Comp. Ex. K	2	2.00 E+05	45	45	
	3	5.10 E+05	35	35	
	4	4.10E+05	25	25	
	5	8.30 E+05	30	30	
	6	1.10 E+06	35	35	
	7	1.10E+06	25	30	
	1	2.30E+04	0	0	2.40E+04
Surlyn® Ex. 12	2	6.70E+04	0	0	
	3	4.90E+04	0	0	
	4	4.00 E+04	0	0	
	5	9.30E+04	0	0	
	6	1.40 E+04	0	0	
	7	1.10E+05	0	0	
	1	1.80 E+04	0	0	1.30E+05
	2	4.30 E+04	0	0	
	3	6.20 E+03	5	5	
	4	3.00E+04	5	5	
	5	2.40 E+04	0	0	
	6	1.10E+05	0	0	
	7	1.70E+04	0	0	

[0068] A key difference can be seen in the psychrophilic counts. They were at least an order of magnitude lower for meats packaged in Surlyn® ionomer film v. PVC. Standard refrigeration conditions favor the growth of these microorganisms over the others tested, and thus the psychrophilic counts more closely reflect the difference in the two packaging methods. Also, it is the psychrophilics, specifically the pseudomonas, that are related to the development of a foul odor, which helps explain the odor differences noticed in these examples and the previous examples.

Example 13 and Comparative Examples L-N

[0069] Sensory characteristics (odor, smell) were compared for 1-inch (2.54 cm) thick inside round beef steaks (NAMP #168; Semimembranosus muscle) packaged in 1) a Surlyn® bag produced in Argentina (Example 13), 2) a foam tray with PVC overwrap produced in Argentina (Example L), 3) a foam tray with PVC overwrap produced in the United States (Example M), and 4) a PVC wrap made in Argentina with no foam tray (Example N). A total of three replications of the experiment were performed.

[0070] For steaks packaged in the Surlyn® bags, steaks were placed inside the bags and sealed using a vacuum packager to achieve approximately 87% vacuum. Following vacuum packaging, Surlyn® bags were passed one time through a hot air tunnel to shrink the film around the product (Shanklin Model T-6XL Shrink Tunnel operating at a temperature setting of 250°F (121.1°C) and a conveyor speed of 25%). For steaks packaged in PVC overwrap (both Argentine and U.S.), steaks were placed on 2S trays with Dri Loc® 50 pads and overwrapped with PVC. For steaks packaged in an Argentine PVC wrap with no tray, steaks were placed on a single layer of PVC (no Dri Loc® pad used) and wrapped in a similar manner as those with trays.

[0071] The packaged steaks were held under simulated retail display at 2-3°C for a total of 8 display days (Day 0 through Day 7). Samples were placed in a retail refrigerated open-top display case (8-ft (2.44-m) length, Unit Model

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DMF8, Tyler Refrigeration Corporation, Niles, MI), which automatically defrosted fourtimes per day at 6 hour intervals. Lighting parameters used during display included 1614 lux (150 ± 5 foot candles; Model 201, General Electric, Cleveland, OH) light intensity (Philips, 40W Deluxe Warm White). The actual display case temperatures were monitored continuously using temperature loggers.

[0072] On each day of display (Day 0 through Day 7), the presence and degree of off-odor characteristics was evaluated by a three member experienced panel using the following scale: 1 = no off odor, 2 = slight off odor, 3 = small off odor, 4 = moderate off odor, 5 = extreme off odor.

[0073] As shown in Figure 1, steaks packaged in the Surlyn® film demonstrated significantly lower (better) off-odor scores than did steaks packaged in PVC films, Comparative Examples L-N ($p \leq 0.05$). For the Surlyn®-packaged steaks, off-odor scores at Day 7 were statistically equivalent to those observed at Day 1 of display. However, for all of the comparative examples, by Day 3 to 5 of display, off-odor scores were significantly higher (worse) than those observed at Day 1. These lower off-odor scores indicate that the Surlyn®-packaged steaks had a more desirable odor than did the PVC-packaged steaks. Steaks packaged in the manner set forth in Comparative Examples L-N demonstrated plastic, styrofoam, and other odors associated with packaging material, thereby decreasing the beefy odor.

Examples 14 and 15 and Comparative Example O

[0074] *Pseudomonas sp* is an important agent of deterioration in fresh red meat because the bacteria is responsible for undesirable odors and flavors associated with spoilage. Consequently, inhibiting the growth of *Pseudomonas sp* should reduce the development of a foul odor and extend the shelf life for such meats. Sensory characteristics (odor, smell) and microbial counts were compared for beef steaks (250-300 grams cut from fresh inside round primal) packaged and stored in a cooling cabinet set at 4°C under fluorescent lighting (intensity 500 Lux) for a total of 10 storage days (Day 0 through Day 9) The steaks were packaged in one of three packaging treatments 1) Surlyn® bags (film thickness 55 microns) heat sealed and then shrunk in a hot air tunnel for 20 sec at 150°C, fan setting #4 (Example 14) or in a hot waterbath for 1 sec at 80 °C (Example 15), and PVC overwrap with a thickness of 12-14 microns (Example O).

[0075] On days 0, 2, 4, 7 and 9 of storage, steaks were analyzed in duplicate at regular time intervals for pseudomonas populations. A three member panel evaluated changes in odor daily. Each sample was cut into 4 x 5 cm² pieces from the surface of the steak. This 20 cm² surface sample was diluted 1:10 with physiological saline and handled in a stomacher for 1 minute. The microbial profile (TABLE III) showed that the growth of *Pseudomonas sp* is significantly inhibited in the Surlyn® bags compared to the steaks packaged in PVC over-wrap. The three member panel reported that steaks packaged in Surlyn® film demonstrated more favorable fresh meat odor retention after two days in storage.

TABLE III

<i>Pseudomonas sp</i> (cfu/cm ²)*			
Sampling Time Day	PVC overwrap	Surlyn® bag hot water	Surlyn® bag hot air
0	1.1x10 ⁴	8.8x10 ³	1.1x10 ⁴
2	1.3x10 ⁵	8.2x10 ⁴	5.1x10 ⁴
4	1.7x10 ⁷	1.3x10 ⁵	6.1x10 ⁵
7	1.1x10 ⁸	2.0x10 ⁶	8.5x10 ⁵
9	n.d.**	8.8x10 ⁵	5.5x10 ⁵
*pH = 5.4, determined on Pseudomonas agar base with CFC supplement (PAB. Oxoid CM559 and SR103, 2 days at 25°C)			
***not determined" because the meat was unfit for sale			

Example 16

[0076] Coextruded films with Surlyn® 1707 (MI 0.9) as the "food contact layer" (20% thickness), Elvax® 3135X (MI 0.35; 12% VA, EVA resin) in the middle (60% thickness), and Affinity® (metallocene ethylene copolymer produced by DOW, (MI1.0) as the outside layer (20% thickness) were tested for gloss and mechanical properties. The total film thickness of the coextruded films was 55 microns.

[0077] Samples of fresh meat (bottom round) placed in bags made with this coextruded structure heat sealed and hot air shrunk (150°C, 12 sec) were stored at 4°C under proper lighting and compared with cuts from the same meat packaged in PVC overwrap with foam trays and absorption pads. Results showed lower purge production, longer color retention,

and same fresh meat odor retention differences reported with monolayer Surlyn® 1707 bags.

[0078] Several combinations of multi-layer films were tested these included the following:

"food contact layer"/middle layer/outside layer

- 5 Suriyn®/Nucrel®/Metallocene
- Surlyn®/EVA/Metallocene
- Surlyn®/Nucrel®/SBS
- Surlyn®/Nucrel®/PP
- Surlyn®/EVA/EVA
- 10 Surlyn®/EVA/Nucrel®
- Surlyn®/Nucrel®/LDPE
- Surlyn®/Metallocene/Metallocene
- Suriyn®/Metallocene/EVA.

15 Resin blends, i.e., LDPE +Metallocene and LDPE+EVA were also used for a particular layer. The structures worked favorably if the OTR was maintained in the range of 1200 to 6000 cc/m²-day-atm for an overall film thickness of 75 to 150 microns. These structures were designed for packaging of fresh meat and poultry, both with and without bones. They can be made via blown film or cast film extrusion manufacturing. The blown film can employ a blow-up ratio (BUR) in the range of 1 to 7, resulting in both shrinkable and non-shrinkable films.

20 **[0079]** It was determined that the layer thickness distribution required the Surlyn® layer to be 20-50% of the total thickness with the other two layers divided to provide a good balance of desired properties, i.e., mechanical, optical, and OTR.

25 **Claims**

1. A method for packaging fresh food to enhance the refrigerated shelf life of such food comprising:

- 30 a. enclosing the food within a film structure having one or more layers, wherein one layer is a food contact layer that comprises a polymer selected from the group consisting of ionomers, acid copolymers, and blends or copolymers comprising ionomers and/or acid copolymers;
- b. vacuum sealing the film structure on its perimeter to achieve a sealed pouch encasing the food;
- c. applying minimal heat for a minimal time necessary to shrink the sealed pouch and/or effect a secondary seal, as the case may be, such that the food surface is placed in intimate contact with the food contact layer
- 35 and any purge is contained; and
- d. maintaining a cold chain throughout steps a. through c. and thereafter, save for the minimum time required to heat in step c,

40 wherein the film structure was made by an extrusion blown process employing a blow-up ratio (BUR) in the range of about 3 to about 7.

2. The method of claim 1 wherein the sealed pouch is enclosed in an oxygen-impermeable "mother bag".

3. The method of any of claims 1-2 wherein the food contact layer comprises an ionomer.

45 4. The method of any of claims 1-3 wherein the food is fresh red meat or poultry.

5. The method of any of claims 1-4 wherein the film structure comprises a biaxially-stretched, heat-shrinkable film.

50 6. The method of claim 5 wherein the film structure has a shrinkage value of from 25% to 70% in each of the machine and transverse directions.

7. The method of claim 3 wherein the ionomer is a terionomer or a blend of a terionomer with dipolymer ionomer

55 8. The method of claim 3 wherein the film structure is monolayer and was made by an extrusion blown process employing a blow-up ratio (BUR) in the range of 3 to 7, the film structure comprises a biaxially-stretched, heat-shrinkable film having a shrinkage value of at least 30% in each of the machine and transverse directions, has an oxygen transmission rate ranging from 2000 to 6000 cc/m²-day-atm for a 40-55 micron film tested at 23°C and 50% relative

humidity per ASTM D-3985, and the food is fresh red meat.

9. A package for fresh red meat or poultry to enhance the refrigerated shelf life of such food comprising:

- (a) fresh red meat or poultry;
- (b) a vacuum-sealed film pouch encasing the raw meat or poultry, said pouch having one or more layers, wherein one layer is a food contact layer that comprises a film comprising a polymer selected from the group consisting of ionomers, acid copolymers, blends or copolymers comprising ionomers and/or acid copolymers and the food contact layer is in intimate contact with the fresh red meat or poultry,

wherein the film pouch was made by an extrusion blown process employing a blow-up ratio (BUR) in the range of 3 to 7.

10. The package of any of claims 9 wherein the film pouch comprises a biaxially-stretched heat-shrinkable film.

11. The package of any of claims 9-10 wherein the food contact layer comprises an ionomer.

12. The package of any of claims 9-11 wherein the film pouch is a monolayer film.

13. The package of claim 9 wherein the film pouch is monolayer and was made by an extrusion blown process employing a blow-up ratio (BUR) in the range of 3 to 7, the film pouch comprises a biaxially-stretched, heat-shrinkable film having a shrinkage value of at least 30% in each of the machine and transverse directions, has an oxygen transmission rate ranging from 2000 to 5000 cc/m²-day-atm for a 50 micron film tested at 23°C and 50% relative humidity, and the food product is fresh red meat.

14. A method to increase the shelf life of fresh food comprising the steps of:

- a. enclosing the food within a film structure having one or more layers, wherein one layer is a food contact layer, further wherein the food contact layer consists essentially of a polymer selected from the group consisting of ionomers, acid copolymers, and blends or copolymers comprising ionomers and/or acid copolymers;
- b. vacuum sealing the film structure on its perimeter to achieve a sealed pouch encasing the food;
- c. applying minimal heat for a minimal time necessary to shrink the sealed pouch and/or effect a secondary seal, as the case may be, such that the food surface is placed in intimate contact with the food contact layer and any purge is contained; and
- d. maintaining a cold chain throughout steps a. through c. and

thereafter, save for the minimum time required to heat in step c; wherein the film structure was made by an extrusion blown process employing a blow-up ratio (BUR) in the range of 3 to 7 and has an oxygen transmission rate (OTR), either before or after step c, ranging from 1500 to 9000 cc/m²-day-atm for a 40-55 micron film tested at 23°C and 50% relative humidity per ASTM D-3985.

Patentansprüche

1. Verfahren zum Verpacken von frischem Nahrungsmittel unter Erhöhen der Kühlhaltbarkeit von derartigem Nahrungsmittel, umfassend:

- a. Einschließen des Nahrungsmittels in einer Folienstruktur mit einer oder mehreren Schichten, wobei eine Schicht eine Nahrungsmittelkontaktschicht ist, die umfaßt ein Polymer, ausgewählt aus der Gruppe, bestehend aus Ionomeren, Säurecopolymeren und Mischungen oder Copolymeren, umfassend Ionomere und/oder Säurecopolymeren,
- b. Vakuumverschließen der Folienstruktur auf ihrer äußeren Umgrenzung unter Erzielen eines versiegelten Beutels, der das Nahrungsmittel umhüllt,
- c. Anwenden von minimaler Hitze für eine minimale Zeit, notwendig, den versiegelten Beutel zu schrumpfen und/oder eine sekundäre Versiegelung zu bewirken, wie es der Fall sein kann, so daß die Nahrungsmitteloberfläche in innigen Kontakt mit der Nahrungsmittelkontaktschicht gebracht wird und eine Spülung enthalten ist, und
- d. Beibehalten einer Kühlkette über Stufen a. bis c. und danach, mit Ausnahme der minimalen Zeit, die in Stufe c. zum Erhitzen benötigt wird;

wobei die Folienstruktur durch ein Extrusionsblasverfahren unter Verwenden eines Aufblasverhältnisses (BUR) in dem Bereich von etwa 3 bis etwa 7 hergestellt wurde.

2. Verfahren nach Anspruch 1, wobei der versiegelte Beutel in einem Sauerstoffundurchlässigen "Mutterbeutel" eingeschlossen wird.

3. Verfahren nach einem von Ansprüchen 1-2, wobei die Nahrungsmittelkontaktschicht ein Ionomer umfaßt.

4. Verfahren nach einem von Ansprüchen 1-3, wobei das Nahrungsmittel frisches rotes Fleisch oder Geflügel ist.

5. Verfahren nach einem von Ansprüchen 1-4, wobei die Folienstruktur eine biaxial-gedehnte, hitzeschrumpfbare Folie umfaßt.

6. Verfahren nach Anspruch 5, wobei die Folienstruktur einen Schrumpfwert von 25% bis 70% in sowohl den Maschinen- wie transversalen Richtungen hat.

7. Verfahren nach Anspruch 3, wobei das Ionomer ein Terionomer oder eine Mischung von einem Terionomeren mit Dipolymerionomer ist.

8. Verfahren nach Anspruch 3, wobei die Folienstruktur Monoschicht ist und hergestellt wurde durch ein Extrusionsblasverfahren unter Verwenden eines Aufblasverhältnisses (BUR) in dem Bereich von 3 bis 7, die Folienstruktur umfaßt eine biaxial-gedehnte, hitzeschrumpfbare Folie mit einem Schrumpfwert von mindestens 30% in sowohl den Maschinen- wie transversalen Richtungen, hat eine Sauerstoffdurchlässigkeitsrate, die im Bereich von 2000 bis 6000 cc/m²-Tag-Atm für eine 40 - 55 Mikrometerfolie, getestet bei 23°C und 50% relative Feuchtigkeit pro ASTM D-3985, liegt, und das Nahrungsmittel ist frisches rotes Fleisch.

9. Verpackung für frisches rotes Fleisch oder Geflügel unter Erhöhen der Kühllhaltbarkeit von derartigem Nahrungsmittel, umfassend:

(a) frisches rotes Fleisch oder Geflügel,

(b) einen Vakuum versiegelten Folienbeutel, umhüllend das rohe Fleisch oder Geflügel, wobei der Beutel eine oder mehrere Schichten hat, wobei eine Schicht eine Nahrungsmittelkontaktschicht ist, die umfaßt eine Folie, umfassend ein Polymer, ausgewählt aus der Gruppe, bestehend aus Ionomeren, Säurecopolymeren, Mischungen oder Copolymeren, umfassend Ionomere und/oder Säurecopolymere, und die Nahrungsmittelkontaktschicht ist in innigem Kontakt mit dem frischen roten Fleisch oder Geflügel,

wobei der Folienbeutel durch ein Extrusionsblasverfahren unter Verwenden eines Aufblasverhältnisses (BUR) in dem Bereich von 3 bis 7 hergestellt wurde.

10. Verpackung nach Anspruch 9, wobei der Folienbeutel eine biaxial-gedehnte, hitzeschrumpfbare Folie umfaßt.

11. Verpackung nach einem von Ansprüchen 9-10, wobei die Nahrungsmittelkontaktschicht ein Ionomer umfaßt.

12. Verpackung nach einem von Ansprüchen 9-11, wobei der Folienbeutel eine Monoschichtfolie ist.

13. Verpackung nach Anspruch 9, wobei der Folienbeutel Monoschicht ist und hergestellt wurde durch ein Extrusionsblasverfahren unter Verwenden eines Aufblasverhältnisses (BUR) in dem Bereich von 3 bis 7, der Folienbeutel umfaßt eine biaxial-gedehnte, hitzeschrumpfbare Folie mit einem Schrumpfwert von mindestens 30% in sowohl den Maschinen- wie transversalen Richtungen, hat eine Sauerstoffdurchlässigkeitsrate, die im Bereich von 2000 bis 5000 cc/m²-Tag-Atm für eine 50 Mikrometerfolie, getestet bei 23°C und 50% relative Feuchtigkeit, liegt, und das Nahrungsmittelprodukt ist frisches rotes Fleisch.

14. Verfahren zum Erhöhen der Haltbarkeit von frischem Nahrungsmittel, umfassend die Stufen von:

a. Einschließen des Nahrungsmittels in einer Folienstruktur mit einer oder mehreren Schichten, wobei eine Schicht eine Nahrungsmittelkontaktschicht ist, ferner wobei die Nahrungsmittelkontaktschicht im wesentlichen besteht aus einem Polymeren, ausgewählt aus der Gruppe, bestehend aus Ionomeren, Säurecopolymeren und Mischungen oder Copolymeren, umfassend Ionomere und/oder Säurecopolymere,

- b. Vakuumversiegeln der Folienstruktur auf ihrer äußeren Umgrenzung unter Erzielen eines versiegelten Beutels, der das Nahrungsmittel umhüllt,
c. Anwenden von minimaler Hitze für eine minimale Zeit, notwendig, den versiegelten Beutel zu schrumpfen und/oder eine sekundäre Versiegelung zu bewirken, wie es der Fall sein kann, so daß die Nahrungsmitteloberfläche in innigen Kontakt mit der Nahrungsmittelkontaktschicht gebracht wird und eine Spülung enthalten ist, und
d. Beibehalten einer Kühlkette über Stufen a. bis c. und danach, mit Ausnahme der minimalen Zeit, die in Stufe c. zum Erhitzen benötigt wird,

wobei die Folienstruktur hergestellt wurde durch ein Extrusionsblasverfahren unter Verwenden eines Aufblasverhältnisses (BUR) in dem Bereich von 3 bis 7 und eine Sauerstoffdurchlässigkeitsrate (OTR), entweder vor oder nach Stufe c, hat, die im Bereich von 1500 bis 9000 cc/m²-Tag-Atm für eine 40-55 Mikrometerfolie, getestet bei 23°C und 50% relative Feuchtigkeit pro ASTM D-3985, liegt.

Revendications

1. Procédé d'emballage d'aliment frais pour augmenter la durée de stockage au réfrigérateur de cet aliment comprenant les étapes suivantes:

- a) incorporation de l'aliment dans une structure de film ayant une ou plusieurs couches, dans laquelle une couche est une couche en contact avec l'aliment qui comprend un polymère choisi parmi le groupe constitué d'ionomères, de copolymères acides, et de mélanges ou de copolymères comprenant des ionomères et/ou des copolymères acides;
- b) scellage sous vide de la structure de film sur son périmètre pour obtenir un sachet scellé recouvrant l'aliment;
- c) application de la chaleur minimale pendant un temps minimal nécessaire pour rétracter le sachet scellé et/ou effectuer un second scellage, selon le cas, de sorte que la surface de l'aliment soit placée en contact intime avec la couche en contact avec l'aliment et ne contienne aucune purge; et
- d) maintien d'une chaîne froide tout au long des étapes a. à c. et après cela, maintien pendant le temps minimum requis à la chaleur de l'étape c,

dans lequel ladite structure de film est obtenue par un procédé d'extrusion-soufflage utilisant un taux de soufflage (BUR) dans l'intervalle d'environ 3 à environ 7

2. Procédé selon la revendication 1 dans lequel le sachet scellé est recouvert d'un «sac mère» imperméable à l'oxygène.
3. Procédé selon l'une des revendications 1 ou 2 dans lequel la couche en contact avec l'aliment comprend un ionomère.
4. Procédé selon l'une quelconque des revendications 1-3 dans lequel l'aliment est une viande rouge ou une volaille fraîche.
5. Procédé selon l'une quelconque des revendications 1-4 dans lequel la structure de film comprend un film étiré de manière biaxiale rétractable à la chaleur.
6. Procédé selon la revendication 5 dans lequel la structure de film a un taux de rétraction de 25% à 70% dans chacun des sens machine et transversal.
7. Procédé selon la revendication 3 dans lequel l'ionomère est un ter-ionomère ou un mélange d'un ter-ionomère avec un ionomère dipolymère.
8. Procédé selon la revendication 3, dans lequel la structure de film est une monocouche et est obtenue par un procédé d'extrusion-soufflage utilisant un taux de soufflage (BUR) dans l'intervalle de 3 à 7, la structure de film comprend un film étiré de manière biaxiale rétractable à la chaleur ayant un taux de rétraction d'au moins 30% dans chacun des sens machine et transversal, présente une vitesse de transmission de l'oxygène variant de 2000 à 6000 cm³/m²-jour-atm pour un film de 40-55 microns testé à 23°C et 50% d'humidité relative selon la norme ASTM D-3985 et l'aliment est de la viande rouge fraîche.
9. Emballage pour de la viande rouge ou de la volaille fraîche pour augmenter la durée de stockage au réfrigérateur d'un tel aliment comprenant:

a) de la viande rouge ou de la volaille fraîche;

b) un sachet d'un film scellé sous vide recouvrant la viande ou la volaille crue, ledit sachet ayant une ou plusieurs couches, dans lequel une couche est une couche en contact avec l'aliment qui comprend un film comprenant un polymère choisi parmi le groupe constitué d'ionomères, de copolymères acides, de mélanges ou de copolymères comprenant des ionomères et/ou des copolymères acides, et la couche en contact avec l'aliment est en contact intime avec la viande rouge ou la volaille fraîche

dans lequel ledit sachet est obtenu par un procédé d'extrusion-soufflage utilisant un taux de soufflage (BUR) dans l'intervalle d'environ 3 à environ 7

10. Emballage selon l'une quelconque des revendications 9 dans lequel le sachet de film comprend un film étiré de manière biaxiale rétractable à la chaleur.

11. Emballage selon l'une quelconque des revendications 9-10 dans lequel la couche en contact avec l'aliment comprend un ionomère.

12. Emballage selon l'une quelconque des revendications 9-11 dans lequel le sachet de film est un film monocouche.

13. Emballage selon la revendication 9, dans lequel le sachet de film est une monocouche et est obtenu par un procédé d'extrusion-soufflage utilisant un taux de soufflage (BUR) dans l'intervalle de 3 à 7, le sachet de film comprend un film étiré de manière biaxiale rétractable à la chaleur ayant un taux de rétraction d'au moins 30% dans chacun des sens machine et transversal, a une vitesse de transmission de l'oxygène variant de 2000 à 5000 cm³/m²-jour-atm pour un film de 50 microns testé à 23°C et 50% d'humidité relative et le produit alimentaire est une viande rouge fraîche.

14. Procédé pour augmenter la durée de stockage d'aliment frais comprenant les étapes de:

a) incorporation de l'aliment dans une structure de film ayant une ou plusieurs couches, dans laquelle une couche est une couche en contact avec l'aliment, dans laquelle en outre la couche en contact avec l'aliment consiste essentiellement en un polymère choisi parmi le groupe constitué d'ionomères, de copolymères acides, et de mélanges ou de copolymères comprenant des ionomères et/ou des copolymères acides;

b) scellage sous vide de la structure de film sur son périmètre pour obtenir un sachet scellé recouvrant l'aliment;

c) application de la chaleur minimale pendant un temps minimal nécessaire pour rétracter le sachet scellé et/ou effectuer un second scellage, selon le cas, de sorte que la surface de l'aliment soit placée en contact intime avec la couche en contact avec l'aliment et ne contienne aucune purge; et

d) maintien d'une chaîne froide tout au long des étapes a. à c. et après cela, maintien pendant le temps minimum requis à la chaleur de l'étape c;

dans lequel la structure de film est obtenu par un procédé d'extrusion-soufflage utilisant un taux de soufflage (BUR) dans l'intervalle de 3 à 7 et présente une vitesse de transmission de l'oxygène (OTR), soit avant soit après l'étape c, variant de 1500 à 9000 cm³/m²-jour-atm pour un film de 40-55 microns testé à 23°C et 50% d'humidité relative selon la norme ASTM D-3985.

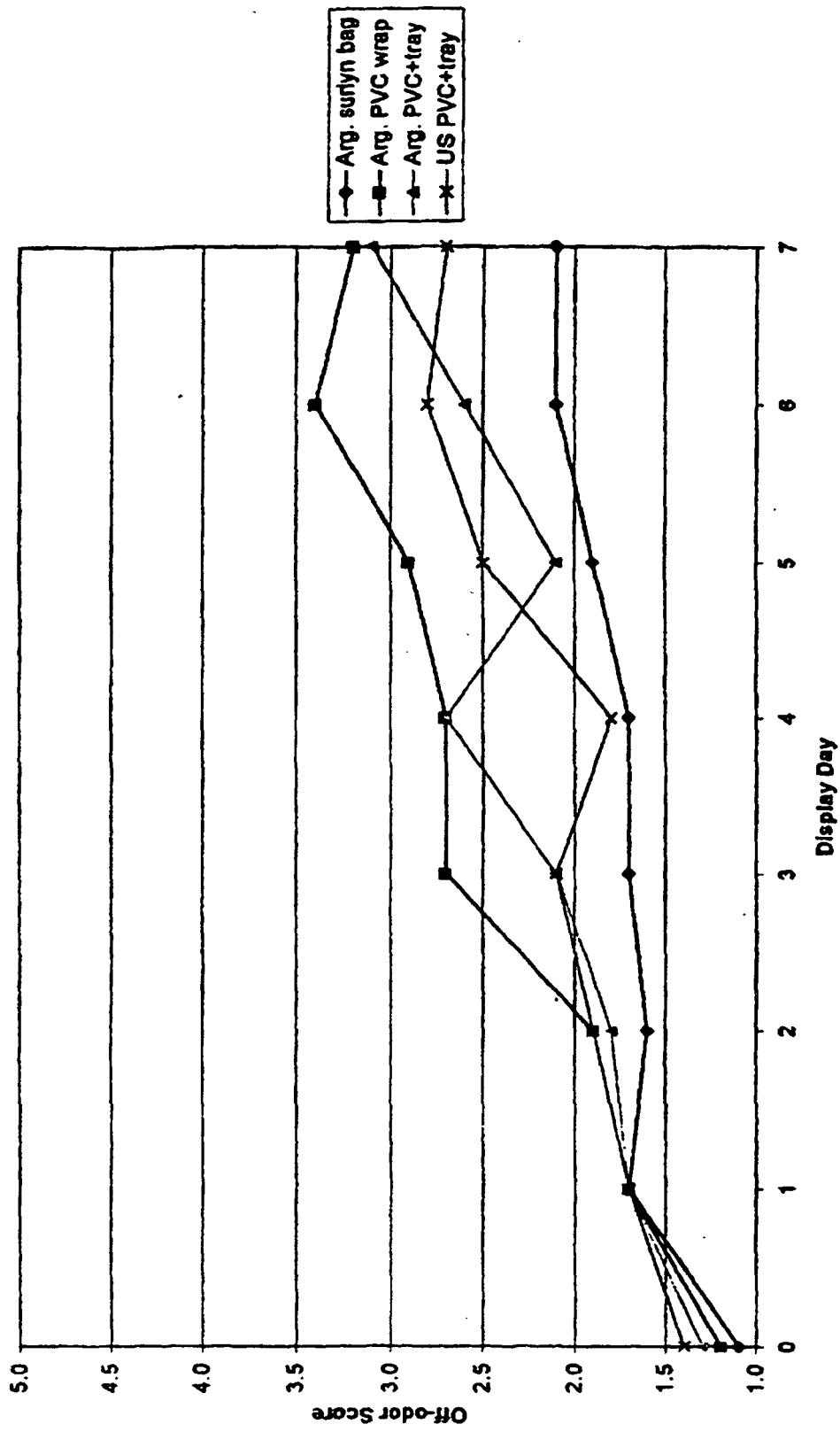


FIG. 1