A polyamide-based sausage casing suitable for use with uncooked meats such as chorizo is disclosed. A polyamide resin is blended with a silicon-based barrier control agent, preferably a polyhedral oligomeric silsesquioxane, to increase the permeability of the sausage casing. The resultant blend can be biaxially stretch-oriented to produce a single-layered polyamide-based sausage casing suitable for use with uncooked sausage meats such as chorizo, and specifically suitable for the gas and moisture permeability needed during the curing process for uncooked sausage meats. Such polyamide-based casings can also be employed for cooked sausages by choosing a silicon-based barrier control agent that increases gas and moisture barrier, thereby increasing shelf-life for unpeeled sausages. A method for improving the peelability of cooked sausage casings by injecting a thin coating of a releasing agent, without the addition of a surfactant, into the sausage casing during the stirring process is also disclosed. The releasing agent is a hydroxypropyl methylcellulose solution that creates a low viscosity releasing agent that effectively improves peelability from any type of sausage casing, but preferably for use with the polyamide-based sausage casing of the present invention.
POLYAMIDE-BASED SAUSAGE CASING

BACKGROUND OF THE INVENTION

[0001] The present invention is related to a polyamide-based casing suitable for encasing cooked and uncooked sausage meats.

[0002] Artificial polymeric sausage casings must fulfill numerous requirements if they are to be suitable for commercial use. These requirements differ depending on the type of meats that are to be encased. For example, cooked meats, such as traditional sausages purchased from a grocery store, wiensers, hams, salamis, and liver pates are inserted into a casing in an uncooked, paste-like form, and are then cooked or smoked in the casing. Depending on the particular market, this cooked meat product may be sold with or without the casing, and are oftentimes stored refrigerated below 4° C. Some of the requirements for these types of cooked meats are as follows:

1. Shirrability—The film must have the ability to be shirred and stay shirred until the filling process.
2. Recovery Power—The film must continue to cling without creasing when the previously heated packaged meat cools or loses weight due to evaporation of water.
3. Strength—The film must ensure that the high filling pressure mainly produces an elastic deformation of the tubular film, without localized bulging.
4. Peelability—The film must be easily removable from the packaged meat without damaging the meat product.
5. Temperature resistance—The film must be able to tolerate temperatures associated with the cooking process.
6. Barrier properties—The film must have good barrier properties against permeation of oxygen and water vapor.

[0009] On the other hand, chorizo is a type of uncooked, ground fresh meat that is often mixed with vinegar and spices, and is stored at ambient temperatures such as 20-25° C. Unlike the cooked meats discussed above, chorizo and other similar products have a fermentation or curing process after production where moisture and CO₂ gas are produced by the meat. Fermented meats and sausages are characterized by their tangy flavor and in most cases chewy texture. The characteristic tang results from bacterial fermentation during which lactic acid and other byproducts of fermentation accumulate. The pH of fermented sausages typically ranges from about 4.6 to about 5.3. Fermented sausages include both dry and semi-dry varieties. Representative fermented, dry sausages include Genoa salami, hard salami, and pepperoni. Representative fermented, semi-dry sausages include summer sausage, farmer sausage, and chorizo. The moisture and gas created during the curing process must be able to permeate through the casing film to avoid breaking or puncturing, and to avoid unwanted bacterial growth and acidity that would otherwise develop and damage the quality and taste of the meat.

[0010] Chorizo and other similar uncooked products are encased primarily with cellulosic casings, but are also produced using collagen casings or natural pork tripe. Tubular cellulosic casings are well known in the art of meat casings, and have been widely used for many years by numerous manufacturers for both cooked and uncooked meats. The basic process for manufacturing regenerated cellulose casings is through the well-known viscose process, whereby a liquefied colloidal dispersion of cellulose fibers is created in an alkaline liquid carrier.

[0011] Once the cellulose casing is formed, it is typically shirred according to well known methods wherein long tubular lengths, often called “strands” are compacted and pleated to provide shorter, coherent tubes, often called “shirred sticks” or “sticks.” High-speed shirring machines are common in the art, such as those disclosed in U.S. Pat. Nos. 2,984,574, 3,451,827, 3,454,981, 3,461,484, 3,988,804, and 4,818,551, which are incorporated by reference herein. The coherency of the shirred stick is important in order that it remain straight and rigid. Small diameter shirred food casings must be packaged for distribution and sale, andthis packaging is critical to commercial performance since the casing has a thickness of from about 20 microns to about 40 microns, and is therefore prone to damage. Although the sticks must be rigid to prevent deformation and survive transportation to the foodstuff manufacturer, the sticks must also be easily dispensed without waste when being filled with meat paste using high speed filling machines.

[0012] Although the standard for chorizo production, cellulosic casings have several drawbacks. The most commercially important drawback is that cellulosic casings are too permeable to moisture. This allows loss of saleable product weight or sometimes the opposite problem—moisture can be absorbed into the cellulosic casing thereby allowing fungus to grow inside the casing. Also, when printed with more than two colors, ink tends to permeate through a cellulosic casing, thereby contacting and staining the product.

[0013] Another synthetic alternative for chorizo casings exists with biaxially stretch-oriented polyamide films. Polyamide, commonly called nylon, is a semi-crystalline thermoplastic that is composed of linear aliphatic segments that are connected by amide linkages. Polyamide can be produced either by the polymerization of a lactam and an amino acid or a dibasic acid and a diamine. The wide variety of routes by which polyamide can be produced make it possible to tailor the backbone to meet specific needs. The various types of polyamide are identified by number designations, which represent the number of carbon atoms in each of the starting materials. For example, nylon 6,6 is made from the 6-carbon hexamethylenediamine and a 6-carbon adipic acid. All nylon absorbs moisture from the atmosphere, and the water that enters their structure causes dimensional changes and acts as a plasticizer. These factors must be taken into account when designing a product constructed of polyamide. Additionally, biaxial orientation—stretching the film in one direction and then at right angles—can be used to orient the crystals and make the film stronger. Polyamide is also inexpensive and has excellent tensile strength as compared to other polymers, which are reasons for its widespread use as a fiber. Unfilled polyamide is biologically inert, and most grades have been cleared for food contact use by the U.S. Food and Drug Administration.

[0014] In general, single-layer polyamide sausage casings are capable of easy integration into the shirring and filling
operations that presently exist for cellulosic sausage casings. Although cheaper to manufacture than cellulosic casings, pure polyamide casings have several shortcomings as compared to traditional cellulosic casing technology, as applied to both cooked and uncooked sausage meats. For example, pure polyamide casings cannot be smoked, cannot be effectively peeled either manually or automatically, and do not allow gas to permeate for uncooked sausages that undergo fermentation.

[0015] For cooked meats, several layers of polyamides and other polymers are often used in order to compensate for certain disadvantageous properties of pure polyamide. For example, a number of different types of cooked meats and sausages require casing materials that exhibit low permeability to water vapor. The barrier against water vapor prevents weight loss due to evaporation of water from the contents, which reduces the saleable value of the product. This also ensures that the sausage casing surrounds the meat in a tight, crease-free manner, even after relatively long periods of storage without formation of hollow spaces between the inner wall of the casing and the sausage meat where jelly pockets can form. For this purpose, it is known to combine a polyamide layer with a second layer of a different polymer whose permeability to water vapor is lower than that of the polyamide layer. There are, however, certain types of meats where even the reduced permeability of this two-layer composite casing is too high to be suitable for use. For example, certain cooked meats severely discolor when exposed to even the slightest amount of oxygen. The prior art has resolved this problem by providing additional polymeric layers to the casing that provides superior oxygen barrier. As a result of these multiple layers, several other commercially important qualities are often sacrificed, such as the transparency of the casing, the printability of the casing, and consistency and operability during the shirring and filling processes. Accordingly, it is desirable to provide a new single-layered polyamide-based casing that meets all of the above requirements for packaging cooked meats and sausages.

[0016] For uncooked meats, polyamide casings provide a different problem. As discussed above, chorizo and other uncooked products that require a curing/fermentation process (such as soft cheeses) require a casing that is permeable to the gases and moisture that are produced. Pure polyamide casings have inherently too high a barrier to gases and moisture for this particular application. As an alternative, several polyamide casing producers have attempted to blend polyamides with other polymers such as polyester, polypropylene, and Surllyn® to provide a permeable film. The problem with this approach is that the shirred stick that results from such films can be too rigid, and have problems with unshirring prior to usage. For these and other reasons, polyamide casings are not used today in the chorizo and uncooked sausage meat industry. For uncooked meats, what is needed is a single-layered polyamide-based casing that can be tailored to meet both product permeability requirements as well as the commercial processing requirements for shirring and filling.

SUMMARY OF THE INVENTION

[0017] To that end, the present invention provides a method for producing a polyamide-based film suitable for use in cooked or uncooked sausage casings, where the film has suitable barrier properties for the specific type of food product to be encased. A polyamide resin is blended with a silicon-based barrier control agent, preferably a polyhydral oligomeric silsesquioxane, at a specific concentration to create a master blend. This master blend may then be further blended or co-extruded with pure polyamide, and then biaxially stretch-oriented, to produce the polyamide-based film. The type of silicon-based barrier control agent used can be varied to provide a resultant film that either increases or decreases the barrier properties of the film relative to pure polyamide. The amount of pure polyamide blended or co-extruded with the master blend can be varied to affect the extent of the increased or decreased permeability of the resultant film.

[0018] In another embodiment, the present invention provides a single-layered polyamide-based sausage casing suitable for use with uncooked meats such as chorizo. A polyamide resin is blended with a silicon-based barrier control agent, preferably a polyhydral oligomeric silsesquioxane, to increase the permeability of the sausage casing. Preferably a linear aliphatic polyamide is blended with a polyhydral oligomeric silsesquioxane, preferably octaisobutyl-polyhydral oligomeric silsesquioxane, where the polyhydral oligomeric silsesquioxane concentration of the blend is in the range of from about 0.2% to about 20% by weight. The resultant blend can be biaxially stretch-oriented to produce a single-layered polyamide-based sausage casing suitable for use with uncooked sausage meats such as chorizo, and specifically suitable for the gas and moisture permeability needed during the curing process for uncooked sausage meats.

[0019] In yet another embodiment, the present invention provides a method for improving the peclability of cooked sausage casings by injecting a thin coating of a releasing agent, without the addition of a surfactant, into the sausage casing during the shirring process. Preferably, the releasing agent is a hydroxypropyl methylcellulose solution with a concentration of from about 1% to about 20% by weight, thereby creating a low viscosity releasing agent with a viscosity in the range from about 2 cp to about 100 cp. This embodiment of the present is intended for use with any type of sausage casing, but preferably for use with the polyamide-based sausage casings of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0020] The present invention provides a method for producing a polyamide-based sausage casing, where the film has suitable barrier properties for the specific type of sausage meat to be encased. The present invention also provides compositions for polyamide-based films suitable for use in sausage casings.

[0021] In one embodiment, a polyamide resin is blended with a silicon-based barrier control agent at a specified silicon-based barrier control agent concentration to create a master blend. This master blend may then be blended or co-extruded with pure polyamide, and then biaxially stretch-oriented, to produce a polyamide-based film. The type of silicon-based barrier control agent used can be varied to provide a film with increased or decreased barrier properties relative to pure polyamide. The amount of pure polyamide blended or co-extruded with the master blend can also be varied to control the permeability of the polyamide-based film.
Polyamides, as intended by the present invention, includes all polyamides as discussed previously, but preferably relates to linear aliphatic polyamides. More preferably, the linear aliphatic polyamides used in the films of the present invention are selected from the group consisting of nylon 6, nylon 6,6, nylon 6/6,6, nylon 12, or any combination or copolymer thereof.

Silicon-based barrier control agents, as intended by the present invention, include molecules containing at least one silicon atom, and are further defined by four basic features. First, the silicon-based barrier control agent used in the present invention must be of a single type of molecule and not a randomly assorted assembly of molecules. However, it is intended that the silicon-based barrier control agent may include an ascertainable blend of molecules, provided that each type of molecule meets the requirements herein described. Second, the silicon-based barrier control agents used in the present invention must have a polyhedral geometry with well-defined three-dimensional shapes, i.e. a cage. Clusters are good examples while planar hydrocarbons, dendrimers, and particulates are not. Third, the silicon-based barrier control agents used in the present invention must have nanoscopic sizes that range from about 0.5 nm to about 7 nm. Fourth, the silicon-based barrier control agents used in the present invention must have systematic chemistries that enable precise control over its size, stereochemistry, reactivity, and physical properties, as well as those they impart to other chemical systems, such a polymer systems.

In a preferred embodiment of the present invention, the silicon based molecule used is a polyhedral oligomeric silsesquioxane. More preferably, the polyhedral oligomeric silsesquioxane has the following structure:

![Polyhedral Oligomeric Silsesquioxane](image)

wherin the groups are independently selectable from organic compounds having 1-30 carbon atoms. It is a preferred aspect of the present invention that the R groups are independently selectable from the group consisting of phenyl, i-octyl, cyclohexyl, cyclopentyl, i-butyl, methyl, trifluoropropyl, and phenethyl. It is most preferred that the R group is i-butyl, which provides a molecule that can be expressed as octaisobutyl-polyhedral oligomeric silsesquioxane.

Polyhedral oligomeric silsesquioxanes meet the four requirements outlined above for silicon-based barrier control agents, and provide more advantages as applied to the present invention. Polyhedral oligomeric silsesquioxanes as defined above possess a Si—O cage-like core surrounded by non-reactive organic groups. This permits the inorganic core to be compatible with an organic matrix, such as the polyamide polymer system of the present invention. This compatibility allows the polyhedral oligomeric silsesquioxanes described above to be compounded into polyamides yielding true nanocomposites with complete molecular level dispersion. It is this unique ability to be dispersed at the molecular level that provides the significant enhancement of the barrier and permeability properties of polyamides. Such polyhedral oligomeric silsesquioxanes are marketed, for example, by Hybrid Plastics Corporation, which specializes in Nanostructured™ chemical technology including POSS® Molecular Silicas™.

It has been determined that the polyamide-based film containing a silicon-based barrier control agent of the present invention can be used to control the barrier properties of the film. For example, it is a preferred aspect of the present invention that the silicon-based barrier control agent concentration in the mixture is in the range of from about 0.1% to about 20% by weight, more preferably in the range of from about 0.1% to about 5% by weight, and most preferably in the range of from about 0.2 to about 1% by weight. Another aspect of the present invention is a method for controlling the concentration of the silicon-based barrier control agent in the polyamide-based film by blending a known quantity of pure polyamide into a master blend of polyamide and silicon-based barrier control agent of a known concentration. For example, a master blend of 20% by weight silicon-based barrier control agent in a polyamide can be coextruded or otherwise blended with pure polyamide to produce a film that has a concentration less than 20% by weight.

The resultant polyamide-based film containing the silicon-based barrier control agent can be biaxially stretch-oriented to produce a single-layered polyamide-based sausage casing suitable for use with uncooked sausage meats such as chorizo. Up until this invention, cellulose casings have been exclusively used for uncooked sausage meats because cellulose casings allow the moisture and gases produced during the curing process to permeate the casing. However, cellulose casings often provide too little barrier to such permeation, thereby limiting the “shelf-life” of such uncooked products because they dry out too quickly. Single-layered polyamide-based casings according to the present invention provide the permeability of cellulose casings, but also provide a means for controlling the gas and moisture permeability associated with the curing process in order to tailor the permeability for specific products and customer needs. Longer shelf-lives can be obtained by either choosing a silicon-based barrier control agent that provides less permeability (i.e. greater barrier), or by effectively reducing the concentration of the silicon-based barrier control agent in the polyamide-based film, thereby reducing the permeability. This embodiment of the present invention discloses for the first time a low cost, single-layered sausage casing that provides the greatest amount of barrier flexibility for foodstuff industry needs.

It is also intended that the polyamide-based films of the present invention can also be used in the packaging of soft cheeses. It is well known in the art that soft cheeses may be packages in cellulose film packaging material because of its superior permeability properties, as is illustrated by U.S. Pat. No. 4,276,340, which is incorporated by reference herein. Soft cheeses such as Camembert and Brie are packaged before the cheese is fully ripened. The ripening process continues after packaging by a dynamic bacterial fermentation process during which time the cheese absorbs oxygen from the atmosphere and releases carbon dioxide, thus
requiring a packaging film that provides sufficient gas permeability. Because soft cheeses are characterized as having a high moisture content, it is also essential that the packaging material be permeable to the passage of water vapor contained within the cheese product, yet not so permeable as to dry out the cheese. The polyamide-based films of the present invention is a perfect fit for such applications because of the exact control over the gas and moisture barrier properties of the film, as was described above for the application with uncooked meats such as chorizo.

[0030] In yet another embodiment of the present invention, the polyamide-based sausage casings of the present invention can be used with sausage meat that is to be cooked or smoked in the casing, and wherein the casing adequately prohibits moisture and gases from permeating the casing. With cooked sausages, such as hot dog sausages or Wieners, market considerations dictate that a gas barrier that is necessary for a commercially viable product. For example, prepeeled hot dog sausages do not require high gas barrier for two reasons. First, the prepeeled hot dog sausage will be peeled in high speed peeling machines soon after cooking, thereby eliminating the need for protection from oxygen permeation through the casing. Second, for prepeeled hot dog sausages that are smoked rather than cooked, it is desirable to have a higher gas permeability so that the smoke can permeate the casing. However, in unpeeled hot dog sausage markets, such as in Mexico, it is important to be able to control the gas permeability to optimize the shelf-life of the product. The polyamide-based sausage casings of the present invention provide the commercial flexibility needed for each type of product. Longer shelf-lives for unpeeled hot dog casings can be obtained by either choosing a silicon-based barrier control agent that provides less permeability (i.e. greater barrier), or by effectively reducing the concentration of the silicon-based barrier control agent in the polyamide-based film, thereby reducing the permeability. A similar analysis can be made for other types of cooked sausage casings. Silicon-based barrier control agents can be carefully chosen to either increase or decrease the gas and moisture permeability relative to either cellulose or pure polyamide-based casings. The concentration of the silicon-based barrier control agent can be carefully chosen to provide the optimal amount of permeability for a given product requirement. This embodiment of the present invention discloses for the first time a low cost, single-layered sausage casing that provides the greatest amount of barrier flexibility for cooked sausage industry needs.

[0031] It has also been determined that polyamide-based films containing a silicon-based barrier control agent as described above can be effectively used to produce a small-diameter sausage casing with a film thickness in the range of from about 6 microns to about 80 microns, and more preferably in the range of from about 20 microns to about 30 microns. Such casings produced according to the present invention adequately provide the recovery power, strength, and temperature resistance that are required for a commercially acceptable sausage product. In fact, a film thickness in the range of 10-20 microns according to the present invention represents a significant reduction in film thickness as compared to the present state of the art cellulose and plastic sausage casings, which typically average about 28 microns. This reduction in film thickness will allow casing manufacturers to produce a shirred stick that contains more casings per stick, thereby reducing operating costs for both the casing manufacturer as well as the downstream sausage producer. This manufacturing advantage coupled with the low costs of polyamide casings versus cellulose casings, and the flexible control of barrier properties makes the present invention an attractive alternative to the present state of the art technologies.

[0032] Yet another embodiment of the present invention is the concurrent use of a releasing agent with the polyamide-based casings herein described to provide commercially acceptable peellability characteristics for sausages that are marketed prepeeled. Prepeeled sausages, such as hot dogs or wiener's that are vacuum packed in downstream operations, are typically peeled using high-speed automatic peeling machines, such as those disclosed in U.S. Pat. Nos. 2,424,346, 2,514,660, 2,686,927, 2,757,409, 3,312,995, 3,487,499, and 3,608,973, which are incorporated by reference herein. Such machines require minimal resistance to the separation of casing from the cooked sausage meat, otherwise the product will jam at the machine or go through the machine unpeeled, which increases operating expense. Sausages and hot dogs that are sold unpeeled from their original casing must also be easy to peel for the consumer.

[0033] Traditionally, polyamide casings, as compared to cellulose casings, have been less popular in the sausage industry for their poorer peellability characteristics as well as their poorer gas permeability properties. A preferred aspect of the present invention involves coating the inside wall of the casing with a releasing agent that will improve the peellability of the casing. The prior art resolves the issue of peellability using releasing agents containing cellulose material in conjunction with a surfactant that provides the even distribution of the coating composition on the casing surface. It is an embodiment of the present invention to provide a cellulose releasing agent that will coat the inside wall of any type of food product casing using a releasing agent that does not contain a surfactant. More specifically, a low viscosity pharmaceutical grade of hydroxypropyl methylcellulose is the preferred releasing agent for use with casings, and preferably for use with the polyamide-based casings of the present invention. Pharmaceutical grade hydroxypropyl methylcellulose comes as a white powder that is diluted with water or another solvent to produce a low viscosity solution. One commercially available pharmaceuti
cal grade hydroxypropyl methylcellulose is Demecol 2910 HE, which is marketed by Demasca.

[0034] It is a preferred aspect of the present invention to dilute the releasing agent with a solvent in a ratio from about 1% to about 20%, and more preferably in a ratio from about 3.5% to about 8%. A viscosity in the range of from about 2 to about 100 cp, and preferably from about 5 to about 20 cp, can be achieved with pharmaceutical grade hydroxypropyl methylcellulose diluted as described above. It is in part this low viscosity that provides adequate coating of the inside wall of sausage casings without the use of surfactant.

[0035] It is also a preferred aspect of the present invention to apply the releasing agent during the shaving process, without the use of a surfactant, to evenly coat the inside of the casing in the shirred stick. The equipment for adding a liquid during the shaving process is common in the art for cellulose casings, as is illustrated by U.S. Pat. Nos. 4,374,871 and 4,818,551, which are incorporated by reference herein. The amount of coating applied to the casing will
typically be in the range of from about 0.5 mg/in² to about
50 mg/in², and more preferably in the range of from about
3.5 mg/in² to about 10 mg/in². It has been determined that
this coating of releasing agent as described by the present
invention provides a shirred stick that is commercially
viable, that is, it is sufficiently rigid for transportation to
sausage manufacturers and provides sufficient resistance to
premature unshirring and breakage during the filling pro-
cess.

[0036] The addition of liquid flavorings and colorants to
the releasing agent are generally well known in the art in
order to provide a different taste and color to the meat
sausage. With the addition of liquid colorants and flavorings,
the thin coating of releasing agent inside the shirred casing
serves to transfer colorant or flavoring to the encased
sausage meat, and specifically to the surface of the encased
sausage meat. The use of liquid flavorings and colorants
have been determined to work especially well with the low
viscosity releasing agents of the present invention as
described herein.

[0037] The printing of words, numbers, and graphics onto
cellulosic casings is well known in the art. In
general, traditional printing on cellulosic casings cannot
exclude two colors because of the tendency for the ink to
permeate through the casing, thereby contacting and staining
the food. With the single-layered polyamide-based sausage
casings of the present invention, the casing is an excellent
surface for printing up to ten colors without any ink perme-
ating through the casing. From a commercial standpoint, in
markets where either cooked or uncooked meats are sold
unpeeled, access to several colors and detailed graphics
avoids the use of stickers or outer packages to differentiate
the product and increase the product’s appearance and
appeal.

[0038] While the apparatus, compositions and methods of
this invention have been described in terms of preferred or
illustrative embodiments, it will be apparent to those of skill
in the art that variations may be applied to the process
described herein without departing from the concept and
scope of the invention. All such similar substitutes and
modifications apparent to those skilled in the art are deemed
to be within the scope and concept of the invention as it is
set out in the following claims.

What is claimed is:

1. A film suitable for use in a small diameter sausage
casing, comprising a mixture of: a polyamide; and
   a silicon-based barrier control agent.

2. The film of claim 1, wherein the mixture is extruded
   and then biaxially stretch-oriented to form the film.

3. The film of claim 1, wherein the silicon-based barrier
   control agent is a polyhedral oligomeric silsesquioxane.

4. The film of claim 3, wherein the polyhedral oligomeric
   silsesquioxane has the structure:

   \[ \text{wherein } R \text{ is independently selectable from organic com-
   pounds having 1-30 carbon atoms.} \]

5. The film of claim 4, wherein R is independently
   selectable from the group consisting of phenyl, i-octyl,
   cyclohexyl, cyclopentyl, i-butyl, methyl, trilouropropyl,
   and phenethyl.

6. The film of claim 5, wherein R is i-butyl.

7. The film of claim 3, wherein the polyhedral oligomeric
   silsesquioxane is octaisobutyl-polyhedral oligomeric silses-
   quioxane.

8. The film of claim 1 wherein the polyamide is a linear
   aliphatic polyamide.

9. The film of claim 8, wherein the linear aliphatic
   polyamide is selected from the group consisting of nylon 6,
   nylon 6,6, nylon 12, and any combination or copolymer
   thereof.

10. The film of claim 1, wherein the casing is suitable to
   encase meat that is to remain uncooked for a substantial
   period of time, and wherein the casing adequately permits
   moisture and gases to permeate the casing.

11. The film of claim 1, wherein the casing is suitable to
   encase soft cheeses that are not fully ripened, and wherein
   the casing adequately permits moisture and gases to per-
   meate the casing.

12. The film of claim 1, wherein the casing is suitable to
   encase meat that is to be cooked or smoked in the casing,
   and wherein the casing adequately prevents moisture and at least
   some gases from permeating the casing, but permits at least
   some smoke to penetrate the casing.

13. The film of claim 1, wherein the silicon-based barrier
   control agent concentration in the mixture is in the range of
   from about 0.1% to about 20% by weight.

14. The film of claim 13, wherein the silicon-based barrier
   control agent concentration in the mixture is in the range of
   from about 0.2% to about 1% by weight.

15. The film of claim 14, wherein the silicon-based barrier
   control agent concentration in the mixture is in the range of
   from about 0.2% to about 1% by weight.

16. The film of claim 13, wherein the silicon-based barrier
   control agent concentration in the mixture is sufficient to
   allow printing on the exterior surface of the casing in up to
   ten colors without permeation of the ink through the casing.

17. The film of claim 1, wherein the film has a film
   thickness in the range of from about 6 microns to about 80
   microns.

18. The film of claim 17, wherein the film has a film
   thickness of from about 20 microns to about 30 microns.

19. A sausage casing, comprising a polyamide-based film
   comprising a mixture of:
   a linear aliphatic polyamide; and
   a polyhedral oligomeric silsesquioxane having the struc-

   \[ \text{ture:} \]
wherein R is independently selectable from organic compounds having 1-30 carbon atoms; and 6 wherein the mixture is extruded and then biaxially stretch-oriented to form the film.

20. The casing of claim 19, wherein R is i-butyl.

21. The casing of claim 19, wherein the polyhedral oligomeric silesquioxane is octaisobutyl-polyhedral oligomeric silesquioxane.

22. The casing of claim 19, wherein the linear aliphatic polyamide is selected from the group consisting of nylon 6, nylon 6,6, nylon 12, and any combination or copolymer thereof.

23. The film of claim 19, wherein the casing is suitable to enrobe meat that is to remain uncooked for a substantial period of time, and wherein the casing adequately permits moisture and gases to permeate the casing.

24. The film of claim 19, wherein the casing is suitable to enrobe soft cheeses that are not fully ripened, and wherein the casing adequately permits moisture and gases to permeate the casing.

25. The film of claim 19, wherein the casing is suitable to enrobe meat that is to be cooked or smoked in the casing, and wherein the casing adequately prevents moisture and at least some gases from permeating the casing, but permits at least some smoke to penetrate the casing.

26. The casing of claim 19, wherein the polyhedral oligomeric silesquioxane concentration in the mixture is in the range of from about 0.1% to about 20% by weight.

27. The casing of claim 26, wherein the polyhedral oligomeric silesquioxane concentration in the mixture is in the range of from about 0.1% to about 5% by weight.

28. The casing of claim 27, wherein the polyhedral oligomeric silesquioxane concentration in the mixture is in the range of from about 0.2% to about 1% by weight.

29. The casing of claim 27, wherein the polyhedral oligomeric silesquioxane concentration in the mixture is sufficient to allow printing on the exterior surface of the casing in up to ten colors without permeation of the ink through the casing.

30. The casing of claim 19, wherein the film has a film thickness in the range of from about 6 microns to about 80 microns.

31. The casing of claim 30, wherein the film has a film thickness of from about 20 microns to about 30 microns.

32. The casing of claim 19, further comprising a releasing agent coated on the inside wall of the casing.

33. The casing of claim 32, wherein the releasing agent comprises hydroxypropyl methylcellulose and a solvent.

34. The casing of claim 32, wherein the releasing agent does not include a surfactant.

35. The casing of claim 33, wherein the solvent is water.

36. The casing of claim 33, wherein the hydroxypropyl methylcellulose concentration in the releasing agent is in the range of from about 1% by weight to about 20% by weight.

37. The casing of claim 36, wherein the hydroxypropyl methylcellulose concentration in the releasing agent is in the range of from about 3.5% by weight to about 8% by weight.

38. The casing of claim 33, wherein the releasing agent has a viscosity in the range of from about 2 cp to about 100 cp.

39. The casing of claim 38, wherein the releasing agent has a viscosity in the range of from about 5 cp to about 6 cp.

40. A method for improving the peelability of a cooked sausage casing, comprising: preparing a releasing agent; and injecting the releasing agent into the sausage casing, wherein the releasing agent forms a thin coating on the inside wall of the casing.

41. The method of claim 40, wherein the releasing agent comprises hydroxypropyl methylcellulose and a solvent.

42. The method of claim 40, wherein the releasing agent does not include a surfactant.

43. The method of claim 40, wherein the injecting step occurs during the shirring process.

44. The method of claim 40, wherein the releasing agent comprises hydroxypropyl methylcellulose and a solvent.

45. The method of claim 40, wherein the releasing agent comprises hydroxypropyl methylcellulose and a solvent.

46. The method of claim 45, wherein the hydroxypropyl methylcellulose concentration in the releasing agent is in the range of from about 1% by weight to about 20% by weight.

47. The method of claim 45, wherein the releasing agent has a viscosity in the range of from about 2 cp to about 100 cp.

48. The method of claim 47, wherein the releasing agent has a viscosity in the range of from about 5 cp to about 6 cp.

49. A method for altering the barrier properties of polyamide, comprising: blending a silicon-based barrier control agent with the polyamide to form a master blend; and extruding the master blend to form a polyamide-based film; and orienting the polyamide-based film to produce a casing with consistent barrier properties.

50. The method of claim 49, further comprising orienting the polyamide-based film to produce a casing with barrier properties suitable for specific applications.

51. The method of claim 49, wherein the extruding step includes adding pure polyamide to the master blend prior to forming the polyamide-based film.

52. The method of claim 49, wherein the orienting step includes biaxially stretch-orienting the casing.

53. The method of claim 49, wherein the silicon-based barrier control agent is a polyhedral oligomeric silesquioxane.

54. The method of claim 53, wherein the polyhedral oligomeric silesquioxane has the structure:
wherein R is independently selectable from organic compounds having 1-30 carbon atoms.

55. The method of claim 54, wherein R is independently selectable from the group consisting of phenyl, i-octyl, cyclohexyl, cyclopentyl, i-butyl, methyl, trifluoropropyl, and phenethyl.

56. The method of claim 55, wherein R is i-butyl.

57. The method of claim 53, wherein the polyhedral oligomeric silsesquioxane is octaisobutyl-polyhedral oligomeric silsesquioxane.

58. The method of claim 49, wherein the casing is suitable to encase meat that is to remain uncooked for a substantial period of time, and wherein the casing adequately permits moisture and gases to permeate the casing.

59. The method of claim 49, wherein the casing is suitable to encase soft cheeses that are not fully ripened, and wherein the casing adequately permits moisture and gases to permeate the casing.

60. The method of claim 49, wherein the casing is suitable to encase meat that is to be cooked or smoked in the casing, and wherein the casing adequately prevents moisture and at least some gases from permeating the casing, but permits at least some smoke to penetrate the casing.

61. The method of claim 49, wherein the silicon-based barrier control agent concentration in the film is in the range of from about 0.1 % to about 20 % by weight.

62. The method of claim 61, wherein the silicon-based barrier control agent concentration in the film is in the range of from about 0.1 % to about 5 % by weight.

63. The method of claim 62, wherein the silicon-based barrier control agent concentration in the film is in the range of from about 0.2 % to about 1 % by weight.

64. The method of claim 49, wherein the film has a film thickness in the range of from about 6 microns to about 80 microns.

65. The method of claim 64, wherein the film has a film thickness of from about 20 microns to about 30 microns.