CONTROLLED ATMOSPHERE PACKAGE FOR BANANAS

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A controlled atmosphere package for respiring fruits and vegetables, particularly for bananas, is disclosed. The package has a convex outer wall and an atmosphere control element that comprises at least one hole in the container bottom which is placed close to the wall opposite the convex wall. A selective gas-permeable membrane is attached to the container bottom in such a way that the atmosphere control element is hermetically covered by the membrane.
CONTROLLED ATMOSPHERE PACKAGE FOR BANANAS

FIELD OF THE INVENTION

[0001] The invention relates to the field of packaging fruits and vegetables and, in particular, to designs of controlled atmosphere banana packages.

BACKGROUND OF THE INVENTION

[0002] During the processes of storing and transporting bananas, starting from harvest, going through delivery into the distribution network, and finally until the bananas are brought directly to the consumer, it is necessary to ensure certain storage conditions.

[0003] The storage conditions can be characterized by defined temperature, moisture, and gas medium composition surrounding the bananas. If the storage conditions are not adhered to, the bananas will not be delivered to the consumer in the required condition, for example, in terms of ripeness of the product, and will even spoil. In particular, during transport and storage the bananas are packaged into boxes as clusters in their green, non-ripe condition. These boxes are assembled in stacks and are placed into big transportation containers. During the process of loading and transport, a temperature between 56-59°F is maintained. At such temperatures, the bananas can be stored for a long time.

[0004] To start the ripening process, the temperature must be increased to 60-62°F and the gas composition surrounding the bananas must be modified by adding ethylene to it. The combination of ethylene and increased temperature helps to start the ripening process.

[0005] Further on, when the bananas are delivered to the distribution network, they should not ripen too quickly, should not spoil, should preserve good market condition, and the buyer should be able to view the bananas. Such requirements lead to the necessity to create special packages, which provide for both the change in the gas medium composition surrounding packaged bananas and the preservation of their market condition.

[0006] Inventions are known in the art that are related to transportation and storage of bananas, and which address the indicated tasks of packaging, transportation, and storage.

[0007] In EPO Published Application EP 752378, "Controlled atmosphere package for fruit and packaging method", published Jun. 13, 2001, a packaging for fruits, in particular, for bananas, is described that includes no less than one hermetically sealed bag with at least one unripe fruit placed inside it; the bag being made of a polymer film material, the thickness of which is 20-50 μm and is filled with a modified atmosphere. The polymer material can be low-density polyethylene, polyethylene, high-density polyethylene, polypropylene, polyethylene terephthalate, and other materials. The modified atmosphere includes 2-20% oxygen (vol.), from 6-13% carbon dioxide (vol.), and from 0.1-1.5% ethylene (vol.), with the remainder being nitrogen.

[0008] In U.S. Pat. No. 6,013,293, "Packing respiring biological materials with atmosphere control member", De Moor, issued Jan. 11, 2000, a package is described that ensures the necessary gas composition in storage of fruits and vegetables, as well as other respiring biological materials. A selective gas-permeable membrane, which is a part of this package, conducts oxygen at a lower rate than other gases, in particular, carbon dioxide and ethylene. Using such a membrane in banana storage is said to ensure optimal conditions of banana ripening.

[0009] In U.S. Pat. No. 6,548,132, "Packaging biological materials", Clarke et al., issued Apr. 15, 2003, a package is described that includes a sealed container, respiring biological material, and a gas medium inside the container. The container has walls that are relatively impermeable to oxygen and carbon dioxide, and is equipped with an atmosphere control element inside the container. The control element includes a gas-permeable membrane, consisting of a microporous film in the form of a polymer matrix, having a network of gas-impermeable pores and a polymer coating applied over the film. The package is said to ensure the generation of a gas medium inside the container which is favorable for storing respiring biological materials.

SUMMARY OF THE INVENTION

[0010] The invention herein provides for the long term storage of bananas prepared for sale utilizing a modified gas medium composition, is easy to manufacture, convenient to use, and ensures a good packing factor for the bananas. The packaging enhances the freshness of the bananas whether they are stored at the warehouse, grocery store, or on a consumer's kitchen counter. Also, at the grocery store, this packaging provides display of bananas, so that consumers can select them.

[0011] The controlled atmosphere package for bananas includes a container with an atmosphere control element. In use, bananas, usually no less than two bananas, are placed inside the container. The container has walls and a bottom, the upper part of the container is sealed with a polymer film. One of the container walls is embodied in such a way that it has a convex side which is turned outwards. An atmosphere control element is placed near the wall of the container which is opposite to the convex wall, and is embodied as a hole in the container bottom. A selective gas permeable membrane is secured to the container bottom in such a way that a hermetic seal covers the holes by said membrane. The bananas are placed closely together with their convex side facing the convex wall of the container.

[0012] The packaging herein claimed enables packing bananas in the container in a row, fairly densely, without significant gaps. The packaging also provides the necessary gas medium composition near each banana, since it is equipped with an atmosphere control element that is located near the wall, opposite to the convex side of the container. Due to the packaging design and

[0013] the positioning of the atmosphere control element near the container wall, the body of the banana, which is located near the wall in a fixed position, does not obstruct the atmosphere control element since the banana has a curved shape. Polymer film that covers the roof of the container leaves gaps between the bananas. Through these gaps, the gas medium inside the container comes into contact with the atmosphere control element and interacts with the surface of each banana.

[0014] To achieve the non-compressibility of packaging, the walls and the bottom of the container could be embodied as rigid. The walls and/or bottom of container could also be embodied as transparent to allow the consumer to view the bananas.

[0015] The upper part of the container walls can be equipped with collars that are convenient to attach to the polymer film, thus ensuring the package is sealed.

[0016] To achieve a convenient arrangement of several packages in a stack, convex areas facing outwards could be created in the corners of the container bottom. The convex areas of the package create a gap between packages when...
they are stacked. This allows air to reach the atmosphere control element in the bottom of container.

[0017] The selective gas-permeable membrane could be attached to the container bottom from the inside. In this case, better protection of the membrane is provided for. During storage when several packages are arranged in a stack, this membrane position insures free access of outside air to the membrane due to the presence of gap between containers created by said convex areas.

[0018] The selective gas-permeable membrane could be attached to the container bottom in such a way that the area of generated membrane parts, which are not attached to the container bottom, will be greater than the area of the said holes. The membrane can also be attached to the container bottom along its perimeter, so that an area of the middle part of the membrane, which is not attached to the bottom, will be greater than the area of the said holes.

[0019] To provide for the required gas atmosphere inside the package, which is preconditioned by the ratio of oxygen content to the content of CO₂, the area of the part of the gas-permeable membrane that stays in contact with the atmosphere should be definite, depending upon the container dimensions. However, it is not always feasible to make the size of the holes in the container equal to the necessary area of the membrane because the larger the holes, the greater the risk of damaging the membrane during packaging. Therefore, it is suggested to make the hole area less than the area of the parts of the membrane that are not attached to the container bottom, because during the gas exchange process, pressure inside the package is less than the atmospheric pressure and part or parts of the membrane that are not attached to the bottom will be pushed inside the container (in a concave manner) and will efficiently operate during the process of gas exchange.

[0020] The container bottom, where the holes of the atmosphere control element are located, can be convex. This embodiment solves the following problems:

[0021] there is decreased risk of damaging the gas-permeable membrane, since the holes for the atmosphere control element are raised above the plane of the package bottom; and

[0022] there is no need to introduce additional convex areas to ensure air accesses the holes of the atmosphere control element.

[0023] Bananas of roughly equal degree of curvature can be placed inside the container, to ensure the highest packing factor.

[0024] If there is a need to place bananas of different curvature inside the container, a banana with a lesser curvature should be placed near the convex wall, which prevents the atmosphere control element from being covered by the body of the banana.

[0025] When bananas of different curvature degree are placed inside the container, bananas could be arranged in an order, which implies that the degree of curvature increases with the increase of the distance between the banana and the convex wall of the container. Such arrangement of the bananas also prevents the atmosphere control element from being covered by the body of banana.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] The invention is illustrated with the following drawings.

[0027] In FIG. 1 the general view of the package is presented as seen from above, in FIG. 2—as seen from above, with bananas inside. FIG. 3 presents a lateral cross-section view of the package and FIG. 5 presents the package as seen from below. FIG. 4 presents the cross-section of the package near the collar. FIG. 6 and FIG. 7 show fragments of the container bottom from above with different options for the embodiment of the atmosphere control element. FIG. 8 and FIG. 9 present cross-sections of the container bottom with different options for the embodiment of the atmosphere control element.

[0029] FIG. 10 shows an option of embodying the package with a convex section of the container bottom where the holes of the atmosphere control element are located—view from above. FIG. 11 shows the lateral view of the same option. FIG. 12 shows another option of embodying a convex area of the container bottom where the atmosphere control element is located—view from above.

[0030] FIG. 13 presents the cross-section of the container bottom.

DETAILED DESCRIPTION OF THE INVENTION

[0031] Banana packaging with a controlled atmosphere (FIG. 1-FIG. 3, FIG. 5) includes a container (1) with an atmosphere control element (2) and bananas (3) placed inside the container (1). The container (1) has walls (4) with collars (5) and a bottom (6). From above, the container (1) with bananas (3) is closed with a polymer film (7) that is hermetically secured on the collars (5). One of the walls (8) has an outward convex shape. The atmosphere control element (2) is placed near the wall (9) of the container (1) in a concave manner and will efficiently operate during the process of gas exchange.

[0032] The container (1) or there can be multiple holes (10) (FIG. 6). The holes can be arranged in different ways, for example, in a line or in a circle, in the cases illustrated it is reasonable that the group of holes (10) would be covered by one membrane (11).

[0033] On the bottom (6) of the container (1) there are convex areas (12) (FIG. 3, FIG. 5) used to arrange a number of packages into a stack. This would allow air to flow between the stacked containers.

[0034] A gas-permeable membrane can be composed of a micro-porous film in the form of a polymer matrix, providing for a network of gas-permeable pores. The material used for the selectively gas-permeable membrane (11) can be an industrially manufactured FreshPak membrane commercially available from Landec. Examples of such membranes are disclosed in U.S. Pat. Nos. 6,376,032 and 6,548,132, and PCT Application WO 03/043447, all incorporated herein by reference.

[0035] Besides the indicated material, other multi-layer materials can be used:

[0036] for example, Amcor-P-Plus Microperforated film, Ceyrave Oxygen Permeable multiplayer film (U.S. Pat. No. 6,294,210), Reusable Air Permeable Film (US Patent Application 2005/003150), Bubble Films (PCT Application WO 2005/068194), as well as one-layer films: Stepae Film, pala Fresh, Fresh Span MACP, Fresh Hold Packaging, Silicone Membrane, Teflon AF 2400 and Branched Polyolefin Membrane (U.S. Pat. No. 6,812,314).

[0037] The membrane (11) (FIG. 6 and FIG. 7) is secured to the bottom (6) to hermetically seal the holes (10). In this case, the holes (10) should be small in diameter so that the membrane (11) does not become damaged during the packaging
process. However, to ensure the required rate of gas exchange of the internal medium of the package with the atmosphere, which is ensured by the corresponding surface of the membrane (11) staying in contact with the atmosphere, its area should be higher than the total area of the holes (10). This is ensured by the corresponding attachment of the membrane (11). Part (13) of the membrane (11) is attached along the perimeter (FIG. 6, FIG. 8) or around the holes (FIG. 7, FIG. 9) to the bottom (6) of the container (1), leaving parts (14) of the membrane (11) unattached.

[0038] The bottom (6) of the container (1), shown in FIG. 10 and FIG. 11, has a convex section (15) that faces the inside of the container (1) where the atmosphere control element (2) is located. Holes (10) are located on the convex section (15) of the container (1). The wall (16) of section (15) is embodied as curvilinear and convex in the direction of the wall (8). This embodiment will make the container (1) more rigid, stronger, and will prevent the membrane (11) from accidental damage. Also, no additional convex sections need to be introduced into the design of the bottom (6) of the container (1) because even when stacked, the containers allow access for air to the atmosphere control element (2).

[0039] FIG. 12 and FIG. 13 represent another option for the convex section (15). If there are no design elements in the bottom (6) of the container (1) to create a gap near the bottom (6) that allows air to access the holes (10), then a convex section (15) can be located near the wall (9).

[0040] During the packaging process, bananas (3) are placed in the container (1) with the atmosphere control element (2). Bananas (3) are placed in a row close to one another and are arranged with their convex side to the wall (8) of the container (1) (FIG. 2).

[0041] Bananas (3) with a similar curvature are placed inside the container (1). If bananas (3) with different curvatures are placed inside the container (1), bananas with a lesser curvature should be placed near the convex wall (8). In this case, bananas (3) could be arranged so that the curvature of the bananas increases as the distance increases between the banana and the convex wall of the container. Such arrangement of the bananas (3) allows them to be packed densely. Due to the curvature of the banana that is placed near the wall (9), access of the internal gas medium to the unattached parts (14) of the membrane (11) is not blocked.

[0042] Bananas (3) can be placed inside the container in one layer, or in several layers.

[0043] Also, the polymer film (7) is hermetically secured on the collars (5) of the walls (4) of the container (1). This film prevents the access of atmospheric air to the packaged bananas and finishes the formation of the assembled package.

[0044] While the bananas are being stored in the package, atmospheric air passes through the holes (10) in the bottom (6) of the container (1) to the external side of the unattached parts (14) of the membrane (11). Through gas permeable parts (14) of the membrane (11), gas exchange occurs by the difference in concentration of gas medium components inside the package (1) and the external atmospheric air. An atmosphere is generated inside the package, which has an oxygen content that is lower than that of atmospheric air (approximately 2-4%) and carbon dioxide content which is higher than that of atmospheric air (approximately 4-7%).

[0045] Concentration of oxygen and of carbon dioxide is maintained inside the package due to atmosphere control element during the entire period of banana storage (at the warehouse, grocery store, during the display of bananas on the counter), so that the customer could observe them, and even during the storage of the purchased banana pack on the customer’s kitchen counter, on condition that it has not been opened.

What is claimed is:
1. A controlled atmosphere package, which comprises a container with an atmosphere control element, wherein the said container has walls, a bottom, and is sealed hermetically from above by a polymer film; wherein one of the container walls is of an outward convex shape, the atmosphere control element comprises one or more holes in the container bottom and is placed near the wall which is opposite to the convex wall, and wherein a selective gas-permeable membrane is attached to the container bottom in such a way that the said holes are hermetically covered by part of the said membrane.
2. The package of claim 1 which contains at least two bananas.
3. The package of claim 2 wherein said bananas are placed close to one another near the container walls and the convex side of each banana is facing the container wall which is shaped convexly outward.
4. The package of claim 3, wherein the container walls and bottom are rigid.
5. The package of claim 3, wherein the container walls are transparent.
6. The package of claim 3, wherein the container bottom is transparent.
7. The package of claim 3, wherein collars are present on top of the container wall and the said polymer film is attached hermetically to the said collars.
8. The package of claim 3, wherein the corners of the container bottom include convex outward areas.
9. The package of claim 3, wherein the said selective gas permeable membrane is attached to the container bottom from the inside.
10. The package of claim 9, wherein the said membrane is attached to the container bottom in such a way that there are membrane parts that are not attached to the container bottom and the area of these parts is greater than the area of the said holes.
11. The package of claim 9, wherein the said selective gas permeable membrane is attached to the container bottom along the membrane perimeter in such a way that the middle part of the membrane is not attached to the container bottom and the area of this part is greater than the area of the said holes.
12. The package of claim 9, wherein the container bottom in the place where the said holes are located is a convex section that faces the inside of the container.
13. The package of claim 3, wherein the bananas with the similar surface curvature are placed in the container.
14. The package of claim 3, wherein a banana with a lesser surface curvature is placed near the convex wall of the container.
15. The package of claim 3, wherein the bananas placed in the container are characterized by surface curvature that increases as the bananas are placed further away from the convex wall of the container.