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(54) DYNAMIC MODIFIED ATMOSPHERE PACKAGE SYSTEM

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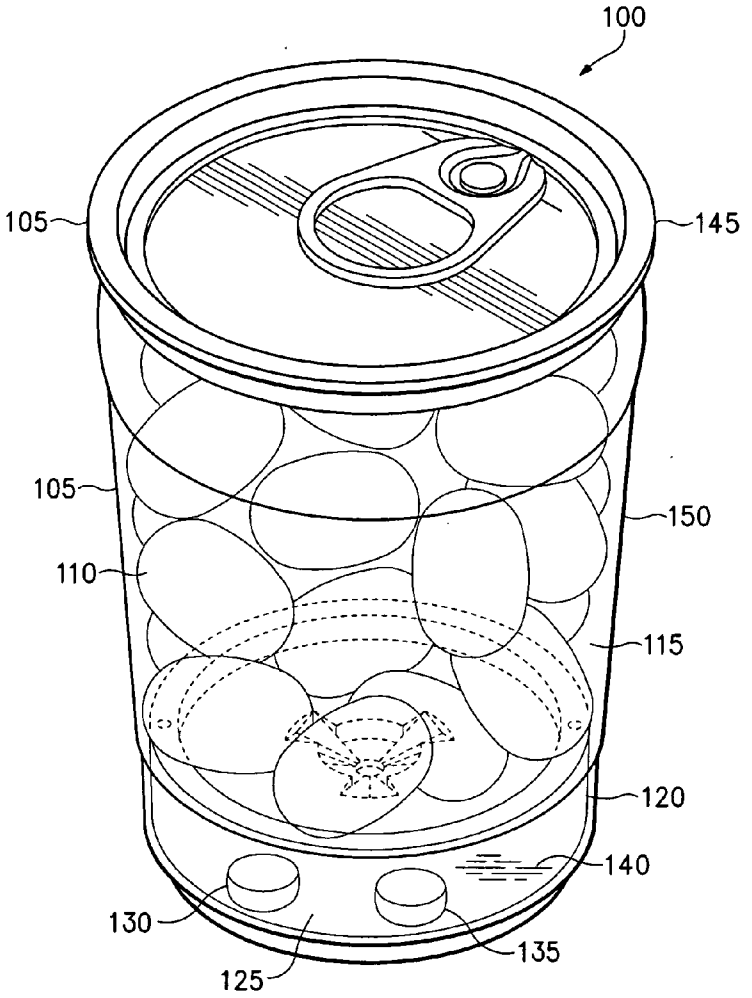
(57) **ABSTRACT**

A dynamic modified atmosphere package system providing a package comprising, according to one embodiment, a sealable container having a first interior space for holding a quantity of product and a second interior space separated from the first interior space, the sealable container configured so that a liquid is able to pass from the first interior space into the second interior space, the liquid becoming substantially trapped within the second interior space, and the sealable container configured so that a gas is able to vent from the second interior space into the first interior space. In one embodiment, the package is capable of providing a pressurized gaseous modified atmosphere for a quantity of product such as, for example, fresh-cut fruits or vegetables. In one embodiment, the package is capable of providing a pressurized carbon dioxide rich atmosphere for carbonating or maintaining the carbonation of a quantity of fruits or vegetables. In one embodiment, an optimum amount of oxygen is provided to avoid harmful anaerobic conditions. In one embodiment, the package includes a pull-tab lid with additional features to slow the release of pressure when the pull-tab lid is opened to access the first interior space and the quantity of product therein.



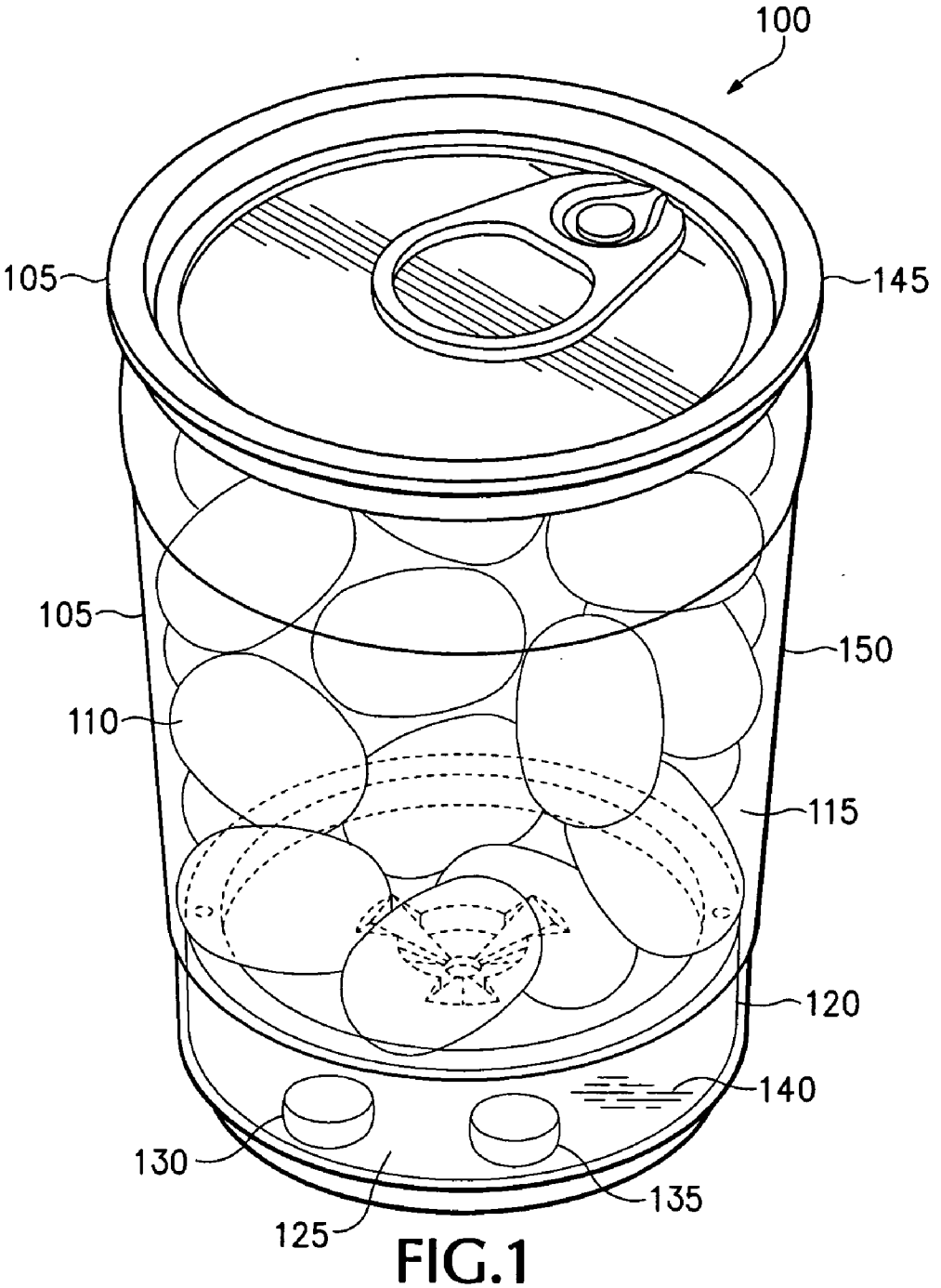


FIG.1

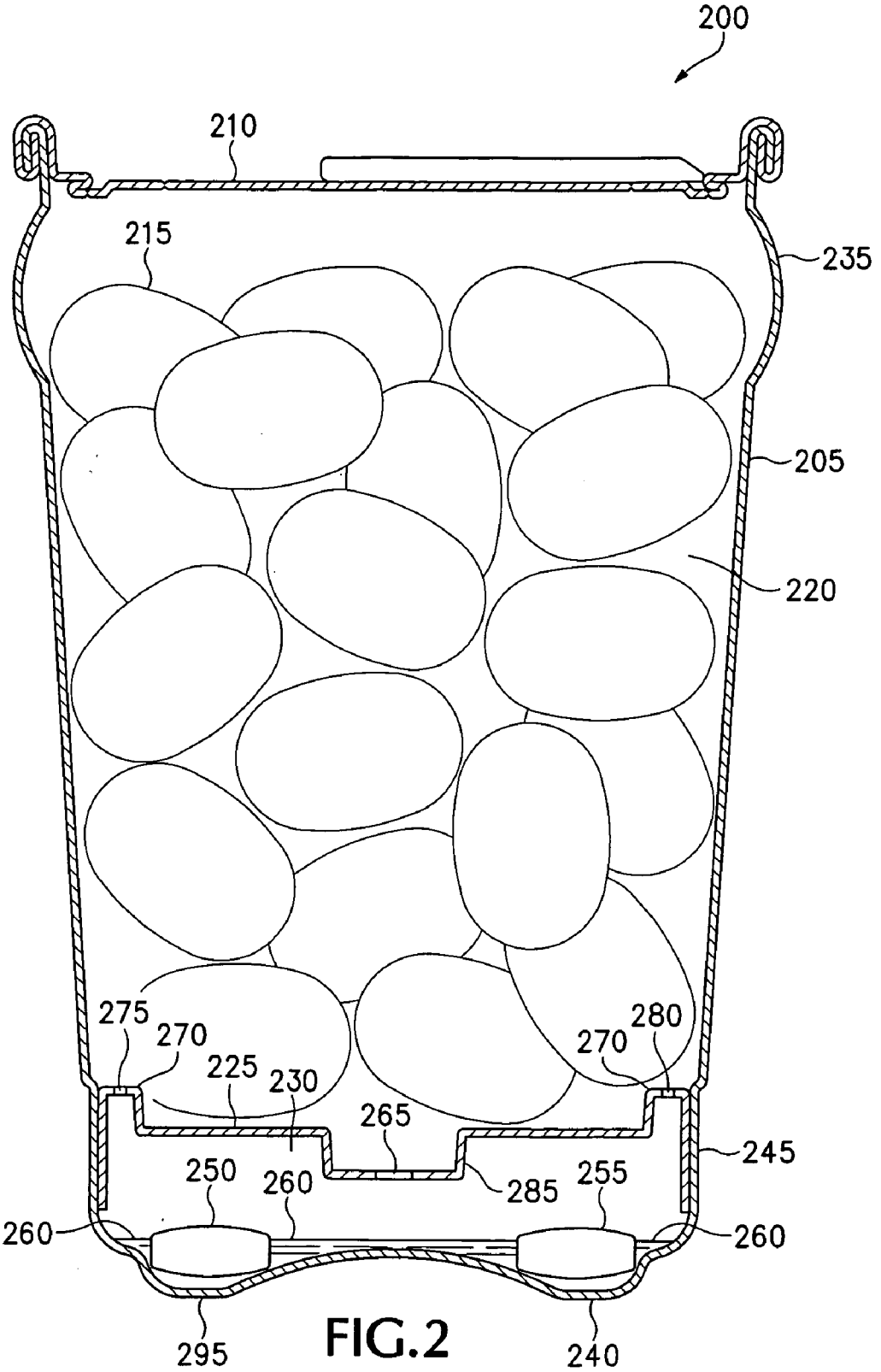

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FIG.2

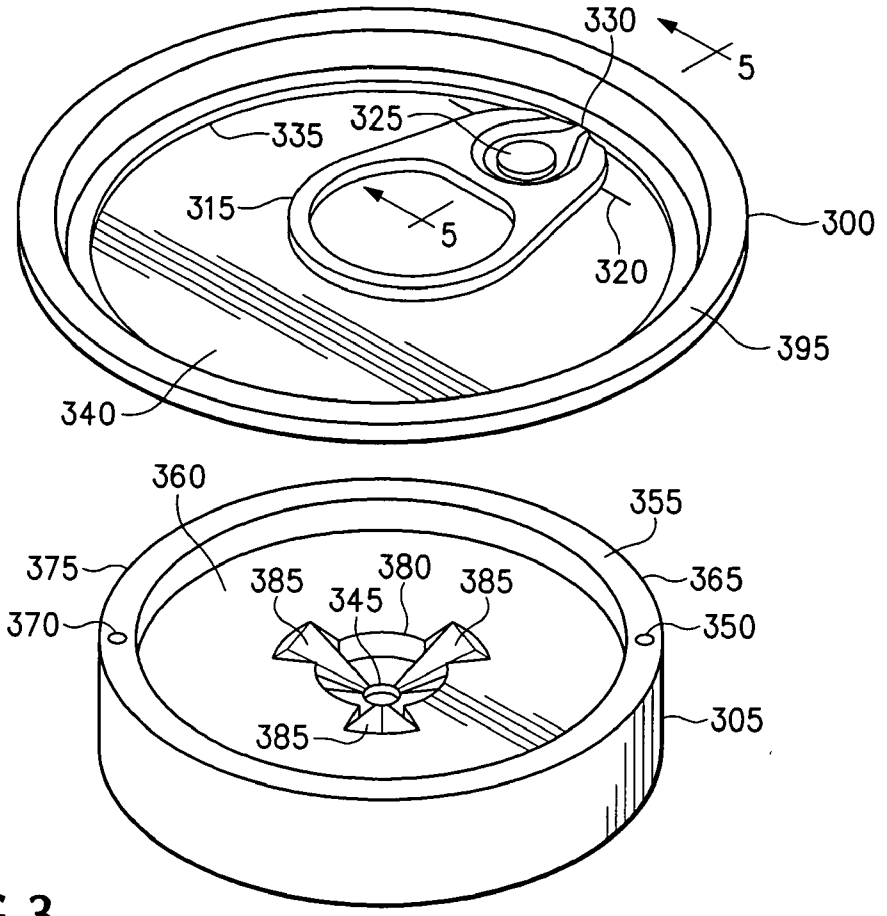
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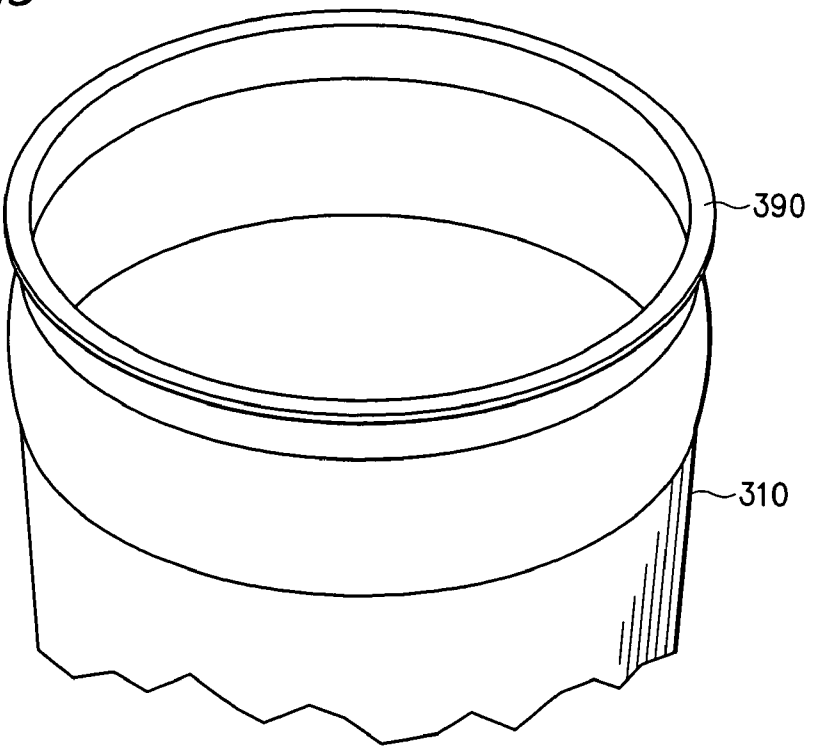
FIG.3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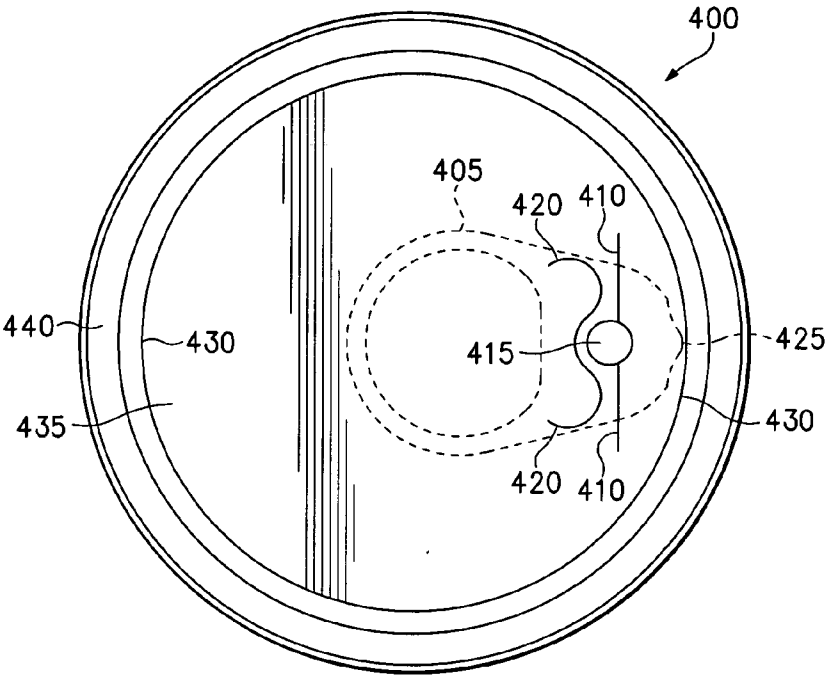

FIG.4

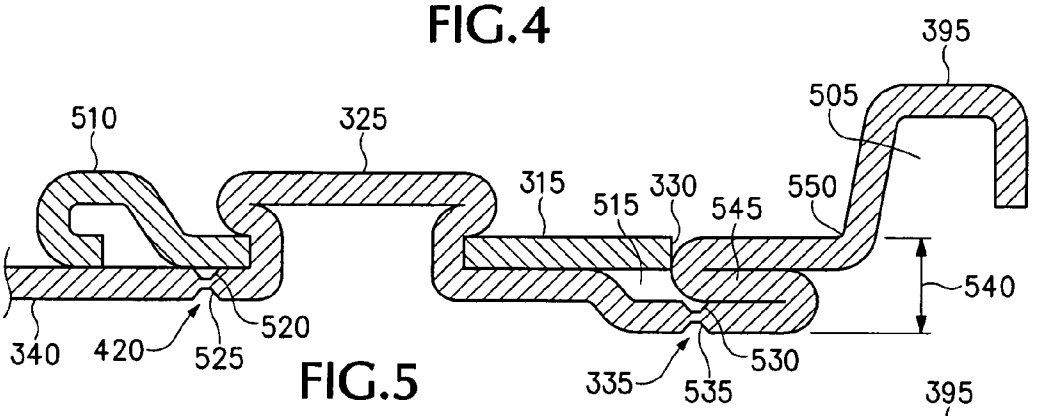

FIG.5

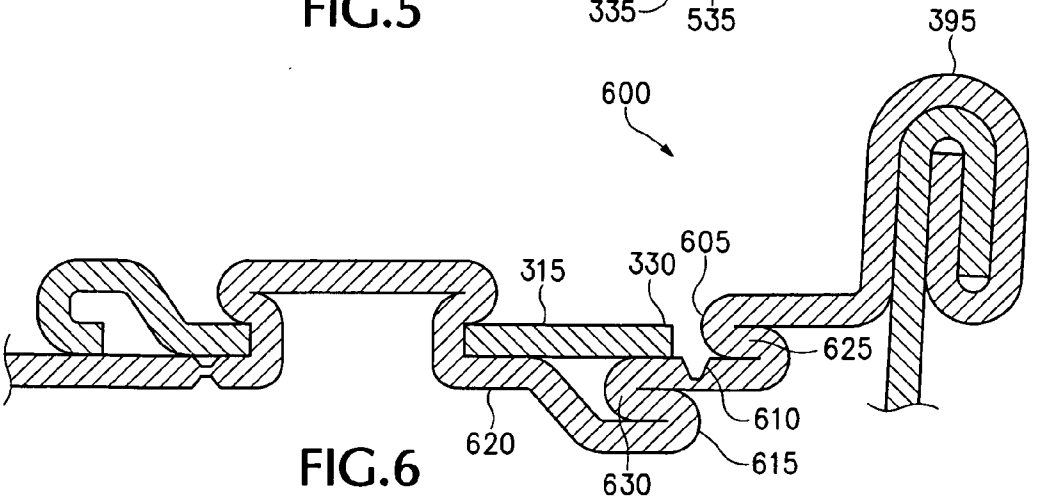

FIG.6

DYNAMIC MODIFIED ATMOSPHERE PACKAGE SYSTEM

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a dynamic modified atmosphere package system. More particularly, the present invention relates to a dynamic modified atmosphere package system for providing a pressurized gaseous environment for a quantity of product.

[0002] Modified atmosphere packaging generally refers to the practice of modifying the composition of the internal atmosphere or headspace of a package in order to improve the shelf-life of the product. The product is typically a food product but may also include pharmaceuticals or other types of products. The modification usually involves attempts to lower the amount of oxygen in order to slow down the growth of aerobic organisms and the speed of oxidation reactions. The removed oxygen is typically replaced with nitrogen, commonly known as an inert gas, or carbon dioxide, which can lower the pH or inhibit the growth of bacteria.

[0003] In the context of food products, modified atmosphere packaging is generally considered a technique used for prolonging the shelf-life of fresh or minimally processed foods. In this preservation technique, the air surrounding the food in the package is changed to another composition using, for example, a gas-flush process. The initial fresh state of the food may be prolonged by slowing the natural deterioration of the food product. Respiring foods such as fruits and vegetables continue to take in oxygen and give off carbon dioxide as they continue to respire and ripen after harvest. Refrigeration and controlled atmosphere storage methods may be used to retard the ripening process. Reducing temperature slows the produce metabolism, including the rate of respiration. Under controlled atmosphere storage, respiration and ripening may be reduced further by lowering the oxygen content of the air, which normally consists of approximately 21% oxygen, 78% nitrogen, and 1% other elements.

[0004] Low permeable/high barrier packaging films are typically used for non-respiring foods such as meat, fish, and cheese. By contrast, permeable or semi-permeable packaging films are typically used for respiring foods such as fruits and vegetables. Such packaging films are typically engineered with enough permeability to allow carbon dioxide concentrations to build within the package, thereby slowing the respiration rate of the produce, and oxygen levels to remain low (1%-5%) to prevent anaerobic fermentation. If the permeability of the film, for oxygen and carbon dioxide, is adapted to the particular respiration rate of the product, an equilibrium modified atmosphere may be established in the package. Such equilibrium modified atmosphere packaging may be used to increase the shelf-life of fresh-cut produce by reducing respiration and ethylene production rates, delaying senescence, and inhibiting the growth of spoilage organisms.

[0005] However, these modified atmosphere packaging techniques necessarily rely on various permeable or semi-permeable films, or barrier films, and are incapable of retaining a positive pressure atmosphere within the package. Currently available modified atmosphere packaging techniques and packaging systems are not suitable for products requiring a positive pressure atmosphere within the package or for products that might benefit by having a positive pressure atmosphere within the package.

[0006] One example of a package capable of retaining a positive pressure atmosphere within the package is a tennis ball can (or tennis ball tube). The air pressure inside a tennis ball is typically 12 psi (pounds per square inch) greater than the ambient air pressure at sea level. Over time, air escapes from the inside of the ball causing a decrease in the amount of air pushing on the inside of the ball and, consequently, decreasing the bounce characteristics of the ball. To prevent the ball from becoming "flat," the ball is packaged in a positive pressure tube, with the tube pressurized to around 12 psi, which is enough to prevent air from escaping from the inside of the ball. Although a tennis ball can or similar package may be capable of retaining a positive pressure, such a package does not include capabilities for dynamically modifying the elements comprising the atmosphere within the package.

[0007] A dynamic modified atmosphere package system that provides a pressurized gaseous environment would be useful, for example, for the carbonated fruits or vegetables products described in U.S. Pat. No. 5,968,573, U.S. patent application Ser. No. 10/857,043, U.S. Provisional Application Ser. No. 60/699,450, and U.S. patent application Ser. No. 10/304,197, all commonly owned or licensed by The Fizzy Fruit Company and herein incorporated by reference. The described carbonated fruits or vegetables products generally include fruits or vegetables that have absorbed enough carbon dioxide so that the fruits or vegetables have acquired an effervescent or "fizzy" quality. The absorbed carbon dioxide tends to remain absorbed within the tissue of the fruits or vegetables for a longer period of time when the carbonated fruits or vegetables are maintained in a pressurized carbon dioxide rich atmosphere.

[0008] What is needed, therefore, is a dynamic modified atmosphere package system that addresses the above and other shortcomings. A dynamic modified atmosphere package system is needed that is capable of providing a pressurized gaseous modified atmosphere for a quantity of product such as, for example, fresh-cut fruits or vegetables.

SUMMARY OF THE INVENTION

[0009] A dynamic modified atmosphere package system is described herein that overcomes the shortcomings of prior art modified atmosphere package systems by providing a dynamic modified atmosphere package comprising, in one embodiment, a sealable container having a first interior space for holding a quantity of product and a second interior space separated from the first interior space, the sealable container configured so that a liquid is able to pass from the first interior space into the second interior space, the liquid becoming substantially trapped within the second interior space, and the sealable container configured so that a gas is able to vent from the second interior space into the first interior space.

[0010] In one embodiment, the package is capable of providing a pressurized gaseous modified atmosphere for a quantity of product such as, for example, fresh-cut fruits or vegetables. In one embodiment, the package is capable of providing a pressurized carbon dioxide rich atmosphere for carbonating or maintaining the carbonation of a quantity of fruits or vegetables.

[0011] In one embodiment, an optimum amount of oxygen is provided to avoid harmful anaerobic conditions. In one embodiment, sodium bicarbonate and citric acid placed in the second interior space of the package is mixed with water

to produce carbon dioxide, and sodium percarbonate placed in the second interior space is mixed with water to generate oxygen.

[0012] In one embodiment, the package includes a pull-tab type lid with additional features to slow the release of pressure when the pull-tab lid is opened to access the first interior space and the quantity of product therein.

[0013] In one embodiment, the package may comprise a clear plastic cup having a separating member that may be inserted into the cup after gas generating tablets have been placed in the bottom of the cup. In one embodiment, a quantity of product is placed within the interior space above the insert, water is added, and a metallic pull-tab lid is sealed over the opening of the cup. In one embodiment, a pressurized atmosphere rich in carbon dioxide is generated, and enough carbon dioxide is absorbed by the tissue of fruits or vegetables within the sealed package so that the fruits or vegetables acquire an effervescent or "fizzy" quality.

[0014] In various embodiments, a quantity of fruits or vegetables is placed within the sealed package, the package is sealed, and, at a time thereafter, mechanical mixing means are used for initiating carbonation of the fruits or vegetables. The mechanical mixing means may involve rupturing membranes filled with the reactants for generating carbon dioxide and oxygen, thereby initiating the carbonation of the fruits or vegetables. The sealed package may include a separating member having at least one gas vent hole for allowing the generated carbon dioxide and oxygen to surround the fruits or vegetables, the separating member configured without a liquid passage hole and with the gas vent hole sized to prevent the passage of liquid through the separating member.

[0015] The foregoing and other objectives, features, and advantages of the invention will be more readily understood upon consideration of the following detailed description of the invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] For a more complete understanding of the present invention, the drawings herein illustrate examples of the invention. The drawings, however, do not limit the scope of the invention. Similar references in the drawings indicate similar elements.

[0017] FIG. **1** is a perspective view of a dynamic modified atmosphere package system according to one embodiment.

[0018] FIG. **2** is a cross-sectional view of a dynamic modified atmosphere package system according to one embodiment.

[0019] FIG. **3** is an exploded view of selected components of a dynamic modified atmosphere package system according to one embodiment.

[0020] FIG. **4** is a bottom view of a pull-tab type lid according to one embodiment.

[0021] FIG. **5** is a cross-sectional view of a pull-tab type lid according to one embodiment.

[0022] FIG. **6** is a cross-sectional view of a pull-tab type lid with double cut protection, according to one embodiment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0023] In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, those skilled in the art will understand that the present invention may be practiced without these specific details, that the present invention is not limited to the depicted embodiments, and that the present invention may be practiced in a variety of alternative embodiments. In other instances, well known methods, procedures, components, and systems have not been described in detail.

[0024] Various operations will be described as multiple discrete steps performed in turn in a manner that is helpful for understanding the present invention. However, the order of description should not be construed as to imply that these operations are necessarily performed in the order they are presented, nor even order dependent. Lastly, repeated usage of the phrase "in one embodiment" does not necessarily refer to the same embodiment, although it may.

[0025] As an overview, the present inventors set out to develop the concept of packaging carbonated (or "fizzy") fruits or vegetables (or other products) in a modified atmosphere of pressurized carbon dioxide. One embodiment of a suitable package incorporates an internal release of carbon dioxide from within the package by using a source of carbon dioxide that can produce a volume of carbon dioxide inside the package that, upon sealing the package, would pressurize the package with enough carbon dioxide for carbonating fruits or vegetables within the package to achieve a sufficient carbonation level within the tissue or fleshy parts of the fruits or vegetables. In one embodiment, it was found that a sealed package having therein between thirty and forty pounds per square inch of pressurized carbon dioxide is enough pressurized carbon dioxide to adequately carbonate a portion of fresh-cut grapes.

[0026] The present inventors experimented with, in one embodiment, using a pellet of dry ice for generating pressurized carbon dioxide within a package. However, it was determined that while such a pellet does comprise a suitable gas generating substance, and is, therefore, to be included as an acceptable gas generating substance in at least one embodiment, the handling of dry ice is not easily accommodated in typical fruit (or food) processing environments. The present inventors subsequently found that a dry powder mixture of sodium bicarbonate and citric acid (or other appropriate carboxylic base and acid) which when activated by water or a water-based solution would generate the requisite volume of carbon dioxide to pressurize the package.

[0027] It was further determined that sodium percarbonate or a food grade hydrogen peroxide or a combination of the two or another substance may be used to generate oxygen within the package so that the modified atmosphere includes enough oxygen to avoid the growth of anaerobic bacteria. As the fruits or vegetables continue to respire and ripen within the package, oxygen is consumed and carbon dioxide is produced. The present inventors found that, unlike any other modified atmosphere or pressurized package system or method, by generating within the sealed package pressurized

carbon dioxide as well as enough oxygen to prevent anaerobic conditions, the atmosphere within the sealed package may be dynamically modified to achieve a desired gaseous composition, even as the fruits or vegetables (or other products) continue to ripen, respire, or otherwise affect the composition of the atmosphere within the sealed package. In one embodiment, a gas generating substance may be included so that the resulting modified atmosphere includes or maintains a level of approximately two to three percent oxygen.

[0028] The present inventors further determined that other combinations of gas generating substances and suitably corresponding liquids (or "reactants") may be used with a suitably designed package system for carbonating products (such as fruits or vegetables) within a package and for prolonging the shelf-life of such products. In one embodiment, sodium bicarbonate and citric acid may be activated with water to generate carbon dioxide in a separated space within the package, and the separated space may be configured to prevent unreacted reactants and residual solution formed in the reaction from coming into contact with and possibly tainting the flavor of fruits or vegetables in the package. It was found that such contact may cause an unpleasant or salty taste in, for example, a "fizzy" fruit product.

[0029] Additional improvements are included, as will be discussed below for various embodiments, to provide suitable strength and commercially viable characteristics for a dynamic modified atmosphere package system. Such improvements include, but are not limited to, using transparent material for display of the product contained in the sealed container, fabricating the sealable container using semi-rigid material and with ribs and other features to improve pressure retention characteristics, sizing and positioning gas vent holes to allow gas flow and prevent liquid flow, sizing and positioning any liquid passage hole to allow for a desired gas generating reaction rate yet prevent liquid from fouling or tainting the product, including mechanical means for initiating carbonation of the product after sealing the package, designing a pull-tab type lid for the package that incorporates opening features for slowing the release of pressure when opening the pressurized package, and other aspects described or depicted in the drawings.

[0030] Turning now to the drawings, FIG. **1** is a perspective view of a dynamic modified atmosphere package system **100** according to one embodiment. The dynamic modified atmosphere package system **100**, as shown, includes a sealable container **105** capable of retaining a positive pressure, a quantity of product **110** within a first interior space **115** within the sealable container **105**, a separating member **120** within the sealable container **105** separating the first interior space **115** from a second interior space **125** within the sealable container **105**, a gas generating substance **130**, **135** within the second interior space **125** within the sealable container **105**, and a predetermined quantity of a liquid **140** capable of reacting with the gas generating substance **130**, **135** within the second interior space **125** to generate a pressurized carbon dioxide rich atmosphere within the first and second interior spaces **115** and **125**, the pressurized carbon dioxide rich atmosphere also including enough oxygen to avoid anaerobic conditions associated with the quantity of product **110**. Also as shown, the sealable container **105** may include a pull-tab type lid **145** sealing an opening to the first interior space **115**.

[0031] The sealable container **105** may be made from any of a wide variety of materials and may be formed into any of a wide variety of shapes. For example, as shown in FIG. **1**, the sealable container **105** may be formed from a transparent material such as a transparent plastic and may be formed into the shape of a cup **150**. As will be appreciated, other shapes and materials may be used. For instance, the cup **150** may be substantially cubic with a square or rectangular base instead of the substantially cylindrical shape shown, and the cup **150** may be made of an opaque or colored material.

[0032] In one embodiment the sealable container **105** is capable of retaining a positive internal pressure of at least thirty pounds per square inch (psi). The sealable container **105** may be designed to retain an internal pressure of between thirty and forty pounds per square inch. To accommodate this positive pressure, a rigid or semi-rigid material may be used. For example, the sealable container **105** may comprise a cup **150** made of polyethylene terephthalate (PET) or a similarly formable semi-rigid material and a metallic pull-tab type lid **145** sealed about the opening of the cup **150**. The pull-tab type lid **145** may be an aluminum pull-tab type lid, or the lid **145** may be made of another material or combination of materials such as laminated or composite materials. In one embodiment, the sealable container **105** includes a pull-tab type lid **145** that may be opened to expose the quantity of product **110** within the first interior space **115** of the sealable container **105** by pulling a pull-tab **155** outward, away from the lid **145** and cup **150**, similar to fruit or pudding cups using similar pull-tab type lids.

[0033] In one embodiment, the pull-tab type lid **145** opens to expose a four ounce or eight ounce volume within the first interior space **115**, suitable for holding a quantity of product **110**. The product is typically a food product but may include pharmaceuticals or other types of products. The quantity of product **110** may include, for example, a portion of fruits or vegetables, where reference to "a portion of fruits or vegetables" is used herein to refer to a portion of any one or any combination of the following: a single type of fruit, a mixture of different types of fruit, a single type of vegetable, a mixture of different types of vegetable, or a mixture of one or more types of fruit and one or more types of vegetable. For example, the fruits or vegetables may comprise fresh-cut whole grapes, de-stemmed grapes mixed with strawberries, a particular type of fruit mixed with a particular type of vegetable, or any other combination of fruits or vegetables. The fruits or vegetables may comprise fresh-cut or minimally processed fruits or vegetables but may also include fruits or vegetables that have been processed. The fruits or vegetables may comprise fruits or vegetables that have been carbonated before placement into the first interior space **115** of the sealable container **105**.

[0034] In one embodiment, the separating member **120** separates the first interior space **115** from the second interior space **125** and includes at least one gas venting hole configured so that gas generated by the gas generating substance **130**, **135** is able to vent from the second interior space **125** into the first interior space **115**. In one embodiment, the separating member **120** includes at least one liquid passage hole configured so that the liquid **140** is able to pass from the first interior space **115** into the second interior space **125**, thereafter becoming substantially trapped within said second interior space **125**. The separating member may be config-

ured to substantially prevent the liquid **140** from passing from the second interior space **125** into the first interior space **115** even as the sealable container **105** is tipped on its side or inverted.

[0035] In one embodiment, the venting hole allows liquid to flow freely from the first interior space **115** into the second interior space **125** by letting gas trapped in the second interior space **125** into the first interior space **115**. Without the gas venting hole, according to one embodiment, the liquid may stop flowing into the second interior space **125**.

[0036] The separating member **120** may be integral to either the material comprising the first interior space **115** or the material comprising the second interior space **125** or both, or the separating member **120** may comprise an insert that fits into the bottom of the cup **150**, thereby separating the first interior space **115** (as a larger upper space within the cup **150**) and the second interior space **125** (as a smaller lower space at the bottom of the cup **150**).

[0037] As will be discussed in more detail below, according to one embodiment, a liquid **140** such as water may be introduced into the first interior space **115** before or after the quantity of product **110** and before or after sealably closing the sealable container **105**. When the sealable container **105** is maintained in a substantially upright orientation, as shown in FIG. **1**, the water initially collects at the surfaces of the separating member in communication with the first interior space. Then, after passing through a liquid passage hole in the separating member, the water collects in the bottom area of the sealable container **105**. As the water collects in the bottom area, or second interior space **125**, the water mixes with gas generating substance **130**, **135**, which may comprise sodium bicarbonate and citric acid, respectively, causing a generation of carbon dioxide gas. The generated carbon dioxide gas is allowed to vent into the first interior space **115** through at least one gas venting hole in the separating member **120** and also through the liquid passage hole as well, filling the first and second interior spaces with pressurized carbon dioxide. The pressurized carbon dioxide is then available for carbonation of fruits or vegetables within the first interior space **115**.

[0038] In one embodiment, the quantity of product **110** comprises a portion of fruits or vegetables with at least some of the fruits or vegetables capable of absorbing at least some of the carbon dioxide for acquiring an effervescent quality. As more carbon dioxide is absorbed into the tissue or fleshy part of the fruits or vegetables, the fruits or vegetables become more effervescent or "fizzy."

[0039] The gas generating substance **130**, **135** may generate both carbon dioxide to create a pressurized carbon dioxide rich atmosphere within the sealable container **105** and just enough (perhaps between 1% to 5%) oxygen to avoid anaerobic conditions. In one embodiment, the gas generating substance **130**, **135** may comprise sodium bicarbonate and citric acid for generating carbon dioxide when mixed with water and sodium percarbonate for generating oxygen when mixed with water. In one embodiment, gas generating tablets may be positioned within the second interior space **125** for generation of carbon dioxide and oxygen when mixed with (or activated by) a liquid **140**. The tablets may comprise active ingredients compressed to a density at least partially dependent upon a desired gas generation rate when the tablets are mixed with a predetermined amount of the liquid **140**. For example, the active ingredients for generating oxygen may be compressed within the respective tablet to a greater density to control the reaction rate and generation of oxygen. Likewise, the active ingredients for generating carbon dioxide may be compressed within the respective tablet to adjust the generation rate of carbon dioxide. The desired gas generation rates for carbon dioxide and oxygen may, therefore, be adjusted based upon, in part, the particular respiration rates of the fruits or vegetables or various other parameters, such as, for example, the time between the insertion of the liquid **140** and sealing the pull-tab type lid **145** to the cup **150**.

[0040] Next, FIG. **2** is a cross-sectional view of a dynamic modified atmosphere package system **200** according to one embodiment. The system **200** may comprise a cup **205** and a pull-tab type lid **210**, which together comprise a sealable container capable of retaining a positive pressure inside and holding a quantity of product **215** within a first interior space **220**. Other types of lids may be used for sealing the sealable container, and, as mentioned, the container need not take the shape of a cup. However, in one embodiment, a cup shape is useful for holding a quantity of product **215**, such as, for example, a portion of fruits or vegetables (depicted in FIG. **2** as de-stemmed grapes), within a first interior space **220**. A separating member **225** may be inserted into the bottom portion of the cup **205** for separating the first interior space **220** from a second interior space **230**. The separating member **225** provides space for reacting a carboxylic base with an acid to form carbon dioxide and other reactants to produce an amount of oxygen, both in gaseous form to dynamically modify the atmosphere within the container for carbonating a quantity of product **215** and maintaining optimum oxygen levels at least partially in response to respiration or other changes in the quantity of product **215** affecting the composition of the atmosphere within the sealable container, according to one embodiment. In other embodiments, the dynamic modified atmosphere package system **200** may be used to dynamically modify the atmosphere for products such as pharmaceuticals and use other reactants for producing different compositions of atmosphere within the sealable package and for dynamically modifying the composition of such atmosphere at least partially in response to changes in the pharmaceutical or other product within the first interior space **220**.

[0041] In one embodiment, a pull-tab type lid **210** (similar, for example, to lid **145** shown in FIG. **1**) may be sealed upon suitably mating rim surfaces of the cup **205** using a can seaming machine. Such a machine may seal a lid **210** over a cup **205** by folding the lid material over the cup material. Commercially available can seaming (or can sealing) machines may be used. However, modifications may be needed so that the resulting sealed container is capable of retaining a positive pressure gaseous atmosphere. In one embodiment, the sealed container is capable of retaining at least thirty pounds per square inch of internal pressure. In one embodiment, the cup **205**, the lid **210**, and the seal between the lid **210** and the cup **205** are capable of retaining between thirty and fifty pounds per square inch of internal gaseous pressure. To accommodate such internal pressure, the cup **205** may incorporate structural features such as a rib **235** about the circumference of the cup **205** near its rim surfaces. The rib **235** feature provides additional strength and rigidity. In addition, material thickness of the cup **205** may be increased to improve pressure retention capabilities. For example, in one embodiment the cup **205** comprises a PET plastic material with a thickness of approximately 0.6

millimeters. It was found that a material thickness of 0.3 millimeters may be too thin without additional structural changes, such as additional rib features. The cup **205** shown in FIG. **2** includes substantially flat sides below the rib **235** and extending away from the lid **210** toward the bottom **240** of the cup **205**. Other shapes are possible, however, substantially flat sides allow for improved readability of shrink type labels or printing processes which may be used for product labeling. The sides of cup **205** are shown tapering down from a larger diameter rib **235** area to smaller diameters toward the bottom **240**. Other configurations are possible. For example, the cup **205** may include straight sides. However, a tapered shape allows for nesting multiple empty cups together for improved shipping densities and lowered overall material costs.

[0042] As shown in FIG. **2**, a lower portion **245** of the cup **205** may have a slightly smaller diameter so that the separating member **225** may be easily and freely inserted into the cup **205**. In one embodiment, the smaller diameter of the lower portion **245** provides an interference fit between the inside surfaces of the lower portion **245** of the cup and the outward (or peripheral) surfaces of the separating member **225**. The interference fit, in one embodiment, is tight enough that the separating member **225** remains positioned within the lower portion **245** of the cup **205** and separates the first interior space **220** from the second interior space **230**. In one embodiment, the interference fit is tight enough to prevent liquid trapped within the second interior space **230** from passing into the first interior space **220** if, for example, the cup **205** is tipped from an upright orientation or inverted. In one embodiment, the inside surfaces of the lower portion **245** of the cup and the outward surfaces of the separating member **225** need not be straight (as shown) but may incorporate complementary or cooperatively mating ribs or bends so that the separating member **225** remains in its position in the lower portion **245** of the cup.

[0043] One method for dynamically modifying an atmosphere within a package, according to one embodiment, includes providing a sealable container, such as the cup **205** and lid **210**, that is capable of retaining a positive pressure and has a first interior space **220** and a second interior space **230**. A gas generating substance, such as tabets **250**, **255**, may be placed into the second interior space **230** of the sealable container. A separating member **225** may be inserted into the sealable container to separate the first interior space **220** from the second interior space **230**. A quantity of product **215**, such as grapes, for example, may be introduced into the first interior space **220**. A predetermined quantity of a liquid **260** may be introduced into the first interior space **220** where the liquid **260** is capable of reacting with the gas generating substance to generate a pressurized carbon dioxide rich atmosphere within the first interior space **220**. The liquid **260**, in one embodiment, is also capable of reacting with the gas generating substance to generate enough oxygen to avoid anaerobic conditions associated with the quantity of product **215**. After the sealable container has been filled with the gas generating substance, insert or separating member **225**, quantity of product **215**, and the predetermined quantity of liquid **260**, the opening to the first interior space **220** may be sealed using a pull-tab type lid **210** as shown in FIG. **2**.

[0044] The above method steps may be performed in the sequence described or in different orders. For example, the liquid **260** may be introduced into the first interior space **220** before the quantity of product **215** or even before the separating member **225** is placed into the lower portion **245** of the cup **205**. Various other embodiments may require differently ordered steps. For example, if the separating member **225** is integrally formed with the cup **205** such that the lower portion **245** comprises a separately formed component, the gas generating substance may be placed within the lower portion **245** before the lower portion **245** is sealably attached to the rest of the cup **205** (perhaps using a thermal welding or other process).

[0045] In one embodiment, the liquid **260** passes downward within the first interior space **220** and through a liquid passage hole **265** in the separating member **225**, collecting as shown in FIG. **2** in the bottom **240** of the cup **205**. The bottom **240** may comprise an annular trough within which the gas generating substance such as tablets **250**, **255** may come to rest. The annular trough may serve to concentrate the liquid **260** or allow for the use of a lower predetermined amount of liquid **260** for sufficient reaction with the gas generating substance.

[0046] In one embodiment, tablet **250** comprises sodium bicarbonate or a mixture of sodium bicarbonate and sodium percarbonate or some other carboxylic base, and tablet **255** comprises citric acid or some other appropriate acid for generating carbon dioxide and oxygen when mixed with water or an appropriate liquid solution. In one embodiment, only a single tablet is needed, such tablet comprising all substances needed for reacting with water or an appropriate liquid solution to produce a sufficient amount carbon dioxide for carbonation of fruits or vegetables within the first interior space **220** and enough oxygen to prevent anaerobic conditions. In one embodiment, the oxygen generating substance may comprise a separate tablet or an oxygen generating substance mixed into or incorporated into a tablet comprising sodium bicarbonate. For example, tablet **250** may comprise an oxygen generating substance such as sodium percarbonate, tablet **255** may comprise a carbon dioxide generating substance such as sodium bicarbonate, and a third tablet (not shown) may comprise citric acid. When such tablets are mixed with a predetermined amount of a liquid solution such as water, carbon dioxide and oxygen are generated.

[0047] In one embodiment, at least one ridge or upward protrusion is formed upon the separating member **225**. A gas venting hole positioned on such a ridge allows for gas generated within the second interior space **230** to vent into the first interior space **220** without becoming blocked by the liquid **260**. For example, in one embodiment, ridges **270** may be formed on the separating member **225**, and gas venting holes **275**, **280** may be positioned on the ridges **270**, as shown. The gas venting holes **275**, **280** are positioned enough above the level of the liquid passage hole **265** so that at least one of the gas venting holes remains unblocked should the cup **205** be tipped to one side or the other or if the liquid **260** accumulates at the liquid passage hole **265** at a rate faster than the liquid **260** is able to pass through the hole **265**. If for example, the liquid **260** is introduced into the first interior space **220** using automated food packaging and processing equipment, the liquid **260** may be introduced very rapidly or at a rate that exceeds the flow rate through the liquid passage hole **265**. In such situation the ridges **270** permit at least one gas vent **275**, **280** to remain unblocked so that gas generated within the second interior space **230** is able to vent into the first interior space **220**. As shown, the

gas vent **275** is positioned opposite the gas vent **280** so that if the cup **205** is tipped causing the liquid **260** to block the gas vent **275** (before the liquid **260** is able to pass downward though the liquid passage hole **265**) then the oppositely positioned gas venting hole **280** will remain unblocked. Additional, perhaps smaller, venting holes may be used to improve efficiency.

[0048] In one embodiment, the liquid passage hole **265** is substantially centered, as shown in FIG. **2**, and positioned within a depression **285** protruding into the second interior space **230**. The depression **285** may help prevent the liquid passage hole **265** from becoming blocked by part of the quantity of product **215** and may include grooves or uneven surfaces (not shown) to further reduce the possibility of product **215** blocking the liquid passage hole **265**. The depression **285** may be positioned to be far enough above a raised bottom portion **290** of the bottom **240** of the cup **205** protruding upward toward the depression **285** so that gas generating tablets **250**, **255** do not become wedged between the lower surface of the depression **285** and the upper surface of the raised bottom portion **290**.

[0049] In one embodiment, the liquid passage hole **265** has a diameter large enough for the liquid **260** to pass substantially freely from said first interior space **220** into the second interior space **230** without becoming blocked due to adhesive forces between molecules of the liquid **260** and surfaces of the liquid passage hole **265**. In one embodiment, the liquid passage hole **265** is sized with a diameter between two millimeters and six millimeters inclusively. It was found, in one embodiment, that a separating member **225** formed of PET material having at least one liquid passage hole with a diameter between two millimeters and six millimeters, inclusively, allows for liquid (such as water) to pass substantially freely through the separating member **225**.

[0050] If the cup **205** with separating member **225** fit into the lower portion **245** of the cup **205** is turned upside down, any liquid **260** will flow downward away from the liquid passage hole **265** and into the spaces formed by the ridges **270**, and because the gas venting holes **275**, **280** are sized with a diameter too small for the liquid **260** to pass, the liquid **260** is substantially trapped within the second interior space **230**. In one embodiment, the gas venting holes **275**, **280** are each sized with a diameter between 0.25 millimeter and one millimeter inclusively. It was found, in one embodiment, that a separating member **225** formed of PET material having at least one gas venting hole with a diameter between 0.25 millimeter and one millimeter, inclusively, allows for gaseaous carbon dioxide and oxygen to pass substantially freely through the separating member **225** while preventing the liquid **260** from passing through the separating member **225**. It was further found, in one embodiment, that having two such gas venting holes, each positioned apart from the other, provides sufficient gaseous permeability of the separating member **225** even in the event one of the two vents might become blocked.

[0051] In various embodiments, a quantity of product (such as fruits or vegetables) may be sealed within a package such as a sealable container comprising a cup **205** and a pull-tab type lid **210** as shown in FIG. **2**. After the package is sealed, mechanical mixing means may be used for initiating carbonation of the fruits or vegetables. The mechanical mixing means may involve rupturing membranes filled with the reactants needed for generating carbon dioxide and oxygen. For example, the liquid **260** may be surrounded by a membrane and positioned within the second interior space **230**. A vigorous shake or tap of the package causes the membrane to rupture, thereby allowing the liquid **260** to mix with the gas generating substance. For example, the liquid **260** may be initially contained within a membrane having a similar cross-section as the gas generating substance **250** shown in FIG. **2**. Therefore, in one embodiment, the liquid **260** may be contained in a liquid containing membrane **250**, which, when ruptured, allows the liquid **260** to fill the bottom **240** and mix with a gas generating substance **255**, thereby initiating the generation of carbon dioxide and oxygen gas and subsequent carbonation of the fruits or vegetables within the first interior space **220**.

[0052] In various embodiments, a convexity or button **295** may comprise a deformable structure capable of deflecting upward and into the second interior space **230** enough for causing a liquid containing membrane **250** (or a gas generating substance filled membrane) to rupture, thereby allowing the appropriate reactants to mix to initiate the generation of carbon dioxide and oxygen and subsequent carbonation of the fruits or vegetables within the package. For example, the exterior convexity or button **295**, according to one embodiment, comprises a deformable structure that may be deflected inward using a finger or thumb. In one embodiment, the deformable structure deflects upward into the second interior space **230** but does not deflect back into its original position even as pressure builds within the first and second interior spaces. In one embodiment, the deformable structure deflects upward into the second interior space **230** for initiating a modification of the atmosphere within the package and then relaxes back into its former position as pressure builds within the package.

[0053] For these embodiments involving mechanical mixing means to initiate atmosphere modification after the package has been sealed, the separating member need not include a liquid passage hole **265** since the liquid **260** may be introduced into the bottom **240** of the cup **205** (or second interior space **230**) before insertion of the separating member. The separating member for such systems may have at least one gas vent hole for allowing the generated gas to vent into the first interior space **220**.

[0054] Moving on, FIG. **3** is an exploded view of selected components of a dynamic modified atmosphere package system according to one embodiment. The structural components of a package suitable for dynamically modifying the atmosphere within the package, according to one embodiment, include a pull-tab type lid **300**, an insert or separating member **305**, and a cup **310**. The pull-tab type lid **300**, as mentioned, may comprise any of a wide variety of commercially produced pull-tab type tops that may be sealed to a cup such as the cup **310** shown. However, in one embodiment, the pull-tab type lid **300** comprises a lid modified to retain a higher than typical internal pressure and to allow for a slowed release of internal pressure when the pull-tab **315** is pulled away from the lid **300** to open the top for access to the contents within the cup **310**. In one embodiment, the lid **300** is made of aluminum. In other embodiments, the lid **300** may be made of other materials such as plastics, laminate (or composite) materials, or any material or combination of materials that may be formed into a lid capable of retaining an internal pressure of at least thirty pounds per square inch. In one embodiment, the lid **300** is capable of retaining an internal pressure of between thirty and fifty pounds per square inch internal gaseous pressure.

[0055] In one embodiment, the lid **300** includes modifications for slowing a release of pressure from within the sealed and pressurized package. The modifications for slowing the release of pressure may include a pressure release score line capable of puncturing a portion of the lid **300** when the pull-tab **315** is initially pulled in an outward direction away from the lid **300** and the interior space within the cup **310**. The pressure release score line may include a rivet score line **320** (running through or on both sides of a rivet **325** formed upon the lid **300**) or a score line beneath pull-tab **315** (not shown) or a combination of score line features that provide a puncturing of the lid **300** to release pressure from within the sealed package prior to the pull-tab tip **330** puncturing an opening score line **335** for removal of the pull-tab **315** and lid material **340** circumscribed by the opening score line **335** about a periphery of the lid **300**.

[0056] In one embodiment, the lid **300** includes modifications for reducing sharpness of the edge exposed after removal of the pull-tab **315** and lid material **340** circumscribed by the opening score line **335** about a periphery of the lid **300**. The lid **300** may also incorporate "double protection" features so that both the inside edge at the opening score line **335** exposed after removal of the lid material **340** and the edge of the removed lid material **340** have reduced sharpness.

[0057] As shown in FIG. **3**, the insert or separating member **305** for a package suitable for dynamically modifying the atmosphere within the package, according to one embodiment, includes at least one liquid passage hole **345** configured so that a liquid is able to pass from a first interior space on one side **360** of the separating member **305** through the liquid passage hole **345** into a second interior space on the other side (opposite side **360**) of the separating member **305** and at least one gas venting hole **350** configured so that a gas is able to vent from the second interior space into the first interior space, with the liquid that passed through the liquid passage hole **345** into the second interior space becoming substantially trapped within said second interior space. The separating member **305** may further include a ridge portion **355** having a gas venting hole **350** thereon so that a predetermined quantity of a liquid may be contained within the first interior space on one side **360** of the separating member **305** without blocking at least one gas venting hole thereby permitting gas to vent from the second interior space on the other side (opposite side **360**) into the first interior space even if liquid accumulates within the first interior space at the liquid passage hole **345** at a liquid accumulation rate that exceeds a liquid passage rate through the liquid passage hole **345**. In one embodiment, for a package having a first interior space of approximately four ounces, approximately eight milliliters of a liquid such as water may be contained within the first interior space on one side **360** of the separating member **305** without blocking at least one gas venting hole. That is, in one embodiment, for a package having a first interior space of approximately four ounces, the ridge portion **355** having a gas venting hole **350** thereon protrudes above the lower surfaces (and depression regions which funnel into the liquid passage hole **345**) enough so that approximately eight milliliters of a liquid such as water may be contained without blocking the gas venting hole **350**.

[0058] In one embodiment, the liquid passage hole **345** has a diameter large enough for a liquid to pass substantially freely from the first interior space on one side **360** of the separating member **305** through the liquid passage hole **345** into the second interior space on the other side of the separating member **305** without becoming blocked due to adhesive forces (surface tension) between molecules of the liquid and surfaces of the liquid passage hole **345**. In one embodiment, the liquid passage hole diameter may be between two milimeters and six milimeters inclusively, depending upon the type of material used and thickness of the separating member **305** proximate to the liquid passage hole **345**. It was found that a liquid passage hole diameter of about two millimeters provides sufficient liquid flow through the separating member **305**, according to one embodiment. If thinner material is used for the separating member **305**, for example, then a small diameter liquid passage hole **345** may be used.

[0059] In one embodiment, the gas venting hole **350** has a diameter large enough for gas to vent substantially freely through the gas venting hole **350** from the second interior space (opposite side **360**) into the first interior space on side **360** and small enough to substantially block passage of a liquid through the gas venting hole **360** from the second interior space into the first interior space. In one embodiment, the gas venting hole diameter may be between 0.25 millimeter and one millimeter inclusively. It was found that a gas venting hole diameter of about 0.25 millimeter provides sufficient gas flow through the separating member **305**, according to one embodiment.

[0060] In one embodiment, one gas venting hole **350** is positioned near a first edge area **365** of the separating member **305** and another gas venting hole **370** is positioned near a second edge area **375** of the separating member **305**, with the first edge area **365** and said second edge area **375** being substantially opposite from one another. In one embodiment, the liquid passage hole **345** is substantially centrally positioned between the first edge area **365** and the second edge area **375**, with the first edge area **365** and the second edge area **375** being substantially opposite from one another. In one embodiment, at least a portion of the separating member **305** in communication with the first interior space, for example, side **360**, includes a formed depression **380** protruding into the second interior space (opposite side **360**) and having the liquid passage hole **345** positioned therein. The formed depression region **380** may also include at least one groove **385** protruding into the second interior space (opposite side **360**) and oriented to channel liquid to the liquid passage hole **345**. As shown, each groove **385** may be V-shaped or U-shaped to improve the channeling of liquid to the liquid passage hole **345**. The depression **380** with grooves **385** leading to the liquid passage hole **345** may be cooperatively sized and oriented so that the chosen quantity of product packaged within the first interior space is less likely to block the liquid passage hole **345**. For example, the depression **380** and grooves **385** may be sized so as to reduce the likelihood that one of a quantity of grapes might block the liquid passage hole **345**. The depression **380** may be somewhat shorter than the longest dimension of a typical grape, and each of the V-shaped grooves **385** may be sized small enough so that the smallest radius on a typical grape is still larger than the radius needed to block one of the V-shaped gooves **385**. The grooves **385** may be formed with any shape, depth, length, and so forth. In one embodiment, the gooves **385** are designed based at least partially upon the shape of the product to be enclosed within the package and a likelihood that some portion of the

product may block the passage of liquid through the separating member or the venting of gas through the separating member.

[0061] Additional depression areas and additional liquid passage holes may be incorporated into the separating member **305**. However, in one embodiment, only a single liquid passage hole **345** is needed for sufficient liquid flow through the separating member **305**, and having only one such liquid passage hole **345** minimizes the likelihood that liquid may flow back from the second interior space into the first interior space and potentially tainting the product.

[0062] The separating member **305** may comprise an insert that fits into a bottom portion of a cup **310**. As shown in FIG. **3**, the separating member **305** may be formed or molded of PET material with a material thickness similar to the material thickness of the cup **310**. The separating member may comprise a thinner (or thicker) material than the cup **310**. The material thickness of the separating member **305**, or for that matter, the material thickness of the cup **310**, may vary throughout the component. For instance, the edge areas **365**, **375** may be formed to include somewhat thicker material so that the separating member **305** fits more tightly into the bottom of the cup **310**. As another example, the cup rim **390** may be formed to include somewhat thicker material than other areas of the cup **310** so that the rim **390** provides additional rigidity for improved sealing characteristics when the outward rim **395** of the pull-tab type lid **300** is sealably folded over the rim **390** of the cup **310**, according to one embodiment. In one embodiment, the material thicknesses of the separating member **305** and the cup **310** are substantially similar with the cross-sectional material thicknesses for the separating member **225** and the cup **205** depicted in FIG. **2**. In one embodiment, the material thicknesses of the separating member **305** and the cup **310** are substantially uniform throughout each of the respective components. In one embodiment, the material thicknesses of the package components may vary throughout and incorporate molded features such as ribs to achieve desired rigidity and strength characteristics.

[0063] FIG. **4** is a bottom view of a pull-tab type lid **400** according to one embodiment. In one embodiment, the lid **400** incorporates modifications for slowing a release of pressure from within a pressurized package sealably closed with the lid **400**. The modifications for slowing the release of pressure may include a pressure release score line capable of puncturing a portion of the lid **400** when the pull-tab **405** (shown in dashed lines) is initially pulled in an outward direction away from the lid **400**. The pressure release score line may include a rivet score line **410** that runs through or on both sides of a rivet **415** formed upon the lid **400** or a neighboring score line **420** that runs near the rivet **415** or a combination of score line features that provide a puncturing of the lid **400** to release pressure from within the sealed package prior to the pull-tab tip **425** (positioned on the other side or top side of lid **400**) puncturing an opening score line **430** for removal of the pull-tab **405** and lid material **435** circumscribed by the opening score line **430** about a periphery of the lid **400** just inside a rim **440** of the lid **400**. In one embodiment, one or both of the rivet score line **410** and the neighboring score line **420** provide a first stage pressure release mechanism for the lid **400**. That is, when the pull-tab **405** is pulled to open the lid **400**, either or both of the score lines proximate to the rivet **415** puncture through the lid material **435** (the place of puncture being along one or both of the score lines near the rivet **415**) before the pull-tab tip **425** punctures through the opening score line **430**. In one embodiment, the lid **400** includes at least one score line feature, such as, for example, rivet score line **410**, for slowing a release of pressurized gas when the lid **400** is opened. The score line feature may comprise at least one pressure release score line designed to puncture through a portion of the lid **400** when the pull-tab **405** on the lid **400** is pulled in an outward direction away from the lid **400**. In one embodiment, the score line feature may provide a two-stage opening mechanism for slowing the release of pressurized gas from the pressurized sealed package. The first stage opening mechanism may comprise a pressure release score line, such as one or both or the rivet score line **410** and the neighboring score line **420**, capable of puncturing a portion of the lid **400** when the pull-tab **405** is initially pulled in an outward direction away from the lid **400**. The second stage opening mechanism may comprise an opening score line **430** about a periphery of the lid **400** that breaks away for removal of the pull-tab **405** and lid material **435** circumscribed by the opening score line **430**.

[0064] FIG. **5** is a cross-sectional view of the pull-tab type lid **300** at the cut line shown in FIG. **3**, according to one embodiment. The outward rim **395** of the pull-tab lid **300** is shown in an unfolded, unsealed position (to be consistent with FIG. **3**). The cup rim **390** may fit within the area **505** under the outward rim **395**. In one embodiment, the outward rim **395** may be sealed to the cup rim **390** using a can seaming (or sealing) machine, which folds the outward rim **395** and cup rim **390** down to create a sealed edge as shown in FIG. **2**. The rivet **325** is shown as a formed protrusion or bubble in the lid material **340** which is then headed down around the pull-tab **315** material, thereby fastening the pull-tab **315** to the lid material **340**. The pull-tab tip **330** is shown in an unopened, as sealed, position. In one embodiment, when the pull-tab end **510** is lifted outward, away from the lid material **340**, the rivet score line **320** (hidden) and neighboring score line **420** deflect and the pull-tab tip **330** plunges into a trough **515** having the opening score line **335** therein. As the pull-tab end **510** is moved outward, away from the lid material **340**, the lid material **340** is punctured along one or both of the rivet and neighboring score lines, providing a slowed release of pressure, according to one embodiment. As the pull-tab end **510** continues to move outward, the pull-tab tip **330** punctures the opening score line **335**. Finally, the pull-tab **315** may be pulled away from the rest of the lid **300** for removing both the pull-tab **315** and the lid material **340**.

[0065] The score lines may be made on one or both surfaces of the lid material **340**. For example, the rivet score line **320** depicted in FIG. **3** may have a cross-section similar to the neighboring score line **420** shown in FIG. **5**, having both a top score **520** and a bottom score **525**, or the rivet score line **320** may have only one of a top score or a bottom score. Likewise, the neighboring score line **420** may include only one of a top score **520** or a bottom score **525**. The opening score line **335** may likewise include both a top score **530** and a bottom score **535**, as shown, or just a top score **530** or just a bottom score **535**. In one embodiment, the rivet score line **320** includes both top and bottom scores, the neighboring score line **420** includes both top **520** and bottom **525** scores (as shown), and the opening score line **335** includes only a top score **530**.

[0066] In one embodiment, the lid **300** includes a reduced profile **540** opening score line **410** about a periphery of the lid **300** that breaks away for removal of the pull-tab **315** and lid material **340** circumscribed by the opening score line **335**. The reduced profile **540** opening score line **335**, in one embodiment, reduces the sharpness of the edge along the opening score line **335** left after removal of the pull-tab **315** and lid material **340**. The reduced profile **540**, in one embodiment, comprises a compressed S-shaped profile **545** as shown in FIG. **5**. Typical pull-tab type lids do not incorporate a similarly compressed S-shaped profile **545**, instead having a deeper or larger profile **540** between a portion of the lid material **340** having the opening score line **335** thereon and a point **550** where the lid bends upward toward the outward rim **395**.

[0067] FIG. **6** is a cross-sectional view of a pull-tab type lid **600**, according to one embodiment. FIG. **6** is a cross-sectional view of a pull-tab type lid as in FIG. **5** but with a pull-tab type lid **600** that incorporates a "double protection" design for reducing sharpness of both the open container edge **605** along the opening score line **610** and the lid material edge **615** on the removed lid material **620**. As shown, the double protection design includes an open container edge S-shaped fold **625**, whereby the open container edge **605** comprises a fold of lid material covering the opening score line **610** that serves to reduce the effective sharpness of the inside edge of the opened container, and a removed lid material edge S-shaped fold **630**, whereby the outward lid material edge **615** comprises a fold of lid material covering the opening score line **610** that serves to reduce the effective sharpness of the outward edge of the removed lid material **620**. In one embodiment, a double protection pull-tab type lid **600** is used to minimize open container edge sharpness, referred to as "can end safety" or cut protection. Other pull-tab type designs may be used.

[0068] The terms and expressions which have been employed in the foregoing specification are used therein as terms of description and not of limitation, and there is no intention in the use of such terms and expressions of excluding equivalents of the features shown and described or portions thereof, it being recognized that the scope of the invention is defined and limited only by the claims which follow.

What is claimed is:

1. A dynamic modified atmosphere package comprising a sealable container having a first interior space for holding a quantity of product and a second interior space separated from said first interior space, said sealable container capable of retaining a positive pressure within said first and second interior spaces, said sealable container configured so that a liquid is able to pass from said first interior space into said second interior space, said liquid becoming substantially trapped within said second interior space, and said sealable container configured so that a gas is able to vent from said second interior space into said first interior space.

2. The package of claim **1**, further comprising a separating member having at least one liquid passage hole configured so that said liquid is able to pass from said first interior space into said second interior space, and said separating member having at least one gas venting hole configured so that said gas is able to vent from said second interior space into said first interior space.

3. The package of claim **2**, wherein said separating member includes a ridge portion having at least one gas venting hole thereon so that a predetermined quantity of said liquid is contained within said first interior space without blocking at least one gas venting hole thereby permitting said gas to vent from said second interior space into said first interior space even if said liquid accumulates within said first interior space at said liquid passage hole at a liquid accumulation rate that exceeds a liquid passage rate through said liquid passage hole.

4. The package of claim **2**, wherein said liquid passage hole has a liquid passage hole diameter large enough for said liquid to pass substantially freely from said first interior space into said second interior space without becoming blocked due to adhesive forces between molecules of said liquid and surfaces of said liquid passage hole.

5. The package of claim **4**, wherein said liquid passage hole diameter is between two milimeters and six milimeters inclusively.

6. The package of claim **2**, wherein said gas venting hole has a gas venting hole diameter large enough for said gas to vent substantially freely through said gas venting hole from said second interior space into said first interior space and small enough to substantially block passage of said liquid through said gas venting hole from said second interior space into said first interior space.

7. The package of claim **6**, wherein said gas venting hole diameter is between 0.25 millimeter and one millimeter inclusively.

8. The package of claim **2**, wherein one of said gas venting holes is positioned near a first edge area of said separating member and another of said gas venting holes is positioned near a second edge area of said separating member, said first edge area and said second edge area being substantially opposite from one another.

9. The package of claim **2**, wherein said liquid passage hole is substantially centrally positioned between a first edge area of said separating member and a second edge area of said separating member, said first edge area and said second edge area being substantially opposite from one another.

10. The package of claim **9**, wherein at least a portion of said separating member in communication with said first interior space forms a depression protruding into said second interior space and having said liquid passage hole positioned therein.

11. The package of claim **10**, wherein said separating member includes at least one groove protruding into said second interior space and oriented to channel said liquid to said liquid passage hole.

12. The package of claim **2**, wherein said sealable container comprises a cup, and said separating member comprises an insert that fits into a bottom of said cup.

13. The package of claim **12**, wherein said insert includes a ridge portion having said gas venting hole thereon so that a predetermined quantity of said liquid is contained within said first interior space without blocking at least one gas venting hole thereby permitting said gas to vent from said second interior space into said first interior space even if said liquid accumulates within said first interior space at said liquid passage hole at a liquid accumulation rate that exceeds a liquid passage rate through said liquid passage hole.

14. The package of claim **12**, wherein at least a portion of said insert in communication with said first interior space forms a depression protruding into said second interior space

toward said bottom of said cup and having said liquid passage hole positioned therein.

15. The package of claim **12**, wherein said bottom includes a raised portion extending toward said first interior space and leaving a depressed portion substantially about a periphery of said bottom, thereby allowing said liquid to collect within said depressed portion.

16. The package of claim **15**, wherein said depressed portion of said bottom is large enough to hold at least one gas generating tablet within said second interior space.

17. The package of claim **1**, wherein said sealable container comprises a semi-rigid cup.

18. The package of claim **17**, wherein said semi-rigid cup comprises a transparent plastic material.

19. The package of claim **18**, wherein said first interior space comprises a four ounce or eight ounce volume suitable for said quantity of product.

20. The package of claim **17**, wherein said quantity of product comprises a portion of fruit or vegetables, said gas comprises enough carbon dioxide for said portion of fruits or vegetables to absorb at least some of said carbon dioxide, and said gas comprises enough oxygen to avoid anaerobic conditions within said first and second interior spaces.

21. The package of claim **1**, wherein said positive pressure is at least thirty pounds per square inch.

22. The package of claim **1**, wherein said sealable container comprises a pull-tab type lid sealing an opening to said first interior space.

23. The package of claim **22**, wherein said lid includes at least one score line feature for slowing a release of pressurized gas when said lid is opened to access said first interior space.

24. The package of claim **23**, wherein said at least one score line comprises at least one pressure release score line designed to puncture through a portion of said lid when a pull-tab on said lid is pulled in an outward direction away from said lid and said first interior space.

25. The package of claim **23**, wherein said score line feature provides a two-stage opening mechanism for slowing said release of pressurized gas from said first and second interior spaces, said two-stage opening mechanism including as a first stage opening mechanism a pressure release score line capable of puncturing a portion of said lid when a pull-tab on said lid is initially pulled in an outward direction away from said lid and said first interior space, and said two-stage opening mechanism including as a second stage opening mechanism an opening score line about a periphery of said lid that breaks away for removal of said pull-tab and lid material circumscribed by said opening score line.

26. The package of claim **22**, wherein said lid includes a reduced profile opening score line about a periphery of said lid that breaks away for removal of said pull-tab and lid material circumscribed by said opening score line, said reduced profile opening score line for at least reducing a sharpness of an inside edge of said lid that remains after said removal of said pull-tab and lid material.

27. The package of claim **1**, wherein said second interior space is large enough to hold at least one gas generating mechanism.

28. The package of claim **27**, wherein said gas generating mechanism comprises a substance capable of generating said gas when mixed with said liquid,

29. The package of claim **28**, wherein said gas generating substance is capable of generating enough carbon dioxide that a portion of fruits or vegetables within said first interior space absorbs at least some of said carbon dioxide and enough oxygen to avoid anaerobic conditions within said first and second interior spaces.

30. The package of claim **29**, wherein said substance comprises sodium bicarbonate and citric acid for generating carbon dioxide when mixed with water and sodium percarbonate for generating oxygen when mixed with water.

31. The package of claim **27**, wherein said gas generating mechanism comprises one or more tablets, said tablets capable of generating said gas when mixed with said liquid.

32. The package of claim **31**, wherein said one or more tablets comprise sodium bicarbonate and citric acid for generating carbon dioxide when mixed with water and sodium percarbonate for generating oxygen when mixed with water.

33. The package of claim **31**, wherein said one or more tablets comprise active ingredients compressed to a density at least partially dependent upon a desired generation rate of said gas when said one or more tablets are mixed with a predetermined amount of said liquid.

34. The package of claim **31**, wherein said one or more tablets are capable of generating enough carbon dioxide that a portion of fruits or vegetables within said first interior space absorbs at least some of said carbon dioxide and enough oxygen to avoid anaerobic conditions within said first and second interior spaces.

35. A separating member for a package, said package having a first interior space for holding a quantity of product and a second interior space separated from said first interior space by said separating member, said separating member having at least one liquid passage hole configured so that a liquid is able to pass from said first interior space into said second interior space and having at least one gas venting hole configured so that a gas is able to vent from said second interior space into said first interior space, said liquid becoming substantially trapped within said second interior space.

36. The separating member of claim **35**, further comprising a ridge portion having said gas venting hole thereon so that a predetermined quantity of said liquid is contained within said first interior space without blocking at least one gas venting hole thereby permitting said gas to vent from said second interior space into said first interior space even if said liquid accumulates within said first interior space at said liquid passage hole at a liquid accumulation rate that exceeds a liquid passage rate through said liquid passage hole.

37. The separating member of claim **35**, wherein said liquid passage hole has a liquid passage hole diameter large enough for said liquid to pass substantially freely from said first interior space into said second interior space without becoming blocked due to adhesive forces between molecules of said liquid and surfaces of said liquid passage hole.

38. The separating member of claim **37**, wherein said liquid passage hole diameter is between two milimeters and six milimeters inclusively.

39. The separating member of claim **35**, wherein said gas venting hole has a gas venting hole diameter large enough for said gas to vent substantially freely through said gas venting hole from said second interior space into said first interior space and small enough to substantially block pas-

sage of said liquid through said gas venting hole from said second interior space into said first interior space.

40. The separating member of claim **39**, wherein said gas venting hole diameter is between 0.25 millimeter and one millimeter inclusively.

41. The separating member of claim **35**, wherein one of said gas venting holes is positioned near a first edge area of said separating member and another of said gas venting holes is positioned near a second edge area of said separating member, said first edge area and said second edge area being substantially opposite from one another.

42. The separating member of claim **35**, wherein said liquid passage hole is substantially centrally positioned between a first edge area of said separating member and a second edge area of said separating member, said first edge area and said second edge area being substantially opposite from one another.

43. The separating member of claim **42**, wherein at least a portion of said separating member in communication with said first interior space forms a depression protruding into said second interior space and having said liquid passage hole positioned therein.

44. The separating member of claim **43**, further comprising at least one groove protruding into said second interior space and oriented to channel said liquid to said liquid passage hole.

45. The separating member of claim **35**, wherein said package comprises a cup, and said separating member comprises an insert that fits into a bottom of said cup.

46. The separating member of claim **45**, wherein said insert includes a ridge portion having said gas venting hole thereon so that a predetermined quantity of said liquid is contained within said first interior space without blocking at least one gas venting hole thereby permitting said gas to vent from said second interior space into said first interior space even if said liquid accumulates within said first interior space at said liquid passage hole at a liquid accumulation rate that exceeds a liquid passage rate through said liquid passage hole.

47. The separating member of claim **45**, wherein at least a portion of said insert in communication with said first interior space forms a depression protruding into said second interior space toward said bottom of said cup and having said liquid passage hole positioned therein.

48. A system for dynamically modifying an atmosphere within a package, said system comprising:

a sealable container capable of retaining a positive pressure;

a quantity of product within a first interior space within said sealable container;

a separating member within said sealable container separating said first interior space within said sealable container from a second interior space within said sealable container;

a gas generating substance within said second interior space within said sealable container; and

a predetermined quantity of a liquid capable of reacting with said gas generating substance within said second interior space to generate a pressurized carbon dioxide rich atmosphere within said first interior space, said pressurized carbon dioxide rich atmosphere including enough oxygen to avoid anaerobic conditions associated with said quantity of product.

49. The system of claim **48**, wherein said positive pressure is at least thirty pounds per square inch.

50. The system of claim **48**, wherein said sealable container comprises a pull-tab type lid sealing an opening to said first interior space.

51. The system of claim **50**, wherein said lid includes a two-stage opening mechanism for slowing a release of pressurized gas from said sealable container, said two-stage opening mechanism including as a first stage opening mechanism a pressure release score line capable of puncturing a portion of said lid when a pull-tab on said lid is initially pulled in an outward direction away from said lid and said first interior space, and said two-stage opening mechanism including as a second stage opening mechanism an opening score line about a periphery of said lid that breaks away for removal of said pull-tab and lid material circumscribed by said opening score line.

52. The system of claim **48**, wherein said quantity of product comprises a portion of fruits or vegetables, said portion of fruits or vegetables defining a portion of a single type of fruit, a portion of a mixture of different types of fruit, a portion of a single type of vegetable, a portion of a mixture of different types of vegetable, or a portion of a mixture of one or more types of fruit and one or more types of vegetable, at least some of said fruits or vegetables capable of absorbing at least some carbon dioxide for acquiring an effervescent quality.

53. The system of claim **52**, wherein said fruits or vegetables comprise fresh-cut or minimally processed fruits or vegetables.

54. The system of claim **48**, wherein said separating member comprises at least one liquid passage hole configured so that said liquid is able to pass from said first interior space into said second interior space and at least one gas venting hole configured so that gas generated by said gas generating substance is able to vent from said second interior space into said first interior space, said liquid becoming substantially trapped within said second interior space.

55. The system of claim **54**, wherein said separating member further comprises a ridge portion having said gas venting hole thereon so that said predetermined quantity of said liquid is contained within said first interior space without blocking at least one gas venting hole thereby permitting said gas to vent from said second interior space into said first interior space even if said liquid accumulates within said first interior space at said liquid passage hole at a liquid accumulation rate that exceeds a liquid passage rate through said liquid passage hole.

56. The system of claim **55**, wherein said liquid comprises water and said gas generating substance comprises sodium bicarbonate and citric acid for generating carbon dioxide when mixed with water and sodium percarbonate for generating oxygen when mixed with water.

57. The system of claim **48**, wherein said predetermined quantity of said liquid comprises said liquid surrounded by a membrane and positioned within said second interior space, said membrane capable of rupturing in response to a vigorous shake or tap of said sealable container, thereby allowing said liquid to mix with said gas generating substance, and wherein said separating member comprises at least one gas venting hole configured so that gas generated by said gas generating substance is able to vent from said

second interior space into said first interior space, said liquid becoming substantially trapped within said second interior space.

58. The system of claim **48**, wherein said predetermined quantity of said liquid comprises a membrane filled with said liquid and positioned within said second interior space proximate a deformable exterior convexity or button on said sealable container, said membrane capable of rupturing in response to a movement of said deformable exterior convexity or button, thereby allowing said liquid to mix with said gas generating substance, and wherein said separating member comprises at least one gas venting hole configured so that gas generated by said gas generating substance is able to vent from said second interior space into said first interior space, said liquid becoming substantially trapped within said second interior space.

59. The system of claim **48**, further comprising a membrane filled with said gas generating substance and positioned within said second interior space proximate a deformable exterior convexity or button on said sealable container, said membrane capable of rupturing in response to a movement of said deformable exterior convexity or button, thereby allowing said gas generating substance to mix with said liquid, and wherein said separating member comprises at least one gas venting hole configured so that gas generated by said gas generating substance is able to vent from said second interior space into said first interior space, said liquid becoming substantially trapped within said second interior space.

60. A method for dynamically modifying an atmosphere within a package, said method comprising:

providing a sealable container capable of retaining a positive pressure and having a first interior space and a second interior space;

placing a gas generating substance into said second interior space of said sealable container;

inserting a separating member into said sealable container thereby separating said first interior space within said sealable container from said second interior space within said sealable container;

introducing a quantity of product into said first interior space within said sealable container;

introducing a predetermined quantity of a liquid into said first interior space within said sealable container, said liquid capable of reacting with said gas generating substance within said second interior space to generate a pressurized carbon dioxide rich atmosphere within said first interior space, said pressurized carbon dioxide rich atmosphere including enough oxygen to avoid anaerobic conditions associated with said quantity of product; and

sealing an opening in said first interior space thereby sealing said sealable container.

61. The method of claim **60**, wherein said positive pressure is at least thirty pounds per square inch.

62. The method of claim **60**, wherein said sealable container comprises a pull-tab type lid sealing said opening to said first interior space.

63. The method of claim **62**, wherein said lid includes a two-stage opening mechanism for slowing a release of pressurized gas from said sealable container, said two-stage opening mechanism including as a first stage opening mechanism a pressure release score line capable of puncturing a portion of said lid when a pull-tab on said lid is initially pulled in an outward direction away from said lid and said first interior space, and said two-stage opening mechanism including as a second stage opening mechanism an opening score line about a periphery of said lid that breaks away for removal of said pull-tab and lid material circumscribed by said opening score line.

64. The method of claim **60**, wherein said quantity of product comprises a portion of fruits or vegetables, said portion of fruits or vegetables defining a portion of a single type of fruit, a portion of a mixture of different types of fruit, a portion of a single type of vegetable, a portion of a mixture of different types of vegetable, or a portion of a mixture of one or more types of fruit and one or more types of vegetable, at least some of said fruits or vegetables capable of absorbing at least some carbon dioxide for acquiring an effervescent quality.

65. The method of claim **64**, wherein said fruits or vegetables comprise fresh-cut or minimally processed fruits or vegetables.

66. The method of claim **60**, wherein said separating member comprises at least one liquid passage hole configured so that said liquid is able to pass from said first interior space into said second interior space and at least one gas venting hole configured so that gas generated by said gas generating substance is able to vent from said second interior space into said first interior space, said liquid becoming substantially trapped within said second interior space.

67. The method of claim **66**, wherein said separating member further comprises a ridge portion having said gas venting hole thereon so that said predetermined quantity of said liquid is contained within said first interior space without blocking at least one gas venting hole thereby permitting said gas to vent from said second interior space into said first interior space even if said liquid accumulates within said first interior space at said liquid passage hole at a liquid accumulation rate that exceeds a liquid passage rate through said liquid passage hole.

68. The method of claim **67**, wherein said liquid comprises water and said gas generating substance comprises sodium bicarbonate and citric acid for generating carbon dioxide when mixed with water and sodium percarbonate for generating oxygen when mixed with water.

69. A dynamic modified atmosphere package capable of carbonating fruits or vegetables and for prolonging the shelf-life of carbonated fruits or vegetables, said package comprising a sealable container capable of holding said fruits or vegetables and retaining a positive pressure dynamic modified atmosphere within said sealable container when said sealable container is sealably closed.

70. The package of claim **69**, wherein said positive pressure dynamic modified atmosphere within said sealable container comprises a carbon dioxide rich atmosphere for carbonating said fruits or vegetables.

71. The package of claim **70**, wherein said carbon dioxide rich atmosphere includes enough oxygen to prevent anaerobic conditions within said sealable container.

72. The package of claim **69**, wherein said positive pressure is at least thirty pounds per square inch.

73. The package of claim **69**, wherein said positive pressure dynamic modified atmosphere within said sealable container comprises enough oxygen to prevent anaerobic conditions within said sealable container.

74. The package of claim **69**, wherein said sealable container comprises means for generating carbon dioxide gas from within said sealable container and means for generating enough oxygen gas from within said sealable container to prevent anaerobic conditions within said sealable container.

75. The package of claim **74**, wherein said carbon dioxide generating means and said oxygen generating means dynamically modify said positive pressure dynamic modified atmosphere within said sealable container as said fruits or vegetables respire within said sealed sealable container.

76. The package of claim **69**, further comprising means for prolonging the shelf-life of said carbonated fruits or vegetables.

77. The package of claim **69**, wherein said package is capable of extending the shelf-life of said carbonated fruits or vegetables to at least ten days, said carbonated fruits or vegetables retaining an effervescent quality for at least ten days.

78. The package of claim **69**, further comprising mechanical mixing means for initiating carbonation of said fruits or vegetables after said fruits or vegetables are sealed within said sealable container.

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