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Netherlands Enterprise Agency

This is to declare that in the Netherlands on **15/10/2021**
under No. **2029437**

in the name of:

Perfo Tec B.V.

in Woerden, the Netherlands

a patent application was filed for:

"PACKAGE FOR PRESERVING RESPIRING PRODUCE AND METHOD "

and that the documents attached hereto correspond with the originally filed documents.



The Hague, 13/07/2022

The president of the Netherlands Patent Office,

M.H. Spigt PhD MSc

ABSTRACT

5 A package for preserving respiring produce contained in the
package, in particular vegetables, fruit, herbs, spices and/or
flowers, and an associated method are provided. The package
defines a package volume for containing a portion of the
produce and a package atmosphere, and comprises a packaging
10 material, in particular a BOPE or MDOPE- containing polymer
film, with a haze of at most 10, preferable at most 5, more
preferably at most 3, and most preferably at most 2, provided
with one or more perforations enabling gas exchange with the
atmosphere surrounding the package to form the package into a
15 Controlled Atmosphere Package (CAP). The package has a package
carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{pack}}$) and the $\text{CO}_2\text{TR}_{\text{pack}}$ is
at least 1000 ml per 100 gram produce to be packed.

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PACKAGE FOR PRESERVING RESPIRING PRODUCE AND METHOD

5 TECHNICAL FIELD

The present disclosure relates to a package for preserving
respiring produce contained in the package, in particular
vegetables, fruit, flowers and herbs, comprising a packaging
10 material, in particular a polymer film, provided with one or
more perforations enabling gas exchange, in particular the
exchange of oxygen and carbon dioxide, with the outside
atmosphere surrounding the package. The invention further
relates to a method for manufacturing such a package.

15

BACKGROUND

Shelf life of natural products is of interest to producers,
sellers, re-sellers and consumers alike. In the case of food
20 stuffs, like vegetables, fruit, herbs and/or spices, taste,
flavour, ripeness and/or structural properties (e.g. firmness)
are particularly relevant, as well as inhibiting decay
processes and/or growth of pathogens. In the case of flowers,
particular concern is the so-called vase life, the time cut
25 flowers and/or flowers in a bouquet retain acceptably pleasing
appearance and/or fragrance on display. Typically, the vase
life is a few days up to about two weeks at most. Shelf life
and vase life are affected by initial produce quality and by
conditions of storage and/or transport.

30

Natural produce such as flowers, vegetables, fruits and/or
herbs tend to respire after being harvested, involving inter
alia to a consumption of oxygen and a generation of carbon

dioxide. The respiration continues for prolonged periods, in particular if the produce has undergone little to no processing, e.g. having been washed and possibly peeled and/or chopped up, but otherwise fresh and uncooked. When such
5 produce is packaged, the atmosphere within the package is affected by the respiring produce. Conversely, an atmosphere surrounding natural produce affects the respiration, maturation, aging and/or deterioration of the packed produce. It has therefore become customary to package fresh produce in
10 packages with a modified atmosphere (Modified Atmosphere Package or MAP) or with a controlled atmosphere (Controlled Atmosphere Package or CAP). In MAP the produce is packaged, and an artificial gas mixture is used to establish a distinct interior atmosphere in the package, which may however change
15 later on due to the respiration of the packed produce. In CAP the produce is packaged, and the composition of the package atmosphere is controlled by including an active absorber for an atmosphere component, e.g. an oxygen scavenger and/or by adapting transmission of the packaging material to allow
20 exchange with an exterior atmosphere outside the package, e.g. by perforating the material. Modified- and controlled atmosphere packaging (MAP/CAP) preserve produce quality by reducing the aerobic respiration rate while avoiding anaerobic processes that may lead to adverse changes, e.g. in one or
25 more of colour, texture, flavour and aroma.

Another aspect of fresh and/or respiring produce is, on the one hand, the production of water vapour by the produce and, on the other hand, sensitivity to humidity by the produce
30 and/or live contaminants (e.g. microbes, insects, parasites, and fungi). Therefore, humidity of the atmosphere inside a package should also preferably be controlled.

In view of the above, different packages and packaging materials have been developed, e.g. see WO 2016/071922 or WO 2016/003899. It is further noted that various aspects of modified /controlled atmosphere packaging are disclosed in US 7,083,837 and in P.V. Mahajan et al., "An interactive design of MA-packaging for fresh produce", in: "Handbook of food science, technology and engineering", Y.H. Hui (ed), CRC Press (Taylor & Francis Group) 2006.

Additional aspects related to packaging materials and/or packaging of respiring produce are disclosed in EP 2 294 923, US 2010/221393, WO 2017/220801, US 2010/151166, WO 2018/147736, WO 2009/003675, DE 699 01 477, and in M.

Mastromatteo, et al. "A new approach to predict the mass transport properties of micro-perforated films intended for food packaging applications", J. Food. Eng. 113 (1):41-46 (2012-05-18), DOI: 10.1016/J.JFOODENG.2012.05.029; and M. Scetar, et al, "Trends in Fruit and Vegetable Packaging - a Review", Croatian J. Food Tech., Biotech. Nutr., 5(3-4):69-86 (2010), ISSN: 1847-3423.

US 6376 032 describes gas-permeable membranes which are useful in the packaging of fresh cut fruit and vegetables, and other respiring biological materials. The membranes are made by forming thin polymeric coatings on microporous polymeric films. Preferred coating polymers are side chain crystalline polymers such as polyacrylates and are applied onto the microporous film by solution coating.

US 2015/321823 is based on synergistic effect of a cyclopropene compound and a modified atmosphere package to extend shelflife and/or storage for avocados. Provided is a method of storing avocados comprising the step of exposing avocados to an atmosphere that contains a cyclopropene

compound, wherein either (a) the avocados are in a modified atmosphere package during exposure to the cyclopropane compound, or (b) the avocados are placed into a modified atmosphere package after exposure to the cyclopropene compound, and the avocados remain in the modified atmosphere package for at least two hours. In some embodiments, the modified-atmosphere package is constructed so that the transmission rate of oxygen for the entire package is from 200 to 40,000 cubic centimeters per day per kilogram of avocados.

However, in view of the ongoing strive to improve produce quality and to prevent spoilage and loss, further improvements are still desired. This is especially the case for packages for freshly cut leafy greens. This type of produce is especially prone to decay and spoilage. Therefore, packages for these types of produce still leave much to be desired especially with respect to transparency and shelf-life.

SUMMARY

Herewith a package for preserving respiring produce and a method of manufacturing a package for preserving respiring produce contained in the package are provided and specified in the appended claims.

A package for preserving respiring produce contained in the package wherein the package defines a package volume for containing a portion of the produce and a package atmosphere, which comprises:

- a packaging material which comprises a Biaxially Oriented Poly Ethylene (BOPE) or a Mono Directed Oriented poly Ethylene (MDOPE)- containing polymer film with a haze of at most 10, preferable at most 5, more preferably at most 3, and most

preferably at most 2, as determined by ASTM D 1003

- said polymer film being provided with one or more perforations enabling gas exchange with the atmosphere surrounding the package to form the package into a Controlled

5 Atmosphere Package (CAP); wherein:

- the packaging material has a material carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{mat}}$) and,

- the one or more perforations provide a perforation carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{perf}}$), such that the package

10 carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{pack}}$) is the sum of the

perforation carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{perf}}$) and the

material carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{mat}}$) of the

packaging material ($\text{CO}_2\text{TR}_{\text{pack}} = \text{CO}_2\text{TR}_{\text{perf}} + \text{CO}_2\text{TR}_{\text{mat}}$), and wherein

- the $\text{CO}_2\text{TR}_{\text{pack}}$ is at least 1000 ml/(m².24 hrs) per 100 gram

15 produce to be packed.

The package of the present disclosure may suitably be used suitable for any respiring produce such as freshly cut leafy greens, freshly cut vegetables, fruit, herbs, flowers or

20 prepared salads.

The freshly cut leafy greens may comprise lettuce, rucola, spinach, romaine, and combinations hereof.

25 The freshly cut vegetables may comprise beans, zucchini, carrots, sprouts, leaks, cauliflower, broccoli, and combinations thereof.

The fresh fruit may comprise berries, apples, stone-fruit such
30 as mango, pears, tomatoes, peppers, bananas, grapes, etcetera, and combinations thereof.

The prepared salad may comprise freshy-cut leafy greens and/or freshly cut vegetables, and/or fresh fruit.

The thickness of the polymer film layer is in the range of 5-200 micrometers, preferably in a range of 10-150 micrometers, more preferably in a range of 15-100 micrometres, most preferably in a range of 20-75 micrometers.

The packaging material has material oxygen transmission rate and a perforation oxygen transmission rate (O_2TR_{perf}). The package oxygen transmission rate (O_2TR_{pack}) is the sum of the perforation oxygen transmission rate (O_2TR_{perf}) and the material oxygen transmission rate (O_2TR_{mat}) of the packaging material ($O_2TR_{pack} = O_2TR_{perf} + O_2TR_{mat}$). The package transmission ratio β_{pack} is $\beta_{pack} = (CO_2TR_{perf} + CO_2TR_{mat}) / (O_2TR_{perf} + O_2TR_{mat})$. The package transmission ratio $\beta_{pack} = CO_2TR_{pack} / O_2TR_{pack}$ may be set to at least 1,5, preferably at least 2, more preferably at least 3, still more preferably at least 4, such as 5 or more.

The packaging material may have an oxygen transmission rate (O_2TR_{mat}) of at least 2000 ml/(m².24 hrs), preferably at least 3000 ml/(m².24 hrs), more preferably at least 4000 ml/(m².24 hrs), most preferably at least 5000 ml/(m².24 hrs).

The packaging material may have a carbon dioxide transmission rate (CO_2TR_{mat}) of at least 15000 ml/(m².24 hrs), preferably at least 20000 ml/(m².24 hrs), more preferably at least 25000 most preferably at least 30000 ml/(m².24 hrs).

A package according to the disclosure may also be in the form of a tray and a lidding film sealed to the tray thus closing the package. In that case the lidding film is a Biaxially Oriented Poly Ethylene (BOPE) or a Mono Directed Oriented poly Ethylene (MDOPE)- containing polymer film polymer film.

The disclosure is further directed to a method for manufacturing a package for preserving respiring produce contained in the package comprising:

- i. providing a closed package defining a package volume for containing in the package volume a portion of the respiring produce from a packaging material comprising a Biaxially Oriented Poly Ethylene (BOPE) or a Mono Directed Oriented poly Ethylene (MDOPE)- containing polymer film with a haze of at most 10, preferably at most 5, more preferably at most 3, and most preferably at most 2, as determined by ASTM D 1003; and
- ii. determining a size, and possibly a number of one or more perforations (3) provided in or to be provided in the packaging material to enable gas exchange between the package atmosphere and the atmosphere surrounding the package to form the package into a Controlled Atmosphere Package (CAP), such that the package has a package carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{pack}}$) which is at least 1000 ml/(m².24 hrs.) per 100 gram produce to be packed.

Suitable the packaging material for the method may have an oxygen transmission rate (O_2TR) of at least 2000 ml/(m².24 hrs), preferably at least 3000 ml/(m².24 hrs), more preferably at least 4000 ml/(m².24 hrs), most preferably at least 5000 ml/(m².24 hrs).

25

The carbon dioxide transmission rate (CO_2TR) of the suitable packaging material for the method may have at least 10000 ml/(m².24 hrs), preferably at least 12000 ml/(m².24 hrs), more preferably at least 15000 most preferably at least 20000 ml/(m².24 hrs).

30

The method of manufacturing a package for package for preserving respiring produce contained in the package may also

be directed to the production of a tray with a lidding film sealed to the tray thus closing the package wherein the lidding film is a Biaxially Oriented Poly Ethylene (BOPE) or a Mono Directed Oriented Poly Ethylene (MDOPE)- containing
5 polymer film polymer film.

DETAILED DESCRIPTION

10 The present disclosure provides a package for preserving respiring produce and a method of manufacturing a package for preserving respiring produce contained in the package are provided and specified in the appended claims.

15 More specifically, the disclosure is directed to a package for preserving respiring produce contained in the package wherein the package defines a package volume for containing a portion of the produce and a package atmosphere, which comprises:

- a packaging material which comprises a Biaxially Oriented
20 Poly Ethylene (BOPE) or a Mono Directed Oriented poly Ethylene (MDOPE)-containing polymer film with a haze of at most 10, preferable at most 5, more preferably at most 3, and most preferably at most 2, as determined by ASTM D 1003
- said polymer film being provided with one or more
25 perforations enabling gas exchange with the atmosphere surrounding the package to form the package into a Controlled Atmosphere Package (CAP); wherein:
- the packaging material has a material carbon dioxide transmission rate (CO_2TR_{mat}) and,
- 30 -wherein the one or more perforations provide a perforation carbon dioxide transmission rate (CO_2TR_{perf}) and a perforation oxygen transmission rate (O_2TR_{perf}), such that the package carbon dioxide transmission rate (CO_2TR_{pack}) is the sum of the

perforation carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{perf}}$) and the material carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{mat}}$) of the packaging material ($\text{CO}_2\text{TR}_{\text{pack}} = \text{CO}_2\text{TR}_{\text{perf}} + \text{CO}_2\text{TR}_{\text{mat}}$), and wherein - the $\text{CO}_2\text{TR}_{\text{pack}}$ is at least 1000 ml/(m².24 hrs) per 100 gram produce to be packed.

The packaging material used is a Biaxially Oriented Poly Ethylene (BOPE) or Mono Directed Oriented Poly ethylene (MDOPE) -containing polymer film. When polyethylene film is extruded and stretched in both the machine direction and across machine direction, it is called *biaxially oriented polyethylene*. When extruded polyethylene film is only stretched on one direction it is called mono directed oriented polyethylene. BOPE film and MDOPE film may be multi-layered. For instance, the BOPE or MDOPE-containing film may also comprise a printable layer and/or a heat sealable layer on a polyethylene core layer. The various layers may optionally be provided with intermediate layers to provide the necessary compatibility between the layers. Preferably the various layers are polyethylene layers. BOPE film and MDOPE film have a higher tensile strength and impact strength than conventional polyethylene film BOPE-film. Further BOPE and MDOPE may be produced with a high transparency. Since the package according to the disclosure is used for preserving produce, transparency of the packing material is important. The customer wishes to ensure himself of the quality and freshness of the produce. BOPE and MDOPE-containing polymer films with a haze of at most 10, preferably at most 5, more preferably at most 3, and most preferably at most 2, as determined by ASTM D 1003 are suitable for the present package. Owing to their higher mechanical strengths, BOPE and MDOPE-containing polymer films may be prepared with a reduced thickness, resulting in a reduced plastic use, and thus

reduced costs and a reduced waste. Furthermore, BOPE and MDOPE are 100% recyclable. We have found that this type of material is especially suitable for creating microperforations in a reproducible way with very homogeneous perforations. We have
5 also found that BOPE and MDOPE have a strongly increased CO₂ permeability and β ratio, as well as a higher water vapour transmission rate compared to conventional polyethylene. These properties make the material highly suitable for use in the package according to the disclosure. It even makes it possible
10 to adjust the package to the specific produce to be packed.

It is known that different species of produce and different varieties within a produce species exhibit different respiration rates, documented in literature. The total open
15 area of the perforations for CAP should be determined based on the produce (to be) packed and the transmission properties of the packaging material itself; the transmission rate of the package for each substance is formed by the combination of the transmission rate of the packaging material and the
20 transmission rate through the perforations for the respective substance.

The package of the present disclosure may suitably be used suitable for any respiring produce such as freshly cut leafy
25 greens, freshly cut vegetables, fruit, herbs, flowers or prepared salads. As mentioned above the BOPE or MDOPE-containing polymer film enables the adjustment to the package of any respiring produce. This can be done by setting the carbon dioxide transmission rate of the package to at least
30 1000 ml/(m².24 hrs) per 100 gram produce to be packed. The impact of carbon dioxide when it reaches a harmful level on for instance leafy greens such as spinach is much higher than for instance dense vegetables such as green beans or brussels

sprouts, because the surface area of spinach per weight is much higher than for green beans. Thus with the present disclosure packages are provided that are suitable both for high demanding produce such as leafy greens, but also for more
 5 dense produce such as green beans or brussels sprouts.

Examples of freshly cut leafy greens are lettuce, rucola, spinach, romaine, and combinations hereof.

10 Examples of freshly cut vegetables are beans, zucchini, carrots, sprouts, leaks, cauliflower, broccoli, etcetera, and combinations thereof.

Examples of fresh fruit are berries, apples, pears, tomatoes,
 15 peppers, bananas, mango, grapes, stone fruit such as mango, grapes, etcetera, and combinations thereof.

The package according to the disclosure may also suitable be used for prepared salads. These may comprise freshy-cut leafy
 20 greens and/or freshly cut vegetables, and/or fresh fruit.

As mentioned above, BOPE and MDOPE can be prepared with smaller thickness than conventional polyethylene, because of its higher mechanical strength. In addition to the
 25 recyclability of these types of films, these reduced thicknesses have advantages with respect to costs and environmental impact. The thickness of the polymer film layer is in the range of 5-200 micrometers, preferably in a range of 10-150 micrometers, more preferably in a range of 15-100
 30 micrometers, most preferably in a range of 20-75 micrometers. The packaging material has a carbon dioxide transmission rate CO_2TR_{mat} and an oxygen transmission rate O_2TR . The package has a package carbon dioxide transmission rate CO_2TR_{pack} and an oxygen transmission rate O_2TR_{pack} and a package transmission ratio β_{pack}

= $\text{CO}_2\text{TR}_{\text{pack}} / \text{O}_2\text{TR}_{\text{pack}}$ of at least 1,5, preferably at least 2, more preferably at least 3, still more preferably at least 4, e.g. 5 or more.

Thus the package as a whole provides a high transmission ratio
5 between the transmission rates for oxygen and carbon dioxide.

The carbon dioxide transmission rate facilitates escape of carbon dioxide and thus reduces elevating CO_2 concentration in the package atmosphere, thus reducing or preventing risks of
10 anaerobic decay processes. Further, CO_2 may dissolve in water, from which it may re-enter the package atmosphere later on, and with which it may react to form carbonic acid which in turn may affect taste and/or composition of food produce stored in the package.

15 When the package is closed comprising respiring produce, the oxygen in the package atmosphere is consumed and the oxygen concentration decreases.

A too-low O_2 -concentration may accelerate anaerobic decay
20 processes; however, a too high concentration causes accelerated aging of the produce. Both should be prevented. The oxygen transmission rate O_2TR of the package enables an inflow of oxygen into the package atmosphere, preventing complete consumption of the oxygen.

25 An oxygen concentration in a range of typically 1-10%, preferably 2-8% e.g. 3-7% more preferably 4-6% may be preferred to decelerate aging processes (also known as "putting the produce to sleep") and maximise shelf life. Such
30 concentrations may be achieved by the one or more perforations forming the package as a CAP. By the one or more perforations the oxygen transmission rate of the package as a whole can be increased.

Each perforation affects the transmission rate of the package as a whole for oxygen and carbon dioxide. The package transmission ratio β_{pack} facilitates control over the oxygen concentration and the carbon dioxide concentration in the package atmosphere by perforating the material with the one or more perforations. Thus increased inflow of oxygen and increased outflow of carbon dioxide may be balanced by the perforation(s).

10 The one or more perforations may be provided as one or more microperforations. The package when formed into the CAP should be devoid of other openings than provided by the one or more perforations for accurate control of the package atmosphere.

15 It is noted that the water vapour transmission rate of the package is only insignificantly affected by the open area of microperforations for CAP.

In an embodiment, the one or more perforations may comprise microperforations having an open area of below 1 square millimetre, preferably below 0.5 square millimetre, e.g. about 0.25 square millimetre or less. Such microperforations facilitate exchange of gases through the packaging material, but hinder contamination of the packed material from outside sources. Such microperforations may be made by (hot) needles. Laser perforation is an effective manner to provide such microperforations fast, reliable, food-safe, and in desired locations. Microperforations also tend not to significantly compromise integrity of the packaging material, in particular if the perforated packaging material comprises a polymeric film. Suitable films may range from a flexible films that can be bent and/or folded multiple times without harm to a rigid film for making a tray.

Laser drilled microperforations may be approximately round or oblong, having a (largest) diameter in a range of 50 - 500 micrometres, in particular in a range of 60 - 400 micrometres, preferably in a range of 70 - 200 micrometres, more preferably in a range of 80 - 150 micrometres such as in a range of 90 - 120 micrometres.

Determining an oxygen transmission rate and/or a carbon dioxide transmission rate provided by a perforation may comprise determining an open area and a film thickness. In case of a generally round, elliptical or oval perforation the open area may be determined by determining on the basis of one or more diameters determined from the hole, for which camera images may be used. A suitable calculation model is provided in Fishman et al, "Mathematical model for perforation effect on oxygen and water vapor dynamics in modified atmosphere packages", J. Food Sci. 61(5):956-961 (1996).

With properly setting the carbon dioxide transmission rate and the oxygen transmission rate of the package, i.e. the β , by choosing the proper packaging material and adding microperforations a CAP can be established. Thus, the one or more perforations perforation provides a perforation carbon dioxide transmission rate CO_2TR_{perf} and a perforation oxygen transmission rate O_2TR_{perf} , such that the package carbon dioxide transmission rate CO_2TR_{pack} is the sum of the perforation carbon dioxide transmission rate CO_2TR_{perf} and the carbon dioxide transmission rate CO_2TR of the packaging material: $CO_2TR_{pack} = CO_2TR_{perf} + CO_2TR_{mat}$; and the package oxygen transmission rate O_2TR_{pack} is the sum of the perforation oxygen transmission rate O_2TR_{perf} and the oxygen transmission rate O_2TR of the packaging material: $O_2TR_{pack} = O_2TR_{perf} + O_2TR_{mat}$. The package transmission

ratio β_{pack} then is $\beta_{\text{pack}} = (\text{CO}_2\text{TR}_{\text{perf}} + \text{CO}_2\text{TR}_{\text{mat}}) / (\text{O}_2\text{TR}_{\text{perf}} + \text{O}_2\text{TR}_{\text{mat}})$. As described above, the package according to the disclosure has β_{pack} of at least 1,5, preferably at least 2, more preferably at least 3, still more preferably at least 4, such as 5 or more.

The packaging material may have an oxygen transmission rate ($\text{O}_2\text{TR}_{\text{mat}}$) of at least 2000 ml/(m².24 hrs), preferably at least 3000 ml/(m².24 hrs), more preferably at least 4000 ml/(m².24 hrs), most preferably at least 5000 ml/(m².24 hrs). The oxygen transmission rate is measured in accordance with ASTM D3985 2556 (coulometric method) at a test temperature of 23 °C.

The packaging material may have a carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{mat}}$) of at least 15000 ml/(m².24 hrs), preferably at least 20000 ml/(m².24 hrs), more preferably at least 25000 most preferably at least 30000 ml/(m².24 hrs). The carbon dioxide transmission rate is measured in accordance with ISO 2556 (manometric method) at a test temperature of 23 °C.

A package according to the disclosure may also be in the form of a tray and a lidding film sealed to the tray thus closing the package. In that case the lidding film is a Biaxially Oriented Poly Ethylene (BOPE) or a Mono Directed Oriented poly Ethylene (MDOPE)- containing polymer film polymer film.

A tray package may protect the produce from mechanical harm and/or may collect juices leaking from the produce, thus it is particularly suitable for soft and/or liquid-producing produce like soft fruits, berries, grapes, and/or flowers. Tray packages comprising a barrier material may be particularly robust for such purposes.

Produce packaged in such tray packages according to the present concepts, may have extended shelf life. The lidding film may be a preferred location for the one or more perforations and it may have a particular influence in determining the transmission ratio of the package. E.g., the lidding film may have the specified carbon dioxide transmission rate and/or oxygen transmission rate of the material.

A tray formed from a sheet of material comprising one or more layers comprising polyethylene terephthalate (PET) may be strong and light weight. The material may be well recyclable reducing an environmental footprint. In such PET-tray, the material of each of the layers of the formed tray may comprise at least 50%, preferably at least 85%, more preferably at least 95% of amorphous polyethylene terephthalate, which facilitates forming the tray and providing high clarity of it.

The package may comprise a peripheral sealing rim provided with a layer of an adhesive along the circumference of the tray, preferably along the full circumference of the tray. The adhesive may facilitate sealing a lidding film of another (non-PET) material to the tray.

The disclosure is further directed to a method for manufacturing a package for preserving respiring produce contained in the package comprising:

- i. providing a closed package defining a package volume for containing in the package volume a portion of the respiring produce from a packaging material comprising a Biaxially Oriented Poly Ethylene (BOPE) or a Mono Directed Oriented poly Ethylene (MDOPE)- containing polymer film with a haze of at most 10, preferably at most 5, more preferably at most 3, most

preferably at most 2, as determined by ASTM D 1003; and
ii. determining a size, and possibly a number of one or more perforations (3) provided in or to be provided in the packaging material to enable gas exchange between the package atmosphere and the atmosphere surrounding the package to form the package into a Controlled Atmosphere Package (CAP), such that the package has a package carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{pack}}$) which is at least $1000 \text{ ml}/(\text{m}^2 \cdot 24 \text{ hrs})$ per 100 gram produce to be packed.

Suitable the packaging material for the method may have an oxygen transmission rate (O_2TR) of at least $2000 \text{ ml}/(\text{m}^2 \cdot 24 \text{ hrs})$, preferably at least $3000 \text{ ml}/(\text{m}^2 \cdot 24 \text{ hrs})$, more preferably at least $4000 \text{ ml}/(\text{m}^2 \cdot 24 \text{ hrs})$, most preferably at least $5000 \text{ ml}/(\text{m}^2 \cdot 24 \text{ hrs})$. However, an oxygen transmission rate O_2TR of the material may preferably be less than $15000 \text{ ml}/(\text{m}^2 \cdot 24 \text{ hrs})$, more preferably less than $10000 \text{ ml}/(\text{m}^2 \cdot 24 \text{ hrs})$, to facilitate adjustment using the one or more perforations.

The carbon dioxide transmission rate (CO_2TR) of the suitable packaging material for the method may have at least $10000 \text{ ml}/(\text{m}^2 \cdot 24 \text{ hrs})$, preferably at least $12000 \text{ ml}/(\text{m}^2 \cdot 24 \text{ hrs})$, more preferably at least 15000 most preferably at least $20000 \text{ ml}/(\text{m}^2 \cdot 24 \text{ hrs})$. However, a carbon dioxide transmission rate CO_2TR of the material may preferably be less than $100000 \text{ ml}/(\text{m}^2 \cdot 24 \text{ hrs})$, more preferably less than $75000 \text{ ml}/(\text{m}^2 \cdot 24 \text{ hrs})$, to facilitate adjustment using the one or more perforations.

The method of manufacturing a package for package for preserving respiring produce contained in the package may also be directed to the production of a tray with a lidding film sealed to the tray thus closing the package wherein the

lidding film is a Biaxially Oriented Poly Ethylene (BOPE) or a Mono Directed Oriented Poly Ethylene (MDOPE)- containing polymer film polymer film.

5 The package containing respiring produce may be closed by hand with a closing device (e.g. tie, clip, tape, elastic band, etc.) and/or by folding and/or knotting. Also or alternatively, the package may be (further) closed by other techniques, e.g. by use of adhesives and/or by welding which
10 may comprise using a hand-held device and/or an automated device which may be comprised in the apparatus. The package may be closed immediately after filling or produce may be filled in the package and the package being closed after a further treatment step and/or conditioning step, e.g. cooling.

15

It was found that the use of BOPE or MDOPE-containing polymer film enabled reducing the amount of oxygen in the package below that normally acceptable for CAP where higher-than-desired amounts of oxygen must be accepted to prevent
20 unacceptably high levels of CO₂.

More importantly, such package enables extending shelf life of respiring produce in CAP packages by several days. This may amount to extending shelf life over 30-100% compared to
25 conventional polymer films used.

In more detail, in CAP, the oxygen concentration in the package atmosphere may be lowered to a reduced oxygen concentration in order to slow down aging processes, while at
30 the same time ensuring a minimum level of oxygen. Also or alternatively, the carbon dioxide concentration in the package atmosphere may be controlled to ensure a level below becoming harmful. Thus, aging, maturation and/or decay are slowed down

and in particular anaerobic processes such as off-smell, decay cell membrane breakdown are prevented. Generally, it is preferred that the equilibrium oxygen concentration and/or carbon dioxide concentration are reached as soon as possible.

5 For that, a combination of CAP and MAP may be used. For the MAP, the initial package atmosphere may be established at or near the time of closing the package by creating in and/or introducing into the package volume an atmosphere modification gas or -gas mixture differing from the ambient atmosphere.

10

For prolonged storage, most produce benefit from both a low CO₂-concentration and a low O₂-concentration in the package atmosphere, wherein the O₂-concentration is in the range of about 1-10% by volume ("%vol"), preferably in a range 3-7

15

%vol. In order to maintain such low O₂-concentration, the perforation(s) in the package should provide an open area configured to control inflow of oxygen into the package volume, in particular establishing a minimum inflow to prevent anaerobicity and a maximum inflow to ensure the low oxygen

20

concentration slowing down the metabolic processes of the produce (a.k.a. "putting the produce to sleep"). This restriction to the open area of the perforation(s) inherently restricts outflow of CO₂ from the package through the perforations, considering that perforations are a-selective

25

with respect to O₂ and CO₂: typically the ratio for the flow of CO₂:O₂ for 1 small laser perforation is approximately 1. The perforations in the package therefore determine simultaneously an upper limit for outflow of CO₂ and inflow of O₂.

Manufacturing a CAP package thus forces a compromise between
30 on the one hand raising the outflow of CO₂, which is desired, and on the other hand raising the inflow of O₂, which is undesired.

A high CO₂TR of the packaging material is therefore beneficial in establishing an improved concentration balance between O₂ and CO₂ in the package atmosphere, since this raises the transmission rate for CO₂ for the CAP package as a whole.

5

The package atmosphere may define an equilibrium amount of oxygen and an amount of carbon dioxide which together make up less than 20 %vol of the package atmosphere, preferably less than 17 %vol such as less than 15 %vol or even less than 13 %vol.

10

It has been found that as a rule-of-thumb, for present-day packaging films for fresh respiring produce, generally in CAP the amounts of O₂ and CO₂ together make up about 21-23 %vol of the package atmosphere ({amount O₂} + {amount CO₂} = ca. 21-23 %vol of the package atmosphere). In the presently provided package, the transmission ratio of the package facilitates escaping the aforementioned rule of thumb and achieving both a low concentration of O₂ and of CO₂ in the package atmosphere and a low concentration of CO₂ in the combined concentration.

20

Most aging processes lead to CO₂ production, causing a build-up in the package atmosphere. An elevated CO₂-concentration may accelerate anaerobic decay processes and should be prevented.

25

However, a too high carbon dioxide transmission rate may prevent a desired deceleration of metabolic processes and associated extension of shelf life. The presently provided ranges are preferred to meet such balance.

30

Respiration and most aging processes lead to O₂ consumption, causing a depletion in the package atmosphere. A high O₂TR of the packaging material and/or a high carbon dioxide transmission rate CO₂TR of the packaging material facilitates

fine control of oxygen influx and, respectively carbon dioxide outflow, e.g. by precisely establishing a ratio of the packaging material area and the open area of the one or more perforations to achieve the transmission ratio of the package.

5

The package volume may be in a range of 2-5 times the volume of the produce in the package, in some cases in a range 3-4 times the volume of the produce in the package. In some cases the package volume may be in range of 5-10 times the produce
10 volume, e.g. 6-8 or 7 times. A larger volume ratio may be in particular used for consumer packages and/or produce that is one or more of hollow, delicate and finely divided like raspberries, cut lettuce, herbs (parsley stalks, thymian sprigs, etc). Package volume unoccupied by produce is
15 generally called headspace.

The present disclosure is further illustrated by means of the following Examples. These Examples are merely meant for illustration and should not be construed as limitative.

20

EXAMPLES

Examples 1-13

5

Several sachets of a BOPE film according to the claims were provided with produce. The BOPE film was a 5-layer film with the following properties:

Thickness: 30 micrometers,

10 Haze: 2,5 as determined in accordance to AST D 1003

Tensile strength: MD= 80, HD= 210 as determined in accordance to AST D882

Density: 0,937 g/cm³

CO₂TR: 30.000 ml/(m².24 hrs) as determined in accordance to ISO

15 2556 at a test temperature of 23 °C

The results are given in TABLE I below.

Comparative Examples 1-13.

For comparison, the days of good quality after packing is

20 given for the same produce in the same amounts packed in

sachets of similar size and volume of conventional

polyethylene and BOPP for packing food products. The results are given in TABLE II.

25

TABLE I

Ex.	Product	CO ₂ TR sachet	film CO ₂ TR _{max} in ml per 100g of packed product	CO ₂ TR of perforations per sachet	Total CO ₂ TR (film plus perfs) per sachet)	Total CO ₂ TR per 100 gram product	Days good quality after packing
1	Spinach 150g	4002	2668	400	4402	2935	14
2	Spinach 150g	4002	2668	400	4402	2935	14
3	Spinach 200g	4368	2184	600	4968	2484	14
4	Spinach 300g	4730,4	1577	900	5630,4	1877	14
5	Spinach 500g	6552	1310	1200	7752	1550	14
6	Salad Mix 500g	6393,6	1279	500	6893,6	1379	12
7	Salad Mix 570g	6571,2	1153	700	7271,2	1276	12
8	Salad Mix 700g	6903	986	900	7803	1115	12
9	Salad Mix 1000g	15019,2	1502	1200	16219,2	1622	12
10	Lollo Bionda 250g	4989,6	1996	500	5489,6	2196	12
11	Lollo Bionda 2x 250g	4972,8	1989	500	5472,8	2189	12
12	Lollo Bionda 300g	5346	1782	600	5946	1982	12
13	Lollo Rosso 250g	4989,6	1996	500	5489,6	2196	12

TABLE II

Comp Ex.	Product	Days good quality after packing with BOPP	Days good quality after packing with conventional PE
1	Spinach 150g	7	9
2	Spinach 150g	7	9
3	Spinach 200g	7	9
4	Spinach 300g	7	9
5	Spinach 500g	7	9
6	Salad Mix 500g	6	7
7	Salad Mix 570g	6	7
8	Salad Mix 700g	6	7
9	Salad Mix 1000g	6	7
10	Lollo Bionda 250g	6	8
11	Lollo Bionda 2x 250g	6	8
12	Lollo Bionda 300g	6	8
13	Lollo Rosso 250g	6	8

CLAIMS

1. A package for preserving respiring produce contained in the package wherein the package defines a package volume for
5 containing a portion of the produce and a package atmosphere, which comprises:

- a packaging material which comprises a Biaxially Oriented Poly Ethylene (BOPE) or a Mono Directed Oriented poly Ethylene (MDOPE)-containing polymer film with a haze of at
10 most 10, preferable at most 5, more preferably at most 3, and most preferably at most 2, as determined by ASTM D 1003,

- said polymer film being provided with one or more perforations enabling gas exchange with the atmosphere
15 surrounding the package to form the package into a Controlled Atmosphere Package (CAP); wherein:

- the package has a package carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{pack}}$)

- wherein the one or more perforations provide a perforation carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{perf}}$) such that the
20 package carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{pack}}$) is the sum of the perforation carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{perf}}$) and the material carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{mat}}$) of the packaging material ($\text{CO}_2\text{TR}_{\text{pack}} =$
25 $\text{CO}_2\text{TR}_{\text{perf}} + \text{CO}_2\text{TR}_{\text{mat}}$) and wherein

- the $\text{CO}_2\text{TR}_{\text{pack}}$ is at least 1000 ml/(m².24 hrs) per 100 gram produce to be packed.

2. The package according to preceding claim 1 wherein the
30 produce to be packed is chosen from freshly cut leafy greens, freshly cut vegetables, fruit, herbs, flowers or prepared salads.

3. The package according to any one of the preceding claims wherein the freshly cut leafy greens comprise lettuce, rucola, spinach, romaine, and combinations hereof.

5 4. The package according to any one of the preceding claims wherein the freshly cut vegetables comprise green beans, zucchini, carrots, sprouts, leaks, cauliflower, broccoli, and combinations thereof.

10 5. The package according to any one of the preceding claims wherein the fresh fruit comprises berries, apples, pears, tomatoes, peppers, bananas, stone fruit such as mangos, and combinations thereof.

15 6. The package according to any one of the preceding claims wherein the prepared salad comprises freshy-cut leafy greens and/or freshly cut vegetables, and/or fresh fruit.

20 7. The package according to any one of the preceding claims wherein the thickness of the polymer film layer is in the range of 5-200 micrometers, preferably in a range of 10-150 micrometers, more preferably in a range of 15-100 micrometres, most preferably in a range of 20-75 micrometers.

25 8. The package according to any one of the preceding claims wherein the packaging material has a material oxygen transmission rate (O_2TR_{pack}) and a perforation oxygen transmission rate (O_2TR_{perf}), and the package oxygen transmission rate (O_2TR_{pack}) is the sum of the perforation oxygen transmission rate (O_2TR_{perf}) and the material oxygen transmission rate (O_2TR_{mat}) of the packaging material ($O_2TR_{pack} = O_2TR_{perf} + O_2TR_{mat}$) and the package transmission ratio β_{pack} is $\beta_{pack} = (CO_2TR_{perf} + CO_2TR_{mat}) / (O_2TR_{perf} +$
 30 $O_2TR_{mat})$, wherein the package transmission ratio $\beta_{pack} =$
 35

$\text{CO}_2\text{TR}_{\text{pack}} / \text{O}_2\text{TR}_{\text{pack}}$ of at least 1,5, preferably at least 2, more preferably at least 3, still more preferably at least 4, such as 5 or more.

- 5 9. The package according to any one of the preceding claims, wherein the packaging material has an oxygen transmission rate ($\text{O}_2\text{TR}_{\text{mat}}$) of at least 2000 ml/(m².24 hrs), preferably at least 3000 ml/(m².24 hrs), more preferably at least 4000 ml/(m².24 hrs), most preferably at least 5000 ml/(m².24
10 hrs).
10. The package according to any one of the preceding claims, wherein the packaging material has a carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{mat}}$) of at least 15000 ml/(m².24
15 hrs), preferably at least 20000 ml/(m².24 hrs), more preferably at least 25000 most preferably at least 30000 ml/(m².24 hrs).
11. A package for preserving respiring produce contained in the
20 package according to any one of the preceding claims wherein the packaging material comprises a tray and a lidding film sealed to the tray thus closing the package wherein the lidding film is a Biaxially Oriented Poly Ethylene (BOPE) or a Mono Directed Oriented poly Ethylene
25 (MDOPE)- containing polymer film polymer film.
12. Method for manufacturing a package for preserving respiring produce contained in the package comprising:
i. providing a closed package defining a package volume
30 for containing in the package volume a portion of the respiring produce from a packaging material comprising a Biaxially Oriented Poly Ethylene (BOPE) or a Mono Directed Oriented poly Ethylene (MDOPE)- containing polymer film with a haze of at most 10, preferably at most 5, more

preferably at most 3, and most preferably at most 2, as determined by ASTM D 1003; and

ii. determining a size, and possibly a number of one or more perforations (3) provided in or to be provided in the packaging material to enable gas exchange between the package atmosphere and the atmosphere surrounding the package to form the package into a Controlled Atmosphere Package (CAP), such that the package has a package carbon dioxide transmission rate ($\text{CO}_2\text{TR}_{\text{pack}}$) which is at least 1000 ml/(m².24 hrs) per 100 gram produce to be packed.

13. Method according to claim 12, wherein the packaging material has a carbon dioxide transmission rate (CO_2TR) of at least 10000 ml/(m².24 hrs), preferably at least 12000 ml/(m².24 hrs), more preferably at least 15000 most preferably at least 20000 ml/(m².24 hrs).

14. Method according to any one of preceding claims 12-13, wherein the packaging material has an oxygen transmission rate (O_2TR) of at least 2000 ml/(m².24 hrs), preferably at least 3000 ml/(m².24 hrs), more preferably at least 4000 ml/(m².24 hrs), most preferably at least 5000 ml/(m².24 hrs)

15. Method of manufacturing a package for package for preserving respiring produce contained in the package according to any one of the preceding claims 12-14 wherein the packaging material comprises a tray and a lidding film sealed to the tray thus closing the package wherein the lidding film is a Biaxially Oriented Poly Ethylene (BOPE) or a Mono Directed Oriented Poly Ethylene (MDOPE)-containing polymer film polymer film.

CONCLUSIES

1. Een verpakking voor het bewaren van ademende producten in de verpakking, waarbij de verpakking een verpakkingsvolume
5 definieert voor het bevatten van een deel van de producten en een verpakkingsatmosfeer, die omvat:

- een verpakkingsmateriaal dat een Biaxiaal Oriënteerde Polyethyleen (BOPE) of een Mono Directed Oriented Poly Ethyleen (MDOPE) bevattende polymeerfilm omvat met een waas
10 van hoogstens 10, bij voorkeur hoogstens 5, meer bij voorkeur hoogstens 3, en met de meeste voorkeur maximaal 2, zoals bepaald door ASTM D 1003,

- waarbij de polymeerfilm is voorzien van een of meer perforaties die gasuitwisseling mogelijk maken met de
15 atmosfeer die de verpakking omringt om de verpakking te vormen tot een gecontroleerde atmosfeerverpakking (CAP);
waarin:

- het pakket heeft een pakket kooldioxide transmissiesnelheid (CO_2TR_{pack} ,

20 -waarbij de een of meer perforaties een perforatie kooldioxide transmissiesnelheid (CO_2TR_{perf}) verschaffen zodanig dat de pakket kooldioxide transmissiesnelheid (CO_2TR_{pack}) de som is van de perforatie kooldioxide transmissiesnelheid (CO_2TR_{perf}) en de materiaal kooldioxide transmissiesnelheid (CO_2TR_{mat}) van het verpakkingsmateriaal ($CO_2TR_{pack} = CO_2TR_{perf} +$
25 CO_2TR_{mat}) en waarin,

- de CO_2TR_{pack} is minimaal 1000 ml/(m².24 uur) per 100 gram te verpakken product.

30 2. Verpakking volgens voorgaande conclusie 1, waarbij het te verpakken product wordt gekozen uit vers gesneden

bladgroenten, vers gesneden groenten, fruit, kruiden, bloemen of bereide salades.

3. Verpakking volgens een der voorgaande conclusies, waarbij
5 de vers gesneden bladgroenten sla, rucola, spinazie, romaine en combinaties hiervan omvatten.

4. Verpakking volgens een van de voorgaande conclusies, waarbij de vers gesneden groenten sperziebonen, courgette,
10 wortelen, spruiten, prei, bloemkool, broccoli en combinaties hiervan omvatten.

5. Verpakking volgens een van de voorgaande conclusies, waarbij het verse fruit bessen, appels, peren, tomaten,
15 paprika's, bananen, en/of steenfruit zoals mango's en combinaties hiervan omvat.

6. Verpakking volgens een der voorgaande conclusies, waarbij de bereide salade vers gesneden bladgroenten en/of vers
20 gesneden groenten en/of vers fruit omvat.

7. Verpakking volgens een van de voorgaande conclusies, waarbij de dikte van de polymeerfilmlaag in het bereik van 5-
200 micrometer ligt, bij voorkeur in het bereik van 10-150
25 micrometer, met meer voorkeur in het bereik van 15-100 micrometer. met de meeste voorkeur in een bereik van 20-75 micrometer.

8. Verpakking volgens een van de voorgaande conclusies,
30 waarbij het verpakkingsmateriaal een zuurstoftransmissiesnelheid (O_2TR_{pack}) en een

perforatiezuurstoftransmissiesnelheid (O_2TR_{perf}) heeft, en de zuurstoftransmissiesnelheid van de verpakking (O_2TR_{pack}) de som is van de perforatiezuurstoftransmissiesnelheid (O_2TR_{perf}) en de materiaalzuurstoftransmissiesnelheid (O_2TR_{mat}) van het verpakingsmateriaal ($O_2TR_{pack} = O_2TR_{perf} + O_2TR_{mat}$) en de pakkettransmissieverhouding $Beta_{pack}$ is $Beta_{pack} = (CO_2TR_{perf} + CO_2TR_{mat}) / (O_2TR_{perf} + O_2TR_{mat})$, waarbij de pakkettransmissieverhouding $beta_{pack} = CO_2TR_{pack} / O_2TR_{pack}$ van ten minste 1,5, bij voorkeur ten minste 2, met meer voorkeur ten minste 3, met nog meer voorkeur ten minste 4, zoals 5 of meer.

9. Verpakking volgens een der voorgaande conclusies, waarbij het verpakingsmateriaal een zuurstoftransmissiesnelheid (O_2TR_{mat}) heeft van ten minste 2000 ml/(m².24 uur), bij voorkeur ten minste 3000 ml/(m².24 uur) met meer voorkeur ten minste 4000 ml/(m².24 uur), met de meeste voorkeur ten minste 5000 ml/(m².24 uur).

10. Verpakking volgens een van de voorgaande conclusies, waarbij het verpakingsmateriaal een kooldioxidetransmissiesnelheid (CO_2TR_{mat}) heeft van ten minste 15000 ml/(m².24 uur), bij voorkeur ten minste 20000 ml/(m².24 uur).), met meer voorkeur ten minste 25000, met de meeste voorkeur ten minste 30000 ml/(m².24 uur).

11. Verpakking voor het bewaren van ademende producten in de verpakking volgens een van de voorgaande conclusies, waarbij het verpakingsmateriaal een schaal omvat en een afdekfolie die aan de schaal is gelast, waardoor de verpakking wordt gesloten waarbij de afdekfolie een biaxiaal georiënteerd

polyethyleen (BOPE) of een Mono Directed Oriented poly Ethylene (MDOPE)-bevattende polymeerfilm polymeerfilm.

12. Werkwijze voor het vervaardigen van een verpakking voor
5 het bewaren van ademende producten in de verpakking, bestaande uit:

- i. het verschaffen van een gesloten verpakking die een verpakkingsvolume definieert voor het in het verpakkingsvolume bevatten van een deel van de ademende
10 producten van een verpakkingsmateriaal bestaande uit een biaxiaal georiënteerd polyethyleen (BOPE) of een mono-gericht georiënteerd polyethyleen (MDOPE)-bevattende polymeerfilm met een waas van maximaal 10, bij voorkeur maximaal 5, met meer voorkeur maximaal 3 en met de meeste voorkeur maximaal 2,
15 zoals bepaald door ASTM D 1003; en
- ii. het bepalen van een maat, en eventueel een aantal van één of meer perforaties (3) aangebracht in of te voorzien in het verpakkingsmateriaal om gasuitwisseling tussen de verpakkingsatmosfeer en de atmosfeer rondom de verpakking
20 mogelijk te maken om de verpakking te vormen tot een Controlled Atmosphere Package (CAP), zodanig dat de verpakking een kooldioxidetransmissiesnelheid (CO_2TR_{pack}) van de verpakking heeft die ten minste 1000 ml/(m².24 uur) per 100 gram te verpakken product is.

25

13. Werkwijze volgens conclusie 12, waarbij het verpakkingsmateriaal een kooldioxidetransmissiesnelheid (CO_2TR) heeft van ten minste 10000 ml/(m²,24 uur), bij voorkeur ten minste 12000 ml/(m²,24 uur), met meer voorkeur
30 bij ten minste 15000 met de meeste voorkeur ten minste 20000 ml/(m².24 uur).

14. Werkwijze volgens een der voorgaande conclusies 12-13, waarbij het verpakkingsmateriaal een zuurstoftransmissiesnelheid (O_2TR) heeft van ten minste 2000 ml/(m².24 uur), bij voorkeur ten minste 3000 ml/(m².24 uur)),
5 met meer voorkeur ten minste 4000 ml/(m².24 uur), met de meeste voorkeur ten minste 5000 ml/(m².24 uur)

15. Werkwijze voor het vervaardigen van een verpakking voor verpakking voor het bewaren van ademende producten die zich
10 in de verpakking bevinden volgens een van de voorgaande conclusies 12-14, waarbij het verpakkingsmateriaal een schaal omvat en een afdekfolie die aan de schaal is gelast, waardoor de verpakking wordt afgesloten waarin de deksel film is een biaxiaal georiënteerd polyethyleen (BOPE) of een mono-gericht
15 georiënteerd polyethyleen (MDOPE)-bevattende polymeerfilm polymeerfilm.