(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
31 December 2014 (31.12.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/205499 A1

(51) International Patent Classification:
B65D 23/02 (2006.01) *B65D 85/72* (2006.01)
B65D 25/14 (2006.01) *C09D 7/12* (2006.01)
B65D 81/24 (2006.01)

(21) International Application Number:
PCT/AU2014/000671

(22) International Filing Date:
26 June 2014 (26.06.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
13173820.5 26 June 2013 (26.06.2013) EP

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

WO 2014/205499 A1

(54) Title: BEVERAGE CONTAINER COATED WITH A RESVERATROL LAYER

(57) Abstract: The present invention relates to a container for a beverage having an inner coating layer comprising resveratrol, a process for preparing such a container, the use of said container for the storage of a beverage and the use of resveratrol as an additive to coating layers of such containers.

BEVERAGE CONTAINER COATED WITH A RESVERATROL LAYER

Technical field

[0001] The present invention relates to a container for a beverage having an inner coating layer comprising resveratrol, a process for preparing such a container, the use of said container for the storage of a beverage and the use of resveratrol as an additive to coating layers of such containers.

Background of the Invention

[0002] Beverages such as wine and wine products have been stored in various containers over the centuries, including timber, animal skins, pottery and leather. The use of glass bottles has evolved more recently as the preferred storage method, however glass has a number of drawbacks as a packaging medium for beverages, including its weight, durability and less than optimum recycling ability. The disadvantages of glass packaging have been further enhanced due to increasing demand of retailers from suppliers to commit to minimising the carbon footprint (Green miles and Water miles coefficients) associated with the supply of goods.

[0003] Alternative packaging forms for wine and other beverages such as metal cans, polyethylenetetraphthate (PET) bottles and Tetra Pak cartons have increased in popularity in the past decade. These offer advantages of lower weight, however for some wine their success has been limited and so far none of these has been successfully used as packaging medium for the storage of wine. This lack of success is primarily due to the relatively aggressive nature of wine, non-specific filling practices and non-specific lacquer specifications which are the cause of adverse wine integrity effects as a result of the interaction between the product and container.

[0004] The development of a robust packaging system for delicate products such as wine and wine based products is considered desirable so as to ensure product integrity, longevity and to meet consumer demands for sustainable packaging and the requirements of maintaining the wines integrity (key notes of sight, nose and taste) under various global storage and transport conditions.

[0005] Over the past decade the global storage and transport of products such as wine has needed to become more environmentally sustainable and has become a key commercial consideration driven by consumer demand for environmentally friendly products and packaging which limit their impact on the environment and do not allow the integrity of the wine inside the container to suffer deterioration during its storage and transport.

[0006] Wine conveyed in more traditional wine containers suffer detrimental impacts to the wines integral notes due to these negative logistics, weather, storage etc. conditions without the assistance of refrigeration.

[0007] Products such as wine that are extremely and continuously interactive with their environment require their internal chemical balance to be maintained in order for the products integrity to be delivered intact to the consumer as the winemaker had intended. With the global markets opening winemakers wish to deliver their products to the consumer globally the way they had made the wine. This is extremely difficult in a global market with its varying weather conditions, temperature fluctuations, quality and ability of logistics systems to maintain the wines' integrity until it reaches the consumer.

[0008] In addition, the need for an integrated wine packaging system and a product that delivers an exact equilibrium for global transport allowing the delivery of a wine that maintains its integral balance and profile from the winemaker to the consumer no matter where that consumer is located with a stable shelf (up to and well over 12 months) has been a long felt commercial requirement but is also environmentally friendly to minimise its overall carbon footprint.

[0009] As the world market demand for wine increases, there is a need to transport wine that maintains its integrity and safety globally with the additional use of a more environmentally sustainable beverage packaging. The need for the development of an integrated wine and beverage packaging system with a closed loop fully recyclable product capability of carrying a diverse product range globally through a variety of storage and transport conditions has emerged.

[00010] To meet the expectations of an increasingly environmentally aware consumer coupled with the desire for product integrity, aluminium containers without the risk of can taint are required in order for the consumer to confidently transition to this form of environmentally friendly packaging for a high value product such as wine over other less environmentally friendly packaging currently available.

[00011] Consumer assurance is reliant on factors such as the non 'tinny' taste (can taint) of products packaged in aluminium containers, shelf life stability and product integrity which need to be maintained by products packaged in aluminium containers.

[00012] Traditionally can manufacturers use lacquers to coat the inside of aluminium cans to form a barrier between the product and can body prior to being filled. These traditional

lacquers are applied to the inside of a beverage can for the purpose of holding a beverage in aluminium container for a short period of between 3-6 months.

[00013] The current general process used by beverage can/container manufacturers to construct and apply a lacquer does not address the issue of wine and wine products shelf life stability and product integrity. Many manufacturers of beverage cans or other beverage containers are faced with product integrity deterioration, some of which include flavour profile degradation, loss of freshness, changes to the taste, aroma and colour of the products and can coating failures leading to pin holing and spoilage. Finally internal product collapse may occur, further damaging the reputation of the aluminium container as a premium beverage container and environmental alternative.

[00014] It is generally recognised in the industry that wine and wine products are known to suffer product breakdown - with loss of product integrity, over a short period of time (6 months) when filled in cans/can bottles etc. using current regular lacquers. Beverage can manufacturers own internal guidelines recommend only 6 months as a stable shelf life and after that it is guess work based on the individual product by product time test evaluation.

[00015] Aluminium beverage container manufacturers receive significant consumer complaints that canned beverages taste “tinny”, “oxidised” or “off”, “lacking in flavour” or “dull tasting”. This is because the product itself has suffered loss of integrity via the interaction of the product with the coating and aluminium container through the breakdown of the coating or even to some extent the lacquer. This leads to the consumer perception that products produced in aluminium containers are inferior, particularly for high value products such as wine when the consumer compares the same wine that is in glass packaging.

[00016] The perceived taste difference causes a negative view of the aluminium containers potential to deliver wine and wine based products with integrity and consistent quality. This has a knock on effect as glass is not as recyclable as aluminium and therefore has a greater negative impact on the environment.

[00017] In today’s competitive market, manufacturers look at ways of reducing costs and staying competitive in the marketplace. Beverage manufactures demand lower priced packaging options from their suppliers, forcing can manufacturers to use the least amount of aluminium and lacquer to deliver a competitive product to their customers.

[00018] Since the mid-nineties there has been a significant shift towards the use of thinner gauged aluminium for the manufacture of aluminium cans. Aluminium beverage container manufacturers look at various ways to reduce the cost of aluminium beverage containers and one way of achieving this is to reduce the aluminium gauge of the aluminium rolls used to manufacture the cans.

[00019] This move to thinner gauged aluminium reduces overall costs while also decreasing the amount of metal and energy required to produce a can. However, the thinner can presents a number of significant issues to the products they carry which are of great concern to can and beverage manufacturers and the consumer. It is more susceptible to exterior damage and also to lacquer damage during the manufacturing, filling, packing, storage, transport and throughout the entire supply chain process.

[00020] Handling of the product may result in damage via dents and depending on the position of these on the can, damage (cracking and fracturing) may also result to the internal can lacquer and subsequently expose the wine to the raw aluminium resulting in product contamination and spoilage. Such damage has the potential of destroying the entire shipment of the products through the leaking aluminium container infecting the surrounding products and causing significant financial losses.

[00021] Additionally, given today's global economy, beverage producers are forced to package their products in a number of countries around the world. These products become susceptible to a variety of local conditions at time of manufacture, including water quality and chemical content, weather conditions etc., all of which have significant potential to impact on product integrity, stability and longevity.

[00022] Therefore, it is an object of the present invention to provide an advantageous container for a beverage, in particular for an aggressive and hard to hold beverage such as wine or a wine-based product, which provides an increased shelf life without a negative influence on product integrity or taste.

[00023] Furthermore, it is another object of the present invention to provide a process for preparing such a container.

Summary of the Invention

[00024] According to one aspect of this invention, a container for a beverage, in particular wine or a wine-based drink, is provided wherein the inner surface of the container is at least partially coated with a coating layer comprising resveratrol.

[00025] In a preferred embodiment, the container does not contain a beverage, in particular wine or a wine-based drink. Thus, one aspect of the invention refers to the container as produced before it is filled with the beverage, in particular wine or a wine-based drink.

[00026] In another preferred embodiment, the inner surface of the container is integrally coated with a coating layer comprising resveratrol.

[00027] In yet another preferred embodiment, the coating layer comprises resveratrol in a concentration of at least 0.0001 weight%, preferably at least 0.001 weight%, more preferably at least 0.01 weight%, even more preferably at least 0.1 weight%, even more preferably at least 1.0 weight%.

[00028] In yet another preferred embodiment, the coating layer comprises resveratrol in a concentration of at most 30 weight%, preferably at most 10 weight%, more preferably at most 1 weight%, even more preferably at most 0.1 weight%, even more preferably at most 0.01 weight%.

[00029] In yet another preferred embodiment, the container is made of glass, metal, polymer material, paper, cardboard, or combinations thereof, in a more preferred embodiment of aluminium.

[00030] In yet another preferred embodiment, the thickness of the coating layer on the inner surface of the container is in the range of between about 3.5 to about 8.4 grams per square meter, in a more preferred embodiment in the range of about 4.0 to about 8.0 grams per square meter, in a most preferred embodiment in the range of about 5.0 to about 8.0 grams per square meter.

[00031] In another preferred embodiment, the coating layer does not contain epoxy resins, in a more preferred embodiment the coating layer does not contain bisphenol A or bisphenol A-releasing substances.

[00032] In yet another preferred embodiment, the coating layer is a thermoset coating layer.

[00033] In yet another preferred embodiment, at least one additional coating layer is present in the container.

[00034] According to a second aspect of the present invention, a process for preparing a container for wine or a wine-based drink is provided comprising the steps of applying an uncured coating layer comprising resveratrol to a surface of a container wall material; and curing the uncured coating layer.

[00035] .

[00036] In one preferred embodiment of the process, the uncured coating layer comprising resveratrol is applied to the surface of a container wall material before the container is formed.

[00037] In another preferred embodiment of the process, the uncured coating layer comprising resveratrol is applied to the surface of a container wall material after the container is formed.

[00038] In yet another preferred embodiment, the process comprises the additional step of filling the container with a beverage, in particular a wine or a wine-based drink.

[00039] According to a third aspect of the present invention, a container obtainable by the described process according to the second aspect of the present invention is provided.

[00040] According to a fourth aspect of the present invention, the use of the container according to the first aspect or the third aspect of the present invention for the storage of a beverage, in particular wine or a wine-based drink, is provided.

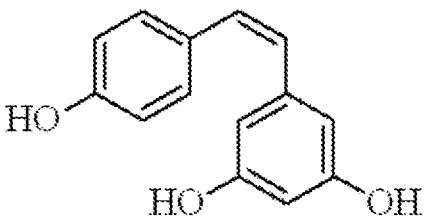
[00041] According to a fifth aspect of the present invention, the use of resveratrol as an additive to a coating layer on the inner surface of a container for a beverage, in particular wine or a wine-based drink, is provided.

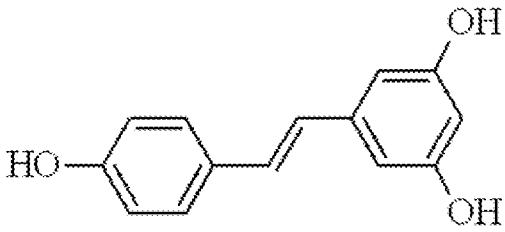
Detailed Description of the Invention

[00042] It has been surprisingly found that a container for a beverage such as wine, wherein the inner surface of the container is at least partially coated with a coating layer comprising resveratrol provides excellent protection from the detrimental and undesired loss of quality, including the undesired consequences of the reaction between the beverage and the packaging material.

[00043] Herein, wine is understood to comprise any beverage which is obtained from viticulture and wine-making techniques as they are known in the art. In one preferred embodiment, the wine is a red wine. In another preferred embodiment, the wine is a white wine. In yet another preferred embodiment, the wine is a rose wine. The wine may be a still wine or a carbonated, sparkling wine. The wine may also be a fortified wine. A wine-based drink is understood to comprise any beverage which comprises a wine as defined above. As examples for wine-based drinks, wines blended with mineral water or fruit juice may be mentioned.

[00044] In addition, a container with a coating comprising resveratrol surprisingly enhances and stimulates the defence mechanism against oxidation and yeast growth in the packaged wine. Resveratrol is also found in the skins of the grapes. Resveratrol is found in wine (grapes) in the cis- as well as in the trans-configuration. Herein, the term resveratrol should be understood in its broadest form. In one embodiment, resveratrol comprises cis-resveratrol as well as trans-resveratrol. In a preferred embodiment, resveratrol should mean trans-resveratrol.





Cis-form (3,5,4'-trihydroxy-cis-stilbene) **Trans-form (3,5,4'-trihydroxy-trans-stilbene)**

[00045] A container according to the present invention surprisingly assists in maintaining and even improving the quality and/or longevity of the beverage. For example, the anti-ageing effect (browning) on the wine and in parallel stimulates the natural immune system of the wine in a container and as a result remarkably extends shelf life, e.g. up to and beyond two years.

[00046] According to one embodiment, 5-10% maturation cycle of the wine occur in the filled can, and essentially in this time reactions within the wine occur continually. Surprisingly we

found that using resveratrol as a component of the coating system inside the container, not only afforded protection for the wine from the container material but it enhances the beneficial effects of resveratrol in the wine.

[00047] In the context of packaging of a hard to hold and aggressive beverage such as wine, there is the risk that the beverage interacts and reacts with the packaging material which might lead to an impact on the taste, appearance or overall integrity of the beverage. This interaction is largely caused by acid or free radicals initially present in the beverage or produced over time.

[00048] Accordingly, the present invention is not limited to wine or wine-based drinks as the beverage but is also useful for the packaging of any beverage which may interact or react with the packaging material, leading to degradation and decomposition of the packaging material and ultimately to spoilage of the beverage. Examples for such beverages are fruit juices, in particular grape juice, soft drinks, lemonades, colas, acidic beverage, carbonated beverages and beverages containing phosphoric acid.

[00049] In a preferred embodiment of the present invention, wine or a wine-based drink are used as beverage. Due to the immanent characteristics of wine as a relatively aggressive and hard-to-hold beverage, the packaging of wine or a wine-based drink according to the present invention yields the most excellent effects.

[00050] A problem of spoilage of the beverage by the packaging material arises if the beverage reacts with the inner coating of the container, making it important to prevent degradation and decomposition of the packaging material. It was surprisingly found by the inventors that resveratrol as part of the coating of the inner wall of a beverage container is able to protect from and prevent this degradation and decomposition.

[00051] While not wishing to be bound by theory, it is assumed that according to one embodiment of the invention, resveratrol present in the coating of the beverage container may function as a component active at the surface of the coating facing and in contact with the beverage, as well as in the coating (which may also act as a reservoir of resveratrol releasable over a prolonged time) and in the beverage upon migration from the coating into the beverage.

[00052] It was observed that resveratrol may have additional desirable functions as part of the invention such as suppression of undesired fermentation in the container. Thus, e.g. excessive growth of yeast can lead to deterioration of taste, aroma and integrity of the wine.

Furthermore, metabolites of yeast or other microorganisms can aggravate the problem of breakdown of the packaging material.

[00053] According to one embodiment, it was also found that when the beverage was in contact with a resveratrol enhanced coating it had a positive effect on maintaining or increasing the actual level of resveratrol in the wine. By creating such a barrier having the positive effects of resveratrol we have surprisingly found that it protects the wines' essential characteristics and enhances the key notes by maintaining the integrity of the resveratrol within the wine/wine products without compromising the stability and longevity of the product.

[00054] According to one aspect of the present invention, it is advantageous that resveratrol is present in the coating of the container before the addition of a beverage to the container. According to this embodiment, the container of the invention refers to an empty container prior to filling with the beverage, in particular the wine or wine-containing drink. According to one embodiment, the container of the invention is an unused container, i.e. has never been used before for filling with a beverage, in particular the wine or wine-containing drink. This way a barrier having the protective functions as laid out above is provided along the inner wall of the container to fend off the aggressive, corrosive, acidic and oxidizing components of the beverage and to provide a protective surface of the coating form the very beginning, i.e. at the time of filling the container. According to one embodiment of this invention, this initial protection is particularly important to keep the coating layer intact from the first contact with the beverage but will also maintain the levels of resveratrol in the beverage to safeguard long-term quality and excellence of the beverage.

[00055] In a preferred embodiment of the present invention, the coating layer comprises resveratrol in a concentration of at least 0.0001 weight%, preferably at least 0.001 weight%, more preferably at least 0.01 weight%, even more preferably at least 0.1 weight%, even more preferably at least 1 weight%, even more preferably at least 10 weight%, even more preferably at least 30 weight%.

[00056] In another preferred embodiment of the present invention, the coating layer comprises resveratrol in a concentration of at most 70 weight%, preferably at most 30 weight%, more preferably at most 10 weight%, even more preferably at most 1 weight%, even more preferably at most 0.1 weight%, even more preferably at most 0.01 weight%, even more preferably at most 0.001 weight%.

[00057] In a particularly preferred embodiment of the present invention, the coating layer according to the present invention comprises resveratrol in a concentration of from 0.0001 to 10 weight%, in one more preferred embodiment from 0.1 to 5 weight%, preferably 0.5 to 1 weight%, in another more preferred embodiment from 0.001 to 0.05 weight%, preferably 0.005 to 0.01 weight%. If resveratrol is present in the coating layer in the preferred amount, the resveratrol levels inside the beverage may be maintained or enhanced and an increased antioxidative effect occurs in the beverage.

[00058] According to one embodiment of the invention, the above weight-% ranges are based on the total weight of the coating layer comprising the resveratrol. If more than one coating layer is present in the container, according to one embodiment of the invention the above weight-% ranges are based on the total weight of all coating layers. According to another embodiment of the invention, the above weight-% ranges are based on the total weight of only the coating layer comprising the resveratrol.

[00059] According to one aspect of the present invention, the concentration of resveratrol may also differ through the cross-section of the coating layer. For example, according to one embodiment, the concentration of resveratrol at or close to the surface of the coating layer facing the beverage may be higher than in the parts of the coating further distanced from this surface. This way, the protective effect on the surface of the coating layer may be improved according to one embodiment of the invention, e.g. in unused containers before being filled with the beverage so that an advantageous protective layer is present when the beverage is filled into the container. According to another embodiments, the opposite concentration profile may be preset and may provide a longer lasting reservoir of resveratrol in the coating layer.

[00060] The container according to the present invention provides producers of beverages such as winemakers around the world with a solution to the transport and storage of beverages such as wine globally without the use of refrigerated or temperature controlled storage and transport facilities which are currently a requirement when transporting wine globally under a variety of conditions impacting negatively on the integrity of wine or other beverages.

[00061] The invention is unique in that the beverage container is transformed into an equilibrium that allows the transport of wine globally without the requirements of climate controls being applied during the storage and transport of wine and wine products in an aluminium container globally. The beverage container according to the present invention achieves the requirements of retailers globally, for a product to be supplied that has a guaranteed shelf life of

up to and greater than 12 months. This is an essential factor taking into consideration that the finished product could take up to 90 days from the time of manufacture to the actual time the product is available to the consumer.

[00062] The resveratrol-containing internal barrier and its application method may be part of an overall packaging system that has the capability to be applied to any beverage container during the normal container manufacturing process. The development of such a unique and novel integrated wine packaging system allows a total solution for beverage container and can manufacturers and consumers alike to enjoy wine as it was filled.

[00063] Furthermore, the container according to the present invention can allow transporting the finished product in non-refrigerated sea-containers therefore minimising the carbon footprint.

[00064] In a preferred embodiment, the container is made of metal, polymer material such as a plastic material, paper, cardboard, glass or combinations thereof, in a more preferred embodiment of aluminium. The present invention is useful for the storage of any beverage, in particular those which is acidic, corrosive, oxidative or able to react in any way with the packaging material. The term “container” as used herein comprises any packaging or packaging material for beverages in rigid or flexible form. The containers may have any suitable form or shape for packaging the beverages. The container may be e.g. without limitation a can, bag, canister, tank, bowl, flask, cask or the like.

[00065] In a preferred embodiment of the present invention the coating layer acts as a two-way barrier. A two-way barrier should be understood in the context of the present invention to not only protect the beverage from undesired interaction with the packaging material leading to deterioration or change of color, aroma and taste of the beverage. In addition, this barrier should also protect the packaging material from undesired interaction with the beverage leading to pin holing, loss of product integrity and leaking.

[00066] Consumer assurance is reliant on factors such as the non ‘tinny’ taste (can taint) of products packaged in aluminium containers, shelf life stability and product integrity which need to be maintained by products packaged in aluminium containers. These consumer requirements have been met with the invention outlined herein.

[00067] One of the global benefits associated with this invention is a solution to the need to use refrigerated transport for wine to ensure the wines stability and integrity are maintained

during transport and storage. A system using the container according to the present invention can remove the need for refrigerated container shipment and logistics reducing CFC's in the environment. The system can also allow the use of a closed loop recyclability application with e.g. aluminium containers for high value beverages (eg. wine/wine products).

[00068] For example, only 5% of original energy used to create an aluminium can having a coating comprising resveratrol is required to recycle it. For every tonne of aluminium recycled, five tonnes of bauxite is conserved with the energy saved by recycling 1 tonne of aluminium cans equalling the amount of electricity used by a typical home in 10 years.

[00069] Furthermore, the present invention and its application address the problems of manufacturers using a thinner drawn can.

[00070] In principle, all coating compositions or lacquers known to the person skilled in the art can be used within the present invention for the coating layer(s). Examples for general methods for the preparation and application of exemplary layers are disclosed in EP 2457840 A1, "Packaging Materials 7. Metal Packaging for Foodstuffs" (Publication of the ILSI Europe Packaging Materials Task Force, September 2007, accessible at https://europa.eu/sinapse/sinapse/index.cfm?fuseaction=lib.attachment&lib_id=C5C03DA0-ED72-0D54-309D55AA14F6C62F&attach=LIB_DOC_EN) or "Preliminary Industry Characterization: Metal Can Manufacturing--Surface Coating" (Publication of the U.S. Environmental Protection Agency, September 1998, accessible at http://www.epa.gov/ttnatw01/coat/mcan/pic-can.pdf).

[00071] Lacquers which have previously been used for an inner coating (coating layer) of beverage containers such as aluminium cans were predominantly based on Bisphenol A (BPA)-containing compounds such as epoxy resins. According to one embodiment of the present invention, the use of Bisphenol A or Bisphenol A-releasing substances in the coating layer of a beverage container is avoided. According to one particular embodiment, the coating layer should not contain any of the following potentially hazardous substances: formalin, potassium permanganate (KMnO4), dibutyl phthalate (DBP), bis(2-ethylhexyl) ph thalate (DEHP), diisobutyl phthalate (DIBP), dimethyl phthalate (DMP), diethyl phthalate (DEP), bis(2-ethylhexyl) adipate (DEHA), diisodecyl phthalate (DIDP), diisononyl phthalate (DINP).

[00072] In another embodiment, the lacquer does not contain epoxy resins, in a further embodiment the coating layer does not contain bisphenol A or bisphenol A-releasing substances.

[00073] In another preferred embodiment, the coating layer is a thermoset coating layer.

[00074] In one preferred embodiment of the present invention, monomers that add flexibility to the lacquer may be added to the coating composition.

[00075] In one preferred embodiment, the lacquer according to the present invention meets all USFDA regulations or other national food safety regulations, in particular the lacquer is food grade. Such lacquers are known to the skilled person and are available on the market. All available lacquers can be used within the present invention.

[00076] The thickness of the coating layer of the container according to the present invention should preferably be selected such that the highly aggressive elements in a beverage such as wine and wine based products do not come into contact with the container material which may lead to wine taint and package spoilage. If the thickness of the coating is appropriately selected, an extended shelf life and enhanced product integrity can be obtained.

[00077] In a preferred embodiment, the thickness of the coating layer on the inner surface of the container is in the range of between about 3.5 to about 8.4 grams per square meter, in a more preferred embodiment in the range of about 4.0 to about 8.0 grams per square meter, in a most preferred embodiment in the range of about 5.0 to about 8.0 grams per square meter.

[00078] In one preferred embodiment, the coating layer is consistently distributed throughout the entire inner wall of the container so that the inner wall is integrally coated with the layer containing resveratrol.

[00079] In another preferred embodiment, the coating layer comprising resveratrol is a non-permeable layer, i.e. the coating layer comprising resveratrol is non-permeable for the beverage to prevent the interaction of the beverage with the packaging material.

[00080] According to one embodiment of the present invention, the wall of the container for a beverage may comprise one or more layers. If the wall of the container consists only of one layer, according to one embodiment of the present invention, this one layer, i.e. the wall of the container may comprise the resveratrol. In other words, the coating layer then is the wall of the container. One example of such an embodiment of the invention is a container made of a one-layer plastic foil sealed together to form a kind of bag for the beverage. The wall of the

container, i.e. the one-layer plastic foil then comprises the resveratrol and is at the same time the wall of the container.

[00081] According to a preferred embodiment of the invention, the layer comprising the resveratrol (e.g. the coating layer, or the wall of the container) is a layer comprising or consisting substantially or completely of polymers.

[00082] According to one preferred embodiment, all, substantially all or at least a part of the resveratrol comprised in the layer (e.g. the coating layer, or the wall of the container) is not covalently bound to a component of the layer, in particular a polymer present in the layer. The resveratrol not covalently bound may migrate and replenish resveratrol at the inner surface of the container or in the packaged beverage. On the other hand, bonding and fixing at least a part of the resveratrol to a component of the layer may in some instances help to keep the resveratrol at its preferred location, in particular in direct contact with the beverage.

[00083] In yet another preferred embodiment, the inner wall is partially coated with the coating layer containing resveratrol. For example, the container may only be coated with the coating layer containing resveratrol in areas of the container where the coating is most prone to crack or fail. Alternatively, the inner wall may be coated with spots of coating layer containing resveratrol. These spots may provide enough resveratrol to obtain beneficial effects of the present invention. Areas that are not coated with the coating layer containing resveratrol according to this embodiment may be coated with a different coating layer to prevent the interaction of the beverage with the packaging material.

[00084] According to one further aspect, the present invention further provides a process for preparing a container for a beverage, in particular wine or a wine-based drink, comprising the steps of applying an uncured coating layer comprising resveratrol to a surface of a container wall material and curing the uncured coating layer.

[00085] The uncured coating layer can be applied to the container wall material e.g. by standard spray application guns as they are known in the art.

[00086] In one embodiment of the invention, the uncured coating layer comprising resveratrol is applied to the surface of a container wall material before the container is formed. The advantage of this embodiment is that the uncured coating layer comprising resveratrol may be applied and distributed more consistently on the surface of the container wall material before the material is formed into a hollow container. In another preferred embodiment, the coating

layer comprising resveratrol may be attached or applied to a surface of the container wall material in the form of a film or a foil which is preferably laminated or otherwise bonded to the container wall material before or after forming the container. According to one embodiment of the invention, the coating layer(s) comprising resveratrol are prepared without extensive heating for prolonged times, e.g. by using foils. Also, if curing of the layer(s) is performed, other curing methods apart from heat curing may be used or the time and temperature of heating may be limited.

[00087] In another embodiment of the invention, the uncured coating layer comprising resveratrol is applied to the surface of a container wall material after the container is formed. The advantage of this embodiment is that standard containers for beverages may be obtained from mass producers and subsequently provided with the coating layer of the present invention to obtain a container having the advantages according to the present invention. Also, according to another embodiment, resveratrol may be added to the composition of a least one of the coating layers and the production process may otherwise remain unchanged.

[00088] In another embodiment, the resveratrol is added, e.g. sprayed on the surface of the coating layer after the coating layer has been applied to the inner wall of the container, but before the beverage is filled into the container. According to a further embodiment the resveratrol is added to the coating layer, e.g. sprayed thereon, after curing of the coating layer, but before the beverage is filled into the container.

[00089] In one preferred embodiment of the present invention, the process comprises the additional step of filling the container with a beverage, in particular a wine or a wine-based drink, preferably after the coating layer comprising resveratrol has been provided at the inner surface of the container.

[00090] The beverage, in particular wine or wine-based product to be filled in the container of the present invention should preferably meet the following parameters in order to achieve a long shelf life of the beverage filled in a can and optimal flavors of the beverage itself after storage.

[00091] Sterile canning of wine is preferably obtained by filling through sterilised equipment. All equipment, including the onsite wine storage tank downstream from the final membrane filter (lines, valves, filler etc) is preferably sterilised and operated in a sterile state. Preferably the filling heads are sprayed with 70 % ethanol prior to start up and repeated when

filler downtime exceeds 10 minutes. Preferably a full sterilization is performed if the filler is subjected to down time longer than 4 hours.

[00092] Microfiltration of the wine is preferably used in the present invention to remove bacteria and yeasts from the wine prior to filling. Correct filter and filter housing preparation is a key protocol to successful wine in an aluminium container production. The inventors have found that for wine in an aluminium container poorly sanitised or prepared wine filters and filter housings will lead to microbiological complications within the wine in the container. According to one preferred embodiment, during storage, the sterile grade filters are preferably stored in a solution of about 0.5 wt.-% to 1.5 wt-% citric acid, in particular about 1% Citric Acid, preferably with the addition of about 20 to 100, in particular about 50 ppm Free SO_2. This is preferably made fresh and repeated on a fortnightly basis. Prior to filling the aluminium container, the filters are preferably sterilised and tested for integrity prior to use. The preferred sterilising time and temperature regime is 80°C for 20 minutes.

[00093] Water can have a direct impact on the sensory profile and stability of wine in an aluminium container. This will occur if hoses and filters are not washed with quality filtered water. This will also occur if process equipment is not rinsed with clean quality filtered water.

[00094] Preferably, treated water for filter washing and filling machine washing in this invention:

- Must meet all applicable local standards and guidelines.
- Must meet the health-based guideline values of the World Health Organization (WHO).
- Must meet all requirements that are product-specific as they relate to stability, shelf-life, and sensory profile of all wine in an aluminium container.

[00095] Chlorine may be used to sanitise equipment but it is preferably completely removed by rinsing with water prior to use of the equipment with wine.

[00096] Sulphur dioxide (SO_2) is an antioxidant that can be added to wine. Preferably, the addition of SO_2 in this invention is to inhibit the reaction of oxygen with the wine and to prevent damage to the wines integrity; colour, aroma and flavour compounds. In this invention, the functions of SO_2 for wine in aluminium containers may include the control of microbiological issues and minimise oxidation effects in the wine in an aluminium container. For wine at filling to have a Free SO_2 level of <35 ppm the wine ex winery is preferred to have a Free SO_2 level of 38 – 44 ppm, this final ppm level dependent on the distance from winery to the filling plant.

[00097] In this invention where the wines have less than 9% v/v alcohol, the antimicrobial agent sorbic acid is preferably added at a level greater than 75 mg/L, more preferably greater than 90 mg/L. This addition will assist in preventing microbial growth and spoilage of the product in storage and transport.

[00098] According to one embodiment of the present invention, the dissolved oxygen of the wine to be filled in the aluminium container may be minimised in wine in the tank prior to filling by sparging the wine with nitrogen gas. This system minimizes the negative influence of Dissolved Oxygen in the wine with the use of sparging with nitrogen gas prior to filling. It is a benefit of this embodiment that dissolved oxygen reduction for wine in an aluminium container achieves stability, extended shelf life and maintains the wines integrity under production, storage and transport. It was found that excessive sparging may result in damage to the wines integrity by reducing the flavour profile and imparting a bitter character presumably caused by dissolved nitrogen. Therefore, according to a preferred embodiment, the amount of nitrogen used for sparging is between 0.1 and 0.8 liter N_2 per liter of wine. This embodiment is also relevant in any filling process for a container, in particular an aluminium container, with a wine or a wine-based product, even in the absence of a coating layer containing resveratrol. However, it works particularly well in the presence of such a coating layer.

[00099] Carbon dioxide is naturally created during the wine fermentation process. During the maturation of the wine in storage most of the dissolved CO_2 has preferably been completely depleted or to acceptable levels of 'spritz' (400 ppm – 800 ppm). Preferably all wine is cross flow filtered to ensure the dissolved CO_2 level of the wine is not the result of microbial infection.

[000100] According to one embodiment of the present invention that the preferred level of dissolved CO_2 may reduce the oxygen content of the wine and assist with protecting the wine from oxidation during the transport of bulk wine from the winery to the aluminium container filler. By preventing oxidation, minimal free SO_2 addition is required and minimum free SO_2 levels are maintained at the winery prior to dispatch.

[000101] The preferred level of dissolved CO_2 for wine is relevant as wine during transport is rarely refrigerated (eg. be it in ISO tankers - 26,000 litres, Flexi tanks - 24,000 litres or road tanker transport - various compartmentalized/litreage volumes), consequently the temperature of the wine increases and the potential for yeast activity enhanced. During this transit time the wine is also susceptible to oxidation by extended contact with air via faulty seals and closures.

[000102] Additionally the dissolved CO_2 may prevent further oxidation of the wine caused by the effects of ullage (namely the gap - air in the headspace) created in any one particular tanker compartment by either under filling, evaporation or leakage of the wine during transit.

[000103] The levels of the actual CO_2 in the wine and resultant effectiveness will diminish as the temperature of the wine increases (during transport). However, the initial level of dissolved CO_2 in the wine at the winery ensures that the wine will arrive at its destination in the same condition as when dispatched from the winery and with preferred final levels of dissolved CO_2 of 50 ppm - 1200 ppm for still white wines and 50 ppm to 400 ppm for still red wines prior to can filling.

[000104] The combination of maximum dissolved oxygen and minimum dissolved carbon dioxide levels with microfiltration allows lower free SO_2 levels and inhibits wine spoilage as the potential for oxidation, microbiological spoilage and re-fermentation are far greater during wine transport and wine transfer than in storage at the winery. In addition, it is impossible to perform any corrective procedures during transit.

[000105] The preferred specific levels of dissolved CO_2 in wine are important in maintaining particularly well the wines varietal character. The preferred range of dissolved CO_2 for still red wine is 50 ppm to 400 ppm, more preferably 200 ppm to 400 ppm as higher levels will create a sharper more aggressive tannic tasting wine.

[000106] The preferred range of dissolved CO_2 for still white wines is 50 ppm to 1200 ppm (dependent on varietal character of the wine and the level of freshness and crispness required) and preferably is 400 ppm to 800 ppm. For sparkling wines the upper limit of dissolved CO_2 is greater but is not critical.

[000107] Preferably the dissolved CO_2 level at the winery and after wine transfer to tanker is 0.8 - 1.2 g/L (800 ppm – 1200 ppm). Preferably the dissolved CO_2 in storage tank at filling facility prior to canning is up to 1.2 g/L (1200 ppm). For still red wines this is preferably up to 0.4 g/L(400 ppm).

[000108] This preferred maximum level will prevent significant loss of shelf life due to minimising oxidation potential during bulk wine transport and the resultant oxidation of the packaged product during storage and transport. Furthermore, a wine to be filled in the aluminium container according to the present invention preferably has a pH of between 2.9 and 3.8.

[000109] After filling, the pressure within the aluminium container is preferably maintained at a pressure above 15 psi at 4°C, so that the corrosion resistant lining in the aluminium container is less likely to fracture or crack exposing fissures as a result of external container damage in storage and transport. In addition the walls of the container are less likely to be buckled which can also lead to damaging the internal lining which can then damage the integrity of the wine.

[000110] Yeasts are the most likely cause of microbial spoilage in packaged wine due to their tolerance of alcohol, low pH and anaerobic conditions. We have discovered that Yeast growth in wine in an aluminium container is inhibited by high volumes of carbon dioxide. Sparkling wine packed according to this invention contains high levels of carbon dioxide, preferably 3.3 - 3.8 volumes. Yeast growth in sparkling wine packaged using the protocols in this invention are extremely unlikely.

[000111] In a filled 250 ml container, the head space volume is preferably less than 3 ml, more preferably less than 2 ml and even more preferably about 1 ml.

[000112] In the context of the present invention, it should be understood that the inner surface of the container should mean the inner side of the container wall facing the interior of the container. Thus, the container according to the invention has a container wall, e.g. made of metal such as aluminium, and this container wall has an outer side facing the exterior of the container and an inner side facing the interior of the container. The inner side (or surface) of the container according to one embodiment of the invention thus may be coated with one or more layers, at least one of which comprises resveratrol. In one embodiment of the present invention, the inner surface of the container (wall) is provided with only one layer (coating layer). This layer comprises resveratrol according to the present invention. In another embodiment of the present invention, the inner surface of the container (wall) is provided with more than one layer. In this case, one or more of the layers may comprise resveratrol.

[000113] According to a broad aspect of the invention, the container for a beverage thus comprises a container wall comprised of one or more layers, wherein at least one layer comprises resveratrol.

[000114] According to one embodiment, one or more layers not comprising resveratrol may be present between the layer comprising resveratrol and the container wall. Also, according to one embodiment, one or more layers not comprising resveratrol may be present

between the (coating) layer comprising resveratrol and the exterior of the container for a beverage.

[000115] According to another embodiment, one or more layers not comprising resveratrol may be present between the layer comprising resveratrol and the interior of the container, i.e. the cavity of the container in which the beverage may be filled. According a further embodiment, the layer comprising resveratrol is the layer directly facing the interior of the container, i.e. is in direct contact with the container cavity or the beverage, respectively, once the container has been filled with the beverage.

[000116] In one embodiment of the present invention, resveratrol may be contained in any of the layers located inside of the outer aluminium shell (container wall) of the can. In a preferred embodiment, resveratrol is contained only in one or more layers located inside of the outer aluminium shell of the can which are able to interact with the beverage (e.g. the wine), either directly or through an additional layer which is permeable for resveratrol and/or the beverage. In another preferred embodiment, resveratrol is contained in one layer which is able to interact with the beverage.

[000117] In another preferred embodiment, the uncured coating layer comprises free metal radicals. The addition of free metal radicals to the uncured lacquer will reduce the baking and curing temperature as well as the curing time, leading to an additional reduction of energy needed for the packaging of a beverage in a container according to the invention.

[000118] In one embodiment, the uncured coating layer is cured for 80 to 230 seconds at a temperature of from 180 to 250°C, more preferably at from 180 to 220°C.

[000119] According to the present invention, it is possible to apply a top coating layer comprising resveratrol to the inside of the beverage container so that the resveratrol-containing layer is in contact with the beverage.

[000120] In yet another preferred embodiment, at least one additional coating layer is present. For example, the bottom layer represents a resveratrol-infused, BPA-free, corrosion resistant coating layer comprising an, in particular water-based, monomer enhancer which drives the resveratrol to the top coating layer which is in contact with the beverage.

[000121] According to one embodiment of the invention, it is ensured that at the final stage of the preparation of the container (i.e. before filling), resveratrol is located on the inner surface in the coating layer of the container which is in contact with the beverage.

[000122] This invention also provides the use of a container as described herein for the storage of a beverage. In a preferred embodiment, the container is used for the storage of wine or a wine-based drink.

[000123] Furthermore, this invention provides the use of resveratrol as an additive to a coating layer, in particular a coating layer on the inner surface of a container for a beverage, in particular for a container for wine or a wine-based drink.

[000124] All embodiments of the present invention as described herein are deemed to be combinable in any combination, unless the skilled person considers such a combination to not make any technical sense.

Examples

Example 1: Preparation of lacquers (coating layers) containing resveratrol

Bisphenol A-free Polyester Acrylate containing layer (prepared according to Example 2 of WO 2008036629 A2)

[000125] A 2-liter flask was equipped with a stirrer, packed column, condenser, thermocouple, heating mantle and nitrogen blanket. The following were added to the flask: 498.6 grams of propylene glycol, 80.1 grams of trimethylolpropane, 880.1 grams of terephthalic acid, 40.0 grams of isophthalic acid, and 2.0 grams of FASCAT 9100 butylhydroxyoxostannane catalyst (available from Total Petrochemicals USA, Inc., Houston, USA).

[000126] The flask contents were slowly heated to 225°C to 235°C under a nitrogen blanket, and the water from the resulting polycondensation reaction was distilled off. Once the reaction mixture became clear and the temperature at the head of the column dropped, the reaction mixture was cooled to 160°C, and 85.5 grams of isophthalic acid and 16.0 grams of maleic anhydride were added to the flask. The reaction mixture was slowly reheated under a nitrogen blanket to 220°C to 230°C.

[000127] Once the reaction mixture became clear and the temperature at the head of the packed column dropped, the reaction mixture in the flask was cooled to 200°C, the packed

column replaced with a Dean & Stark column for azeotropic distillation, and 30.0 grams of xylene were added to the flask. The contents of the flask were reheated under a nitrogen blanket to reflux temperature, and more reaction water was distilled off until the acid number of the reaction mixture fell below 5. The contents of the flask were cooled to 145°C to 150°C, and 744.6 grams of butyl glycol, 104.7 grams of n-butanol, and 219.6 grams of xylene were then added to form a solution of dissolved Polyester.

[000128] A 5-liter flask was equipped with a stirrer, reflux condenser, thermocouple, heating mantle, and nitrogen blanket. A sample of the solution of dissolved Polyester prepared as described above (1782.0 grams) and butyl glycol (123.0 grams) were placed in the 5-liter flask and preheated under nitrogen blanket to 120°C. In a separate flask, 321.0 grams of ethyl acrylate, 68.3 grams of glacial acrylic acid, 96.1 grams of styrene and 11.9 grams of VAZO 67 free radical initiator (2,2'-azobis(2-methyl-butyronitrile, available from Du Pont de Nemours, Wilmington, DE, USA) were premixed. The mixture of monomers and initiator was then added to the polyester solution over a period of 135 minutes under a nitrogen blanket and at a temperature of 120°C – 122°C. The temperature in the 5-liter flask was then maintained for 1 hour at 122°C.

[000129] Following this, 2.6 grams of TRIGONOX C free radical initiator (tert-butyl peroxybenzoate, available from Akzo Nobel) were added to the 5-liter flask, and the reactor temperature was maintained for 2 hours at 122°C. The reaction mixture was then cooled to 105°C, and a premix containing 150.3 grams of dimethylethanolamine and 150.3 grams of demineralized water was added to the 5-liter flask over a 10-minute period, followed by a hold of 10 minutes. The reaction mixture dropped in temperature to 90°C at the end of the addition. Finally, 2554 grams of water were added to the 5-liter flask over a 30-minute period, and the solution of the polyester acrylate inverted into an aqueous dispersion of the Polyester Acrylate.

[000130] A 60% solution of VARCUM 2227 phenolic resin (211 grams) (Reichhold Corporation, Durham, USA) was incorporated in the inverted polyester acrylate resin that was at a temperature of about 60°C after the final water addition to the polyester acrylate resin had been completed. This VARCUM 2227 resin addition was followed by a hold of 20 minutes.

[000131] The aqueous dispersion of Polyester Acrylate Phenolic contained 29.8 wt-% solids (nonvolatile matter), based on the total weight of the aqueous dispersion of Polyester Acrylate Phenolic, as determined by heating a 1-gram sample of the aqueous dispersion of Polyester Acrylate Phenolic for 60 minutes at a temperature of 150°C. The aqueous dispersion

of the Polyester Acrylate Phenolic had a pH of 8.53 standard pH units at a temperature of about 20°C.

[000132] To 70.43 parts of polyester acrylic phenolic resin as prepared above under stirring were added 14.40 parts deionized water and a premix consisting of 0.022 part CYCAT 600 aromatic sulphonic acid, 10.75 parts w-butanol, and 2.57 part CYMEL 303 hexamethoxymethymelamine. To the resulting composition under stirring was added 0.17 parts Carnauba Wax emulsion and 0.65 part BACOTE 20 AZC (MEL Chemicals, Manchester, UK; diluted 10% in water). The resulting product is suitable for spray application on the interior and beverage cans and crosslinks at high temperature.

[000133] In the following Examples, however, Valspar 40Q60AA (available from The Valspar Corporation, Minneapolis, USA) was used as the Bisphenol A-free Polyester Acrylate containing layer (**Lining A**). To illustrate the effect of the present invention, the Bisphenol A-free Polyester Acrylate containing layer was prepared without the addition of Resveratrol, or with the addition of 0.001 wt%, 0.01 wt% and 0.1 wt% directly to the solution suitable for spray application.

Epoxy-Acrylate containing layer (prepared according to Example 18 of WO 2008036629 A2)

[000134] A 5-liter flask was equipped with a stirrer, reflux condenser, thermocouple, heating mantle, and nitrogen blanket. Low molecular weight liquid epoxy and bisphenol A were charged to the reactor plus butyl tri-phenyl phosphonium bromide catalyst and xylene. A Nitrogen purge was carried out and heat was applied initially, after which an exotherm raised the temperature in the reactor.

[000135] A target weight per epoxy value of around 2900 - 3100 was achieved in a typical reaction time of 6 hours. Butyl glycol, n-butanol, and amyl alcohol solvents were then added slowly over a 90-minute period. Acrylic monomers styrene, and methacrylic acid plus benzoyl peroxide initiator LUCIDOL 78 (available from Akzo Nobel, Amsterdam, The Netherlands) were then added to a monomer addition tank. After stirring, the acid number of this monomers/catalyst pre-mix was checked. The monomers/catalyst were then slowly added to the hot epoxy solution and the acrylic polymerization took place. The epoxy acrylic resin solution was then cooled and discharged from the reactor into a thinning tank containing a solution of water and diaminoethanolamine. The epoxy acrylic solution formed a dispersion in the water by inversion.

[000136] To 76.02 parts epoxy acrylic resin dispersion as prepared above was added with stirring, 18.82 parts deionized water, 3.68 parts w-butanol, and a premix consisting of 0.25 parts dimethylaminoethanol and 1.23 parts deionized water. The resulting product was suitable for spray application on the interior of beverage cans and crosslinked at high temperature.

[000137] In the following Examples, however, Aqualure 900 (available from Akzo Nobel, Amsterdam, The Netherlands) was used as the Epoxy-Acrylate containing layer (**Lining B**). To illustrate the effect of the present invention, the Epoxy-Acrylate containing layer was prepared without the addition of Resveratrol, or with the addition of 0.001 wt%, 0.01 wt% and 0.1 wt% directly to the solution suitable for spray application.

Example 2: Application of resveratrol-containing coating layer to packaging material/container wall (before/after forming of the container)

[000138] The lacquers as described in Example 1 are applied to the aluminium can as a coating layer by using a twin gun to coat the internal wall and dome of the can. The amount of lacquer to be applied depends on the size of the can to be coated. In this Example, cans with a volume of 150 to 440 ml have been coated using 100 to 240 mg of Lining A or Lining B containing 0.01 wt% resveratrol.

[000139] The uncured coating layer is cured for 80 to 230 seconds at a bake temperature between 180 and 250°C. The resulting distribution thickness of the layer lies between 3.5 and 8.4 grams per square meter (gsm). The thickness of the film layer is indicated for the top, middle, bottom and dome section of a can coated with Lining A containing 0.01 wt% resveratrol in Table 1.

[000140] Table 1

Can size – ml	Film weight – mg	Film distribution – gsm			
		Top	Middle	Bottom	Dome
150	100	6.0	6.9	6.9	6.5
200	120	5.2	5.5	5.5	5.0
250	170	7.0	7.6	7.3	6.6
300	180	6.0	6.2	6.1	6.0
330	200	6.5	6.0	6.0	5.7
375	215	6.0	6.8	7.3	6.9
440	230	6.2	6.9	6.3	6.0

Example 3: Assessment of physical parameters of coated cans

[000141] The cans obtained in Example 2 were examined for adhesion of the coating layer (AS 1580 Method 408.4), impact resistance at 18 Joule (AS 1580 Method 406.1), pinholing after incubation in HCl for 5 minutes (SSL test method). They were further examined microscopically for blistering (AS 1580 Method 481.1.9), delamination (AS 1580 Method 481.1.10) and corrosion (AS 1580 Method 481.3). The performance of the can in all tests was excellent and the integrity of the coating layer was maintained. Results of these tests are shown in Table 2.

[000142] Table 2

Test	Test Method	Result
Adhesion Cross Cut	AS 1580 Method 408.4 Rating 0 = no removal of coating 5 = complete removal of coating	0, 0, 0 Av = 0
Impact Resistance Reverse Impact	AS 1580 Method 406.1	No failure of coating at 18 Joule (1.8 kgf m)
Pinholing	SSL Test Method Can filled with HCl and allowed to stand for 5 minutes. Points of hydrogen evolution observed.	0 pinholes / can
Microscopic examination		
Blistering	AS 1580 Method 481.1.9	Rating 0 (no blistering)
Delamination	AS 1580 Method 481.1.10	Rating 0 (no delamination)
Corrosion	AS 1580 Method 481.3	Rating 0 (no corrosion)

[000143] Example 4: Organoleptic assessment of packaged red wine

[000144] Red wines were packaged in 250ml slimline cans as obtained in Example 2 and then stored for 24 months. Organoleptic assessment was done initially, after 3 months, after 6 months, after 12 months and after 24 months. The results of this Example are shown in Table 3.

[000145] Table 3

Coating (gsm)	**Initial**	**3 months**	**6 months**	**12 months**	**24 months**
6.0	Clean, fresh	Sustained full flavour, good nose	Sustained full, rich flavour, good nose	Sustained full flavour, good nose	Intense berry colour and nose. Full clean taste

gsm = gram per square meter

Example 5: Organoleptic assessment of packaged white wine

[000146] White wines were packaged in 250 ml slimline cans as obtained in Example 2 and then stored for 24 months. Organoleptic assessment was done initially, after 3 months, after 6 months, after 12 months and after 24 months. The results of this Example are shown in Table 4.

[000147] Table 4

Coating (gsm)	**Initial**	**3 months**	**6 months**	**12 months**	**24 months**
6.0	Clean, fresh	Sustained crisp flavour and straw colour. Good nose	Sustained crisp flavour and straw colour. Good nose	Bright citrus colour. Fruity and fresh	Intense berry colour and nose. Full clean taste

Example 6: Organoleptic assessment of packaged carbonated red wine

[000148] Carbonated red wines were packaged in 250ml slimline cans as obtained in Example 2 and then stored for 24 months. Organoleptic assessment was done initially, after 3 months, after 6 months, after 12 months and after 24 months. The results of this Example are shown in Table 5.

[000149] Table 5

Coating (gsm)	**Initial**	**3 months**	**6 months**	**12 months**	**24 months**
6.0	Clean, fresh Good bubbles /Mousse	Sustained fresh flavour, vibrant colour and bubbles/Mousse	Sustained fresh flavour, vibrant colour and bubble/Mousse	Sustained fresh flavour, vibrant colour and bubble/Mousse	Crisp clean with sustained bubbles. Aromatic nose

Example 7: Organoleptic assessment of packaged carbonated white wine

[000150] Carbonated white wines were packaged in 250ml slimline cans as obtained in Example 2 and then stored for 24 months. Organoleptic assessment was done initially, after 3 months, after 6 months, after 12 months and after 24 months. The results of this Example are shown in Table 6.

[000151] Table 6

Coating (gsm)	**Initial**	**3 months**	**6 months**	**12 months**	**24 months**
6.0	Clean, fresh Good bubbles /Mousse	Sustained fresh flavour, vibrant colour and bubbles/Mousse	Sustained fresh flavour, vibrant colour and bubble/Mousse	Sustained fresh flavour, vibrant colour and bubble/Mousse	Crisp clean with sustained bubbles.

Example 8: Comparative test of cans coated with commercially available lacquers against can according to the present invention

[000152] Cans as obtained in Example 2 are tested against cans lined with commercially available lacquer. Standard cans with comparative lacquers were obtained from the market (Comparison Cans 1 and 2, respectively). All containers were filled with wine and stored for 24 months. Organoleptic assessment was done by a panel of 16 consumers initially, after 6 months, after 12 months, after 18 months and after 24 months. The results of this Example are shown in Table 7 (red wine), Table 8 (white wine) and Table 9 (rose wine).

[000153] Table 7

Storage	Initial	6 months	12 months	18 months	24 months
Inventive can with red wine	Fresh full taste	Fresh full taste	Fresh full taste	Fresh full taste	Fresh full taste
Comparison Can 1 with red wine	Fresh full taste	Flat	Foreign taste	Poor taste	Dull chemical taste
Comparison Can 2 with red wine	Fresh full taste	Low in fruit flavour	Dull	Chemical foreign taste	Flat

[000154] Table 8

Storage	Initial	6 months	12 months	18 months	24 months
Inventive can with white wine	Fresh full taste	Fresh full taste	Fresh full taste	Fresh full taste	Fresh full developed characters
Comparison Can 1 with white wine	Fresh full taste	Can corrosion	High aluminium/ can corrosion	Can corrosion, poor taste	Flat oxidised characters
Comparison Can 2 with white wine	Fresh full taste	Low in fruit flavour	Dull	Chemical foreign taste	Flat

[000155] Table 9

Storage	Initial	6 months	12 months	18 months	24 months
Inventive can with rose wine	Fresh full taste	Fresh full taste	Fresh full taste	Fresh full taste	Fresh full taste
Comparison Can 1 with rose wine	Fresh full taste	Can corrosion	High aluminium/ can corrosion	Can corrosion, poor taste	Flat oxidised characters
Comparison Can 2 with rose wine	Fresh full taste	Low in fruit flavour	Dull	Chemical foreign taste	Flat

Example 9: Comparative test of wine cans coated with coating layers containing resveratrol according to the present invention against comparative cans coated with coating layers without resveratrol

[000156] Red wines were packaged in 250ml slimline cans being coated with Lining A or Lining B without or with 0.001 wt%, 0.01 wt% or 0.1 wt% resveratrol as obtained in Example 2 and then stored. Key notes of the wine were assessed by a panel of 16 consumers initially, after 6 months and after 24 months, and resveratrol levels in the wine were determined according to "Method to determine resveratrol and pterostilbene in grape berries and wines using high-performance liquid chromatography and highly sensitive fluorimetric detection", Pezet et al., Journal of Chromatography A, Volume 663, Issue 2, 11 March 1994, Pages 191–197 initially and after 6 months. Results are shown in Table 10.

[000157] Table 10

LINING	RESULT 1	RESULT 2	RESULT 3	RESULT 4	RESULT 5	RESULT 6	RESULT 7
Lining A w/o Resveratrol	X						
Lining A 0.001 wt% Resveratrol		X				X	X
Lining A 0.01 wt% Resveratrol		X	X	X	X	X	X
Lining A 0.1 wt% Resveratrol		X	X	X	X	X	X
Lining B w/o Resveratrol	X						
Lining B 0.001 wt% Resveratrol		X				X	X
Lining B 0.01 wt% Resveratrol		X	X	X	X	X	X
Lining B 0.1 wt% Resveratrol		X	X	X	X	X	X
Summary of Results							
1	Diminished key notes after 6 months.						
2	Maintained key notes e.g wine profile after 6 months						
3	Improved key notes e.g nose fresh clean after 6 months						
4	Improved key notes e.g colour/bright,intense after 6 months						
5	Improved key notes e.g taste /fresh fruity after 6 months						
6	Original resveratrol level of wine maintained or enhanced after 6 months						
7	Increased shelf life e.g more than 24 months						
Lining Food Grade							
Lining A	Bisphenol A-free Polyester Acrylate; Valspar® 40Q60AA (Valspar Corp.)						
Lining B	Bisphenol A Epoxy-Acrylate; Aqualure® 900 (AkzoNobel Packaging Coatings)						

Claims

1. A container for a beverage, in particular wine or a wine-based drink, wherein the inner surface of the container is at least partially coated with a coating layer comprising resveratrol.

2. A container according to claim 1, not containing a beverage, in particular wine or a wine-based drink.

3. The container according to any one of the preceding claims, wherein the inner surface of the container is integrally coated with a coating layer comprising resveratrol.

4. The container according to any one of the preceding claims, wherein the coating layer comprises resveratrol in a concentration of at least 0.0001 weight%, preferably at least 0.001 weight%, more preferably at least 0.01 weight%, even more preferably at least 0.1 weight%, even more preferably at least 1 weight%.

5. The container according to any one of the preceding claims, wherein the coating layer comprises resveratrol in a concentration of at most 30 weight%, preferably at most 10 weight%, more preferably at most 1 weight%, even more preferably at most 0.1 weight%, even more preferably at most 0.01 weight%.

6. The container according to any one of the preceding claims, wherein the container is made of glass, metal, polymer material, paper, cardboard, or combinations thereof, in particular aluminium.

7. The container according to any one of the preceding claims, wherein the thickness of the coating layer on the inner surface of the container is in the range of between about 3.5 to about 8.4 grams per square meter, preferably in the range of about 4.0 to about 8.0 grams per square meter.

8. The container according to any one of the preceding claims, wherein the coating layer is a thermoset coating layer.

9. The container according to any one of the preceding claims, wherein at least one additional coating layer is present, optionally between the coating layer comprising resveratrol and the container wall made of metal.

10. A process for preparing a container for a beverage, in particular wine or a wine-based drink, the container having a container wall, comprising the steps of:
    a) applying an uncured coating layer comprising resveratrol to a surface of the container wall material;
    b) curing the uncured coating layer.

11. The process according to claim 10, wherein uncured coating layer comprising resveratrol is applied to the surface of a container wall material before or after the container is formed.

12. The process according to claim 10 or 11, wherein the process comprises the subsequent step of filling the container with the beverage, in particular a wine or a wine-based drink.

13. Container obtainable by the process according to any one of claims 10 to 12.

14. Use of the container according to any one of claims 1 to 9 and 13 for the storage of a beverage, in particular wine or a wine-based drink.

15. Use of resveratrol as an additive to a coating layer of a container for a beverage, in particular wine or a wine-based drink.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2014/000671

A. CLASSIFICATION OF SUBJECT MATTER

B65D 23/02 (2006.01) B65D 25/14 (2006.01) B65D 81/24 (2006.01) B65D 85/72 (2006.01) C09D 7/12 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI, TXTAU1, TXTCA1, TXTEP1, TXTGB1, TXTSG1, TXTUS0, TXTUS1, TXTUS2, TXTUS3, TXTUS4, TXTUS5, TXTWO1 USING IPC AND CPC MARKS (/IC/CC OR B65D23, B65D25, B65D81, B65D85, B32B, C09D7) AND KEYWORDS (CONTAINER, BOTTLE, LINING, RESVERATROL AND OTHER SIMILAR TERMS); GOOGLE PATENTS USING KEYWORDS (WINE, BOTTLE, CONTAINER, LINING, RESVERATROL AND OTHER SIMILAR TERMS); ESP@CENET SEARCH IN APPLICANT FIELD USING KEYWORD (BAROKES); ESP@CENET SEARCH IN INVENTOR FIELD USING KEYWORDS (BARICS STEVEN; GREGORY STOKES)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 July 2014	17 July 2014
Name and mailing address of the ISA/AU	**Authorised officer**
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustralia.gov.au	Gilbert Lim AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262832597

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/AU2014/000671**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2003/029089 A1 (BAROKES PTY LTD) 10 April 2003 Abstract	13
X	US 3888224 A (OKUHARA ET AL) 10 June 1975 Abstract	13
X	JP 2003291281 A (TOYO BOSEKI) 14 October 2003 & English abstract retrieved from EPODOC database English abstract retrieved from EPODOC database	13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2014/000671

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:

because they relate to subject matter not required to be searched by this Authority, namely:

the subject matter listed in Rule 39 on which, under Article 17(2)(a)(i), an international search is not required to be carried out, including

2. ☐ Claims Nos.:

because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos:

because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box for Details

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Supplemental Box

Continuation of: **Box III**
This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

- Claims 1-12, 14-15 are directed to a container having a coating layer comprising resveratrol or a process for preparing a container by applying a coating layer comprising resveratrol or use of resveratrol as an additive to a coating layer of a container. The feature of the coating layer comprising resveratrol is specific to this group of claims.
- Claim 13 is directed to a container per se. This feature is specific to this claim. (Claim 13 defines a container obtainable by the process according to any one of claims 10 to 12. Due to the use of the word 'obtainable' in the claim, the claim is construed to be a container per se.)

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature common to all the claimed inventions there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. Therefore there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied *a priori*.

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2014/000671**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
WO 2003/029089 A1	10 April 2003	AU 2002304976 B2	12 Jul 2007
		AU 2007214288 A1	20 Sep 2007
		AU 2007214288 B2	30 Jul 2009
		BR 0212782 A	16 Nov 2004
		CA 2460716 A1	10 Apr 2003
		CN 1596213 A	16 Mar 2005
		EP 1429968 A1	23 Jun 2004
		EP 1429968 B1	26 Apr 2006
		HK 1069366 A1	29 Sep 2006
		IL 160956 A	11 Feb 2009
		JP 2005503971 A	10 Feb 2005
		JP 3668240 B2	06 Jul 2005
		KR 20040058188 A	03 Jul 2004
		KR 100857679 B1	08 Sep 2008
		MX PA04002800 A	23 Nov 2005
		PT 107017 A	13 Dec 2013
		RU 2004113110 A	10 Mar 2005
		US 2004028778 A1	12 Feb 2004
		US 2008014317 A1	17 Jan 2008
		US 2008254164 A1	16 Oct 2008
		ZA 200303128 A	27 Jan 2004
US 3888224 A	10 June 1975	DE 2012010 A1	10 Dec 1970
		DE 2012010 B2	14 Nov 1974
		JP S5127741 B1	14 Aug 1976
		US 3851076 A	26 Nov 1974
JP 2003291281 A	14 October 2003	None	

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.