

## COLORING COMPOSITION, METHOD OF MAKING, AND CONSUMABLE

## TECHNICAL FIELD

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This disclosure relates to a coloring composition for a consumable, a method of making the coloring composition, a consumable containing the coloring composition, and a method of making a consumable containing the color composition.

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## BACKGROUND

Today, a decreasing number of people are willing to eat or drink foodstuffs which are colored synthetically, resulting in a steady growth of the market for clean label colorants that do not include any ingredients perceived by consumers as undesirable. For example, studies  
15 have linked artificial food dyes such as red dye 40 ("Red 40") to hyperactivity, including ADHD.

Up to date, there is no stable natural clean label colorant that can substitute Red 40 without off notes. Often, a typical red anthocyanin could be blended with a yellow color like beta-carotene or turmeric to create an orange red hue similar to Red 40 for a beverage. The  
20 drawbacks to blending an anthocyanin and beta carotene are that vitamin C (ascorbic acid) is added to improve the light stability of the carotenoid, but vitamin C causes degradation of anthocyanins. Thus, the orange shaded colorant so obtained would have stability problems. In addition, the emulsification system(s) used in beta-carotene may be incompatible with flavour systems which contain emulsifiers or with clouding systems. This incompatibility may  
25 cause the beta-carotene emulsion to break and develop color ringing which is unacceptable.

Another possible blend to obtain the Red 40 appearance is a blend of red anthocyanin with turmeric (curcumin). This is not a good option for beverages stored in transparent bottles since turmeric is light sensitive and it fades easily, resulting in a shift away from the original  
30 hue. Turmeric may also contain an emulsification system which could have compatibility issues.

Thus, a clean label color, especially a clean label red-orange coloring composition that has a similar color shade as Red 40 without off notes and that is stable to light, heat and acidic conditions is needed in the art.

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## SUMMARY

According to a first illustrative embodiment, disclosed is a coloring composition comprising one or more pelargonidins selected from pelargonidin 3-glucoside, pelargonidin 3-(6''-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and  
10 pelargonidin 3,5-dimalonylglucoside, and at least one red anthocyanin.

According to a second illustrative embodiment, provided is a coloring composition comprising a pelargonidin selected from pelargonidin 3-glucoside and pelargonidin 3-(6''-malonylglucoside) and at least one red anthocyanin. In certain embodiments, the coloring  
15 composition further comprises pelargonidin 3,5-dimalonylglucoside.

According to a further illustrative embodiment, provided is a consumable composition comprising a consumable base and a coloring composition comprising one or more pelargonidins selected from pelargonidin 3-glucoside, pelargonidin 3-(6''-malonylglucoside),  
20 pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and pelargonidin 3,5-dimalonylglucoside, and at least one red anthocyanin.

According to a further illustrative embodiment, provided is a consumable composition comprising a consumable base and a coloring composition comprising a pelargonidin selected  
25 from pelargonidin 3-glucoside, pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and pelargonidin 3-(6''-malonylglucoside) and at least one red anthocyanin. In certain embodiments, the coloring composition further comprises pelargonidin 3,5-dimalonylglucoside.

According to a further illustrative embodiment, provided is a consumable composition  
30 comprising a consumable base and a coloring composition comprising a pelargonidin selected from pelargonidin 3-glucoside, pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and pelargonidin 3-(6''-malonylglucoside) and at least one red anthocyanin. In certain

embodiments, the coloring composition further comprises pelargonidin 3,5-dimalonylglucoside.

According to a further illustrative embodiment, provided is a method of making a consumable composition comprising adding a coloring composition comprising one or more  
5 pelargonidins selected from pelargonidin 3-glucoside, pelargonidin 3-(6''-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and pelargonidin 3,5-dimalonylglucoside, and at least one red anthocyanin to a consumable base.

According to a further illustrative embodiment, provided is a method of making a consumable composition comprising adding a coloring composition comprising a pelargonidin  
10 selected from pelargonidin 3-glucoside and pelargonidin 3-(6''-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and at least one red anthocyanin to a consumable base. In certain embodiments, the coloring composition further comprises pelargonidin 3,5-dimalonylglucoside.

15 According to a further illustrative embodiment, provided is a beverage comprising a beverage base and a coloring composition comprising one or more pelargonidins selected from pelargonidin 3-glucoside, pelargonidin 3-(6''-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and pelargonidin 3,5-dimalonylglucoside and at least one red anthocyanin.

20 According to a further illustrative embodiment, provided is a beverage comprising a beverage base and a coloring composition comprising a pelargonidin selected from pelargonidin 3-glucoside and pelargonidin 3-(6''-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and at least one red anthocyanin. In certain  
25 embodiments, the coloring composition further comprises pelargonidin 3,5-dimalonylglucoside.

According to a further illustrative embodiment, provided is a method of making a beverage comprising adding to a beverage base a coloring composition comprising one or  
30 more pelargonidins selected from pelargonidin 3-glucoside, pelargonidin 3-(6''-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and pelargonidin 3,5-dimalonylglucoside and at least one red anthocyanin.

According to a further illustrative embodiment, provided is a method of making a beverage comprising adding to a beverage base a coloring composition comprising a pelargonidin selected from pelargonidin 3-glucoside and pelargonidin 3-(6"-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and at least one red anthocyanin. In certain embodiments, the coloring composition further comprises pelargonidin 3,5-dimalonylglucoside.

According to a further illustrative embodiment, provided is the use of a coloring composition comprising one or more pelargonidins selected from pelargonidin 3-glucoside, pelargonidin 3-(6"-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and pelargonidin 3,5-dimalonylglucoside and at least one red anthocyanin to impart an orange-red color similar to dye Red 40 to a consumable.

According to a further illustrative embodiment, provided is the use of a coloring composition comprising a pelargonidin selected from pelargonidin 3-glucoside and pelargonidin 3-(6"-malonylglucoside) and at least one red anthocyanin to impart an orange-red color similar to dye Red 40 to a consumable. In certain embodiments, the coloring composition further comprises pelargonidin 3,5-dimalonylglucoside and/or pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu)

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#### DETAILED DESCRIPTION

The following text sets forth a broad description of numerous different embodiments of the present disclosure. The description is to be construed as exemplary only and does not describe every possible embodiment since describing every possible embodiment would be impractical, if not impossible. It will be understood that any feature, characteristic, component, composition, ingredient, product, step or methodology described herein can be deleted, combined with or substituted for, in whole or part, any other feature, characteristic, component, composition, ingredient, product, step or methodology described herein. Numerous alternative embodiments could be implemented, using either current technology or technology developed after the filing date of this patent, which would still fall within the scope of the claims.

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The terms "comprises," "comprising," "has," "having," "includes," "including," "contains," "containing," or any other variation are open-ended and are intended to cover a non-exclusive inclusion of elements, such that an article, apparatus, compound, composition, combination, method, or process that "comprises," "has," or "includes," or "contains" a recited list of elements does not include only those elements but may include other elements not expressly listed, recited or written in the specification or claims. An element or feature proceeded by the language "comprises . . . a," "contains . . . a," "has . . . a," or "includes . . . a" does not, without more constraints, preclude the existence or inclusion of additional elements or features in the article, apparatus, compound, composition, combination, method, or process that comprises, contains, has, or includes the element or feature.

The terms "a" and "an" are defined as one or more unless expressly stated otherwise or constrained by other language herein. An element or feature proceeded by "a" or "an" may be interpreted as one of the recited element or feature, or more than one of the element or feature.

The terms "about," "approximately," "essentially," "substantially," any other version thereof, or any other similar relative term, or similar term of approximation, are defined as being close to as understood by one having ordinary skill in the art. By way of non-limiting, illustrative embodiments, these terms are defined to be within 10% of recited value, or defined to be within 5% of a recited value, or defined to be within 4% of a recited value, or defined to be within 3% of a recited value, or defined to be within 2% of a recited value, or defined to be within 1% of a recited value, or defined to be within 0.5% of a recited value, or defined to be within 0.25% of a recited value, or defined to be within 0.1% of a recited value.

It should be understood that when an amount in weight percent is described in the present disclosure, it is intended that any and every amount within the range, including the end points, is to be considered as having been expressly disclosed. For example, the disclosure of "a range of from about 1 to about 100" is to be read as indicating each and every possible number along the continuum between about 1 and about 100. It is to be understood that the inventors appreciate and understand that any and all data points within the range are to be

considered to have been specified, and that the inventors have possession of the entire range and all points within the range.

When a concentration is expressed as “ppm”, the concentration is parts per million  
5 by weight based on the total weight of the caramel color composition or consumable. It should  
be understood that when a range of values is described in the present disclosure, it is intended  
that any and every value within the range, including the end points, is to be considered as  
having been disclosed. For example, “a range of from 1 ppm to 1000 ppm” of a component  
10 of the color composition is to be read as indicating each and every possible number along the  
continuum between 1 and 1000. It is to be understood that the inventors appreciate and  
understand that any and all values within the range are to be considered to have been  
specified, and that the inventors have possession of the entire range and all the values within  
the range.

When a concentration is expressed as weight percent, it should be understood that  
15 is on dry basis. It should be understood that when a range of values is described in the present  
disclosure, it is intended that any and every value within the range, including the end points,  
is to be considered as having been disclosed. For example, “a range of from 1 weight percent  
to 10 weight percent” of a component of the color composition is to be read as indicating each  
and every possible number along the continuum between 1 and 10. It is to be understood that  
20 the inventors appreciate and understand that any and all values within the range are to be  
considered to have been specified, and that the inventors have possession of the entire range  
and all the values within the range.

For the avoidance of doubt, alternative and optional features indicated for a given  
25 aspect, component, feature, or parameter of the invention should, unless the context  
indicates otherwise, be regarded as having been disclosed in combination with any and all  
other alternative or optional features and the like as indicated for the same or other aspects,  
features and parameters of the invention.

30 Disclosed is a coloring composition comprising one or more pelargonidins selected  
from pelargonidin 3-glucoside, pelargonidin 3-(6"-malonylglucoside) and pelargonidin 3,5-  
dimalonylglucoside, and at least one red anthocyanin. In certain embodiments, derivatives of

pelargonidin 3-glucoside, pelargonidin 3-(6''-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and pelargonidin 3,5-dimalonylglucoside may be used in addition to or as an alternative to the disclosed pelargonidins.

5 Disclosed is a coloring composition comprising a pelargonidin selected from pelargonidin 3-glucoside and pelargonidin 3-(6''-malonylglucoside), and at least one red anthocyanin. According to other illustrative embodiments, the coloring composition further comprises other pelargonidins, such as pelargonidin 3,5-dimalonylglucoside and/or pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu)

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According to certain illustrative embodiments, the ratio of the one or more pelargonidin to the at least one red anthocyanin is about 0.5:95.5 to about 95.5:0.5. According to certain illustrative embodiments, the ratio of the pelargonidin to the at least one red anthocyanin is from about 0.5, about 1, about 5, about 10, about 15, about 20, about 25,  
15 about 30, about 35, about 40, about 45, about 50, about 55, about 60, about 65, about 70, about 75, about 80, about 85, about 90, about 95, about 95.5 to about 90, about 85, about 80, about 75, about 70, about 65, about 60, about 55, about 50, about 45, about 40, about 35, about 30, about 25, about 20, about 15, about 10, about 5, about 1 or about 0.5. According to certain illustrative embodiments, the ratio of the one or more pelargonidin to the at least one  
20 red anthocyanin is from about 10:90, or about 20:80, or about 30:70, or about 40:60. According to certain illustrative embodiments, the ratio of the pelargonidin to the at least one red anthocyanin is from about 90:10, or about 80:20, or about 70:30, or about 60:40.

According to certain illustrative embodiments, the ratio of the pelargonidin 3-glucoside to the pelargonidin 3-(6''-malonylglucoside), is about 1:99 to about 99:1, such as  
25 from about 5, about 10, about 15, about 20, about 25, about 30, about 35, about 40, about 45, about 50, about 55, about 60, about 65, about 70, about 75, about 80, about 85, about 90, about 95, about 99 to about 99, about 95, about 80, about 85, about 80, about 75, about 70, about 65, about 60, about 55, about 50, about 45, about 40, about 35, about 30, about 25,  
30 about 20, about 15, about 10, about 5, or about 1. In certain embodiments, the ratio of the pelargonidin 3-glucoside to the pelargonidin 3-(6''-malonylglucoside) is about 40:60 to about 60:40, such as about 45:55, about 50:50 or about 55:45.

According to certain illustrative embodiments, the coloring composition comprises from about 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, about 70 weight percent to  
5 about 68, 66, 64, 62, 60, 58, 56, 54, 52, 50, 48, 46, 44, 42, 40, 38, 36, 34, 32, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 10 weight percent pelargonidin 3-glucoside based on the total weight of the coloring composition.

According to certain illustrative embodiments, the coloring composition comprises from about 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 32,  
10 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, about 70 weight percent to about 68, 66, 64, 62, 60, 58, 56, 54, 52, 50, 48, 46, 44, 42, 40, 38, 36, 34, 32, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 10 weight percent pelargonidin 3-glucoside based on the total weight of the total anthocyanin content of the coloring composition.

15 According to certain illustrative embodiments, the coloring composition comprises from about 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70 weight percent to about 68, 66, 64, 62, 60, 58, 56, 54, 52, 50, 48, 46, 44, 42, 40, 38, 36, 34, 32, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 10 weight percent pelargonidin 3-(6"-  
20 malonylglucoside), based on the total weight of the coloring composition.

According to certain illustrative embodiments, the coloring composition comprises from about 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70 weight percent to about 68, 66, 64, 62, 60, 58, 56, 54, 52, 50, 48, 46, 44, 42, 40, 38, 36, 34, 32, 30, 29, 28, 27, 26, 25,  
25 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 10 weight percent pelargonidin 3-(6"-malonylglucoside), based on the total weight of the total anthocyanin content of the coloring composition.

According to certain illustrative embodiments, the coloring composition comprises from  
30 about 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70 weight percent to about 68, 66, 64, 62, 60, 58, 56, 54, 52, 50, 48, 46, 44, 42, 40, 38, 36, 34, 32, 30, 29, 28, 27, 26, 25, 24, 23,

22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 10 weight percent pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu), based on the total weight of the coloring composition.

According to certain illustrative embodiments, the coloring composition comprises from about 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70 weight percent to about 68, 66, 64, 62, 60, 58, 56, 54, 52, 50, 48, 46, 44, 42, 40, 38, 36, 34, 32, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 10 weight percent pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu), based on the total weight of the total anthocyanin content of the coloring composition.

10        According to certain illustrative embodiments, the coloring composition comprises about 10 weight percent to about 70 weight percent pelargonidin 3-glucoside and about 10 weight percent to about 70 weight percent pelargonidin 3-(6"-malonylglucoside), based on the total weight of the coloring composition.

      According to other illustrative embodiments, the coloring composition comprises  
15    about 20 weight percent to about 60 weight percent pelargonidin 3-glucoside and about 20 weight percent to about 60 weight percent pelargonidin 3-(6"-malonylglucoside), based on the total weight of the coloring composition.

      According to certain illustrative embodiments, the coloring composition comprises about 10 weight percent to about 70 weight percent pelargonidin 3-glucoside and about 10  
20    weight percent to about 70 weight percent pelargonidin 3-(6"-malonylglucoside), based on the total weight of the total anthocyanin content of the coloring composition.

      According to other illustrative embodiments, the coloring composition comprises about 20 weight percent to about 60 weight percent pelargonidin 3-glucoside and about 20 weight percent to about 60 weight percent pelargonidin 3-(6"-malonylglucoside), based on  
25    the total weight of the total anthocyanin content of the coloring composition.

      According to other illustrative embodiments, the coloring composition comprises about 30 weight percent to about 45 weight percent pelargonidin 3-glucoside and about 30 weight percent to about 45 weight percent pelargonidin 3-(6"-malonylglucoside), based on  
30    the total weight of the coloring composition.

      According to other illustrative embodiments, the coloring composition comprises about 30 weight percent to about 40 weight percent pelargonidin 3-glucoside and about 30

weight percent to about 40 weight percent pelargonidin 3-(6''-malonylglucoside), based on the total weight of the coloring composition.

According to other illustrative embodiments, the coloring composition comprises about 35±5 weight percent pelargonidin 3-glucoside and about 35±5 weight percent pelargonidin 3-(6''-malonylglucoside), based on the total weight of the coloring composition.

According to other illustrative embodiments, the coloring composition comprises about 30 weight percent to about 45 weight percent pelargonidin 3-glucoside and about 30 weight percent to about 45 weight percent pelargonidin 3-(6''-malonylglucoside), based on the total weight of the total anthocyanin content of the coloring composition

According to other illustrative embodiments, the coloring composition comprises about 30 weight percent to about 40 weight percent pelargonidin 3-glucoside and about 30 weight percent to about 40 weight percent pelargonidin 3-(6''-malonylglucoside), based on the total weight of the total anthocyanin content of the coloring composition.

According to other illustrative embodiments, the coloring composition comprises about 35±5 weight percent pelargonidin 3-glucoside and about 35±5 weight percent pelargonidin 3-(6''-malonylglucoside), based on the total weight of the total anthocyanin content of the coloring composition

According to other illustrative embodiments, the coloring composition comprises about 2 weight percent to about 45 weight percent pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu).

According to other illustrative embodiments, the coloring composition comprises about 2 weight percent to about 20 weight percent pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu).

According to other illustrative embodiments, the coloring composition comprises about 2 weight percent to about 45 weight percent pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) based on the total weight of the total anthocyanin content of the coloring composition.

According to other illustrative embodiments, the coloring composition comprises about 2 weight percent to about 20 weight percent pelargonidin-dimalonylglucoside (Pel-3-3,6-

DiMalo-Glu) based on the total weight of the total anthocyanin content of the coloring composition.

In certain embodiments, the coloring composition comprises from about 0.1 % to about 99.9 % weight percent of total anthocyanin based on the total weight of the coloring composition.

In certain embodiments, the coloring composition comprises from about 0.1 weight percent to about 20 weight percent of total anthocyanin content based on the total weight of the coloring composition, such as from about 0.1%, 0.2%, 0.3%, 0.4%, 0.5%, 0.6%, 0.7%, 0.8%, 0.9%, 1%, 2%, 3%, 4%, 5%, 6%, 7%, 8%, 9%, 10%, 11%, 12%, 13%, 14%, 15%, 16%, 17%, 18%, 19%, 20% to about 20%, 19%, 18%, 17%, 16%, 15%, 14%, 13%, 12%, 11%, 10%, 9%, 8%, 7%, 6%, 5%, 4%, 3%, 2%, 1%, 0.9%, 0.8%, 0.7%, 0.6%, 0.5%, 0.4%, 0.3%, 0.2%, 0.1% weight percent of total anthocyanin content based on the total weight of the coloring composition.

In certain embodiments, the coloring composition comprises from about 2 weight percent to about 5 weight percent of total anthocyanin content based on the total weight of the coloring composition, such as from about 3 weight percent to about 4 weight percent of total anthocyanin content based on the total weight of the coloring composition.

In certain embodiments, the coloring composition is a corn product rich in anthocyanins as described herein. In certain embodiments, when the coloring composition is a corn product, it may further comprise other constituents that are naturally present in the corn such as starches, vitamins etc.

Pelargonidin 3-glucoside can be derived from a natural extract, or can be synthetic, or can be a combination of natural extract and synthetic. It may be extracted from a variety of natural sources such as *Lonicera caerulea* (honeysuckle), *Ribes uva-crispa* (gooseberry), pomegranate juice, strawberries, corn, and a variety of other plants. In a preferred embodiment, the pelargonidin 3-glucoside is obtained from corn. In a more preferred embodiment, the pelargonidin 3-glucoside is obtained from the corn hull or pericarp. It is also found in the berry skins of Cabernet Sauvignon and Pinot Noir grapes (*Vitis vinifera* L.) pelargonidin 3-glucoside may be extracted from one or more botanical sources, and/or synthetic pelargonidin 3-glucoside may be used.

Pelargonidin 3-(6"-malonylglucoside) can be derived from a natural extract, or can be synthetic, or can be a combination of natural extract and synthetic. It may be extracted from

a variety of natural sources such as *Rubus idaeus*, *Fragaria*, *Rubus chamaemorus*, *Callistephus chinensis* (Chinese Aster), corn (e.g., corn hull or pericarp), and a variety of other plants. Pelargonidin 3-(6"-malonylglucoside) may be extracted from one or more botanical sources, and/or synthetic pelargonidin 3-(6"-malonylglucoside) may be used.

- 5 Pelargonidin 3,5-dimalonylglucoside can be derived from a natural extract, or can be synthetic, or can be a combination of natural extract and synthetic. It may be extracted from a variety of natural sources such as *Rubus idaeus*, *Fragaria*, *Rubus chamaemorus*, *Callistephus chinensis* (Chinese Aster), corn, and a variety of other plants. Pelargonidin 3,5-dimalonylglucoside may be extracted from one or more botanical sources, and/or synthetic
- 10 Pelargonidin 3,5-dimalonylglucoside may be used.
- Pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) can be derived from a natural extract, or can be synthetic, or can be a combination of natural extract and synthetic. It may be extracted from a variety of natural sources such as *Rubus idaeus*, *Fragaria*, *Rubus chamaemorus*, *Callistephus chinensis* (Chinese Aster), corn, and a variety of other plants.
- 15 Pelargonidin 3,5-dimalonylglucoside may be extracted from one or more botanical sources, and/or synthetic pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) may be used.

- In certain embodiments, the coloring composition does not comprise pelargonidin-3-sophoroside-5-glucoside acylated with malonic acid and either p-coumaric and/or ferulic acids
- 20 and/or pelargonidin-3-rutinoside-5-glucoside acylated with p-coumaric acid.

- According to other illustrative embodiments, the coloring composition comprises at least one red anthocyanin selected from the group consisting of peonidins, cyanidins, and combinations thereof.

- 25 Cyanidins that can be used in the present invention include but are not limited to one or more of cyanidin 3-glucoside, cyanidin 3-5- dimalonylglucoside, cyaniding 3-malonylglucoside Antirrhinin (cyanidin-3-rutinoside or 3-C-R), Cyanidin-3-xylosylrutinoside, Cyanidin-3,4'-di-O- $\beta$ -glucopyranoside, Cyanidin-4'-O- $\beta$ -glucoside, Chrysanthemin (cyanidin-3-O-glucoside), Ideain (cyanidin 3-O-galactoside), Cyanin (cyanidin-3,5-O-diglucoside).
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Peonidins that can be used in the present invention include but are not limited to one or more of peonidin or Peonidin-3-O-glucoside.

According to certain illustrative embodiments, the coloring composition comprises  
5 cyanidin 3-glucoside.

According to certain illustrative embodiments, the coloring composition comprises peonidin-3-glucoside.

According to certain illustrative embodiments, the coloring composition comprises peonidin-3-glucoside and cyanidin 3-glucoside.  
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According to certain illustrative embodiments, the coloring composition comprises about 0.5 weight percent to about 30 weight percent cyanidin 3-glucoside, based on the total weight of the coloring composition. According to other illustrative embodiments, the coloring composition comprises about 0.5 weight percent to about 20 weight percent cyanidin 3-  
15 glucoside, based on the total weight of the coloring composition. According to other illustrative embodiments, the coloring composition comprises about 0.5 weight percent to about 15 weight percent cyanidin 3-glucoside, based on the total weight of the coloring composition.

According to certain illustrative embodiments, the coloring composition comprises  
20 about 0.5 weight percent to about 30 weight percent cyanidin 3-glucoside, based on the total weight of the total anthocyanin content of the coloring composition.

According to other illustrative embodiments, the coloring composition comprises about 0.5 weight percent to about 20 weight percent cyanidin 3-glucoside, based on the total weight of the total anthocyanin content of the coloring composition.

According to other illustrative embodiments, the coloring composition comprises  
25 about 0.5 weight percent to about 15 weight percent cyanidin 3-glucoside, based on the total weight of the total anthocyanin content of the coloring composition

Cyanidin 3-glucoside can be derived from a natural extract, or can be synthetic, or can be a combination of natural extract and synthetic. It may be extracted from a variety of  
30 natural sources such as colored legumes (e.g., black soybean, common bean, Black bean, cowpea, Soybean seed coat and lentils), corn (e.g. corn hull or pericarp), black elderberries, rubus (blackberry, raspberry), bilberries, strawberries, sweet oranges, red radish, red

cabbage, red onion, black carrot, purple carrot, eggplant, purple sweet potato, red sweet potato, strawberry, red currant, chokeberry/aronia, elderberry, plum, apple (Gala), cranberry, grape (red), Blueberry and a variety of other plants. Cyanidin 3-glucoside may be extracted from one or more botanical sources, and/or synthetic cyanidin 3-glucoside may be used.

5 According to a preferred embodiment, the cyanidin 3-glucoside is from corn.

According to certain illustrative embodiments, the coloring composition comprises from about 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, about 30 weight percent to about 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1 weight percent peonidin-3-glucoside, based on the total weight of the coloring composition. According to certain illustrative  
10 embodiments the coloring composition comprises about 0.5 weight percent to about 30 weight percent peonidin-3-glucoside, based on the total weight of the coloring composition. According to other illustrative embodiments, the coloring composition comprises about 0.5 weight percent to about 20 weight percent peonidin-3-glucoside, based on the total weight  
15 of the coloring composition. According to other illustrative embodiments, the coloring composition comprises about 0.5 weight percent to about 15 weight percent peonidin-3-glucoside, based on the total weight of the coloring composition. According to other illustrative embodiments, the coloring composition comprises about 5 weight percent to about 15 weight percent peonidin-3-glucoside, based on the total weight of the coloring  
20 composition. According to other illustrative embodiments, the coloring composition comprises about 10 weight percent peonidin-3-glucoside, based on the total weight of the coloring composition.

According to certain illustrative embodiments, the coloring composition comprises from about 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, about 30 weight percent to about 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1 weight percent peonidin-3-glucoside, based on the total weight of the total anthocyanin content of the coloring composition. According to certain illustrative embodiments the coloring composition comprises about 0.5 weight percent to about 30 weight percent peonidin-3-glucoside, based on the total weight  
25 of the total anthocyanin content of the coloring composition. According to other illustrative  
30 embodiments, the coloring composition comprises about 0.5 weight percent to about 20 weight percent peonidin-3-glucoside, based on the total weight of the coloring composition.

According to other illustrative embodiments, the coloring composition comprises about 0.5 weight percent to about 15 weight percent peonidin-3-glucoside, based on the total weight of the total anthocyanin content of the coloring composition. According to other illustrative embodiments, the coloring composition comprises about 5 weight percent to about 15 weight percent peonidin-3-glucoside, based on the total weight of the total anthocyanin content of the coloring composition. According to other illustrative embodiments, the coloring composition comprises about 10 weight percent peonidin-3-glucoside, based on the total weight of the total anthocyanin content of the coloring composition.

Peonidin-3-glucoside can be derived from a natural extract, or can be synthetic, or can be a combination of natural extract and synthetic. It may be extracted from a variety of natural sources such as *Ribes uva-crispa* (gooseberry), *Vaccinium* (e.g., cranberry, blueberry, bilberry, lingonberry, huckleberry, corn (e.g. corn hull or pericarp)), and a variety of other plants. Peonidin-3-glucoside may be extracted from one or more botanical sources, and/or synthetic peonidin-3-glucoside may be used. According to a preferred embodiment, the Peonidin-3-glucoside is from corn.

According to certain illustrative embodiments, the coloring composition comprises from about 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 weight percent to about 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 0.5 weight percent cyanidin 3-glucoside, based on the total weight of the coloring composition. According to certain illustrative embodiments about 0.5 weight percent to about 30 weight percent cyanidin 3-glucoside and about 0.5 weight percent to about 30 weight percent peonidin-3-glucoside, based on the total weight of the coloring composition. According to other illustrative embodiments, the coloring composition comprises about 0.5 weight percent to about 20 weight percent cyanidin 3-glucoside and from about 0.5 weight percent to about 20 weight percent peonidin-3-glucoside, based on the total weight of the coloring composition. According to other illustrative embodiments, the coloring composition comprises about 0.5 weight percent to about 15 weight percent cyanidin 3-glucoside and from about 0.5 weight percent to about 15 weight percent peonidin-3-glucoside, based on the total weight of the coloring composition. According to other illustrative embodiments, the coloring composition comprises about 10 weight percent cyanidin 3-glucoside and from about 0.5 weight percent to about 10 weight percent peonidin-3-glucoside, based on the total weight of the coloring composition.

According to certain illustrative embodiments, the coloring composition comprises from about 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 weight percent to about 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 0.5 weight percent cyanidin 3-glucoside, based on the total weight of the total anthocyanin content of the coloring composition. According to certain illustrative embodiments about 0.5 weight percent to about 30 weight percent cyanidin 3-glucoside and about 0.5 weight percent to about 30 weight percent peonidin-3-glucoside, based on the total weight of the total anthocyanin content of the coloring composition. According to other illustrative embodiments, the coloring composition comprises about 0.5 weight percent to about 20 weight percent cyanidin 3-glucoside and from about 0.5 weight percent to about 20 weight percent peonidin-3-glucoside, based on the total weight of the total anthocyanin content of the coloring composition. According to other illustrative embodiments, the coloring composition comprises about 0.5 weight percent to about 15 weight percent cyanidin 3-glucoside and from about 0.5 weight percent to about 15 weight percent peonidin-3-glucoside, based on the total weight of the total anthocyanin content of the coloring composition. According to other illustrative embodiments, the coloring composition comprises about 10 weight percent cyanidin 3-glucoside and from about 0.5 weight percent to about 10 weight percent peonidin-3-glucoside, based on the total weight of the total anthocyanin content of the coloring composition.

According to certain illustrative embodiments, the coloring composition comprises about 10 weight percent cyanidin 3-glucoside, about 36 weight percent pelargonidin 3-glucoside, about 10 weight percent peonidin-3-glucoside, and about 36 weight percent pelargonidin 3-(6"-malonylglucoside), based on the total weight of the coloring composition.

According to certain illustrative embodiments, the coloring composition comprises about 10 weight percent cyanidin 3-glucoside, about 36 weight percent pelargonidin 3-glucoside, about 10 weight percent peonidin-3-glucoside, and about 36 weight percent pelargonidin 3-(6"-malonylglucoside), based on the total weight of the total anthocyanin content of the coloring composition.

The concentration of the different pigments, such as pelargonidin and other anthocyanins, in the invention's composition, is measured using High-Performance Liquid

Chromatography coupled with an Ultra-Violet detector (HPLC/UV 1260 series; from Agilent Technologies, Santa Clara, USA). Briefly, pigments were separated on Zorbax Extend C18 (250x4.6), 5.0µm column (Agilent Technologies) with an Acetonitrile/Methanol/water/Formic acid gradient as mobile phase at a flow rate of 1.0 mL/min, column temperature 30°C, and injection volume of 10µL. Quantification was done using Kuromanin (Cyanidin-3-O-Glucoside) and Callistefin (Pelargonidin-3-O-glucoside) for the calibration curve.

The coloring composition may suitably be prepared in the form of a liquid, a paste or a powder. For example, the coloring composition may be in the form of a free-flowing powder. By way of example, and not by way of limitation, suitable starting material may be extracted with constant agitation in solvents composed of water and polar organic solvents. The organic solvents that may be used include methanol, ethanol, n-propanol, 2-propanol, acetone and propylene glycol. The extraction may be carried out either with water alone or with water in combination with one or more solvents listed above. The composition of the solvents may range between 100/0 water/organic solvent (w/w) to 10/90 water/organic solvent (w/w). In a preferred embodiment, the solvent is 100% water. The extraction temperature may be between 30° C. to 90° C. and the extraction time may be between 1 hours and 40 hours. Extraction may be carried out with equipment known to those skilled in the art, such as a counter current extractor or an extractor with constant solvent circulation. It will be well known to those skilled in the art that the extraction can be carried out in various types of equipment.

The extract may be collected either by decanting, centrifuging or filtering. The plant material optionally may then be extracted one or two more times under similar conditions, and the extracts combined and the solvents evaporated under vacuum to concentrate the extract. An organic solvent that is miscible with water may be added to the concentrated extract to induce precipitation of proteins and other materials that are insoluble in those organic solvents. Preferably the solvent used is ethanol, but other solvents including methanol, acetone, n-propanol or 2-isopropanol may also be used. After about 1 hour, protein precipitation is complete and the protein removed by, e.g. centrifugation or filtration.

Alternatively, the concentrated extract may be washed by an organic solvent or solvents, which are not miscible with water. The solvents that may be used include hexane, cyclohexane, heptane, dichloromethane, chloroform, toluene, petroleum ether, methyl t-butyl ether, ethyl acetate and butanol. To facilitate the phase separation, a second solvent  
5 that is miscible with water may be added. The second solvent that may be used includes methanol, ethanol, acetone, n-propanol and 2-propanol. Normally, one washing step is sufficient to clarify the extract. However, additional washing may be performed if necessary. After the phase separation is reached the aqueous phase may be collected and treated under vacuum to have the residual solvents removed.

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The aqueous solution obtained after any of the above operations may be further concentrated under vacuum. It may be directly dried under vacuum to a powder. Alternatively, it may be concentrated and spray-dried to a powder. The spray-drying may be performed with or without carriers.

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One or more natural sources of pelargonidins may be used to prepare the composition of the invention. One or more natural sources of red anthocyanin may be used to prepare the composition of the invention. In certain preferred embodiments, the composition of the invention comprises pelargonidins obtained from corn, such as from the corn hull or pericarp.  
20 In certain preferred embodiments, the composition of the invention comprises red anthocyanin obtained from corn, such as from the corn hull or pericarp or also husk. In certain embodiments, one or more corn varieties may be used to obtain the pelargonidins. In certain embodiments, one or more corn varieties may be used to obtain the red anthocyanin.

25 Different corn varieties are available to the public with a red - orange color. Those red/orange corn varieties contain pelargonidins and/or red anthocyanins described herein in different concentrations.

For example, the red/orange corn varieties that can be used in the present invention  
30 include but are not limited to: corn variety CV414351 or Peruvian corn described in US8124143\_B2, the CV589782 variety described in US8071865 B2, CV165560 variety described in US8362332 B2, CV897903 variety described in US8071864 B2, CV596775 variety

described in US8076548 B2, CV724812 variety described in US8076549 B2, CV935311 variety described in US7667110 B2, Apache Red OP, Mandan Red OP, Texas Gourdseed Red OP, Strawberry OP (<http://www.richfarmgarden.com/corn.html>), Bloody butcher corn, Jimmy red corn, Double Red or Hopi blue, NOCTURNO and TENEBRO varieties (https://www.geves.fr/catalogue/), and between others, the varieties listed in table below obtained from Global Germplasm Resource Information Network (GRIN <https://npgsweb.ars-grin.gov/gringlobal/descriptors>) with the kernel color and pericarp color descriptors RED:

| ID      | ACCESSION  | NAME                                      | ORIGIN                        |
|---------|------------|-------------------------------------------|-------------------------------|
| 1072880 | Ames 15668 | Strawberry Popcorn                        | California, United States     |
| 1072998 | Ames 15692 | Boyaca 560                                | Boyacá, Colombia              |
| 1073901 | Ames 15932 | Burford Ornamental Popcorn                | Indiana, United States        |
| 1077877 | Ames 16950 | PCM-WCG 910                               | Cochabamba, Bolivia           |
| 1078974 | Ames 17352 | PCM-WCG 1353                              | Caldas, Colombia              |
| 1087378 | Ames 21960 | Red Popcorn                               | Illinois, United States       |
| 1087379 | Ames 21961 | Strawberry Popcorn                        | Illinois, United States       |
| 1505575 | Ames 22707 | Pennsylvania Colored Corn (Barnes Strain) | Pennsylvania, United States   |
| 1575958 | Ames 24603 | Bolivia 1037                              | Pando, Bolivia                |
| 1575975 | Ames 24633 | Panama 113                                | Panamá, Panama                |
| 1575632 | Ames 25207 | Burford 2                                 | United States                 |
| 1575633 | Ames 25208 | Burford 5                                 | United States                 |
| 1575634 | Ames 25209 | Burford 7                                 | United States                 |
| 1575638 | Ames 25213 | Burford 22                                | United States                 |
| 1575639 | Ames 25214 | Burford 24                                | United States                 |
| 1645457 | Ames 27063 | A272                                      | North-West, South Africa      |
| 1713413 | Ames 28370 | Red @@@rc# (NCLB)                         | Wisconsin, United States      |
| 1715221 | Ames 28674 | HVC 112                                   | Huancavelica, Peru            |
| 1715252 | Ames 28705 | Cuzco 89                                  | Cusco, Peru                   |
| 1715292 | Ames 28745 | Bolivia 331                               | Chuquisaca, Bolivia           |
| 1715301 | Ames 28754 | Bolivia 740                               | Santa Cruz, Bolivia           |
| 1715303 | Ames 28756 | Bolivia 786                               | Santa Cruz, Bolivia           |
| 1715377 | Ames 28830 | GUIRUA                                    | Colombia                      |
| 1715414 | Ames 28867 | PAGALADROGA                               | Peru                          |
| 1715420 | Ames 28873 | ALAZAN                                    | Peru                          |
| 1715459 | Ames 28912 | CATETO                                    | Bolivia                       |
| 1715460 | Ames 28913 | PORORO                                    | Bolivia                       |
| 1842810 | Ames 30532 | MR18 (Reventador) S6                      | Wisconsin, United States      |
| 1918536 | Ames 32345 | Bloody Butcher                            | Texas, United States          |
| 2091818 | Ames 34457 | SWN Syn 17 OR                             | North Carolina, United States |
| 2091830 | Ames 34469 | Karapampa/Painted Mountain Composite      | North Dakota, United States   |

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|---------|------------|-------------------------------|-----------------------------|
| 2169474 | Ames 36272 | 'Synthetic A Improved'        | Iowa, United States         |
| 1000961 | NSL 27     | COSTENO SEGREGATIONS          | Colombia                    |
| 1001010 | NSL 28     | PUYA AMARILLO                 | Colombia                    |
| 1022160 | NSL 2841   | NAL-TEL                       | Mexico                      |
| 1023769 | NSL 3231   | Intermediate Synthetic        | Pennsylvania, United States |
| 1084230 | NSL 20133  | AVATI PICHINGA IHU            | South America               |
| 1098986 | NSL 30056  | W703                          | Wisconsin, United States    |
| 1105284 | NSL 42706  | Chile 314                     | Chile                       |
| 1113605 | NSL 67053  | ARIZONA 116                   | Arizona, United States      |
| 1113606 | NSL 67054  | ARIZONA 117                   | Arizona, United States      |
| 1113607 | NSL 67055  | ARIZONA 118                   | Arizona, United States      |
| 1113608 | NSL 67056  | ARIZONA 119                   | Arizona, United States      |
| 1113611 | NSL 67059  | ARIZONA 122                   | Arizona, United States      |
| 1113612 | NSL 67060  | ARIZONA 123                   | Arizona, United States      |
| 1113613 | NSL 67061  | ARIZONA 124                   | Arizona, United States      |
| 1113614 | NSL 67062  | ARIZONA 125                   | Arizona, United States      |
| 1113616 | NSL 67064  | ARIZONA 127                   | Arizona, United States      |
| 1114282 | NSL 68325  | ARIZONA 064                   | Arizona, United States      |
| 1114283 | NSL 68326  | ARIZONA 066                   | Arizona, United States      |
| 1114286 | NSL 68329  | ARIZONA 075                   | Arizona, United States      |
| 1114292 | NSL 68335  | ARIZONA 100                   | Arizona, United States      |
| 1125870 | NSL 92643  | CORNELL TROPICAL<br>COMPOSITE | New York, United States     |
| 1125871 | NSL 92644  | CORNELL EARLY<br>COMPOSITE    | New York, United States     |
| 1127922 | NSL 102722 | Northwest Dent                | Colorado, United States     |
| 1127939 | NSL 102735 | Northwest-Extra Early         | Colorado, United States     |
| 1169875 | NSL 202126 | Six Nations Variety #3        | United States               |
| 1177942 | NSL 219135 | Strawberry Ann                | Colorado, United States     |
| 1185704 | NSL 236318 | Wright Round Strawberry       | Illinois, United States     |
| 1193448 | NSL 250323 | 'Urozajnaja'                  | Russian Federation          |
| 1193452 | NSL 250327 | VIR-1309                      | Russian Federation          |
| 1210469 | NSL 283388 | Sinaloa 2                     | Sinaloa, Mexico             |
| 1686826 | NSL 437868 | AusTRCF 305772                | Queensland, Australia       |
| 1140259 | PI 162927  | (MKT., ASUNCION)              | Central, Paraguay           |
| 1140349 | PI 163145  | MAKKI                         | India                       |
| 1140569 | PI 163563  | No. 1009                      | Guatemala                   |
| 1141646 | PI 164375  | MAKKAI                        | Punjab, India               |
| 1142086 | PI 164994  | No. 70                        | Ankara, Turkey              |
| 1142808 | PI 165982  | MAKA                          | India                       |
| 1142881 | PI 166042  | MAKA                          | India                       |
| 1142981 | PI 166160  | No. 9706                      | Bāgmatī, Nepal              |
| 1142983 | PI 166162  | No. 9708                      | Bāgmatī, Nepal              |
| 1142985 | PI 166164  | No. 9710                      | Bāgmatī, Nepal              |
| 1144499 | PI 167948  | No. 3500                      | Bursa, Turkey               |
| 1144500 | PI 167949  | No. 3193                      | Balıkesir, Turkey           |
| 1144502 | PI 167951  | No. 1482                      | Manisa, Turkey              |

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| 1144508 | PI 167957 | No. 1640             | Antalya, Turkey    |
| 1144520 | PI 167969 | No. 1765             | Aydın, Turkey      |
| 1144533 | PI 167982 | No. 1913             | Muğla, Turkey      |
| 1144551 | PI 168000 | No. 2360             | İstanbul, Turkey   |
| 1144553 | PI 168002 | No. 2512             | Edirne, Turkey     |
| 1144557 | PI 168006 | No. 2600             | Kırklareli, Turkey |
| 1144558 | PI 168007 | No. 2601             | Kırklareli, Turkey |
| 1144559 | PI 168008 | No. 2602             | Kırklareli, Turkey |
| 1144568 | PI 168017 | No. 2745             | Tekirdağ, Turkey   |
| 1144583 | PI 168032 | No. 3160             | Balıkesir, Turkey  |
| 1144584 | PI 168033 | No. 3189             | Balıkesir, Turkey  |
| 1144590 | PI 168039 | No. 3337             | Balıkesir, Turkey  |
| 1147157 | PI 170881 | No. 2442             | Kocaeli, Turkey    |
| 1148844 | PI 171895 | No. 6577             | Zonguldak, Turkey  |
| 1148886 | PI 171916 | No. 6905             | Tokat, Turkey      |
| 1149799 | PI 172600 | No. 7567             | Kars, Turkey       |
| 1150919 | PI 173830 | No. 8619             | Malatya, Turkey    |
| 1151371 | PI 174416 | No. 8370             | Gaziantep, Turkey  |
| 1152006 | PI 175334 | (TUSA RANI)          | Nepal              |
| 1152379 | PI 175976 | No. 5950             | Çanakkale, Turkey  |
| 1152387 | PI 175984 | No. 9122             | Kayseri, Turkey    |
| 1153581 | PI 177116 | No. 9353             | Konya, Turkey      |
| 1153957 | PI 177596 | No. 5238             | Ankara, Turkey     |
| 1153959 | PI 177598 | No. 5240             | Ankara, Turkey     |
| 1153982 | PI 177621 | No. 5263             | Ankara, Turkey     |
| 1154000 | PI 177639 | No. 5281             | Ankara, Turkey     |
| 1154003 | PI 177642 | No. 5284             | Ankara, Turkey     |
| 1155105 | PI 179141 | No. 10210            | Kırklareli, Turkey |
| 1155684 | PI 179566 | No. 5917             | Balıkesir, Turkey  |
| 1155688 | PI 179568 | No. 5918             | Turkey             |
| 1155700 | PI 179574 | No. 10040            | Erzurum, Turkey    |
| 1155994 | PI 180016 | (DELHI)              | India              |
| 1157706 | PI 182322 | No. 10460            | Balıkesir, Turkey  |
| 1157707 | PI 182323 | No. 10461            | Balıkesir, Turkey  |
| 1157708 | PI 182324 | No. 10462            | Manisa, Turkey     |
| 1158671 | PI 183368 | Jondra               | India              |
| 1159112 | PI 183735 | No. 10752            | Manisa, Turkey     |
| 1159114 | PI 183737 | No. 10754            | Giresun, Turkey    |
| 1159128 | PI 183751 | No. 10768            | Zonguldak, Turkey  |
| 1159160 | PI 183783 | No. 10800            | Edirne, Turkey     |
| 1159171 | PI 183794 | No. 10811            | İzmir, Turkey      |
| 1159180 | PI 183803 | No. 10820            | Konya, Turkey      |
| 1159181 | PI 183804 | No. 10821            | Konya, Turkey      |
| 1160343 | PI 185853 | No. 10               | Czechoslovakia     |
| 1164711 | PI 193655 | No. 8544             | Ethiopia           |
| 1166608 | PI 196125 | No. 9677             | Ethiopia           |
| 1168047 | PI 197261 | (SHASHAMANNA,ARUSSI) | Ethiopia           |

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| 1172302 | PI 204837 | No. 1089                           | Muğla, Turkey               |
| 1175931 | PI 213737 | Red Navajo                         | Arizona, United States      |
| 1175942 | PI 213748 | Concho Brown                       | Oklahoma, United States     |
| 1175944 | PI 213750 | Stilwell                           | Oklahoma, United States     |
| 1175948 | PI 213755 | Bighorse Spotted                   | Oklahoma, United States     |
| 1175994 | PI 213801 | Bear Island Chippewa               | North Dakota, United States |
| 1175999 | PI 213806 | Mandan Black                       | North Dakota, United States |
| 1176001 | PI 213808 | Mandan Red Flour                   | North Dakota, United States |
| 1176127 | PI 214198 | Northwestern Dent (Brandon Strain) | Manitoba, Canada            |
| 1176128 | PI 214199 | Rainbow Flint                      | Manitoba, Canada            |
| 1177485 | PI 217460 | King Philip                        | Pennsylvania, United States |
| 1177487 | PI 217462 | Rainbow                            | New York, United States     |
| 1177488 | PI 217463 | Eight Row                          | Pennsylvania, United States |
| 1179795 | PI 222297 | Peruvian Red                       | North Dakota, United States |
| 1179817 | PI 222319 | Red Meadowbrook Reid               | Nebraska, United States     |
| 1184587 | PI 233007 | Calico Corn                        | Missouri, United States     |
| 1194557 | PI 251884 | BELOYHARVE PSHENO                  | Former, Soviet Union        |
| 1198307 | PI 260381 | Cariaco                            | Cundinamarca, Colombia      |
| 1203190 | PI 270080 | No. 595                            | Pakistan                    |
| 1208187 | PI 279022 | Enano                              | La Palma, Spain             |
| 1215041 | PI 286383 | Ames 144                           | Iowa, United States         |
| 1246645 | PI 331441 | (TEPI, KAFFA PROVINCE)             | Kefa, Ethiopia              |
| 1246646 | PI 331442 | (TEPI, KAFFA PROVINCE)             | Kefa, Ethiopia              |
| 1246647 | PI 331443 | (GORI ILLUBABOR PROV.)             | Ilubabor, Ethiopia          |
| 1254141 | PI 340836 | CA-4                               | Iowa, United States         |
| 1254142 | PI 340837 | R-4524                             | Iowa, United States         |
| 1254145 | PI 340840 | R-Strawberry Open Pollinated       | Iowa, United States         |
| 1254148 | PI 340843 | CA-15-2 DENT STERILE               | Iowa, United States         |
| 1254155 | PI 340853 | R-17 INBR.FR.SUPERGOLD             | Iowa, United States         |
| 1254158 | PI 340856 | R-18 INBR.FR.SUPERGOLD             | Iowa, United States         |
| 1254161 | PI 340859 | R-22 INBR.FR.SUPERGOLD             | Iowa, United States         |
| 1254164 | PI 340862 | R-28                               | Iowa, United States         |
| 1254165 | PI 340863 | R-28-2                             | Iowa, United States         |
| 1254167 | PI 340866 | R-53-1 INBR.FR.YELPEARL            | Iowa, United States         |
| 1254168 | PI 340867 | R-53-2 INBR.FR.YELPEARL            | Iowa, United States         |
| 1254170 | PI 340869 | R-PAH-1 IN.FR.TOM-THUMB            | Iowa, United States         |
| 1254171 | PI 340870 | R-PAH-2                            | Iowa, United States         |
| 1254173 | PI 340872 | R-PAH-1                            | Iowa, United States         |
| 1254174 | PI 340873 | R-RAH-2 IN.FR.TOM-THUMB            | Iowa, United States         |
| 1258936 | PI 347252 | DOKATU MKT., KONSO                 | Ethiopia                    |
| 1266499 | PI 357115 | No. 22815                          | Gojam, Ethiopia             |
| 1266504 | PI 357120 | No. 22883                          | Welo, Ethiopia              |
| 1266506 | PI 357122 | No. 22885                          | Welo, Ethiopia              |
| 1266513 | PI 357129 | No. 22910                          | Welega, Ethiopia            |

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|---------|-------------------|-----------------------|------------------------------|
| 1267585 | PI 358278         | BELA LOKALNA          | Former Serbia and Montenegro |
| 1267586 | PI 358279         | CRVENA LOKALNA        | Former Serbia and Montenegro |
| 1267589 | PI 358282         | BELA PUKANKA          | Former Serbia and Montenegro |
| 1267735 | PI 358544         | B 1420                | Spain                        |
| 1267736 | PI 358545         | B 1421                | Spain                        |
| 1276418 | PI 368834         | PUKANKA 1377          | North Macedonia              |
| 1276420 | PI 368836         | PUKANKA 1400          | North Macedonia              |
| 1295287 | PI 393726         | VIII/26               | North Macedonia              |
| 1295320 | PI 393759         | VIII/59               | North Macedonia              |
| 1302515 | PI 401759         | Comstock Family Flint | Maine, United States         |
| 1306139 | PI 406243         | VIII/153              | Former Serbia and Montenegro |
| 1312398 | PI 414184         | Strawberry Dent       | Texas, United States         |
| 1312399 | PI 414185         | Old Wisconsin Red     | Wisconsin, United States     |
| 1313201 | PI 415208         | VIII/162              | Former Serbia and Montenegro |
| 1338928 | PI 443992         | Atlántico 314         | Atlántico, Colombia          |
| 1339010 | PI 444074         | Bolívar 385           | Bolívar, Colombia            |
| 1339061 | PI 444125         | Boyaca 406            | Boyacá, Colombia             |
| 1339109 | PI 444173         | Boyaca 475            | Boyacá, Colombia             |
| 1339272 | PI 444336         | Cauca 312             | Cauca, Colombia              |
| 1339273 | PI 444337         | Cauca 313             | Cauca, Colombia              |
| 1339422 | PI 444486         | Cordoba 334           | Córdoba, Colombia            |
| 1339428 | PI 444492         | Cordoba 342           | Córdoba, Colombia            |
| 1339512 | PI 444576         | Cundinamarca 424      | Cundinamarca, Colombia       |
| 1339859 | PI 444923         | Magdalena 355         | Magdalena, Colombia          |
| 1340037 | PI 445101         | Narino 389            | Nariño, Colombia             |
| 1340234 | PI 445298         | Putumayo 358          | Putumayo, Colombia           |
| 1340236 | PI 445300         | Putumayo 360          | Putumayo, Colombia           |
| 1344462 | PI 449526<br>CYMT | I-74-7 Original       | Brazil                       |
| 1344706 | PI 449770         | Xurimas               | Brazil                       |
| 1344727 | PI 449791<br>CYMT | Vermelho              | Brazil                       |
| 1344734 | PI 449798<br>CYMT | Mistura - 2           | Brazil                       |
| 1346967 | PI 452031         | Ames 1765             | Iowa, United States          |
| 1346969 | PI 452033         | Maiz blanco           | Ecuador                      |
| 1346972 | PI 452036         | Brindle corn          | Pennsylvania, United States  |
| 1362109 | PI 467173         | CHZM 05 023           | Valparaíso, Chile            |
| 1362129 | PI 467193         | CHZM 05 047           | Valparaíso, Chile            |
| 1366758 | PI 471822         | Costa Rica 88         | Alajuela, Costa Rica         |
| 1366774 | PI 471838         | Costa Rica 172        | Costa Rica                   |
| 1366777 | PI 471841         | Costa Rica 176        | Costa Rica                   |

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| 1366781 | PI 471845 | Costa Rica 184                   | Costa Rica                              |
| 1366808 | PI 471872 | Costa Rica 242                   | Guanacaste, Costa Rica                  |
| 1366817 | PI 471881 | Costa Rica 261                   | Guanacaste, Costa Rica                  |
| 1366820 | PI 471884 | Costa Rica 268                   | Costa Rica                              |
| 1366833 | PI 471897 | Bolivia 1063                     | Bolivia                                 |
| 1367053 | PI 472117 | Pichinga Redondo I               | Paraguay                                |
| 1369149 | PI 474213 | Dulcillo de Noroeste, Caca sunu. | Sonora, Mexico                          |
| 1371805 | PI 476869 | Pueblo Blue Flour                | Arizona, United States                  |
| 1371807 | PI 476871 | Maiz chapalote                   | Sonora, Mexico                          |
| 1372477 | PI 477541 | Uruguay 96A                      | Canelones, Uruguay                      |
| 1372563 | PI 477627 | Uruguay 603A                     | Rivera, Uruguay                         |
| 1372573 | PI 477637 | Uruguay 626A                     | Rivera, Uruguay                         |
| 1372577 | PI 477641 | Uruguay 633A                     | Rivera, Uruguay                         |
| 1372629 | PI 477693 | Uruguay 753A                     | Cerro Largo, Uruguay                    |
| 1372675 | PI 477739 | Uruguay 1146A                    | Colonia, Uruguay                        |
| 1373232 | PI 478296 | AP80-236                         | Madagascar                              |
| 1373880 | PI 478944 | Honduras 62                      | Choluteca, Honduras                     |
| 1373886 | PI 478950 | Honduras 81                      | Comayagua, Honduras                     |
| 1373900 | PI 478964 | Campeche 39                      | Campeche, Mexico                        |
| 1373971 | PI 479035 | Michoacan 173                    | Michoacán de Ocampo, Mexico             |
| 1373981 | PI 479045 | Nayarit 47                       | Nayarit, Mexico                         |
| 1373995 | PI 479059 | Oaxaca 127                       | Oaxaca, Mexico                          |
| 1373996 | PI 479060 | Oaxaca 129                       | Oaxaca, Mexico                          |
| 1374003 | PI 479067 | Sinaloa 4                        | Sinaloa, Mexico                         |
| 1374050 | PI 479114 | Panama 70                        | Panama                                  |
| 1374051 | PI 479115 | Panama 80                        | Panama                                  |
| 1374053 | PI 479117 | Panama 104                       | Panama                                  |
| 1374102 | PI 479166 | Uruguay 356A                     | Lavalleja, Uruguay                      |
| 1378451 | PI 483515 | Guanajuato 25                    | Guanajuato, Mexico                      |
| 1378964 | PI 484028 | Dominican Republic 150           | Dominican Republic                      |
| 1378974 | PI 484038 | Suriname 804                     | Suriname                                |
| 1379082 | PI 484146 | Oaxaca 262                       | Oaxaca, Mexico                          |
| 1379092 | PI 484156 | Oaxaca 306                       | Oaxaca, Mexico                          |
| 1379344 | PI 484408 | Chihuahua 133                    | Chihuahua, Mexico                       |
| 1379347 | PI 484411 | Chihuahua 136                    | Chihuahua, Mexico                       |
| 1379357 | PI 484421 | Chihuahua 147                    | Chihuahua, Mexico                       |
| 1379360 | PI 484424 | Chihuahua 150                    | Chihuahua, Mexico                       |
| 1379367 | PI 484431 | Chihuahua 158                    | Chihuahua, Mexico                       |
| 1379444 | PI 484508 | Chihuahua 258                    | Chihuahua, Mexico                       |
| 1379475 | PI 484539 | Durango 181                      | Durango, Mexico                         |
| 1379618 | PI 484682 | Guanajuato 96                    | Guanajuato, Mexico                      |
| 1379767 | PI 484831 | Nayarit 60                       | Nayarit, Mexico                         |
| 1379858 | PI 484922 | Veracruz 13                      | Veracruz de Ignacio de la Llave, Mexico |
| 1380040 | PI 485104 | Brazil 2296                      | São Paulo, Brazil                       |

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| 1380054 | PI 485118 | Chihuahua 157    | Chihuahua, Mexico           |
| 1380143 | PI 485207 | Ancash 516       | Ancash, Peru                |
| 1380147 | PI 485211 | Ancash 522       | Ancash, Peru                |
| 1380183 | PI 485247 | Apurimac 137     | Apurímac, Peru              |
| 1380187 | PI 485251 | Apurimac 165     | Apurímac, Peru              |
| 1380258 | PI 485322 | Lambayeque 15    | Lambayeque, Peru            |
| 1380265 | PI 485329 | Libertad 28      | La Libertad, Peru           |
| 1380266 | PI 485330 | Libertad 34      | La Libertad, Peru           |
| 1380335 | PI 485399 | Bolivia 1035     | Bolivia                     |
| 1380396 | PI 485460 | Uruguay 646      | Lavalleja, Uruguay          |
| 1382688 | PI 487752 | Mexico 516       | México, Mexico              |
| 1382820 | PI 487884 | Zacatecas 209    | Zacatecas, Mexico           |
| 1383323 | PI 488387 | Lambayeque 1     | Lambayeque, Peru            |
| 1383325 | PI 488389 | Libertad 10      | La Libertad, Peru           |
| 1383329 | PI 488393 | Cuzco 18         | Cusco, Peru                 |
| 1383344 | PI 488408 | Peru 561         | Lima, Peru                  |
| 1383351 | PI 488415 | Libertad 14      | La Libertad, Peru           |
| 1383353 | PI 488417 | Lima 8           | Lima, Peru                  |
| 1383391 | PI 488455 | Ancash 21        | Ancash, Peru                |
| 1383423 | PI 488487 | Cuzco 116        | Cusco, Peru                 |
| 1383425 | PI 488489 | Cuzco 114        | Cusco, Peru                 |
| 1383429 | PI 488493 | Madre de Dios 5  | Madre de Dios, Peru         |
| 1383582 | PI 488646 | Ancash 582       | Ancash, Peru                |
| 1383583 | PI 488647 | Ancash 583       | Ancash, Peru                |
| 1384016 | PI 489080 | Puebla 455       | Puebla, Mexico              |
| 1384017 | PI 489081 | Puebla 456       | Puebla, Mexico              |
| 1385348 | PI 490412 | Massarsaba       | Mali                        |
| 1385351 | PI 490415 | Massarsuka       | Mali                        |
| 1385857 | PI 490921 | Nayarit 15       | Nayarit, Mexico             |
| 1385871 | PI 490935 | Puebla 219       | Puebla, Mexico              |
| 1386874 | PI 491938 | ARZM 05 054      | Misiones, Argentina         |
| 1387865 | PI 492929 | ARZM 14 057      | Córdoba, Argentina          |
| 1389890 | PI 494954 | ZFA 3290         | Zambia                      |
| 1389891 | PI 494955 | Chivwale         | Zambia                      |
| 1389892 | PI 494956 | Kangulungu       | Zambia                      |
| 1389895 | PI 494959 | ZFA 3354         | Zambia                      |
| 1389896 | PI 494960 | ZFA 3362         | Zambia                      |
| 1389901 | PI 494965 | ZFA 3404         | Zambia                      |
| 1389932 | PI 494996 | ZFA 3666         | Zambia                      |
| 1393395 | PI 498459 | Brazil 2796      | Brazil                      |
| 1393405 | PI 498469 | Brazil 2819      | Brazil                      |
| 1393410 | PI 498474 | Brazil 3077      | Brazil                      |
| 1393555 | PI 498619 | Honduras 38      | Francisco Morazán, Honduras |
| 1393581 | PI 498645 | Queretaro 12     | Querétaro, Mexico           |
| 1393589 | PI 498653 | Nicaragua 116    | Nicaragua                   |
| 1393597 | PI 498661 | Panama 173       | Panama                      |
| 1393598 | PI 498662 | Panama Group 78A | Panama                      |

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| 1393603 | PI 498667 | Paraguay 108                                | Guairá, Paraguay       |
| 1393605 | PI 498669 | Paraguay 168                                | Misiones, Paraguay     |
| 1396122 | PI 501186 | ZM-1874                                     | Zambia                 |
| 1396125 | PI 501189 | ZM-1930                                     | Zambia                 |
| 1396148 | PI 501212 | ZM-2200                                     | Zambia                 |
| 1396182 | PI 501246 | Punga                                       | Zambia                 |
| 1396193 | PI 501257 | Mataba                                      | Zambia                 |
| 1396195 | PI 501259 | ZM-3034                                     | Zambia                 |
| 1398364 | PI 503428 | KABA-Langan                                 | Guinea                 |
| 1398366 | PI 503430 | KABA-Sagata                                 | Guinea                 |
| 1398372 | PI 503436 | KABA-Sata                                   | Guinea                 |
| 1398618 | PI 503682 | Cuzco 364                                   | Cusco, Peru            |
| 1398624 | PI 503688 | Cuzco 372                                   | Cusco, Peru            |
| 1398656 | PI 503720 | Lambayeque 29                               | Lambayeque, Peru       |
| 1398663 | PI 503727 | Lambayeque 40                               | Lambayeque, Peru       |
| 1398664 | PI 503728 | Lambayeque 42                               | Lambayeque, Peru       |
| 1398668 | PI 503732 | Lambayeque 46                               | Lambayeque, Peru       |
| 1398742 | PI 503806 | Piura 144                                   | Piura, Peru            |
| 1398746 | PI 503810 | Piura 148                                   | Piura, Peru            |
| 1398780 | PI 503844 | Piura 196                                   | Piura, Peru            |
| 1398785 | PI 503849 | Piura 208                                   | Piura, Peru            |
| 1398858 | PI 503922 | Brazil 2953                                 | Alagoas, Brazil        |
| 1398919 | PI 503983 | Brazil 3039                                 | Ceará, Brazil          |
| 1398937 | PI 504001 | Brazil 3159                                 | Brazil                 |
| 1399011 | PI 504075 | Guatemala 179                               | Guatemala              |
| 1399028 | PI 504092 | Guatemala 679                               | Guatemala              |
| 1399041 | PI 504105 | Guatemala 81                                | Guatemala              |
| 1399047 | PI 504111 | Guatemala Group 2-4A                        | Guatemala              |
| 1399072 | PI 504136 | Nicaragua Group 73A                         | Nicaragua              |
| 1399232 | PI 504296 | Lambayeque 154                              | Lambayeque, Peru       |
| 1400437 | PI 505501 | Kamanda                                     | Sahel, Burkina Faso    |
| 1400442 | PI 505506 | Mendnde                                     | Burkina Faso           |
| 1400456 | PI 505520 | Akokone                                     | Burkina Faso           |
| 1400689 | PI 505753 | ZM/A 5074                                   | Zambia                 |
| 1400699 | PI 505763 | ZM/A 5134                                   | Zambia                 |
| 1400704 | PI 505768 | ZM/A 5167                                   | Zambia                 |
| 1400705 | PI 505769 | ZM/A 5168                                   | Zambia                 |
| 1400708 | PI 505772 | ZM/A 5171                                   | Zambia                 |
| 1400710 | PI 505774 | Emivuale                                    | Zambia                 |
| 1400718 | PI 505782 | ZM/A 5200                                   | Zambia                 |
| 1400732 | PI 505796 | ZM/A 5265                                   | Zambia                 |
| 1401075 | PI 506139 | Kpabd'djak                                  | Togo                   |
| 1401082 | PI 506146 | Kalbontdjanioug                             | Togo                   |
| 1401099 | PI 506163 | Adjipoe                                     | Togo                   |
| 1403206 | PI 508270 | Arizona Maize Germplasm<br>for Saline Env's | Arizona, United States |
| 1406355 | PI 511419 | Brazil 1108-AF                              | Brazil                 |

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| 1406367 | PI 511431 | Brazil 1120-AF                 | Brazil                                  |
| 1406392 | PI 511456 | Brazil 1144-AF                 | Brazil                                  |
| 1406402 | PI 511466 | Brazil 1154-AF                 | Brazil                                  |
| 1406434 | PI 511498 | Brazil 1185-AF                 | Brazil                                  |
| 1406450 | PI 511514 | Brazil 1199-AF                 | Brazil                                  |
| 1406456 | PI 511520 | Brazil 1279                    | Rio Grande do Sul, Brazil               |
| 1406547 | PI 511611 | Nicaragua 108                  | Jinotega, Nicaragua                     |
| 1406575 | PI 511639 | Uruguay 685A                   | Tacuarembó, Uruguay                     |
| 1406605 | PI 511669 | Veracruz Group 48              | Veracruz de Ignacio de la Llave, Mexico |
| 1409762 | PI 514826 | Ancash 439                     | Ancash, Peru                            |
| 1409902 | PI 514966 | Libertad 39                    | La Libertad, Peru                       |
| 1410027 | PI 515091 | San Martín 114                 | San Martín, Peru                        |
| 1410030 | PI 515094 | San Martín 123                 | San Martín, Peru                        |
| 1410079 | PI 515143 | Aguascalientes 31              | Aguascalientes, Mexico                  |
| 1410303 | PI 515367 | Nayarit 215                    | Nayarit, Mexico                         |
| 1410306 | PI 515370 | Nayarit 223                    | Nayarit, Mexico                         |
| 1410467 | PI 515531 | Veracruz 51                    | Veracruz de Ignacio de la Llave, Mexico |
| 1415562 | PI 520626 | 27                             | Burkina Faso                            |
| 1415567 | PI 520631 | 42                             | Burkina Faso                            |
| 1415614 | PI 520678 | 244                            | Burkina Faso                            |
| 1415627 | PI 520691 | 439                            | Burkina Faso                            |
| 1426405 | PI 531469 | NAGYBAJOMI NARANCS<br>FILLERES | Hungary                                 |
| 1426411 | PI 531475 | SZEKKUTASI<br>ARANYBANYAI      | Hungary                                 |
| 1426412 | PI 531476 | TIMARI VOROS LOFOGU            | Hungary                                 |
| 1426428 | PI 531492 | SZOREGI 100 NAPOS              | Hungary                                 |
| 1427246 | PI 532310 | 7114                           | Oman                                    |
| 1427248 | PI 532312 | 7132                           | Oman                                    |
| 1427249 | PI 532313 | 7196                           | Oman                                    |
| 1427258 | PI 532322 | 7429                           | Oman                                    |
| 1427265 | PI 532329 | 7451                           | Oman                                    |
| 1427692 | PI 532756 | Masangu                        | Democratic Republic of the Congo        |
| 1427717 | PI 532781 | Masa (Masangu)                 | Democratic Republic of the Congo        |
| 1433275 | PI 538339 | Khumultar                      | Yemen                                   |
| 1437623 | PI 542687 | Kabl                           | Algeria                                 |
| 1437624 | PI 542688 | Kabl                           | Algeria                                 |
| 1437625 | PI 542689 | Kabl                           | Algeria                                 |
| 1444150 | PI 549214 | TCD 152                        | Chad                                    |
| 1445381 | PI 550445 | BSSSS                          | Iowa, United States                     |
| 1448034 | PI 553062 | 'OC9'                          | Iowa, United States                     |
| 1457091 | PI 562119 | GMN 149                        | Burundi                                 |
| 1457095 | PI 562123 | GMN 177                        | Burundi                                 |

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| 1457109 | PI 562137 | GMN 283          | Burundi            |
| 1457113 | PI 562141 | GMN 313          | Burundi            |
| 1466394 | PI 571423 | Apurímac 154     | Apurímac, Peru     |
| 1466398 | PI 571427 | Arequipa 204     | Arequipa, Peru     |
| 1466411 | PI 571440 | Lima 68          | Lima, Peru         |
| 1466437 | PI 571466 | Tacna 33         | Tacna, Peru        |
| 1466505 | PI 571534 | Lambayeque 129   | Lambayeque, Peru   |
| 1466548 | PI 571577 | Apurímac 56      | Apurímac, Peru     |
| 1466575 | PI 571604 | Apurímac 234     | Apurímac, Peru     |
| 1466580 | PI 571609 | Apurímac 259     | Apurímac, Peru     |
| 1466675 | PI 571704 | San Martín 35    | San Martín, Peru   |
| 1466725 | PI 571754 | Cuzco 76         | Cusco, Peru        |
| 1466735 | PI 571764 | Cuzco 348        | Cusco, Peru        |
| 1466736 | PI 571765 | Cuzco 355        | Cusco, Peru        |
| 1466742 | PI 571771 | Huancavelica 88  | Huancavelica, Peru |
| 1466743 | PI 571772 | Huancavelica 95  | Huancavelica, Peru |
| 1466755 | PI 571784 | Huancavelica 132 | Huancavelica, Peru |
| 1466767 | PI 571796 | Junín 8          | Junín, Peru        |
| 1466775 | PI 571804 | Junín 105        | Junín, Peru        |
| 1466777 | PI 571806 | Junín 176        | Junín, Peru        |
| 1466778 | PI 571807 | Puno 23          | Puno, Peru         |
| 1466783 | PI 571812 | Puno 34          | Puno, Peru         |
| 1466785 | PI 571814 | Lambayeque 13    | Lambayeque, Peru   |
| 1466842 | PI 571871 | Apurímac 40      | Apurímac, Peru     |
| 1466848 | PI 571877 | Apurímac 114     | Apurímac, Peru     |
| 1466854 | PI 571883 | Apurímac 164     | Apurímac, Peru     |
| 1466859 | PI 571888 | Arequipa 156     | Arequipa, Peru     |
| 1466862 | PI 571891 | Arequipa 170     | Arequipa, Peru     |
| 1466868 | PI 571897 | Cajamarca 195    | Cajamarca, Peru    |
| 1466907 | PI 571936 | San Martín 27    | San Martín, Peru   |
| 1466916 | PI 571945 | San Martín 108   | San Martín, Peru   |
| 1466933 | PI 571962 | Ancash 188       | Ancash, Peru       |
| 1466943 | PI 571972 | Ancash 379       | Ancash, Peru       |
| 1466946 | PI 571975 | Cajamarca 101    | Cajamarca, Peru    |
| 1466947 | PI 571976 | Cajamarca 106    | Cajamarca, Peru    |
| 1466996 | PI 572025 | Ancash 497       | Ancash, Peru       |
| 1466998 | PI 572027 | Ancash 528       | Ancash, Peru       |
| 1467000 | PI 572029 | Apurímac 29      | Apurímac, Peru     |
| 1467004 | PI 572033 | Apurímac 252     | Apurímac, Peru     |
| 1467006 | PI 572035 | Apurímac 283     | Apurímac, Peru     |
| 1467008 | PI 572037 | Arequipa 76      | Arequipa, Peru     |
| 1467010 | PI 572039 | Arequipa 126     | Arequipa, Peru     |
| 1467015 | PI 572044 | Ayacucho 132     | Ayacucho, Peru     |
| 1467016 | PI 572045 | Ayacucho 135     | Ayacucho, Peru     |
| 1467019 | PI 572048 | Cuzco 20         | Cusco, Peru        |
| 1467020 | PI 572049 | Cuzco 43         | Cusco, Peru        |
| 1467021 | PI 572050 | Cuzco 46         | Cusco, Peru        |

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| 1467022 | PI 572051 | Cuzco 50                | Cusco, Peru                   |
| 1467030 | PI 572059 | Cuzco 382               | Cusco, Peru                   |
| 1467031 | PI 572060 | Huancavelica 87         | Huancavelica, Peru            |
| 1467032 | PI 572061 | Huancavelica 91         | Huancavelica, Peru            |
| 1467037 | PI 572066 | Junin 45                | Junín, Peru                   |
| 1467042 | PI 572071 | Junin 128               | Junín, Peru                   |
| 1467044 | PI 572073 | Puno 6                  | Puno, Peru                    |
| 1467060 | PI 572089 | Apurimac 94             | Apurímac, Peru                |
| 1467063 | PI 572092 | Apurimac 121            | Apurímac, Peru                |
| 1467064 | PI 572093 | Apurimac 132            | Apurímac, Peru                |
| 1467068 | PI 572097 | Apurimac 158            | Apurímac, Peru                |
| 1467069 | PI 572098 | Apurimac 181            | Apurímac, Peru                |
| 1467070 | PI 572099 | Apurimac 182            | Apurímac, Peru                |
| 1467074 | PI 572103 | Apurimac 217            | Apurímac, Peru                |
| 1467077 | PI 572106 | Apurimac 228            | Apurímac, Peru                |
| 1467080 | PI 572109 | Apurimac 248            | Apurímac, Peru                |
| 1467082 | PI 572111 | Apurimac 250            | Apurímac, Peru                |
| 1467086 | PI 572115 | Apurimac 294            | Apurímac, Peru                |
| 1467094 | PI 572123 | Arequipa 174            | Arequipa, Peru                |
| 1467117 | PI 572146 | Junin 195               | Junín, Peru                   |
| 1467128 | PI 572157 | Ancash 366              | Ancash, Peru                  |
| 1467136 | PI 572165 | Arequipa 192            | Arequipa, Peru                |
| 1467138 | PI 572167 | Cajamarca 20            | Cajamarca, Peru               |
| 1467148 | PI 572177 | Huanuco 127             | Huánuco, Peru                 |
| 1467172 | PI 572201 | Piura 149               | Piura, Peru                   |
| 1483754 | PI 585230 | 'LASER'                 | Michigan, United States       |
| 1484191 | PI 586705 | CHZM 08 129             | Biobío, Chile                 |
| 1511858 | PI 593016 | 'Hi35'                  | Hawaii, United States         |
| 1084084 | PI 596506 | 'OC19'                  | Iowa, United States           |
| 1539318 | PI 596543 | 'N-pH-P'                | Nebraska, United States       |
| 1117157 | PI 608458 | Newton Red              | North Carolina, United States |
| 1117229 | PI 608528 | Iredell Virus Resistant | North Carolina, United States |
| 1026688 | PI 608599 | Bloody Butcher          | Colorado, United States       |
| 1026711 | PI 608603 | Calico                  | Colorado, United States       |
| 1026718 | PI 608604 | Calico                  | Colorado, United States       |
| 1026773 | PI 608614 | Iowa Silvermine         | Colorado, United States       |
| 1026916 | PI 608639 | Yellow Dent             | Colorado, United States       |
| 1597792 | PI 613093 | CG-Coroico Flour        | Ontario, Canada               |
| 1602988 | PI 614735 | EPM6                    | Georgia, United States        |
| 1599396 | PI 619187 | 'Red'                   | Korea, South                  |
| 1042743 | PI 620813 | Guerrero 304            | Guerrero, Mexico              |
| 1061775 | PI 628419 | Guanajuato 17           | Guanajuato, Mexico            |
| 1061805 | PI 628428 | Guanajuato 181          | Guanajuato, Mexico            |
| 1061806 | PI 628429 | Guerrero 28             | Guerrero, Mexico              |
| 1073422 | PI 629155 | Durango 100             | Durango, Mexico               |
| 1073494 | PI 629174 | Guerrero 214            | Guerrero, Mexico              |
| 1073717 | PI 629231 | Nayarit 158             | Nayarit, Mexico               |

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| 1073748 | PI 629242 | Puebla 2                          | Puebla, Mexico                          |
| 1073783 | PI 629253 | San Luis Potosi 49                | San Luis Potosí, Mexico                 |
| 1082969 | PI 645775 | Guerrero 252                      | Guerrero, Mexico                        |
| 1083148 | PI 645919 | Morelos 147                       | Morelos, Mexico                         |
| 1083155 | PI 645925 | Nayarit 191                       | Nayarit, Mexico                         |
| 1083181 | PI 645941 | Oaxaca 197                        | Oaxaca, Mexico                          |
| 1083402 | PI 646061 | Veracruz 58                       | Veracruz de Ignacio de la Llave, Mexico |
| 1083520 | PI 646105 | Zacatecas 182                     | Zacatecas, Mexico                       |
| 1947542 | PI 685993 | 'BGEM-0015-S'                     | Iowa, United States                     |
| 1947554 | PI 686005 | 'BGEM-0156-S'                     | Iowa, United States                     |
| 1947556 | PI 686007 | 'BGEM-0164-S'                     | Iowa, United States                     |
| 1947560 | PI 686011 | 'BGEM-0188-S'                     | Iowa, United States                     |
| 1947561 | PI 686012 | 'BGEM-0196-N'                     | Iowa, United States                     |
| 1947566 | PI 686017 | 'BGEM-0247-N'                     | Iowa, United States                     |
| 1489936 | PI 686077 | Martinique 3                      | Martinique                              |
| 1715126 | PI 686079 | Martinique 9                      | Martinique                              |
| 1021743 | PI 690678 | King Phillip's Rhode Island Flint | Massachusetts, United States            |
| 1606109 | PI 694087 | CI 75                             | United States                           |
| 1522446 | PI 700787 | Suwan 1-SR                        | Nigeria                                 |
| 1066759 | PI 705065 | Argentine Pop                     | Indiana, United States                  |
| 1066788 | PI 705067 | Strawberry Pop                    | Indiana, United States                  |
| 1083635 | PI 705660 | BENZ 485                          | México, Mexico                          |
| 1083745 | PI 705676 | BENZ 682                          | Oaxaca, Mexico                          |

In certain embodiments, one or more pelargonidins selected from pelargonidin 3-glucoside, pelargonidin 3-(6''-malonylglucoside) and pelargonidin 3,5-dimalonylglucoside, and  
5 and/or the derivatives thereof are extracted from the same variety.

In certain embodiments, one or more pelargonidins selected from pelargonidin 3-glucoside, pelargonidin 3-(6''-malonylglucoside) and pelargonidin 3,5-dimalonylglucoside, and  
and/or the derivatives thereof and the at least one red anthocyanin are extracted from the  
same variety.

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In certain embodiments, one or more pelargonidins selected from pelargonidin 3-glucoside, pelargonidin 3-(6''-malonylglucoside) and pelargonidin 3,5-dimalonylglucoside, and  
and/or the derivatives thereof are extracted from different varieties of corns.

In certain embodiments, the one or more pelargonidins selected from pelargonidin 3-  
15 glucoside, pelargonidin 3-(6''-malonylglucoside) and pelargonidin 3,5-dimalonylglucoside, and

and/or the derivatives thereof and the at least one red anthocyanin are extracted from one variety of corn or from different varieties of corns.

5 In some embodiments, the one or more pelargonidins selected from pelargonidin 3-glucoside, pelargonidin 3-(6''-malonylglucoside) and pelargonidin 3,5-dimalonylglucoside, and and/or the derivatives thereof and the at least one red anthocyanin are extracted from different corn varieties and then mixed to obtain the inventive composition of the invention.

10 In certain embodiments, the coloring composition of the invention is a corn extract comprising one or more pelargonidins selected from pelargonidin 3-glucoside, pelargonidin 3-(6''-malonylglucoside) and pelargonidin 3,5-dimalonylglucoside, and/or the derivatives thereof and the at least one red anthocyanin.

15 In certain embodiments, the corn variety used to prepare the composition of the invention is selected so that it comprises one or more of pelargonidin 3-glucoside, pelargonidin 3-(6''-malonylglucoside), pelargonidin 3,5-dimalonylglucoside, pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and red anthocyanin. In a preferred embodiment, the corn variety used to prepare the composition of the invention is selected so that ideally contains quantities of pelargonidin and red anthocyanin so that after extraction it provides the concentrations of  
20 the composition of the invention.

In certain embodiments, the corn used to produce the coloring composition of the invention has a ratio of the at least one pelargonidin to the red anthocyanin from about 10:90, about 20:80, about 30:70, or about 40:60.

25 In certain embodiments, the corn used to produce the coloring composition of the invention has ratio of the at least one pelargonidin to the red anthocyanin from about 90:10, about 80:20, about 70:30, or about 60:40.

In certain embodiments, the corn used to produce the coloring composition of the invention comprise red anthocyanin that is selected from the group consisting of peonidin-3-glucoside, cyanidin 3-glucoside, and combinations thereof.

30

In certain embodiments, the corn used to produce the coloring composition of the invention comprise from about 10 weight percent to about 70 weight percent pelargonidin 3-

glucoside and from about 10 weight percent to about 70 weight percent pelargonidin 3-(6"-malonylglucoside) based on the total weight of the total anthocyanin content.

5 In certain embodiments, the corn used to produce the coloring composition of the invention comprises from about 20 weight percent to about 60 weight percent pelargonidin 3-glucoside and from about 20 weight percent to about 60 weight percent pelargonidin 3-(6"-malonylglucoside) based on the total weight of the total anthocyanin content.

10 In certain embodiments, the corn used to produce the coloring composition of the invention from about 30 weight percent to about 45 weight percent pelargonidin 3-glucoside and from about 30 weight percent to about 45 weight percent pelargonidin 3-(6"-malonylglucoside) based on the total weight of the total anthocyanin content.

15 In certain embodiments, the corn used to produce the coloring composition of the invention comprises from about 0.5 weight percent to about 30 weight percent cyanidin 3-glucoside and from about 0.5 weight percent to about 30 weight percent peonidin-3-glucoside based on the total weight of the total anthocyanin content.

20 In certain embodiments, the corn used to produce the coloring composition of the invention comprises from about 0.5 weight percent to about 20 weight percent cyanidin 3-glucoside and from about 0.5 weight percent to about 20 weight percent peonidin-3-glucoside based on the total weight of the total anthocyanin content.

25 In certain embodiments, the corn used to produce the coloring composition of the invention comprises from about 0.5 weight percent to about 15 weight percent cyanidin 3-glucoside and from about 0.5 weight percent to about 15 weight percent peonidin-3-glucoside based on the total weight of the total anthocyanin content.

30 In certain embodiments, the corn used to produce the coloring composition of the invention comprises about 10 weight percent cyanidin 3-glucoside, about 36 weight percent pelargonidin 3-glucoside, about 10 weight percent peonidin-3-glucoside, and about 36 weight

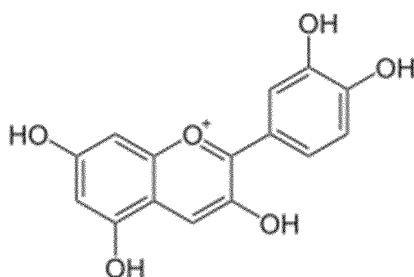
percent pelargonidin 3-(6"-malonylglucoside) based on the total weight of the total anthocyanin content.

In certain embodiments, the corn used to produce the coloring composition of the invention comprises about 1 to 50 weight percent pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) based on the total weight of the total anthocyanin content.

In certain embodiments, the coloring composition of the invention does not have unpleasant off notes.

In certain embodiments, the coloring composition of the invention does not comprise one or more of isothiocyanates, sulfides and nitrogen containing compounds or any volatile precursors, glucosinolates. In certain embodiments, the coloring composition of the invention is substantially free of one or more of isothiocyanates, sulfides and nitrogen containing compounds or any volatile precursors, glucosinolates

Cyanidin is a water-soluble anthocyanin represented by the following formula:



According to certain illustrative embodiments, the coloring composition is substantially free of cyanidin. According to certain illustrative embodiments, the coloring composition comprises less than 1 weight percent cyanidin, or less than 0.9 weight percent cyanidin, or less than 0.8 weight percent cyanidin, or less than 0.7 weight percent cyanidin, less than 0.6 weight percent cyanidin, or less than 0.5 weight percent cyanidin, or less than 0.4 weight percent cyanidin, or less than 0.3 weight percent cyanidin, or less than 0.2 weight percent cyanidin, or less than 0.1 weight percent cyanidin, based on total weight of the coloring composition. According to other illustrative embodiments, the coloring composition is free of cyanidin. Further disclosed is a method of making an orange coloring composition that contains no or substantially no cyanidin.

In certain embodiments of the composition of the invention, the coloring composition has an L\* value of about 46 to about 69; an a\* value of about 44 to about 61; and a b\* value of about 41 to about 75, wherein L\*, a\* and b\* values represent CIELAB L\*a\*b\* chromaticity coordinates at pH 3 at concentrations ranging from 0.05-0.2% of extract.

In certain embodiments of the composition of the invention, the coloring composition has an L\* value of about 46 to about 66; an a\* value of about 51 to about 61; and a b\* value of about 45 to about 75, wherein L\*, a\* and b\* values represent CIELAB L\*a\*b\* chromaticity coordinates at pH 3 at concentrations ranging from 0.05-0.2% of extract.

According to other illustrative embodiments, the coloring composition has an L\* value of about 51 to about 61; an a\* value of about 54 to about 58; and a b\* value of about 47 to about 60 at pH 3 at concentrations ranging from 0.05-0.2% of extract.

According to other illustrative embodiments, the coloring composition has an L\* value of about 60; an a\* value of about 56; and a b\* value of about 50 at pH 3 at concentration ranging from 0.05-0.2% of extract.

The term “dE2000” indicates that the standard CIE dE2000 formula, published by the CIELAB®, has been calculated to provide a dE2000 value, which measures the color difference between two colors. The larger the dE2000 value, the larger the color difference. A dE2000 of 1.5 to 3 is generally considered to be at the limit of visual perception.

According to any of the disclosed illustrative embodiments, the coloring composition is stable after exposure to light irradiation of 500 kJ/m<sup>2</sup> exhibiting a dE2000 of 0.87 from an initial reference color. This dE2000 value cannot be detected by the human eye and corresponds to a coloring composition that is very stable to light irradiation.

According to any of the disclosed illustrative embodiments, the coloring composition is stable after storage for 1 week at 43°C exhibiting a dE2000 of 1.62 from an initial reference

color. This dE2000 value cannot be detected by the human eye and corresponds to a coloring composition that is very stable to heat over an extended period of time.

5 According to any of the disclosed illustrative embodiments, the coloring composition is stable after storage for 2 weeks at 43°C exhibiting a dE2000 of 3.23 from an initial reference color. This small color deviation corresponds to a coloring composition that is very stable to heat over an extended period of time.

10 According to any of the disclosed illustrative embodiments, the coloring composition is stable after storage for 3 weeks at 43°C exhibiting a dE2000 of 3.33 from an initial reference color. This small color deviation corresponds to a coloring composition that is very stable to heat over an extended period of time. It was also surprising to find that the color stability of a beverage containing the disclosed coloring composition stabilizes over time, as the dE2000 of 3.23 after storage for 2 weeks at 43°C only exhibited an insignificant increase to 3.33 after  
15 storage for 3 weeks at 43°C.

According to any of the disclosed illustrative embodiments, the color strength of the coloring composition has a range of  $E1\% = 1$  up to 150, when measured at 500+/-3 nm.

20 In certain embodiments, color unit or E1% data for the liquid coloring composition includes E1% of 4.5 to 5.5 or color units of 450 to 550. In certain embodiments, color unit or E1% data for the powder coloring composition includes E1% of 17 to 25 or color units of 1700 to 2500.

25 According to any of the disclosed illustrative embodiments, the coloring composition of the invention may be formulated together with other pigments, being a second colorant composition or colorant formulation of the invention.

In certain embodiments, the further pigments may be of natural or synthetic origin.

30 In a preferred embodiment, the further pigments are of natural origin and are selected but are not limited to one or more of anthocyanin pigments that are not from corn.

Anthocyanin pigments may be present as an extract obtained or obtainable from a plant from the Brassicaceae, the Rosaceae, the Solanaceae, the Convolvulaceae, the Apiaceae family, the Poaceae family, Hylocereus, the Opuntia or mixtures thereof. The term mixture refers to a mixture obtained or obtainable either when the plant, or the part of the plant  
5 containing the anthocyanins, from the Brassicaceae, the Rosaceae, the Solanaceae, the Poaceae and/or the Apiaceae family are extracted together using a single solvent or when the plant or the part of the plant containing the anthocyanins, from the Brassicaceae, the Rosaceae, the Solanaceae, and/or the Apiaceae family are extracted independently and the resulting extracts combined. The plant of the Brassicaceae family may be *Raphanus sativus* L.  
10 (red radish). The plant of the Rosaceae family may be the *Fragaria* (strawberry). The plant of the Solanaceae family may be the *Solanum tuberosum* (red potato). The plant of the Convolvulaceae family may be *Ipomoea batatas* (purple sweet potato root). The plant of the Apiaceae family may be *Daucus carota* ssp. *sativus* var. *atrorubens* Alef. (black carrot). Anthocyanins from Grape, Berries and hibiscus can also be used in the present invention.

15

Red radishes (*Raphanus sativus* L.) and red-fleshed potatoes (*Solanum tuberosum* L.) provide colour characteristics similar to FD&C Red #40. According to some embodiments, the anthocyanin is a red radish derived colour.

20 The major pigments of red radish and red-fleshed potatoes have been identified as pelargonidin-3-sophoroside-5-glucoside acylated with malonic acid and either p-coumaric and/or ferulic acids and pelargonidin-3-rutinoside-5-glucoside acylated with p-coumaric acid, respectively (Rodríguez-Saona, L.E. et al, J. Food Sci. 1999, 64, 451-456, the disclosure of which is herein incorporated by reference). According to certain embodiments, the anthocyanins  
25 used in the colourant composition may further comprise pelargonidin-3-sophoroside-5-glucoside acylated with malonic acid and either p-coumaric and/or ferulic acids, and/or pelargonidin-3-rutinoside-5-glucoside acylated with p-coumaric acid.

According to certain illustrative embodiments of the second colorant composition of  
30 the invention, the anthocyanin is a black carrot derived colour.

Cyanidin 3-xylosyl(glucosyl)galactosides acylated with sinapic acid, ferulic acid, and coumaric acid were identified as the major anthocyanins in black carrot (Cuevas Montilla, E., et al, J. Agric. Food Chem. 2011, 59, 3385–3390, the disclosure of which is herein incorporated by reference). According to certain embodiments, the anthocyanins used in the colourant composition comprises cyanidin 3-xylosyl(glucosyl)galactosides acylated with sinapic acid, 5 ferulic acid, and coumaric acid.

In particular embodiments of the present invention the second colourant composition may comprise betalain pigments.

10

Betalains are a class of red and yellow tyrosine-derived pigments found in plants of the order Caryophyllales. There are two categories of betalains: the first is the betacyanins, which appear reddish to violet in colour, and examples of which include betanin, isobetanin, probetanin, and neobetanin; and the second is the betaxanthins, which appear yellow to 15 orange, and examples of which include vulgaxanthin, miraxanthin, portulaxanthin, and indicaxanthin.

In certain embodiments of the invention the second colour composition may comprise at least 0.001% of a Betalain pigment. In certain embodiments of the invention the colour composition may comprise from 0.001% w/w to 95% w/w of a Betalain pigment, such as from 20 about 0.01% w/w to about 80% w/w, such as from 0.01%w/w, 0.02 %w/w, 0.03%w/w, 0.04 %w/w, 0.05 %w/w, 0.06 %w/w, 0.07 %w/w, 0.08 %w/w, 0.09 %w/w, 0.1 %w/w, 0.2 %w/w, 0.3 %w/w, 0.4 %w/w, 0.5 %w/w, 0.6 %w/w, 0.7 %w/w, 0.8 %w/w, 0.9 %w/w, 1%w/w, 2%w/w, 3 %w/w, 4 %w/w, 5 %w/w, 6 %w/w, 7 %w/w, 8 %w/w, 9 %w/w, 10 %w/w to 95%, 90%, 80%, 70%, 60%, 50%, 40%, 30%, 20%, 15%w/w of a Betalain pigment. In certain embodiments, one 25 or more betalain pigments are used. In certain embodiments, the colour composition may comprise from 0.01% w/w to 5% w/w of a betalain pigment.

Betalains particularly useful in the present invention include betacyanins, such as betanin, isobetanin, probetanin, and neobetanin; and/or betaxanthins, such as vulgaxanthin, 30 miraxanthin, portulaxanthin, and indicaxanthin.

Betalains are glycosides of a betanidin aglycone, the core structure of which is betalamic acid (i.e. 4-(2-oxoethylidene)-1,2,3,4-tetrahydropyridine-2,6-dicarboxylic acid).

Betanin is usually obtained from the extract of the juice of *Beta vulgaris* (e.g. red beets, such as beetroot).

According to particular embodiments of the invention, betalains may be present as extracts obtained or obtainable from a plant from the *Amaranthaceae* family. Optionally, the plant from the *Amaranthaceae* family may be *Beta vulgaris* (beet). According to particular  
5       embodiments of the inventions, betalains may be present as extracts obtained or obtainable from a plant from the *Hylocereus* family. Optionally, the plant from the *Hylocereus* family may be Dragon fruit. According to particular embodiments of the inventions, betalains may be present as extracts obtained or obtainable from a plant from the *Opuntia* family. Optionally,  
10       the plant from the *Opuntia* family may be cactus pear.

In one embodiment, the betalain is a beetroot derived colour. Optionally, the betalain used in the present invention may be betanin.

15       In particular embodiments of the present invention the second colourant composition may comprise santalin pigments and/or santalin complexed with metal.

Other colourants providing blue or green colours may also be used, including but not limited to phycocyanin, butterfly pea anthocyanin, chlorophyll.

20       Other colourants providing brown colours and other shades may also be used including but not limited to caramels, caramelized fruit and vegetables juices, burnt sugars, caramel colors, carotenoids, malt, sorghum, fruit juice extracts, iron oxide colors, santalin, santalin complexed with metal etc.

In certain embodiments of the invention the second colour composition may comprise  
25       at least 0.001% of a phycocyanin, butterfly pea anthocyanin and /or chlorophyll pigment. In certain embodiments of the invention the colour composition may comprise from 0.001% w/w to 95% w/w of a phycocyanin, butterfly pea anthocyanin and /or chlorophyll pigment, such as from about 0.01% w/w to about 80% w/w, such as from 0.01%w/w, 0.02 %w/w, 0.03%w/w, 0.04 %w/w, 0.05 %w/w, 0.06 %w/w, 0.07 %w/w, 0.08 %w/w, 0.09 %w/w. 0.1  
30       %w/w, 0.2 %w/w, 0.3 %w/w, 0.4 %w/w, 0.5 %w/w, 0.6 %w/w, 0.7 %w/w, 0.8 %w/w, 0.9 %w/w, 1%w/w, 2%w/w, 3 %w/w, 4 %w/w, 5 %w/w, 6 %w/w, 7 %w/w, 8 %w/w, 9 %w/w, 10 %w/w to 95%, 90%, 80%, 70%, 60%, 50%, 40%, 30%, 20%, 15%w/w of a phycocyanin, butterfly

pea anthocyanin and /or chlorophyll pigment. In certain embodiments, the colour composition may comprise from 0.01% w/w to 5% w/w of a phycocyanin, butterfly pea anthocyanin and /or chlorophyll pigment.

In certain embodiments of the invention the second colour composition may comprise at least 0.001% of a malt and /or caramel color. In certain embodiments of the invention the colour composition may comprise from 0.001% w/w to 95% w/w of malt and /or caramel color, such as from about 0.01% w/w to about 80% w/w, such as from 0.01%w/w, 0.02 %w/w, 0.03%w/w, 0.04 %w/w, 0.05 %w/w, 0.06 %w/w, 0.07 %w/w, 0.08 %w/w, 0.09 %w/w, 0.1 %w/w, 0.2 %w/w, 0.3 %w/w, 0.4 %w/w, 0.5 %w/w, 0.6 %w/w, 0.7 %w/w, 0.8 %w/w, 0.9 %w/w, 1%w/w, 2%w/w, 3 %w/w, 4 %w/w, 5 %w/w, 6 %w/w, 7 %w/w, 8 %w/w, 9 %w/w, 10 %w/w to 95%, 90%, 80%, 70%, 60%, 50%, 40%, 30%, 20%, 15%w/w of a malt and /or caramel color. In certain embodiments, the colour composition may comprise from 0.01% w/w to 5% w/w of a malt and /or caramel color.

In certain embodiments of the invention the second colour composition may comprise a first composition of the invention and a black carrot extract. In certain embodiments, the second composition of the invention comprises between 1% w/w and 3% w/w, such as 2.7 % Afzelechin Pel-3,5 Di-Glu, between 20 % w/w and 40 % w/w, such as 30% w/w Cyd-3-Xyl-Gal, between 0.1 and 5 % w/w, such as 3%w/w Cyd-3-Glu, between 2% w/w and 8 % w/w, such as 6.5 % Cyd-3-DiGlu, between 15 %w/w and 45%w/w such as 33 %w/w Cyd-3-Xyl-Sinapoyl-Glu-Gal, between 5.5%w/w and 7,5% w/w such as 6.5 %w/w Pel-3-glu, between X %w/w and %w/w such as X % w/w Cyd-3-Xyl-Feruloyl-Glu-Gal, between 1.5%w/w and 2.5 %w/w such as 2.1% w/w Cyd-3-3 Malo-Glu, between 4.7 %w/w and 5.7 %w/w such as 5.7% w/w Pel-3-6-Malo-Glu. (Pel = pelargonidin, Cyd= cyaniding, Glu = glucoside, Xyl = xylosyl, Gal = galactosidase)

In certain embodiments, the second composition of the invention has a Lab value as follows:

|        | Dosage of blend | L*(D65) | a*(D65) | b*(D65) | C*(D65) | h(D65) |
|--------|-----------------|---------|---------|---------|---------|--------|
| PH=3   | 0.06            | 95.7    | 10.74   | 3.26    | 11.22   | 16.89  |
|        | 0.12            | 88.37   | 22.58   | 6.48    | 23.49   | 16.01  |
|        | 0.24            | 75.99   | 40.16   | 14.21   | 42.6    | 19.48  |
| PH=3.5 | 0.06            | 97.62   | 5.54    | 4.06    | 6.87    | 36.24  |
|        | 0.12            | 93.39   | 10.62   | 7.05    | 12.75   | 33.58  |

|        |      |       |       |       |       |       |
|--------|------|-------|-------|-------|-------|-------|
|        | 0.24 | 82.56 | 24.24 | 13.66 | 27.82 | 29.4  |
|        | 0.06 | 98.83 | 3.25  | 4.13  | 5.26  | 51.81 |
|        | 0.12 | 95.8  | 5.85  | 7.9   | 9.83  | 53.46 |
| PH=3.8 | 0.24 | 84.06 | 20.51 | 14.14 | 24.91 | 34.57 |

Further provided is a consumable composition comprising a consumable base and a coloring composition as described herein (first or second composition of the invention).

5

Further provided is a consumable composition comprising a consumable base and a coloring composition comprising one or more pelargonidins selected from pelargonidin 3-glucoside, pelargonidin 3-(6''-malonylglucoside) and pelargonidin 3,5-dimalonylglucoside, and at least one red anthocyanin of any of the illustrative embodiments disclosed herein.

10

Further provided is a consumable composition comprising a consumable base and the coloring composition according to the invention comprising a pelargonidin selected from pelargonidin 3-glucoside and pelargonidin 3-(6''-malonylglucoside) and at least one red anthocyanin of any of the illustrative embodiments disclosed herein. In certain embodiments, the coloring composition further comprises pelargonidin 3,5-dimalonylglucoside.

15

The consumable composition may be selected from foods, beverages, nutraceutical products, cosmetic products, consumer products and perfumes.

According to certain illustrative embodiments, the consumable composition comprises a beverage composition comprising a beverage base. The beverage comprises the beverage base and the coloring composition comprising one or more pelargonidins selected from pelargonidin 3-glucoside, pelargonidin 3-(6''-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and pelargonidin 3,5-dimalonylglucoside, and at least one red anthocyanin of any of the illustrative embodiments disclosed herein.

25

In certain embodiments, the beverage comprises the beverage base and the coloring composition of the invention comprising a pelargonidin selected from pelargonidin 3-glucoside and pelargonidin 3-(6''-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-

3,6-DiMalo-Glu) and at least one red anthocyanin of any of the illustrative embodiments disclosed herein.

According to certain embodiments, the beverage comprises a carbonated beverage, such as a carbonated soft drink, and the coloring composition of any of the illustrative  
5       embodiments disclosed herein.

The “beverage base” as used herein means a combination of the normal ingredients used to prepare a beverage, apart from the disclosed coloring composition. These are  
10       standard ingredients used in art-recognized quantities, and include water, carbonated water, sugars, artificial/synthetic sweeteners, natural sweeteners, artificial/synthetic flavors, natural flavors, surfactants, and suspending agents, thickeners, rheology modifiers, dyes, coloring agents, stabilizers, and preservatives. The beverage base may comprise carbonated water, flavor, sweetener, and all other ingredients desired or necessary for a complete carbonated  
15       beverage, apart from the coloring composition.

According to certain illustrative embodiments, the consumable is an acidic beverage. According to certain illustrative embodiments, the consumable is a beverage having a pH of 4 or less, or 3.5 or less, or 3 or less, or in the range of about 2 to about 4.5, or in the range of  
20       about 2 to about 4, or in the range of about 2 to about 3.5, or in the range of about 2 to about 3, or in the range of about 2.2 to about 4.2, or in the range of about 2.5 to about 3.5. Any food grade acid can be used in order to reduce the pH of the beverage to the desired acidic condition. Examples of acids include hydrochloric acid, lactic acid, phosphoric acid, acetic acid, citric acid, malic acid, tartaric acid, oxalic acid, tannic acid, caffeic acid, benzoic acid, butyric  
25       acid, and combinations thereof. In general, the amount of acid required depends on the type of acid.

The beverage composition may include at least one flavor. Without limitation, and only by way of illustration, suitable flavors include, a tea flavorant, a coffee flavorant, a citrus  
30       flavorant (e.g. a lemon flavorant, a lime flavorant, an orange flavorant, a grapefruit flavorant, a mandarin orange flavorant, a tangerine flavorant, or a combination of any of the foregoing), an herbal flavorant, a berry flavoring (e.g., a flavorant derived from one or more of Barbados

cherry, bearberry, blackberry, blueberry, boysenberry, cherry, choke cherry, cloudberry, cranberry, current, date, dewberry, elderberry, grape, gooseberry, huckleberry, loganberry, olallieberry, mulberry, raisin, plains berry, prairie berry, raspberry, saskatoon berry, salmonberry, seabuckthorn berry, sloe berry, strawberry, thimbleberry, thornberry, wineberry, whortleberry, or a combination of any of the foregoing), a botanical flavorant (e.g. one or more flavors derived from a part of a plant other than the fruit, including flavors derived from essential oils and extracts of nuts, bark, roots and leaves along with synthetically prepared flavors made to simulate botanical flavors derived from natural sources), and mixtures thereof.

10

The beverages may comprise full sugar, reduced sugar, or zero sugar added carbonated beverages. The full sugar or reduced sugar beverages may include at least one nutritive sweetener. Without limitation, and only by way of illustration, suitable nutritive sweeteners include sucrose, fructose, glucose, high fructose corn syrup, corn syrup, xylose, arabinose, rhamnose, erythritol, xylitol, mannitol, sorbitol, isomaltulose, inositol, allulose, tagalose, trehalose, and combinations thereof.

15

Reduced sugar and zero sugar beverages of the present disclosure include at least one non-nutritive sweetener that either partially (reduced sugar beverages) or wholly (zero sugar beverages) replaces the nutritive sweetener in the carbonated beverage composition.

20

According to certain illustrative embodiments, the non-nutritive sweeteners that may be used in the reduced sugar and/or zero sugar beverages are selected from natural non-nutritive sweeteners, synthetic non-nutritive sweeteners, and combinations thereof.

25

Without limitation, and only by way of illustration, suitable synthetic non-nutritive sweeteners that may be included in the reduced sugar or zero sugar beverages may be selected from acesulfame K, advantame, aspartame, cyclamate, neotame, neohesperidin dihydrochalcone, saccharin, sucrolose and combinations thereof.

30

Without limitation, and only by way of illustration, suitable natural non-nutritive sweeteners include steviol glycosides selected from stevioside, rebaudioside A, rebaudioside B, rebaudioside C, rebaudioside D, rebaudioside E, rebaudioside F, rebaudioside G,

rebaudioside H, rebaudioside I, rebaudioside J, rebaudioside K, rebaudioside L, rebaudioside M, rebaudioside N, rebaudioside O, dulcoside A, dulcoside B, rubusoside, and combinations thereof, mogrol glycosides selected from mogroside I, mogroside II, mogroside III, mogroside IV, mogroside V, isomogroside V, 11-oxomogroside, siamenoside I and combinations thereof, 5 naringin dihydrochalcone, Luo Han Guo Extract, Swingle Extract, brazzein, cellobiose, glycyrrhizic acid, monatin, psicose, stevioside, thaumatin, trilobatin, and combinations thereof.

In certain embodiments, the beverage is a carbonated beverage. According to this 10 embodiment, carbon dioxide gas is dissolved in the water of the beverage base to provide a desired level of carbonation to create a carbonated beverage. Any of the methods and carbonating equipment known in the art for carbonating beverages may be used. According to certain illustrative embodiments, by way of example, and not in limitation, the beverage may have a carbon dioxide level in the range of about 0.5 to about 5 volumes of carbon 15 dioxide. According to other embodiments, the beverage may have a carbon dioxide level of up to about 1 volume of carbon dioxide, or up to about 2 volumes of carbon dioxide, or up to about 3 volumes of carbon dioxide, or up to about 4 volumes of carbon dioxide. As used herein, one volume of carbon dioxide refers to the amount of carbon dioxide absorbed by a given quantity of liquid, such as water, at 60°F and one atmospheric pressure. A volume of 20 gas occupies the same space as does the liquid by which it is dissolved. The carbon dioxide content can be selected by those skilled in the art based on the desired level of effervescence and the impact of the carbon dioxide on the taste or mouthfeel of the beverage.

According to other embodiments, a beverage concentrate is provided. The beverage 25 concentrate comprises a beverage concentrate base. The term “beverage concentrate base” as used herein means a combination of the normal ingredients used to prepare a carbonated beverage or non-carbonated beverage, apart from still water or carbonated water and the disclosed coloring composition. These are standard ingredients used in art-recognized quantities, and include sugars, artificial/synthetic sweeteners, natural sweeteners, 30 artificial/synthetic flavors, natural flavors, surfactants, and suspending agents, thickeners, rheology modifiers, dyes, coloring agents, stabilizers, and preservatives. The carbonated beverage concentrate base may comprise flavor, sweetener, and all other ingredients desired

or necessary for a complete carbonated beverage, apart from carbonated water and the disclosed coloring composition.

Further disclosed is a method of making a consumable composition comprising adding a coloring composition comprising one or more pelargonidin selected from pelargonidin 3-glucoside, pelargonidin 3-(6"-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and at least one red anthocyanin of any of the illustrative embodiments disclosed herein to a consumable base.

10 According to certain embodiments, further disclosed is a method for making a beverage by adding a coloring composition comprising one or more pelargonidin selected from pelargonidin 3-glucoside, pelargonidin 3-(6"-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and at least one red anthocyanin of any of the illustrative embodiments disclosed herein to a beverage base.

15 According to certain embodiments, further disclosed is a method for making a carbonated beverage by adding a coloring composition comprising one or more pelargonidin selected from pelargonidin 3-glucoside and pelargonidin 3-(6"-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and at least one red anthocyanin of any of the illustrative embodiments disclosed herein to a carbonated beverage base.

20 According to certain embodiments, the method for making a carbonated beverage composition comprises adding a coloring composition comprising one or more pelargonidin selected from pelargonidin 3-glucoside, pelargonidin 3-(6"-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and at least one red anthocyanin of any of the illustrative embodiments disclosed herein to a beverage base comprising carbonated water, at least one nutritive and/or non-nutritive sweetener, and at least one citrus flavorant to prepare a carbonated citrus beverage or carbonated citrus soft drink. The carbonated citrus beverage or soft drink may comprise a full sugar, reduced sugar, or zero sugar carbonated citrus beverage or soft drink.

The method of making the consumable, such as, for example, a beverage, comprises adding from about 100 ppm to about 50000 ppm, or from about 200 ppm to about 10000 ppm or from about 200 ppm to about 7500 ppm , or from about 200 ppm to about 4500 ppm, or from about 400 ppm to about 4000 ppm, or from about 600 to about 3500 ppm, or from about 700 ppm to about 3000 ppm, and from about 1000 ppm to about 2500 ppm, or any percentage ranges or specific percentages within these ranges, of the coloring composition of any of the illustrative embodiments disclosed herein to a beverage base.

According to certain embodiments, provided is the use of the coloring composition of any one of the illustrative embodiments disclosed herein to impart a color, in particular, an orange color, to a consumable, in particular, a beverage.

Further disclosed is a method of making a consumable composition comprising adding a coloring composition according to the invention (first or second composition of the invention)

Further disclosed is a method of making a consumable composition comprising adding a coloring composition comprising one or more pelargonidin selected from pelargonidin 3-glucoside, pelargonidin 3-(6''-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and at least one red anthocyanin of any of the illustrative embodiments disclosed herein to a consumable base.

According to certain embodiments, further disclosed is a method for making a snack by adding a coloring composition comprising one or more pelargonidin selected from pelargonidin 3-glucoside, pelargonidin 3-(6''-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and at least one red anthocyanin of any of the illustrative embodiments disclosed herein to a snack.

According to certain embodiments, further disclosed is a method for making a snack or a carbonate beverage by adding a coloring composition according to the invention (first or second composition of the invention) to a snack base or a carbonate base.

According to certain embodiments, further disclosed is a method for making a snack by adding a coloring composition comprising one or more pelargonidin selected from pelargonidin 3-glucoside, pelargonidin 3-(6"-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and at least one red anthocyanin of any of the illustrative embodiments disclosed  
5 herein to a snack base.

According to certain embodiments, the method for making a carbonated beverage composition comprises adding a coloring composition comprising a pelargonidin selected from pelargonidin 3-glucoside and pelargonidin 3-(6"-malonylglucoside) and at least one red  
10 anthocyanin of any of the illustrative embodiments disclosed herein to a carbonated beverage base, and optionally at least one nutritive and/or non-nutritive sweetener, and at least one flavorant to prepare a carbonated beverage or carbonated soft drink.

The method of making the consumable, such as, for example, a snack, comprises  
15 adding from about 1% to 10%, such as 1% to 5%, such as from 100 ppm to about 50000 ppm, or from about 200 ppm to about 10000 ppm or from about 200 ppm to about 7500 ppm , or from about 200 ppm to about 4500 ppm, or from about 400 ppm to about 4000 ppm, or from about 600 to about 3500 ppm, or from about 700 ppm to about 3000 ppm, and from about 1000 ppm to about 2500 ppm, or any percentage ranges or specific percentages within these  
20 ranges, of the coloring composition of any of the illustrative embodiments disclosed herein to the consumable base (such as a snack base or a beverage base).

According to certain embodiments, provided is the use of the coloring composition of any one of the illustrative embodiments disclosed herein to impart a color, in particular, an  
25 orange color, to a consumable, in particular, a snack.

According to certain embodiments, provided is the use of the coloring composition of any one of the illustrative embodiments disclosed herein to impart a color shade that is the same or substantially the same as the color shade imparted by Red 40 without off notes and that is stable to light, heat and acidic conditions.

30

Also disclosed is a method of coloring a beverage comprising: preparing a composition comprising one or more pelargonidins selected from pelargonidin 3-glucoside, pelargonidin 3-

(6"-malonylglucoside), pelargonidin-dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and pelargonidin 3,5-dimalonylglucoside and at least one red anthocyanin of any of the illustrative embodiments disclosed herein; and adding the composition to a beverage base in a concentration of about 10 ppm to about 50000 ppm, or from about 200 ppm to about 10000 ppm or from about 200 ppm to about 7500 ppm, or from about 200 ppm to about 4500 ppm, or from about 400 ppm to about 4000 ppm, or from about 600 to about 3500 ppm, or from about 700 ppm to about 3000 ppm, and from about 1000 ppm to about 2500 ppm, or any percentage ranges or specific percentages within these ranges.

Also disclosed is a method of coloring a beverage comprising: preparing a composition comprising a pelargonidin selected from pelargonidin 3-glucoside and pelargonidin 3-(6"-malonylglucoside) and at least one red anthocyanin of any of the illustrative embodiments disclosed herein; and adding the composition to a beverage base in a concentration of about 10 ppm to about 50000 ppm, or from about 200 ppm to about 10000 ppm or from about 200 ppm to about 7500 ppm, or from about 200 ppm to about 4500 ppm, or from about 400 ppm to about 4000 ppm, or from about 600 to about 3500 ppm, or from about 700 ppm to about 3000 ppm, and from about 1000 ppm to about 2500 ppm, or any percentage ranges or specific percentages within these ranges.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1A shows a red colored beverage comprising a comparative coloring composition containing cyanidin 3-glucoside, peonidin-3-glucoside, and cyanidin. Figure 1B shows an orange-red colored beverage containing a coloring composition according to the present invention.

Figure 2 shows an undetectable color/shade change of a beverage containing the inventive coloring composition without exposure to light irradiation (A) and a separate identical beverage containing the same coloring composition after exposure to extreme light irradiation of 500 kJ/m<sup>2</sup> (B).

Figure 3 shows essentially no color/shade change of a beverage containing the inventive coloring composition without exposure to heat (A), after storage for 1 week at 43°C (B), after storage for 2 weeks at 43°C (B), and after storage for 3 weeks at 43°C (C).

5           Figure 4 shows the evolution of dE2000 values under storage at 43°C of a beverage containing the inventive coloring composition.

Figure 5. Sensory profile of Inventive orange red (obtained from corn) compared to red radish.

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Figure 6. Sensory profile of blend with Inventive orange red (obtained from corn) compared to red radish.

15           Figure 7. Light stability of a blend of New Inventive orange red (obtained from corn) with black carrot.

Figure 8. Heat stability of a blend of New Inventive orange red (obtained from corn) with black carrot.

Figure 9. Evolution of color during storage of new inventive orange red (obtained from corn) with black carrot.

20

## EXAMPLES

25           The disclosure is further described with reference to the following non-limiting examples. The following examples are given solely for the purpose of illustration and are not to be construed as limitations of the present invention, as many variations of the invention are possible without departing from the spirit and scope of the present disclosure.

30

Example 1. Beverage base

Beverage Base – A beverage base was prepared by mixing the following components: 89.9% water, 10% sucrose, and about 0.040% of a preservative (e.g., potassium sorbate and sodium benzoate). The final pH of the beverage was fixed to 3 with citric acid.

Inventive 1a – A coloring composition according to the present disclosure was prepared comprising about 10 weight percent cyanidin 3-glucoside, about 36 weight percent pelargonidin 3-glucoside, about 10 weight percent peonidin-3-glucoside, and about 36 weight percent pelargonidin 3-(6''-malonylglucoside) by weight of the total anthocyanin content. All pigments were obtained from one corn variety.

Inventive 1b – A coloring composition according to the present disclosure was prepared comprising about 10 weight percent cyanidin 3-glucoside, about 36 weight percent pelargonidin 3-glucoside, about 10 weight percent peonidin-3-glucoside, and about 36 weight percent pelargonidin 3-(6''-malonylglucoside) by weight of the total anthocyanin content. All pigments are obtained from different corn varieties.

Inventive 1c – A coloring composition according to the present disclosure was prepared comprising about 1 weight percent cyanidin 3-glucoside, about 36 weight percent pelargonidin 3-glucoside, about 1.5 weight percent cyaniding 3-3-malonylglucoside, 4% Pel-3-3,6 DiMalo-Glu and about 57 weight percent pelargonidin 3-(6''-malonylglucoside) by weight of the total anthocyanin content. All pigments are obtained from one corn variety.

The coloring composition 1a, 1b and 1c have between 3 % and 4% of total anthocyanin by weight of the coloring composition.

All 3 inventive compositions give a similar color as inventive composition 1a (see figure 1B)

Comparative – A red coloring composition commercially available under the tradename AMAIZE® (Givaudan SA) was obtained. Using high-performance liquid chromatography-mass spectrometry (HPLC-MS), it was determined that the AMAIZE® coloring composition

comprises about 73 weight percent cyanidin 3-glucoside, about 11% peonidin-3-glucoside, and about 15% cyanidin by weight of the total anthocyanin content.

The concentration of the different pigments, such as pelargonidin and other anthocyanins, in the invention's composition, is measured using High-Performance Liquid Chromatography coupled with an Ultra-Violet detector (HPLC/UV 1260 series; from Agilent Technologies, Santa Clara, USA). Briefly, pigments were separated on Zorbax Extend C18 (250x4.6), 5.0 $\mu$ m column (Agilent Technologies) with an Acetonitrile/Methanol/water/Formic acid gradient as mobile phase at a flow rate of 1.0 mL/min, column temperature 30°C, and injection volume of 10 $\mu$ L. Quantification was done using Kuromanin (Cyanidin-3-O-Glucoside) and Callistefin (Pelargonidin-3-O-glucoside) for the calibration curve.

Samples were prepared as follows depending on the concentration of the powder (weigh adjustment may be done accordingly to fit with the calibration curve):

For Amaize (Comparative):

100mg of the extract was dissolved directly into 10 mL of water/formic acid (98:2 v/v). After 5 minutes in an Ultrasonic bath, the solution is filtrated through a 0.45 $\mu$ m RC filter and injected into the HPLC/UV system.

For Inventive coloring composition 1a, 1b or 1c::

200mg of the extract was dissolved directly into 10 mL of water/formic acid (98:2 v/v). After 5 minutes in an Ultrasonic bath, the solution is filtrated through a 0.45 $\mu$ m RC filter and injected into the HPLC/UV system.

The Inventive and Comparative coloring compositions were added to two separate identical beverage bases, as described above. The three coordinates L\*, a\* and b\* according to CIELAB scale were determined of the colored beverages. Therein, the "L" value gives information about the lightness of the color, the "a" value indicates the position on the red vs. green axis, and the "b" value indicates the position on the yellow vs. blue axis. As shown in Table 1, the beverage containing the inventive coloring composition has different CIELAB values, and therefore a different color/shade, as compared the beverage containing the comparative coloring composition. This difference in color/shade is also demonstrated in FIGS. 1A (comparative) and 1B (inventive) of the present disclosure.

Table 1

| Sample      | L*    | a*    | B*    |
|-------------|-------|-------|-------|
| Inventive   | 56.08 | 56.74 | 65.5  |
| Comparative | 46.66 | 63.31 | 46.42 |

5 Light Stability Test

A beverage base was prepared by mixing the following components: 89.9% water, 10% sucrose, and about 0.040% of a preservative (e.g., potassium sorbate and sodium benzoate). The final pH of the beverage was fixed to 3 with citric acid.

10

A coloring composition according to the present disclosure (Inventive composition 1a and 1b) was prepared comprising about 10 weight percent cyanidin 3-glucoside, about 36 weight percent pelargonidin 3-glucoside, about 10 weight percent peonidin-3-glucoside, and about 36 weight percent pelargonidin 3-(6"-malonylglucoside) by weight of the total anthocyanin content

15

The inventive coloring composition 1a was added to two separate identical beverage bases, resulting in Samples 1 and 2. Sample 1 was set as a reference and Sample 2 was exposed to extreme light irradiation 500 kJ/m2. Samples 1 and 2 were measured on a spectrophotometer (Konica Minolta) for evaluation of dE2000 parameters. The term "dE2000" indicates that the standard CIE dE2000 formula, published by the CIELAB®, has been calculated to provide a dE2000 value, which measures the color difference between two colors. The larger the dE2000 value, the larger the color difference. A dE2000 of 1.5 to 3 is generally considered to be at the limit of visual perception. Sample 2 exhibited a dE2000 value of 0.87. As demonstrated by FIGS. 2A and 2B of the present disclosure, this insignificant color change cannot be detected by the human eye and demonstrates that the disclosed coloring composition is very stable to light irradiation.

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Heat Stability Test

A beverage base was prepared by mixing the following components: 89.9% water, 10% sucrose, and about 0.040% of a preservative (e.g., potassium sorbate and sodium benzoate).

5 The final pH of the beverage was fixed to 3 with citric acid.

A coloring composition according to the present disclosure (Inventive composition 1a) was prepared comprising about 10 weight percent cyanidin 3-glucoside, about 36 weight percent pelargonidin 3-glucoside, about 10 weight percent peonidin-3-glucoside, and about  
10 36 weight percent pelargonidin 3-(6''-malonylglucoside) by weight of the total anthocyanin content

The coloring composition was added to four separate identical beverage bases, resulting in Samples 1-4. Sample 1 was set as a reference. Sample 2 was stored for 1  
15 week at 43°C. Sample 3 was stored for 2 weeks at 43°C. Sample 4 was stored for 3 weeks at 43°C. Samples 1-4 were measured on a spectrophotometer (Konica Minolta) for evaluation of dE2000 parameters. Sample 2 exhibited a dE2000 value of 1.62. Sample 3 exhibited a dE2000 value of 3.23. Sample 4 exhibited a dE2000 value of 3.33. As shown by  
20 FIGS. 3A-3D of the present disclosure, only small deviations in color can be detected which demonstrates that the disclosed coloring composition is very stable to heat over an extended period of time, and also that the heat stability of the disclosed coloring composition stabilizes over time. In particular, the dE2000 of 3.23 after storage for 2 weeks at 43°C only exhibited an insignificant increase to 3.33 after storage for 3 weeks at 43°C (figure 4).

25 Example 2. Performance of Inventive orange red (obtained from corn) in snack seasoning:

30

## Materials and methods

Powder used for seasoning: A coloring composition according to the present disclosure  
5 (Inventive composition 1a) was prepared comprising about 10 weight percent cyanidin 3-glucoside, about 36 weight percent pelargonidin 3-glucoside, about 10 weight percent peonidin-3-glucoside, and about 36 weight percent pelargonidin 3-(6"-malonylglucoside) by weight of the total anthocyanin content.

The inventive composition was obtained from corn. The inventive composition was spray  
10 dried on maltodextrine as carrier final colour strength is E1%=3.

For a more blue-toned red, inventive composition (corn extract) and maltodextrin slurry was spray dry, as is.

For a more intense Red 40 look, the slurry was acidified with HCl down to a pH of 2, and then dried the mixture. This created a more true red surface shade.

- 15 - Radish extract: standard Market radish powder was used as benchmark  
- FD&C colour: market red 40 colour was used as artificial benchmark  
- Black carrot extract: Liquid black carrot extract was used in the blend formulation. Content of anthocyanin is around 3%

20 Recipe--preparation of red snacks:

- Corn puffs were coated in a slurry containing flavor seasoning, maltodextrin, salt, corn oil, and color to be tested
- Flavor seasoning, maltodextrin, salt, and color. 3 different colours were used: FD&C, red radish and Inventive orange red (obtained from corn). The 3 colors were dry  
25 blended
- Dry blend was added to oil and mixed
- Oil slurry was warmed to around 70°C while mixing
- Blank puffs were added to a plastic-lined panner and tumbled
- Oil slurry was added drop-wise by air spraying onto the puffs while tumbling
- 30 • Coated puffs were allowed to tumble for an additional 2-3 minutes at the end
- Coated puffs were counted out and added to foil-lined bags
- Bags were triple sealed for tasting

Results:

5

Sensory evaluation results of puffs coloured with different options

As shown in figures 5 and 6, compared to red radish that presents significant off notes,  
Inventive orange red (obtained from corn) offers a very close sensory profile to the FD&C used  
10 in snack seasoning.

In addition, thanks to the neutral taste and red shade of orange red corn, blending with  
radish reduced off notes of red radish while maintaining a similar hue to a radish only solution.

Example 3. Innovative shade in beverages through blending with black carrot.

15

Inventive orange red (obtained from corn) as described in example 1 and 2 was used  
in a blend with black carrot (50% - 50%).

Beverage recipe: Beverage Composition: 89.96% water + 10% sucrose + 0.025% potassium  
20 sorbate + 0.015% sodium benzoate. Final pH was fixed to 3 with citric acid.

The inventive blend has a Lab value as follows:

|        | Dosage of blend | L*(D65) | a*(D65) | b*(D65) | C*(D65) | h(D65) |
|--------|-----------------|---------|---------|---------|---------|--------|
| PH=3   | 0.06            | 95.7    | 10.74   | 3.26    | 11.22   | 16.89  |
|        | 0.12            | 88.37   | 22.58   | 6.48    | 23.49   | 16.01  |
|        | 0.24            | 75.99   | 40.16   | 14.21   | 42.6    | 19.48  |
| PH=3.5 | 0.06            | 97.62   | 5.54    | 4.06    | 6.87    | 36.24  |
|        | 0.12            | 93.39   | 10.62   | 7.05    | 12.75   | 33.58  |
|        | 0.24            | 82.56   | 24.24   | 13.66   | 27.82   | 29.4   |
| PH=3.8 | 0.06            | 98.83   | 3.25    | 4.13    | 5.26    | 51.81  |
|        | 0.12            | 95.8    | 5.85    | 7.9     | 9.83    | 53.46  |
|        | 0.24            | 84.06   | 20.51   | 14.14   | 24.91   | 34.57  |

25

Results: Performance of new red-orange corn blend (with black carrot) in beverage application:

#### Light stability

5        New Inventive orange red (obtained from corn) was blend with black carrot. The blend was dissolved in beverage (recipe described below). Beverage containing the blend (Inventive orange red (obtained from corn) with black carrot) was exposed to extreme light irradiation 500 kJ/m<sup>2</sup>; Daylight filter system; 300 to 400 nm irradiance control. Beverages were measured on the spectrophotometer (Konica Minolta) for evaluation of initial L,a,b parameters and set  
10 as a reference.

Samples were then submitted to light irradiation. After light exposure, samples were measured again against the initial reference for the evaluation of difference of L,a,b and DE2000 parameters.

As shown in Figure 7, sample was very stable to light irradiation (De2000=0.87), this small  
15 colour change is not significant and cannot be detected by human eye.

#### Heat stability

New Inventive orange red (obtained from corn) was blend with black carrot. The blend was dissolved in beverage (recipe described below). Beverage was stored at 43°C for accelerated ageing.

20        Beverages were measured on the spectrophotometer (Konica Minolta). Initial L,a,b parameters was used as a reference.

Samples were then stored at 43°C. The L,a,b of the samples were measured every week (during 3 weeks) The DE2000 parameters was calculated using the different measurements (every week of aging) against the initial reference (time=0)

25        As shown in figure 7, 8 and 9, after 4 weeks of storage a small deviation on colour was recorded which indicates a very good heat stability of the Inventive orange red (obtained from corn).

While the coloring composition, method of making the coloring composition, uses of the coloring composition, consumables, and methods of making consumables have been described in connection with various embodiments, it is to be understood that other similar embodiments may be used or modifications and additions may be made to the described  
5   embodiments for performing the same function. Furthermore, the various illustrative embodiments may be combined to produce the desired results. Therefore, coloring composition, consumables containing the coloring composition and methods of making the coloring composition and consumables should not be limited to any single embodiment, but rather construed in breadth and scope in accordance with the recitation of the appended  
10   claims. It will be understood that the embodiments described herein are merely exemplary, and that one skilled in the art may make variations and modifications without departing from the spirit and scope of the invention. All such variations and modifications are intended to be included within the scope of the invention as described hereinabove.

## CLAIMS:

1. A coloring composition comprising one or more pelargonidins selected from pelargonidin 3-glucoside, pelargonidin 3-(6''-malonylglucoside), pelargonidin-  
5 dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) and pelargonidin 3,5-dimalonylglucoside, and at least one red anthocyanin.
2. The coloring composition according to claim 1, wherein the ratio of the pelargonidin to the red anthocyanin is about 0.5:95.5 to about 95.5:0.5.  
10
3. The coloring composition according to claim 2, wherein the ratio of the pelargonidin to the red anthocyanin is selected from about 10:90, about 20:80, about 30:70, or about 40:60.
4. The coloring composition according to claim 2, wherein the ratio of the pelargonidin  
15 to the red anthocyanin is selected from about 90:10, about 80:20, about 70:30, or about 60:40.
5. The coloring composition according to any one of claims 1 to 4, wherein the red anthocyanin is selected from the group consisting of peonidin-3-glucoside, cyanidin 3-glucoside, and combinations thereof.  
20
6. The coloring composition according to any one of claims 1 to 5 comprising from about 10 weight percent to about 70 weight percent pelargonidin 3-glucoside and from about 10 weight percent to about 70 weight percent pelargonidin 3-(6''-malonylglucoside), and optionally from about 1 weight percent to about 40 weight percent pelargonidin-  
25 dimalonylglucoside (Pel-3-3,6-DiMalo-Glu) based on the total weight of the total anthocyanin content of the coloring composition.
7. The coloring composition according to claim 6 comprising from about 20 weight percent to about 60 weight percent pelargonidin 3-glucoside and from about 20 weight  
30 percent to about 60 weight percent pelargonidin 3-(6''-malonylglucoside) based on the total weight of the total anthocyanin content of the coloring composition.

8. The coloring composition according to claim 7 comprising from about 30 weight percent to about 45 weight percent pelargonidin 3-glucoside and from about 30 weight percent to about 45 weight percent pelargonidin 3-(6"-malonylglucoside) based on the total weight of the total anthocyanin content of the coloring composition.

5

9. The coloring composition according to claim 1 to 5, comprising from about 0.5 weight percent to about 30 weight percent cyanidin 3-glucoside and from about 0.5 weight percent to about 30 weight percent peonidin-3-glucoside based on the total weight of the total anthocyanin content of the coloring composition.

10

10. The coloring composition according to claim 7, comprising from about 0.5 weight percent to about 20 weight percent cyanidin 3-glucoside and from about 0.5 weight percent to about 20 weight percent peonidin-3-glucoside based on the total weight of the total anthocyanin content of the coloring composition.

15

11. The coloring composition according to claim 8 comprising from about 0.5 weight percent to about 15 weight percent cyanidin 3-glucoside and from about 0.5 weight percent to about 15 weight percent peonidin-3-glucoside based on the total weight of the total anthocyanin content of the coloring composition.

20

12. The coloring composition according to any one of claims 1 to 11 comprising about 10 weight percent cyanidin 3-glucoside, about 36 weight percent pelargonidin 3-glucoside, about 10 weight percent peonidin-3-glucoside, and about 36 weight percent pelargonidin 3-(6"-malonylglucoside) based on the total weight of the total anthocyanin content of the coloring composition.

25

13. The coloring composition according to any one of claims 1 to 12, wherein the at least one pelargonidin is extracted from one or more botanical sources, specially from corn and/or is synthetic pelargonidin.

30

14. The coloring composition according to any one of claims 1 to 12, wherein the at least one red anthocyanin is extracted from one or more botanical sources, specially from cornand/or is at least one synthetic red anthocyanin.
- 5 15. The coloring composition according to any one of claims 1 to 14, wherein the coloring composition is substantially free of cyanidin.
16. The coloring composition according to any one of claims 1 to 14, wherein the coloring composition is free of cyanidin.
- 10 17. The coloring composing according to any one of claims 1 to 16, wherein the coloring composition has an L\* value of from about 46 to about 66; an a\* value of about 51 to about 61; and a b\* value of about 40 to about 60, wherein L\*, a\* and b\* values represent CIELAB L\*a\*b\* chromaticity coordinates at pH 3 aqueous preparation.
- 15 18. The coloring composing according to any one of claims 1 to 17, wherein the coloring composition is color stable after exposure to light irradiation of 500 kJ/m<sup>2</sup>.
19. The coloring composing according to any one of claims 1 to 18, wherein the coloring  
20 composition is color stable after storage for at least 3 weeks at 43°C.
20. The coloring composition comprising a coloring composition according to any one of claims 1 to 19 characterized by comprising from about 0.1 weight percent to about 99.9 weight percent of total anthocyanin based on the total weight of the coloring composition,  
25 specially from about 0.1 % to about 20% weight percent of total anthocyanin content based on the total weight of the coloring composition, such as from about 0.1%, 0.2%, 0.3%, 0.4%, 0.5%, 0.6%, 0.7%, 0.8%, 0.9%, 1%, 2%, 3%, 4%, 5%, 6%, 7%, 8%, 9%, 10%, 11%, 12%, 13%, 14%, 15%, 16%, 17%, 18%, 19%, 20% to about 20%, 19%, 18%, 17%, 16%, 15%, 14%, 13%, 12%, 11%, 10%, 9%, 8%, 7%, 6%, 5%, 4%, 3%, 2%, 1%, 0.9%, 0.8%, 0.7%, 0.6%, 0.5%, 0.4%, 0.3%, 0.2%,  
30 0.1% of total anthocyanin content based on the total weight of the coloring composition.

21. A coloring formulation comprising a coloring composition according to any one of claims 1 to 20 and further comprising one or more natural or synthetic pigments.
22. A coloring formulation according to claim 21, wherein the further pigments are of natural origin and are selected from one or more anthocyanin pigments that are not from corn.
23. A coloring formulation according to claim 21 or 22, wherein the pigment is a red radish derived colour.
24. A coloring formulation according to claim 21 or 22, wherein the pigment is black carrot derived colour.
25. A consumable comprising a consumable base and the coloring composition according to any one of claims 1 to 20 or a coloring formulation according to any one of claims 21 to 24
26. The consumable of claim 25, wherein the consumable comprises a beverage.
27. The consumable of claim 26, wherein the beverage has an acidic pH.
28. The consumable of claims 26 or 27, wherein the beverage is selected from the group consisting of energy drinks, carbonated soft drinks, vitamin waters, alcoholic beverages, juices, and combinations thereof.
29. The consumable of claim 25, wherein the consumable comprises a food.
30. The consumable of claim 29, wherein the food is selected from the group consisting of snack, dairy, dairy alternative, meat, meat alternatives, confectionary, sweets, baked goods, and combinations thereof.

31. A method of coloring a consumable comprising adding the coloring composition of any one of claims 1 to 20 or a coloring formulation according to any one of claims 21 to 24 to a consumable base.
- 5 32. Use of the coloring composition of any one of claims 1 to 20 or a coloring formulation according to claims 21 to 24 as a colorant for a consumable.