EXBERRY® Basics Training for Beverages

How to use EXBERRY® Coloring Foods?

GROWING COLORS

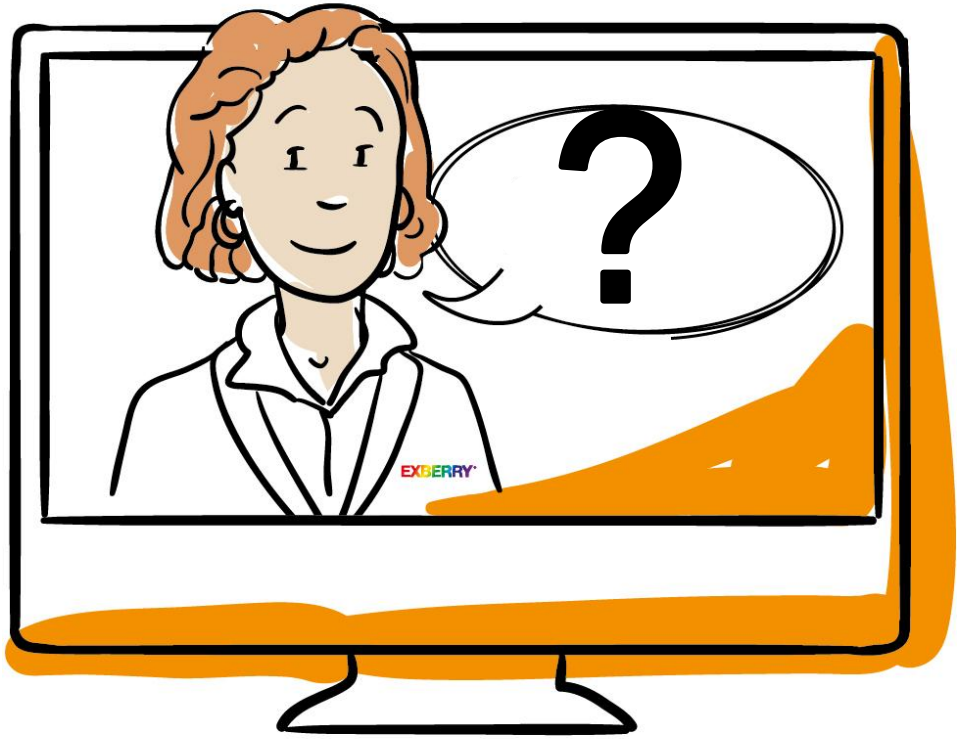
EXBERRY®

GROWING COLORS EXBERRY®

1

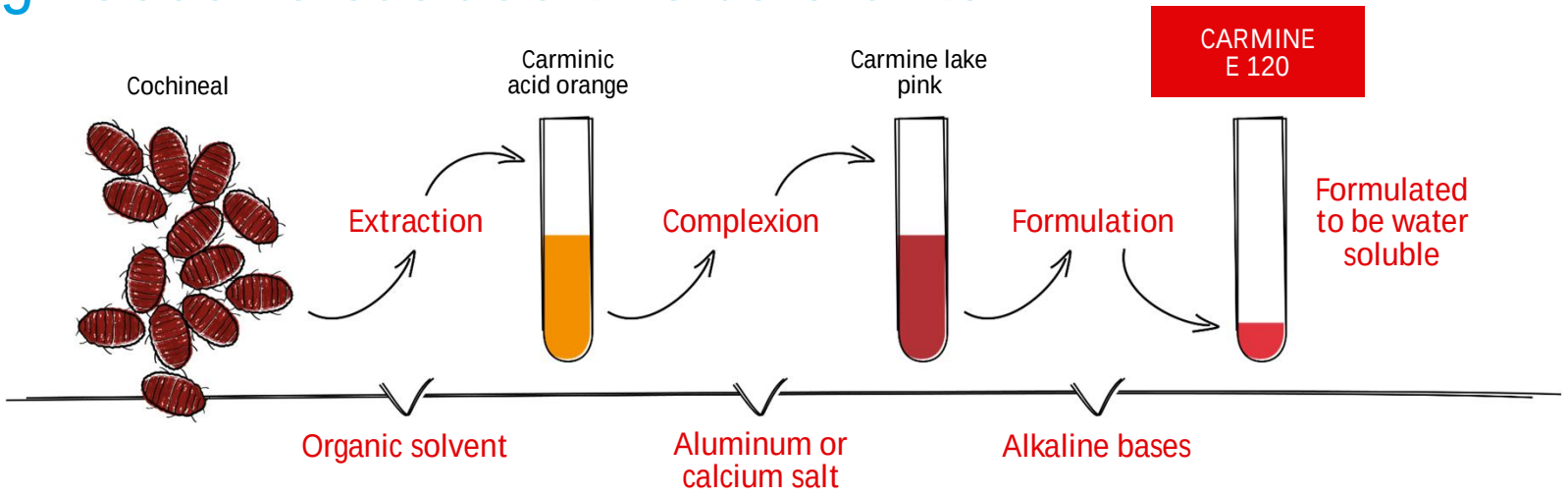
What are Coloring Foods?

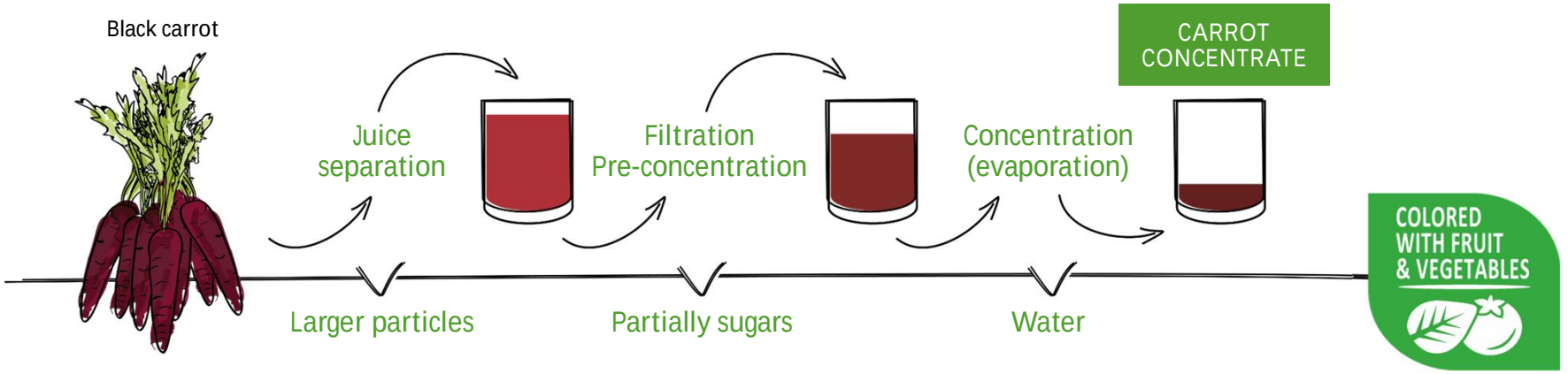
What are Coloring Foods?



- “Food ingredients with coloring properties”
- “Concentrates of fruits and vegetables”
- “Coloring food with food”
- “No additives – different from colorants”

Coloring Foods versus additive colorants

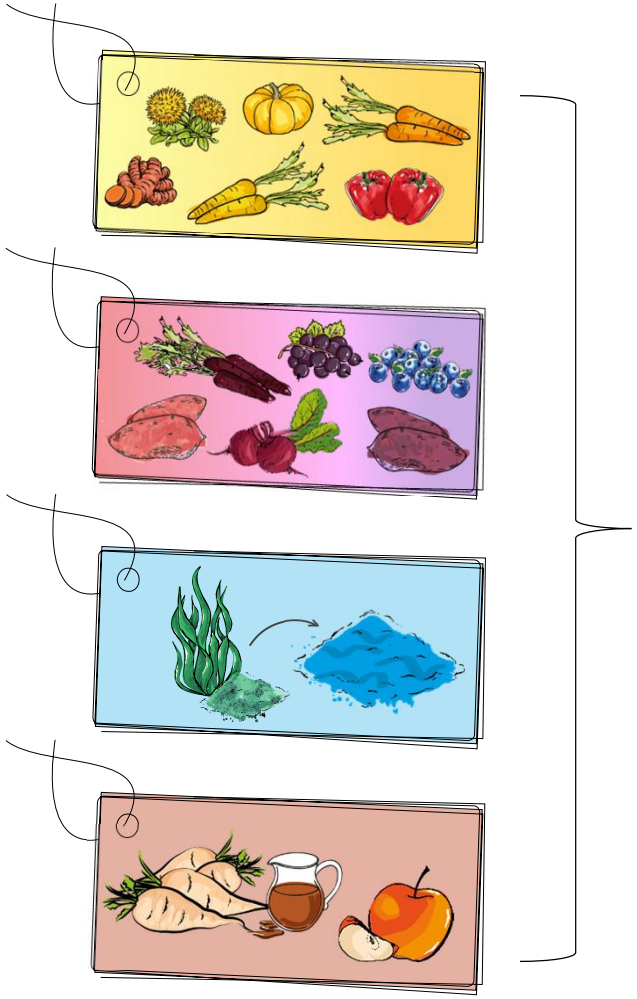


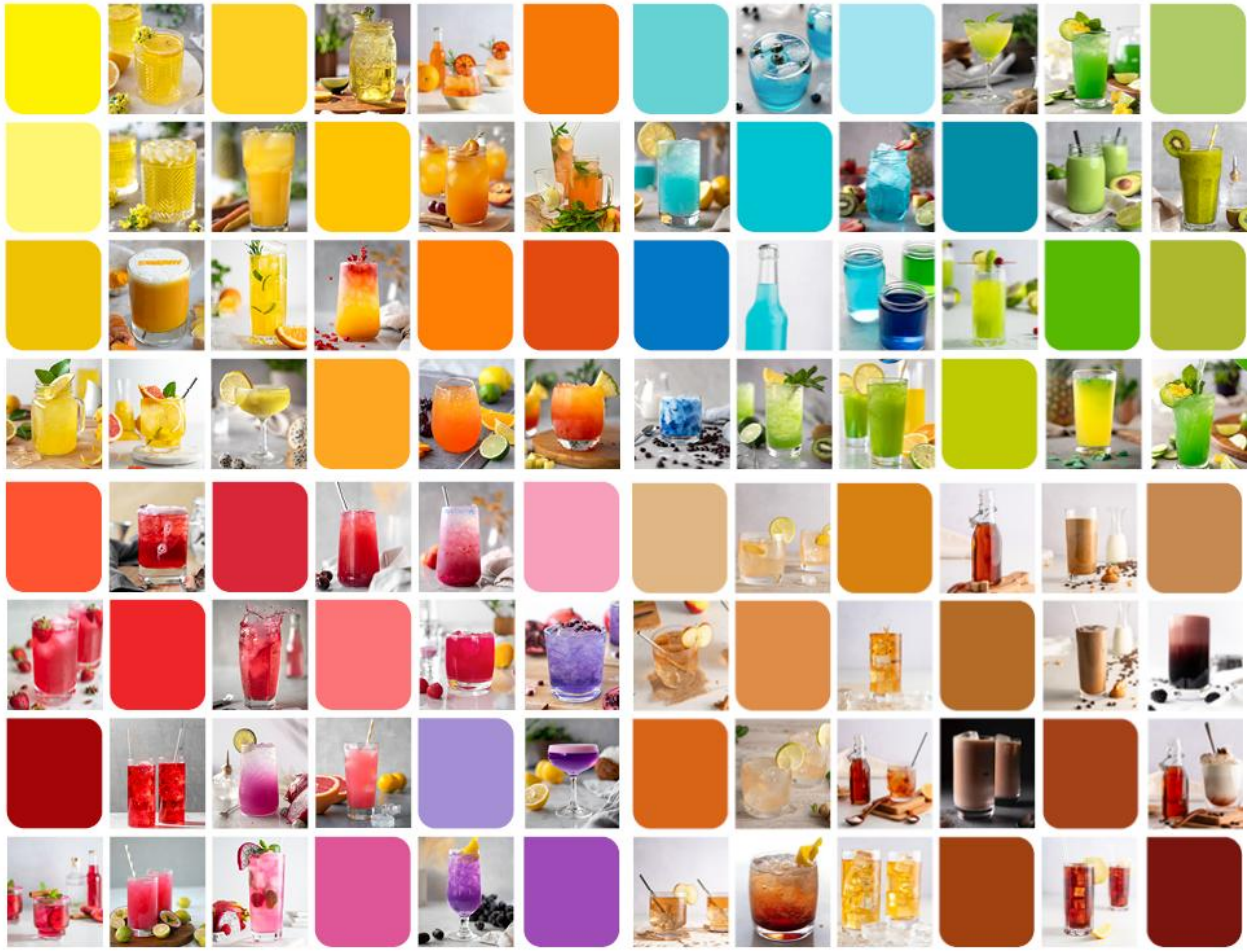


Labelling recommendation within the EU

Coloring food (concentrate of carrot, …) or concentrate (carrot, …).

Raw materials for color opportunities





EXBERRY® experience

Tasting of three different EXBERRY® products. Which raw materials do you taste?

1. EXBERRY® Shade Mandarin → Carrot + Apple
2. EXBERRY® Shade Vivid Red → Carrot + Blackcurrant
3. EXBERRY® Shade Blue - HP → Spirulina

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What type of EXBERRY® products exist?

EXBERRY® ranges

1	2	3	4	5
				
Standard liquid concentrate	HP (hard panning) range	Standard powder	MN (micronized) powder	OD (oil dispersible) range
		*dry applications & reconstitution* 	*water-free applications* 	*water-free, fat-based applications* 

GNT offers more EXBERRY® ranges for specific purposes, e.g. the OS (oil soluble) range.
We also have organic EXBERRY® products in our portfolio (liquids and powders).

Instant powder beverage application

Product parameters

Ingredients: Sugar, dextrose, maltodextrin, citric acid, tri-sodium citrate
10 g powder mix per 100 mL water
pH 3.0 when reconstituted with still water

Color	[%] w/w Powder	[%] w/w RTD	EXBERRY® Shade...
Yellow	0.70	0.070	Yellow - MN Powder
Orange	0.70 0.30	0.070 0.030	Yellow - MN Powder Rubescent Red - MN Powder
Red	1.00	0.100	Rubescent Red - MN Powder
Pink	0.50	0.050	Pink - MN Powder
Plum	0.50	0.050	Purple - MN Powder
Purple	0.50 0.25	0.050 0.025	Blue - MN Powder Pink - MN Powder
Violet	0.80 0.15	0.080 0.015	Blue - MN Powder Pink - MN Powder
Blue	1.00	0.100	Blue - MN Powder
Green	1.00 0.50	0.100 0.050	Blue - MN Powder Yellow - MN Powder
Lime Green	0.80 0.70	0.08 0.07	Blue - MN Powder Yellow - MN Powder

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What is important when using EXBERRY®?

EXBERRY®: Experiment

1. In front of you are three small bottles with buffer solutions (pH 3, 4 and 7).
2. If you choose one of these EXBERRY® products (RED), add 2 drops into the buffer solutions:
   - Lemon Yellow
   - Sunstone Orange
   - Rubescent Red
   - Vivid Red
   - Brilliant Pink
   - Purple Plum
3. If you choose one of these EXBERRY® products (BLUE), add 4 drops into the buffer solutions:
   - Yellow – Cloudy
   - Mandarin
   - Fiesta Pink
   - Green
   - Blue – HP
   - Golden Brown

GROWING COLORS

EXBERRY®

Properties of RED, PINK & PURPLE EXBERRY® products

Product overview: Red, Pink and Purple EXBERRY®

Product parameters: 8° Brix
pH 3.0
Cold preserved
Color 1

EXBERRY® Shade Rubescent Red (0.10 %)

EXBERRY® Shade Vivid Red (0.07 %)

EXBERRY® Shade Brilliant Pink (0.04 %)

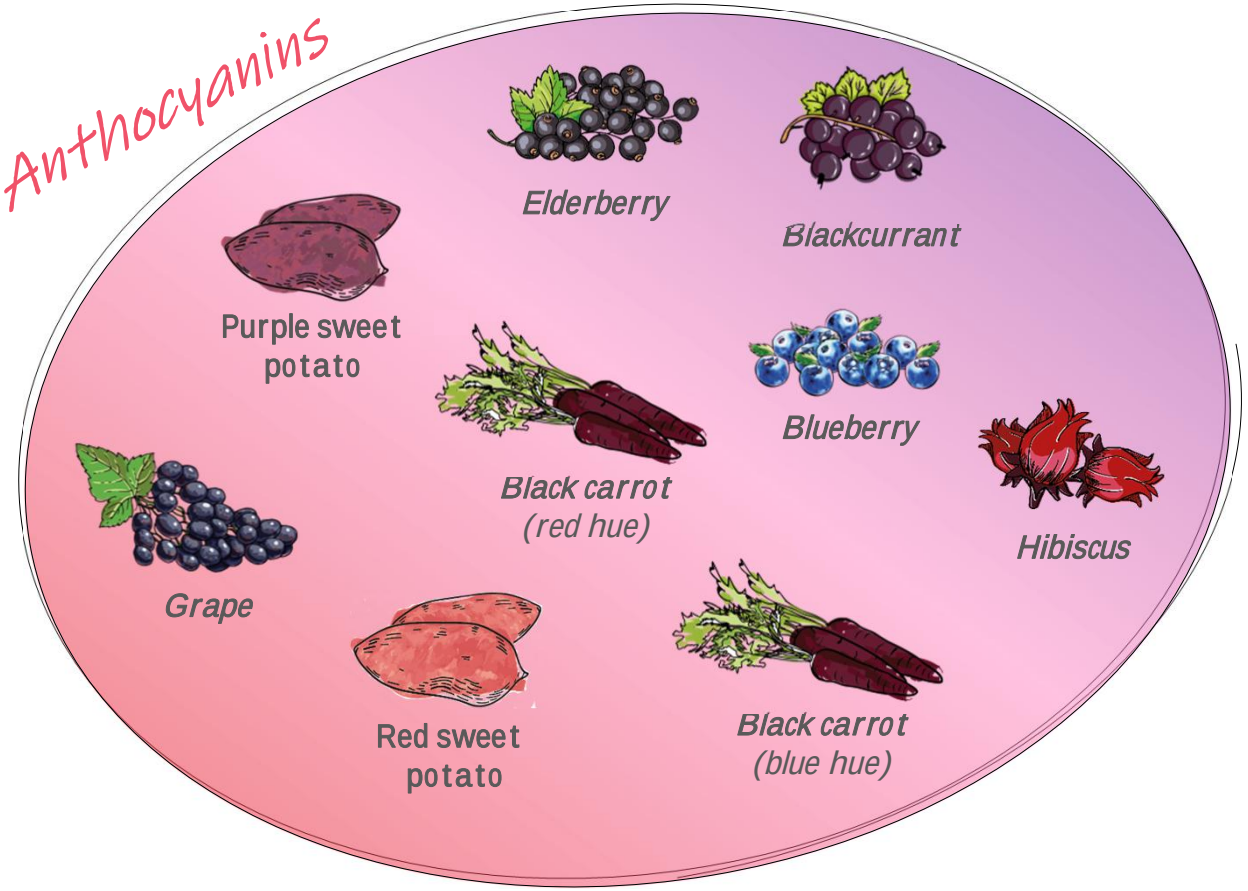
EXBERRY® Shade Pink Red (0.06 %)

EXBERRY® Shade Purple Plum (0.04 %)

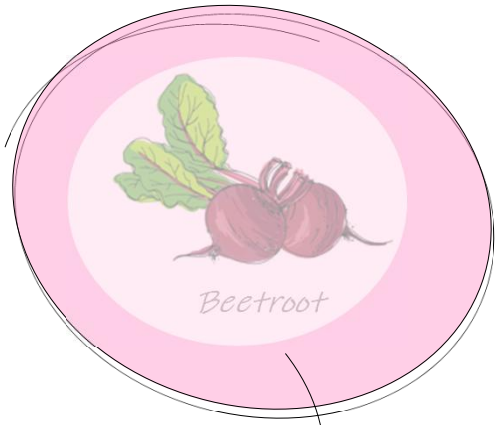
- All red, pink and purple EXBERRY® products suitable for acidic non-alcoholic beverages are completely water soluble and give a clear solution.
- Depending on the raw material, a variety of color hues from yellowish red to bluish red can be achieved.

Pigments in Red, Pink and Purple EXBERRY® raw materials

Anthocyanins



Betanin



Only suitable for refrigerated juices & smoothies

EXBERRY®: Experiment

1. Add 10 drops of EXBERRY® Shade Vivid Red into the beaker with tap water (2 L) and mix.

   Take a sample by pouring the colored water into one of the small beakers.

2. Add 1 drop of citric acid solution (50 % w/w) to the beaker and mix.

   Take a sample.

3. Add a whole pipette of citric acid solution to the beaker and mix.

   Take a sample.

➢ What do you see?

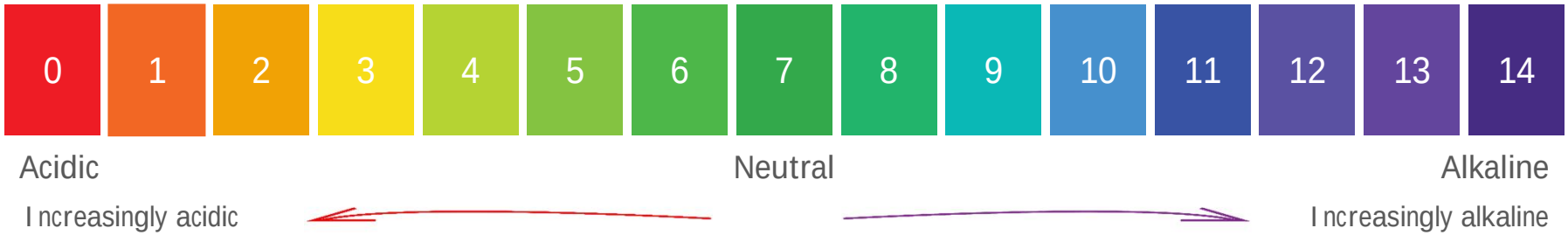
Addition of citric acid

pH 6-7 pH 4-5 pH 2-3

Beverage parameters: pH value

pH value

- Measure of the acidity or alkalinity of a solution
- Ranges from 0 to 14



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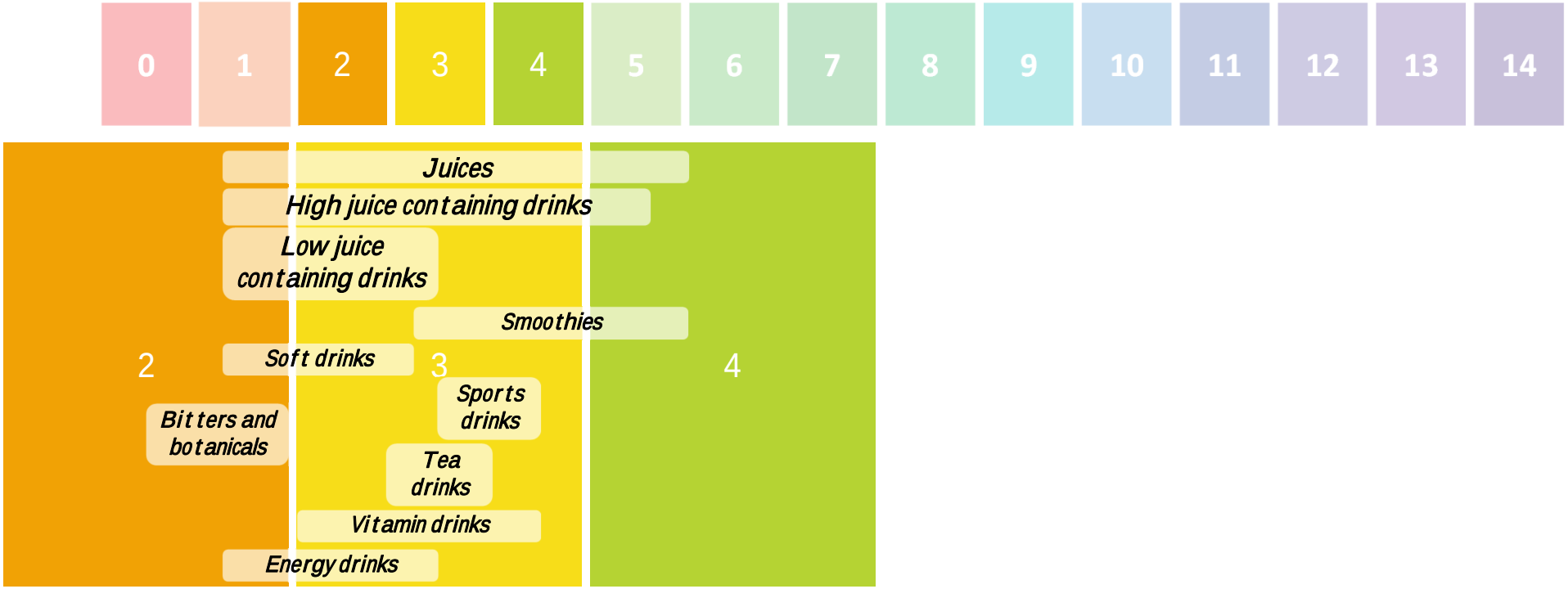


BK0

Red, Pink and Purple EXBERRY®: Influence of pH value

Product parameters: Buffers pH 2 - 7
Cold preserved

- Appearance of RED, PINK & PURPLE EXBERRY® at different pH values

EXBERRY® made from beetroot are not pH dependent.

EXBERRY® products made from red fruits and vegetables that contain anthocyanins are pH dependent.

BK0 [@Vine, Helen] [@Ringkamp, Sarah] [@Krimmel, Björn] Are we able to further expand on the raw materials? So red sweet potato not just sweet potato? Or do you want to keep them generic?

Briers, Kati, 2024-08-22T15:59:48.084

Red, Pink and Purple EXBERRY®: Influence of heat

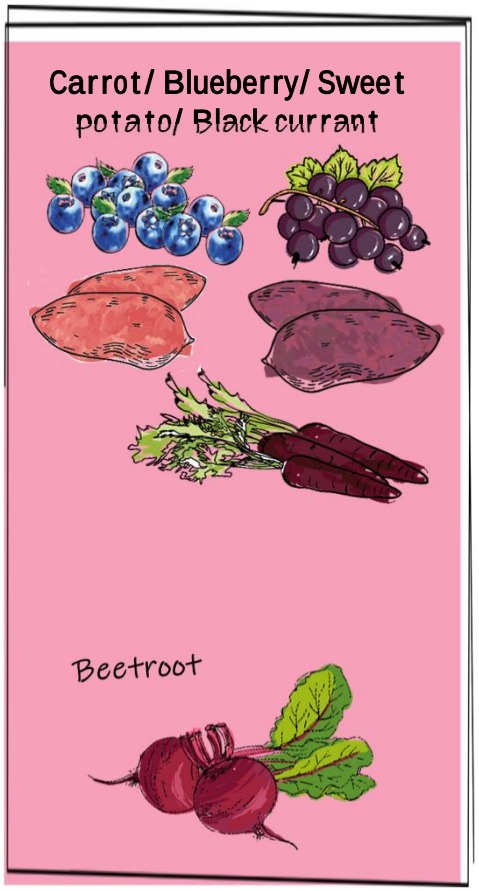
Product parameters: 8 °Brix
pH 3.0

- Red, Pink and Purple EXBERRY® containing anthocyanin-based raw materials are very stable against heat.

- EXBERRY® Shade Fiesta Pink which contains beetroot (pigment: betanin) is less heat stable.
  - Ascorbic acid can help to reduce color loss during pasteurization to some extent.
  - Nevertheless, color loss over shelf life will still be worse compared to all other Red, Pink and Purple EXBERRY® products (stored at non-refrigerated conditions).

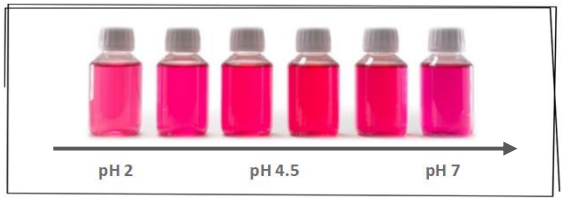
Red, Pink and Purple EXBERRY®: Color stability

Raw Materials



- Red, Pink and Purple EXBERRY® made from raw materials containing anthocyanins are:
  - Heat stable
  - Light stable
  - pH dependent

- Pink EXBERRY® made from raw materials containing betanin are:
  - Less heat stable
  - Less light stable
  - pH independent



Light and heat stability can be improved with **ascorbic acid** addition.

GROWING COLORS EXBERRY®

Properties of YELLOW & ORANGE EXBERRY® products

EXBERRY®: Experiment

1. In front of you are two bottles containing instant beverage powders.
2. Fill water into the bottles and shake well.

➢ What do you see?

0.10 % EXBERRY® Shade
Lemon Yellow - Powder

0.12 % EXBERRY® Shade
Yellow - Cloudy Powder

Product overview: Yellow and Orange EXBERRY®

Product parameters: 8° Brix
pH 3.0
Cold preserved

EXBERRY® Shade Lemon Yellow
(0.07 %)

EXBERRY® Shade Sunstone Orange
(0.04 %)

Clear EXBERRY®

EXBERRY® Shade Yellow - Cloudy Powder
(0.12 %)

EXBERRY® Shade Mandarin
(0.12 %)

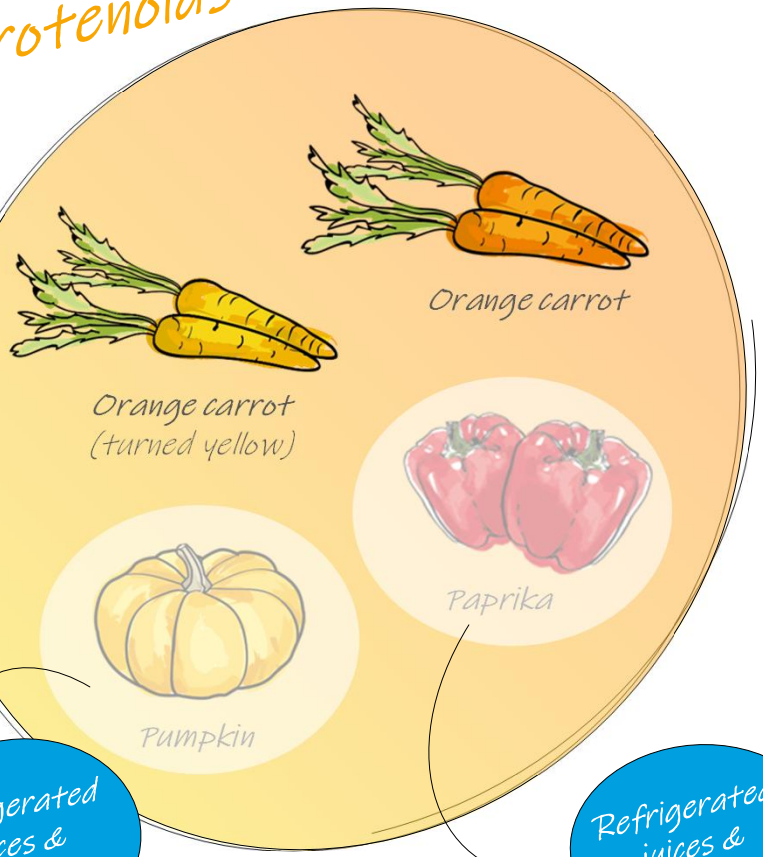
Cloudy EXBERRY®

- EXBERRY® Shade Lemon Yellow and Sunstone Orange are completely water soluble
- Clear yellow and orange EXBERRY® products contain safflower as one raw material

- EXBERRY® Shade Yellow - Cloudy Powder and Mandarin are not completely water soluble but can be dispersed in water
- Cloudy EXBERRY® products are based on raw materials like carrot

Pigments in Yellow and Orange EXBERRY® raw materials

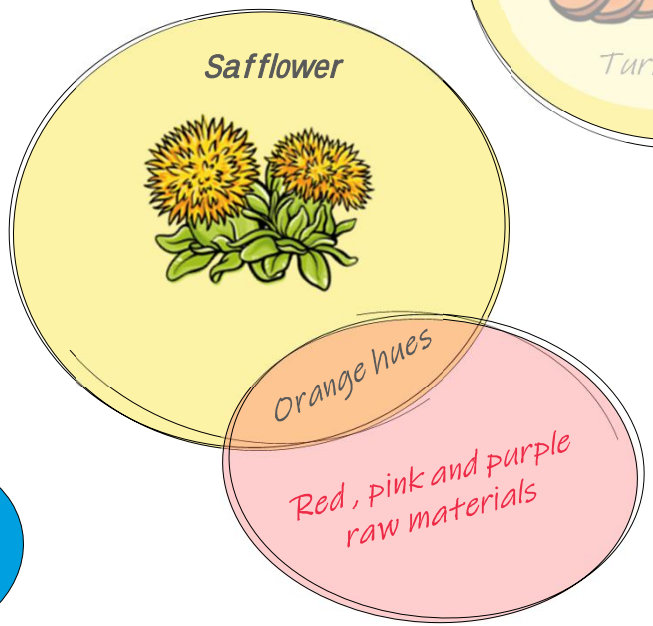
Carotenoids



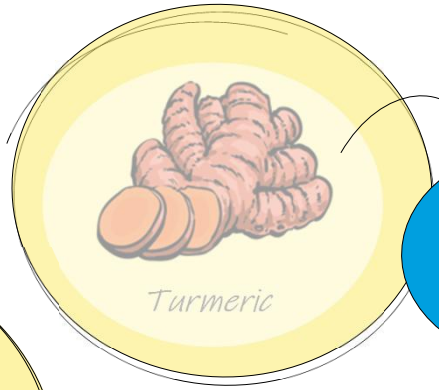
Refrigerated juices & smoothies

Refrigerated juices & smoothies

Safflomin A



Curcuminoids



Refrigerated juices & smoothies

Yellow EXBERRY®: Influence of pH value

0.03 % Shade Lemon Yellow
(safflower, lemon)

0.13 % Shade Yellow - Cloudy Powder
(carrot, pumpkin)

Yellow EXBERRY® products are not pH dependent.

Orange EXBERRY®: Influence of pH value

Cloudy orange EXBERRY®
(e.g. Shade Mandarin)

Cloudy orange EXBERRY® products are <u>not</u> pH dependent.

Clear orange EXBERRY®
(e.g. Shade Sunstone Orange)

Safflower

Raw material containing anthocyanins

Clear orange EXBERRY® products are pH dependent.

EXBERRY®: Experiment

1. Mix 5 drops EXBERRY® Shade Mandarin with 80 mL invert sugar in a small bottle (2 x).
2. Add 20 mL sunflower oil to the first bottle and 20 mL invert sugar to the other bottle.
3. Shake both bottles heavily.

➢ What do you see?

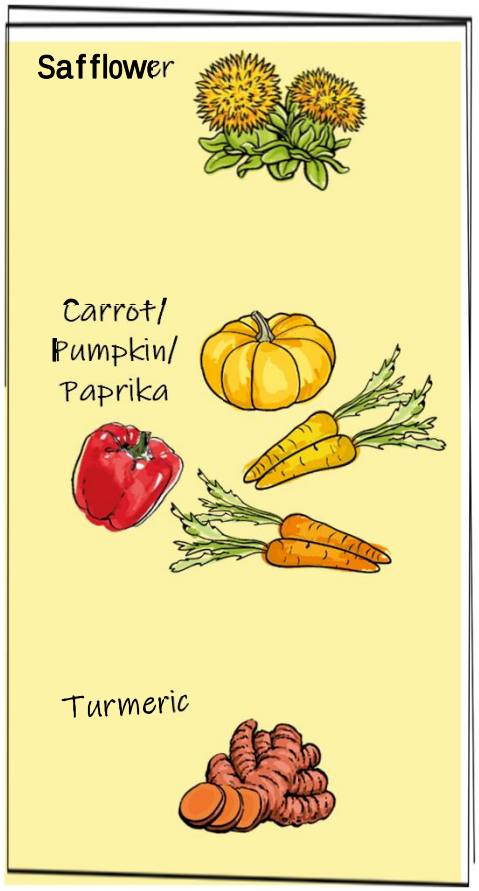
- EXBERRY® Shade Mandarin contains orange carrot concentrate which contains carotenoids.
- Carotenoids are soluble in fat and the color shade shifts from reddish orange to yellowish orange with increasing fat content.

without sunflower oil

with sunflower oil (+ high shear mixing)

Yellow and Orange EXBERRY® products: Color stability

Raw Materials



- Clear yellow and orange EXBERRY® made from raw materials containing safflomin A (safflower) are:
  - Light and heat stable
  - pH dependent (only clear orange EXBERRY®)

- Cloudy EXBERRY® products made from raw materials containing carotenoids are:
  - Light stable (highly dependent on application)
  - Heat stable
  - pH independent

Light stability can be highly improved with antioxidants like **ascorbic acid**.

- Cloudy EXBERRY® made from raw materials containing curcumin (turmeric) are:
  - Less light stable
  - Heat stable (heat can increase color intensity)
  - pH independent

BK0

Slide 30

BK0 [@Krimmel, Björn] we don't outline the need for AA or hydrocolloids with carotenoids in this section. Do you think we should mention it briefly?
Briers, Kati, 2024-08-22T15:37:43.805

BK0 0 [@Briers, Kati] I usually mention it briefly on slide 29 when we talk about clear and cloudy EXB
Krimmel, Björn, 2024-08-23T06:08:42.671

GROWING COLORS EXBERRY®

Properties of BLUE & GREEN EXBERRY® products

Product overview: Blue and Green EXBERRY®

Product parameters: Buffer pH 7

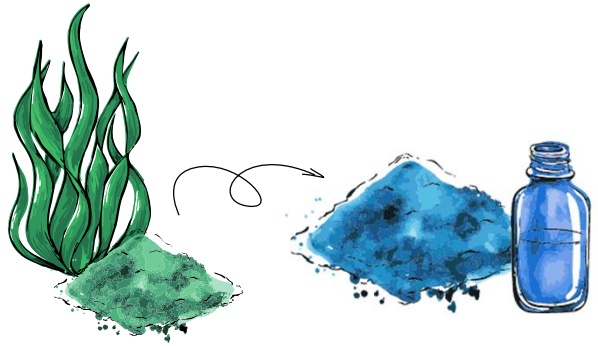
0.25% EXBERRY® Shade Blue - HP (spirulina)

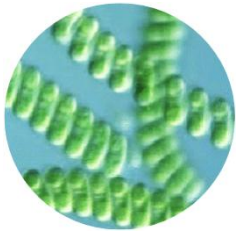
0.125% EXBERRY® Shade Green (spirulina, safflower)

0.23% EXBERRY® Shade Jade Green (turmeric, spirulina)

0.23% EXBERRY® Shade Lime Green (turmeric, spirulina)

- All blue and green EXBERRY® products are completely water soluble or water dispersible depending on their raw material composition.
- The blue color is coming from the Spirulina algae*.
- Coloring pigment is called phycocyanin.

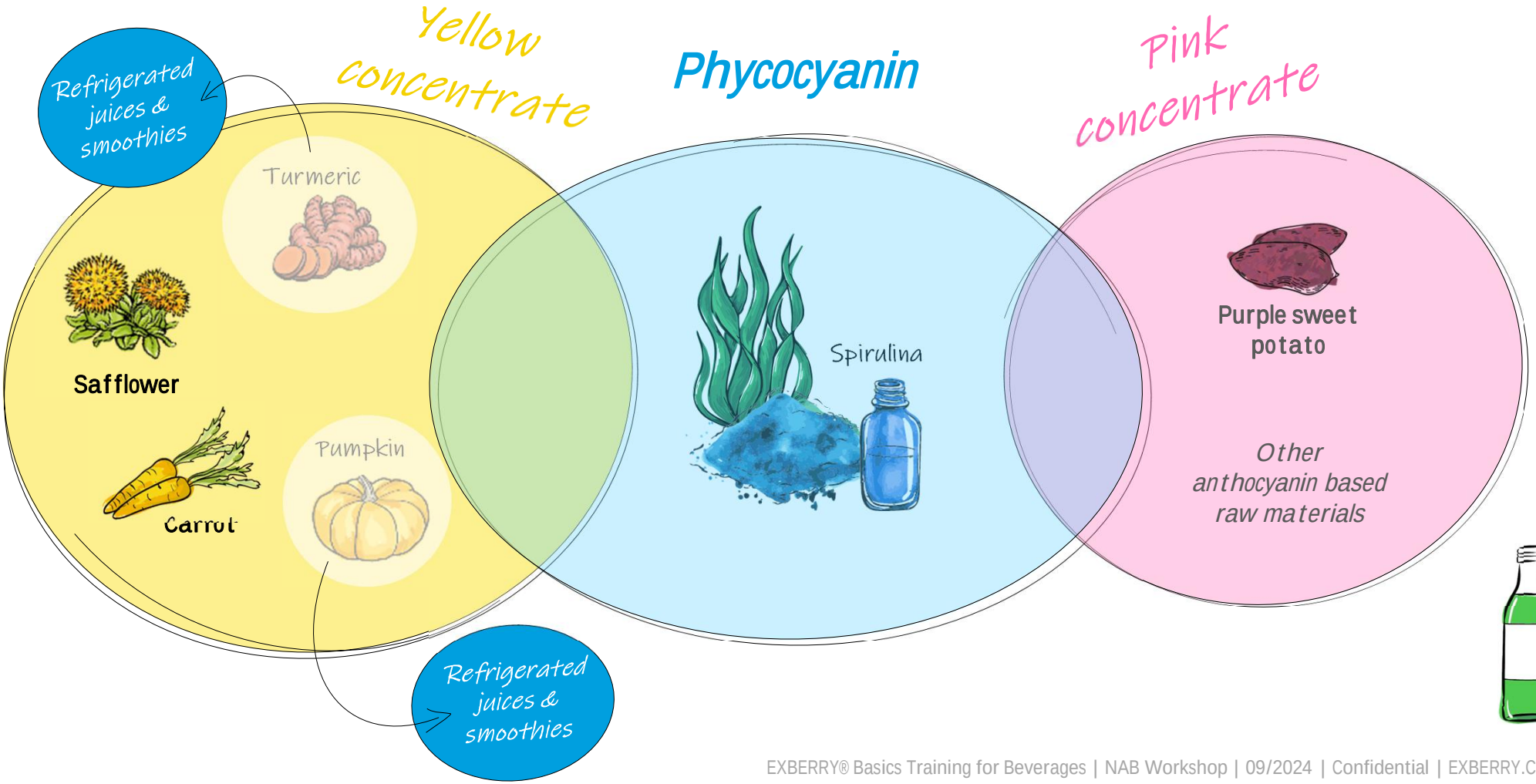




*The common name “Spirulina” refers to the dried biomass of *Arthrospira platensis.*

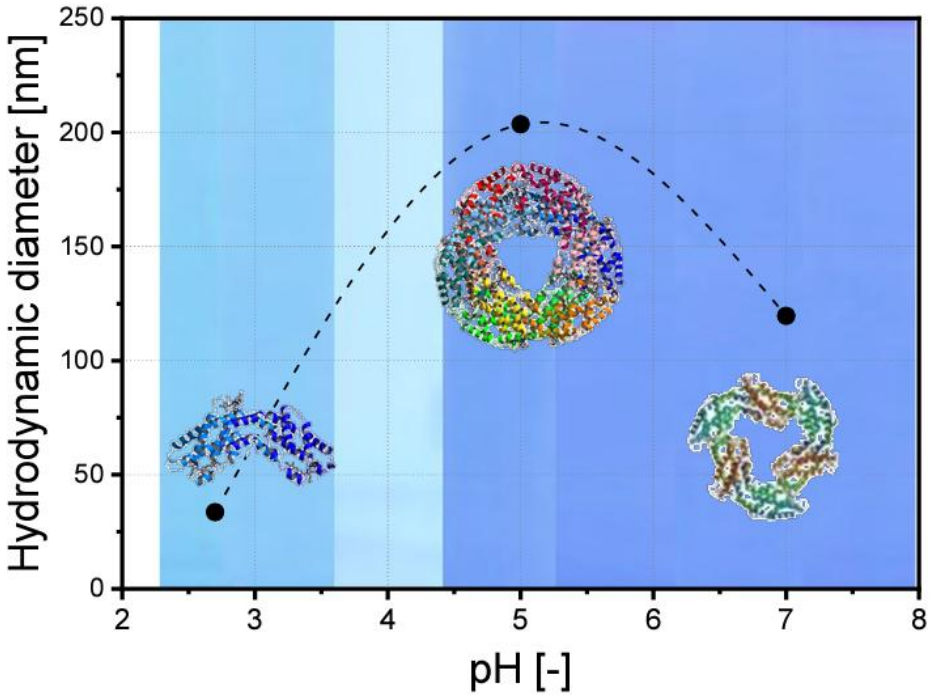
Pigments in Blue, Green and Violet EXBERRY® raw materials

Suitability for NAB



Blue and Green EXBERRY® products: Influence of pH value

Color shift and conformation change of C-phycocyanin



- Color shifts from purple blue to aqua blue as the pH value decreases due to the change in protein quaternary structure.

EXBERRY®: Experiment

Part 1:

1. Mix 20 drops EXBERRY® Shade Blue - HP with a full pipette of citric acid solution (50 % w/w).
2. Add 200 mL invert sugar and mix again.

Part 2:

1. Mix 20 drops EXBERRY® Shade Blue - HP with 200 mL invert sugar.
2. Add a full pipette of citric acid solution and stir again.

➢ What do you see?

EXBERRY®: Experiment

EXBERRY®: Experiment

Part 1:

1. Mix 20 drops EXBERRY® Shade Blue - HP with a full pipette of citric acid solution (50 % w/w).
2. Add 200 mL invert sugar and mix again.

Part 2:

1. Mix 20 drops EXBERRY® Shade Blue - HP with 200 mL invert sugar.
2. Add a full pipette of citric acid solution and stir again.

➢ What do you see?

Part 1 Part 2

- Direct contact of blue and green EXBERRY® with acids should be avoided.
- Blue and green EXBERRY® are sensitive to acid.

EXBERRY®: Experiment

1. Mix half a pipette EXBERRY® Shade Blue - HP with 1 L invert sugar in a pot.
   - Fill ~100 mL) into a beaker and do not heat it (reference sample).
2. Heat the rest of the colored syrup to 70 °C.
   - Fill ~100 mL into a second beaker.
3. Bring the rest of the syrup to the boil.
   - Fill ~100 mL into a third beaker.

- What do you see?

EXBERRY®: Experiment

EXBERRY®: Experiment

1. Mix half a pipette EXBERRY® Shade Blue - HP with 1 L invert sugar in a pot.
   - Fill ~100 mL) into a beaker and do not heat it (reference sample).
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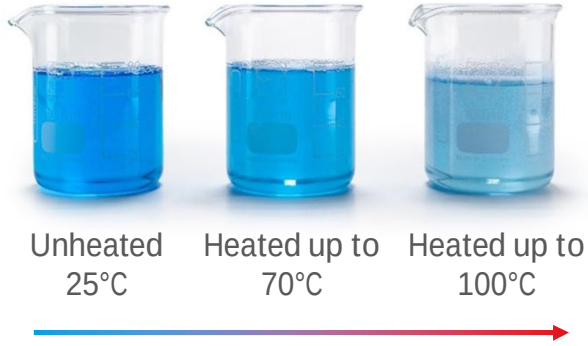
- What do you see?



- High temperatures of blue and green EXBERRY® products should be avoided.
- Color degradation already starts at temperatures > 60°C.
- Important parameters beside the temperature itself are holding time, water availability and the dosage level of EXBERRY®.

Blue and Green EXBERRY® products: Color stability

Raw Materials

- Clear blue or green EXBERRY® made from raw materials containing phycocyanin (spirulina) and safflomin A (safflower) are:
  - Light stable
  - Heat and acid sensitive

- Cloudy green EXBERRY® products made from raw materials containing phycocyanin and carotenoids are:
  - Light stable (highly dependent on application)
  - Heat and acid sensitive

Light stability can be highly improved with antioxidants like **ascorbic acid**

- Cloudy green EXBERRY® made from raw materials containing phycocyanin and curcuminoids (turmeric) are:
  - Less light stable
  - Heat and acid sensitive

What about Blue, Green and Violet low pH beverages?

- Natural Blue, Green and Violet are currently no options for low pH beverages (except juices and smoothies).
- Spirulina is the only natural blue currently approved for food in US, Europe, and codex countries.
- Spirulina has historically not been an option due to stability issues (low pH value, water activity, pasteurization).

GNT FORMULATION SOLUTION (PATENTED)

- Solution stabilizes spirulina and prevents protein aggregation during storage and thermal processing
- Allows for a wider range of color shades – purple, green
- Applies to a wide range of beverage types

GROWING COLORS EXBERRY®

Properties of BROWN EXBERRY® products

Product overview: Brown EXBERRY®

Product parameters: 8° Brix
pH 3.0
Cold preserved
Color 1

EXBERRY® Shade
Golden Brown
(0.17 %)

EXBERRY® Shade
Autumn Brown
(0.17 %)

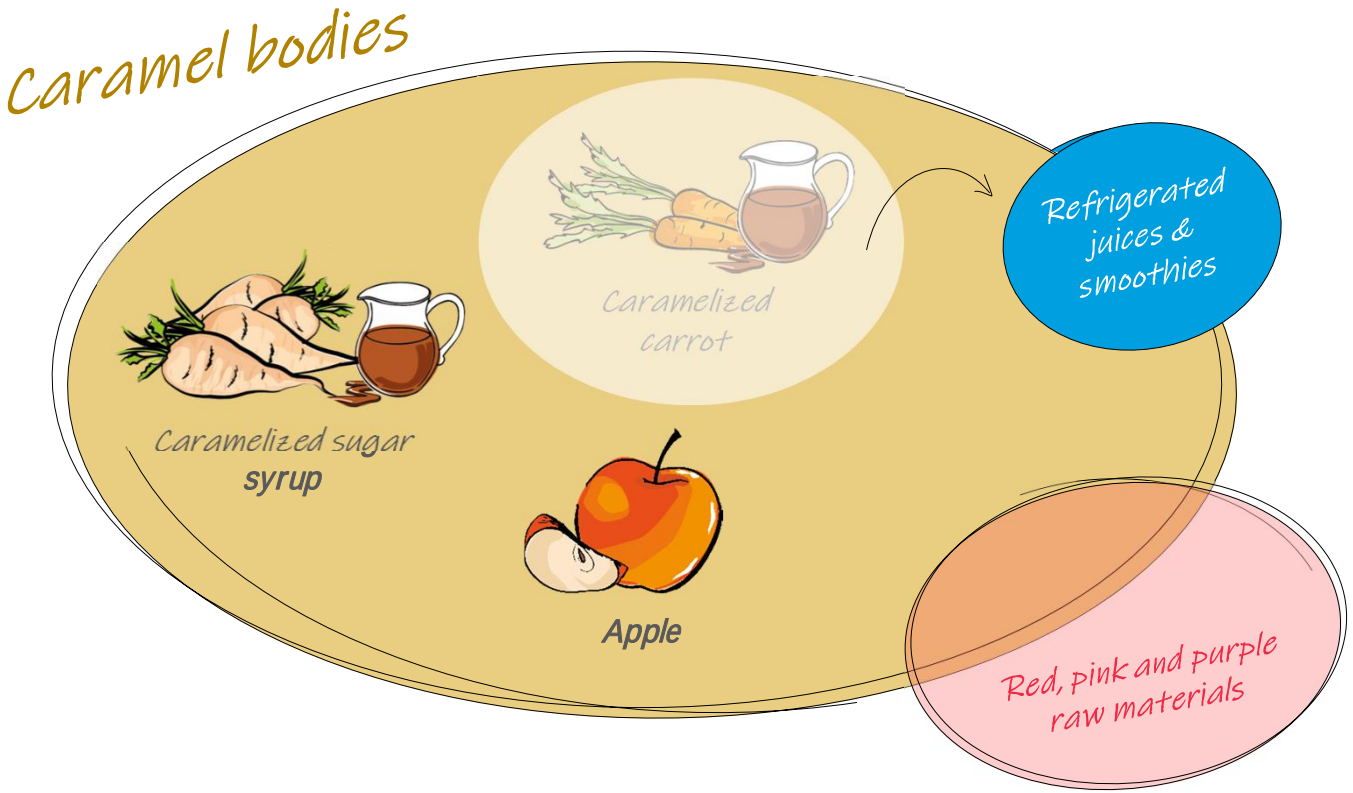
EXBERRY® Shade
Amber
(0.31 %)

EXBERRY® Shade
Chestnut Brown
(0.34 %)

- All brown EXBERRY® products are completely water soluble.
- Color shades from light caramel brown to dark reddish browns.

Pigments in Brown EXBERRY® raw materials

Suitability for acidic NAB



Brown EXBERRY® products: Influence of pH value

0.08 % EXBERRY®
Shade Golden Brown

EXBERRY® Shade Golden Brown is <u>not</u> pH dependent.

0.09 % EXBERRY®
Shade Autumn Brown

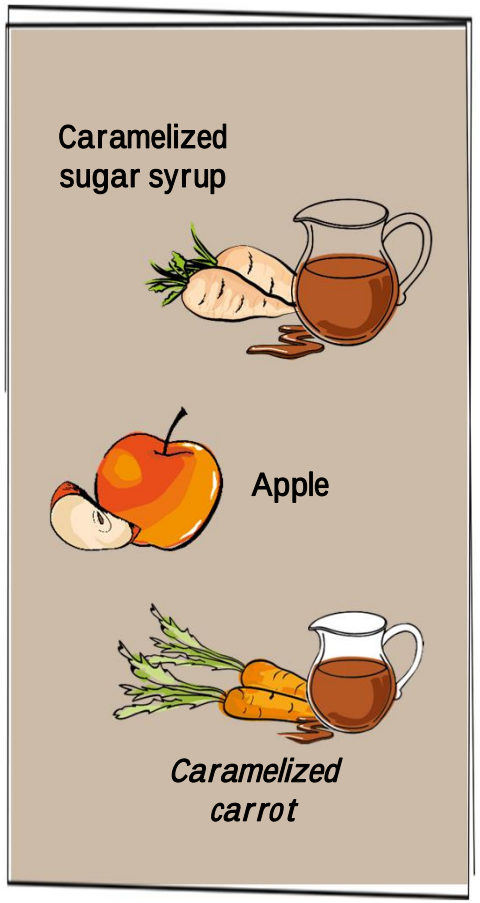
Caramelized sugar syrup

Black carrot

EXBERRY® Shade Autumn Brown is pH dependent.

Brown EXBERRY® products: Color stability

Raw Materials



- Brown EXBERRY® products based on caramelized sugar syrup, apple and caramelized carrot are:
  - Light stable
  - Heat stable
  - pH independent

GNT also offers products with a more chocolate brown color shade. These have additional black carrot and are therefore PH dependent.

Disclaimer
The information contained herein or any other information given by us is, to the best of our knowledge and belief, accurate. Nothing contained herein is to be construed as a recommendation for use in violation of any patents or of applicable laws or regulations.

GROWING COLORS EXBERRY®