# Design and development of innovative beverages

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**WEBINAR**
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# Beverages: role in health and wellbeing

**Water and beverages: essential component of humans diet to fulfil essential metabolic activities**

<u>**Water in humans:**</u> adult : 60% (of the body weight)
children: 80%

<u>Body water content vary during the day time, depending on</u> water losses = ca 2.0-2.5 l/day (breath, urine, feces, sweat)

1. **Physiological functions :**
   - integrity of cells and osmotic equilibrium
   - Mineral salts

     Recommended amount: 1-2 l/day of water depending on :
   - season, physical activity, sex, age, body build

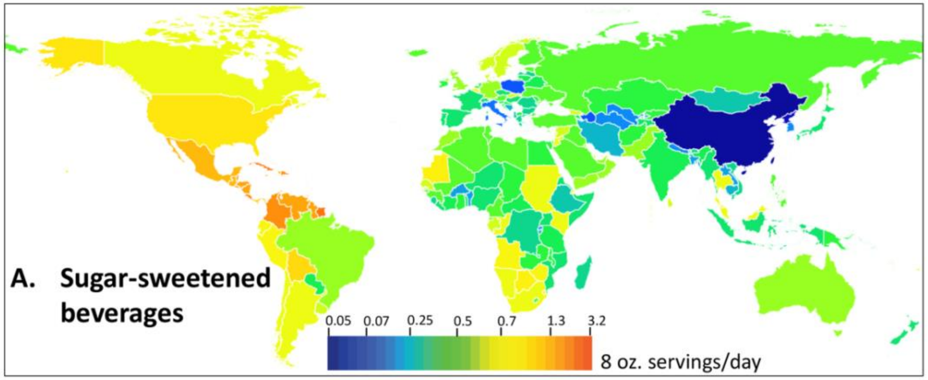
2. **Therapeutic action** (hydrotherapy) **:** for specific illnesses (hydroponic treatments with specific mineral waters)

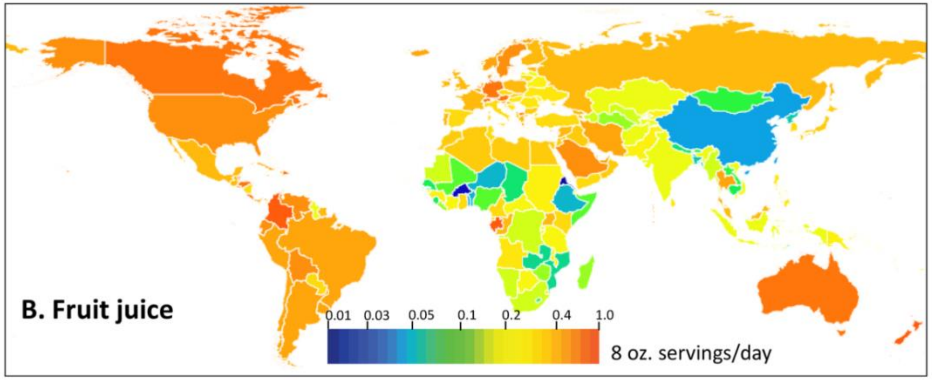
# Beverages: role in health and wellbeing

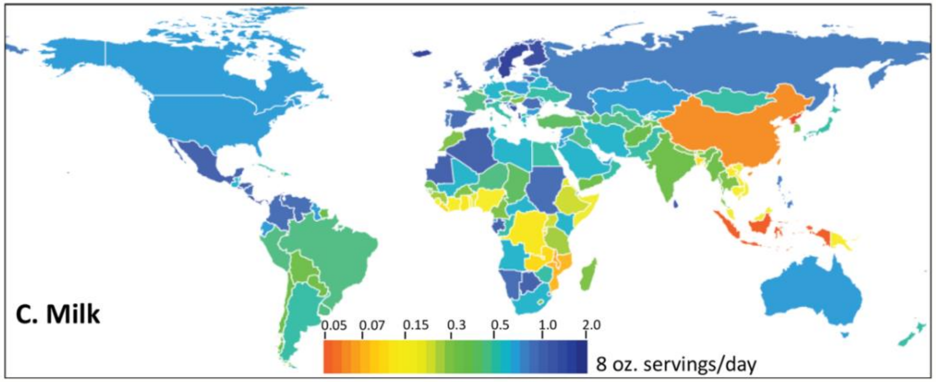
**BEVERAGES definition:**
**“Any liquid that can quench the thirst”**

- Beverage is a noun that defines any kind of liquid. Water, tea, coffee, milk, juice, beer and any kind of drinks......
- Beverage can be hot and clod or an alcohol item and the beverage can be used for every thing that you can drink but sometimes it’s define gone to style of drinks like soft drinks.

# Current consumption




*World consumption of the main beverage categories (2016)*

UNIVERSITÀ DEGLI STUDI DI TERAMO UNITE

# Beverages: classification criteria?

**Chemical "complexity"**

Simple, single ingredient (water…)

Formulated (soft-drinks, …)

**Composition**

- Presence of alcohol (alcoholic/non alcoholic)
- carbonation (still/sparkling)
- main component (fruit/vegetable/milk, ..)
- sugar (added/no added/…)

**Processing**

No processed (milk)

Pressing (juices)

Diffusion /infusion/percolation (coffee, tea, ….)

**Temperature of serving**

Cold

wam/hot

**Stability**

- fresh/short shelf-life
- shelf-stable
- …

# Beverages: innovation?

| Old (type) | Old (examples) | New/innovative (type) | New (examples) |
|---|---|---|---|
| **water** | Mineral (still/sparkling) water | **Flavoured** | Apple, lemon, … |
| **Infusion/percolation /…** | Coffee/tea | **Origin, raw materials** | Herbal infusions<br>Monovarietal coffee |
| **Natural/no processed** | milk | **Milk-based drinks** | |
| **Juices** | fruit | **Juices (e.g. seeds)** | Quinoa, rice, almond…. |
| **Juices (liquid)** | fruit | **Smooties** | Single fruit/mix |
| **Soft drinks** | Orange soft drinks…, Coca Cola, … | **Fortified/energy drinks** | Various |

**Increased importance of some quality attributes:**

- **Healthy**
- **Sensory**

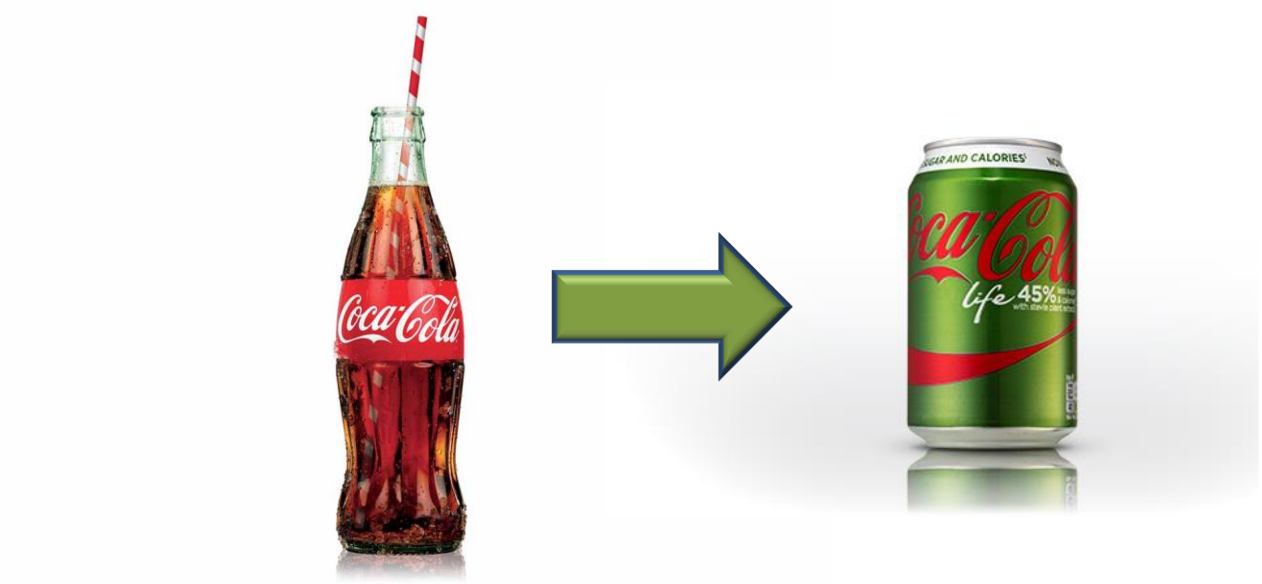
**Naturally present ⇒Added/formulated**

# Beverages: innovation?

## Four key areas of market trends of beverage innovation

### 1. Formulation

- **<u>Presence</u>** of desired ingredients (e.g. natural sweeteners, probiotics, proteins, antioxidants, ….)
- **<u>Absence/exclusion</u>** of undesired ingredients (artificial colours, high-fructose corn syrup, preservatives, caffeine, …)




| NUTRITION INFORMATION | | | |
|---|---|---|---|
| Per | 100ml | 330ml | RI(%*) |
| Energy | 98kJ/23kcal | 323kJ/76kcal | 4 |
| Fat | 0g | 0g | 0 |
| of which saturates | 0g | 0g | 0 |
| Carbohydrate | 5.8g | 19g | 7 |
| of which sugars | 5.8g | 19g | 21 |
| Protein | 0g | 0g | 0 |
| Salt | 0g | 0g | 0 |

*Reference intake of an average adult (8400kJ/2000Kcal)

**Naturally present ⇒Added/formulated**

# Beverages: innovation?

## Four key areas of market trends leading beverage innovation

### 2. Function

- Energy (sport)
- Cognitive health
- Digestive health
- Beauty and wellness
- Age
  - Children
  - Eldery
  - ....



# Beverages: innovation?

## Four key areas of market trends leading beverage innovation

### 3. Experience and convenience

- Packaging
- Serving
- Use convenience (self-cold/warm)
- Shelf-life (reduced-fresh like …. enhanced)
- ….



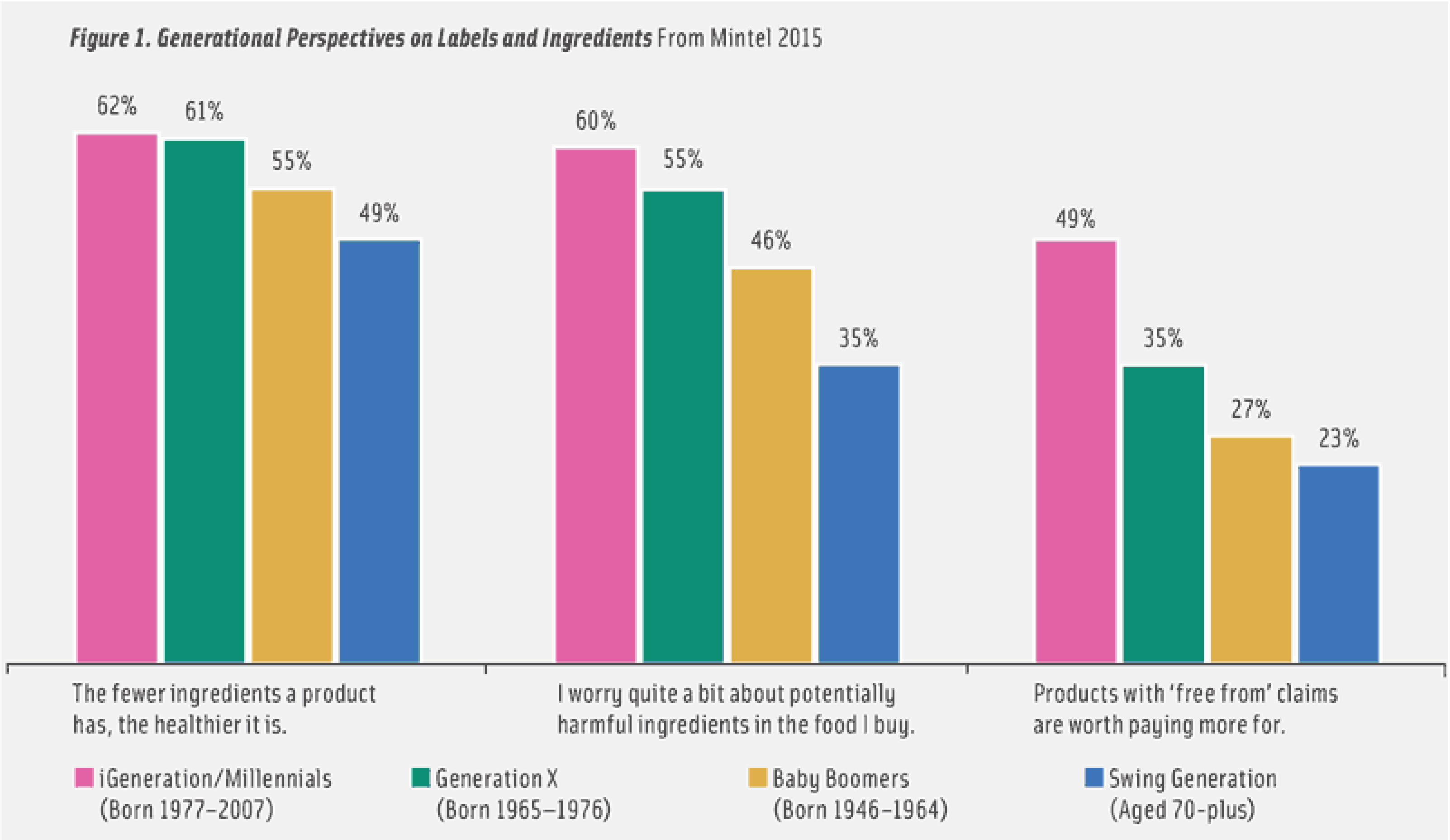
# Beverages: innovation?

## Four key areas of market trends leading beverage innovation

### 4. Taste and sensory properties

- Flavour
- Taste (sweeteness, acidity)
- viscosity and body

# Beverages: market trends

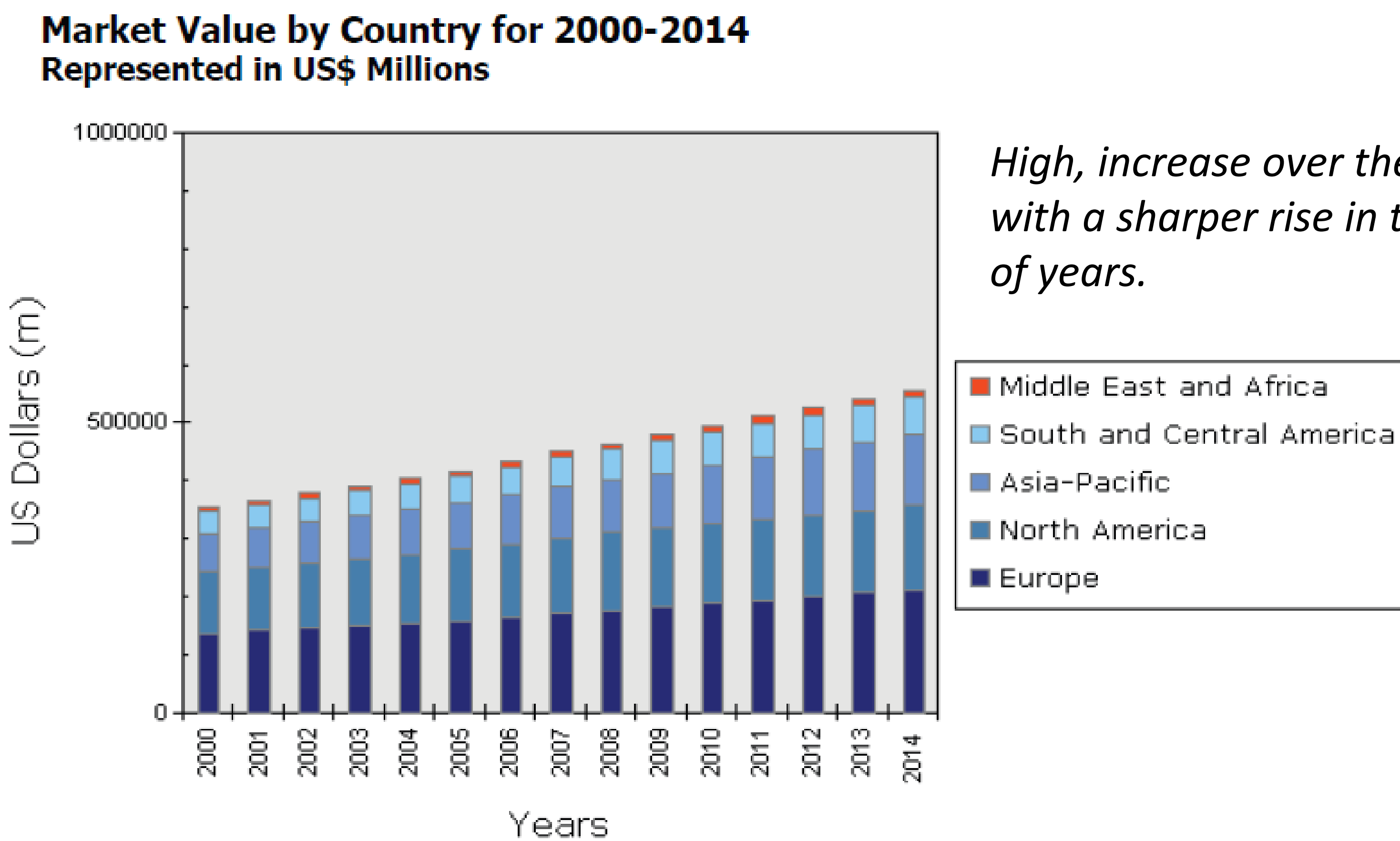



**Top 10 Functional Foods Trends**

*A. Elizabeth Sloan, Food Technology, 2016, 70 (4)*

# Beverages: market trends

## **Functional beverage** market trend

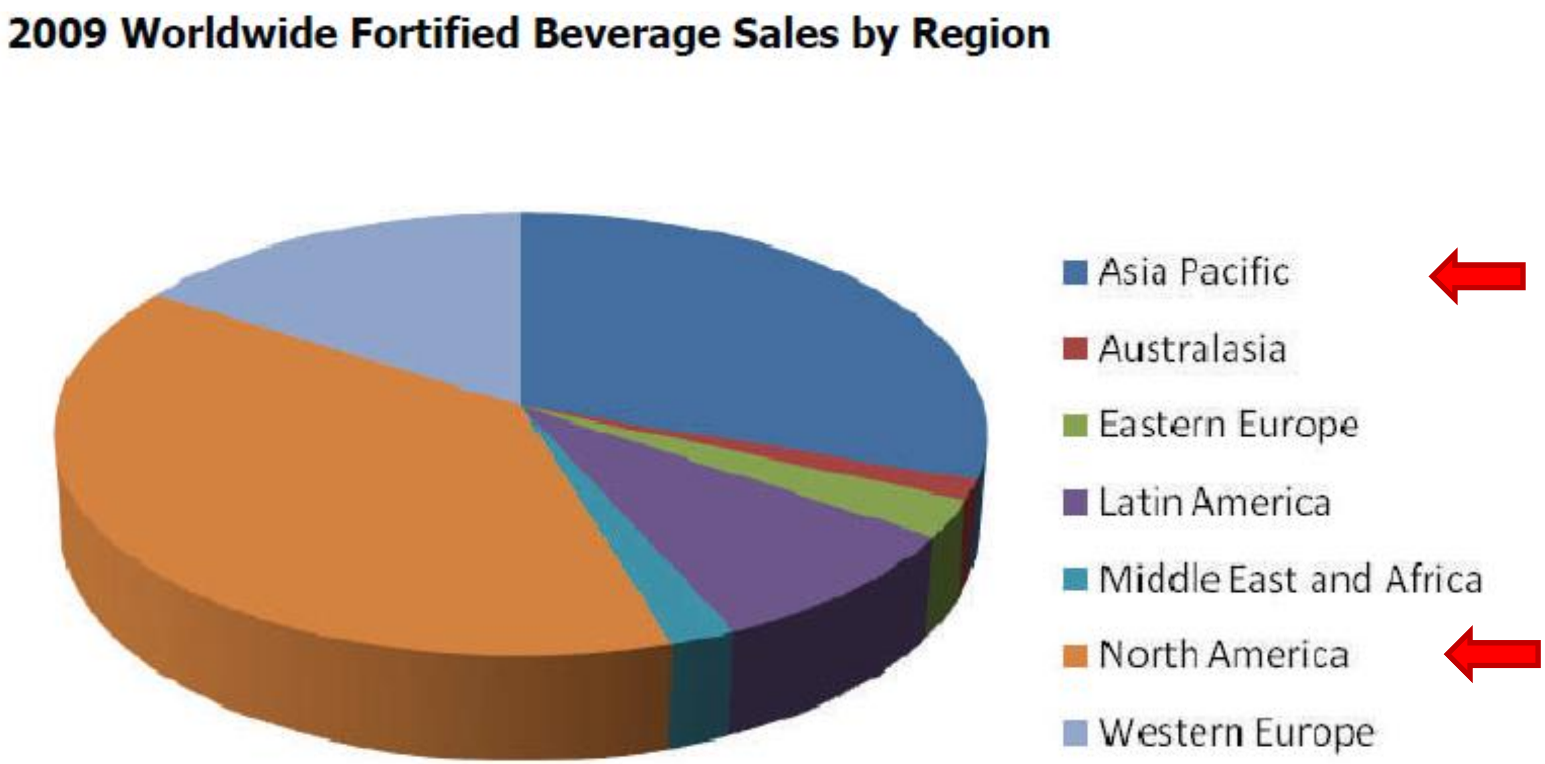



Source: Datamonitor

*High, increase over the past decade, with a sharper rise in the last couple of years.*

# Beverages: market trends

## **Functional beverage** market trend



# Beverages innovation: where and how?

1. **Processing**
    1. New technologies
    2. Optimisation of conventional technologies
    3. Combination of technologies

2. **Formulation**
    1. Target consumers
    2. Diversification
    3. New nutritional/consumption trends
    4. New raw materials/sources

3. **Convenience**
    1. Packaging
    2. Shelf-life (shorter/longer)
    3. **….**

# Beverage innovation and processing

## Use of innovative technologies

- **High Hydrostatic Pressure (fresh, refrigerated beverages and juices)**
  Stability
  Improved Quality and Healthy properties

- **High Dynamic Pressure**
  Dispersion/Homogeneisation
  Physical properties (viscosity)
  Stability

- **Radiofrequency and Pulsed Electric Fields (PEF)**
  Improved extraction juices
  Stability

# Beverage innovation and processing

- ***High Hydrostatic Pressure (case studies)***

***SAFETY AND SHELF-LIFE***

***IMPROVED QUALITY AND HEALTHY PROPERTIES***

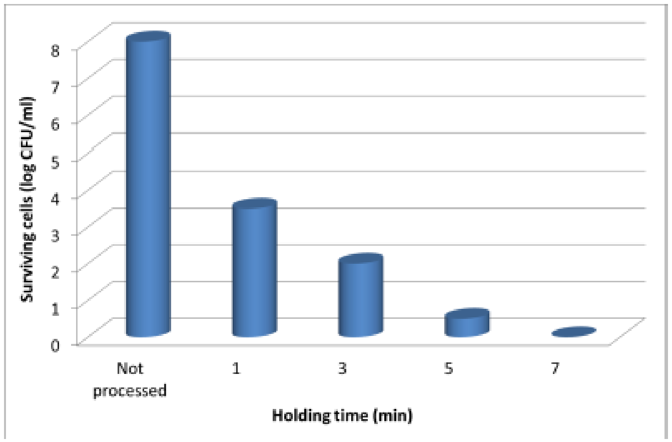
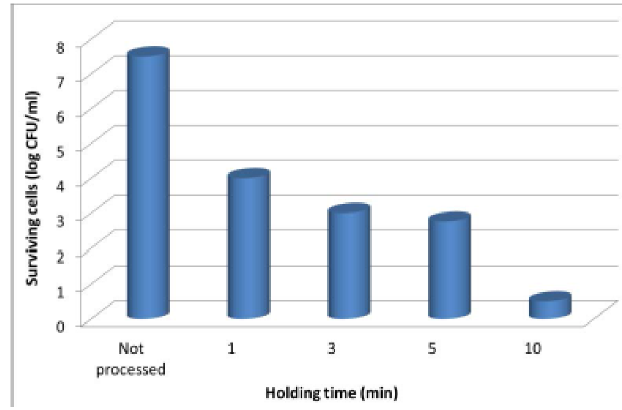



Figure 1: Total aerobic microflora of HPP orange juice *versus* holding time at 600 MPa (Erkmen *et al*. 2004)




ure 2: Total aerobic microflora of HPP peach juice *versus* holding e at 600 MPa (Erkmen *et al*. 2004)

| Juice | Pathogen | Initial counts (Not processed) (log cfu/ml) | Survival after HPP (600 MPa, 2 min) (log cfu/ml) |
|---|---|---|---|
| Orange | *E. coli* | 8.09 | 2.70 |
| | *S. enteritidis* | 8.40 | No detected |
| Grape | *E. coli* | 8.34 | No detected |
| | *S. enteritidis* | 8.09 | No detected |
| Carrot | *E. coli* | 8.10 | No detected |
| | *S. enteritidis* | 8.40 | 0.81 |
| Coconut water | *E. coli* | 7.26 | < 1 log |
| | *S.* Typhimurium | 7.11 | < 1 log |
| | *L. monocytogenes* | 7.25 | < 1 log |

Table 1: Survival of pathogens on orange, carrot, grape juice (Teo et al., 2001) and coconut water (Lukas, 2013) processed at 600 MPa during 2 min.

- ***High Hydrostatic Pressure (case studies)***

*SAFETY AND SHELF-LIFE*
*IMPROVED QUALITY AND HEALTHY PROPERTIES*

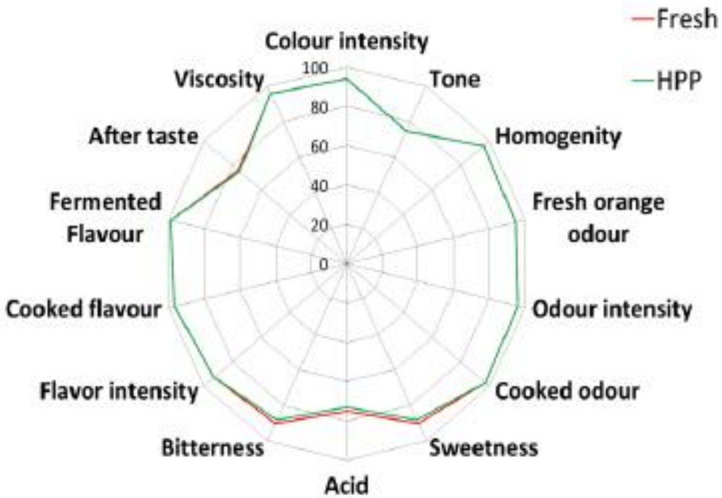



Figure 3: Sensorial evaluation by expert panelists of HPP (600MPa, 1 min) and fresh orange juice (Matser *et al.*, 2012).

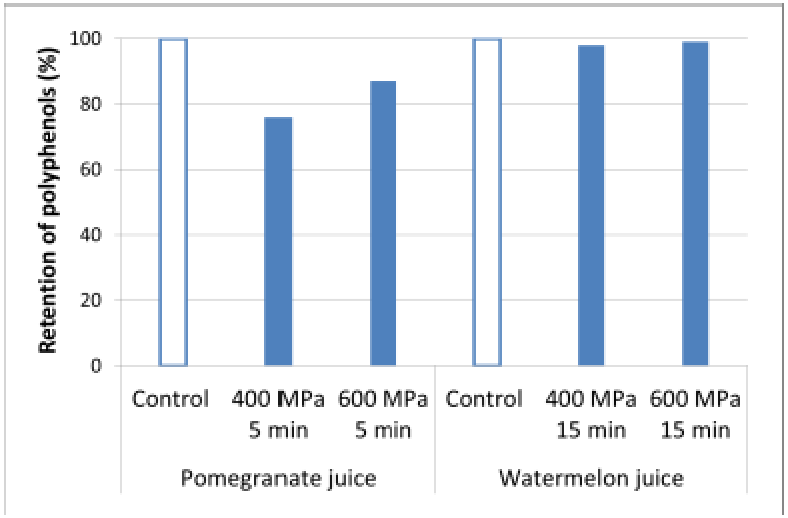



Figure 5: Retention of polyphenols in pomegranate (Ferrari et al. 2010) and watermelon juices after HPP processing (Liu et al., 2013).

# Beverage innovation & processing

## - High Dynamic Pressure

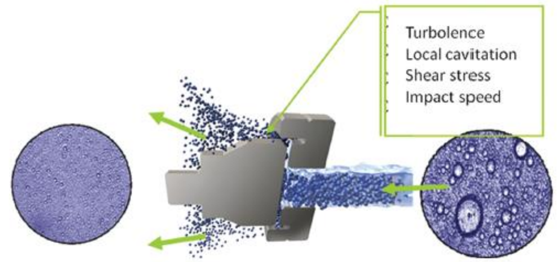


FIGURE 3 | Most probable mechanisms of action of HPH (GEA Niro Soavi, Italy).

- **Emulsification**
- **Lipid/apolar compounds dispersion**
- **Viscosity**
- **Bioactive compounds extractability**

**Microbial stability**

TABLE 1 | High pressure homogenization (HPH) microbial inactivation in relation to the model system, species and process conditions adopted.

| Matrix | Microorganisms | Reduction | Conditions | Homogenizer/type of valve | Reference |
|---|---|---|---|---|---|
| Saline solution and nisin | *Escherichia coli* K12 | 7.0 log | Tin = 5 *P* = 300 Tout = 70 | Axial-flown through orifice valve | Taylor et al., 2007 |
| PBS buffer (pH 7) | *Escherichia coli* O157:H7 ATCC 35150 | 8.0 log (after three passes) | Tin = 25 *P* = 200 Tout = NR flow 1.5 L/h | Counterjet dispergator | Vachon et al., 2002 |
| LB nutrient | *Escherichia coli* | 7.0 log | 300 MPa | Stansted high-pressure homogenizer (model FPG11300:350 | Donsì et al., 2009b |

*Pittia P., Design and development of innovative beverages*

# Beverage innovation & processing

## - High Dynamic Pressure

**TABLE 2 | High pressure homogenization microbial inactivation in relation to the food matrix, species and process conditions adopted.**

| Matrix | Microorganisms | Reduction | Conditions | Homogenizer/type of valve | Reference |
|---|---|---|---|---|---|
| Milk | *Yersinia enterocolitica, Listeria monocytoges* | *Yersinia enterocolitica* 5 log at 150 MPa *Listeria monocytogenes* : the same | *P* range = 40–150 MPa Tout max = 65 | PS valve, Gea Homogenizer | Lanciotti et al., 1994 |
| Egg yolk 10%, yoghurt 13%, sunflower oil 60%, water in relation to pH and NaCl | *Salmonella enteritidis* | Reduction was obtained at 50 MPa with pH 4 and 2% NaCl. No re-growth at 10°C | *P* range = 0.1–50 MPa | PS valve, Gea Homogenizer | Guerzoni et al., 2002 |
| Skim, soy, and strawberry-raspberry milk | *Escherichia coli* MG1655 | Skim 3.5 log Soy 3.0 log Straw/rasp 3.0 log | Tin = 25, *P* = 300 MPa, Tout = 18 | Counterjet dispergator | Diels et al., 2005 |
| Bovine milk | *Pseudomonas fluorescens* AFT 36 | 6 log | Tin = 45 *P* = 250 Tout = 76.8 | Axial-flown through orifice valve | Hayes et al., 2005 |
| Milk | *Staphylococcus aureus* CECT 976 | 7 log | Tin = 20 *P* = 330 Tout = NR flow 16 L/h | Axial-flown through orifice valve | López-Pedemonte et al., 2006 |
| Orange juice | *Escherichia coli* O58:H21 ATCC 10536, *Escherichia coli* O157:H7 CCUG 44857 | 3.9 log (O58:H21) 3.7 log (O157:H7) | Tin = 20 *P* = 300 Tout = NR, flow 18 L/h | Axial-flown through orifice valve | Brinez et al., 2006b |
| Milk | *Listeria innocua* ATCC 33090 | 2.7 log | Tin = 20, *P* = 300; Tout = NR, flow = 18 L/h | Axial-flown through orifice valve | Brinez et al., 2006a |
| Milk and orange juice | *Staphylococcus aureus* ATCC 13565 | Milk 3.6 log Orange juice 4.2 log | Tin = 20 *P* = 300 Tout = 18 flow 18 L/h | Axial-flown through orifice valve | Brinez et al., 2007 |

*Patrignani & Lanciotti, 2016*

# Beverage innovation & processing

## - High Dynamic Pressure: no effects on spores!

**Table 1 | Overview of literature on non-successful HPH/UHPH inactivation of bacterial spores.**

| Equipment | Matrix | Spore strain | Initial count (spore/mL) | Maximal reduction [$\log_{10}$ ($N/N_0$)] | Pressure (MPa) | $T_{inlet}$ (°C) | Max $T_{valve}$ (°C) | Source |
|---|---|---|---|---|---|---|---|---|
| Microfluidizer® | Ice cream | *B. licheniformis* ATCC 14580 | 2.00E + 04 | 0.55 | 200 | 50 | ? | (18) |
| Niro Soavi homogenizer | Double distilled water | *B. cereus* SV3, SV98, *B. subtilis* SV50, SV108 | 1.00E + 07 – 1.00E + 08 | <0.5 with single pass – five with three cycles | 150 | 20 | ? | (21) |
| Panda – Niro Soavi | Laboratory medium at pH 4.5 and 3.5 | *A. acidoterrestris* DSMZ 2498, Γ4, and c8 | 1.00E + 05 | 0.67 (140–170 MPa) | 140–170 | ? | ? | (19) |
| Panda – Niro Soavi | Malt extract broth (pH 4.5) and apple juice (pH 3.7) | *A. acidoterrestris* DSMZ 2498 and Γ4 | 1.00E + 05 | 0.82 ± 0.07 | 140 | ? | ? | (23) |

Georget et al, 2014

# Beverage innovation & processing

## - New technologies : Pulsed Electric Fields

**EXTRACTION purposes**

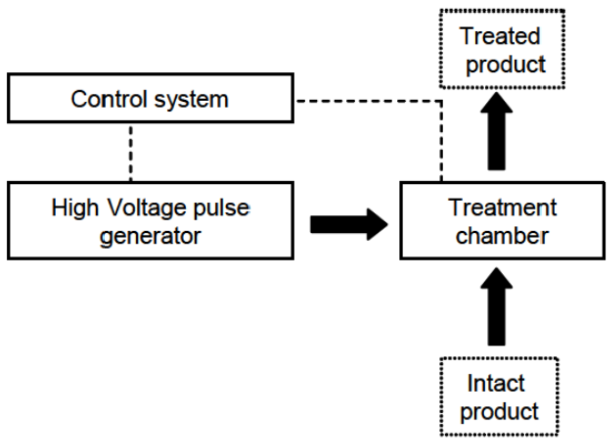



**Figure 3.** Scheme of a pulsed electric field system for food processing.

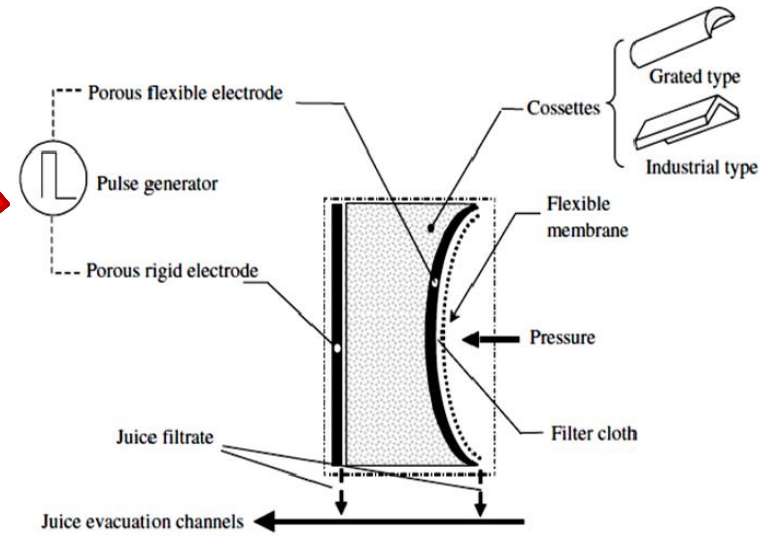
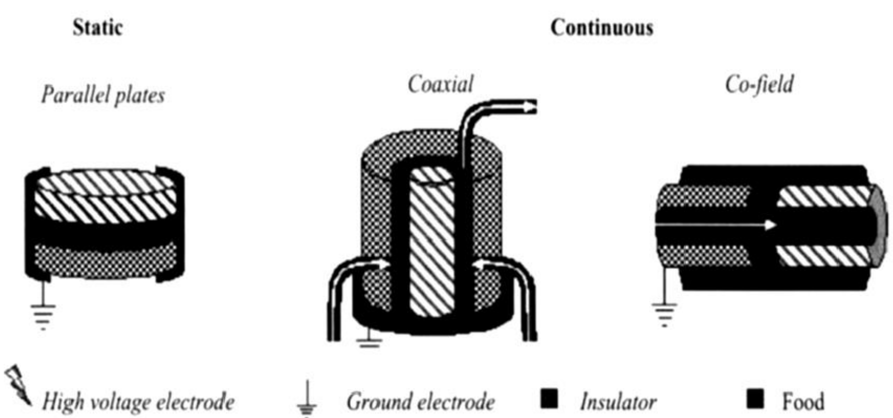



**Figure 11.** Schematic of a one chamber configuration of plate and frame filter press




**STABILISATION purposes**

**Figure 8.** Schematic configurations of the three most used PEF treatment chambers.

Mohamed & Amer Eissa, the book Structure and Function of Food Engineering Downloaded from: http://www.intechopen.com/books/structure-and-function-of-foodengineering

# Beverage innovation & processing

- **New technologies** : **need to be optimised for enzymatic stability and quality over storage time**

R.A.H. Timmermans et al. / Innovative Food Science and Emerging Technologies 12 (2011) 235–243

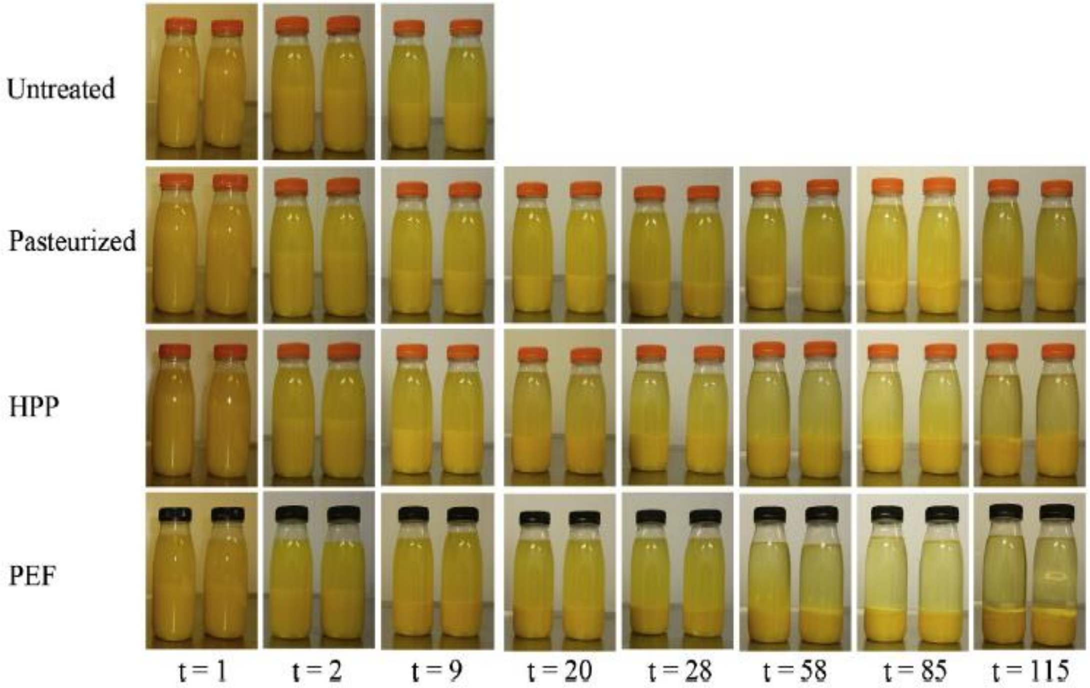



**Fig. 6.** Observed sedimentation and cloud loss of untreated, mild heat pasteurized, high pressure pasteurized (HPP) and pulsed electric field (PEF) processed orange juice bottles during the first 115 days of storage at 4 °C.

Similar microbial quality and stability of orange juices treated by HT, HP and PEF

**HPP & PEF =** sedimentation and cloud degradation due to activity of PME

**HHP, PEF, …may enhance the activity of enzymes (several causes): need of optimisation**

# Beverage innovation & processing

## - New technologies : HHP…new approaches

HPP of enzymes in fruit purees & juices . . .

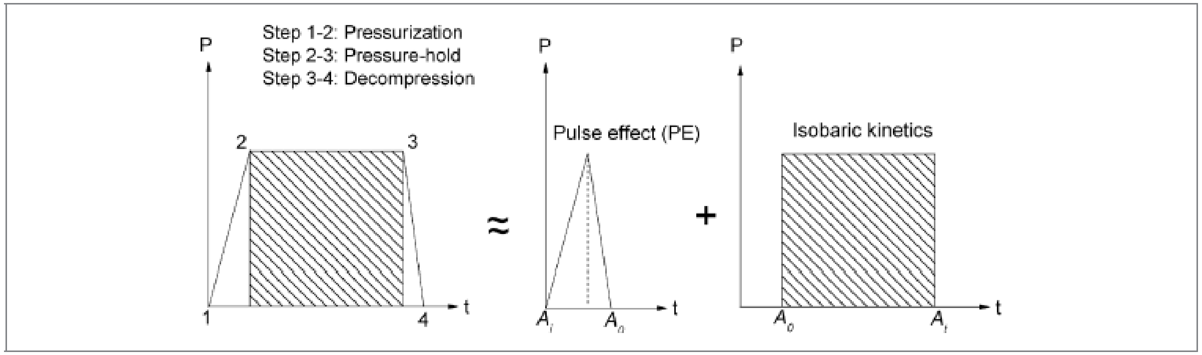



Figure 2–Mechanism of segregation of pulse-pressure and pressure-hold period for kinetic modeling describing the effects of HPP on enzyme activity; *P* and *t* denote the pressure and processing time, respectively.

Table 2–Effect of pulse pressure on the enzymes in fruit purees and juices.

| Sample (medium) | Enzyme | Target *P*/*T* in (MPa/°C) | CUT/DCT> in (min/min) | Activation or inactivation | Maximum *PE* (log) values (treatment condition) | Reference |
|---|---|---|---|---|---|---|
| Apple juice (pH 3-4; 12 °Brix) | Amylase | 100-400/6-40 | 0.5-3/<0.15 | Inactivation | 1.79 (400 MPa/30 °C/pH 3) | Riahi and Ramaswamy (2004) |
| Pineapple puree (pH 3-4; 12 °Brix) | PPO and POD | 200-500/30-60 | 0.8-1.8/<0.15 | Inactivation | 0.332 (PPO) and 0.319 (POD) (500 MPa/60 °C/pH 3) | Chakraborty and others (2013) |
| Strawberry puree (pH 3.52; 6.5 °Brix) | PPO, PME, and PG | 200-600/40-80 | 0.25-0.75/<0.15 | Inactivation | 0.135 (PPO), 0.223 (PME), and 0.315 PG) (600 MPa/80 °C/30% added sugar) | Chakraborty (2012) |
| Litchi juice (pH 4) | PPO and POD | 300-600/30 | 1.1-2.11/<0.15 | Activation for both (max.> 130% and 225%, respectively, at 300 MPa) | – | Kaushik and others (2013) |
| Apple juice (pH 3.5, 12 °Brix) | PME | 250-400/25 | 1.5-3/<0.25 | Inactivation | 1.05 (400 MPa/25 °C/-) | Riahi and Ramaswamy (2003) |

*P*, pressure; *T*, temperature; CUT, pressure come-up time; DCT, decompression time; *PE*, pulse-effect (calculated using Eq. 6); Max., maximum.

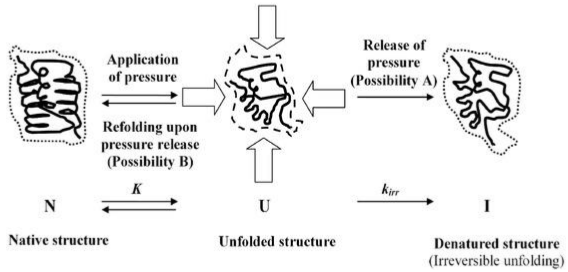
Comprehensive Reviews in Food Science and Food Safety • Vol. 13, 2014

## - New technologies : HHP and enzyme inactivation

Table 6–Summary of high-pressure inactivation of nonoxidative and nonpectic enzymes in fruit purees and juices.

| Sample (medium) | Enzyme investigated | Range given as MPa/min/°C/ others, if any | Max. inactivation at (MPa/min/°C/ others, if any) | Other observation | Reference |
|---|---|---|---|---|---|
| Kiwifruit juice | Actinidin | 200-800/-/25-50 | – | 90% inactivation at 500 MPa/3.2 min/50 °C; *P–T* synergy at > 600 MPa, > 40 °C; 26-fold rise in *k* from 25 °C to 50 °C at 600 MPa | Katsaros and others (2009) |
| Apple juice (pH 3 to 4, 12 °Brix) | Amylase | 100-400/0-60/6-40 | 90% (400/30/22/pH 3) | 30.5% and 93.1% inactivation due to pulse pressure at 100 and 400 MPa, respectively. | Riahi and Ramaswamy (2004) |
| Tomato juice (Cv. Admiro) | LOX | 100-650/12/20 | 100% (550/12/20) | Activation at < 400 MPa | Rodrigo and others (2007) |
| | HPL | 100-650/12/20 | 80% (650/12/20) | 20% inactivation at 300 MPa/12 min/20 °C | |
| Tomato puree (21.4 °Brix) | LOX | 100-650/0-58/10-60 | – | Maximum $k = 0.5835$ min$^{-1}$ at 650 MPa/20 °C; *P–T* were antagonistic at $T \geq$ 50 °C and $P <$ 300 MPa | Rodrigo and others (2006) |

*P*, pressure in MPa; *T*, temperature in °C; *k*, Inactivation rate constant in min$^{-1}$; Max., maximum.

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**AIMS**

- Convenience and easy use
- New materials
- Sustainability and environmental friendly


**Mineral water «Sant'Anna» Bio Bottle** : bioplastic (PLA) obtained from plants (corn, cassava, sugar cane or beets, Ingeo™)
**- biodegradabie: 100%** (80 days under compostable conditions)

# Beverage & packaging innovation


***Glass closures for glass whisky bottles (New Master of Malt)***


***Can with an integrated straw (Ball Packaging Europe)***

# Beverage & packaging innovation

***Flexible multi-layer stand-up pouch, with an intermediate seal which forms two separate compartments (Mixpack)***


***Fully compostable cup (Reduce.Reuse.Grow. )***
***The cup is studded with seeds for native Californian wildflowers that will come to life post-use.***
***Eventually the cups could be made based on location, so that each cup contains native seeds from the area it is served.***

# Beverage & <u>packaging innovation</u>


***New edible coffee cup called the Scoff-ee (KFC & The Robin Collective )***
***The packaging is made from biscuit, sugar paper and white chocolate.***
***The cup looks similar to the standard KFC cup.***

# Beverage innovation & formulation


Fortitech, 2016

# Beverage innovation & formulation

**Besides water……naturally present/added**

## IN THE PAST…..

| | Nutritional value | Technological functionality | Energy | Sensory properties |
|---|---|---|---|---|
| **proteins** | **YES (eg. Milk)** | emulsifiers | **YES** | Colour/visual |
| **HMW carbohydrates** | **YES** | Viscosity/stabilisation | **YES** | Viscosity/body |
| **LMW carbohydrates** | **YES** | Viscosity<br>Stability (aw) | **YES** | Sweeteness |
| **Lipids** | **YES** | Apolar compounds vehicle, emulsions | **YES** | Aroma/colour |
| **Odorous volatile compounds** | **NO** | Sensory properties | **NO** | Aroma |
| **Pigments** | **NO** | Sensory properties | **NO** | Colour |
| **Acids** | **NO** | Stability (pH)<br>Sensory properties | **NO** | Acidity |

# Beverage innovation & formulation

Besides water……naturally present/added

## INNOVATIVE

| | Technological functionality | examples | Others |
|---|---|---|---|
| **Antioxidants** | Healthy properties Stability | vitamins A, C, and E Phenolic compounds, …. | Boost immune system, improve Blood circulation, mental activity |
| **Prebiotic/probiotic** | Healthy properties (gut) | inulin, fructooligosaccharides (FOS), lactulose Various m.o. | Ability to reduce diseases (e.g. osteoporosis), to lower triglyceride and cholesterol levels; to combat food allergies |
| **Minerals** | Healthy properties | Ca, Mg, K, Fe, … | *Various* |
| **Vitamines** | Healthy properties | Vitamines B, C, … | *Various* |
| **Amino Acids** | Energy and healthy properties (sport/energy drinks) | L-Leucine, L-Isoleucine, and L-Valine | Muscle development, recovery from injury; aid in the growth and strengthening bones, improved immune system |
| **Nutraceuticals** | Physiological/metabolic effects | Fibers, omega 3-FA, … | Various |
| **Psyco-active compounds** | Energy, menthal | Caffeine, taurine, … | |

# Beverage innovation & formulation

## Besides water……naturally present/added

## INNOVATIVE

| Product group | Products/product ranges | Forms | Typical applications*** |
|---|---|---|---|
| Carotenoids | Lucarotin® [Beta-carotene, E 160a (ii)] | Powder, emulsions, dispersions* | Soft drinks, juices & juice mixes, beer/beer mixes, instant powder drinks |
| | Natural Beta-carotene with mixed-carotenoids from algae E160a (i) | Powder, suspensions* | Soft drinks, juices & juice mixes, instant powder drinks |
| | LycoVit® (Lycopene, E 160d) | Oil, powder | Soft drinks, juices & juice mixes, instant powder drinks |
| | Xangold® (Lutein, Lutein ester, E 161b) | Oil, powder | Soft drinks, juices & juice mixes, instant powder drinks |
| Beverage clarifiers/ stabilizers | Divergan® | Powder (used in filtration/ clarification step, not used in end-product directly) | Wine and beer, ready-to-drink tea |
| | Crosspure® | Powder (used in filtration/ clarification step, not used in end-product directly) | Wine and beer, ready-to-drink tea |
| Caffeine | Caffeine | Powder | Soft drinks, juices & juice mixes, beer/beer mixes, instant powder drinks |
| Vitamins** | Vitamin A | Oil, powder | Soft drinks, juices & juice mixes, instant powder drinks |
| | Vitamin E | Oil, powder | Soft drinks, juices & juice mixes, instant powder drinks |
| | Vitamin $B_2$ (Riboflavin) | Powder | Soft drinks, juices & juice mixes, beer & beer mixes, instant powder drinks |
| Health Ingredients & Lipids | Tonalin® Conjugated linoleic acid (CLA) | Oil, powder | Soft drinks, juices & juice mixes, instant powder drinks |
| | Vegapure® Plant sterols | Oil, powder | Soft drinks, juices & juice mixes, instant powder drinks |

* Oils/dispersions are available for producers of colorant emulsions.

** Other vitamins ($B_5$, $B_{12}$, $D_3$, K) as well as antioxidants (D,L-alpha-tocopherol, natural mixed-tocopherol) are available for use in beverages, other food applications, flavours and colorants.

*** Where regulations allow use.

*www.basf.com*

# Beverage innovation & formulation

Besides water……naturally present/added

**INNOVATIVE…functional ingredients in mix**

**Antioxidant Cocktail for Healthy Aging**

| Nutrient | Per Serving/Dosage |
|---|---|
| Vitamin E | 20% |
| Vitamin C | 25% |
| Beta-Carotene | 0.25 mg |
| EGCG | 20 mg |
| Resveratrol | 20 mg |
| Coenzyme Q10 | 4 mg |
| Lycopene | 1 mg |
| Lutein | 1 mg |
| Zeaxanthin | 0.5 mg |
| Niacin | 10% |
| Calpan | 10% |
| Vitamin B6 | 10% |
| Biotin | 10% |
| Vitamin B12 | 10% |
| Omega 3 | 40 mg |

**Energy Stick Pack**

| Nutrient | Per Serving/Dosage |
|---|---|
| Coenzyme Q10 | 5 mg |
| L-Carnitine | 15 mg |
| D-Ribose | 50 mg |
| Magnesium | 40 mg |
| Taurine | 100 mg |
| Caffeine | 40 mg |
| Niacinamide | 2 mg |
| Pantothenic Acid | 2 mg |
| Vitamin B6 | 1 mg |
| Vitamin B12 | 2 mg |
| Vitamin C | 12 mg |

# Beverage innovation & formulation

Besides water……naturally present/added

**INNOVATIVE…new flavour trends**

| Flavor | 2006 | 2009 |
|---|---|---|
| Orange | 5.9% | 4.6% |
| Lemon | 7.6% | 4.1% |
| Apple | 3.9% | 3.7% |
| Strawberry | 2.6% | 3.7% |
| Chocolate | 2.6% | 3.0% |
| Vanilla | 2.6% | 2.9% |
| Grape | 2.1% | 2.6% |
| Berry | 3.1% | 2.4% |
| Pomegranate | 0.4% | 2.4% |
| Peach | 2.3% | 2.3% |
| Mango | 1.2% | 2.3% |
| Citrus | 2.4% | 2.1% |
| Lime | 3.3% | 1.9% |
| Grapefruit | 2.1% | 1.7% |
| Blueberry | 0.7% | 1.6% |

Source: Business Insights

*Pomegranate*
*Strawberry*
*Mango*
*Tropical*
*Blueberry*
*Acai*
*Pear*
*Grape*
*Tangerine*
*Chocolate*
*Coffee*
*Goji*
*Ginseng*
*Almond*
*Mandarin*
*Vanilla*
*Blackberry*
*Dragon fruit*
*Blood orange*
*Cinnamon*

# Beverage innovation & <u>formulation</u>

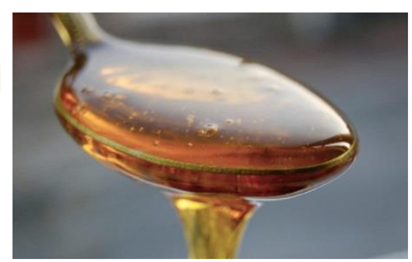
Besides water……naturally present/added

**INNOVATION: sweeteners**

- **Naturally present (fruit juices)**
- **No sugar** (sucrose, fructose, ….)
- **Sweeteners** (alternative, intensive)
- **Natural/plant extracts** (stevia, honey, agave, …

**Re-formulation for stability and sensory perception…**



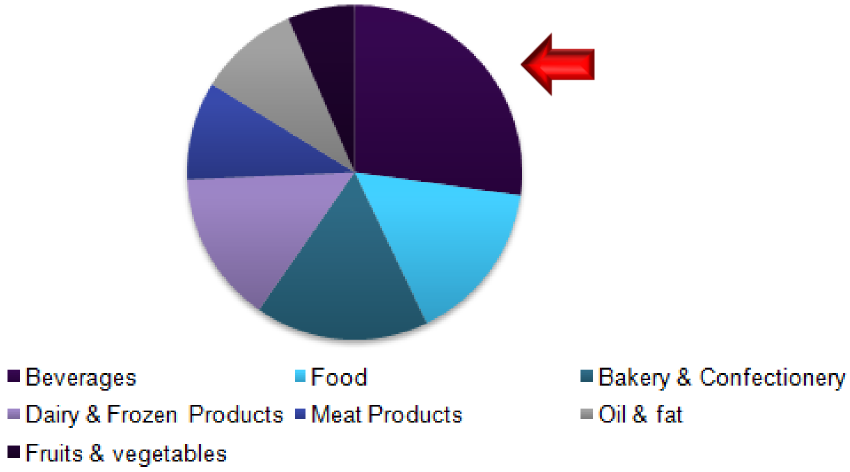



# Beverage innovation & formulation

Besides water……naturally present/added

**INNOVATION: Colours**

- ***Artificial/syntetic*** *(authorised by law)*
- **Naturally present (pigments from fruit and vegetables)**
- **Colouring foodstuff** (EU regulated)




*Global natural food colors revenue share, by application, 2015 (%)*

http://www.grandviewresearch.com/industry-analysis/natural-food-colors-market, 2017

Besides water……naturally present/added

## INNOVATION: Colours

- **Colouring foodstuff** (EU regulated): f***ood extracts with colouring properties***

***EC guidelines for the classification and use of colouring food in food products (29 Nov 2013 EC)***

**AIM:** simple e practical differentiation test to discriminate additive food colours and colouring foods

***Video on EC guidance notes:*** ***https://www.youtube.com/watch?v=0-u8dIGQyfc***

# Beverage innovation & formulation

Besides water……naturally present/added

**INNOVATION: Colours**

- **Colouring foodstuff**

***Main issues:*** *stability (highly sensitive to pH, light, temperature and other matrix and environmental conditions, …*


*Thermal stress*

*pH stress (3.3)*

# Beverage innovation, traditional/conventional products

**…need to improve appealing of traditional/conventional products**

<u>Example</u>: Fruit juices

- Introduction of new cultivars (higher polyphenolic content)
- Alternative processing methods to preserve

bioactive compounds

- blending and formulation of apple juice to further improve the health benefits and functionality (carrot juice, ….)
- New pressing conditions (use of pectolytic enzymes) or concentration (osmotic concentration)

# Innovation, quality and stability issues

**Any change/action on processing and formulation of a beverage requires an optimisation step to identify factors affecting its expected quality, safety and stability.**

**Stability**

- microbial
- enzymatic
- physical (e.g. colloidal)
- chemical (e.g. oxidation)

***When tea steeps, volatile flavor and aroma compounds** are released. This is fine for consumers enjoying a cup of tea at home, but manufacturers of tea ingredients want to ensure that these compounds are not lost during production. They use a process that captures the compounds to develop a final tea extract that is as close to freshly brewed tea as possible.* © xfotostudio/iStock/Thinkstock

# Innovation, quality and stability issues

**Any change/action on processing and formulation of a beverage requires an optimisation step to identify factors affecting its expected quality and stability.**

**Formulation**

- ***selection ingredients and additives***
- ***recipe/formulation***

**Processing main factors:**

- ***Technological parameters***
- ***Formulation properties***
  - ***pH (high, low acidity)***
  - ***Ingredients (nutrients, natural/added antioxidants….)***
  - ***expected shelf-life (stability: microbial, enzymatic, …)***

***When tea steeps, volatile flavor and aroma compounds*** *are released. This is fine for consumers enjoying a cup of tea at home, but manufacturers of tea ingredients want to ensure that these compounds are not lost during production. They use a process that captures the compounds to develop a final tea extract that is as close to freshly brewed tea as possible.* ©xfotostudio/iStock/Thinkstock

# Conclusions

**Innovation in Processing & Beverage Design and Development require adequate knowledge, scientific and technological skills and competences.**

***THANKS FOR YOUR ATTENTION***

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*Author claims no conflict of interest.*