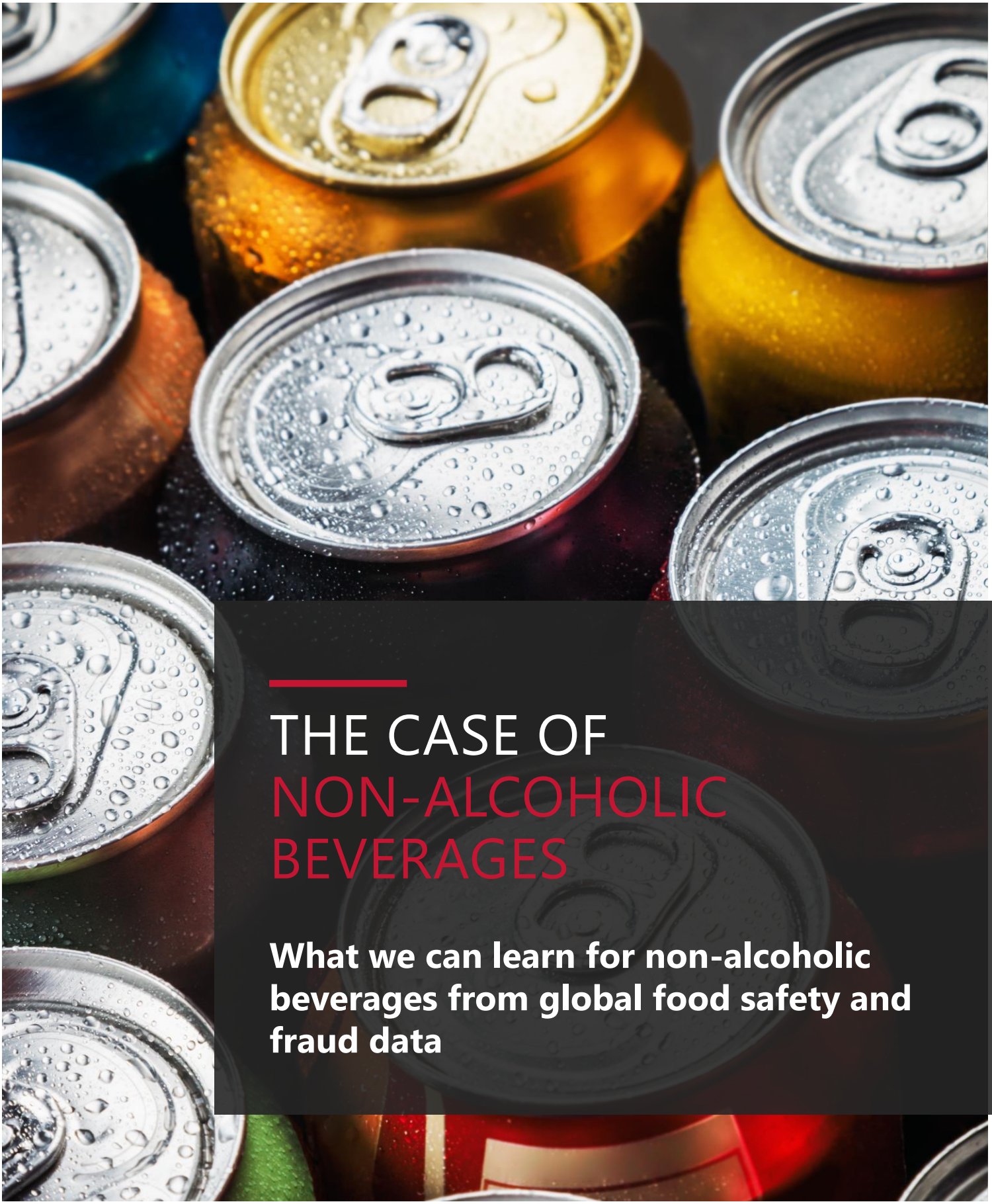
FOODAKAI

INDUSTRY REPORT SERIES



THE CASE OF NON-ALCOHOLIC BEVERAGES

What we can learn for non-alcoholic beverages from global food safety and fraud data

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DEFINITIONS

INCIDENTS BASED RISK ESTIMATION APPROACH

The following **risk estimation formula** is being used for the estimation of the risk, where:

Risk = Incident x Hazard Severity x Probability

Incident Severity: is the **severity based on the type of the incident** (e.g. food recall, food alert, border rejection). A table with the severity classification values mapped to incident types is presented later in this document.

Hazard Severity: is the **severity of the hazard based on the health impact**. The hazard severity is classified as: 1, 2, 3 and follows the classification defined by organizations such as FDA. e.g listeria spp=3, pesticide=2. Detailed values for the hazard severity are presented later in this document.

Probability: is **the probability of the specific hazard to occur** for the specific ingredient. The estimation of the probability is based on the frequency of the incidents that the FOODAKAI collects and processes every day.

The **estimated risk** is classified as **Low**, **Medium** and **High**.

- 1- 15 = I - Low
- 16 - 24 = II - Low
- 25 - 48 = III - Medium
- 49 - 75 = IV – High

The **formula** for the **estimation** of the **tendency** is:

$$\textbf{\textit{Tendency}} = \frac{Risk\ for\ the\ period\ of\ the\ last\ 12\ months - Risk\ for\ the\ period\ of\ N-12\ months}{Risk\ for\ the\ period\ of\ last\ N-12\ months} \%$$

where N = 36 months or 60 months

If the **tendency** is **negative**, then we have a **decrease** and if the **tendency** is **positive** we have an **increase** of the risk.

DEFINITIONS

HAZARD PERCENTAGE

The percentage for each hazard (%) in the insights bar charts is estimated based on the occurrences of the hazards in incidents. There are cases where a single incident (e.g. a recall) may contain more than one hazard types (e.g. both chemical and biological hazards).

INCIDENTS

Under the term of incidents are collected all food safety related incidents that are announced by official sources, of national and international food safety authorities, customs, ministries for food, health and the environment. As "incidents" are classified all following terms: food recalls, border rejections, food alerts, public announcements, official information announcements, information for attention, import refusals, import alerts, enforcement reports, imported food reports and consumer advisories.

FOREWORD

The non-alcoholic beverage sector plays a key role in the global economy, as it is among the top performing F&B industries. According to the American Beverage Association [1], the direct impact of the industry accounts for 182.6 billion dollars. Among others, soft drinks, juices and functional drink products rely on high-quality ingredients and raw materials, strict supplier partnership schemes and conformity to a wide range of quality and safety standards. When it comes to food safety, there have been several recall incidents over the last few years associated with non-alcoholic beverages.

Especially during the last decade, incidents relating to chemical hazards are the top concern in the non-alcoholic beverage sector, with food additives and flavourings being among the main associated ingredients that have been reported on a global scale.

Non-alcoholic beverages constitute **a diverse group of products**. There are several ways in which they are classified, e.g. on the basis of their sugar and fruit juice content, flavoring, carbonation level, main non-water ingredients, and functionality.
The **main categories** of non-alcoholic beverages that this industry report covers are:

- **Soft Drinks**
- **Juice Drinks**
- **Juices**
- **Energy Drinks**
- **Water**
- **Functional Drinks**

FOREWORD

With the exception of water, the most popular types of non-alcoholic beverages are: **(i) ready-to-drink essence-flavored beverages** (categorized as **soft drinks**); **(ii) ready-to-drink beverages containing 100% fruit juice or fruit juice and other ingredients** (categorized under **juice** or **juice drinks**, respectively); **(iii) functional and energy drinks**. As for the last category, it is a rapidly growing subsector of the market and includes enric**he**d (with vitamins and minerals) **drinks**, **sports** and **energy drinks**, as well as **wellness drinks** and **nutraceuticals**. Many functional drinks have been developed to provide specific medical or health benefits, such as promoting heart health, improving immunity and digestion, and acting as energy boosters.

In the last three years, the industry has shifted towards more **"natural" non-alcoholic beverages**. Beverage manufacturers go to great lengths to **source fruit and vegetables of the highest quality**, to produce **mildly-processed beverages** that are placed in premium retail positions. In addition, demand for **plant-based protein** is constantly increasing in tandem with the emphasis producers are placing on **purity**, **heritage** and **transparency** of production and the **functional** and **health benefits** of their drinks (especially in the case of fruit juices).

In this transformative age, **food and beverage supply chains are getting more complex** and should be readily **adaptable** to the **changing landscape** of the non-alcoholic beverage sector, covering the diverse needs of multiple stakeholders, including, among others, consumers, producers and processors, regulatory bodies and certification companies. In the constant race for **smarter, adaptive food safety** and quality management systems, **digital technology** is anticipated **to play an increasingly significant supporting role** for all actors in the beverage industry.

A. NON-ALCOHOLIC BEVERAGES: HAZARDS AND FRAUD STATISTICS

There are many **web sources** that publish information on food safety and fraud incidents.

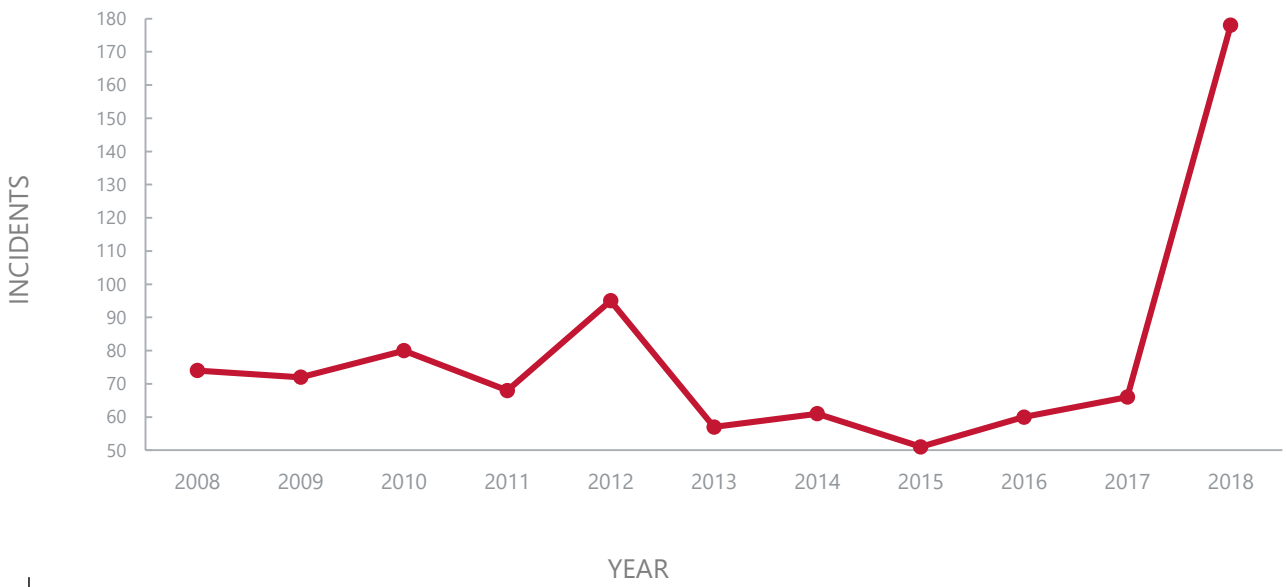
Examples of such sources include the **European Commission's Rapid Alert System for Food and Feed** (RASFF) database, regulatory and statutory authorities such as the **United States Food and Drug Administration** (US FDA), the **Japanese Ministry of Health and Food Standards Australia New Zealand** (FSANZ), as well as various professional portals like "**Food Safety News**" and "**Food Safety Tech**".

Such **information** can be **used** to **identify critical food protection trends**, including **food safety** and **authenticity**, for different food and beverage products.

A **review** of this **publicly available information**, clearly **shows** a considerable **increase** in **food safety** and **food fraud-related recall incidents for non-alcoholic beverages** during the last decade.

INCIDENT TRENDS IN NON-ALCOHOLIC BEVERAGES (2008-2018)

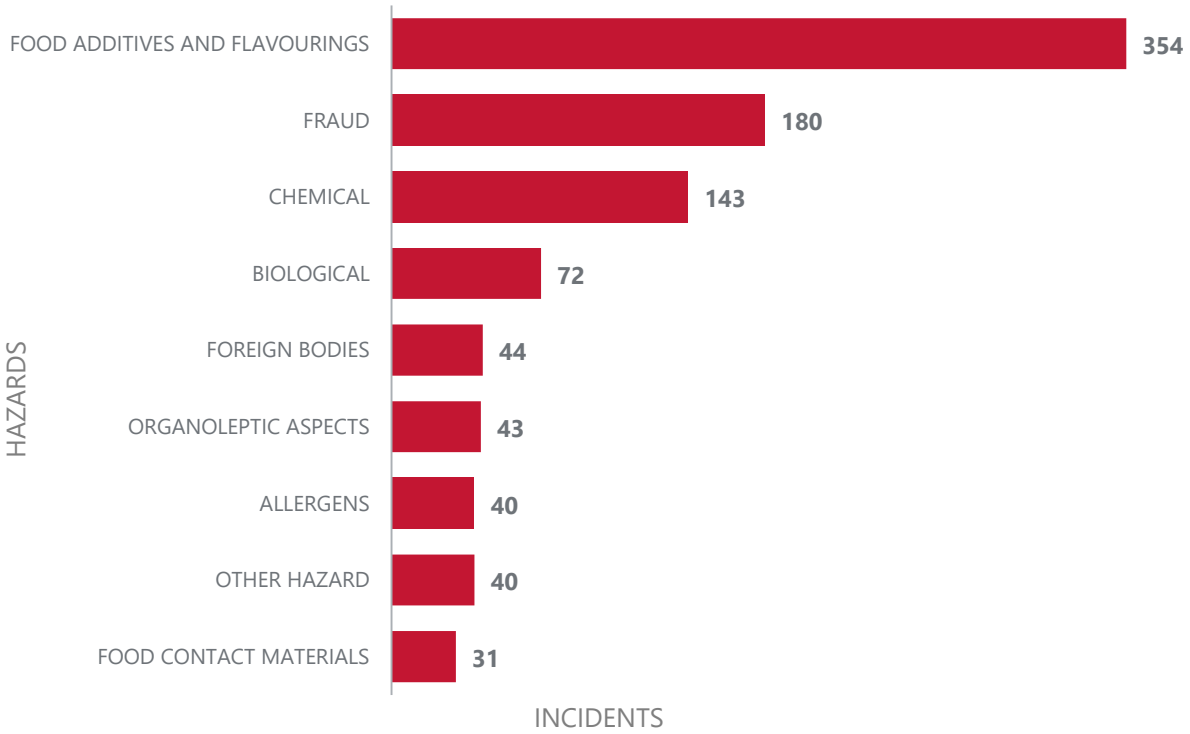
The available data from 47 official sources (for example: European Union RASFF, the Australian Competition and Consumer Commission and the Republic of China Import Refusals) provide useful insights on the top emerging hazards for non-alcoholic beverages and the associated ingredients for a period of ten years (2008-2018).



Overall, a relative **stability** in the number of recall/ import refusal incidents associated with the non-alcoholic beverages sector was observed the **last decade**. However, between **2017** and **2018**, the number of incidents skyrocketed, presenting an **increase** of almost **200%**. This increase will be further analyzed in the next section.

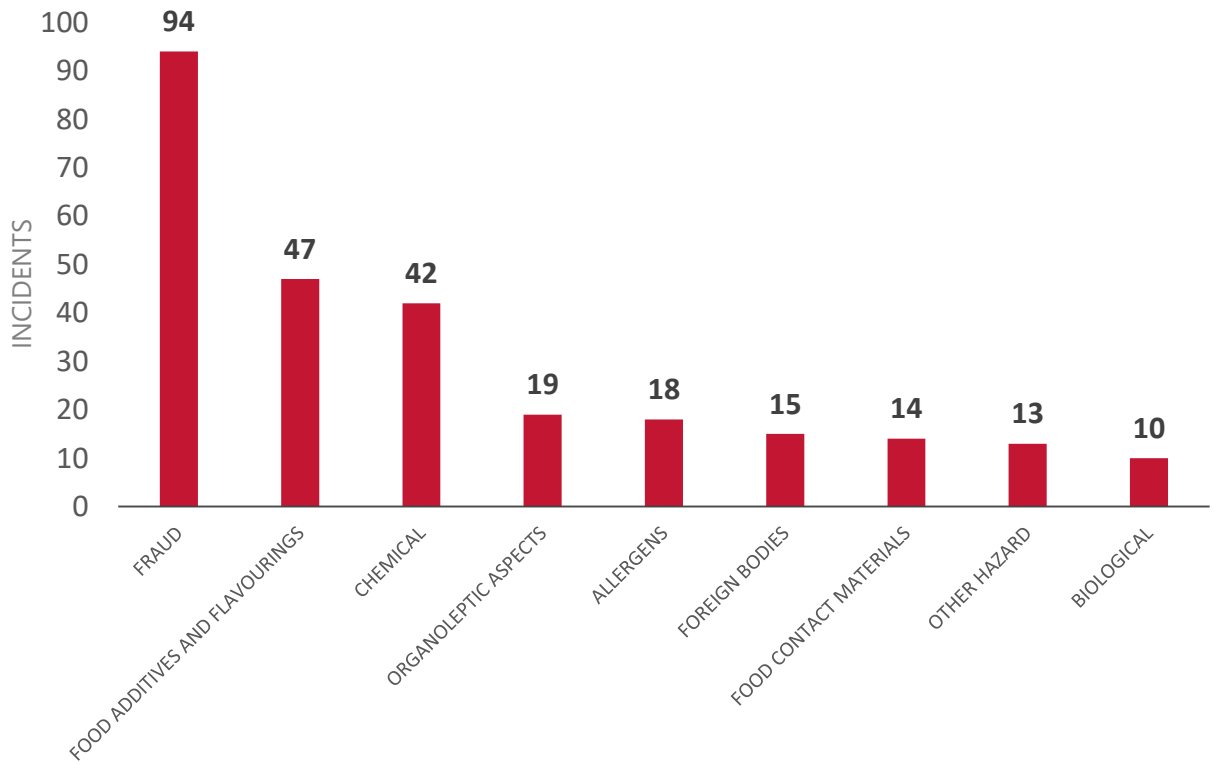
TOP EMERGING HAZARDS IN NON-ALCOHOLIC BEVERAGES

For the whole category of non-alcoholic products, the publicly available data shows that "**food additives and flavourings**" is the hazard category with the **biggest amount of recall/import refusal incidents** during the last few years. This category includes **hazards** such as **high concentration of food additives** (e.g. benzoic acid, sodium benzoate), **unauthorised use of colourings** in non-alcoholic beverages (e.g. E122 - azorubine), **high content of sweeteners** (e.g. E952 - cyclamate) and **unauthorised use of additives** (e.g. E385 - CdEDTA).



TOP EMERGING HAZARDS IN NON-ALCOHOLIC BEVERAGES (2017-1018)

In regard to the **200% increase** in the number of incidents between **2017** and **2018**, data shows that the majority (almost 40%) concerns **fraud** incidents. Actually, fraud is ranked, for the first time, as the **top incident category**, being linked to **94 cases** on a global level.



RECENT INSIGHTS IN THE KEY NON-ALCOHOLIC BEVERAGE CATEGORIES

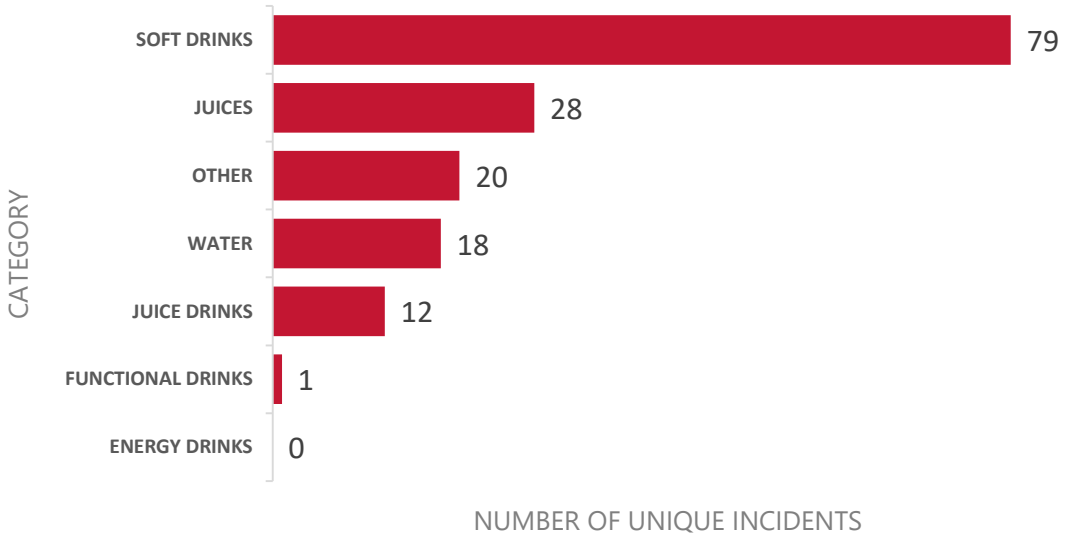
Over the last five years, there were **354 incidents related with non-alcoholic beverages** - mostly food recalls, alerts and border rejections. The food protection incidents **affected 191 suppliers** in **64 countries** around the globe. The key categories of non-alcoholic beverages in the aforementioned incidents include **soft drinks**, **juice drinks**, **juices**, **energy drinks**, **water** and **functional drinks**. A top-level **list** of the **most common hazards** - according to available data- can be found below:

NON-ALCOHOLIC BEVERAGE CATEGORY	TOP HAZARD
SOFT DRINKS	FOOD ADDITIVES & flavourings
JUICE DRINKS	PESTICIDES
JUICES	FRAUD
ENERGY DRINKS	FOOD ADDITIVES & flavourings
WATER	CHEMICAL COMPOSITION
FUNCTIONAL DRINKS	FOOD ADDITIVES & flavourings

B. INSIGHTS FOR KEY CATEGORIES OF NON-ALCOHOLIC BEVERAGES

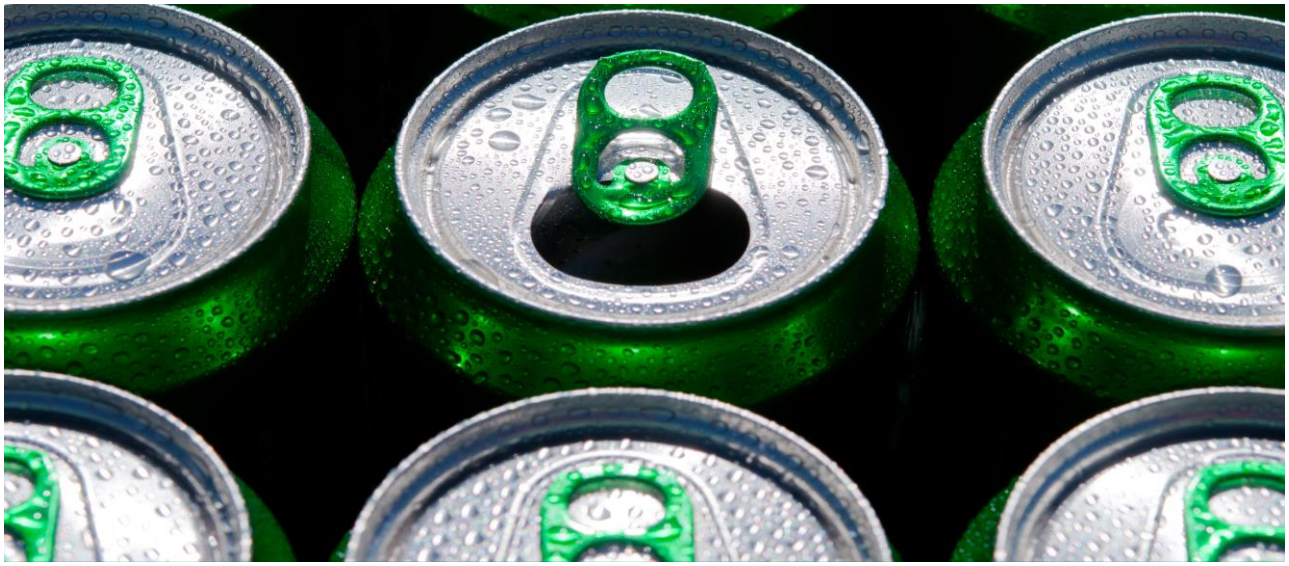
In order to **evaluate** the **dispersion** of **food protection incidents** per non-alcoholic beverage top categories, the following chart was created. It seems that **soft drinks take the lion's share** in comparison to other non-alcoholic beverage categories. In fact, **soft drink incidents are equal to the total number of incidents in the rest** of the categories.

FIVE-YEAR OVERALL INCIDENTS IN KEY CATEGORIES



An **in-depth analysis follows, aiming to shed light** on the **nature** of these **incidents** and the **top hazards** that food safety and quality assurance (FSQA) professionals should look out for.

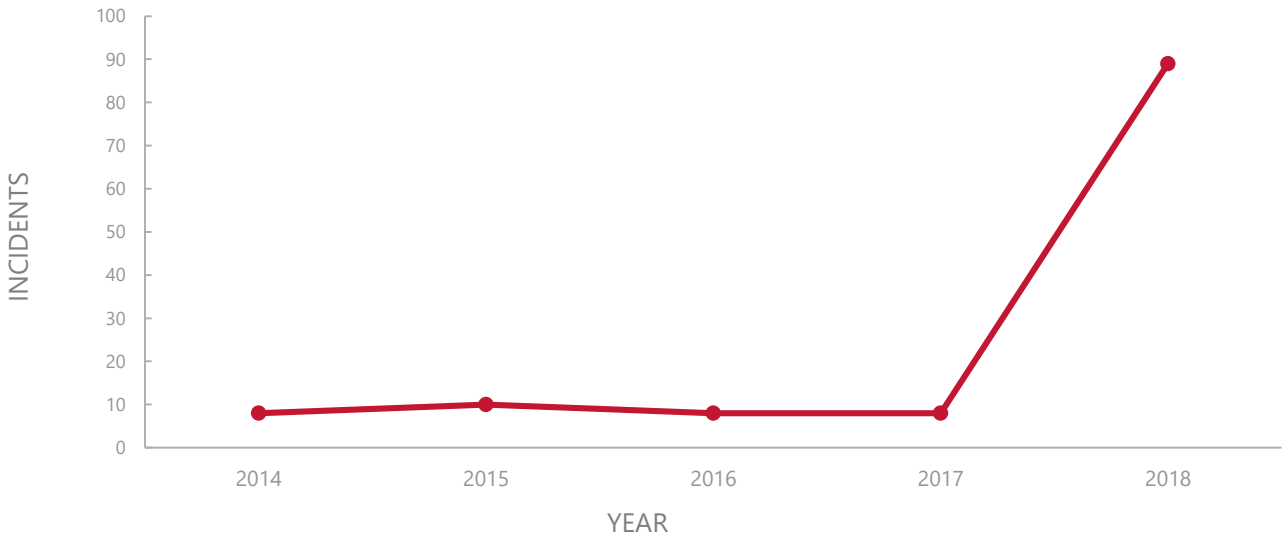
RECENT INSIGHTS FOR SOFT DRINKS (LAST FIVE YEARS)



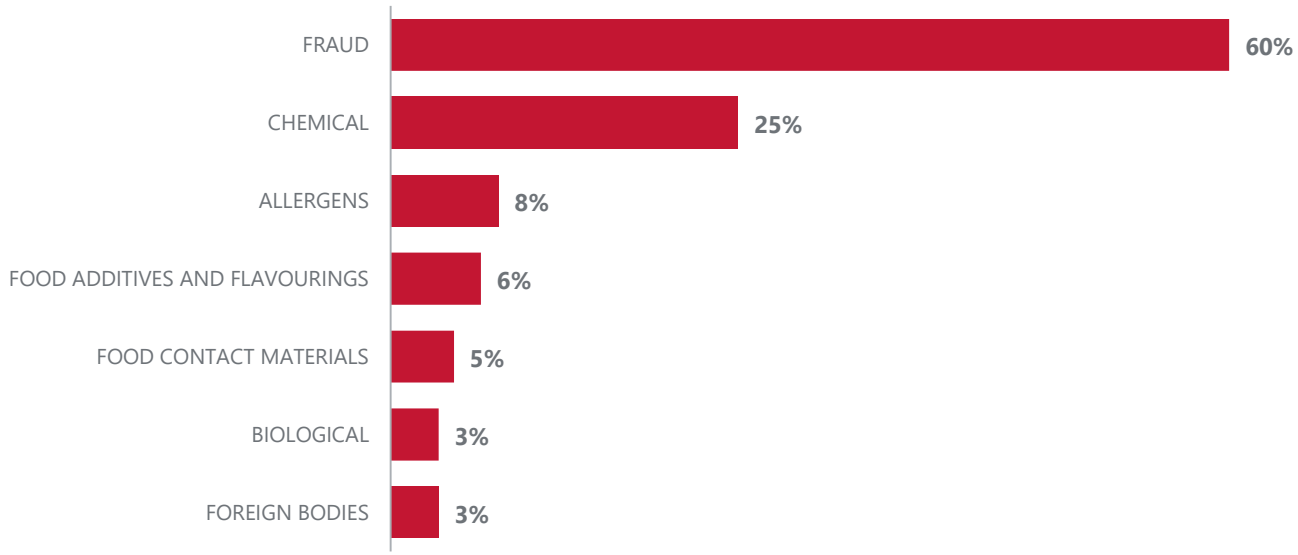
In the soft drinks' quality requirements checklist, **elimination of product contamination with pathogenic microorganisms** is a **top priority**. Pathogens, if at all present in a soft drink, are most likely to be **introduced through contaminated water supplies**. The issue of pathogen contamination, unlikely as it may be, is **addressed by** the **various disinfection stages** of **multiple barrier principles** of **water treatment**, the key process in soft drink quality systems. **Added steps** to control pathogen contamination are **rigorously enforced good manufacturing practices** (GAP), **good hygiene practices** (GHP), as well as other prerequisite processes of safety management systems such as **appropriate pest control programs**. **Staff health monitoring** supervised by administration or human resources is also a prerequisite in a soft drink factory. **Microbiological control**, including **pathogen control interventions**, is also addressed to a great extent via the implementation of effective **cleaning** and **sanitization** programs.

THE CASE OF NON-ALCOHOLIC BEVERAGES

INSIGHTS FOR KEY CATEGORIES OF NON-ALCOHOLIC BEVERAGES

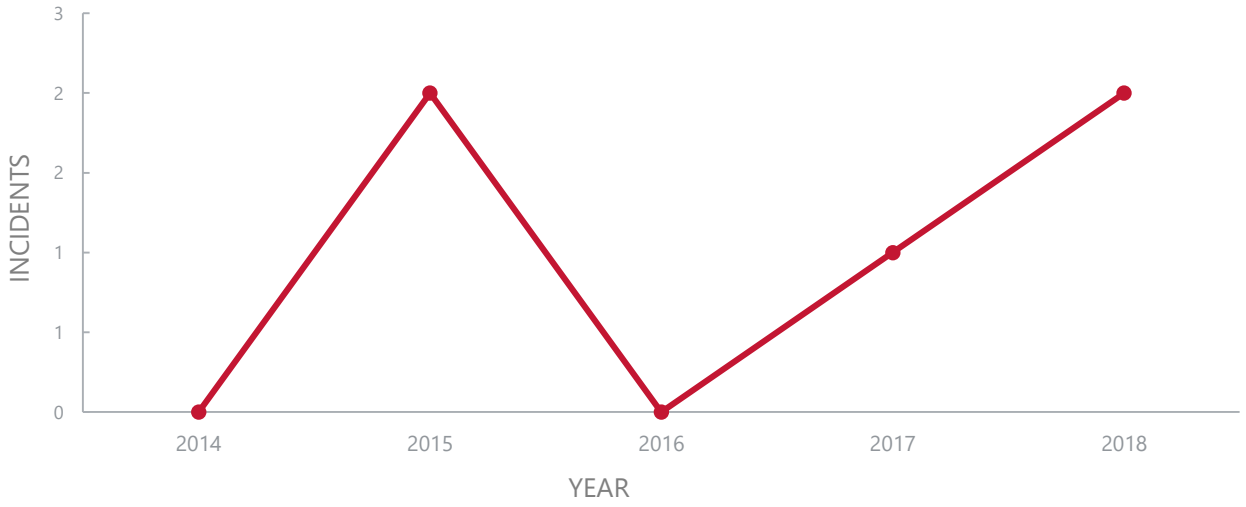


Although **pathogens** are **major hazards** for the non-alcoholic beverage sector, the practices followed, especially for water sanitation and disinfection, have contributed to **microbiologically safe beverages** - ranking this **hazard** in **sixth place**. On the other hand, **fraud** was **considered** the **top hazard** in 2018. The majority of fraud incidents were related to **incorrect labelling** and **misdescription**. The category that came **second** and according to historical data is among the top two hazards for non-alcoholic beverages, is **chemical hazards**.



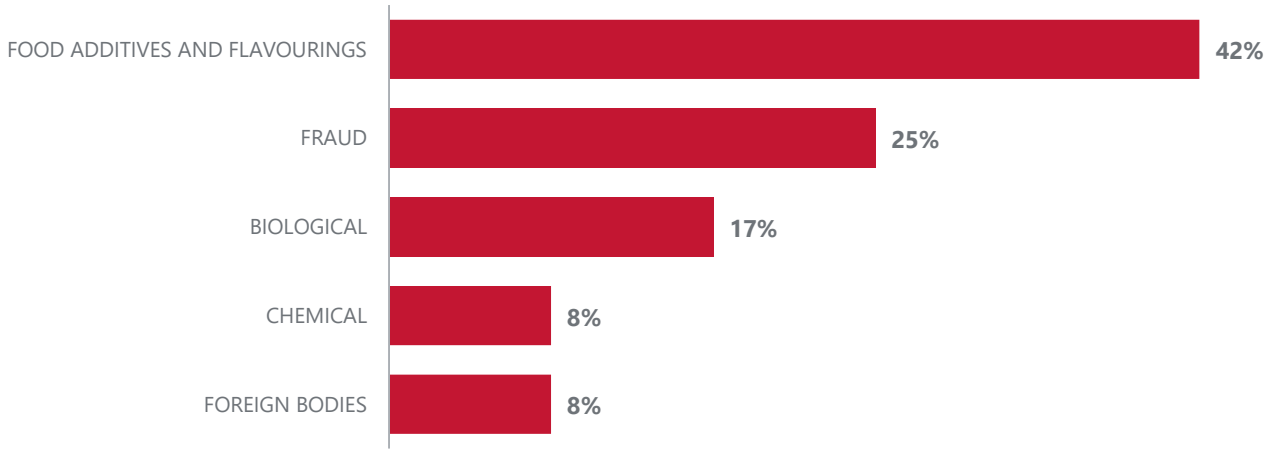
RECENT INSIGHTS FOR JUICE DRINKS (LAST 5 YEARS)

From a statistical standpoint, the **juice drinks** category has a **rather limited association with food protection incidents**, since the majority of products have water as the key ingredient.



RECENT INSIGHTS FOR JUICE DRINKS (LAST FIVE YEARS)

The top hazard related to this category is "**food additives and flavourings**", mainly associated with unauthorized use of additives such as **E223 - sodium metabisulfite**, **E954 - saccharin**, **E122 - azorubine** and others.



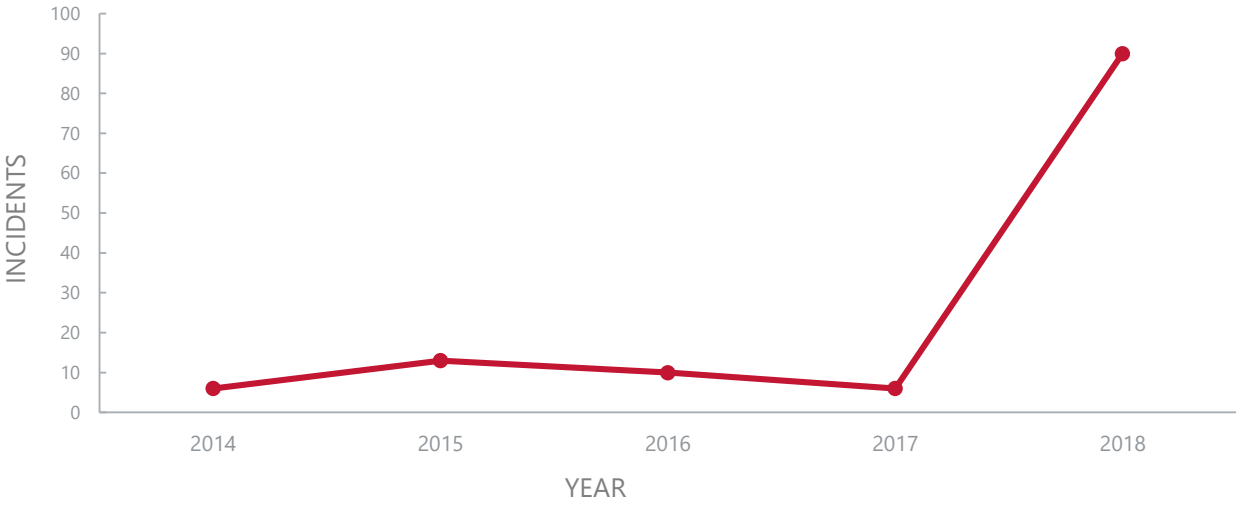
The **top 10 countries of origin** of non-alcoholic beverages associated with food protection incidents during the last five years were:

01 **COLOMBIA**
02 **VIETNAM**
03 **AUSTRALIA**
04 **GHANA**
05 **PERU**
06 **PHILIPPINES**
07 **RUSSIA**
08 **TURKEY**
09 **UNITED KINGDOM**
10 **UZBEKISTAN**

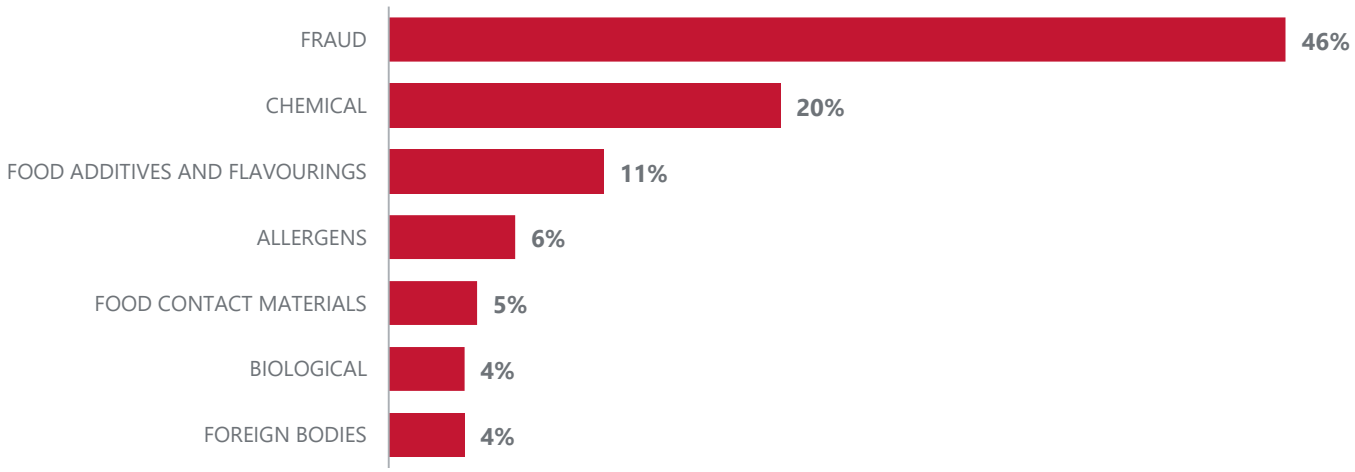
RECENT INSIGHTS FOR FRUIT AND VEGETABLE JUICES (LAST FIVE YEARS)

Although during the last five years the fruit and vegetable juice category remained stable with approximately 5 to 10 food protection incidents occurring each year, a **surprisingly significant increase of 1300% was observed in 2018**, and it was **linked** to **89 incidents**, with the **majority** of them (i.e. 68 out of 89 incidents) being **associated with fraud**.

RECENT INSIGHTS FOR FRUIT AND VEGETABLE JUICES (LAST FIVE YEARS)



It should be pointed out though, that **fraud-related incidents concern mainly labelling/ misdescription issues** such as misbranding, insufficient documentation and missing nutrition information. When it comes to **chemical hazards**, the **majority** of **incidents** are **related** to the presence of **mycotoxins** (e.g. patulin and ochratoxin) in **fruit** and **vegetable juices**, whereas there were rather few **incidents involving heavy metals**, **industrial contaminants** and **pesticides**.



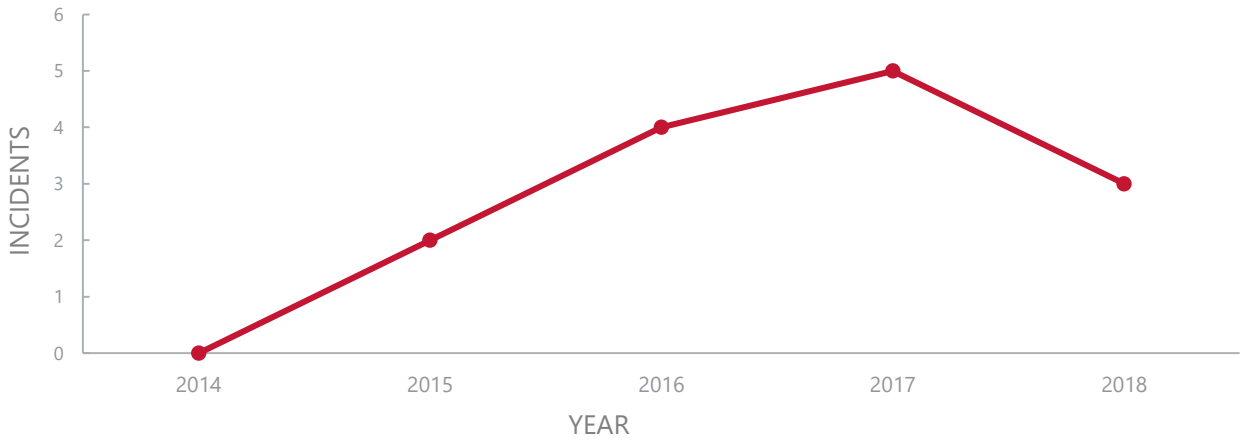
RECENT INSIGHTS FOR FUNCTIONAL DRINKS (LAST FIVE YEARS)

Functional drinks are a rapidly growing subsector of the non-alcoholic beverage market. This category includes **enriched vitamin** and **mineral drinks**, **sports** and **energy drinks**, as well as **wellness** drinks and **nutraceuticals**. Many functional drinks have been developed to **provide specific medical** or **health benefits**, such as promoting heart health, improving immunity and digestion, and acting as energy boosters. On top of that, this category also includes **plant-based drinks** produced from **coconut**, **oat**, **hemp**, **almonds** and other **nuts**.

As this **category** is a **relatively new**, pertinent prevalence **data** is **limited**, and only **five incidents** have been recorded at global level during the study period: three of the identified hazards were related with "**overly high content of E210 - benzoic acid**", and the rest were related to the presence of **chlorate** and **perchlorate**.

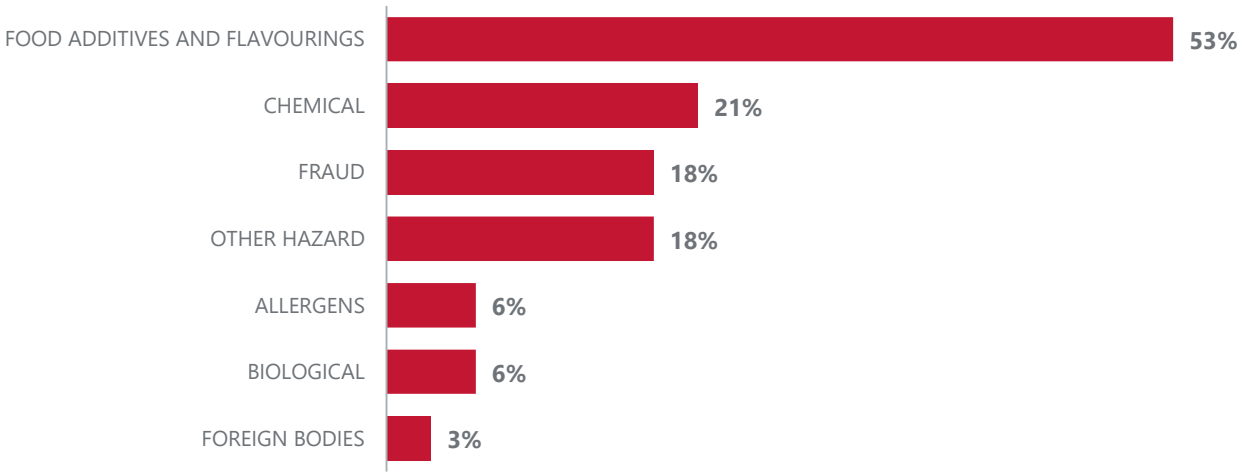
RECENT INSIGHTS FOR ENERGY DRINKS (LAST FIVE YEARS)

Energy drinks are **part of the broader functional drinks category**. However, in the context of the category-based insights, they are analyzed as **two distinct subcategories**. The energy drinks subsector can be considered as a **rather safe** sector, considering that during the **last five years** only **14 food protection incidents** have been recorded.



RECENT INSIGHTS FOR ENERGY DRINKS (LAST FIVE YEARS)

> Almost **half** of these **incidents** (i.e. 53%) were related to "**food additives and flavourings**" and refer to **high content of food additives** such as benzoic acid and sorbic acid.



THE TOP FIVE HAZARDS FOR ENERGY DRINKS (OVERALL):

01 High content of caffeine

02 Overly high content of E210 – benzoic acid

03 Overly high content of E200 – sorbic acid

04 Overly high content of E211 – sodium benzoate

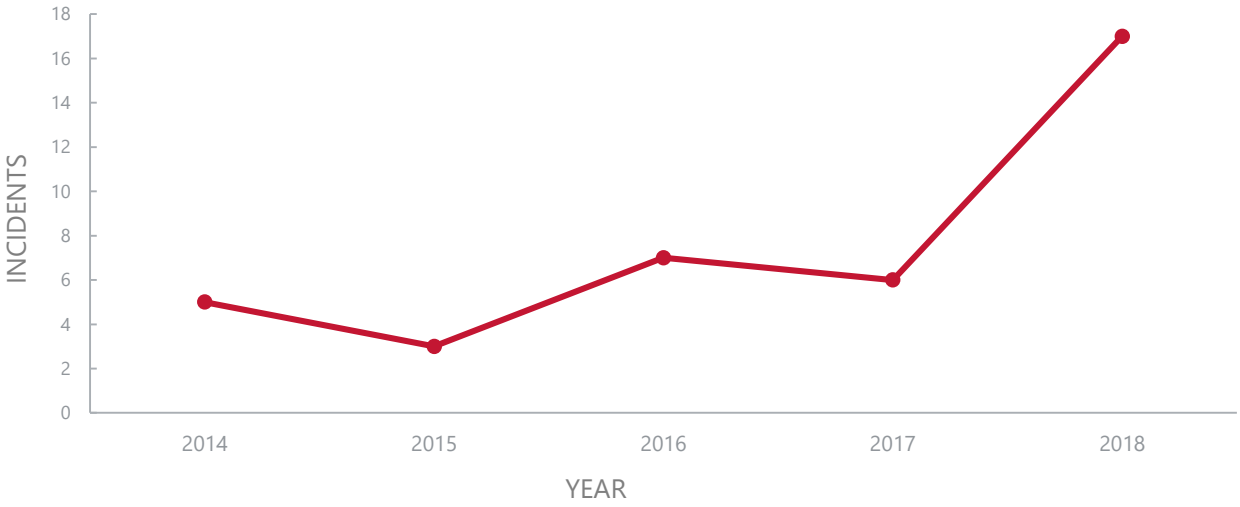
05 Overly high content of E124 – Ponceau 4R

RECENT INSIGHTS FOR WATER (LAST FIVE YEARS)

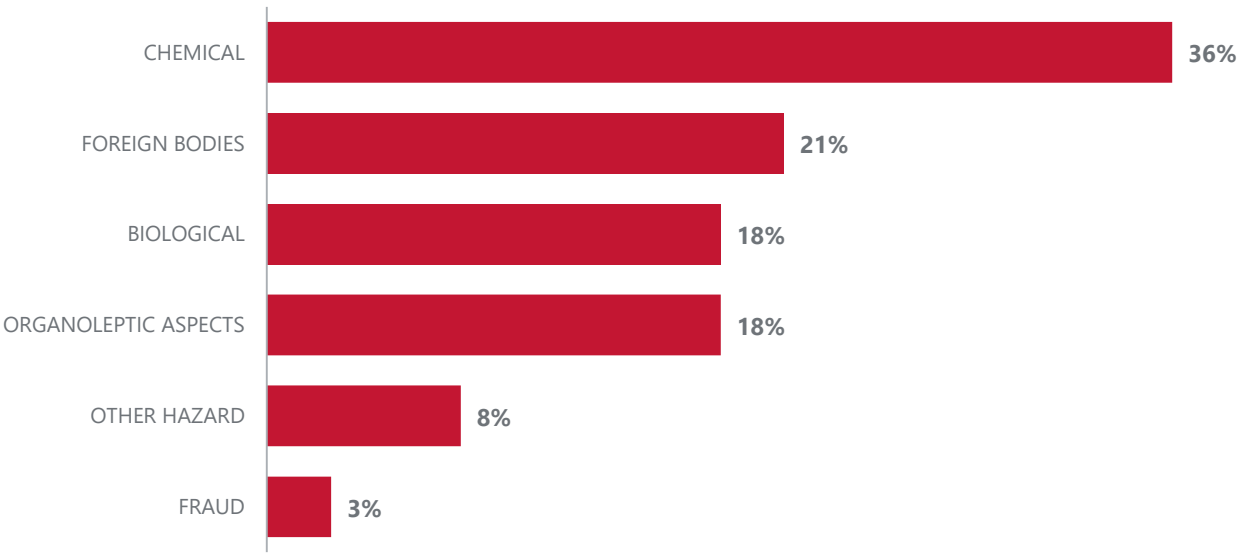
Under the subcategory of water, all **different types** of **bottled water** are included: **spring** water, **purified** water, **mineral** water, **sparkling bottled** water, **artesian** water/ **artesian well** water and **well** water. During the last five years, **39** food protection **incidents** occurred globally concerning **21 suppliers** of bottled water products.

Despite the fact that incidents from 2013 to 2016 remained stable, at an approximate rate of 5 incidents per year, a **considerable increase** was noted **in 2017** and the trend **will be monitored** in coming years.

RECENT INSIGHTS FOR WATER (LAST FIVE YEARS)



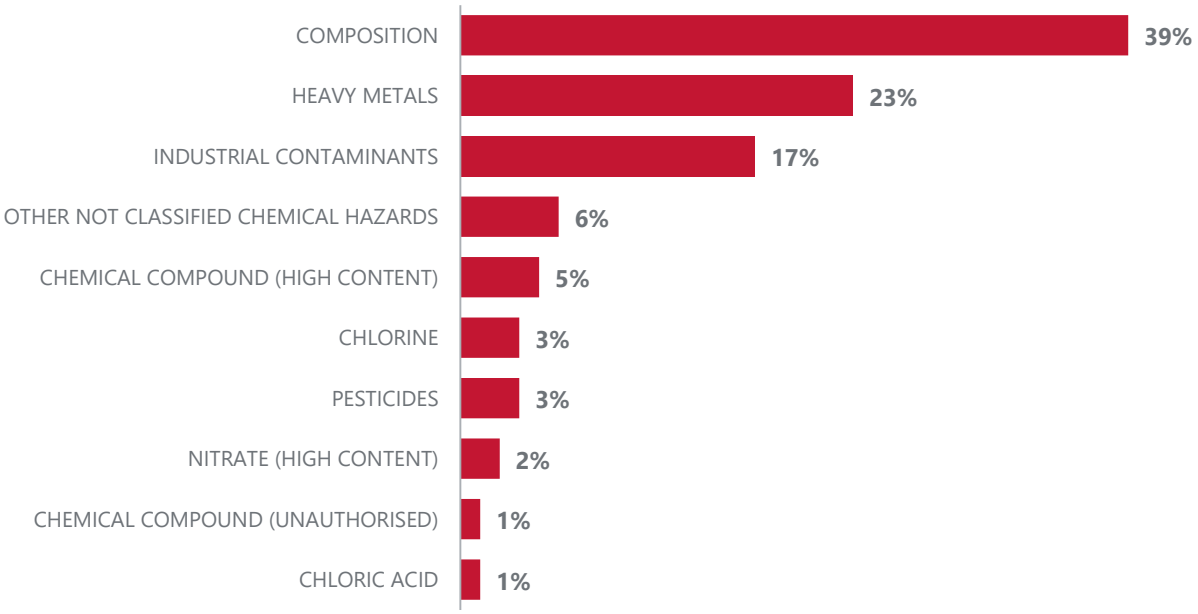
The majority of incidents refer to **chemical hazards**, whereas **foreign bodies** and **biological** and **organoleptic aspects** account for almost **60%** of the prevalent **incidents**.



THE CASE OF CHEMICAL HAZARDS IN BOTTLED WATER ACCORDING TO GLOBAL FOOD SAFETY DATA

According to global food safety and quality incidents for bottled water, **60%** of the **prevalent chemical incidents** were related to **water composition** and the **presence** of **heavy metals**.

With reference to heavy metals, there were **17 incidents** dealing with **arsenic** in bottled water, **three** with **chromium** and **one** with **manganese** during the last five years (i.e. 2013-2018).



THE CASE OF CHEMICAL HAZARDS IN BOTTLED WATER ACCORDING TO GLOBAL FOOD SAFETY DATA

THE TOP FIVE WATER COMPOSITION INCIDENTS (OVERALL):

Globally, **42 incidents** were recorded, with the top five hazards being:

01 Overly high content of nitrite
02 Overly high content of boron
03 Overly high content of barium
04 Overly high content of fluoride
05 Overly high content of nitrate

THE CASE OF PATHOGENS IN BOTTLED WATER:

The **top biological hazard** for **bottled water** is **pathogens**; indeed, **32 incidents** occurred during the **last 20 years** and were related to pathogens, with the **most prevalent** being ***Pseudomonas aeruginosa***.

01 *Pseudomonas aeruginosa*
02 *Escherichia coli*
03 Sulphite reducing *Clostridium* spp.
04 *Enterococcus* spp.
05 *Salmonella enterica* ser. *Kottbus*

C. FOOD PROTECTION TRENDS: MONITORING INCOMING RAW MATERIALS AND INGREDIENTS

Assessment and identification of potential food protection issues, including food safety and fraud, at the stage of incoming raw materials is of vital importance for food manufacturers. Indeed, knowledge of the associated risks is anticipated to allow for timely actions and appropriate measures that may ultimately prevent an incident from occurring.

Specifically, the **efficient utilization** of global food safety and fraud information should allow for:

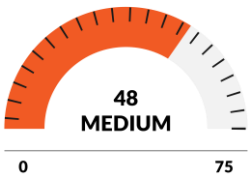
A. **identification of prevalent**, **increasing** and/or **emerging risks** associated with **raw materials**;

B. **comparative evaluation** of the risk **profile** for different **raw materials**' **origins**; and

C. **critical evaluation** and **risk-based selection** of **raw materials**' **suppliers**.

Functional drinks have been identified as a "**high risk**" category in terms of their raw materials, based on data from border rejections, food recalls and food safety alerts, as provided by international food safety authorities. As functional drinks are a **fast-growing** non-alcoholic beverages **subsector** and consumers consistently demand new products, the **origins** and **suppliers** of raw materials and associated ingredients **should be carefully examined** as part of the risk assessment process at the manufacturer/ processor level.

RISK ANALYSIS FOR JUICE KEY RAW MATERIALS & INGREDIENTS



Fruits and **vegetables** are two **product categories** that the entire **juice industry relies on**. Hence, ensuring the safety and good quality of raw materials, is a top priority for juice production companies. According to the European Fruit Juice Association [2], **consumers** are **pushing companies** to **produce premium fruit juices** and **smoothies** that are **healthier** and **more natural** than ambient offerings. Specifically, according to the Association, "*Juice production companies are responding to the premiumization trend by emphasizing the purity, heritage, transparency of production and the functional/health benefits of their fruit juices*" [2]. Besides that, **organic juices** are also **getting traction** in the **European** and **US markets**, creating a demand for strong and reliable relationships of the juice producers with organic fruit and vegetables suppliers.

An analysis has been performed in order to collect useful insights for key raw materials in the juice production process. By performing an incident-based risk assessment, a 5-year risk analysis of **fruit** and **vegetables** used by the juice industry shows that they **are ranked** as **medium risk raw materials**.

THE CASE OF NON-ALCOHOLIC BEVERAGES

FOOD PROTECTION TRENDS: MONITORING INCOMING RAW MATERIALS AND INGREDIENTS

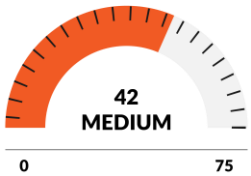
A **Top 5 risks list** was compiled taking into account all the **key fruit** and **vegetables** for **juice production**. The **raw materials** below are ranked based on the level of the risk:

INGREDIENT	HAZARD	RISK	TENDENCY
CANTALOUPE MELONS	SALMONELLA	MEDIUM (48)	∇ 100%
APRICOTS	TOO HIGH CONTENT OF SULPHITE	MEDIUM (45)	∇ 24%
PARSLEY	ESCHERICHIA OIL	MEDIUM (48)	∇ 100%
MELONS	LISTERIA MONOCYTOGENES	MEDIUM (42)	∇ 100%
CANTALOUPE MELONS	LISTERIA MONOCYTOGENES	MEDIUM (41)	∇ 100%

It is also important to highlight the overview of the **top 5 newly emerging risks** based on the **density** of food safety incidents occurrence.

INGREDIENT	HAZARD	RISK
PASSION FRUIT	CARBENDAZIM	MEDIUM (40) !
CHERRIES	MILK AND PRODUCTS THEREOF	MEDIUM (30)
RED BEETROOTS	ABNORMAL SMELL	MEDIUM (25) !
RED BEETROOTS	APPEARENCE	MEDIUM (25) !
KIWI	PRESERVATIVES	LOW (24) !

RISK ANALYSIS FOR SOFT DRINKS' KEY RAW MATERIALS & INGREDIENTS



Soft drinks typically contain water, sweetener(s) (8 - 12%, w/v), carbon dioxide (0.3 to 0.6% w/v), acidulants (0.05 to 0.3% w/v), flavourings (0.1 to 0.5% w/v), colourings (0 to 70 ppm), chemical preservatives (at authorised levels depending on the compound and the type of soft drink), antioxidants (<100 ppm), and/or foaming agents (e.g. saponins up to 200 mg/mL).

Following an incident-based risk assessment, a 5-year risk analysis for soft drinks was performed, indicating that the value of the **total product risk score** detected for **all ingredients** for the last 5 years is **42 out of 75** - suggesting a **medium risk** for the **associated ingredients**.

Based on global incident data, the **tendency** of the **maximum product risk** is **positive** showing an **estimated 30% increase**.

A top-5 list of the main soft drinks' ingredients, the 5-year risk value and the risk tendency are presented on the following page.

RISK ANALYSIS FOR SOFT DRINKS' KEY RAW MATERIALS & INGREDIENTS

INGREDIENT	5 YEARS RISK ▾	TENDENCY
FOOD ADDITIVES AND FLAVOURINGS	MEDIUM (42)	△ 30%
FOOD COLOURING AGENTS	MEDIUM (30)	▽ 100%
WATER FOR HUMAN CONSUMPTION	LOW (22)	▽ 52%
SUGARS AND SYRUPS	LOW (20)	NEW

The **most prevalent risk** concerns the "**food additives and flavourings**" category, with the **top hazard** being **undeclared allergens**, and an **ascending tendency** of **30%**. In the same **medium risk** category, we can include **food coloring agents**, which do **exhibit** a **descending tendency** however. The **key hazard** associated with **food coloring** agents is the **pathogenic bacterium *Salmonella enterica***, with the **second highest** being **high content of copper**, showcasing a **33% tendency increase**.

>> KEY INGREDIENTS: WATER

The **most crucial ingredient** of any soft drink is **water**, which usually **constitutes up** to **94%** of the final product. To **preserve purity** of water, it has to be **cleaned** from almost **all impurities**, and **set** to the **most optimal pH levels** that will be in **perfect balance** with **other ingredients** that can change pH levels and **affect taste**. Water presents an **overall low 5-years risk**, with the bacterial **pathogen *Pseudomonas aeruginosa*** being the **top-ranking hazard**.

HAZARD	5 YEARS RISK ▾	TENDENCY
PSEUDIMONAS AERUGINOSA	LOW (22)	▽ 52%
PSEUDIMONAS APP.	LOW (22)	▽ 52%
SEDIMENT	LOW (16)	△ 100%
CLOSTRIDIUM	LOW (15) !	▽ 100%
CLOSTRIDIUM SULPHITE REDUCER	LOW (15) !	▽ 100%

>> KEY INGREDIENTS: ADDITIVES

Additives are traditionally used in **very small quantities**, effectively **enhancing appearance** (emulsions), **aroma** and **mouth feel**. In the last few decades, additives are **almost always of natural origin**. The occurrence of **milk** and **milk products constitutes** the **top hazard** for additives.

HAZARD	5 YEARS RISK ▾	TENDENCY
MILK AND PRODUCTS THEREOF	MEDIUM (42)	△ 30%
EGGS AND PRODUCTS THEREOF	LOW (15)	△ 100%
SALMONELLA	LOW (156)	▽ 100%
CEREALS CONTAINING GLUTEN AND PRODUCTS THEREOF	LOW (15)	▽ 100%
MUSTARDS AND PRODUCTS THEREOF	LOW (15) !	▽ 100%

>> KEY INGREDIENTS: FOOD COLORING AGENTS

Food coloring agents are common **ingredients** in soft drinks, used to **stabilize** their **appearance**. The **top-ranking risk** for this additive category, namely ***Salmonella enterica***, is very **uncommon in soft drinks**. However, the incidents related to this outcome demonstrate that **this bacterial pathogen may have been introduced** to these ingredients **during the manufacturing process**, due to the **lack** of **personal hygiene**

HAZARD	5 YEARS RISK ▾	TENDENCY
SALMONELLA	MEDIUM (30) !	▽ 100%
HIGH CONTENT OF COPPER	MEDIUM (27)	△ 33%
UNAUTHORIZED COLOUR ORANGE I	LOW (20) !	▽ 100%
UNAUTHORIZED COLOUR RHODAMINE B	LOW (20) !	▽ 100%
UNAUTHORIZED COLOUR SUDAN 1	LOW (20) !	▽ 100%

THE CASE OF NON-ALCOHOLIC BEVERAGES

>> KEY INGREDIENTS: SUGARS & SYRUPS

Sugar in non-alcoholic beverages can be used both in **dry** or **liquid form**, often being **responsible** for **7-12% of the contents** of the bottle/ can. Its presence **increases** not only the **sweetness** of the drink, but also **balances acids** and **flavours**. The **most critical hazard** according to the risk analysis is **foreign bodies**, such as **metal pieces**.

HAZARD	5 YEARS RISK ▾	TENDENCY
METAL PIECES	LOW (20)	NEW
HAZELNUT	LOW (15) !	NEW
BENZOIC ACID	LOW (8)	NEW
MOULDS	LOW (8)	▽ 100%
HIGH CONTENT OF CYANIDE	LOW (8) !	▽ 100%

>> KEY INGREDIENTS: FLAVOURINGS

flavourings are commonly present in soft drinks. They are **either artificial** (used to **boost** or **balance** the **taste** that is created by other ingredients) or **natural** (in **powder** of **jelly form**). **Contamination** with **milk** and **relevant milk products** is the **highest hazard** in the flavourings category.

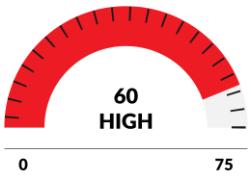
HAZARD	RISK ▾	TENDENCY
MILK AND PRODUCTS THEREOF	HIGH (69)	△ 11%
EGGS AND PRODUCTS THEREOF	MEDIUM (30)	NEW
METAL PIECES	LOW (20) !	NEW
LEAD	LOW (15)	△ 20%
UNAUTHORIZED GENETICALLY MODIFIED	LOW (10) !	NEW

RISK ANALYSIS FOR FUNCTIONAL DRINKS' KEY RAW MATERIALS & INGREDIENTS

As was stated previously, **functional drinks** are a **newly established** and **very promising non-alcoholic beverages category**. According to Tolun and Altintas [3], functional drinks can be **classified** into **four distinct categories**, based on their **formulation**: **dairy-based**, **non dairy-based**, **fruit-based** and **herbal-based**.

For these categories a 5-year risk analysis was conducted, including key ingredients and raw materials for each.

>> DAIRY-BASED FUNCTIONAL DRINKS



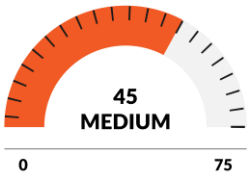
By analyzing the key raw materials and ingredients for this subcategory of functional drinks, the **value** of the **total product risk** detected for the last 5 years is **60 out of 75** - suggesting a **high risk** for the associated ingredients.

The **top hazard** is the **pathogenic bacterium *Listeria monocytogenes*** presenting a considerably high risk value. A list of the 5-year risk value and risk tendency for dairy-based functional drinks is presented below:

HAZARD	5 YEARS RISK ▾	TENDENCY
LISTERIA MONOCYTOGENES	HIGH (60)	∇ 100%
MILK AND PRODUCTS THEREOF	MEDIUM (42)	∇ 8%
SOYBEANS AND PRODUCTS THEREOF	MEDIUM (32)	-
LISTERIA MONOCYTOGENES	MEDIUM (30) !	∇ 100%
NUTS	MEDIUM (30) !	∇ 100%
PEANUTS AND PRODUCTS THEREOF	MEDIUM (30) !	∇ 100%
PISTACHIO NUT	MEDIUM (30) !	∇ 100%
SALMONELLA	MEDIUM (30) !	∇ 100%

THE CASE OF NON-ALCOHOLIC BEVERAGES

>> NON DAIRY-BASED FUNCTIONAL DRINKS



This subcategory of functional drinks includes products **mostly** with **plant-based ingredients** allowing **vegetarians**, **vegans** and **lactose-intolerant** consumers to get a "similar flavour experience" with dairy drinks but without actually consuming dairy products. Such drinks are **produced from coconut**, **oat**, **hemp, almonds** and **other nuts**. **Dairy-free probiotic drinks** are one of the **best product examples** in this subcategory.

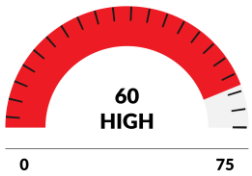
A 5-year risk assessment was conducted, and the **risk level** was valued as **Medium** - scoring **45 points out of 75**.

Among the top-5 hazards, **milk** and **milk products** are the hazard with the **highest risk factor**, constituting not only an **undeclared allergen threat** but also a **fraud issue**. It should also be noted that ***Salmonella*** **incidents** are **constantly increasing**, based on the last 5 years' data, showcasing an increasing trend.

HAZARD	RISK ▾	TENDENCY
MILK AND PRODUCTS THEREOF	MEDIUM (45)	▽ 33%
SALMONELLA	MEDIUM (40)	△ 43%
AFLATOXIN	MEDIUM (32)	▽ 3%
PESTICIDES	MEDIUM (31)	▽ 100%
SALMONELLA	MEDIUM (25)	△ 108%

THE CASE OF NON-ALCOHOLIC BEVERAGES

>> FRUIT-BASED FUNCTIONAL DRINKS



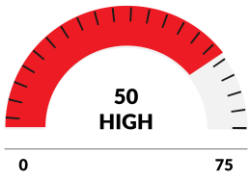
Many fruit-based functional drinks have been developed to provide specific medical or health benefits, such as promoting heart health, improving immunity and digestion and acting as energy boosters. This subcategory **mainly** uses raw materials like **fruit** and **vegetable juices**, which can act as **carriers** for **probiotics** (e.g. *Lactobacillus* spp.) that are destined for a variety of consumer groups e.g. lactose-intolerant people.

In this subcategory the 5-year risk is indicated high, due to hazards such as **allergens** and **pathogens** that were reported as the common ingredients of fruit-based functional drinks. The top-5 risks and the associated hazards are:

HAZARD	RISK ▾	TENDENCY
MILK AND PRODUCTS THEREOF	HIGH (60) !	NEW
NOROVIRUS	MEDIUM (45) !	▽ 100%
LISTERIA MONOCYTOGENES	MEDIUM (45)	NEW
OCHRATOXIN A	MEDIUM (40)	▽ 100%
SAMLOINELLA	MEDIUM (36)	▽ 100%

THE CASE OF NON-ALCOHOLIC BEVERAGES

>> HERBAL-BASED FUNCTIONAL DRINKS



This subcategory includes non-alcoholic functional drinks that **contain herbal infusions**, or **other herb-derived ingredients**. "Energy drinks", which contain such ingredients, fit under this classification. The most common ingredients for herbal-based functional drinks (including energy drinks) usually include **water**, **sugar**, **caffeine**, **vitamins**, **minerals** and **nonnutritive stimulants** (e.g. guarana, ginseng, yerba mate, taurine, inostiol).

Although the **two top hazards** accounting for high risk factors for this subcategory are classified under **polycyclic aromatic hydrocarbons** (PAHs), it should be noted that the number of samples that were detected with such incidents during the last five years is considered small.

HAZARD	RISK ▾	TENDENCY
BENZO(A)PYRENE	HIGH (50) !	∇ 100%
POLYCYCLIC AROMATIC HYDROCARBONS	HIGH (50) !	∇ 100%
UNAUTHORIZED SUBSTANCE SYNEPHRINE	HIGH (50)	∇ 100%
MILK AND PRODUCTS THEREOF	MEDIUM (45)	∇ 100%
QUINTEOZENE	MEDIUM (32)	∇ 100%

D. THE ROLE OF GLOBAL FOOD SAFETY DATA

HOW CAN GLOBAL FOOD SAFETY DATA CONTRIBUTE TO THE ESTABLISHMENT OF AN ADAPTIVE FOOD SAFETY/ QA PROCESS?

> **Based on the continuous analysis of food recalls and rejections, from key national and international food authorities, a FS/ QA Manager could set up an adaptive Supplier Verification process by utilizing the knowledge provided by such data.**

In that way, **QA**, **Procurement**, **Food Safety** and **Quality departments** can be **empowered** with **critical supplier data** that will **inform** the **internal procedures** for **incoming materials** and **ingredients** (e.g. raw materials, packaging materials) and allow for adaptive laboratory testing routines and compliance protocols.

Moreover, **food safety systems become adaptive**, **enabling quality assurance** and **safety professionals** to **quickly update points of critical control** when needed, and **intervene at** important stages of the drinks manufacturing process.

E. FOODAKAI's 5 + 5 STEPS PROCESS FOR RAW MATERIAL RISK ASSESSMENT

CHECKLIST FOR MAPPING POTENTIAL RISKS AND VULNERABILITIES PER PRODUCT GROUP AND INGREDIENT

- ✔ Did you take into consideration the **product category's specific legal demands**?
- ✔ Do you have **available laboratory test results** for (at least) **two batches** of this product/ raw material **from each** of your **suppliers**?
- ✔ Do you have **available test results** from the **sensory evaluation** of this product/ raw material?
- ✔ Do you have the **global trends in recalls** for this product category/ specific raw material **for the next 5 to 10 years?**
- ✔ Have you **identified** the **top hazards** and **vulnerabilities** for this **product category for the last 10 years**?

THE SUPPLIERS' RISK ASSESSMENT CHECKLIST

1. GEOPOLITICAL CONSIDERATIONS

- ✔ Is the supplier based in a **country** with a **history of frequent of food recalls** for this type of raw material **during the last 5 years?**
- ✔ Is the **food safety regulatory system** in the **country** of **origin based** on **Codex principles** or considered to be a "**similar**" **system** to **the US**?
- ✔ Is the supplier based in a **country** with a **high corruption index**?
- ✔ Is the supplier based in a **country** with a **high-risk index**, **according** to **OECD**?
- ✔ Is the supplier based in a **country** that has **experienced significant fluctuations** in **crop production** during the past 5 years?

2. SUPPLY CHAIN DUE DILIGENCE

- ✔ Does the supplier provide **verified information** on **raw material transparency**?
- ✔ Does the supplier provide **verified information** on **raw material** traceability?
- ✔ Does the supplier provide **verified information** on **raw material certification compliance**?

THE SUPPLIERS' RISK ASSESSMENT CHECKLIST

3. CERTIFICATION STATUS

- ✔ Does the supplier possess a **valid certificate of compliance** to a **global standard** of **food safety**, such as **GFSI**?
- ✔ What is the **status** of the **certificate**?
- ✔ Does the supplier possess **more than one food safety certification**?

4. HISTORY OF FOOD RECALLS, FOOD SAFETY INCIDENTS OR FOOD FRAUD INCIDENTS

- ✔ Has the supplier been **involved** in **food recalls**, **food safety** or **food fraud incidents** during the **last 5 years**?
- ✔ Has the supplier been **involved in food recalls** , **food safety** or **food fraud incidents** during **the last 2 years**?

5. HISTORY OF BORDER REJECTIONS, IMPORT DETENTIONS, COMPLAINTS OR WARNING LETTERS

- ✔ Does the supplier have any **records of border rejections**, **import detentions**, **complaints** or **warning letters** in the **last 5 years**?
- ✔ Does the supplier have any **records of border rejections**, **import detentions**, **complaints** or **warning letters** in the **last 2 years**?

WITH DATA PROVIDED FROM

- RASFF
- Ministry of Health Labour and Welfare Japan
- Australian Department of Agriculture
- Imported Food Reports
- FDA Import Refusals
- FDA Import Alerts
- Czech Agriculture and Food Inspection Authority
- Hellenic Food Authority
- Food Standards Australia New Zealand
- Australian Competition and Consumer Commission
- Canadian Food Inspection Agency
- Food Safety and Standards Authority of India
- German Federal Office of Consumer Protection and Food Safety
- Republic of China Import Refusals
- FDA
- Federal Agency for the Safety of the Food Chain of Belgium
- Ministry of Environment and Food of Denmark
- UK Food Standards Agency

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[2] European Fruit Juice Association, 2018 Liquid Fruit Market Report

[3] Aysu Tolun, Zeynep Altintas,7 - Medicinal Properties and Functional Components of Beverages, Editor(s): Alexandru Mihai Grumezescu, Alina Maria Holban, Functional and Medicinal Beverages, Academic Press, 2019, Pages 235-284, ISBN 9780128163979, http://doi.org/10.1016/B978-0-12-816397-9.00007-8.

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[7] British Soft Drinks Association, Fruit Juice - Technical Guidance, 1st edition, May 2016

EXPLORE HOW YOUR INTERNAL QA PROCESS CAN BE ADAPTED BASED ON GLOBAL FOOD SAFETY DATA

GET THE DATA BEHIND THIS REPORT

FOODAKAI is an intelligent online system that minimizes the food safety risks in your supply chain by delivering insights about hazards in raw materials and products.

It strategically gathers, processes and delivers live food safety data and risk estimation for ingredients, products and suppliers in a fast and easy way.

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