R-Biopharm AG

Enzymatic FAQ

Applications in Food and Feed

15/06/2018

R-Biopharm – for the safety of your analysis.

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1 Overview of tests

Item	ID Numbers (1) Roche (2) E-Generic (3) E-Fluid (4) E-Liquid (5) RIDA® CUBE	Text
Acetaldehyde	10668613035 n.a. n.a. n.a. n.a.	Acetaldehyde occurs in nature in all organisms, even if in very small quantities, because it is a product of many metabolic processes. Acetaldehyde occurs naturally in coffee, bread and ripe fruit, and is produced by plants. In food production, the concentration of acetaldehyde rises considerably when ethanol fermentation takes place, with as much as 100 mg/L in wine and 20 mg/L in beer. On the other hand, acetaldehyde is an important flavor compound in wine and beer. In dairy products like yogurt and cheese, it is responsible for desirable flavors but also for flavor defects.
Acetic acid	10148261035 E1226 E5226 E8226 RCS4226	Acetic acid is an important metabolic analyte, the end product of fermentation processes and the oxidation product of acetaldehyde and ethanol. Acetic acid is the main component of the "volatile acids" in wine and is measured throughout the entire vinification process. Vinegar is roughly 3 - 9 % acetic acid by volume and gives the monetary value of this product. Acetic acid is also used in food production as a preservative (E260) and as taste-improver. Acetic acid (acetate) is tested in a wide range of products like foodstuffs such as beer, bread and bakery goods, baking agents and sourdough, dairy, fish, fruit and vegetable products, meat, ketchup, mayonnaise, mixed pickles, salts and spices, sauces and dressings, soy sauce, tea, vinegar, wine, as well as in paper and cardboard, animal feed (silage), pharmaceuticals (e. g. solutions for infusion, acetyl-salicylic acid formulations), in household chemicals and in biological samples.
Ammonia	11112732035 n.a. E5390 n.a. n.a.	Ammonia is present in the environment as a result of natural processes from the nitrogen cycle, but also from industrial activity including intensive farming. High concentrations of ammonia can indicate the (microbial) decomposition of substances like milk, meat and seafood, where it is a major component of the off-flavors and odors associated with spoilage. Ammonia also indicates the presence of feces, urine and micro-organisms in water. On the positive side, Ammonia is an important source of nitrogen for many microorganisms in fermentation processes like winemaking. Ammonium salts produced on a large scale are used for the production of fertilizers, animal feed, paper, and in the case of food as leavening agents, stabilizers, and for flavoring purposes.
L-Ascorbic acid	10409677035 E1267 n.a. n.a. n.a.	Ascorbic acid (Vitamin C) is a naturally occurring organic compound with antioxidant properties, and is found ubiquitously in fruit and vegetables. Its quantitative determination is especially important in the production of wine, beer, milk, soft drinks and fruit juices, where it can be a quality indicator. Given the essential role played in the human diet, L-ascorbic acid (E300) and salt derivatives (E301-303) are commonly used as food additives, with the additional advantage of their antioxidant and flavour enhancing properties. In the wine industry, L-ascorbic acid can be added to prevent oxidation of wine. Ascorbic acid is also used in the pharmaceutical industry and as additive in animal feed.
Cholesterol	10139050035 n.a. n.a. n.a. n.a.	Cholesterol is the most important of the animal sterols. It is an important component of the cell membranes of the higher species, and a precursor to a whole series of steroid hormones. Cholesterol is found in all animal fats. It is an important component of egg yolk. Due to the relative constancy of its content, it is frequently used in the determination of the egg content of foodstuffs like bakery goods, noodles and liqueur with egg yolks.

Citric acid	10139076035 E1214 n.a. n.a. n.a.	Citric acid is a very important metabolite in animals, plants and micro-organisms. It is the best known acid of the fruit acids and is contained in a high amount e. g. in citrus fruits (approx. 10 g citric acid/l orange juice). Citric acid is manufactured biotechnologically on a large scale as an additive for food (E330). Citric acid is used as preservative (acidifier) for food or cosmetics, as a chelating agent for metals (e.g. for iron in wine), as an emulsifier (e. g. in the production of processed cheese), and as flavoring agent in the production of soft drinks and candies. It is also a component of many pharmaceuticals and washing powders.
Ethanol	10176290035 n.a. E5340 n.a. n.a.	Ethanol occurs in nature in practically all organisms, even if in very small quantities. It is the end product of alcoholic fermentation and a desired component of alcoholic beverages, but also the undesirable component in non-alcoholic and low-alcoholic beverages, or in other foodstuffs including chocolates, sweets, jam, honey, vinegar and dairy products. The presence of ethanol in fruit products like fruit juices indicates that the components used for production may have decomposed. The presence of ethanol is also an indirect indicator for the presence of yeasts. In the non-food industry, Ethanol is a solvent e. g. for essential oils and pharmaceutical substances.
Formic acid	10979732035 n.a. n.a. n.a. n.a.	Formic acid occurs as a metabolite in many biochemical reactions, but its concentration is invariably very low. It is the oxidation product of methanol and formaldehyde. As formic acid in low concentrations has both a bactericidal and fungicidal effect, it can be used as a food preservative (Exxx). Moulds tend to produce formic acid as a metabolite; hence, determination of formic acid can give an indication as to the properties, e. g. the degree of decomposition, of samples. Formic acid belongs to the dangerous substances in the production of yeast. Formic acid is a side product in acetic acid fermentation in vinegar production, and is also a part of the "volatile acids" in wine.
D-Gluconic acid	10428191035 E1223 n.a. n.a. n.a.	Gluconic acid occurs naturally in fruit, honey and wine, but also in meat or diary products. As a food additive (E574), it is an acidity regulator. It is also used in cleaning products where it dissolves mineral deposits. This acid imparts a sour but refreshing taste. For the wine industry, *Botrytis* infected grapes exhibit increased levels of this acid that can reach 1 - 2 g/L. D-Glucono-δ-lactone is found in association with D-gluconic acid, e.g. in wine, and is also widely used in the food industry (yogurt, cottage cheese, bread, confectionery, meat and sausages) in order to control accurately the acidity.
D-Glucose	10716251035 E1210 E5140 E8140 RCS4140	D-Glucose occurs widely in the animal and plant kingdoms. It is an essential component of carbohydrate metabolism and occurs frequently in free form along with D-fructose and sucrose. However, the more important forms are those of di-, tri-, oligo- and polysaccharides (lactose, maltose, sucrose; Raffinose, dextrins and starch, cellulose). In food, it is present in significant quantities in honey, wine, beer and fruit juices, and in a range of solid foodstuffs such as bread and pastries, chocolate and candies.
D-Glucose/ Fructose	10139106035 E1245 E5160 E8160 RCS4160	D-Glucose and D-fructose are found in most plant products. In food, they are present in significant quantities in honey, wine and beer, and a range of solid foodstuffs such as bread and pastries, chocolate and candies. Fructose, or fruit sugar, is a monosaccharide found in many plants, where it is often bonded to glucose to form the disaccharide sucrose. In the wine industry, the sum of D-glucose and D-fructose is a key parameter, as this represents the amount of sugar that is available to the yeast for the conversion into ethanol. In honey, the ratio between both sugars allows detecting an un-allowed addition of "sugar" like glucose syrup monitor. D-Glucose and D-Fructose are measured in many food samples and can be measured either independently (like for honey) or simultaneously (like for wine).

L-Glutamic acid	10139092035 n.a. n.a. n.a. n.a.	L-Glutamic acid (L-glutamate), one of the 20 common amino acids, occurs naturally in foods such as cheese, milk, meat, fish, corn, tomatoes, mushrooms, soybean and sugar beet. The knowledge of the L-glutamate content is of interest e. g. in the ripening of plants, in liver used for the production of human food, and in the control of ripening of cheese. L-glutamic acid is one of the major flavour enhancing components of food (Monosodium glutamate MSG). Excessive use of MSG as a food additive (E621) may result in the symptoms of “Chinese Restaurant Syndrome”.
Glycerol	10148270035 n.a. E5360 n.a. n.a.	Glycerol, a by-product of alcoholic fermentation, and its fatty acid esters (glycerides) occur frequently in nature. In the food industry, glycerol is an important moistening agent for baked goods. It is also added to candies and icings to prevent crystallization, as a solvent for food colors and a carrier for extracts and flavoring agents. As a product of fermentation, glycerol is monitored in the beer and wine industries, where it occurs at concentrations of approx. 1% (v/v). The sweet taste of glycerol gives the wine "body". In the pharmaceutical industry, the smoothness of lotions, creams and toothpaste is due to the incorporation of glycerol. The glycerol backbone is found in all lipids known as triglycerides.
Hydroxy butyric acid	10907979035 n.a. n.a. n.a. n.a.	An increase in the content of D-3-hydroxybutyric acid in eggs can be detected 6 days after chickens have been fertilized. This increase continues even after the embryo has died. D-3-Hydroxybutyric acid is thus a typical indicator for fertilized and incubated eggs up to 10 mg/kg (legal limit), and can reach as much as 800 mg/kg in badly spoiled eggs.
D-Isocitric acid	10414433035 n.a. n.a. n.a. n.a.	D-Isocitric acid is part of the citric acid cycle, and hence occurs in all animals and plants. The contents are usually very low. The determination of D-isocitric acid has become of importance in the analysis of fruit juices (especially of orange juice) for the detection of illegal additives (e. g. citric acid). Not only the minimum content of D-isocitric acid in juices is of interest, but also the ratio citric acid to D-isocitric acid: a ratio which is too high indicates the addition of citric acid. In authentic orange juice, for example, the ratio of citric acid to D-isocitric acid is usually less than 130 and a higher value may be indicative of fruit juice adulteration. The content of D-isocitric acid in products containing orange juice may also be used to calculate its content, e. g. in soft drinks that declare on the bottle label "contains orange juice".
L-Lactic acid	10139084035 E1254 E5260 n.a. n.a.	L-Lactic acid is found in many foods and beverages. Produced naturally by lactic acid bacteria, L-lactic acid is found in many fermented milk products such as yoghurt, and also in pickled vegetables, cured meats and fish. It is commonly supplemented into foods and beverages (E270) as a non-volatile acidulant. In the wine industry, the course of malolactic fermentation is monitored by following the falling level of L-malic acid, and the increasing level of L-lactic acid. The content of L-lactate in beer indicates the presence of Lactobacilli in production. The content of L-lactate in liquid whole egg or in egg powder gives good information about the hygienic situation of the products. Similarly, the quality of milk and fruit and vegetables can be established by measurement of L-lactic acid content. L-Lactate in milk powder indicates the use of neutralized sour milk for the production of milk powder. L-Lactate in wine is also formed during the "second fermentation" (malo-lactic fermentation, biological de-acidification).
D-/L Lactic acid	11112821035 E1255 E5240 n.a. n.a.	D-Lactate is very often measured together with L-lactate, and almost never alone. D-Lactic acid is formed by some micro-organisms only, e. g. from Lactobacillus lactis, Lb. bulgaricus and Leuconostoc cremoris. D-Lactic acid is not formed or only in traces by "higher organisms", e. g. by animals. Therefore the presence of D-lactate may serve as an indicator for microbial contamination or spoilage, presumed that fermentation techniques have not been used in the production of the foodstuff.

Lactose/ D-Galactose	10176303035 E1213 n.a. n.a. n.a.	Lactose is a disaccharide sugar composed of Galactose and Glucose. Lactose is an important carbohydrate component of mammalian milk, therefore it is of nutritional importance. The lactose concentration of milk from healthy cows is approx. 4.6 to 5 g/100 g. Lactose gives D-galactose and D-glucose after hydrolysis by Lactase(ß-galactosidase), an enzyme found in gastric juice. People who lack this enzyme after childhood cannot digest milk and are said to be lactose intolerant. D-Galactose occurs very seldom in the free form, therefore the measurement over the Galactose moiety (Lactose/Galactose test) is more reliable than over the Glucose moiety (Lactose/Glucose test).
Lactose/ D-Glucose	10986119035 n.a. n.a. n.a. n.a.	Lactose is a disaccharide sugar composed of Galactose and Glucose. Lactose is an important carbohydrate component of mammalian milk, therefore it is of nutritional importance. The lactose concentration of milk from healthy cows is approx. 4.6 to 5 g/100 g. Lactose gives D-galactose and D-glucose after hydrolysis by Lactase(ß-galactosidase), an enzyme found in gastric juice. People who lack this enzyme after childhood cannot digest milk and are said to be lactose intolerant. D-Galactose occurs very seldom in the free form, therefore the measurement over the Galactose moiety (Lactose/Galactose test) is more reliable than over the Glucose moiety (Lactose/Glucose test).
D-Malic acid	11215558035 n.a. n.a. n.a. n.a.	D-Malic acid practically does not occur in nature; it is a metabolite produced only by some micro-organisms. Analysis of freshly pressed fruit juices shows the presence of D-malic acid at the detection limit. Hence, the legal limits for fruit and fruit juices are recommended as being 10 mg/l. D-Malic acid is a component of the (racemic) D-/L-malic acid when prepared chemically. As natural products are practically free from D-malic acid, the detection of D-malic acid indicates that D-/L-malic acid has been added e. g. to wine or to fruit juice, which may be allowed or forbidden depending on the country.
L-Malic Acid	10139068035 E1215 E5280 E8280 RCS4280	L-Malic acid is one of the most important fruit acids, and the quantitative determination of L-Malic acid is especially important in the manufacture of wine, beer, bread, fruit and vegetable products, as well as in cosmetics and pharmaceuticals. Microbial decomposition of L-Malic acid leads to the formation of L-Lactic acid, which can be a desirable reaction in the production of wine (malo-lactic fermentation, biological de-acidification), or an undesirable reaction in the case of beer (second fermentation). L-Malic acid also finds many applications as a food preservative (E296) because it is a stronger acid than citric acid.and as flavour enhancing compound.
Maltose/Sucrose/ D-Glucose	11113950035 n.a. n.a. n.a. n.a.	Malting grains develops the enzymes required for modifying the starch from the grain into various types of sugar, including the monosaccharide glucose, the disaccharide maltose, the trisaccharide maltotriose, and higher sugars called maltodextrines. Glucose-syrup ("starch-sugar") produced from starch by means of amyloglucosidase also contains maltose. Maltose is measured together with sucrose and D-Glucose, because the enzyme α-glucosidase not only reacts with Maltose but also with Sucrose.
Nitrate	10905658035 n.a. n.a. n.a. n.a.	The nitrogen required by plants for growing (formation of proteins) is taken up by plants almost entirely in the form of nitrate (fertilizers). Nitrate in foodstuffs is of nutritional importance due to its reduction to nitrite and the formation of compounds that attach to hemoglobin. It also forms nitrosamines that are known to be carcinogenic. Some plants, e. g. cabbage, red beets, radish, spinach, and salad have the ability to store nitrate in their tissue. The content of nitrate in potatoes is relatively low. When cooking these vegetables, a lot of nitrate will be eliminated in the boiling water. There are also limits for the concentration of nitrate in drinking / tap water (e.g. 50 mg/l in Europe). "Natural" water contains approx. 1 mg nitrate/l.

Raffinose	10428167035 n.a. n.a. n.a. n.a.	Raffinose is a trisaccharide composed of galactose, glucose, and fructose. It can be found in beans, cabbage, brussels sprouts, broccoli, asparagus, other vegetables, and whole grains. Raffinose can be hydrolyzed to D-galactose and sucrose by the enzyme α-galactosidase (α-GAL), an enzyme not found in the human digestive tract. Humans and other monogastric animals (pigs and poultry) do not possess the α-GAL enzyme, and these oligosaccharides pass undigested through the stomach and upper intestine. In the lower intestine, they are fermented by gas-producing bacteria that do possess the α-GAL enzyme and make carbon dioxide, methane or hydrogen—leading to the flatulence commonly associated with eating beans and other vegetables.
D-Sorbitol/Xylitol	10670057035 n.a. n.a. n.a. n.a.	D-Sorbitol is a sugar alcohol that occurs extensively in fruits, e. g. in apples, cherries, pears, plums, but it is not or only in traces contained in grapes, grape juice and wine. The concentration of D-sorbitol may be used for the calculation of the apple juice content of beverages declared as "contains apple juice". D-Sorbitol has an anti-cariogenic influence, but may have a laxative effect if large quantities are consumed (10-50 g per day). D-Sorbitol is used in the food technology industry as a moisturizing agent and as a sugar substitute (E420) for diabetic products because insulin is not necessary for metabolism. D-Sorbitol is stable to acids, improves the texture of food and is a non-browning component. Xylitol is a sugar alcohol that occurs frequently in fruits, vegetables and mushrooms. Xylitol is produced on an industrial scale. Xylitol is also not fermented by cariogenic bacteria (e. g. of Streptococcus mutans) in the mouth.
Starch	10207748035 E1268 n.a. n.a. n.a.	Starch is a polymeric carbohydrate consisting of a large number of glucose units joined by α-1,4- and α-1,6-glycosidic bonds (amylose, amylopectin). This polysaccharide is produced by most green plants as an energy store. It is the most common carbohydrate in human diets and is contained in large amounts in staple foods such as potatoes, wheat, maize (corn) and rice. Starch is an important ingredient of food and animal feed. It serves as binder e. g. in sauces, filler, thickener and texturizer in the production of foodstuffs.
Succinic acid	10176281035 n.a. n.a. n.a.	As a metabolite of the citric acid cycle, succinic acid occurs widely in animals, plants and micro-organisms. Succinic acid is a specific indicator of microbial decomposition in eggs and egg products (> 5 mg/kg). Succinic acid concentration is also monitored in the manufacture of numerous foodstuffs and beverages, including wine, soy sauce, soy bean flour, fruit juice and dairy products (e.g. cheese), and is also used as a flavouring agent. The ripening process of apples can be followed by monitoring the falling levels of succinic acid. Succinic acid also finds use in many non-food applications (dyes, drugs, perfumes, lacquers, coolants)
Sucrose/ D-Glucose	10139041035 E1246 E5180 E8180 RCS4180	Sucrose and Glucose have a central position in plant metabolism. In food, they are present in significant quantities in honey, wine, beer and fruit juices, and in a range of solid foodstuffs such as bread and pastries, chocolate and candies. Sucrose is also known as table sugar, and its isolation from cane and beet is of great economic interest. When sucrose is hydrolyzed (inverted), D-glucose and D-fructose are formed. Sucrose is an important ingredient of foodstuffs, not only as sweetener but also giving monetary value. Specific sugar ratios exist for many fruits and for honey, this can be used as an indication of added sugar.
Sucrose/Glucose/ Fructose	10716260035 n.a. n.a. n.a. n.a.	Sucrose, D-glucose and D-fructose are found in most plants and food products. In plant materials, D-glucose and D-fructose occur as free sugars and in a range of oligo- and polysaccharides such as fructans (inulins), starch, and cellulose. In food, they are present in significant quantities in honey, wine, beer and fruit juices, and in a range of solid foodstuffs such as bread and pastries, chocolate and candies.

Sulfite	10725854035 E2200 / E2300 n.a. n.a. n.a.	Sulfur dioxide, sulfurous acid and its salts (sulfites) occur in very low concentrations in nature. However, they have been used for a very long time in the industrial production of foodstuffs ("sulfurating"). Sulfur dioxide is widely used as a preservative in food industry, in order to prevent microbial spoilage and oxidation (E220 to E228). The usage of sulfite (SO_3^{2-}) and sulfur dioxide (SO_2) belongs to the most important techniques in order to improve stability and taste of wine. Sulfite is regarded as being poisonous for cells, and in the metabolism it is rapidly oxidized and excreted. The sulfite content in foodstuffs is legally prescribed for certain foodstuffs in a number of countries and the content has often to be declared on the label because of sulfite intolerance in some individuals. As example, a limit value of 10 mg/l exists for juices.
Urea / Ammonia	10542946035 n.a. n.a. n.a. n.a.	Urea is the most important decomposition product of protein metabolism. Measurement of urea in body fluids gives an indication of the state of protein balance in muscle cells and of the protein supply e. g. of cows. Urea is sometimes added (illegally) to meat products in order to indicate a higher content of muscle protein than is actually present (the addition of 1 % urea pretends the addition of approx. 3 % of protein). Urea is an indicator for the presence of urine in swimming pools. It is also used as a component in the manufacture of cosmetics, pharmaceuticals and paper.

2 Applications in Food and Feed

2.1 Alcoholic beverages

Acetaldehyde	Acetaldehyde is an important flavour for many alcoholic beverages (Spirituosen)
Ethanol	
L-Malic acid	Present in alcoholic beverages made from wine (Spirituosen).
Sulfite	

2.2 Bakery/flour

Acetic acid	see German legislation §64 (ASU 17.00-16, June 1990)
Ammonia	
Ascorbic acid	Ascorbic acid might be added to supplemented flour, the maximum level allowed is 300 mg/kg
Cholesterol	When egg is included in the bakery product, cholesterol content can be measured. In noodles, the cholesterol content allows to calculate how many eggs have been added, and to compare to the official recipe.
Citric acid	Is added to bread and bakery products
Ethanol	A lot of confectionery and bakery products contain cream. Ethanol concentration is critical and has to be checked.
Formic acid	
Glucose	The Glucose and Fructose content are determined in order to give nutritional information on the labels
Glucose/Fructose	
Hydroxybutyric acid	If egg is included in the bakery product, the level of Hydroxybutyric acid is an indicator on how fresh the eggs were when they were used.
Iron	Iron might be added to supplemented flour
Lactose/Galactose	see German legislation § 64 (ASU 17.00-7, November 1983)
Lactose / Glucose	
Maltose	Method nº 22-15.01 from the AACC
Raffinose	Raffinose is present in cereals (full corn) but can be the reason for intolerance in people lacking alpha-lactosidase (similar to lactose intolerance).
Sorbitol	Sorbitol is a sugar substitute (E420) that might be added to bakery products
Starch	In flour the starch content varies between 55 to 75 %, and must be controlled for nutritional assessment. The analysis can also be extended to "damaged starch".
Sucrose	Sucrose is added as sweetener to bakery products, and the content is usually controlled for nutritional assessment.
Urea / Ammonia	

2.3 Beer

Overview	**Beer** (by order of importance): Bitterness, Beta-Glucan, Amino Acid Nitrogen, SO_2, Diacetyl, Polyphenols, Soluble proteins, CO_2, Color, pH, ß-Glucanase, Ethanol, Thiobarbituric acid, Acetaldehyde, Flavonoids, Nitrate, Starch, Reducing sugars, SO2-Total, Nitrogen (Total Kjedahl) **Malt** (by order of importance): Alpha-Amylase, ß-Glucan, Free Amino Nitrogen, Soluble proteins, Color, pH, density
Acetaldehyde	Acetaldehyde is formed during fermentation.
Acetic acid	Acetic acid is formed during fermentation of beer, a high concentration is caused by contamination.
Alpha Amino Nitrogen	Like for wine, the Yeast assimilable Nitrogen (YAN) is the sum of Amino Acid Nitrogen (AAN) and Ammonia Nitrogen (AN). It helps planning appropriate fermentation.
Alpha-acids	Alpha acid in hop give the bitterness of the beer. The methods of analysis are not enzymatic but conductivity (EBC 7.4) or HPLC
Alpha-amylase	Alpha amylase is a major mash enzyme of critical concern to brewers in their production of fermentable wort. It digests starch, a large polymer of glucose, into smaller units, exposing it to further digestion by beta amylase. Together, these two amylases produce the spectrum of wort sugars essential in the production of a beer.
Ammonia	Ammonia is an important source of nitrogen in wort for yeasts. A deficit of aminoacids can be balanced by ammonium salts.
Ascorbic acid	L-Ascorbic acid (vitamin C, E300) and its salts (E301, E302) are efficient anti-oxidants and have a positive influence on aroma, taste and stability. The natural L-ascorbic acid content is < 10 mg/l, its addition to beer is regulated.
ß-Glucan	ß-Glucans are polysaccharides present in malt. When present at high concentration, ß-Glucan can lead to the formation of gels which will block the filters. Therefore, it should be tested in malt before the brewing process
Citric acid	Citric acid is already present in the malt and formed during fermentation
Ethanol	Recommended method especially for low-alcohol beer (0.5 - 1.5 %).
Formic acid	Beer contains only small quantities of formic acid. It is formed by lactic bacteria.
Glucose	The determination of glucose is particularly important in diet beer.
Glucose/Fructose	Glucose and fructose play a crucial role to evaluate the quality of beer and malt beverages.
Glycerol	Glycerol is formed during the fermentation, it contributes to the aroma
Iron	Iron is tested in some breweries
D/L-Lactic	D-/L-Lactic acid are formed during the fermentation or are pre-formed in the malt.
L-Lactic	L-Lactic acid is formed during the fermentation or is pre-formed in the malt.
L-Malic	L-Malic acid is present in the malt and is also formed during the fermentation.
Maltose	Maltose is the major component
Nitrate	Nitrate is present in various quantities in drinking water used for brewing. A too high concentration can have the effect of poisoning yeast and other cells.
Oxalic acid	Oxalic acid is present in the malt. Cloudiness of the beer is due to the precipitation of oxalic acid with calcium ions present in the brewing water.

Polyphenols	Beer has a complex mixture of phenolic compounds from 150 mg/L to 330 mg/L in concentration. About 2/3 are malt derived and 1/3 comes from the hops. Polyphenols have the ability to react with proteins, so they can be responsible for the formation of a haze in beer. The majority of modern treatments used to improve the final beer stability are aimed at the removal of either half of the protein fraction, or half of the polyphenol fraction.
Starch	The major component in malt is starch which is hydrolysed during the mash process to fermentable sugars or dextrines.
Sucrose	Sucrose is used up during beer fermentation. It plays an important role in the evaluation of beer.
Sulfite	Brewing materials can generate varying amounts of SO_2 of which much is lost during mashing and boiling. It is important to watch the condition of the yeast.

2.4 Coffee/Tea/Tobacco

Ascorbic acid	(Tea)
Citric acid	(Tea and tobacco)
Glucose/Fructose	
Glycerol	(Tobacco)
Nitrate	
Oxalic acid	(Tobacco)
Sucrose/Glucose	

2.5 Dietetic food

Ascorbic acid	The amount of ascorbic acid must be measured and declared on the label
Succinic acid	Succinate might be added instead of NaCl

2.6 Egg products

	L-Lactic acid (mg/kg dry matter)	Succinic acid (mg/kg dry matter)	D-3-Hydroxybutyric acid (mg/kg dry matter)
Fresh eggs	200	max. 5	max. 5
Egg yolk	120	max. 2	max. 1.5
Egg white	200	max. 2.5	max. 4
Incubated or spoiled eggs	>1500	10 - 1000	10 - 800

L-Lactic Acid (mandatory)	The L-lactate concentration is an indicator for contaminated eggs. The regulation N.853/2004 (CE) states that the level of lactic acid in egg products should not exceed 1000 mg/kg of dry matter.
Succinic Acid (mandatory)	The succinic acid concentration is an indicator for microbial contamination of eggs.
Hydroxybutyric acid (mandatory)	D-3-Hydroxybutyric acid is an indicator for the incubation of eggs. The regulation N.853/2004 (CE) states that the level of D-3-hydroxybutyric acid in egg products should not exceed 10mg/kg of dry matter. It is also excreted from animals affected by ketosis

Glutamic Acid	The typical glutamic acid concentration in egg is 1800 mg/100 g
Cholesterol	A high cholesterol diet can cause heart, liver and kidney diseases. The daily intake should not exceed 300 mg.
Glucose	The typical glucose concentration in eggs is 340 mg/ 100 g.

2.7 Fruit juices

Acetic Acid	Common additive in fruit juice, can also indicate microbial activity. Normal healthy fruit juices contain 0.1 g/l volatile acids (formic and acetic acid), the limit value for volatile acids is 0.4 g/l for orange and apple juice (AIJN).
Ascorbic acid	If the amount of Vitamin C is declared on the label, it must be controlled too
Ammonia	Ammonia is assayed in the course of the amino acid analysis
Citric Acid	Characteristic concentrations for every fruit, depends on variety and ripeness, typical concentrations 6.3-17 g/l for orange juice and 50-200 g/l for apple juice. Citric acid is also an additive used as anti-oxidant (E330).
Ethanol	Indicates the ripeness of the fruit. Ethanol is a product of microbiological fermentation, the limit value is 3 g/l for juices (AIJN).
Formic Acid	Several bacteria produce formic acid. It is also used as a preservative.
Gluconic Acid	In botrytis infected grapes gluconic acid is present, the recommended limit value is 800 mg/l.
D-Glucose	D-Glucose is a common sugar in fruits. The glucose conc. in orange juices should be 20-50 g/l and in apple juices 14-35 g/l (AIJN).
D-Glucose/ D-Fructose	The fructose conc. in orange juices should be 20-50 g/l and in apple juices 45-85 g/l. In orange juices the glucose/fructose ratio is practically constant, a glucose/fructose ratio smaller than 0.85 may indicate glucose decomposition through fermentation.
Glycerol	Can be produced either by botrytis or yeasts. Recommended limit value for glycerol < 1 g/l.
Isocitric Acid	Typical conc. in orange juice is 65-200 mg/l. The ratio citric acid / isocitric acid is used for authenticity control, because of known levels for several fruits.
D-/L-Lactic Acid	D-/L-lactic acid is caused by microbiological fermentation, the limit value is 0.5 g/l for orange and apple juice (AIJN).
L-Lactic Acid	Indicates fermentation in juices. Up to 5 g/l L-lactic acid (E270) is added to nectar.
D-Malic Acid	D-malic acid is not present naturally, its presence indicates the addition of synthetic D-/ L-malic acid (racemic mixture), which is vorbidden.
L-Malic Acid	L-malic acid occurs naturally, its concentration depends on variety and ripeness. Characteristic concentrations are defined for every fruit, so it allows to recognize faked products (i.e. 0.8-3 g/l for orange juice, minimum of 3 g/l in apple juice)
Nitrate	High concentrations indicate that tap water has been added to the juice. The limit value is 5 mg/l (AIJN). For carrot juices, nitrate might be in excessive amount because of the carrot itself.
Oxalic acid	Oxalic acid can be in excessive amount in Rhubarb juice.
Sorbitol/Xylitol	D-Sorbitol only occurs in some stone fruits. It is a parameter to determine the authenticity of red colored juices and to check the fruit content. If the sugar free extract of e.g. orange juice is > 40 g/l, tests should be carried out to extract additives like Sorbitol. The concentration of Sorbitol in apple juices is 2.5-7 g/l.
Starch	If the sugar free extract of e.g. orange juice is > 40 g/l, tests should be carried out for extract raising additives like starch hydrolysate.
Succinic Acid	The ripening process in apples during which the concentration of succinic acid decreases can be monitored.
Sucrose/Glucose	The sucrose conc. in orange juices should be 10-50 g/l and in apple juices 5-30 g/l. Specific sugar ratios exist for many fruits, can also indicate added sugar.
Sucrose/Glucose/ Fructose	The most common sugars in juices are glucose, fructose and sucrose. The percentage share of sucrose in total sugar is less than 50%. A glucose surplus and/or too high proportion of sucrose in the total sugar indicate additional

	sweetening of orange juices.
Sulfite	A limit value of 10 mg/l exists for juices. In grape juice, a concentration of 10 mg/l indicates incomplete desulphiting.

2.8 Other Fruit & Vegetables products (cans, dried, jam, etc…)

Ascorbic acid	Might be added in order to compensate for vitamin C losses
Acetic acid	
Ethanol	
Formic acid	
Gluconic acid	
Glucose/Fructose	
Glutamic acid	
D/L Lactic acid	Avery important parameter in tomato juice and tomato can products
L-Lactic acid	
Nitrate	

2.9 Honey

Acetic acid	Acetic acid, alone or in conjunction with formic acid, is used to treat the bees against varroa mites and against Nosema apis. Residues of acetic acid can be found in the honey.
Ethanol	Ethanol is a product of microbiological fermentation (similar to Glycerol). Usually it should not exceed 100 mg/kg.
Formic acid	Formic acid is a natural constituent of honey (20 – 300 mg/kg). Formic acid, alone or in conjunction with acetic acid, is used to treat the bees against populations of varroa mites, so Formic acid level is tested in the honey.
Glucose/Fructose	Specific Fructose/Glucose ratios exist for many honeys: – a different ratio may indicate glucose decomposition through fermentation – a high ratio Glucose/Fructose (typically > 1.25) leads to an unwanted cristallisation of the honey, whereas a low ratio prevents it
Glycerol	Harvesting honey with too high water content (> 20 %) leads to spoilage by microbiological fermentation, leading to a high level of Glycerol (> 300 mg/kg).
Invertase	Honey can be adulterated by adding sucrose and invertase, in order to obtain more Glucose and Fructose. However, the ratio Fructose/Glucose will tend to 1, which is not correct. Testing Invertase activity will be difficult, because heating the honey is enough to destroy the enzyme, so it won't be detected anymore.
Lactic acid	Lactic acid bacteria (LAB) are present in the stomach of bees and transferred to the honey. The lactic acid produced is helping to prevent spoilage organisms in honey.
Maltose	Specific sugar ratios exist for many honeys.
Oxalic acid	Oxalic acid is a natural constituent of honey (10 – 100 mg/kg). Honeybee colonies are treated for parasitic mites with either spraying or trickling of oxalic acid.
Sucrose/Glucose	Specific sugar ratios exist for many honeys, this can be used as an indication of added sugar.
Sucrose/Glucose/ Fructose	A glucose surplus and/or too high proportion of sucrose in the total sugar indicates additional sweetening of honeys.
Tartaric acid	Tartaric acid may also be used to treat the bee colonies, similar to the other acids mentioned above

2.10 Margarine and Oil

Overview	Cholesterol, Citric acid, Glycerol

2.11 Meat and meat products

Acetic acid	Sodium acetate (E262) is added to increase the microbiological stability of meat and meat products. Normally 0.3 g/100 g are added to meat products. Some bacteria also produce acetic acid.
Ascorbic acid	Ascorbic acid (E300) is used as a reddening agent for meat and as an antioxidant.
Cholesterol	Cholesterol is found in foods such as meat, poultry, seafood and dairy products. A high cholesterol diet can cause heart, liver and kidney diseases. The daily cholesterol intake should be less than 300 mg/day.
Citric acid	Citric acid (E330) improves the peelability of sausages and stabilizes colour, taste and flavour in meat/meat products. Normally 0.15 g citric acid /100 g are added to sausages.
Ethanol	Ethanol indicates spoilage in meat products.
Gluconic acid	Gluconic acid (E575) is used as a slow release acidifier in meat products and as a cutter aid agent. Normally 0.1 g/100 g are added to sausages.
Glucose	Glucose is used as a sweetening agent for meat and meat products. Meat marinated with glucose exhibits better lean colour. Normally 0.5 g/100 g glucose is added to sausages.
Glucose/Fructose	Glucose and Fructose are used as a sweetening agent for meat and meat products
Glutamic acid	Monosodiumglutamate (E621) intensifies the taste of meat products. Normally, 0.13 g/100 g is added to sausages. Glutamate is also an allergen.
Lactic acid	L-lactic acid is used as a cutter aid agent. Sodium lactate (E325) is used as an acid regulator to improve the microbiological stability of meat and meat products. Up to 0.3 % is added to sausages. L-lactic acid originates from the glycogen metabolism while D-lactic acid is produced from bacteria. Meat products contain normally 0.55 g / 100 g L-lactic acid and 0.02 g / 100 g D-Lactic acid.
Lactose/Galactose	Lactose is used as a sweetening agent it also improves colouring of meat and meat products. Normally 0.5 g/100 g is added to sausages. On the opposite, other meat products are sold as lactose-free and must be tested.
Maltose	Maltose is added as a sweetening agent and as a Glucose flavor enhancer.
Nitrate/Nitrite	Potassium nitrate (E252) is used as a salting and reddening agent for meat products. During salting, up to 2.4% nitrite is added of which 20 - 50 mg/kg are converted to nitrate. The nitrate/nitrite conc. in meat products must not exceed 100 mg/kg.
Starch	Starch is added to cooked sausages to give maximum moisture retention. Usually 1.3 g/100 g starch is added to sausages. Also tested for nutritional assessment.
Sucrose/Glucose	Sucrose is used as a sweetening agent and a preservative for meat and meat products. Usually 1 g/100 g is added to sausages. Also tested for nutritional assessment.

2.12 Milk and Dairy products

Acetaldehyde	Acetaldehyde is an important flavour in yoghurts.
Acetic acid	Acetic acid concentrations can be up to 360 mg/100 g in certain cheeses.
Ammonia	Ammonia is a metabolite of microbial activity in milk and is not sensitive to thermal treatment (pasteurization), so it is a reliable indicator of milk's hygienic quality. Ammonia in yoghurt = 117 mg/kg, Emmental = 550 mg/kg, Camembert = 970 mg/kg.
Ascorbic acid	Raw milk contains 20 mg/l vitamin C (ascorbic acid). Ascorbic acid is also an additive to milk products.
Cholesterol	High-cholesterol diet can cause heart, liver and kidney diseases.
Citric acid	Citric acid is measured in cheese and processed cheese. Citric acid is also an additive to other milk products like for example whey powder (can reach 2.5 % of the dry mass)
Ethanol	The ethanol concentration is monitored in kefir (0.7 - 3 %). In Quark, it means that Yeast is present.
Fomic acid	Formic acid is present in milk at low concentrations, as a result of sterilization processes. Resulting (5 – 10 mg/l in pasteurized milk but 20 – 200 mg/kg in milk powder). But the main source of formic acid is the metabolic activity of *Streptococcus thermophilus* which is used for the production of fermented milk, yogurt and cheese, and gives concentrations up to 3 g/kg). Since it allows to improve the fermentation process, it can be also added as exogenous Formic acid.
Gluconic acid	The determination of D-gluconate in milk and milk products plays an important role.
Glucose/fructose (Lactulose)	Lactulose is an important parameter with a maximum value allowed in some countries. It is measured with the Glucose/fructose enzymatic test after hydrolysis of Lactulose using ß-Galactosidase.
Glutamic acid	Glutamic acid is a product of the protein degradation and can be used as an indicator for the proteolysis in cheese. Glutamic acid concentration grows steadily and can reach 6000 mg/100 g at the end of the ripening.
L-Lactic acid	The lactate concentration is close to zero in fresh milk, but increases if fermentation of Lactose by Lactic acid bacteria occurs. This activity is necessary when producing cheese and is called "acidifying power".
D-/L-Lactic acid	To produce sour milk products, micro-organisms are added to the milk and D-/L-Lactic acid is formed
Lactose/Galactose	The lactose concentration in milk is around 50 g/l ((ISO 5765-2), and decreases to almost zero in processed cheese. Galactose is an important parameter in processed cheese and whey powder.
Lactose/Glucose	The Lactose content can be determined via the Glucose moiety (ISO 5765-1). The lactose content of lactose-free products can be determined after glucose oxidation. The glucose concentration is measured in dried milk, dried ice-mixes and whey powder.
Nitrate/(Nitrite)	Natural milk should be close to zero for nitrate, but it can be added up to 0.01 - 0.02 % to avoid cheese blowing by bacteria. It is also used in order to control the ratio between Acetic acid and Propionic acid in cheese.
Starch	Strac is used in order to increase the thickness of milk-based desserts
Succinic acid	Is used in order to monitor the fermentation of cheese
Sucrose/Glucose	Sucrose is added as sweetener for milk-based desserts.
Urea/Ammonia	The urea content in milk is an indicator of the efficiency of feeding on dairy cattle, because it is related to the ratio between energy and proteins in foodstuffs. The analysis of urea also allows to distinguish the urea content from the protein content in the milk. Normally the urea concentration in milk is 18 - 32 mg/dl.

2.13 Pharmaceutical and cosmetic products

Acetic acid	
Ascorbic acid	If ascorbic acid is added, the content must be controlled
Citric acid	
Cholesterol	
Ethanol	
Glycerol	
Glutamic acid	
L-Lactic acid	Can be present in cosmetics
L-Malic acid	
Sorbitol / Xylitol	
Sulfite	Belongs to the European pharmacopea
Urea / Ammonia	

2.14 Sea food and fish

Acetic acid	Organic acids affect the rate of growth of pathogenic bacteria in food. Lactic acid and acetate are widely used as additive / preservative. If the preservatives are injected into the fish, the concentration is precisely known. But if the fish is soaked into a solution, it is necessary to check the concentration in the tissues. Diacetate is also used as preservative, and it can be monitored via the acetic acid assay (details available). Otherwise, naturally occurring organic acids are important in some cases. Lactic acid is more important in dairy and meat than in fish, but if lactic acid bacteria are in the bacterial flora, lactic acid amount maybe important also in fish.
L-Lactic acid	
Ascorbic acid	Ascorbic acid is used as anti-oxydant in fish and sea-food products.
Sulfite	Sulfite is widely use as preservative, especially for shrimps. There are legal limits depending on the country.

2.15 Soft drinks / Mineral water

Nitrate	Nitrate is monitored in mineral water and tap water

2.16 Sugar and refinery products

Acetic acid and L-Lactic acid	The sugar juice (from sugar beets) contains approx. 18% of sucrose which give its value to the production lot. In case of bacterial contamination, the sucrose level will decrease and cause an immediate financial loss. The lactic acid and the acetic acid are measured at the beginning of process (on beet, beet juice and processing liquors). The usual concentrations are about 50 to 60 mg/l in the sugar beet juice. Above 150 mg/l, there is a bacterial contamination of the juice and a bactericidal treatment is needed.
Ascorbic acid	
Ethanol	Ethanol is present if the sugar juice (melass) has fermented, which is obviously unwanted.
Glucose / Fructose	Glucose/Fructose can be tested in two circumstances: – if Sucrose is hydrolysed through bacterial contamination, this can be monitored via the increasing Glucose and Fructose concentrations – when fermentation products are produced from the sugar juice, monitoring of Glucose/Fructose is an important tool
Citric acid	Citric acid is analysed in gelling sugar (for marmalade). The gelling sugar is made of crystal sugar (pure saccharose), dry Pectin and tartaric acid (0,4-0,7 %) or citric acid (0,6-0,9 %).
Raffinose	Raffinose-Monitoring in Sugar beet. Raffinose interferes with crystallisation of sugar: if the concentration is above > 1% of the dry matter, the speed of crystallisation is strongly reduced and the crystals have the shape of a needle.
Starch	Monitoring of starch in finished glaze and Fondant. Fondant has a content of approx. 88 to 89.5 % dry matter and 10.5 – 12 % wate. The dry matter consist of Saccharose (90 %) and glucose syrup (10 %)
Sorbitol	Sorbitol is analysed in Mixed Syrup.
Sulfit Total	Sulfite is added in order to decolorize some refinery products (additives E221 to E228). Since SO_3 is an allergen, the concentration must be monitored and declared. The concentration is low (around 1 mg/kg dry matter), so the determination is performed with the max. sample volume in the assay (2ml).
Sucrose	When the sugar beets are paid to the grower, the sucrose content is the first parameter for price determination. Since the concentration is high, this measurement is usually performed wit refractometry. However, Sucrose determination via enzymatic tests is performed when monitoring fermentation processes (like production of citric acid)

2.17 Wine laboratories and wineries

Acetaldehyde	Acetaldehyde indicates the fermentative production of ethanol. A high concentration is caused by the bacteria acetobacter which transforms ethanol into acetaldehyde and finally into acetic acid. Excessive levels of acetaldehyde can give an unpleasant "oxidized" taint to wine. Acetaldehyde binds SO_2, and therefore causes the difference between Total SO_2 and free SO_2.
Acetic acid	This is a sensory compound that adds flavour and complexity in small amounts, but spoils wine at high concentrations. Produced naturally by yeast in small amounts and by spoilage organisms such as *Acetobacter aceti* in large quantities. This is the predominant of the acids comprising ~ 95 % volatile acidity. The quantity of acetic acid formed during fermentation ranges from 0.15 to 0.8 g/l. A concentration higher than 0.8 g/l indicates the presence of spoilage organisms (acetobacter).
Ammonia	Ammonia is an important source of nitrogen for bacteria (see also YAN Yeast Assimilable Nitrogen). A high concentration indicates that amino acids have been added. Excessive levels of nitrogen contribute to the urea formation, and thus to carcinogenic ethyl carbamate. During the malolactic fermentation, the ammonia concentration increases.
Ascorbic acid	Ascorbic Acid is used in winemaking as an anti-oxidant.
Calcium	Presence of calcium may cause instability problems (as calcium tartrate deposits). Calcium/Tartrate determination gives an indication of whether the wine is likely to throw a calcium tartrate deposit. The following tests are performed: Calcium, Tartaric Acid, Alcohol and pH
Citric acid	An important wine acid and also an additive (E330) used to balance the acidity of wine. Can be added to wines in order to prevent ferric casse, instead of using Potassium ferrocyanide which is dangerous. A limit of 1 g/L applies for EU member countries.
Copper	Excess copper ions, e.g. from fining, can cause formation of an unsightly haze (a casse) in finished wine
Ethanol	If > 140 g/l then ethanol has been added. Normally the concentration is between 80 and 100 g/l.
Formic acid	Formic acid occurs as a metabolite in many biochemical reactions, constitutes a typical fermentation product of pectin. Typical concentrations vary from 150 - 250 mg/l in wine.
Iron	Implicated in haze formation (along with copper), iron ions can contaminate the wine through contact with exposed iron surfaces (non-stainless steel). The maximum value is around 8 mg/l, above this limit the danger of iron haze is high.
Gluconic acid	In *botrytis* infected grapes, gluconic acid is present at higher concentrations. For wine, the ratio Glycerol/Gluconic acid and Ethanol/Gluconic acid can give indications whether glycerol or ethanol have been added.
Glucose/ Fructose	These are the main fermentable sugars in juice and wine and results are usually reported as the total of these two parameters. Glucose/fructose is close but not 100 % equal to "reducing sugars". During alcohol fermentation, the content of ethanol rises while the level of D-fructose / D-Glucose falls from 25% (w/v) to < 0.2% (w/v). After fermentation, the fructose / glucose ratio will be approx. 6:1 (fermentation of fructose is slower). Thus, an unusual glucose/fructose ratio indicates whether sugar has been added.
Glycerol	Produced by yeast during primary fermentation, glycerol contributes to mouthfeel (wine "body"). The ethanol/glycerol ratio indicates whether glycerol has been added (average glycerol/ethanol ratio is around 7 – 10%).
Lactic acid	As a result of Malo-lactic fermentation (MLF), lactic acid is increasing during the wine-making process.
D-Malic acid	Only present in significant quantities in adulterated wine (racemic mixture added)
L-Malic acid	Malic acid is measured in juice to allow for any future acid corrections, or to assess whether MLF has been completed in a wine (< 0.05 g/L). D-Malic Acid is only prepared industrially, so its presence indicates that D-/L-malic acid has been added

Nitrate	A high concentration of nitrate might indicate the addition of tap water.
Polyphenols	The phenolic compounds in wine (natural phenol and polyphenols) include a large group of several hundred chemical compounds that affect the taste, color and mouthfeel of wine. The large group of natural phenols can be broadly separated into two categories, flavonoids and non-flavonoids. Flavonoids include the anthocyanins and tannins, while the non-flavonoids include resveratrol and phenolic acids
Potassium	Excessive potassium contributes to higher pH in wines, and potential tartrate instability problems. Some countries have maximum allowable limits.
Reducing sugars	This method determines the total reducing sugars in the sample, including glucose, fructose and pentose. Sucrose is not a reducing sugar, and will not be determined unless inversion takes place before.
Sodium	Excess sodium ions may impart a salty taste to wine, and some countries have maximum allowable limits (it is illegal to add sodium based additives to wine, e.g. sodium metabisulfite).
Sorbic acid	Sorbic acid is a preservative used to suppress potential yeast growth in sweet and semi sweet wines. Its analysis is required for certain export destinations.
Sorbitol / Xylitol	The natural D-Sorbitol concentration is approx. 0.02 g/l. Concentration of up to 60 g/l indicates blending with stone fruits. Sorbitol is often also added to increase the sugar free extract.
Starch	Partially hydrolysed starches are used in soft drinks, and illegally added to wine to increase the dry extract (pretends better wine quality).
Succinic acid	Succinic acid is formed during fermentation, and may contribute significantly to titratable acidity.
Sucrose	Sucrose is hydrolysed quickly under acid conditions present in wines. Sucrose might be added to musts in order to increase the ethanol concentration.
Sulfur Dioxide (free and total)	The sulfur dioxide content of wine is one of the most important parameters a wine maker needs to know. SO_2 is added throughout fermentation to inhibit wild yeast growth and so to stabilize the wine. The EU limit value is 175 mg/l SO_2 for red wine. Concentrations of > 300 mg/l SO_2 pose health risk to humans.
Tartaric acid	Tartaric acid is one of the main acids in grapes.
Urea	If excess urea is formed in wine it will combine with the ethanol in wine during the storage and ageing period to form ethyl carbamate, a known carcinogen. Often urease is added at the end of the fermentation process to convert urea into CO_2 and NH_3.
Volatile acidity	If requested, the Steam Distillation method may be used. This method may slightly overstate the acetic acid content due to other volatile acids.
Yeast Assimilable Nitrogen (YAN)	YAN is the sum of Amino Acid Nitrogen (AAN) and Ammonia Nitrogen (AN). It gives the nutritional status of juice, and helps planning appropriate addition of nutrients to minimize the possibility of a stuck ferment.