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ACIDULANTS

INTRODUCTION

Acidulants are substances (organic or inorganic) which release hydrogen and a salt part in water solution. When the concentration of hydrogen ions goes up then the acidity of the whole system is increasing and the pH is decreasing. Human saliva is slightly acid (pH approximately 6.8) and when we consume sour food or drink, our taste receptors interact with the acids present in the food or drink and this sensation is recognized by us as sourness.

Many foods, like most fruits, contain natural acids such as citric acid, malic acid and tartaric acid and these are responsible for the authentic taste and flavor of the specific fruit.

Many naturally preserved foods (fermented foods) also contain a composition of various acids and the sour taste sensation is commonly a signal for good quality food.

Acids are used by food producers in order to achieve the required pH, to buffer, to influence taste and flavour, to keep colour and texture of foods. Acids also play an important role in the natural preservation of foods.

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There are several acids used by the food industry and this publication describes their main characteristics and functionalities.

DESCRIPTION OF MAIN ACIDULANTS IN FOOD

Acetic acid (E260) – the most commonly known organic acid, naturally present in many fruits and fermented foods, found in vinegar. Acetic acid is available in a liquid form and is in high concentrations strongly corrosive. Presently can be produced by fermentation (natural acetic acid) or by synthesis, in food mostly natural acetic acid is used. Acetic acid has a very intensive specific pungent smell and taste, commercially is used as 6-10% solution. Acetic acid is applied in many food products as natural preservative.

Citric acid (E330) - is a naturally occurring in many fruits organic acid (first isolated from lemon), produced commercially by microbial fermentation of carbohydrate substrates. Citric acid is colourless and odourless and exist in crystal or crystalline powder form, it has a sharp and well pronounced acid taste. Citric acid is well soluble in water and alcohol and it is hygroscopic.

Malic acid (E296) – is a naturally occurring in many fruits organic acid (first isolated from apples) and present in human metabolism (Krebs cycle), produced commercially by a synthesis. DL malic acid is colourless and odourless and can exist in crystal or granulated form, it has strong acid taste very well boosting fruit flavours, specially citrus taste. Malic acid is well soluble in water. Limited volumes of L malic acid are commercially produced.

Fumaric acid (E297) – is a naturally present in live cells chemical compound (various fungi), produced also in human skin when exposed to sunlight and also present in some fruits and vegetables. Commercially produced by chemical synthesis from malic acid. It is a crystalline, odourless substance non hydroscopic and with limited solubility in water.

Lactic acid (E270) is a naturally occurring in many fermented foods and human body organic acid (first isolated from sour milk), produced commercially by microbial fermentation of carbohydrate substrates. Lactic acid is commonly available in liquid form (50-80% concentration), clear colourless to pale yellow solution. It has specific sour taste and no strong smell, giving well balanced, less sharp and nice acidity in the final product. Lactic acid is very well soluble in water. Lactic acid is also available in a powder form.

Tartaric acid (E334) is a naturally occurring in many fruits organic acid (first isolated from cream of tartar “wine stone”), produced commercially as a natural grade during wine production. Tartaric acid is colourless and odourless crystal, it has strong and sharp acid taste. Tartaric acid is well soluble in water.

Succinic acid (E363) is a naturally-occurring dicarboxylic acid found in most fruit and vegetables. Traditionally is produced by catalytic hydrogenation of maleic acid & anhydride, can

be also extracted from the fruits or recently produced by bioconversion. Odourless, colourless, white crystalline solid that has a slightly bitter and acid taste, and is soluble in water.

Phosphoric acid (E338) is an inorganic acidulant obtained by chemical reaction from phosphorus rock. It gives very strong acid taste in low concentrations. Commercially is available in liquid form and most commonly 70-80% concentrations. Food grade phosphoric acid is a colourless clear liquid.

FUNCTIONALITY OF ACIDULANTS IN VARIOUS FOOD PRODUCTS

PRODUCT	E NUMBER	FORM	TASTE AND FLAVOUR	AVERAGE pH OF 1% SOLUTION	SOLUBILITY	NATURAL	FUNCTIONALITY
Acetic acid	E260	liquid	Vinegar	2.7	High	Yes	Flavour enhancer, pH control, microbial control
Lactic acid	E270	liquid	Mild taste sour	2.4	High	Yes	Flavour enhancer, pH control, microbial control
Malic acid	E296	solid	Sour slightly sharp	2.3	High	No	Flavour enhancer, pH control, microbial control
Fumaric acid	E297	solid	Bitter to sour	2.1	Low	No	Leavening agent, Flavour enhancer, pH control,
Citric acid	E330	solid	Citrus strong	2.3	High	Yes	Flavour enhancer, pH control, microbial control, chelating agent
Tartaric acid	E334	solid	Sour with tartaric notes	2.1	Low	Yes	Leavening agent, dough conditioner, flavour enhancer, pH control
Phosphoric acid	E338	liquid	Sour	1.6	High	No	Flavour enhancer, pH control, microbial control
Succinic acid	E363	solid	Bitter to sour	2.6	Low	Yes*	Flavour enhancer, pH control, microbial control

Note: * bioconversion grade

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FORMULATING WITH ACIDULANTS

Generally majority of acidulants, with exception of fumaric, phosphoric and succinic acids have no legal limitations towards applications in food and beverage products. The dosage is adjusted to individual needs of the formula and required pH value as well as taste profile (required sourness).

PRODUCT	E NUMBER	POPULAR APPLICATIONS	TYPICAL DOSSAGE
Acetic acid	E260	Pickled vegetables, fish salads, sauces and salad dressings, processed meats	quantum satis
Lactic acid	E270	Processed meats, snacks, confectionery, soups and sauces, dairy, bakery, salad dressings	quantum satis
Malic acid	E296	Beverages, low alcoholic coolers and flavoured beers, confectionery	quantum satis
Fumaric acid	E297	Tortillas, bakery, confectionery, desserts	limited
Citric acid	E330	All type of foods and beverages	quantum satis
Tartaric acid	E334	Bakery, confectionery, beverages	quantum satis
Phosphoric acid	E338	"Cola" type beverages, sauces and salad dressings, food processing	limited
Succinic acid	E363	Instant beverages, dairy and desserts, bouillons and stocks, flavours and flavourings	limited

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HOW TO CHOOSE THE RIGHT ACIDULANT

In general acidulants play a very similar role in food formulations and choosing the right acid or their combinations is subject to some important factors and differences between acidulants.

- Form of the acid: solid or liquid – does the application limit the form of acidulant. For example for most of the food applications which are aqueous systems do not need to use solid form of acids but some of them like tablets, instant beverages, powder blends, etc. strictly require solid form of acidulant.

- Solubility – it is important to understand how much of acid is required to achieve expected pH level (acidity), when playing with low soluble acids.

- Taste profile and interaction with flavours – most of acidulants have a great role in creating the overall taste profile and have synergies with flavours and sweetening systems.

APPLICATIONS

Beverages

In most of beverages, citric acid is the first choice to be used as acidulant. The main reason is the specific, relatively mild to slightly sharp sourness and refreshing effect on most of fruit flavours. Malic acid is used when strong flavour enhancement is expected and mostly in combination with citric acid. Phosphoric acid is commonly used in “cola” type beverages to bring specific taste profile and strong effect on pH. In alcoholic beverages, mostly in fruity coolers and low alcohol drinks malic acid is commonly used. Succinic acid is used due to the legislation only in instant beverages for home preparation.

Confectionery

Malic acid as well as fumaric acid provide more persistent sourness than other food acids at the same concentration. Malic acid enhances fruit flavours and boosts the impact of high intense sweeteners. Buffered systems of various acids can be used to control sugar inversion and crystallization as well as gel texture of hydrocolloids (special impact on pectin).

Savoury foods

Acidulants play mostly role as a shelf life regulators (pickled fish, processed meat) and can improve processing efficiency as well as help to stabilise quality of fermented meat and cheese product. Acidulant combinations are widely used in spice blends that are dusted on snack foods and used in variety of processed meat, fish and seafood. Succinic acid is used as a typical umami taste enhancer providing at low concentrations required taste impact.

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REGULATORY

Acidulants are food additives and their use is subject to several laws and regulations. For the member states of the European Union, their use is inter alia subject to Regulation (EC) No 1333/2008 on food additives published in December 2008.

Annex I of this Regulation describes the functional classes of food additives:
'acids' are substances which increase the acidity of a foodstuff and/or impart a sour taste to it.
'acidity regulators' are substances which alter or control the acidity or alkalinity of a foodstuff.

Annex II provides the community list of food additives approved for use in foods
The list is published in November 2011, in Commission Regulation (EU) No 1129/2011 amending Annex II to Regulation (EC) No 1333/2008.

The list includes:

- The name of the food additives and the E numbers (part B)
- Definitions of groups of additives (part C)
- The foods to which the food additives may be added, food categories (part D)
- The conditions under which the food additives may be used (part E)

Specifications of food additives
Commission Regulation (EU) No 231/2012 published in March 2012, provides the specifications, such as purity criteria, origin and other necessary information, for food additives.

For a complete overview of approved acidulants and the exact approved applications, dosage and conditions of use in the European Union, the most current Regulations and directives as well as any other applicable national laws and regulations must be checked. The complete texts as well as consolidated versions of the European Regulations and directives with last updates can be viewed and downloaded from the following website: http://eurlex.europa.eu/en/index.htm
For any use outside the European Union, please check carefully the laws and regulations applicable for you. Please keep in mind that you are responsible for compliance with any applicable legal and regulatory requirements.

Best regards,

Gustavo Garcia
Regulatory Compliance Manager