

Toxicology Topics in Brief

Food Additives

Introduction

Food additives are substances that are used in recipes to improve the texture, shelf life, or appearance of food products. Only food additives that have been through extensive testing and been approved are permitted to be used. Approximately 450 substances are approved for use as additives in food in the UK and the European Union.

What are food additives?

The official definition of a food additive is provided by the Codex Alimentarius Commission, an international body established by the FAO/WHO Food Standards Programme. It is “any substance not normally consumed as a food in itself and not normally used as a typical ingredient of the food, whether or not it has nutritive value, the intentional addition of which to food for a technological (including organoleptic¹) purpose in the manufacture, processing, preparation, treatment, packing, packaging, transport or holding of such food results, or may reasonably be expected to result, (directly or indirectly) in it or its by-products becoming a component of or otherwise affecting the characteristics of such foods.” The definition does not include ‘contaminants’ or substances added to food for maintaining or improving nutritional qualities.

So, a food additive is a substance which is specially selected for a specific role in a food product. It may be a natural substance, like sodium carbonate, a compound identical to one found in nature like malic acid or an entirely new compound like saccharin.

Enzymes and flavouring substances are not included within the definition of food additives and are covered by separate legislation.

There are approximately 450 food additives permitted within the EU and the UK. Of these, only about 100 are commonly found in retail food products.

E numbers

When the six member states of the European Common Market began the process of bringing together their food legislation in the 1960s, they decided that permitted additives would be listed in Directives and that, because some additives have names that would be unfamiliar to consumers, they should have a number, preceded by an E, to denote that they were approved.

So the E number was born.

Did you know?

The ‘E’ in E numbers stands for ‘Europe’.



¹ Organoleptic substances are those that introduce sensory properties to a food or beverage (e.g. taste, colour, odour or feel).

Before the harmonisation of food additives, each country had its own approach to the use of additives. Some countries had a list of prohibited substances within a general requirement that food should be safe, while others had a list of permitted additives. It was decided that the Common Market would have a list of permitted additives and the scientists working on bringing together the regulations of individual countries approached the problem by reviewing the additives in functional classes. The first class was colours so colours have numbers beginning with one. Then followed preservatives, antioxidants and so on.

Other parts of the world now use the same numbers but not, of course, with the preceding E. Negative consumer reaction to the E number in Europe has meant that it is now rare to see this on a label, the name being used instead. Although the UK has now left the EU, the number preceded by the E can still be used.

What do additives do?

The EU Regulation on food additives, 1333/2008, identifies 27 different roles for food additives:

Sweeteners, colours, preservatives, antioxidants, carriers, acids, acidity regulators, anticaking agents, antifoaming agents, bulking agents, emulsifiers, emulsifying salts, firming agents, flavour enhancers, foaming agents, gelling agents, glazing agents, humectants, modified starches, packaging gases, propellants, raising agents, sequestrants, stabilisers, thickeners, flour treatment agents and contrast enhancers.

Did you know?

Many E numbers are only permitted to be added to specific foods. E127, also known as erythrosine, is a red dye and is only permitted for use in glacé cherries.

Food additive	Uses & benefits	Example
Preservatives	Preservatives prolong the shelf-life of food by slowing bacterial degradation. This means that food is kept safe to eat for a longer period of time.	Sulphur dioxide (E220) has been used to preserve wine for hundreds of years.
Flavour enhancers	These are substances that have no flavour or taste but instead bring out and improve the flavours of the foods to which they are added.	Monosodium glutamate (E621) is used to enhance the flavour of crisps.
Sweeteners	Sweeteners are sugar substitutes. Foods suitable for diabetics often contain sweeteners.	Sweeteners such as aspartame (E951) are used in 'diet' versions of soft drinks.

Emulsifiers and thickeners

These are used to help the mixing process for foods that do not normally mix well, such as oil and vinegar in salad dressings. They also stabilise mixtures, i.e. ensure that the oil and vinegar don't separate to form two layers but stay mixed together. Thickeners are used in foods such as ice-cream to make it more viscous.

Xanthan gum (E415) and guar gum (E412) are used as stabilisers and thickeners in mayonnaise.

Antioxidants

Antioxidants slow down the process by which foods 'go off'. They delay oxidation in oils and fats.

Antioxidants such as ascorbic acid (E300, also known as vitamin C) and sodium ascorbate (E301) are commonly used in cured meats and pastries to prevent them from going rancid.

Colours

Colours are added to food to make it more visually appealing or to restore the original colour of the food after processing. They can be natural or synthetic chemicals.

Colours, both natural (eg E161b, also known as lutein) and synthetic (eg E102, also known as tartrazine) can be used to produce bright colours in sweets and other foods.

Raising agents

Raising agents release gas when a food mixture is heated. The gas can be steam (generated from liquid in the ingredients or food), air (added mechanically during food preparation) or carbon dioxide (produced chemically or biologically).

Bicarbonate of soda (E500) is often used as a raising agent in baking.

Flavourings

Flavourings are different from flavour enhancers and can be natural or man-made substances. Lots of flavourings are developed from substances found naturally in foods. The use of flavouring agents is not currently controlled in the same way as other additives. They do not have E numbers.

Vanilla is a commonly used flavouring in ice-cream.

What does testing cover?

Before an additive can be approved for use in the EU it has to be assessed by the European Food Safety Authority (EFSA) in the EU and the Food Standards Agency (FSA) in Great Britain. The individual tests used across the world may be slightly different but the code is generally agreed by the Food Standards Agency (FSA), EFSA, the Joint FAO/WHO Expert Committee on Food Additives (JECFA) and the Food and Drug Administration (FDA) in the USA. These usually start with experimental animals studies on absorption, distribution, metabolism and excretion to

guide the design of further tests, such as those over a longer time period and multigenerational studies. All these tests are necessary to ensure that the additive will not cause illness. They enable experts to calculate the Acceptable Daily Intake (ADI) of the additive. With many additives there is no limit, while others have a limit determined as the maximum daily intake per kilogram of bodyweight.

Some additives, like the emulsifier mono- and di-glycerides of fatty acids (E472) are used widely while others like beeswax (E901) are only appropriate for particular products. Where a numerical ADI has been set, food consumption databases are consulted to ensure that, at the required usage rate of the additive, not even high consumers of the product will exceed the ADI. On occasion the experts will conclude that it would be possible for a consumer to exceed the ADI if the additive were to be permitted in all the types of food for which it is proposed. In that situation the manufacturer will reduce the range of foods to ensure that the ADI cannot be exceeded.

Allergies and other reactions

However, some people are affected by individual additives. Others think that they are allergic to an additive, that it affects the behaviour of their children or that they have some sort of immediate reaction to food containing a particular additive.

It is certain that sulphur dioxide and compounds that release the gas in wine can aggravate asthma in sensitive people. Similarly, those who are born without the enzyme phenylalanine hydroxylase cannot metabolise the sweetener aspartame. In other cases the evidence for adverse reactions is weaker. About 1 in 20 people consider that they have an allergy to one or more additives but studies have shown that this can only be demonstrated in about 1 in 10,000 individuals. For a long time there were concerns that food colours could adversely affect the behaviour of sensitive young children and in 2007 the FSA funded a study on this at the University of Southampton. The results were inconclusive but the FSA decided that, using the precautionary principle, these products should be banned. However, since the UK was at that time in the EU, the matter had to be reviewed by EFSA who decided that there was insufficient evidence to ban the products. However, the European Parliament decided that, using the precautionary principle, the use of the colours should be accompanied by a warning statement to the effect that they could have an adverse effect on the behaviour of children. Since then these colours, and indeed most synthetic colours, have ceased to be used and have been replaced by fruit and vegetable extracts.

For many years there has been a suggestion that monosodium glutamate (E621) could cause a reaction in sensitive people. Monosodium glutamate is used to enhance the flavour of meat products. It is made industrially by fermentation but it naturally occurs in a range of foods including tomatoes and seaweed. It is commonly added in Chinese cuisine because it is believed to increase brain function in addition to improving the flavour of food.

The “Southampton Six”

Sunset Yellow (E110)
Quinoline Yellow (E104)
Carmoisine (E122)
Allura Red (E129)
Tartrazine (E102)
Ponceau 4R (E124)



Did you know?

Glutamates naturally occur in tomatoes, peas, potatoes and maize



Ongoing Evaluation

The EU continues to review the evidence for the need for and safety of additives. As a result of a review of data by EFSA in 2021 they decided that there was some evidence that particles of Titanium Dioxide, E 171, might accumulate in the body. The Expert Panel on Food Additives and Flavourings applied the EFSA guidance on nanotechnology since up to 50% of the particles of titanium dioxide might be in the nano (less than 100 nanometres) range. They concluded that they could not disregard a risk of genotoxicity. In Great Britain the FSA has reviewed the EFSA opinion and is considering whether or not they should follow suit.

Animal Testing

It is generally agreed that animal testing is not a completely accurate predictor of the safety of an additive and alternative methods are being sought. In some cases it is clear that animals metabolise chemicals through different pathways from humans and produce different metabolites. One approach being developed is to identify the pathways in the human body which lead to an adverse outcome such as liver fibrosis or neurotoxicity. Once these have been identified the intention is to identify the structures in compounds proposed as additives that might trigger such a pathway. Other approaches are using computer modelling and cell culture. In all cases the objective is to reduce the number of laboratory animals and increase the rigour of the safety assessment. This subject is reviewed in more detail in a separate note.

Further Reading

European Food Safety Authority (EFSA) Food Additives website:

<http://www.efsa.europa.eu/en/topics/topic/additives.htm>

EFSA 'Frequently Asked Questions' on the 'Southampton Six' colour additives:

<http://www.efsa.europa.eu/en/faqs/faqfoodcolours.htm>

List of E numbers: <http://www.food.gov.uk/policy-advice/additivesbranch/enumberlist>

UK Food Standards Agency (FSA) website on Food Additives and E numbers: <http://www.food.gov.uk/policy-advice/additivesbranch/>

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