Food Saftey (level 3)

Food Additives FS0724

Prepared by

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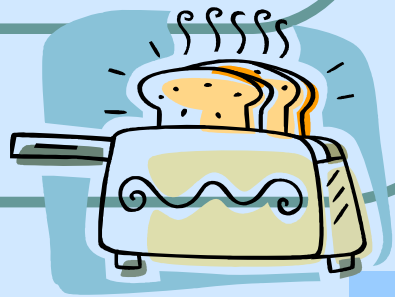

TYPES OF FOOD ADDITIVES

Type of additive	First digit of the E number	Purpose	Example
Colourings 	1	to improve colour	tartrazine (E 102), a synthetic yellow dye added to sweets, fizzy drinks and packet food
Preservatives 	2	to preserve food so that it goes bad less quickly	benzoic acid (E 210) added to beer, sauce and jam
Flavourings 	(*not* numbered)	to add or enhance flavour	ethyl ethanoate, a synthetic ester, added to give a pineapple flavour in drinks and sweets
Anti-oxidants 	3	to stop fats and oils getting oxidized, changing colours and tasting bad	BHA (E 320) added to biscuits, butter, margarine and oils
Emulsifiers and stabilizers 	3 or 4	to make oil and water mix, and alter the texture of food	lecithin (E 322) added to ice cream, salad dressings and margarine
Acid and bases 	5	to control pH	citric acid added to soft drinks; sodium hydrogencarbonate (E 500) added to canned custard etc.

Sweeteners 	4 or 6	to sweeten food without using sugar	sorbitol (E420) added to certain drinks and sweets (suitable for diabetics and those on diet)
Nutrients 	(*not* numbered)	to increase the nutritive value	vitamin C added to soft drinks; minerals added to milk powder

Advantages of additives

- Increase shelf life – preservatives
- Reduce risk of food poisoning – preservatives
- Prevent waste – preservatives
- Make food more appetising – colouring
- Improve taste – flavouring
- Improve texture – physical conditioning agents
- Increase nutritive value
- Provide wider variety of foods
- Ensure consistency of quality

Disadvantages of additives

- Allergies: migraine, hyperactivity, rashes e.g.tartrazine
- Little known about cumulative or combined effect of additives.
- Bulking agents can deceive consumers
- Some additives destroy nutrients e.g.sulphur dioxide destroys vit. B
- Sweetners can leave bitter aftertaste e.g. saccharine

E110 is used as an artificial colouring.

E201 is used as a preservative.

E320 is used as an anti-oxidant.

E322 is used as an emulsifier and stabilizer.

Colouring, preservative and flavouring.

الأقسام الرئيسية للمواد المضافة

Main Classifications of food

أولاً : من حيث تعمد اضافتها :-

١- مواد مضافة مباشرة Direct Additives :

- وهى تلك المواد التى يتم اضافتها للمنتجات الغذائية لتحقيق أغراض معينة . فعلى سبيل المثال اضافة مركب الأسبرتام الى الكثير من الأغذية والمشروبات بغرض التحلية حيث يعتبر مادة مضافة مباشرة لأنها أضيفت بغرض اعطاء المذاق الحلو للأطعمة دون زيادة فى القيمة السعرية كبديل للسكريات الطبيعية كالسكروز

٢ - مواد مضافة غير مباشرة Indirect additives :

- وهى تلك المواد التى تصبح جزءا من الطعام دون أن يتعمد اضافتها الى المنتج الغذائى . فهى تدخل الى الطعام نتيجة لعمليات التعبئة والتغليف والتخزين أو نتيجة عمليات الاعداد أو الأدوات المستخدمة فى ذلك .

ثانيا : على أساس الوظيفة أو الغرض من استخدامها :

١- المغذيات (تحسين القيمة الغذائية) Improve nutritive value

٢- مضادات الفساد Antispoilage agents

٣- مضادات الأكسدة Antioxidants

٤- مكسبات النكهة Flavoring

٥- محسنات النكهة Flavor Enhancer

٦- مركبات الحموضة Acidulants

٧- مركبات قلوية Alkaline compounds

٨- المحليات Sweeteners

٩- المواد المغلظة Thickning agents

١٠- مواد الفصل Seqesterants agents

١١- الملونات Colourants

١٢- مواد رافعة Leaving agents

١٣- مواد النشاط السطحى Surface active agents

١٤- ترطيب العجائن Dough conditioning

١٦ - مانعة التكتل Anticaking

١٧ - انتاج الرغوة Foaming agents

١٨ - مواد حافظة Preserving agents

١٩ - ترويق العصائر Clarifying juices

٢٠ - مزيل الرغوة Antifoaming agents

٢١ - مبيضات الدقيق Bleaching agents

٢٢ - مواد مساعدة للخفق Hipping agents

٢٣ - مواد الأستحلاب Emulsifiyng agents

٢٤ - منظمات الرطوبة Water proofing

٢٥ - الأنزيمات Enzymes

❖ **بعض الهيئات الأجنبية العاملة فى مجال مضافات الأغذية :**

١ - لجنة دستور الأغذية Codex Alimentarius Commission (CAC)

٢ - لجنة المواد المضافة المنبثقة عن لجنة دستور الأغذية Codex Committee on Food Additives (CCFA)

٣ - لجنة السمية Committee on Toxicity (COT)

٤ - وكالة حماية البيئة Environmental Protection Agency (EPA)

٥ - منظمة الأغذية والزراعة Food and Agriculture Organization (FAO)

٦ - لجنة مستشارى الغذاء Food Advisory Committee (FAC)

٧ - لجنة المواد المضافة والملوثات الغذائية Food Additives and Contaminants (FACC) Committee

٨ - ادارة الأغذية والعقاقير Food and Drug Administration (FDA)

٩ - لجنة خبراء المواد المضافة من منظمتى الأغذية والزراعة The Joint FAO / WHO Expert Committee on Food Additives (JECFA)

١٠ - اللجنة العلمية للغذاء Scientific Committee for Food (SCF)

١١ - وزارة الزراعة الأمريكية U . S . Department of Agriculture (USDA)

١٢ - هيئة الأغذية والتفتيش التابعة لوزارة الزراعة الأمريكية USDA - Food Safety and Inspection Service (USDA- FSIS)

Content

- Preservatives
- Flavouring Agents
- Colouring Agents
- Emulsifiers, Stabilizers and Thickeners
- Nutrients
- Antioxidants
- Harmful Effects of Food Additives
- Monitoring of Use of Food Additives

Preservatives

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- Nitrates (III) and Nitrates (V)
- Sulphur Dioxide and Sulphates (IV)
- Benzoic Acid and Benzoates
- Sorbic Acid and Sorbates
- Propanoic Acid and Propanoates

FOOD PRESERVATIVES

TO PRESERVE FOOD

Food spoilage is mainly due to micro-organisms (microbes). Thus there are two ways to preserve food:

- **Kill the microbes in food**
- **Keep food in conditions where the microbes cannot multiply**

Improving Storage Properties

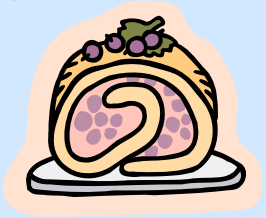
- Two hundred years ago, diets were largely limited to locally produced foods
  - Example 100 years ago a California orange sent to Boston would be inedible LONG before it arrived
    - Today that orange can be treated with preservatives
      - These are usually chemicals used to prevent mold and bacteria from spoiling food
      - Commonly used preservatives include sodium nitrate, sorbic acid, sodium bisulfite, and sodium nitrate
      - Preservatives are normally chosen because they are economical and don't affect a food's flavor, color or texture
      - Some perseveres are chosen to enhance color (meat is sometimes sprayed with sodium nitrate – why?????)

Preservatives E200-E299

Classes	Examples	Use	Origins	Functions
Natural	Sugar Salt Vinegar Alcohol Smoke	Jam, sweets Bacon, pickles Pickles, chutney Fruit, cake Fish, meat, cheese	Beet/cane Rock, sea Fermentation Fermentation Burning wood	•Prevents spoilage by preventing microbial growth. •Extend shelf life. •Prevents food poisoning. •Reduces waste. •Greater variety foods available
Artifical	Sulphur dioxide (E220) Sorbic acid (E200) Diphenyl	Sausages, fruit juice, dried fruit & veg. Soft fruit, fruit yoghurt, processed cheese. Citrus fruit, bananas	Made in labs	
Not permitted in baby foods				

Nitrates (III) and Nitrates (V)

- Nitrates (III) and nitrates (V) of sodium and potassium
  - Slow down microbial growth



  - Maintain the pink colour of meat
  - Prevent botulism in canned foods

Nitrates & Nitrites

- Curing salts, which produce the characteristic colour and flavor of products such as bacon and ham, have been used throughout history
- Curing salts have traditionally contained nitrate and nitrite
  - The discovery that nitrite was the active compound was made in about 1890
  - Currently, nitrite is not considered to be an essential component in curing mixtures
  - It is sometimes suggested that nitrate may be transformed into nitrite, thus forming a reservoir for the production of nitrite

Nitrates & Nitrites

- Both nitrates and nitrites are thought to have antimicrobial action
- Nitrate is used in the production of Gouda cheese to prevent gas formation by butyric acid-forming bacteria
- The action of nitrate in meat curing is considered to involve inhibition of toxin formation by *Clostridium botulinum*, an important factor in establishing safety of cure meat products

Nitrates & Nitrites

- Major concern about the use of nitrite was generated by the realization that secondary amines in foods may react to form nitrosamines (structure, p436)
- The nitrosamines are powerful carcinogens, and they may be mutagenic
- It appears that very small amount of nitrosamines can be formed in certain cure meat products

Nitrates & Nitrites

- There appears to be not suitable replacement for nitrite in the production of cured meats such as ham and bacon
- The ADI of nitrite has been set at 60 mg per person per day
- It is estimated that the daily intake per person in Canada is about 10 mg
- There has been dramatic declines in the residual nitrite levels in cured meat products
- This reduction of nitrite levels by about 80 percent has been attributed to lower ingoing nitrite, increased use of ascorbates, improved process control, and altered formulations Nitrates & Nitrites

Nitrates & Nitrites

- The nitrate-nitrite intake from natural sources is much higher than that from processed foods
- Its estimated that the nitrate intake from
  - 100 g of processed meat might be 50 mg
  - and from 100 g of high-nitrate spinach, 200 mg

Sulphur Dioxide and Sulphates (IV)

- Maintain the colour and the vitamin C content of the food
- Prevent fruit tissues from browning
- Provide an acidic medium that is not favourable for microbial growth

Sulfites

- Sulfur dioxide and sulfites have long been used as preservatives
- Serving both as antimicrobial substance and as antioxidant
- Sulfur dioxide is a gas that can be used in compressed form in cylinders
  - It is liquid under pressure of 3.4 atm and can be injected directly in liquids
  - It can also be used to prepare solutions in ice cold water
  - It dissolves to form sulfurous acid

Sulfites

- Instead of sulfur dioxide solutions, a number of sulfites can be used (table 11-2, p434)
- Because, when dissolved in water, they all yield active SO_2
- The most widely used of these sulfites is potassium metabisulfite
  - In practice, a value of 50 percent of active SO_2 is used

Sulfites

- When sulfur dioxide is dissolved in water, the following ions are formed:
  - $SO_2(gas) \rightarrow SO_2(aq)$
  - $SO_2(aq) \rightarrow H_2O \ \ H_2SO_3$
  - $H_2SO_3 \rightarrow H^+ + HSO_3^-$
  - $HSO_3^- \rightarrow H^+ + SO_3^{2-}$
  - $2HSO_3^- \rightarrow S_2O_5^{2-} + H_2O$
- All of these forms of sulfur are known as free sulfur dioxide

Sulfites

- The bisulfite ion (HSO_3^-) can react with aldehydes, dextrins, pectic substances, proteins, ketones, and certain sugars to form addition compounds
- The addition compounds are known as bound sulfur dioxide
- Sulfur dioxide is used extensively in wine making
- and in wine acetaldehyde react with bisulfite

Sulfites

- It is possible to classify bound SO_2 into three forms:
  - Aldehyde sulfurous acid
  - Glucose sulfurous acid
  - Rest sulfurous acid
    - Holds the SO_2 in a less tightly bound form
- Sulfites in wine serve a dual purpose
  - (1) antiseptic or bacteriostatic
  - (2) antioxidant

Sulfites

- These activities are dependant on the form of SO_2 present
- The various forms of SO_2 in wine are represented schematically (Figure 11-1, p435)
- The antiseptic activity of SO_2 is highly dependent on the pH (table 11-3, p435)
  - The lower the pH the greater the antiseptic action of SO_2

Sulfites

- Sulfurous acid inhibits molds and bacteria and to a lesser extent yeasts
- For this reason, SO_2 can be used to control undesirable bacteria and wild yeasts in fermentations without affecting the SO_2-tolerant cultured yeasts
- The undissociated acid is 1 000 times more active than HSO_3^- for *Escherichia coli*, 100 to 500 times for *Saccharomyces cerevisiae*, and 100 times for *Aspergillus niger*

Sulfites

- The amount of SO_2 added to foods is self-limiting because at levels from 200 to 500 ppm the product may develop an unpleasant off-flavor
- The acceptable daily intake (ADI) is set at 1.5 mg/kg body weight
- Because large intakes can result consumption of wine, there have been many studies on reducing the use of SO_2 in wine making
- Although some other compounds (sorbic acid and ascorbic acid) may partially replace SO_2 there is no satisfactory replacement for SO_2 in wine making

Sulfites

- The use of SO_2 is not permitted in foods that contain significant quantities of thiamine, because this vitamin is destroyed by SO_2
- SO_2 are used in
  - Wine, meat products
  - Dried fruits, dried vegetables
- Because SO_2 is volatile and easily lost to the atmosphere, the residual levels may be much lower than the amounts originally applied

Benzoic Acid and Benzoates

- Preventing mould and yeast from growing
- Widely used in jams, fruit juices, oyster sauce(蠔油), margarine(黃油), non-alcoholic beverages and pickled(醃菜) products

Benzoic acid – drinks, **low sugar products**, cereals , **meat products**

Side effects:

- May temporarily inhibit digestive enzyme function . May deplete GLYCINE levels . AVOID in asthma ,or allergies

Benzoic Acid

- Benzoic acid occurs naturally in many types of berries, plums, prunes, and some spices
- As an additive, it is used as benzoic acid or as benzoate
- The latter is used more often because benzoic acid is sparsely soluble in water, and sodium benzoate is more soluble
- The undissociated form on benzoic acid is the most effective antimicrobial agent
  - pK_a of 4.2; optimum pH range is from 2.5 to 4.0

Benzoic Acid

- This makes it an effective antimicrobial in high-acid foods, fruit drinks, cider, carbonated beverages, and pickles
- It is also used in margarines, salad dressings, soy sauce, and jams

Sorbic Acid and Sorbates

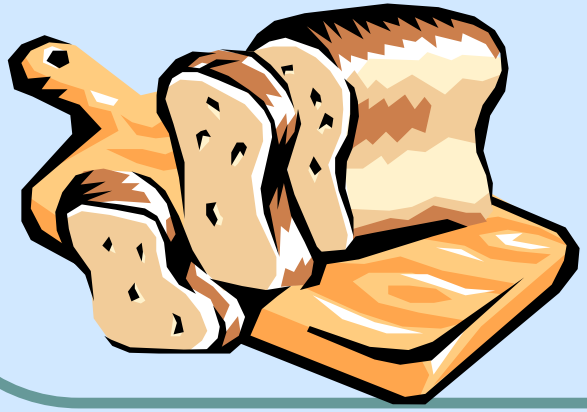
- Prevent mould formation
- Mainly used in cheese and in flour confectionery(糖果)

Sorbic Acid

- Sorbic acid is a straight-chain, *trans-trans* unsaturated fatty acid, 2,4-hexadienoic acid
- As an acid, it has a low solubility in water at room temp
- The salts, sodium, or potassium are more soluble in water
- Sorbates are stable in the dry form; the are unstable in aqueous solutions because they decompose through oxidation
- The rate of oxidation is increased at low pH, by increased temp, and by light exposure

Propanoic Acid and Propanoates

- Prevent the formation of mould in bread.
- Used in chocolate products and cheese.



Acids

- Acids as food additives serve a dual purpose
  - Acidulants
  - Preservatives
- Phosphoric acid is used in cola soft drinks to reduce the pH
- Acetic acid is used to provide tartness in mayonnaise and salad dressings
- Similar functions are served by organic acids
  - Citric acid, tartaric, malic, lactic… acids

Acids

- Straight-chain carboxylic acids, propionic and sorbic acids, are used for their antimicrobial properties
- Propionic acid is mainly used for its antifungal properties

Antioxidants

- Food antioxidants in the broadest sense are all of the substances that have some effect on preventing or retarding oxidative deterioration in foods
- They can be classified into a number of groups:

Bacteriocins - Nisin

- Nisin is an antimicrobial polypeptide produced by some strains of *Lactococcus lactis*
- Nisin-like substances are widely produces by lactic acid bacteria
- These inhibitory substances are known as becteriocins
- Nisin has been called an antibiotic, but this term is avoided because nisin is not used for therapeutic purposes in humans or animals
- Nisin-producing organisms occur naturally in milk

Bacteriocins - Nisin

- Nisin can be used as a processing aid against gram-positive organisms
- Because its effectiveness decreases as the bacterial load increases, it is unlikely to be used to cover unhygienic practices
- Nisin is a polypeptide with a molecular weight of 3 500, which is present as a dimer of molecular weight of 7 000
- It contains some unusual sulfur amino acids, lanthionine and B-methyl lanthionine

Bacteriocins - Nisin

- It contains no aromatic amino acids and is stable to heat
- It has been used effectively in preservation of processed cheese
- It is also used in the heat treatment of nonacid foods and in extending the shelf life of sterilized milk