SYNTHETIC ORGANIC PRESERVATIVES USED IN FOOD

Popa Roxana – Gabriela, *Constantin Brâncuși University from Tg-Jiu, Gorj, ROMANIA*

ABSTRACT: Food diversity on the agri-food market justifies the need to extend the guarantee term for all rights, due to the mechanism of physical, chemical and biological degradation. To meet food safety conditions, a wide range of synthetic chemical preservatives are used, which prevent or destroy microorganisms. Food preservation is classified according to the chemical structure and the way it is obtained in organic, inorganic, antibiotic, in time and natural conservation. The paper may have theoretical aspects regarding the conservation of the synthetic organs, the conditions in which the care is efficient, the food for their care can use and make the products for the human body.

KEY WORDS: nutrition, preservatives, role, conditions, effects

1. INTRODUCTION

Because of the rich composition in nutritive elements, food is exposed to slowly degradation. The deterioration of the food can be reduced by having control over the composition, the procesing terms, the way of packing, stocking and manipulation of the product.

Because of the changes from the agrifood market, food are rarely consumed imideately after they had been produced, being consumed after a few weeks, months or even years. The mecanisms of food deterioratin are of phisical, chemical and microbiological nature. The presence of some microorganisms in food represents a nutritional safety problem, becouse they can cause food poisoning, chemical methods being used for reducing the food degradation phenomens.

2. THE ROLE AND FEATURES OF FOOD PRESERVATIVES

Food preservatives = chemical compounds that have the role of reducing or stopping the growth of microorganisms and of preventing the development of processes of alteration, fermentation, modification of taste and texture and reduction of the nutritional value of foods.

The role of preservatives in foods:

- extension of the period during which the food retains its properties unchanged sensory
- keeping the nutritional value of the food for a longer period of time
- supplying consumers with foods lacking microorganisms

General characteristics of food preservatives:

- antimicrobial action (vegetative or sporulated forms of *Gram positive* bacteria, vegetative forms of *Gram negative* bacteria, yeasts, mice)
- physico-chemical properties: polarity (influences water solubility; hydrophilic preservatives disperse more easily in the aqueous environment, but because they act at the level the lipid-rich bacterial cell membrane, for maximum efficiency, the preservative must have a balanced amphiphilic structure); the boiling point; stability to temperature variations; pH
- interaction between food and preservative (depending on the characteristics of the food: composition, physical-chemical

characteristics, constituents: lipids, proteins, carbohydrates, other additives), affects the antimicrobial action and can lead to the formation of compounds that modify the organoleptic food
- pH of the food (reduces the antimicrobial effect to pH> 5,5)
- the presence of chelating substances (enhances the antimicrobial action of the preservative, by extending the spectrum of action)
- food processing technologies (use of physical preservation methods: pasteurization, sterilization, dehydration, reduces the concentration of food preservatives); modern packaging technologies in aseptic conditions and in controlled atmosphere, associated with keeping
- the persistence of the active principle of the food during its processing and storage
- lack of toxic and metabolic adverse effects

3. ORGANIC PRESERVATIVES USED IN NUTRITION

3.1. Benzoic acid and its salts E 210 – E213

- the first description of the antimicrobial properties of benzoic acid was made in 1875, but for its antimicrobial properties it was used more frequently after 1900
- E 211 = sodium benzoate, is used as a preservative against yeasts and bacteria, in acidic products, salad dressings, carbonated beverages with citrus aromas, jams, citrus juices, pickles and spices, mouth water based on alcohol
- E 212 = potassium benzoate
- in combination with E 300 = ascorbic acid, sodium benzoate and potassium benzoate can form benzene, which is very carcinogenic, in the presence of high temperatures, light and storage time (fig.1.)

Fig. 1. Foods containing benzoic acid

- due to the fact that the relationship between E 211, hyperactivity, attention deficit in ADHD children and modification of some parts of DNA has been demonstrated, Coca-Cola has decided to gradually withdraw E211 from products
- is found in varying amounts in some fruits, vegetables, spices, fermented products, green tea, coffee beans, tobacco, foods with acidic pH and low water content: low alcohol and non-alcoholic drinks, oysters, salads
- it is a preservative that can be used in products obtained by bacterial fermentation, because it exerts its antimicrobial action on yeasts, mice and lactic bacteria; prevents mycotoxin synthesis of some mice (*Aspergillus, Penicillium, Fusarium*); lipids, Fe ions and some anionic surfactants act antagonist, reducing the efficiency of antimicrobial action (fig.2.)

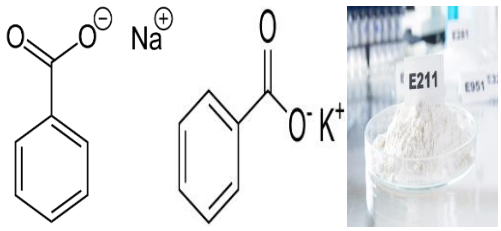

Fig. 2. Sodium and potassium benzoate

- it has antimicrobial action in the undisociated form and the intensity of the antibacterial action decreases as the pH increases; over 4.6 the dissociation rate increases dramatically, so the microbial action is maximal at acidic pH
- because it is lipophilic, it crosses the cell membrane, decreasing the cellular

pH determines the concentration increase, it denatures the proteins, it affects the cellular metabolism, it reduces and it stops the multiplication of microorganisms

- toxicity of benzoic acid and benzoates is low and does not accumulate in the body; it is decomposed in the kidneys and liver and is eliminated as hippuric acid
- recommended daily acceptable dose = 0 -5 mg / kg body weight

3.2. Sorbic acid and sorbates E 200 – E 203

- E 200 = sorbic acid, was first highlighted in 1859, in *Sorbum aucuparia*, a fruit shrub in the mountain area; in 1939 the antibacterial effects were highlighted, and from 1940 it is used in the food industry (fig. 3.)
- is a preservative that prevents the formati on of molds and yeasts, not being effective against bacteria
- E 202 = potassium sorbate is used as a preservative for dried plums (fig. 4.)
- are active at higher pH against *Gram positive* and *Gram negative* bacteria (*Acinetobacter, Aeromonas, Bacillus, Escherichia, Vibrio, Salmonella),* yeasts (*Candida, Debaryomyces, Hansenula, Pichia)* and mice (*Alternaria, Cladosporium, Botrytis, Sporotrichum, Geotrichum)* (fig. 5.)
- the low concentrations used in foods have an inhibitory effect on cell development, the proliferation of vegetative forms and the germination of spores; it acts by altering the pH of the internal microbial environment, altering the cell wall structure and interfering with the activity of some enzymes that play a role in microbial metabolism
- sorbic acid is most commonly used in wines, cheeses, pastries, fresh produce, cold meat and crustaceans; It is used for book keeping, it can market natural antibiotic capabilities; the first to use a more toxic celebrity, *Clostridium botulinum* bacteria, which can cause botulism

Fig. 3. Sorbum aucuparia

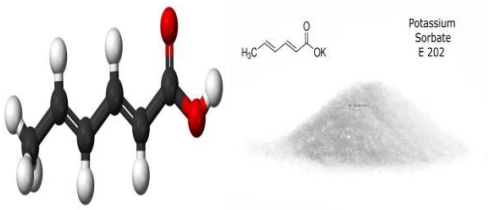

Fig.4. Sorbic acid and potassium sorbate

- is introduced directly into the composition of the food or applied to the outside by sprinkling or immersion, for: yogurt and other fermented dairy products, fruit salads, lemonade, cheese, rye bread, cakes and bakery products, pizza, seafood, lemon juice, cider, soups, non-alcoholic aromatic drinks, dried fruits, olives, cheeses, egg products, bakery products, sauces, emulsions, in quantities up to 2g/kg /l
- are free from toxicity, sorbic acid being a fatty acid metabolizable in the human body
- acceptable daily dose = 25 mg / kg corg

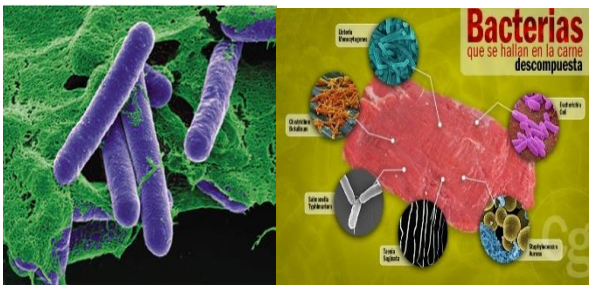

Fig. 5. Clostridium botulinum and the bacteria in the meat

3.3. Parahydroxybenzoates and their salts E 214 – E 219

- are para-hydroxybenzoic acid esters with organic fatty acids (fig. 6):

E 214 = p-hydroxybenzoate of ethyl, ethyl paraben
E 215 = sodium derivative of p-hydroxybenzoic acid ethyl ester
E 216 = p-hydroxybenzoate of propyl, propyl paraben
E 217 = sodium derivative of propyl ester of p-hydroxybenzoic acid
E 218 = methyl p-hydroxybenzoate, methyl paraben
E 219 = sodium derivative of p-hydroxybenzoic acid methyl ester

- The European Food Safety Authority (EFSA) has not been able to recommend a daily allowable dose (DZA) for propyl paraben (E216), as it has had an effect on sex hormones and male reproductive organs in rats
- in Directive 2006/52 / EC it is mentioned that it is necessary to prohibit the use of p-hydroxybenzoates (PHB) = parabens, in liquid food supplements
- the antimicrobial effect has been reported since 1920, due to the structural similarities with phenol
- in Europe methyl, ethyl and propyl-parabens are used, but in other countries butyl-paraben and heptyl-paraben are used
- are active in environments with neutral pH, but the optimum pH of action = 3-8
- solubility in water is inversely proportional to the length of the alkyl chain, while solubility in oils and antimicrobial action is directly proportional
- have antimicrobial action on yeasts and mice and less on bacteria (especially *Gram-positive* ones), due to inhibition of enzymes involved in cell respiration, inhibition of spore germination, blocking of protein synthesis and bacterial DNA or RNA
- is used in foods, in mixtures methyl: propyl = 3: 1 and with sorbic acid or benzoic acid and their salts, for meat preparations, snacks, confectionery, in quantities up to 0.3 g / kg
- have low toxicity (LD50 in mice = 8 g / kg), are detoxified in the liver and kidneys, so they have a mild anesthetic effect on the buccal mucosa and can give skin reactions following direct skin contact, at high concentrations

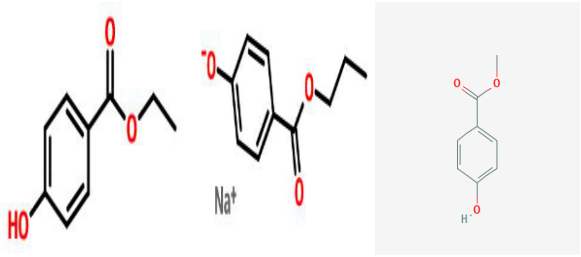

Fig. 6. Ethyl, propyl and methyl parabens

3.4. Propionic acid (PPA) and propionates E 280 – E 283

- propionic acid is a short-chain fatty acid with strong anti-mold effects, which is found in some assortments of cheeses, as a result of bacterial fermentation; in bakery, the propionate of Ca and Na is used, due to the mineral contribution of Ca and favoring the action of the growth agents Na (fig. 7.)

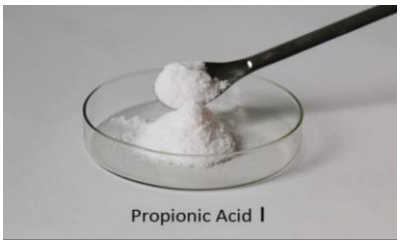

Fig. 7. Propionic acid

- have a large remanence in food products, due to the increased resistance to the action of physico-chemical factors; have limited antibacterial and antifungal effect; does not act on yeasts and does not affect normal fermentation

phenomena, being used in the cheese and bakery industry
- propionic acid toxicity is extremely low, this being the usual form of fatty acid metabolism in the body
- the presence of PPA is justified by the fact that it prevents the appearance of mold in processed foods (bread or cheese); propionic acid causes cellular changes in the products it comes into contact with and passes from mother to fetus; a connection between gastrointestinal disorders and various forms of autism has been demonstrated

3.5. Iron gluconate E579

- iron D-gluconate dihydrate is a derivative of iron and glucose, a food additive with the role of preservative, acidity regulator and color fixer
- it is mainly used for the blackening of olives, but also for products from vegetables preserved in vinegar, brine, oil or soy sauce (fig. 8.)

Fig. 8. Use of iron gluconate for the integration of olives

- comes in the form of brown-yellow crystals, dust or granules yellow-green, yellow-gray, with a slight odor of burnt sugar
- is soluble in water and insoluble in ethanol
- does not pose a health risk, but excess iron can cause gastric disorders

3.6. Hexylresorcinol E 586

- it is obtained synthetically from resorcine and coconut chloride, in the presence of the zinc chloride catalyst
- comes in the form of a light yellow powder, which becomes solid at room temperature
- only add in fresh, chilled and frozen crustaceans, in doses of 2 mg / kg, to maintain the appearance (shortly after capture, black spots (melanosis) can form, which are not harmful to health and do not influence the taste, but lead to a decrease in commercial value)
- sometimes it is also used to prevent browning of cut fruits and fruit purees
- it is a necessity for the products to which it is added, due to its antioxidant action, because it prevents degradation, prolongs the shelf life and has antiseptic effect on some microorganisms (due to its antiseptic and antioxidant properties it is used in pharmaceutical and cosmetic products) (fig. 9.)

Fig. 9. Use of E 586 Hexylresorcinol to preserve the appearance of crustaceans

- has an astringent taste and pungent odor; it is soluble in water, alcohol and ether
- can cause allergies manifested through hives, dizziness, contact dermatitis, eczema, asthma attacks, abdominal pain, headache

3.7. Polydimethylsiloxane PDMS E 900

- is a linear, macromolecular compound that is part of the silicone class (fig. 10.)

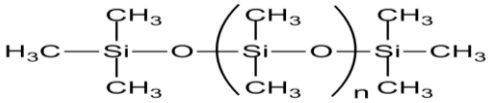

Fig.10. Polydimethylsiloxane

- it is a food additive with a preservative role, anti-caking agent, support substance for other additives, anti-foaming agent
- added to liquid foods, changes surface tension and forms a more uniform appearance, which is why it is used in fast food restaurants, cooking oils
- is used as an additive for jams, jellies, marmalades, similar spreadable fruit pastes and for low calorie products, in doses of 10 mg / kg
- has anti-foaming properties (for aromatic non-alcoholic beverages, wine, liqueurs, nectars, pineapple juice), anti-caking agents and emulsifiers (chewing gum, confectionery, dough), soups, soups, vegetable oils and fats for fruit and vegetables, fruit canned foods, sweets, creams, milk powder
- is considered a carrier substance and an authorized carrier solvent (frosting agent for fruit)
- is a non-biogradable synthetic substance, being used also in shampoos and conditioners (the properties of PDMS give the hair a shiny and slippery feeling), laundry detergents and for cleaning carpets, creams and various lotions for skin, in the manufacture of tires, lubricants, various adhesives, mold removal agents, polishing substances
- causes kidney, liver, nervous system problems and various allergies
- because it contains traces of asbestos and formaldehyde it can be carcinogenic

Other organic preservatives are:

- E 230 diphenyl
- E 231 orthophenylphenol
- E 232 orthophenylphenylate
- E 233 thiabendazole
- E 239 hexamethylenetetramine
- E 242 methyl dicarbonate

To withstand transportation from the countries of origin and to protect against diseases and pests, citrus fruits or citrus wrapping paper are treated with E 230, E 231, E 232 or E 233. Until 2004 these chemicals were considered food additives and are now considered pesticides. These substances produce negative effects on the human body (fig. 11.)

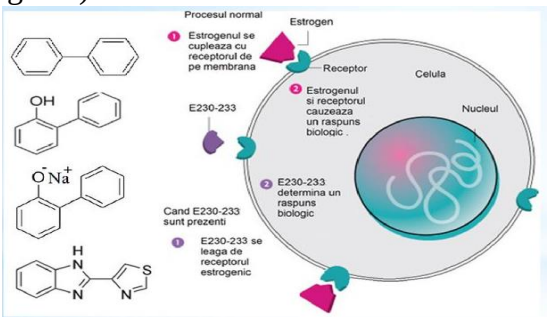

Fig. 11. The effects of E 230, E 231, E 232 or E 333 on the human body

4. CONCLUSION

1. Food preservatives stop the development and action of microorganisms (bacteriostatic substances) or they can destroy them (bactericidal substances).
2. Classification of food preservatives according to the chemical structure and the way of obtaining: organic, inorganic, antibiotic substances and enzymes.
3. The main organic food preservatives are: benzoic acid and its salts E 210 – E213, sorbic acid and sorbates E 200 – E 203,parahydroxybenzoates and their salts E 214 – E 219, propionic acid (PPA) and propionates E 280 – E 283, iron gluconate E579, hexylresorcinol E 586, polydimethylsiloxane PDMS E 900

REFERENCES

[1] Banu, C., Additives and ingredients for the food industry, Technical Publishing, Bucharest, 2000
[2] Tofana, M., Food additives and preservability, Academic Pres Publishing, Cluj Napoca, 2003
[3] Socaciu, C., Food chemistry course and food additives, Cluj Napoca, 1997
[4] http/www.siguranţa-alimentara.ro
[5] http/www.europa.eu.int/making
[6] http/www.anpc.ro
[7] http://www.aditivi.org/tag/aditivi-alimentari/