

<https://doi.org/10.29013/AJT-22-9.10-50-52>

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ANTIOXIDANTS AND SYNERGISTS USED IN MEAT PRODUCTS

Abstract. This article talks about antioxidants and their enhancers, types and properties used in the production of minced meat semi-finished products and to extend their shelf life. Natural and synthetic additives with antioxidant properties, their use and benefits in various meat products are also reviewed.

Keywords: meat products, semi-finished products, food additives, fats, antioxidants, synergists, E-index, oxidation.

Introduction

Oxidation of fat components in meat products is one of the current problems of the meat processing industry. Oxidation processes reduce the nutritional value of meat products by changing the chemical composition of fats (liberation of fatty acids, formation of peroxides and secondary oxidation products) and by reducing the amount of fat-soluble vitamins (A, D, E, biotin, carotenoids). Free fatty acids, carbonyl compounds, alcohols and other secondary products of oxidation give an unpleasant taste and smell, have a negative effect on the quality of the finished product and shorten its shelf life.

Today, the list of antioxidants and their synergists used in the meat industry is much larger and they are defined by 42 E-indexes [1, 2].

Antioxidants used to prevent oxidative damage can be divided into two groups — synthetic and natural.

Materials and methods

Many synthetic substances can be cited as synthetic antioxidants: phenol derivatives (E 310–313, E 319–321), isoascorbic (erythorbic) acid (E315) and sodium isoascorbate (erythorbate) E316, E310–312 gallates. The most common in the world are butyloxy-

anisole (BOA or VNA) E320, butyloxytoluene (BOT or VTN) E321 and tert-butylhydroquinone (TBGX or TBHQ) E 319. These substances are soluble in oil and insoluble in water and can effectively resist the oxidation process of oil components (concentration is 20–200 mg per 1 kg of product). But this compound has no nutritional value, besides its carcinogenic effect on living organisms has been proven. For this reason, humanity is abandoning synthetic additives and turning to natural antioxidants that are harmless to health. Also, natural antioxidants have biological value.

Synthetic antioxidants such as BOA, BOT, DG are considered phenolic inhibitors and stop oxidation processes under the influence of peroxide radicals or have a synergistic effect with natural antioxidants. In contrast to the mentioned antioxidants, the antioxidant activity of ascorbic acid is related to its ability to return natural and synthetic antioxidants to their initial form due to the interruption of the hydrogen atom in it [3].

Antioxidants slow down oxidation processes by interacting with air oxygen (blocking air oxygen from reacting with the product), stopping oxidation reactions in the product (blocking active radicals)

or breaking down peroxide compounds that have been formed. In this case, the antioxidant substances themselves are used up. In addition, antioxidants can be conditionally divided into two more groups: real and secondary. Real antioxidants interact with air oxygen, slow down oxidation processes (block the effect of oxygen on the product), deactivate active radicals, interrupt oxidation reactions, or decompose the peroxides formed. Secondary antioxidants affect the product's redox potential, activity, and water in the product. Secondary antioxidants can be both antioxidant and oxidant depending on the dose. For example, ascorbic acid in a small amount (up to 200 mg/kg) slows down oxidation, and when its amount is increased to 5000 mg/kg, it has an oxidizing effect on the product. An unlimited increase in the dose of real antioxidants does not extend the protection time of the product. In practice, a threshold concentration is established for most antioxidants, beyond which the shelf life of the product will not be extended [4].

There is little information on the permissible limit concentration of peroxides and hydroperoxides in food products. The use of antioxidants to eliminate the oxidation of fatty products is of particular practical importance. Because such products undergo a high degree of oxidative destruction during extraction, processing and storage [2].

Many types of synthetic and natural antioxidants are used worldwide. The antioxidant activity of compounds depends on the nature of the product

and a number of factors. Therefore, it is necessary to conduct scientific research to justify the effect of antioxidants and their complexes on specific food products [3].

Natural antioxidants found in plants and foods include: flavanoids (flavone, flavonol, flavonone, isoflavonone, flavonol, flavan, chalcone, dihydrochalcone, flavone-3,4-diol, anthocyanidins); benzoic acid derivatives (gallic, protocatechin acids, vanillin, sirenin acids); cinnamic acid derivatives (ferulic acid, para- and ortho-coumaric acid, caffeic and sinanic acids); coumarin derivatives; phytoestrogens (lignans, estrogens, lactones, etc.); vitamins: vitamin E (a, b, g, d-tocopherols and a, b, g, d-tocotrienols), vitamin C; carotenoids (lycopene, α , β -carotenes, lutein, etc.) [5].

Result and discussion

Spices, various oils, tea, seeds, grains, cocoa pods, fruits and vegetables are used as natural antioxidants. The antioxidant activity of natural compounds containing various individual antioxidants such as ascorbic acid, tocopherols, carotenoids, as well as flavonoids (quercetin, kaempferol, myricetin), catechins or phenols (carnosol, rosmanol, rosamiridiphenol) and phenolic acids (carnosine, rosemary) has been proven [6, 7, 8]. In particular, it was found that the activity of essential oils of anise, cumin, Indian basil, peppermint is stronger than the synthetic antioxidant butyloxytoluene in sunflower oil, and the oil of Ayovan (cumin) is almost 2 times more effective (Table 1).

Table 1. — Antioxidant activity of essential oils in sunflower oil

The name of the essential oil	Peroxide number of sunflower oil, mg-equiv	
	After 7 days	After 14 days
Control	86.3	581.0
Butyloxytoluene	51.2	418.5
Anise oil	40.6	238.2
Cumin oil	42.2	312.4
Peppercorn oil	41.0	248.2
Indian basil oil	46.2	302.5
Iowan oil	32.2	229.5

E 306–309 tocopherols are natural fat-soluble antioxidants found in vegetable oils. All tocopherols, except natural tocopherol extract E 306, are obtained synthetically in industry. These substances show different levels of vitamin E activity, but 8-tocopherol E 309 has the highest antioxidant activity [9].

The use of individual antioxidants does not always allow to protect the product from oxidative deterioration. Therefore, it is advisable to use several antioxidants together. In this case, a synergism phenomenon occurs, and the combination of several (usually 2) antioxidants increases their antioxidant capacity. For example, when ascorbic acid is added to the mixture of tocopherols in the production of meat products, the efficiency increases significantly [10].

The effect can be enhanced by mixing substances that do not have an antioxidant effect or are weak antioxidants with antioxidants. Such synergistic substances include some polybasic organic oxyacids (citric acid E 330), a number of amino acids, polyphosphates, EDTA and other compounds.

Oils and fats have different natural stability against oxidation according to the structure of fatty acids, as well as the presence of natural antioxidants such as tocopherols, tocotrienols, carotenoids, phospholipids. The natural stability against oxidation is expressed by multiplying the number of unsaturated acids in the oil (in decimal form) by its relative oxidation rate and adding the value of this rate to the obtained number.

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