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Food Additives: Natural Food Dyes

Jéssica Souza Ribeiro*

Center for Science and Technology in Energy and Sustainability (CETENS), Federal University of the Recôncavo of Bahia (UFRB), Brazil

Editorial

The demand for natural additives in the food industry is increasing as a response to an increasingly demanding market for the appeal of what is natural, as well as concerns about the health risks that some artificial additives pose.

Several studies indicate that there are potential risks arising from the consumption of artificial dyes, ranging from genotoxic and carcinogenic effects to the development of urticaria, asthma, nausea, eczema, bronchitis, bronchitis, bronchospasm, headache, reduced blood coagulation, hyperactivity and increase of iron and zinc urinary excretion in children, even at concentrations recommended as safe. As a result, interest in the substitution of artificial dyes for natural alternatives increases [1-3].

Natural dyes can be classified as tetrapyrrolides (chlorophylls), isoprenoids (carotenoids: beta-carotene, bixin, astaxanthin, curcumin, among others), benzopyrans (flavonoids and anthocyanins), N-heterocyclic compounds (betalains), quinones (carmine), caramel (which are the result of processing sugars). These dyes confer varying coloring depending on their chemical structure and class, covering spectra of yellow, orange, red, purple, green and brown. In addition, other dyes have been studied for their application in foods, such as genipin, which may show staining that varies from blue to black [4,5].

Three important classes of natural dyes that can be used in food and present biological activity, but have great limitations with regard to stability are carotenoids, anthocyanins and betalains.

Carotenoids are tetraterpenoid compounds, as they are formed by the union of eight isoprenoid units, having a long chain of conjugated double bonds that form a chromophore system, which gives it the coloring pigment characteristic that varies between yellow, orange and red, present in various foods. Various changes in its primary molecular structure, such as cyclization, hydrogenation, dehydrogenation, introduction of oxygen-containing groups, rearrangements, chain shortening or combinations of these modifications, result in an immense variety of molecules belonging to this group, so that more than 650 carotenoids were isolated and characterized, disregarding the cis and trans isomers, and about 100 of these have already been identified in foods. Beta-carotene, alpha-carotene and beta-cryptoxanthin are pro-vitamins A, and lutein, zeaxanthin and lycopene do not have this activity. Because they are lipids, carotenoids are essentially hydrophobic. Although stable at pH changes, they are sensitive to light and high temperature, especially in the presence of oxygen [6].

Anthocyanins are flavonoids responsible for a variety of attractive colors of fruits, flowers and leaves ranging from red to purple and blue. Anthocyanins are among the most important groups of natural pigments extracted from plants and are very soluble in water. The anthocyanin molecule is typically composed of two or three parts: a non-glycosylated basic structure called anthocyanidin (aglycone), one or more sugar molecules and often one or more sugar molecules attached to sugars [4,7]. pH variations generate structural changes in anthocyanin molecules, producing different colorations depending on pH, including yellow in strongly alkaline medium. pH extremes lead to irreversible degradation of these compounds [8,9].

Betalains are water-soluble pigments containing nitrogen, divided into betacyanins and betaxanthines. The red and violet shades result from different substitution patterns in betacyanins, whereas different amino acid side chains or amines determine the color of the betaxanthines, generally yellow [4,7]. Betalains are an alternative to synthetic dyes, with stability in a wide range of pH and with a high molar extinction coefficient, besides being neither toxic nor allergenic. Degradation occurring during processing or storage includes reactions such as isomerization, deglycosylation, hydrolysis, decarboxylation and dehydrogenation, involving color changes and changes in absorption. The factors affecting the stability of betalain in food include its chemical

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Correspondence:
Jéssica Souza Ribeiro, Center for Science and Technology in Energy and Sustainability (CETENS), Federal University of the Recôncavo of Bahia (UFRB), Brazil,
E-mail: jessica.ribeiro@ufrb.edu.br

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structure, amount of pigment, matrix, additives, enzymes, pH, heat treatment, water activity, exposure to oxygen and light and storage temperature [10].

As observed, in addition to the color capacity, several natural dyes present other functionalities such as antioxidant capacity, but most present as a limitation the sensitivity to oxidation at high temperatures and in the presence of light and color variation dependent on pH, as well as its solubility be dependent on the array in which they are added. In order to be used by the food industry with dye function without loss of quality during processing or storage, it is necessary that its stability be preserved during processing and storage. Several studies have been carried out with this objective, ranging from the study of kinetics of dye degradation, combined use with antioxidants and micro and nanoencapsulation with satisfactory results but not yet fully implemented by the food industry [11-14].

It is therefore essential that more studies are carried out for the development and production of natural dyes and more user-friendly food processing methods in order to avoid the risks that the consumption of artificial colors can bring to health. In addition, it is essential to carry out toxicity studies of the developed natural dyes in order to attest their safety and maximize their technological and health functionalities.

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