WHEN FLAVOR TURNS INTO COLOR: NEW INSIGHTS ON (ETHYL)VANILLIN CHEMISTRY IN FOODS

Marco Arlorio[1*], Roberto Negri[1], Giorgia del Favero[1], Jean Daniel Coisson[1], Fabiano Travaglia[1], Vural Gokmen[2], Doris Doris [3], Giovanni Battista Giovenzana[1]

[1] Dipartimento di Scienze del Farmaco & Drug and Food Biotechnology Center, Università del Piemonte Orientale A. Avogadro, Novara, Italy

[2] Department of Food Engineering, Hacettepe University, Ankara, Turkey

[3] Department of Food Chemistry and Toxicology, University of Vienna, Wien, Austria

*Corresponding author - E-mail: marco.arlorio@uniupo.it, Phone: +399321375772

The Maillard Reactions (MRs), a complex group of reactions allowing the formation of aroma, color and, sometimes, potentially toxic compounds in foods, were deeply studied in the past. The appearance of brown color triggered by the formation/accumulation of melanoidins in food is correlated with the chemical profile of foods, mainly at sensorial level. Beside MRs, caramelization of sugar can contribute to the browning of some foods (e.g. baked products), but other chemical reactions involving ingredients are still under-investigated. Natural or synthetic vanillin (4-hydroxy-3-methoxybenzaldehyde), with the more aromatic and stable synthetic analog ethyl vanillin (4-hydroxy-3-ethoxybenzaldehyde), is broadly used as flavoring agent, especially in bakery products. Previous data suggested loss of intensity of the sweet/flavored aroma of vanillin during baking – in addition to the simple volatilization in oven - supporting the idea that "vanillin aroma" is affected by food components, especially proteins and amino acids [1]. Moreover, old data suggest the reaction of vanillin in alkaline medium with carbonyl-bearing compounds, yielding yellow, orange or red colorations (particularly aliphatic ketones containing a methyl group) [2]. Starting from these highlights, this oral communication will present a deep investigation on the reactions occurring between (ethyl)vanillin and secondary amines/amino acids, showing its ability to participate to "colored" chemical reactions and highlighting the prompt and efficient formation of benzoquinone derivatives, which color may contribute, together with the MRs, to the overall browning process. Colored derivatives (moving from brown/brilliant red to orange) were produced in laboratory as result of the reaction between (ethyl)vanillin and secondary amino groups in aerobic (hydro)alcoholic conditions. The 2,5-diamino-1,4-benzoquinones were produced with high yields (70-80%), then characterized by NMR, and the mechanism of their formation was elucidated. A model food (biscuit) was used to study the formation of these "new pigments", further evaluated by HPLC-MS, bringing new information about the influence of food additives in biscuit formulas. Information about the uniformity of the color on the food surface, as well as new toxicological data (cyto- and genotoxicity) will be also provided. Interaction with proteins, hydrolyzed protein and amino acids will be also discussed, finally showing the coloring/solubility properties of diaminobenzoquinone-like molecules. Concluding, the reactions triggering loss of (ethyl)vanillin flavoring capacity, thus leading to new colored molecules in foods, were elucidated, opening a new scenario for food chemists involved in color development-based studies.

[1] Chobpattana et al., 2000, J. Agric. Food Chem. 48, 3885-3889

[2] V. E. Levine V.E. and Taterka, 1956, M. Anal. Chim. Acta (1956) 15, 237-245

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