Chapter

# Introductory Chapter: Current Knowledge on Biogenic Amines

*Proestos Charalampos*

## 1. Introduction

Human health can be affected by minor food compounds which sometimes are neglected by consumers. Biogenic amines are naturally occurred amines and for sure they can be one group belonging to the aforementioned compounds. Their concentrations are positively affected by microbial fermentation of food or during food spoilage. Many analytical methods are published regarding extraction and characterization of these minor food substances. Biogenic amines (BAs) are nitrogen-contained compounds occurring by decarboxylation of amino acids or by amination and ransamination of ketones and aldehydes. The structure of BAs can be aliphatic, aromatic, and heterocyclic. Depending on the number of amine groups, amines are classified into monoamines (tyramine and phenylethylamine), diamines (histamine, putrescine, and cadaverine), or polyamines (spermidine and spermine). Currently, there are research papers that have classified cadaverine, putrescine, spermine, and spermidine among polyamines [1].

## 2. BAs occurrence in foods and health effect

BAs are found in a variety of food products including seafood, meat, dairy, fruits, vegetables, nuts, chocolates, and fermented products. Foods containing proteins or amino acids in free form can have microbial or biochemical activity and BAs may be present.

Fermented products can contain BAs such as milk products, for example, cheese 5–4500 ppm, wines 5–135 ppm, beer 2.7–14 ppm. BAs can also be present in foods that are spoiled or in the beginning of spoilage such as fish and fish products 2300–5000 ppm, animal liver like beef about 330 ppm, processed meat and meat products 9–650 ppm [2]. BAs can be used in nonfermented products such as decomposition markers or indicator compounds. Deteriorated foods contain high amounts of BAs with the most abundant being cadaverine and putrescine. BAs contained in high amounts can have a serious health risk for consumers who belong to sensitive population. Symptoms may include hot flushes, respiratory discomfort, nausea, cold sweat, headaches, palpitations, red rash, low or high blood pressure. Alcohol consuming and presence of acetaldehyde may increase sensitivity to biogenic amines.

## 3. Safety issues and function

Scombroid poisoning which is caused due to histamine presence is a very important issue that is why only histamine has a regulatory limit, according to EU regulation (maximum 200 mg/kg in fresh fish and 400 mg/kg in fish products

after enzyme treatment and maturation in brine). After fish, cheese is the next most commonly implicated food item associated with tyramine poisoning, so called "cheese reaction," related with its high content in aged cheeses. Other potential BAs, especially histamine and putrescine, are also present in milk-based fermented foods. Among the approaches useful to control the formation of BAs are the reduction of microbial growth through chilling and freezing or hydrostatic pressures, irradiation, controlled atmosphere packaging, or the use of food additives, etc.

Proteins and protein-like compounds such as alkaloids, hormones, and nucleic acids can be synthesized by precursors such BAs which contain nitrogen. BAs could probably affect organism in processes like body temperature regulation, nutrient intake, blood pressure decrease or increase. As far as plants are concerned, putrescine (diamine) and spermidine and spermine (polyamines) play important role in physiological processes, such as flowering, cell division, fruit development, and stress response. Spermine and spermidine are essential for growth, metabolism, and renovation, of almost all organs in the human body and important for high metabolic activity maintenance of the proper functioning and immunological gut system [3].

BAs are potential precursors for the formation of carcinogenic N-nitroso compounds. In lipid-containing foods, such as ham, bacon, at high temperature and in high water content, the carcinogenic compound N-nitrosopyrrolidine can be produced from spermidine or putrescine. BAs like putrescine, cadaverine, spermidine may play the role of free radical quenchers. Tyramine is regarded as a very good antioxidant, and its antioxidant capacity increases with its concentration. Free radical inhibition depends on amino and hydroxy groups. Spermine, for example, can regenerate tocopherol from tocopheroxyl radical through hydrogenic donor from amino group.

The radical formed binds lipid or peroxide radicals into lipid complexes. Some BAs contribute to the flavor and taste of food.

## 4. BAs analytical methods

The analytical methods reported for identification and quantification of BAs are based on different types of chromatography: gas chromatography (GC), thin layer chromatography (TLC), and high-performance liquid chromatography (HPLC) combined with precolumn or postcolumn derivatization techniques. Aliphatic BAs do not have absorption bands in the UV-VIS region, hence simple spectrometric detectors cannot be applied [4, 5]. Analysis of BAs without prior derivatization includes ion-pair chromatography combined with octylamine or heptanesulfonate as ion-pair reagents. For BAs ion-pair separation in reversed-phase columns with C12-C18 aliphatic chains, phenyl residues bound to a silica core are efficient. HPLC procedures usually involve precolumn or postcolumn derivatization procedure. Chemical reagents that are usually used for BA analysis by postcolumn derivatization are mainly ninhydrin and o-phthalaldehyde and for precolumn derivatization the following reagents: dansyl and dabsyl chloride, fluorescein, benzoyl chloride, 9-fluorenylmethyl chloroformate [5].

## 5. Conclusion

BAs are low-molecular-mass organic bases which occur in plant- and animal-derived products. BAs in food can occur by free amino acid enzymatic decarboxylation and other metabolic processes. Usually, in the human body, amines contained in foods are quickly detoxified by enzymes such as amine oxidases or by conjugation; however, in allergic individuals or if monoamino oxidase (MAO) inhibitors

are applied, the detoxification process is disturbed and BAs accumulate in the body. Knowing the concentration of BAs is essential because they can affect human health, and also because they can be used as freshness indicators to estimate the degree of food spoilage.





## Author details

Proestos Charalampos
Department of Chemistry, Laboratory of Food Chemistry, National and Kapodistrian University of Athens, Athens, Greece

*Address all correspondence to: harpro@chem.uoa.gr

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