# Bacterial biogenic amine production

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Biogenic amines (BA) are low molecular weight organic bases mainly produced by the decarboxylation of certain amino acids by microbial action. Some of them play a major role in many human and animal physiological functions, such as regulation of body temperature, stomach volume, stomach pH and brain activity. However, if these compounds are consumed in high quantities they could give rise to different alterations in the organism. Several toxicological problems resulting from the ingestion of food containing BA have been described.

Histamine and tyramine are the most studied BA due to their toxicological effect. Most of the intoxications produced by BA are related to histamine, because this amine may lead in a dilation of blood vessels, capillaries and arteries, causing headaches, hypotension, gastrointestinal distress and edemas. Tyramine causes the increase of the noradrenaline concentration in blood as an indirect effect, acting like a vasoconstrictor, provoking headache, hypertension and migraine. The presence of monoamine and diamine oxidase inhibitors or the presence of other BA such diamines (putrescine or cadaverine) can potentiate their toxicity. Moreover, putrescine and cadaverine are potential precursors of carcinogenic nitrosamines. For this reason it is particularly important to prevent the accumulation of these amines in cured food products.

BA are present in a wide range of foods products, including fish products, meat products, dairy products, wine, beer, vegetables, fruits, and nuts. In fermented foods, the presence of BA is due to the decarboxylase activity of the lactic acid bacteria (LAB) used as starter culture, and to the action of some spoilage bacteria. In non-fermented foods, the presence of BA is only indicative of undesired microbial activity. Therefore, the amine level could be used as an indicator of microbial spoilage. The amounts of histamine, putrescine, and cadaverine usually increase during spoilage of fish and meat. Early detection of BA-producing bacteria is essential in the food industry, in order to avoid the risk of amine formation and, subsequently, a cause of food-borne disease. Strains of a wide range of genera, such enterobacteria, *Clostridium, Pseudomonas,* and LAB, are able to produce BA. The capability of BA formation seems to be strain dependent rather than being related to species specificity. Several methods to detect the production of BA by microorganisms have been developed, from simple methods as paper chromatography or spectrofluorimetric determination, to more sophisticate techniques, such automated systems for detection of microbial metabolic activities or automated conductance measurements.

The detection of BA-producing bacteria using culture techniques is often slow and variable. Several studies describing loss of ability to produce BA in LAB after prolonged storage or cultivation of isolated strains in synthetic media have been reported. As methods based on molecular biology are fast, reliable and culture-independent, they are an interesting alternative. These methods provide information about the potential risk of formation of these compounds.

Since the BA are produced by the decarboxylation of a precursor amino acid by the enzymatic action of an amino acid decarboxylase, it is possible to develop molecular detection methods targeting the genes coding for these amino acid decarboxylase enzymes. Two enzyme groups of bacterial histidine decarboxylases have been found: the pyruvoil-dependent and the pyridoxal phosphate-dependent. Pyruvoil-dependent histidine decarboxylases are present in Gram-positive bacteria. Pyridoxal phosphate dependent histidine decarboxylases are encountered in Gram-negative bacteria.

Several oligonucleotides for the detection of genes encoding tyrosine decarboxylases have been designed. Ornithine decarboxylases, as well as lysine decarboxylases, are grouped in two different groups and specific oligonuclotides have been designed for all of them. Some multiplex PCR reactions have been developed, achieving simultaneous amplification of several amino acid decarboxylases encoding genes.

**Further reading**

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