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## Review

# Progress and recent advances in fabrication and utilization of hypoxanthine biosensors for meat and fish quality assessment: A review

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## ARTICLE INFO

*Article history:*

Received 14 March 2012

Received in revised form

28 July 2012

Accepted 31 July 2012

Available online 7 August 2012

*Keywords:*

Hypoxanthine

Biosensor

Xanthine oxidase

Fish and meat quality

Nanomaterials

Screen-printed electrodes

## ABSTRACT

This review provides an update on the research conducted on the fabrication and utilization of hypoxanthine (Hx) biosensors published over the past four decades. In particular, the review focuses on progress made in the development and use of Hx biosensors for the assessment of fish and meat quality which has dominated research in this area. The various fish and meat freshness indexes that have been proposed over this period are highlighted. Furthermore, recent developments and future advances in the use of screen-printed electrodes and nanomaterials for achieving improved performances for the reliable determination of Hx in fish and meat are discussed.

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## 1. Introduction

### 1.1. Significance of hypoxanthine

Hypoxanthine (Hx) is a naturally occurring purine derivative with a molecular structure consisting of both benzene and

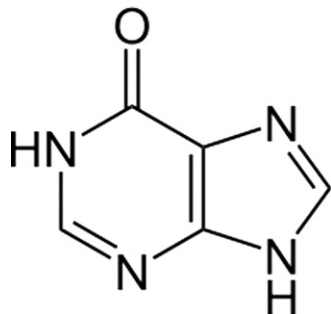


Fig. 1. Molecular structure of hypoxanthine.

cyclopentane rings, as shown in Fig. 1. It is a minor constituent of its nucleoside, inosine, in transfer RNA. As shown in Fig. 2, it is one of the products of ATP decomposition during fish and meat spoilage. In this process, the oxidation of Hx is catalysed by xanthine oxidase (XOD) to form xanthine (X) and uric acid (UA). It is occasionally found as a constituent of nucleic acids and known to accumulate in fish and beef, as well as in organs, such as heart, kidney and skeletal muscle [1–8]. Thus, the monitoring of Hx concentration in dead fish or animals can provide a useful measure for predicting the time of death. Consequently, the freshness of fish and meat can be readily determined by measuring the Hx concentration. For this reason, the levels of Hx and X are commonly used in the food industry as an index for evaluating meat or fish freshness. Particularly linked to the presence of Hx is the suggestion that it causes a bitter taste which is easy to identify in the degrading fish or meat [9].

Associated with the presence of Hx are various medical and clinical conditions that have also been beneficial in forensic studies. For example, the presence of Hx is known to protect the heart during heart surgery by reducing ischaemic damage [10,11]. Elevated levels of Hx is also an indicator of prolonged

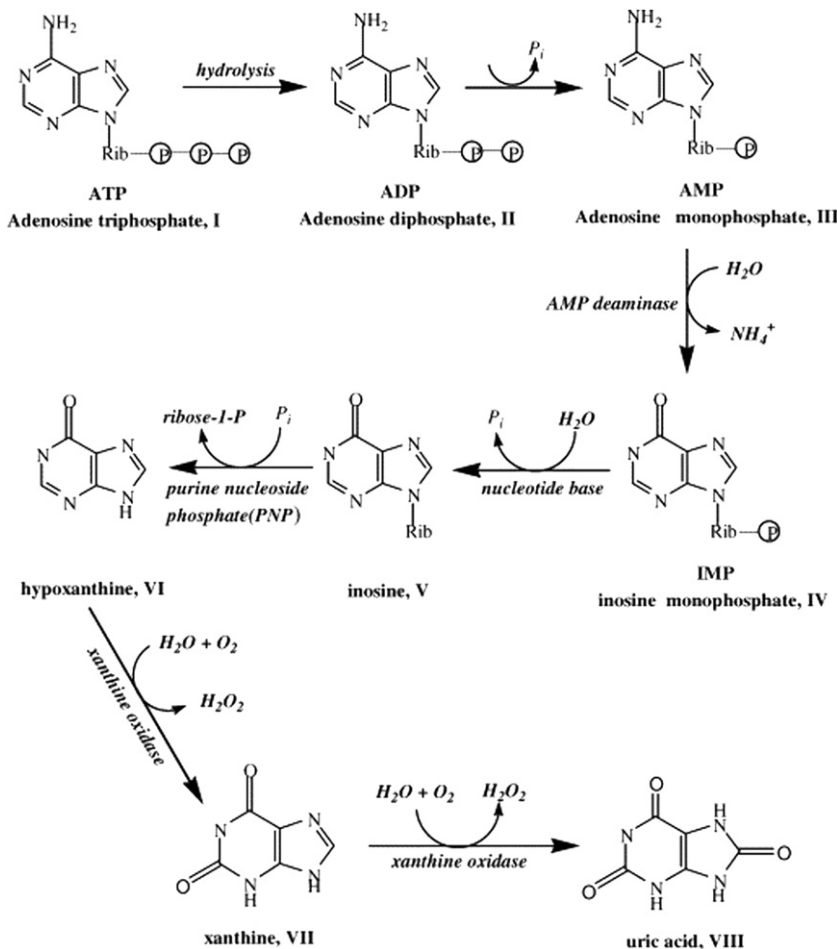


Fig. 2. ATP decomposition during the process of fish or meat spoilage. Reproduced from [210].

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