

Characterisation of Biogenic Amines in Fish Collected from Sarawak Using Gas Chromatography

MUHAMMAD ABDURRAHMAN MUNIR*, ZAINI ASSIM & FASIHUDDIN AHMAD

Department of Chemistry, Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia

*Corresponding author: muhammadabdurrahman2220@gmail.com

ABSTRACT

Determination of five biogenic amines (heptylamine, histamine, tyramine, cadaverine and spermidine) in fish was optimised and validated using gas chromatography – flame ionisation detector (GC-FID) followed by confirmation using mass spectrometry (MS). The biogenic amines were derivatised using BSA (N, O-bis(trimethylsilyl) acetamide) + TMCS (trimethylchlorosilane) as a derivatisation agent. The linear working range was between 0.9995 – 0.9999. The limit of detection (LODs) were in the range of 1.20 – 2.90 µg/mL. The efficiency of recovery for every biogenic amines, which ranged between 98.41 – 116.39%, indicated that analytical procedure can be used to extract biogenic amines in fish. Using GC-FID, the concentration of five biogenic amines were simultaneously determined in fresh and salted fish samples such as mackerel (*Scomberomorus guttatus*), sardine (*Sardinella gibbosa*), whiptail (*Himantura walga*), gourami (*Trichogaster pectoralis*) and toli shad (*Tenuialosa toli*). Histamine is found in fresh mackerel (*S. guttatus*) and sardine (*S. gibbosa*) at concentration of 5.96 and 2.69 mg/kg, respectively. Salted sardine (*S. gibbosa*) has histamine concentration of 8.95 mg/kg. All histamine concentrations detected were below 50 mg/kg (FDA regulation) which is below the permissible threshold associated with scombroid poisoning. Cadaverine was detected in fresh sardine (*S. gibbosa*), whiptail stingray (*H. walga*) and salted gourami (*T. pectoralis*) with concentration of 4.96, 146.39 and 18.80 mg/kg, respectively. None of them has biogenic amines, and histamine within FDA regulation levels (below 50 mg/kg).

Keywords: Biogenic amines, fish, gas chromatography, limit of detection, recovery

INTRODUCTION

Biogenic amines are nitrogenous compounds which are usually low in molecular weight and have aliphatic, aromatic or heterocyclic chemical structures. Spermidine, cadaverine, putrescine and spermine are aliphatic structures whilst tyramine and phenethylamine are in aromatic form, and histamine and tryptamine are in the heterocyclic structure (Kalac, 2009; Kim *et al.*, 2009; Mohamed *et al.*, 2009; Rabie & Toliba, 2013). Furthermore, those which can be classified such as monoamines are tyramine and phenylethylamine, diamines are putrescine and cadaverine and polyamines for spermidine and spermine based on the number of amine groups (Spano *et al.*, 2010). Biogenic amines can be found in food that contain protein such as fish, meat, cheese, vegetables and wines (Lorenzo *et al.*, 2007). Biogenic amines can be shaped by means of amino acids decarboxylation which relies on the presence of a particular bacterial strain, or by amination and transamination of ketones and aldehydes (Rivas *et al.*, 2008; Linares *et al.*, 2011; Zhai *et al.*, 2012). The factors that influence biogenic amines

accumulation in food, are distribution and storage conditions, food physico-chemical parameters (pH, NaCl and ripening temperature), raw material quality, manufacturing processes, presence of decarboxylase-positive microorganisms and free amino acids and (Pons-Sanchez-Cascado *et al.*, 2006; Linares *et al.*, 2012).

Consumption of histamine by humans, especially at concentrations higher than 500 mg/kg, can lead to a serious issue of histamine poisoning (scombroid poisoning) (Gonzaga *et al.*, 2009). The FDA has also determined, histamine concentration at below 50 mg/kg in fish could be consumed (FDA, 2011). Histamine is one of the amines implicated in the toxicity of food (Zaman *et al.*, 2010), however at low levels histamine is not toxic; the presence of cadaverine and putrescine which have five times higher levels than histamine will contribute to histamine toxicity (Emborg & Dalgaard, 2006). High concentrations of tyramine can cause intoxication. Cheese reaction with symptoms like histamine toxicity (Naila *et al.*, 2010) can cause heart failure and brain