UNIVERSITI TEKNOLOGI MARA

MODIFICATION OF FORMALDEHYDE METHOD, OPTIMISATION OF FORMALDEHYDE CONTENT IN *RASTRELLIGER FAUGHNI* AND *EUTHYNNUS AFFINIS* AND STORAGE STUDIES

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ABSTRACT

The purposes of this study were to modify method for formaldehyde determination content in fish, to determine optimum natural formaldehyde content in mackerel (*Rastrelliger faughni*) and kawakawa (*Euthynnus affinis*) and also to study their acceptability during storage. The modification of the formaldehyde analysis method was done for mackerel based on AOAC 931.08 and Nash's methods. Detection limit of formaldehyde using modified formaldehyde method was 0.025 ppm with condition variables: 50 gram sample, pH of sample 2.2-2.4 and volume distillated 250 milliliter. Recoveries were obtained 84.8% and 63% when 0.5 ppm and 3 ppm spikes of formaldehyde were applied respectively. The advantages of the modified formaldehyde method are: several hazardous chemicals were no longer used, interferences could be avoided and time of analysis could be shortened. There were no significant difference in formaldehyde absorbance at the 5% level for the case of formaldehyde working standards 0.1 to 0.9 ppm which were kept in chilled temperature (5^{o}C) for less than 10 days followed by mixing with freshly prepared Nash's reagent or mixing with Nash's reagent which were kept in chilled temperature (5^{o}C) for not more than 24 hours before being put in cuvettes and then promptly kept in closed box for not more than 3 hours before detecting their absorbances using UV spectrophotometer. It was found that the optimum conditions in the determination of formaldehyde content in mackerel and kawakawa using Response Surface Methodology were 31.97 gram of fish flesh, pH of fish flesh 5.7 and volume distillated 234 ml, and 46.73 gram of fish flesh, pH of fish flesh 4.3 and volume distillated 234 ml respectively. In addition, the significant regression equations or models at the 5% level were also created for both mackerel and kawakawa. It was also found that the range of formaldehyde content detected in mackerel and kawakawa were 0.2–1.2 ppm and 0.2–1.8 ppm respectively. This means that the highest acceptable level of natural formaldehyde present in mackerel and kawakawa were 1.2 ppm and 1.8 ppm respectively. For the verification purpose of modified formaldehyde method using optimum conditions, recoveries for 0.5 ppm spike of formaldehyde in mackerel and kawakawa were 73.4% and 86.7% respectively. Besides, formaldehyde contents in mackerel and kawakawa determined using modified formaldehyde method at the optimum conditions were higher than when using AOAC 931.08 methods. This means that modified formaldehyde method could be accepted and more accurate in determination of formaldehyde in fishes. For the storage study, it was found that fishes stored in freezer (-20^{o}C) were still in a good condition until 27 days because sensory analysis on eyes, gills, skin, odour and texture of mackerel and kawakawa stored in freezer for 27 days gave mean scores of more than 6 even though their formaldehyde contents increased up to 1.2 ppm and 1.8 ppm respectively. For the case of fishes stored at chilled temperature (5ºC), formaldehyde contents fluctuated but eyes and odour scores gave indication that mackerel and kawakawa were still in a good condition until three days with mean scores of more than 6 even though gill, skin and texture scores of mackerel and kawakawa were more than 6 until five days.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Formaldehyde (FA) with the chemical formula CH_2O or HCHO, is water soluble, colourless, pungent and irritant. FA is manufactured on a large scale by oxidation of methanol under high temperature (Stocker, 2004). It is marketed as 37-56% aqueous solution known as formalin. An Amount of 8% FA in water is considered as about 13% formalin. About 8% formalin in 70% alcohol is considered as a very good disinfection against vegetative bacteria, spores and viruses. It is useful for space decontaminant for rooms, cubicles and safety cabinets (Australian Standard 2248, 1979). Formalin is widely used for treating fungal infections of fish eggs. During outbreak of shrimp culture it was applied directly in pond at a level 10 – 25 ppm (Jaafar *et al*., 2000). Inhalation of FA may result in severe irritation in the nasal passages. Exposure to FA can irritate the mucosa in the eyes. Skin will be sensitized by direct contact with FA of more than 20,000 ppm. As a reducing agent, FA can also be converted to a less harmful and less volatile substance that is formic acid HCOOH using an oxidant such as aluminum oxide (Al_2O_3) or potassium permanganate ($KMnO_4$) (Chang, 2005). Oxidoreductase can catalyze the reaction of two molecules of FA with water to produce formate and methanol (Purich & Allison, 2002).

FA is moderately toxic probable LD_{50} 30 gram for man. In 1989, World Health Organization classified FA gas as 2B – "Possibly carcinogenic to humans". In Malaysian Food Regulation 1985, regulation number 159 stated that smoked fish is only allowed to have up to 5 ppm FA.

Earlier studies have shown that trimethylamine oxide (TMAO) breaks down more rapidly to dimethylamine (DMA) and FA **(**Pigott & Tucker, 1990**).** The amount of