INTRODUCTION

1.1 3-Monochloropropanediols (3-MCPD) – as a compound

3-Monochloropropanediols (3-MCPD) is the most common of a group of chemical contaminants known as chloropropanols. The most common name used is 3-MCPD. Some of the synonyms are alpha-Chlorohydrin, Chloropropanediol, Glyceryl chloride, 1-Chloro-2,3-dihydroxypropane; 2,3-Dihydroxypropyl chloride and alpha-Monochlorohydrin.

The molecular structure of 3-MCPD is given below:-

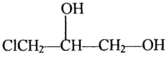

Figure1.1: Molecular structure of 3-MCPD

3-MCPD was detected in food products containing hydrolysed vegetable proteins like soy sauce and oyster sauce. Acid-hydrolysed vegetable protein (acid-HVP) is widely used as a flavoring ingredient in savoury foods.

1.2 Where is 3-MCPD found?

3-MCPD is found in acid-hydrolysed vegetable protein (acid-HVP), due to the interaction between fat in the vegetable protein source and the concentrated hydrochloric acid used to make HVP. HVP is a food ingredient. It is used to flavor a variety of savoury foods including many processed and pre-prepared foods, soups, gravy mixes, savoury snacks and sauces. The Chloropropanol (the most common, 3-MCPD) are formed oils in the crude protein starting materials. This genotoxic carcinogen (3-MCPD) is absent in naturally brewed soy sauce using the old fermentation method [1,2].

A survey of the levels of 3-MCPD in a range of selected food products available in the UK was reported. The survey was carried out on behalf of the Food Standards Agency (FSA) to identify the food groups that might provide a significant contribution to 3-MCPD exposure from the diet. Three hundred samples comprising meat, dairy, cereal, and soup products were purchased from retail outlets and analysed using a GC-MS procedure, which had been formally validated. 3-MCPD was found detected in 89 (30%) of the samples. All crackers were found containing levels of 3-MCPD > 0.1mg/kg, and the highest level being 0.134mg/kg. Levels of 3-MCPD were generally slightly higher in foods after cooking [18].

1.3How is 3-MCPD formed?

3-MCPDs and Dichloropropanols, (DCPs) are frequently formed during manufacturing of protein hydrolysates. The protein sources typically contain residual lipids that have the potential to react under unfavourable conditions to produce MCPDs and DCPs, especially if hydrolysis is carried out using hydrochloric acid. Through improved manufacturing processes for example, enzymatic fermentation instead of hydrochloric acid treatment, levels of chloropropanols could be lowered considerably. MCPD levels have been reduced within the last decade from up to 700 mg/kg to less than 1 mg/kg and DCPs are not longer detectable [3].

3-MCPD was formed from the precursor glycerol, triolein and soy lecithin in the presence of Sodium chloride. The precursors were reacted with Sodium chloride in an emulsion stabilized with an emulsifier under conditions which modeled the thermal treatment of foods during processing. The formation of 3-MCPD strongly depended on the concentration of Sodium chloride and reached a maximum level at approximately 4-7% Sodium chloride. The highest amount of 3-MCPD was formed in media containing 13-17% water. The amount of 3-MCPD increased with increasing temperature over the range 100-230°C and reached its highest value at 230°C. The production of 3-MCPD was also followed in models very closely related to selected foods which had been shown to have a high potential to yield 3-MCPD during processing [17].

1.4 Toxicity of 3-MCPD

Monochloropropanediols (MCPDs) and Dicholoropropanols (DCPs) are toxic compounds, often present in different foods containing protein hydrolysates, like seasonings and savoury food products [3]. 3-MCPD is known to have a post-testicular anti-fertility effect in male rats [4] and has been shown to be mutagenic in bacterial assays [5]. Studies of its carcinogenicity have led to controversial results and there is no direct evidence for toxic effects in humans. Nevertheless, all efforts should be made to minimize its occurrence in the human diet and efficient monitoring is required.

1.5 Objective of present study

Owing to their high rate of production of hydrolysed vegetable protein, 3-MCPD has been found in some food sample [3]. Based on the study of the toxicity of 3-MCPD, it is necessary to know the amount of this compound present in food sample. In addition, it was stated clearly in Malaysian Food Act 1983 [6] the maximum proportion of 3-MCPD allowed in specified food given in Fourteenth A Schedule (Regulation 38A).

The objective of this study is to ensure that this method employed can be used to meet the specified regulation focusing on several types of food sample like oyster sauce, soy sauce, seasoning powder and various types of sauces.

1.6 Review of 3-MCPD Analysis

Several analytical methods for the quantitative determination of 3-MCPD have been published. Gas chromatography with different detectors was shown to be the method of choice.

Rodman and Ross [7] utilized phenylboronic acid to derivatise 3-MCPD in non-aqueous media for subsequent determination by gas chromatography. The same derivative was used by Plantinga et al.[8] and Ushijima et al.[9] to determine 3-MCPD in hydrolysed vegetable proteins (HVPs) and seasonings. Quantitative determination of 3-MCPD in water using butaneboronic acid derivative was reported by Pesselman and Feit [10]. Van Bergen et al. [11] describe a procedure for the determination of chloropropanols in protein hydrolysates based on gas chromatography with electron capture detection of heptafluorobutyrate derivatives. Determination of 3-MCPD and related dioxolanes by gas chromatography was reported by Kissa [12] using N,O-bis-(trimethylsilyl)trifluoroacetamide as the derivatising agent, and the reaction of 3-MCPD with acetone have been discussed. Methods to determine underivatised MCPDs have been published by Wittmann [13], using mass spectrometric detection and by Spyres [14], who used gas chromatography with electrolytic conductivity detection.

Limitations of these methods include the potential for incomplete derivatisation, inefficient partitioning and short term stability of the derivatives, whereas the direct determination of MCPDs has proven difficult, because of reactions with other components of the sample or with active sites on the column or in the inlet. As a result, peak shape is often rather poor and deteriorates with time.