EFFECTS OF CHEMICAL INTERESTERIFICATION ON THE PHYSICOCHEMICAL PROPERTIES OF PALM STEARIN AND RICE BRAN OIL BLENDS

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ABSTRACT

THE EFFECTS OF CHEMICAL INTERESTERIFICATION ON THE PHYSICOCHEMICAL PROPERTIES OF PALM STEARIN AND RICE BRAN OIL BLENDS

The aims of this study were to determine the effects of chemical interesterification on the physicochemical properties of palm stearin, rice bran oil and their blends, and to identify the most suitable blend that could be used for certain food applications. Palm stearin and rice bran oil (PSRBO) were blended according to mass ratios of 100:0, 30:70, 50:50, 70:30 and 0:100 (PS:RBO) followed by chemical interesterification using sodium methoxide as catalyst. The effects of chemical interesterification on the triacylglycerol (TAG) composition, slip melting point (SMP), solid fat content (SFC), microstructure, polymorphism and hardness index (HI) of the blends were determined. Results show that after chemical interesterification there were decrease and increase in the amount of several TAG. Changes in TAG composition caused changes in the physical properties of the blends. Both SMP and SFC of all blends decreased significantly ($p<0.05$) after interesterification except for 100% RBO. However, only the HI of blends of 100% and 50% PS were decreased significantly ($p<0.05$) after interesterification. The crystals of the blends became smaller and reduced in number after interesterification. Interesterification promoted the formation of more β' crystals than β in all blends. The 30:70 PSRBO blend was the most suitable for margarine production as it melted close to body temperature.

CHAPTER 1

INTRODUCTION

1.1 Background and problem statement

Fats are mixtures of triacylglycerols (TAG) consisting of various fatty acids (FA) esterified with glycerol. Interesterification (IE) is the result of heat treatment that causes exchange of some of the fatty acids between the glycerol molecules and alters the properties of the fat (Bender, 2005). There are two types of interesterification: enzymatic interesterification and chemical interesterification.

In this research, the effects of chemical interesterification on the physicochemical properties of palm stearin (PS) and rice bran oil (RBO) blends are studied. Interesterification is an alternative and healthier technique because it does not cause fatty acids to saturate and also trans-fatty acids are not formed in this process. Palm stearin has properties that limit the usage in food products until it is modified. Therefore, it is subjected to chemical interesterification which is one of the fat modification techniques in order for the palm stearin to have properties suitable for specific application. The high melting point of palm stearin (44-56°C) leads to many problems in the manufacturing of edible fats such as margarine and shortenings as it confers low plasticity to the end product.

Hydrogenation is another method of fat modification and is commonly used in the industry, but this method poses health problem primarily by producing *trans*

fatty acids (TFA). In the past few years, several nutritional studies have suggested a direct relationship between TFA and increased risk for coronary heart disease (Tarrago-Trani *et al*., 2006). There is a trend towards utilisation of vegetable oil based shortenings without hydrogenation to avoid *trans* fatty acids (TFA). Consequently efforts have been made to replace hydrogenated oils by other hard fats to reduce TFA intake through shortenings.

For producing shortenings with desired functional properties, the essential requirement is an appropriate blend of liquid and solid fats. Palm stearin (PS) in this context deserves attention as a potential hard fat of vegetable origin to replace hydrogenated fat (Reshma *et al*., 2008). Rice bran oil (also known as rice bran extract) is the oil extracted from the germ and inner husk of rice. It is notable for its high smoke point of 213 °C (415 °F) and its mild flavour. It is also beneficial for health as it lowers the cholesterol level in blood (Orthoefer, 2005).

1.2 Significance of Study

The binary blends of palm stearin and palm olein were commonly used in industrial shortenings (Zhou *et al*., 2010). In this study, the replacement of palm olein with rice bran oil is significant because it will portray different properties and thus affect the food product. Interesterification of palm stearin with liquid vegetable oils yields a good solid fat stock that may impart desirable physical properties, because PS is a useful source of vegetable hard fat, providing β′ stable solid fats (da Silvaa *et al*., 2010). The new altered properties of chemically interesterified blends can be used to manufacture food that is not possible with the unmodified fats. Also, it is to replace the normally used fat modification technique, the hydrogenation that elevates health problem for its production of *trans* fats. Hence, blending and chemical interesterification allow the possibility of obtaining fats with various degrees of plasticity and increasing

the possibilities for their commercial use. By this way, the desired properties of palm stearin can be used to broaden the newly generated oil varieties. The RBO is selected as the liquid oil to blend with PS because it contains high levels of natural antioxidants such as γ-oryzanol, phytosterols and tocotrienols, which impart high resistance to thermal oxidation with less deterioration of the oil under frying conditions (Krishna *et al.*, 2005). Rice bran oil is the preferred oil for frying application due to its high oxidative stability (Semwal and Arya, 2001) and high heat transfer (Debnath *et al.*, 2012). Palm stearin is seen as a potential fat for a wide food application for its ability to contribute solid fat content in the shortening and also to provide naturally present carotene at high concentration which is unique to palm oil (Reshma *et al.*, 2007). Therefore, palm stearin is blended with rice bran oil which is beneficial for health and this blend is subjected to CIE as means of fat modification.

To obtain a desirable end product, the effectiveness of chemical interesterification of fat blends are evaluated in this study by comparing the interesterified (IE) and non-interesterified (NIE) fat blends of various ratios of palm stearin, in terms of the blends' Slip Melting Point (SMP), Solid Fat Content (SFC), microstructure, polymorphism, textural properties and triacylglycerol (TAG) profiles. Results of this study can be used to improve the properties of PS and RBO, thus broaden the usage and application of these fats in the food industry.

1.3 Objectives of study

The objectives of this study are:

1. To evaluate the effect of chemical interesterification on selected physicochemical properties of palm stearin and rice bran oil blends.
2. To identify the most suitable blend for certain food applications.