

OPTIMIZATION OF EPOXIDATION REACTION OF RICE BRAN OIL USING RESPONSE SURFACE METHODOLOGY

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ABSTRACT

The use of modified plant oils as a renewable feedstock in the chemical industry has become more desirable. In particular, epoxidized fatty acid derivatives derived from vegetable sources may be utilized as stabilizers and plasticisers in polymer, as lubricant additives and as constituents of urethane foam. Rice bran oil (RBO) is a by product of the rice milling process (conversion of brown to white rice) at its epoxidized oil is a potential raw material for such products. A response surface methodology was utilized for this duty. The effect of the key variables reaction time and temperature on conversion and product oxirane content is quantified and optimal conditions (high oxirane content) are determined. The epoxidation reaction was performed in a batch reactor using acetic acid as an oxygen carrier. A central composite design, with two variables and two response functions was applied to determine influence of the input variables. The conversion of reaction in the RBO increases linearly with increasing reaction time and temperature. Optimal condition (maximum oxirane oxygen content) was achieved with a reaction time of 4.3-h and at a temperature of 63.8°C.

Keywords: Epoxidized rice bran oil (ERBO); epoxidation; reaction conversion; oxirane content

INTRODUCTION

The existence of double bonds in vegetable oils and fats has attracted many researchers to study their derivatives for numerous applications particularly as supplies of petroleum cannot be guaranteed. Therefore, attention has been paid to the application of derivative vegetable oils in the chemical industry as vegetable oils are renewable resources (Goud et al., 2007). Double bonds in the vegetable oils can be converted chemically or enzymatically to produce epoxidized oil that has several applications such as stabilizers of polymer materials and plasticizers (Du et al., 2004). Hence, the world's demand for epoxidized oil is projected to increase each year.

World-wide rice production is roughly 500 million metric tons (MMT) per year (Jahani et al., 2008). Rice bran oil (RBO) is a by-product of the rice-milling process; hence, it is cheap and readily available. Availability and price are key determinants for the use of the oil as a raw material. RBO provides an attractive alternative raw material to produce