Research Paper

Conjugated linoleic acid (CLA) production and lipase-catalyzed interesterification of purified CLA with canola oil

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In this study, two important isomers of CLA, *i.e. c*9,*t*11 and *t*10,*c*12, were produced up to ca. 73% of total fatty acids, employing alkali isomerization of safflower oil, followed by purification with only one-step urea crystallization to 85.6%, while the recovery of the purification process was 35%. Interesterification (acidolysis) of purified CLA with canola oil was then conducted by *Thermomyces lanuginosus* lipase. The CLA content incorporated into the triacylglycerols (TG) was 26.6 mol-% after 48 h of reaction time. Physical and chemical properties of the TG were then changed according to the degree of substitution of oleic acid in canola oil with CLA.

Keywords: Canola oil / Conjugated linoleic acid / Enzymatic interesterification / Production and purification

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1 Introduction

Conjugated linoleic acids (CLA) are a group of positional and geometrical isomers of linoleic acid (LA) with a conjugated double bond system. The major natural sources of CLA are fat tissues of ruminants (meat and dairy products). The *cis*9,-*trans*11 (*c*9,*t*11) isomer is the most abundant natural isomer (about 75–90% of total CLA) which is also called rumenic acid [1]. Studies (*in vivo* and *in vitro*) have revealed biological activities of CLA including antioxidative, anticarcinogenic, antiatherosclerotic, antidiabetogenic and antiobesity properties, along with immune-enhancing effects [2–5]. Different methods, such as dehydration of ricinoleic acid [6], photoproduction of CLA [7], alkaline isomerization of LA or LA-rich oils [8–11], are used to synthesize CLA. Alkaline isomerization of LA is usually used for commercial production of CLA containing two isomers, *c*9,*t*11 (43–45%) and *t*10,*c*12 (43–45%), accompanied by small amounts of other CLA isomers [5]; however, since the biological activity of the product is due to the presence of both isomers, a purification step would be necessary. Urea-inclusion crystallization has been generally employed to concentrate useful polyunsaturated fatty acids (PUFA) as well as CLA in edible oils [12–15].

Although CLA have several beneficial effects, the consumption of CLA has decreased due to replacement of milk and animal fats by vegetable oils. Enzyme-catalyzed acidolysis is an approach to increase the CLA content in structured lipids (SL). Several researches of enzymatic interesterification of CLA with fats and oils were reported; Garcia *et al.* [16, 17] prepared SL from butter and fish oils with CLA by enzymatic acidolysis. Ortega *et al.* [18], using a lipase, incorporated CLA in fully hydrogenated soybean oil; Lee *et al.* [19, 20] reported the interesterification of CLA with soybean, sunflower and safflower oils. The altered composition of triacylglycerols in SL (incorporation of CLA) provides different changes in physical and chemical characteristics of SL compared to the initial lipid, which possibly improve the functional properties of the oil.

The objective of this study was to produce high-purity CLA from safflower oil and the incorporation of this functional ingredient into canola oil to prepare CLA-rich triacylglycerols (TG) by enzymatic interesterification and to compare the TG with the starting lipid with respect to physical and chemical properties.

2 Materials and methods

Safflower seed was prepared by Oilseed Research & Development Company (Tehran, Iran). CLA (mixture of *c*9,*t*11 and *t*10,*c*12 isomers) and other fatty acid standards were

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