Chapter 14
Imports and Use of Palm Oil as a Way to Increase Safety of Food Fats

Inna Simakova
https://orcid.org/0000-0003-0998-8396
Saratov State Vavilov Agrarian University, Russia

Roman Perkel
https://orcid.org/0000-0003-1435-1330
Peter the Great Saint Petersburg Polytechnic University, Russia

ABSTRACT

The authors compare the biological value and safety of hydrogenated fat containing trans-isomers of oleic acid and palm oil-based fat. The chapter assesses the potential of replacing hydrogenated fats by palm oil in the production of special fat products. Hematological and histological studies are carried out in a form of biological experiment on animals (white rats). The study reveals the explicit negative effect of trans-isomers even with a relatively low concentration of trans-isomers in a diet. Pathological changes are not observed in animals when palm-based fat is introduced into their ration. The findings suggest that palm oil along with its fractions may be considered as an alternative to hydrogenated fats in the production of margarine, cooking, baking, and deep-frying fats. The use of palm oil in the production of special fats of increased hardness (spreads. confectionery, waffles and fillings, and chocolate coating) requires the application of modern methods for modifying triglyceride composition of fats – biocatalytic interesterification and fractionation.

INTRODUCTION

Ensuring a sufficient amount of food fats in the diet is one of the most important factor in establishing food security. Consumption of fats affects food security status as fats are the every-day components of the diets and food products. Special fat products play an important role in the production of catering

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products and home cooking as they provide taste, aroma, formation of the structure of a product, oxidative stability during storage, and other characteristics of culinary products. They also have a significant impact on the quality of finished products (O'Brien, 2007).

Recently, natural vegetable oil has been increasingly displacing cooking fats based on hydrogenated fats which are characterized by a high content of trans-isomers of fatty acids. Palm oil occupy a significant part of consumed vegetable oils today (AB-Center, n.d.) due to thermal stability and physicochemical properties which make it possible to consider palm oil as an alternative to partially hydrogenated fats.

Until recently, the technology of partial hydrogenation has been intensively used in many countries being the most important industrial method of stabilizing vegetable oils to oxidation and obtaining plastic food fats for margarine products on their basis. The technology of partial hydrogenation is specifically aimed at increasing the content of trans-isomers of oleic acid in fat which makes it possible to regulate the ratio of melting point and structural characteristics of resulting solid hydrogenated fats. However, in recent years, numerous studies have revealed negative effect of oleic acid trans-isomers in a body. According to the World Health Organization (WHO) (n.d.), human body should receive no more than 1% of daily norm of total energy consumption from trans-fats (about 2-3 grams of trans-fats). Based on these recommendations, the content of trans-isomers in fat products has been legally limited (no more than 2%) in the EU since 2010 and in Russia and the USA since 2018.

Therefore, improvement of the quality and safety of edible fats and regulation of the content of trans-isomers are relevant and require close attention of scientists, producers, and government agencies.

BACKGROUND

For almost 100 years and until very recently, selective hydrogenation has been the most important industrial method of stabilizing vegetable oils and obtaining plastic edible fats for margarine products on their basis. The technology of partial hydrogenation is specifically aimed at increasing the content of trans-isomers in the fat in order to provide necessary ratio between melting point and structural characteristics of the resulting solid hydrogenated fat.

The formation of trans-isomers is associated with a complex of reactions that occur during the partial hydrogenation of vegetable oils (Gassenmeier & Schieberle, 1994; Schmidt, 2000). As a result of the addition of hydrogen to double bonds in molecules of unsaturated fatty acids, the content of polyunsaturated fatty acids (PUFAs) in fat decreases while the content of oleic and stearic acids increases with simultaneous formation of trans- isomers of oleic acid. For this reason, various producers periodically brought fats containing 15% or more trans-isomers to the market (Table 1).

The content of trans-fatty acids in fast-food products reaches one-third of total fatty acids and accounts for a significant proportion of a daily diet (Table 2).

In addition, the process of formation of trans-isomers was studied in detail during deodorization of oils at the refining stage. Non-hydrogenated refined vegetable oils contain a small amount of trans-isomers (0.5-2.0%) depending on the degree of their unsaturation and the exposure conditions used for their processing (Schwarz, 2000; Schmidt, 2000).

In frying technology, the process of formation of trans-isomers has not been investigated sufficiently. Beatriz, Oliveira, and Ferreira (1994), Gamel, Kiritsakis, and Petrakis (1999), and Sebedio et al. (1996) demonstrated that when using non-hydrogenated oils that did not contain trans-isomers of oleic and linoleic acids, their concentration in the frying medium was low. Therefore, if they present in fried foods