Chapter 33
Recent Advances in Waste Cooking Oil Management and Applications for Sustainable Environment

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ABSTRACT

This chapter discusses the management of waste cooking oil (WCO) in a sustainable manner in order to protect the environmental pollution. Increasing consumption of edible oils worldwide leads to generation of substantial amount of waste cooking oil (WCO). While WCO is not considered toxic, large amount of WCO can contribute to environment pollution if not being handled properly. The huge generation of WCO in the world creates problem of collection, treatment and disposal. Due to its chemical features, the recycling of WCO not only provides a renewable feedstock for producing biofuels and bio-based products, but also alleviates environmental pollution arising from its improper handling. This chapter also provides an overview of some recent approaches in WCO recycling and applications.

INTRODUCTION

The increase of population and living standards has led to higher demand of edible oils worldwide. This can be seen from the growth in global production of vegetable oils of 90.5 million metric tons in year 2000/2001 to 197.23 million metric tons in year 2017/2018 (Statista, 2019a). Edible oils are oils mainly extracted from plants or vegetables such as, oil palm fruit, soybean, rapeseed, sunflower seed, peanut, coconut and etc. Palm oil is the most common type of edible oil (Statista, 2019b). Edible oils consist mostly of triacylglycerides (96%) that composed of different fatty acids and some other compounds such as free fatty acids, phospholipids, phytosterols, tocopherols, other antioxidants or waxes (Matthäus, 2010).

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All over the world, edible oil is essential in food preparation and substantial quantity of edible oils are used for food frying either in home, restaurants or in food industry. Waste cooking oils (WCO) are bio-based oils that have been used for the same purpose. During the frying process, cooking oil undergoes various physical and chemical changes due to chemical reactions including hydrolysis, thermal degradation, oxidation, and polymerization (Panadare & Rathod, 2015). Repeated frying and usage of edible oil alters its physiochemical and nutrition properties, and leads to the formation of Total Polar Compounds (TPCs), which in high rates have been found to have a negative effect on a person's health. At certain point after reused multiple times, the oil becomes unfit for human consumption and may pose serious health risks such as hypertension, liver disease, increased cholesterol and atherosclerosis by consuming such oil (The news minute, 2019).

High amount of cooking oil consumption leads to significant wastage. WCO and fat generated from kitchens and food preparation have created serious problems for their disposal, due to its slow degradation. Proper waste management is thus necessary for WCO in order to preserve a sustainable environment.

WCO implies an economic loss in edible oils. Due to its chemical composition and physical nature, WCO can be considered as a potential waste which can be utilized as energy source and raw material for chemical or biological processes. It has been getting more attention as a low-cost feedstock for producing biodiesel or other biofuels and nonfuel products comparing to the use of edible oils as a food resource for human beings. The present article provides an overview regarding recent advancement in WCOs management and applications for recycled WCO.

DETRIMENTAL EFFECTS OF FOOD DERIVED USED OIL AND FAT

Fat and oil consumption per capita in developed countries was estimated at over 50 kg/annum compared to less than 20 kg/annum in less developed countries (Williams, Clarkson, Mant, Drinkwater, & May, 2012). It is estimated that 2.5 L of WCO are produced per person per month domestically (European Biomass Industry Association, 2015). In Japan, it is presumed that 100–140 ktonne WCO from household sector are discarded every year (Ministry of Environment, 2006). Oil cannot be removed from cooking operations as it is inveterate in many culinary customs. Used cooking oil is considered a waste upon being discharged into the sewer systems. The waste oil from multiple sites can accumulate in the sewer with other non-flushable waste to cause sewage blockage and overflow, leading to odor, nuisance and creating the corrosion of sewer lines under anaerobic conditions. It has been estimated that 50-75% of approximately 24,750 inline blockages per year in the UK (Arthur et al., 2008) are due to fat, oil and grease (FOG) deposits (Keener et al., 2008). In 2000, the Drainage Services Department of Hong Kong claimed that more than 60% of sewer blockages were due to excessive grease build-ups (Chan, 2010). These deposits can impact human health and the environment.

In addition, oil and fat that pass through the sewer system and enter wastewater treatment plants will increase the difficulties to treat. Additional techniques such as dissolved air flotation, centrifugation, filtration, biological removal and ultrafiltration are needed, in order to treat the oil contaminated water, which leading to increase operational and maintenance costs (Wallace et al., 2017).

Another concern is gutter oil, which is illicit cooking oil that has been recycled from waste oil collected from restaurant fryers, drains, grease traps, and slaughterhouse waste has emerged as a serious food-safety issue in China. Taking food prepared from oxidation and hydrogenation of this 'gutter oil' can cause health problems in humans (Lu & Wu, 2014). In September 2014, an incident of "food safety

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