Researches Reviews of the Department of Geography, Tourism and Hotel Management
45-1/2016

Original scientific paper UDC 664.314

PROCESS OF USING WASTE OILS IN THE HOSPITALITY INDUSTRY

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Received: April 10, 2016 | Accepted: May 21, 2016

ABSTRACT: *Significant quantities of used cooking oil are generated in restaurants when preparing meals that require thermal processing - frying in deep fat. Since 2012, disposal of used cooking oils is controlled in Serbia delivering to the authorized institutions for further processing. Considering importance of the proper use and disposal of cooking oils, the aim of this paper is to explore the way of manipulation with used oils and the level of awareness on their proper elimination among employees in restaurants. The aim is to show the level of environmental awareness of employees in restaurants related to oils. The research results indicate a lack of education, information and awareness on environmental protection among employees related to the proper manipulation of used cooking oils in the hospitality industry.*

Keywords: *waste, cooking oils, environmental protection, restaurants.*

INTRODUCTION

Edible oils in the hospitality industry are widely used in food preparation. The most common types of oils used in restaurants are:

- palm oil, which has the greatest application for frying in deep fat;
- refined sunflower oil used for frying in shallow fat and
- olive oil used in the raw state for seasoning various types of salads and dishes.

Used cooking oils are result of many chemical reactions creating various products that have a common name, total polar materials (TPM). TPM besides that affect the taste, consistency and appearance of fat TPM significantly influence on the quality of thermal processing of foods.

By definition: Used cooking oil is any oil that is result of performing hospitality and tourist activities, in industry, commerce and other similar activities that include preparation of more than 50 meals a day ("Sl. Glasnik RS", br. 71/2010).

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Used oils are classified as non-hazardous waste, but these oils can cause environmental pollution. Spilling of used cooking oils into the drains and sewers causes clogging of sewer pipes, which can lead to flooding of facilities or parts of streets. Discharge of used cooking oils in the sewers directly endangers the flora and fauna of rivers, lakes and seas.

A significant fact is that only one liter of used cooking oil can contaminate up to one million cubic meters of water (www.recikliraj.rs). Since 2012, in Serbia it is forbidden to throw used cooking oil from restaurants either of commercial (restaurants, pubs, pizzerias, etc.) or subsidized type (working, student canteens, hospitals, etc.) which must be delivered to the registered operators for processing.

Used oil, which is classified as biomass, most commonly is used as an alternative fuel, that is, it is processed into biodiesel (Kulkarni and Dalai, 2006; Mitrović et al., 2008; Zhang et al., 2012; Đerčan et al., 2012; Rodrigues Pereira et al., 2014). Biodiesel is an environmentally friendly fuel, which is obtained from vegetable oils, agricultural, industrial and municipal waste, does not cause greenhouse gas emissions, SO2 is neutral, it is less flammable than other types of fuel and importantly, consumption of biodiesel releases the amount of carbon dioxide used by plants in the process of photosynthesis, i.e. multiple lower compared to other fuels (www.euractiv.rs).

By studying the importance of proper use and disposal of cooking oils used in heat treatment of food, the subject of the paper is adequate manipulation of them.

The aim is to show the level of environmental awareness of employees in restaurants related to the oil manipulation.

The task of this work is to provide answers to the following research questions:

- What is extent of dishes that require heat treatment in oil?
- Is management aware of the law on used oils?
- Do facilities have storage areas for oil?
- Who used oils are delivered to? And
- Do they control oil age during its use?

LITERATURE REVIEW

Used cooking oil

Thermal processing of foods by frying takes place at a temperature of 160-200°C, a part of oil is absorbed into the product being fried, while a part of the product is falling apart, separates and remains in oil (Cvengroš and Cvengrošová, 2004). In the oil, physical and chemical changes occurs which may be different in different types of oil, depending on their composition and way of frying, or temperatures (Kulkarni and Dalai, 2006). These changes are reflected in the change of nutritional, sensory and rheological characteristics of the fried product. During frying three types of reactions occur: thermolysis, oxidation and hydrolysis (Nawar, 1984; Ng, et al., 2007; Li et al., 2008).

Frying in deep fat is a traditional and popular method used around the world because of its convenience and unique effects on the taste and texture of food. Frying in used oil can contain more than 400 different heat-induced reaction products, most of which are

absorbed into the fried food (Paul and Mittal, 1996; Škrinjar and Tešanović, 2007; Bansal et al., 2010; Sunisa et al, 2011). It has been shown that many compounds are harmful to human health (Kubow, 1991 Innawong et al., 2004; Aladedunye and Przybylski, 2009), which further emphasizes the importance of proper heat treatment of food in this way.

Frying is primary process of dehydration, which means that water and substances dissolved in water are extracted from the product that is fried and transferred into cooking oil. At the same time it absorbs surrounding fat. If the foodstuff is inserted into the hot oil, water evaporates from the surface and runs from the center of the product to the outer parts to compensate the loss of water on the surface. As the released water does not move easily from hydrophilic surface into hydrophobic cooking oil, it creates a thin layer of vapor between the oil and the product being fried (www.super-lab.com).

To what extent the amount of oil in the foodstuff increases (is absorbed) in heat treatment in oils is shown in Table 1.

Table 1: The amount of fat absorbed during frying of different kinds of food.

NAME OF FOODSTUFF	RAW FOODSTUFF	FRIED FOODSTUFF
Chicken without skin	3.9	9.9
Chips	0.1	39.8
Fried potatoes	0.1	13.2
Doughnuts	5.2	21.9

Source: www.super-lab.com

Used edible oils may be a problem for the environment, especially for water due to improper disposal. As a result, many developed countries have introduced legislation on punishment for disposal/discharge of used cooking oils into drains.

According to estimates the EU collects from 700.000 to 1.000.000 t/year of used cooking oil (Kulkami and Dalai, 2006; Yaakob et al., 2013). According to the Fund for Environmental Protection and Energy Efficiency collected quantities of waste cooking oil from year to year increase. Data from the Ministry of Energy and Infrastructure indicate that consumption of edible oils in Serbia is around 16 liters per capita per year, which points to the fact that around 10,000 tons of edible oil suitable for biodiesel production could be collected per year.

Processing of used oils can be used in order to obtain compounds that can be re-used as fuel (Kopetz et al, 1998).

Regulations related to used oil

Manufacturer of used cooking oils is required to temporarily store these oils until the moment of delivery to operator that obtained the license from the competent authority for the collection and/or transportation of used oil, or person who has a license for the storage and/or treatment of used oils. This means that these oils are temporarily stored in packaging/containers/cans designed for this in a separate part of room, which is separated, labeled and intended for the temporary storage of used cooking oil.

Collection of used cooking oils is done in appropriately, impermeable and closed containers that bear the index number of used oil in accordance with the Waste Catalogue. Equipment for collecting used cooking oils is placed and provided by the authorized firm in accordance with the provisions of Article 70 of the Law on Waste Management, and in accordance with the permission obtained from the competent authority. This means that the manufacturer of used cooking oil must sign an agreement on the takeover of used cooking oil with the authorized firm, which must provide the equipment for the collection and put it at disposal to the used cooking oil manufacturer.

Dynamics of used cooking oil takeover are contracted between the producer and the subject who takes the used cooking oil, that is, the person who holds a license for the collection. Waste Management Law sets penalties for all companies and entrepreneurs who do not treat their used cooking oils in the prescribed manner in the amount of RSD 250.000 to 1.000.000 and for the authorized persons from RSD 25.000 to 50.000.

In Serbia, the license for collection and transportation of used cooking oils have 23 enterprises, while two operators: "Biodizel co.", Boleč and "Bio-Energoil", Sombor are licensed for treatment, or their processing.

Total polar materials

Results of many reactions are released different degradation products, which have a common name, total polar materials. TPM affect not only the consistency, taste and appearance of fat, but also the quality of the cooking/frying.

Darkened oil during frying is the most visible change that occurs and can be used as a parameter to indicate the quality of the frying oil (Xu, 2003). Foodstuff that is fried in spent oil very quickly forms a dark crust and at the same time absorbs a large amount of fat. In fats with a high proportion of polar materials, the water quickly evaporates from the fat and the product dries out more quickly. Fried potatoes, for example, become hollow. Free fatty acids and total polar compound levels are the most widely used measures for determination of frying oil quality (Chen and al., 2013). The optimum range for frying is between 14% and 20%. By regular measuring, this optimum can be maintained by mixing old and fresh oils, so that the user gets a product of uniform quality. TPM value is determined by regulations and it varies between 24% and 30% depending on the country (www.super-lab.com). Table 2 shows the classification of oil aging.

Table 2: Classification of oil aging

PERCENTAGE OF POLAR MATERIALS	CLASSIFICATION OF OIL AGING
Below 1-14% TPM	Fresh edible oil
15-18% TPM	Slightly used
19-22% TPM	Used, still good to use
23-24 TPM	Utilized, should be replaced
Above 24%	Spent oil

Source: www.super-lab.com

Methods for determination of age of the oil used for thermal processing of food are as follows:

- determination of polar materials by column chromatography;
- determination of free fatty acids by indicator strips and
- Testo 270, cooking oil tester.

When testing the oil for frying, the best results are obtained if one takes into account the following indicators related to the proper use of oil:

1. frying temperature should not exceed 175°C, as above this temperature, acrolein formation increases significantly;
2. set the optimum frying point;
3. quantity of foods that are fried should be measured and take into account what temperature would not fall too sharply during frying, which would give a negative effect
4. turn off the fryer at a time when not in use, in order to prevent unnecessary exposure of oil to heat and premature aging (www.super-lab.com).

METHODOLOGY

For the purpose of this research it was made personal insight into written offers and business, as well as interviewing managers in restaurants in Novi Sad. The research was done on a sample of 40 facilities of 266 recorded by census of 2014 in the city. The study was conducted in a la carte restaurants, 26 facilities with a daily capacity of 100 meals and 14 restaurants with the production of over 100 meals a day.

The research results are obtained using the following methods:

- use of domestic and foreign literary sources;
- field research (observation and interviewing);
- statistical and graphical method and
- method of criticism.

RESULTS AND DISCUSSION

Analysis of oil use in food heat treatment from restaurant offers

Analyzing food offers in 40 restaurants in Novi Sad we came to the data that 20% of dishes are prepared in a fryer that is deep fat or shallow fat in a pan (Figure 1). It should be noted that during the collection and processing of data we excluded soups, stews, salads and desserts because these types of dishes do not require preparation in oil, but oil is an ingredient of the dish and as such is directly served to the guest. On average each object in its offer has 19 dishes prepared by frying.

As a reason for this proportion of fried dishes is a side dish to the main course which is usually French fries or seasoned now potatoes prepared in oil. In addition to side dish,

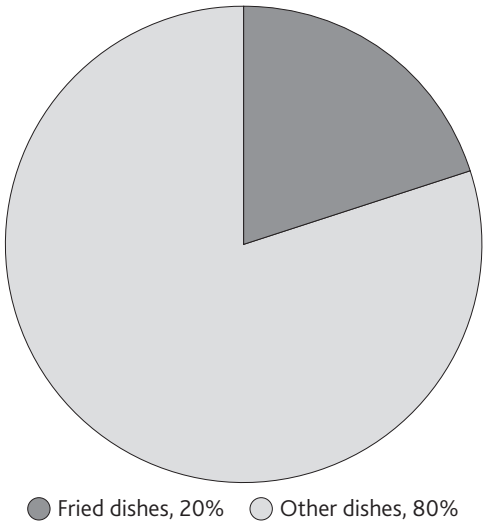

Figure 1: Proportion of dishes that are prepared in oil compared to the total number of dishes in restaurants

another reason is that the offer includes some sort of breaded meat (Wiener Schnitzel, Parisian steak, Karađorđeva šnicla, various kinds of meat with filling) and vegetables. Likewise, different hot appetizers such as fried cheese, pancakes, croquettes and the like.

Analysis of familiarity of management of restaurants with the Law on Waste Oils

By interviewing the management of restaurants in the territory of Novi Sad we came to the data that 28% of restaurant managements are familiar with the law related to the used cooking oils in the hospitality industry, while 72% of the restaurants are not familiar with the legal requirements (Figure 2).

The data suggest that the awareness and familiarity of employees with the legal requirements in restaurants is poor, which affect the quality of dishes.

The only thing with which some staff are aware of is that it has been passed the law used cooking oils. When questioned whether they know what is the goal and task of the passed regulations 34% of respondents had the correct answer.

Studies have shown that countries in the region pay much more attention to the above subject matter which resulted in raising awareness among staff and therefore the environmental protection.

Analysis of disposal of cooking oils after use

Through interviews with employees in restaurants it was discovered that all objects possess tankers for disposal of used cooking oils and used cooking oils deliver to an authorized dealer without compensation.

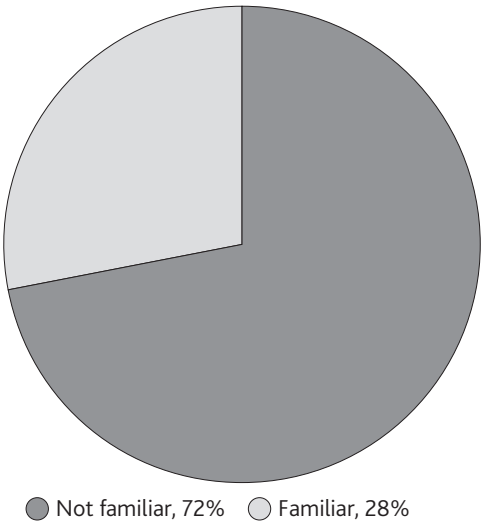

Figure 2. Familiarity with legal regulations on used cooking oils

Analyzing whether the facilities have provided a place for disposal of used cooking oils until it comes to their transportation, it was discovered that 55% do not have adequate space for disposal of used cooking oils, while 45% have provided storage space for tankers.

The data are consistent with the standards as facilities that have implemented in their operations HACCP system, have provided storage space for tankers (Arnold and Butts, 2014). While facilities that do not apply all regulations of HACCP system in most cases do not have the space for disposal of tankers but dispose them in the most convenient places. Often these places are in the open without any protection, and near the sew-

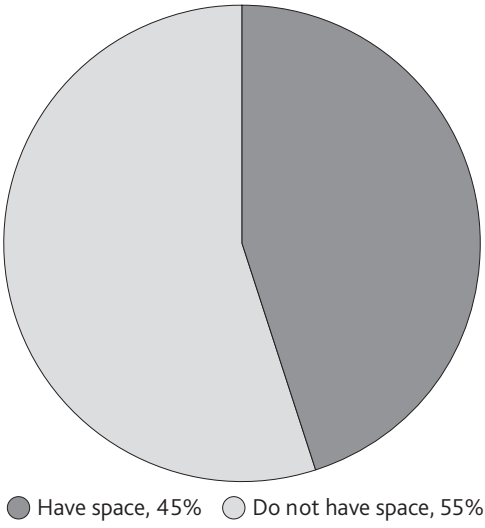

Figure 3. Possession of storage space for oil tankers

ers. In situations when it comes to accidents and accidental spills from tankers with used cooking oil, it goes into drains and pollutes the environment.

Analysis of a partner company for disposal of waste oils

By analyzing obtained data it was found that 45% of sampled facilities operate with "Eso tron" company, while 55% operate with "Aik" company that deal with collecting used cooking oils.

Taking into account the fact that the country does not have a large number of companies which collect used cooking oils it is assumed that for this reason in the territory of Novi Sad companies that collect used cooking oils are exclusively "Eso tron" and "Aik". It is important to note that these companies only collect used cooking oils and pass them on for further processing. It is assumed that the reason for the existence of a small number of companies engaged in the collection and processing of used cooking oil is because the government did not give any incentives for the establishment of businesses of that activity.

Analysis of oil age control

The most devastating data show that only one restaurant uses one of the methods for control of oil age, namely it uses strips. This statement means initial deviation from the standardization and uniform quality of food that is prepared by frying in oil and jeopardizes the health safety of dishes of analyzed restaurants.

CONCLUSION

Based on the research with consulted national and international literature in the field of thermal processing of foods in oil and manipulating the same we came to significant conclusions affecting food quality and environmental protection. Restaurants in their offers have fifth of dishes that require heat treatment in oil, which accounts for a significant share of the offer and confirms that it is a substantial consumption of oils which can be used in some another purposes.

Unfortunately, a large number of employees in restaurants is not familiar with legal requirements related to used cooking oils and most restaurants (55%) do not have adequate storage space for tanks with oil which threats protection of the environment.

Only one restaurant uses strips for determination of the age of oil, which represents the most devastating segment in terms of quality of dishes, in clinical, nutritional and sensory terms.

ACKNOWLEDGMENTS

The work is part of the research project III-046009 financed by the Ministry of Science and Technological Development of Republic of Serbia.

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