THE PRODUCTION OF BIODIESEL FROM WASTE FOOD OILS AND ANIMAL FATS
BIODĪZEĻA IEGŪŠANA NO LIETOTĀM PĀRTIKAS EĻĻĀM UN DZĪVNIEKU TAUKIEM

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Summary
Most important sources of used food oils and animal fats within Latvia were find out and possibilities of their utilization as raw materials for the production of biodiesel were investigated. Quality indices of raw materials and obtained biodiesel were determined.

Biodiesel has ecological effect both at local scale and at global scale: reducing greenhouse effect it is environment friendly fuel. Even larger ecological effect can be achieved using waste cooking oils and fats, which arise as byproducts during food processing.

Waste cooking oils become an important source of raw materials for the production of biodiesel as a network of fast food enterprises using large amounts of vegetable oils are getting more and more popular in Latvia; the another benefit - recycling of used oils is solved. Quality indices of waste oils varies a lot, as during food processing various species, salt, fats, sometimes even washing means get in oil; these admixtures influence kinematic viscosity, acid value, iodine value and other quality parameters of oil.

Our purpose was to elaborate methods for the production of biodiesel from used food oils and fats corresponding to requirements of EN standard. We worked with palm oil taken from potatoes fritting, *Chili pizza* cooking a.o., various soybean oils from restaurants of *RIMI* supermarkets, hydrogenated rapeseed oil from *McDonald's* restaurants and animal fats from fallen animals (see Table 1).

Table 1 Quality indices of raw materials used for production of biodiesel

Raw materials	Acid value, mg KOH/g	Peroxide value, meq O_2/kg	Kinematic viscosity at 40 °C, mm^2/s	Iodine value, mg I_2/100g	Water content, % (m/m)	Saponification value, mg KOH/g	Density at 20 °C, kg/m^3
Waste hydrogenated rapeseed oil R_H	3.12	3.49	48.2	111.9	0.042	186.3	912
Waste palm oil: P-1	0.92	1.01	46.0	54.8	0.030	194.3	s*
P-2	2.32	2.60	42.7	66.3	0.149	193.0	s
P-3	1.26	3.87	42.4	55.8	0.102	207.4	s
P-4	0.95	4.8	47.0	97.5	0.026	194.6	s
Waste soybean oil: S-1	4.3	7.2	47.6	116.6	0.080	191.2	929
S-2	0.63	3.1	32.5	122.0	0.033	194.6	922
S-3	1.14	62.0	35.1	115.0	0.120	196.0	923
S-4	1.18	4.6	34.8	85.9	0.095	196.6	920
Animal fats AF	32.02	1.39	46.1	62.32	0.034	202.1	s

* s – solid

Waste oils were purified by filtration from mechanical admixtures and decantation, if it was necessary. One of the quality indices of oils is total contamination (admixtures insoluble in oil), which may not exceed 25 mg/kg. Oils used for experiments had larger values, e.g., for total contamination of soybean oil before and after filtration (paper filter) was 180,2 and 114,8 mg/kg, accordingly. In order to remove admixtures soluble in water, soybean oil used for meat cooking and palm oil from *RIMI* restaurants were washed with hot water. Kinematic viscosity at 40 °C of palm oil before washing was very large - 386,1 mm^2/s, but after washing – 47,0 mm^2/s. Other quality indices were not improved by washing.

Methyl esters were obtained from both washed and unwashed oils. Similar results were obtained at the same conditions of synthesis; it seems that water soluble admixtures don't hinder process of transesterification and they stay in glycerol layer. Due to large energy consumption for washing and drying, such pretreatment of waste oils is not economically favourable in industry.

Soybean oil used for chicken grilling contained chicken fat and water as admixtures; it turned out that such oil before transesterification should be settle for sufficiently long time in order to separate undesirable admixtures.

In order to simplify process of biodiesel production from animal fats and to diminish energy consumption (heating up of pipes, containers a.o. as fats have thick, soft consistency (solidity) at room temperature) in industry, hydrogenated rapeseed oil from *McDonald's* restaurant was added to fats in proportion 1:1.

Table 2. Transesterification of waste oils with methanol at temperature 65-70 °C

Raw material	Acid value of oil, mg KOH/g	Methanol, wt % from oil mass	Catalyst	Catalyst, % of oil mass	Reaction time, h	Yield, %	Properties of methyl esters		
							Acid value, mg KOH/g	Kinematic viscosity at 40 °C, mm^2/s	Total contamination, mg/kg
Soybean oil S-1	4.3								
1st stage		10	H_2SO_4	1	4	100.1	1.84	19.0	
2st stage		10	NaOH	0.6	1	95.0	0.40	4.3	160.0
Palm oil P-3	1.26	15	NaOH	0.6	1	98.0	0.24	4.8	139.0
Hydrogenated rapeseed oil R_H	1.38	12	NaOH	1	0.5				
		8			0.5	98.0	0.47	4.7	106.0
Animal fats AF	32.0								
1st stage		10	H_2SO_4	1	4	99.0	1.18	20.3	
2st stage		10	NaOH	0.6	1	91.0	0.45	4.8	96.9

Transesterification of waste food oils and animal fats were carried out with methanol at laboratory scale. Depending from acid value of oil or fat we used acid (conc. H_2SO_4) and/or alkaline (NaOH) catalyst and it was one or two stage method; addition of methanol-alkaline solution was realized also in two steps (see Table 2).

Quality indices of methyl esters obtained from used food oils and fats correspond to requirements of standard LV EN 14214, except total contamination and low temperature properties; such biodiesel may be used by adding 5 % (m/m) of biodiesel to fossil diesel fuel.

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