Sys Rev Pharm 2020;11(12): 167-171
A multifaceted review journal in the field of pharmacy

Catfish (Silurus Glanis) Remaining Parts as A Source of Biodiesel Preparation

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Abstract

There are scanty studies about biodiesel production from aqueous organisms in comparison with other sources like plants and microorganisms. residual parts of Silurus glanis fish was used as the provenance to biodiesel production, therefore, the percentage of oils extracted from remaining parts of Silurus glanis fish was showed 28% of the total weight contained the most important fatty acids methyl esters that important in creation of biodiesel, which included Tetradecanoic acid, Hexadecanoic acid, Octadecanoic acid, Hexadecenoic acid, Octadecenoic acid, Octadecadienoic acid , and Octadecatrienoic acid, where the percentage of produced fatty acids methyl esters that important for the biodiesel productivity reached to 92.53% of the total fatty acids yields. Moreover, Octadecenoic acid methyl ester appeared the highest rate of production by 53.95%, followed by Hexadecenoic acid methyl ester and Tetradecanoic acid methyl ester by 16.99% and 7%, respectively. Furthermore, the results of the study showed that the product of fatty acids methyl esters revealed cetane number reached to 59.8 where this number was corresponded with the Iraqi specifications and European standards for diesel.

Keywords: Biodiesel, lipids, Silurus glanis, residual parts
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INTRODUCTION

The high adaptation and scarcity of traditional fossil fuels, as well as the increase in emissions of pollutants generated from combustion, have made biomass sources more Attractive (Saidur et al, 2011). Biofuels can be defined as fuel that can be produced from a variety of different sources, biofuel can be produced from agricultural products, industrial or agricultural waste and it can also be produced from by-products. Biofuels generally can be three types, liquid, solid and gas, liquid type such as biodiesel, ethanol ,and vegetable oils, while the solid fuel such as plant wastes as wood variety ,moreover the gas fuel has been included methane gas resulting from the decomposition of plant , waste and animal manure (Demirbas, 2008 ; Abu al Naga, 2011 and Nigam and Singh,2011).

Sources of biofuel production evolved during the so-called four generations, where the sources of plant grains have been considered the first generation of biofuel sources while the biomass has been evaluated the second generation of biofuel roots, such as wood, as well as the third generation of biofuel performing from microorganisms like algae .However, the fourth generation of biofuel can be produce by genetic engineering through the genetic modification of some plants. (Abu al Naga, 2011; Carriquiry et al, 2011 and Maity et al, 2014).

Biomass-based biofuels, whether gas, liquids or solid fuels are biodegradable alternative fuels that produced from different renewable biodegradable sources and characterized by sulfur free, low amount of aromatic and pollutant compounds, and nontoxic (Tayal, 2006 and Demirbas, 200 8). Biodiesel is a type of biofuel; it's the potential renewable fuels that have attracted the most attention, where biodiesel is the alternative diesel fuel that can be produced from renewable sources such as vegetable oils, animal fats, cooking oils and fish oils. It consists of the mono alkyl esters derived from long chain fatty acids formed by a catalyzed reaction of the triacylglycerol (TAG) with a simple monohydric alcohol (Van, 2005; Yahyaee et al, 2013 and Da Costa Cardoso et al, 2019).

Biodiesel contributes effectively to the process of reducing pollutants and improving the climate, it reduces emissions of non-burnt hydrocarbons, carbon dioxide, carbon monoxide, and solid particles emitted from diesel engines ,biodiesel can be used purely(B100), but it is better if mixed with petroleum diesel fuel ,on the other hand the European standard EN 19214 and EN590 determine the ratios of diesel oil which consolidates with biodiesel, the process of biodiesel extraction from lipids has been used an acid or base as a catalyzes in transesterification reaction (Christopher and Weaver, 2002 ; Aranda et al, 2008 ; Kouzu , 2008 ; Tesfa, 2010 and Maia et al, 2011).

MATERIAL AND METHODS

Samples collection and Oils extraction

Catfish samples were caught from aquatic regions in Basrah province / Iraq. Then, unconsumed parts of fish samples (head part, dorsal fin, pectoral fin, pelvic fin, anal fin, adipose fin, caudal fin and tail parts) were collected and dried completely for oil extraction methodology. Thus, all selecting fragments were crushed by an electric grinder, then, 250 gm were

extracted by using chloroform and methanol as extraction solvents. (2:1 chloroform: methanol, volume / volume). The composition was mixed by using vortex mixer for 20 minutes then centrifuged at 4000 rpm for 15 min, the upper phase of the mixture was expelled several times after adding saline solution to the mixture according to Kamoun et al (2018), the lower phase (containing oils of fish) was obtained after repeating the above step several times, finally oils was estimated after the solvent was dried.

Biodiesel production

Transesterification reactions were followed for biodiesel production and determine the content of fatty acids methyl esters (FAME) from extracted oils of the residual parts of fish according to Shin et al (2015). The water in the extracted oils was removed by boiling the oils at 100 ° C, then the sulfuric acid was used as a catalyst with methanol to separate the glycerol, while, esterification process was completed by adding (2.5 volume / volume of sulfuric acid / methanol) to 3 gm of extracted oils at 90 ° C for 45 minutes. Then, by using magnetic poles at 100 rpm, 2 ml of hexane and 1 ml of water were incorporated and finally, to separate hexane layer that containing fatty acids methyl esters from aqueous layer the mixture was centrifuged at 2000 for 15 minutes. Eventually the hexane phase was transferred to another tube in order to achieve fatty acids methyl esters determination in further step.

Analysis of Gas Chromatography Mass Spectrometry GC/MS

Fatty acids methyl esters were detected using Gas Chromatography Mass Spectrometry technique (GC/MS, 7890 B/USA); this test was conducted by the laboratories of the Iraqi Ministry of Oil, Basrha Oil Company Research and Quality Control Center-Nahran Omar.

Calculation of Cetane Number (CN)

Cetane Numbers were calculated of biodiesel outcome based on proportion of fatty acid methyl ester according to (Bamgboye and Hansen, 2008), where the following formula was used: Cetane number = 61.1 + (0.088* Myristic acid) + (0.133* Palmitic acid) + (0.152* Stearic acid) – (0.101*Palmitoleic) – (0.039*Oleic acid) – (0.243*Linoleic acid) – (0.395*Linolenic acid).

Statistical analysis

In the current study all data were analyzed by SPSS program of statistical, where ANOVA at significant level $p \leq 0.05$ was used.

RESULTS

Oils and Biodiesel production

The results of extracting and estimating process were showed that the percentage of oils was reached to 28%. On the other hand, determination of fatty acids methyl esters types were appeared significant fatty acids for biodiesel composition which represented by (Myristic acid :Tetradecanoic acid), (Palmitic acid: Hexadecanoic acid), (Stearic acid: Octadecanoic acid), (Palmitoleic acid : Hexadecenoic acid), (Oleic acid: Octadecenoic acid), (Linoleic acid: Octadecadienoic acid) and (Linolenic acid: Octadecatrienoic acid) . Fatty acids methyl esters product were revealed a significant differences at the level of significance 0.05, where the highest percentage was 53.95% for Octadecenoic acid methyl ester , followed by Hexadecenoic acid methyl ester and Tetradecanoic acid methyl ester with 16.99% and 7%, respectively (figure 1) .

Moreover, the present study was showed that Retention Time (RT) for fatty acids by-product were ranged between 21.86 to 29.17 min, whereas, the lowest Retention Time was found for Palmitoleic acid by 21.8 min then Palmitic acid was go after with 22.07 min , while the highest Retention Time was appeared in Oleic acid by 29.172 min (figure 2) .

Furthermore, the result of cetane number was showed that the number of fatty acids methyl esters product from unconsumed parts of Silurus glanis (59.8) was approximated with the Iraqi specifications and accepted according to European standards for diesel (figure 3).

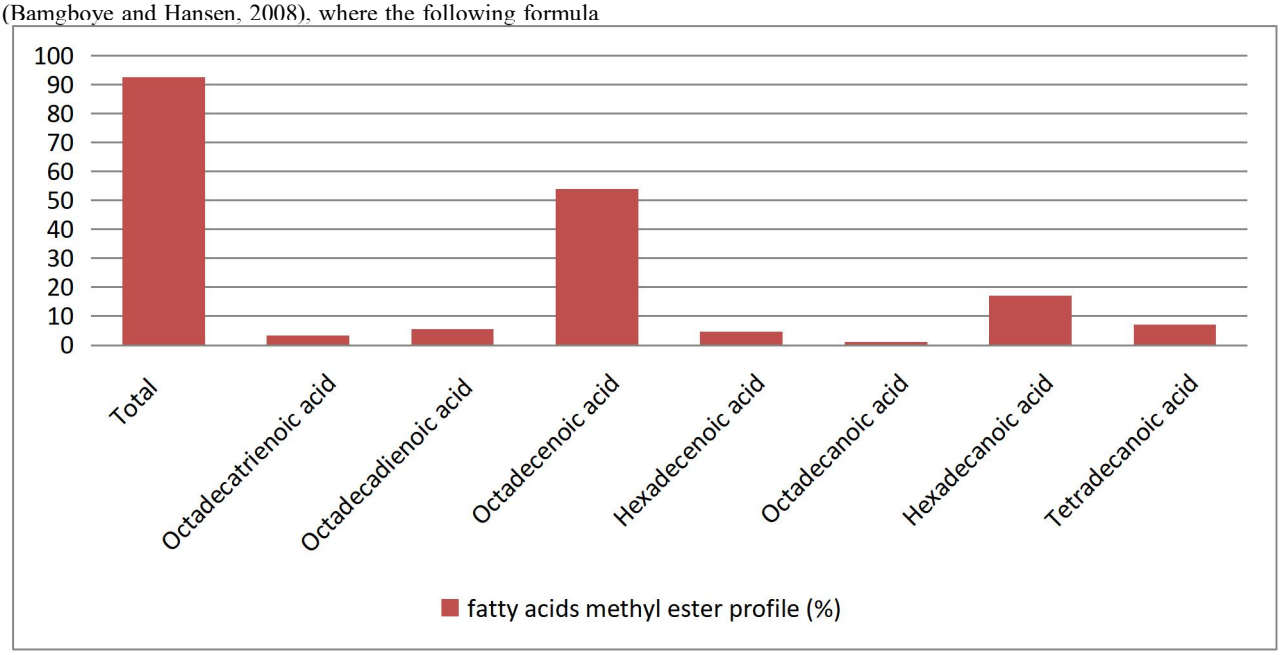

Figure (1): Fatty acids methyl esters product from Silurus glanis

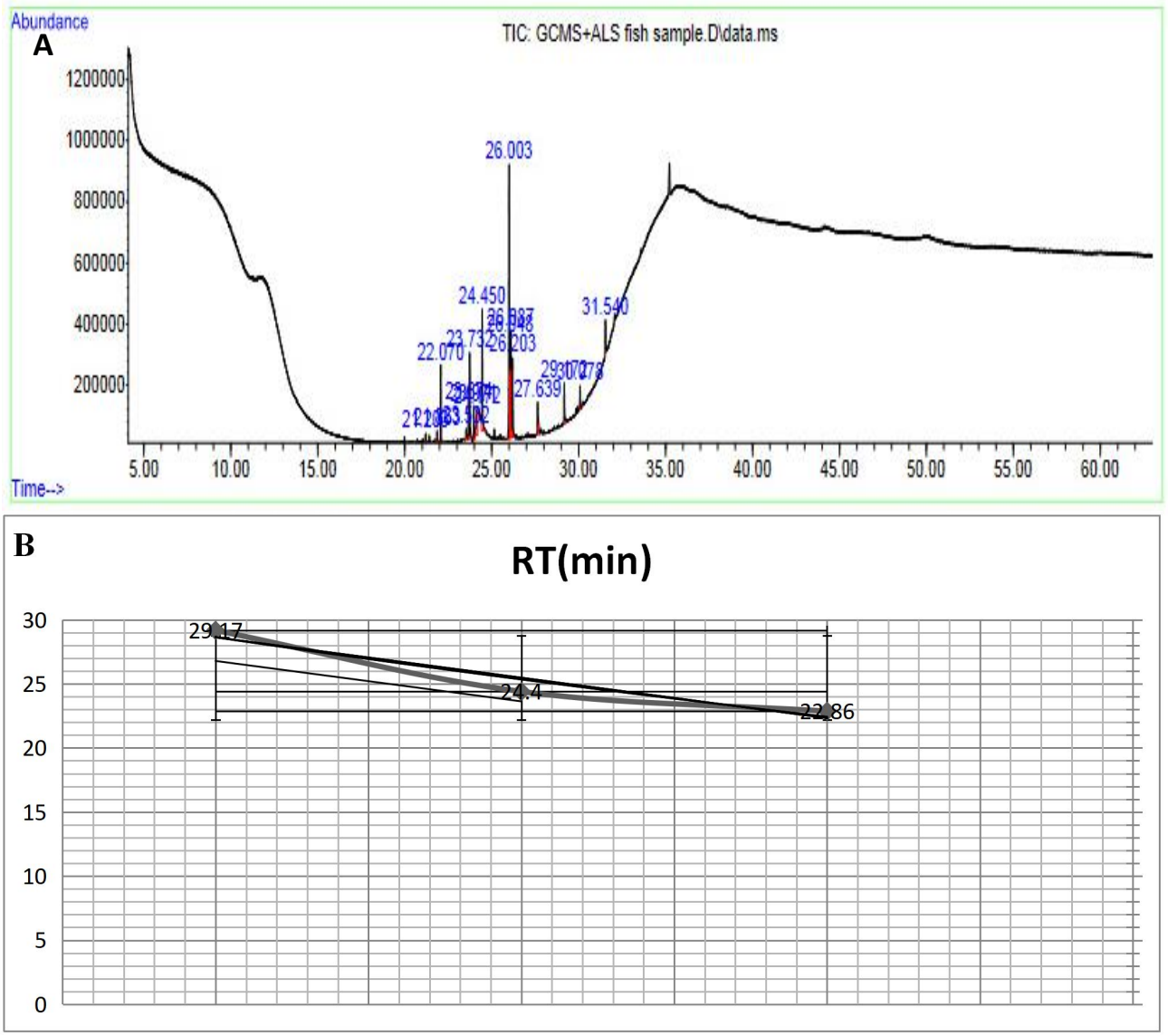

Figure (2): Retention Time (RT) for all compounds from extracted oils (A), RT area for the important fatty acids methyl esters yields for catfish (B).

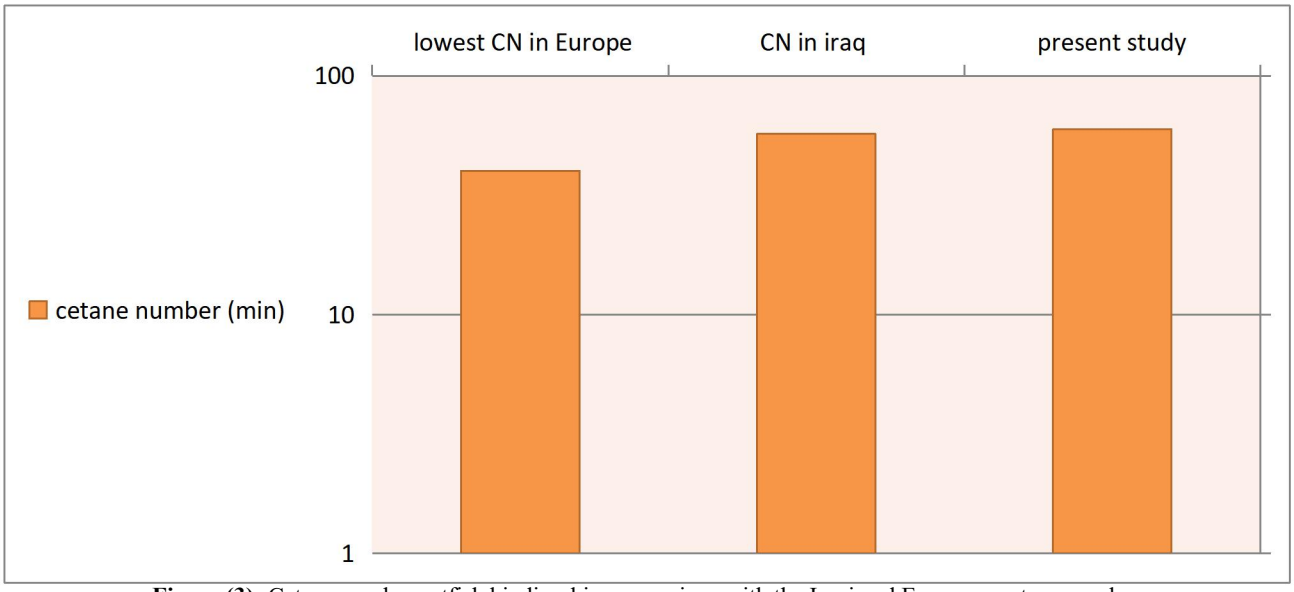

Figure (3): Cetane number catfish biodiesel in comparison with the Iraqi and European cetane number.

DISCUSSION

Lipid is a significant crude material for the creation of distinctive fundamental compounds associated with food and non- food commercial implementations. Among food utilization, stockpiling lipid has been believed since numerous years as origin of substantial fatty acids especially polyunsaturated fatty acids (PUFAs) and other nutraceuticals as dietary enhancements for fishes, poultry birds ,household animals and human. While, among non- food industrial purposes, biodiesel yield from raw materials, explicitly from plant seed oil, has enormously expanded in the last years. Nevertheless, for adequate manufacturing of oilseed crops, plants are required rich soil and various fundamental agro-inputs. Furthermore, worries about the expansion food cost combined with the worldwide food security and the ambitious isolation of cultivation wealth between food production and energy field have taken community understanding. Consequently, enlargement of insufficient prospective and cost-efficient replacement to the classic agriculture and agroforestry crops is of critical requirement for biofuel creation in the current situation of heightening around the world request (dey et.al, 2014).

The present study was focused of biodiesel production from unconsumed parts of catfishes as alternative source of renewable and clean energy without any competition with the nutritional requirements of community.

The production of important fatty acids methyl esters from catfish biodiesel was showed varieties of saturated and unsaturated fats which contain carbon atoms between 14-18 atoms, where these esters formed a high percentage reached to 92.53% from the total fatty acids methyl esters yield. The results of the current study agree with Abu al Naga (2011) , Li et al (2011) and Yahyaee et al (2013), however, fatty acids (esters) represented an important factor that determine the quality of the fuel product . As well as, the results were revealed the similarity of fatty acids that yielding from catfish remaining segments with those extracted from plants that were used in the production of biodiesel, on the other hand, the constitution of fatty acids which included: Myristic acid , Palmitic acid , Stearic acid , Palmitoleic acid , Oleic acid , Linoleic acid , and Linolenic acid.

One of the most important advantage of biodiesel quality illustrated with reduction of sulfur and carbon residual after burning biodiesel, this characteristic which decrease pollution very significantly (Kadhim ,2019) , and this was consistent with the results of the fatty acids methyl esters that produced in the current study . Moreover, the results were showed a good cetane number that was conformity with the measurements of Iraqi and international specifications for fuel quality (DMSIOP,2000 and Teama, 2008), where cetane number considered from the properties used to evaluate the quality of biodiesels (Tong et al,2011 ; Bamgboye and Hansen, 2008 and Bemani et al, 2020) . A higher cetane number value reduces the brake fuel consumption and raise brake thermal efficiency (Ahmed and Chaichan, 2012) and this was consistent with the current study, where based on the resulted fatty acids, the number of cetane was reached 59.8min.

CONCLUSION

The study showed that the oils were accumulated in the remaining parts of Silurus glanis fish by 28% (weight to weight), moreover the study revealed that the important fatty acids for the production of biodiesel formed 92.53%, which were represented by saturated and unsaturated fatty acids. On the other hand, the resulting fatty acids methyl esters formed a good cetane number, conforming to the Iraqi and European specifications for the quality of the fuel.

ACKNOWLEDGMENT

The authors thank the staff of the laboratories of the Iraqi Ministry of Oil, Basra Oil Company Research and Quality Control Center-Narran Omar for assistance to carry out this work.

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