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Comparison of Bioethanol and Biodiesel Feedstock with Futuristic-Look at Biofuel

Hamidreza Jaliliannosrati[1+], AminTalebian Kiakalaieh[2] and Alireza Zarei[3]

University Technology Malaysia (UTM), Chemical Reaction Engineering Group (CREG).

Abstract. Biofuels have been considerably developed as a probable alternative resource of fossil fuel. In recent times, the continuously increasingdemand and prices of fossil fuel as well asclimate change, makes biodiesel and bioethanol as the only key target for future energy market especially in transportation sector.A large amount of biodiesel and bioethanol productions cost belongs to feedstock that makes it to be as an essential issue for the future of biofuel. The significance of feedstock will be increased while it derives from food feedstock.The purpose of this paper is to describe various type of biodiesel and bioethanol feedstock. Apart from that, this paper will also attempt to compare the biodiesel and bioethanol respect to feedstock.

Keywords: Biofuel, Biodiesel, Bioethanol, Feedstock, Energy Balance

1. Introduction

Today, global transport section fuel supply is base on liquid fuel. Generally,two basically altered typesof liquid fuel exist: fuel made from fossil resources and biofuel made from renewable resources. Biofuels derived from biomass conversion, as well as liquid fuels, solid biomass and various biogases[1].With the latest record of oil prices, the need for increased energy security, concern over global changing due to gases emission from fossil fuel, the future of biofuel is of keen interest worldwide. However, global biofuel production has still less than 3% of global transportation fuel supply in 2010. Nevertheless, the worldwide supply of biofuel used for transport section is expected to gain5% in 2030, according to the IEA [2].The outlook of biofuel depends on several numbers of interrelated factors such as low cost feedstock, future oil price, government support, improving the technology.The usualform of biofuel is biodiesel, bioethanol and biogas. Biodiesel and bioethanol are known as the best environmentally substitution fordieseland petrol fuel. The leading feedstock for producing biodiesel and bioethanol are sugar, corn and vegetable oil[3]. Concentrated effort are being undertaken to ensurelow-cost feedstock is one of the main factors of sustainable development for the future of bioethanol and biodiesel. This paper presents a future direction and concise review in biodiesel and bioethanol feedstock.

2. Review of Literature

As mentioned earlier, Potential of biomass discuss the continuously re-growing and available biomass as the feedstock resources. The potential of biomass depends on land availability, climate and productivity of allocated energy crops

Bioethanol is an alcohol that drives from cereal-based crop. The alcohol mostly made by fermentation from the existing carbohydrate in starch or sugar crops. In addition, cellulosic biomass is being developed as a supply for ethanol production [4]. Biodiesel drives from vegetable oil and animal fat by using

[+] Correspondingauthor. Tel.: + 60108805626
E-mail address:hrjns727@gmail.com

transesterification. Bioethanol has the similar composition as gasoline (Petrol) but biodiesel has similar composition as fossil diesel. In pure form, biodiesel and bioethanol can be used as fuel for vehicle with modified engine. Though, biodiesel is usually used as a fossil diesel additive but bioethanol as gasoline additive [5].

First generation feedstock are defined as the feedstock that just part of the plant such as oil, starch and sugar are used for biofuel production. In contrast, the second-generation feedstock almost whole plant (lignocellulose) is used for biofuel production such as grains and stalks. In general, both biodiesel and bioethanol are known as first generation feedstock. The first generation of biofuel can be produced in decentralized installation but second generation is more competitively in wide range of installation such as cellulosic bioethanol that requires very large investments in commercialization stage. As a result, the first generation of biofuel is accessible in today's technology [6].

To show the importance of feedstock of biodiesel and bioethanol several surveys have been done in some area such as economic, first-second generation biofuel and food vs. fuel [7][8][9].Some supplies such as maize (corn) sugar cane or vegetable oil can be utilized as feed, food or to make biofuels. Enormous growth in biofuel production is the major reason behind the sharp rise in global food prices in the United State and Europe [10]. In addition, the price of vegetable oil that is used to make biodiesel has increased recently. The price is approximately following crude oil prices[11]. In the production of second-generation biofuels from non-food crops, crop residues and waste much research and development are lately being made [12].

3. Bioethanol Feedstock

Bioethanol can be produced from sugar (sugar beet, sugar cane, sweet sorghum), starch (corn, barley, ray, wheat, potatoes, cassava) and cellulose (willows, poplar, straw, corn stover, switchgrass, bagasse). Hence, the large scale of bioethanol production needs substantial amount of cultivable land.Furthermore, some of the most important feedstock factors that should be considered for bioethanol follow: growing condition (dry, wet, hot and cold weather), food for human race, short growing season (can be harvests 1-3 times per year) and percentage of sugar contain.

Sugar easily ferments to ethanol but starch must be converted to sugar (saccharification) then to ethanol. This process includes long chains glucose molecules of starch that have to be broken into simple glucose molecules. So, starchy materials need a reaction of starch with water (hydrolysis). The most popular bioethanol feedstock is sugar cane (Brazil), sugar beet (Europe), grain and maize (UAS and Europe) [13]. USA and Brazil are the top producers for 90% of bioethanol production in the worldwide [14].Brazil has been known to have the world first sustainable biofuel economy and its government states that Brazil's sugar cane grounded ethanol industry has not contributed to the 2008 food crisis [15].

Cellulosic bioethanol is made from structural material, lignocellulose, which constitutes much of the mass of plants. Moreover, Cellulosicbioethanol production is expected to become increasingly significant in developed countries from 2017 but it is not yet applicable for bioethanol production in large scale [16]. Recently, cellulose bioethanol price is estimated more than $2.5 per gallon in comparison with $1.65 per gallon forcornbioethanol [17]. However, the unique feature of cellulosic bioethanol than other bioethanol and biodiesel products is belonging to second-generation biofuel.

It is obvious from the figure 1 both coarse grains and sugar beet are still the most significant bioethanol feedstock. It is also predicted that coarse grains and sugar beet will be kept as a top bioethanol feedstock. On the hand, researchers put more effort into produce bioethanol from biomass feedstock.

4. Biodiesel Feedstock

The lipid resources of biodiesel can be sub-divided into seeds (sunflowers, jatropha seed, soybean, rapeseed, peanut), algae (microalgae), palm fruit (oil palm fruit, coconut) and waste oil (waste cookingoil (WCO) and animal oil).The choice of biodiesel feedstock is pre-determined by climate, agricultural, geographical. Moreover,fatty acid and the oil saturation content are varying in different feedstock that can be considerably affected on biodiesel process and characteristic of production. Biodiesel production from highly

saturated oil feedstock is more suitable for warmer climate [13].Almost 85% of biodiesel production made from rapeseed, followed by soybean oil, sunflower seed oil and palm oil [18]. Rapeseed and sunflower seed are the major feedstock of biodiesel in Europe, such as soybean in US & Brazil, palm oil in Malaysia & Indonesia and jatropha in India [13]. Palm fruit feedstock is characterized by high amount of fatty acid that has been grown in warm climate such as Malaysia that has the highest productivity.The fatty acid of different oilseed feedstock is varyingsignificantly.In addition, oilseed needs fewer processes that can be more favorable due to energybalance.

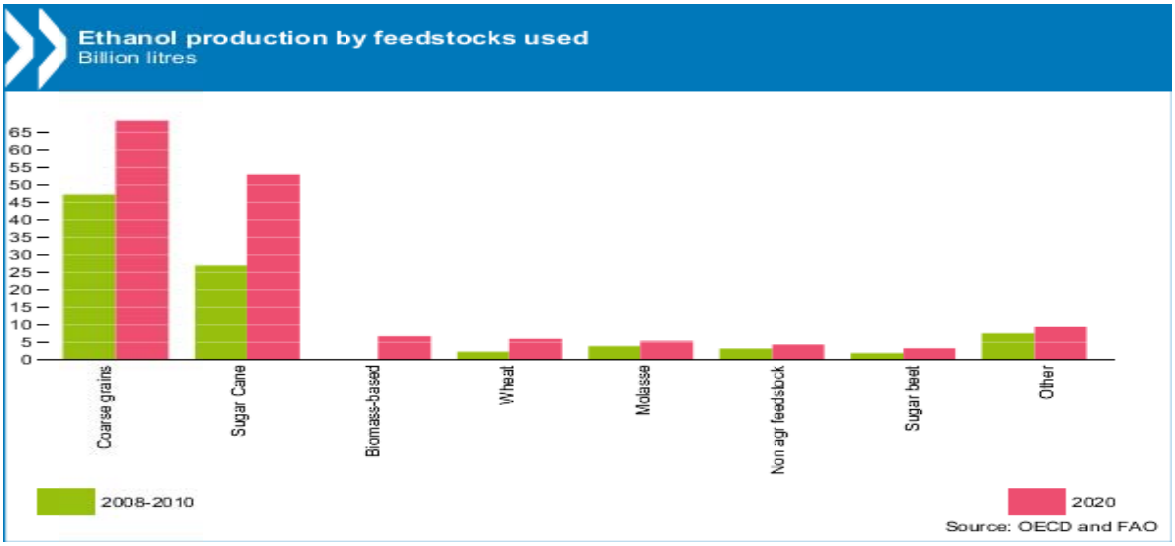

Fig. 1: Bioethanolproduction by feedstock used

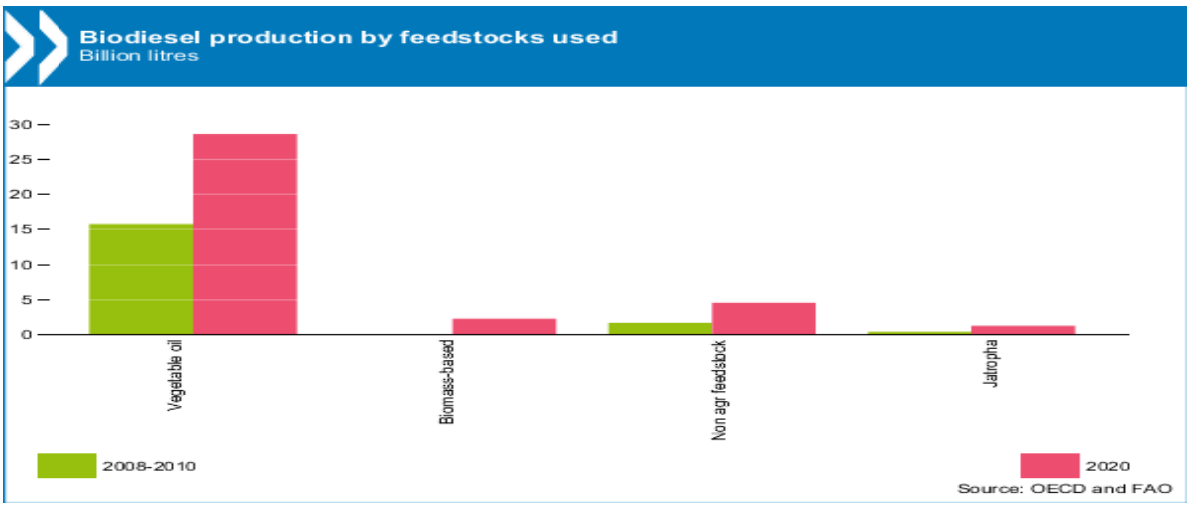

Fig. 2: Biodiesel production by feedstock used

Algae-based fuel is another feedstock that can be worked just as well as fossil fuel. In fact, more than 50% algae body weight is oil and fat, which can be used to produce biodiesel. Algae, on the other hand, has the highest yield feedstock for biodiesel, producing approximately 24 times oil per acre more than the next leading feedstock, palm oil with 635 gallon/acre/year as shown in the figure 3 [19].In addition,the rapid growth of algae,no need fresh water,no need quality cultivate land,and harvest 1-10 times a day, naturally take CO2 and release O2 are the other benefit of algae.To extend the utilization of algae as one of the biodiesel feedstock is still in progress to achieve commercial goals.

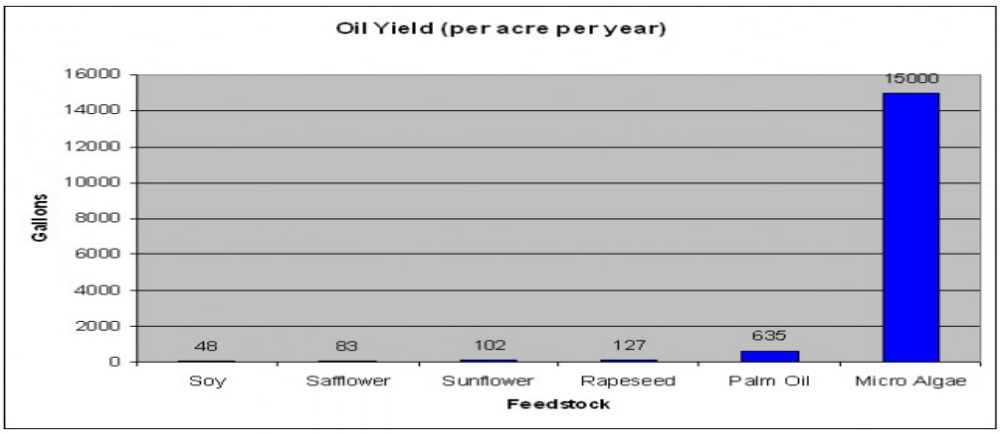

Fig. 3: Oil yield of biodiesel feedstock

5. Energy Balance

Energy balance is defined as the ratio of energy inputting for processing biofuel during its life cycle to the energy content of final biofuel. Actually in this equation just energy of fossil fuel is used as the inputting energy. Indeed, the energy balance of biofuel can bedepended on agricultural practices, feedstock type, process technology, regional feedstock productivity and final driving efficiency. The better energy balance indicates the higher value of biofuel. Most researches show that the net energy balance of biofuel production is affirmative, but estimates differbroadly [20].Apart from, biodiesel has 90% energy content of diesel but bioethanol has only two-thirds that of gasoline [17]. The table below shows the energy balance for biodiesel and bioethanol from altered feedstock [20].

Table 1: Estimates fossil energy balance

Fuel type (Ethanolfeedstock)	Estimate of Fossil Energy Balance	Fuel type (Biodieselfeedstock)	Estimate of Fossil Energy Balance
Cellulose	2-36	Palm oil	~ 9
Sugar cane	~ 8	WCO	5-6
Wheat	~ 2	Soybeans	~ 3
Sugar beets	~ 2	Sun flower	~ 3
Corn	~ 1.5	Rapeseed	1.9- 2.9
Sweet sorghum	~ 1	Castor	~ 2.5
Crude oil	~ 0.8	Crude oil	0.8-0.9

6. Conclusion

The government support, global trading and technological advances could continuously reduce the economic cost of final biofuel production and make it more competitive to fossil fuel. Rising oil prices steadily in 6 years have provided economic support for biodiesel and bioethanol. In contrast, increasing feedstock prices has been negatively affected on biodiesel and bioethanol production. A large amount of bioethanol and biodiesel cost of production pertains to feedstock. Most of the bioethanol and biodiesel feedstock productions belong to food feedstock that can diminish food supply.So, it can be raised the global debate in foodneeds vs. fuel needs.Regarding above, biodiesel was chosen in preference to bioethanol due to non-food feedstock productions such as jatropha and algae.

Large-scale farming for bioethanol and biodiesel feedstock need large amounts of cultivated land. In this aspect,there is no need for all biodiesel feedstock to deforest in order to free up land for feedstock supplies in comparison with bioethanol.It seems that the paper would have been more informative and generalizable if done other aspects of bioethanol and biodiesel such as the technology application, environmental impact, and standardization.From the point of authors view, it is essential to avoid conflict between advocates of

biodiesel and bioethanol. With the review, it is hope that researchers concentrate on producing non-food feed stock and second-generation biofuel.

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