A Brief Study on Different Biofuels

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Abstract:

The human inhabitant's explosion is the primary driver of today's mass extinction. The need of people in various aspects is so increasing for their survival. The use of fossil fuel is one of such needs to us. Though it is known burning of fossil fuels generally changes the global climate. Acceleration of global warming is now a day's an important aspect for discussion. It is proved scientifically that the emission of greenhouse gas from burning of fossil fuel is one of the main sources. So to supply the significant energy and to reduce air pollution, biofuels may be an alternative energy sources. The excessive use of fossil fuels results the lack of storage in underground earth then people naturally have to depend on biofuels. But the problem also arises there. At the same time increasing demand of the production of biofuels will put a huge burden on agriculture and food prices. Biofuels, generally attributed as liquid fuels are obtained from biomass. It comprises mainly wood, forestry products, agricultural crops and products, residues of animal wastes and aquatic plants. This can be made from vegetable oils also. Existing raw materials like agricultural residues or municipal garbage are the main sources for the production of biofuels. In this paper we travel around the different types of biofuels including biodiesel and their comparative study and also the production and use from an ecological perspective.

Key Words: *Biofuels; vegetable oil; biodiesel; Natural Gas; Biomass.*

Introduction:

Biofuels are derived from biological material, mainly from plants, microorganisms, animals and wastes [1]. Biomass is organic components are the source of alternative energy and all types of biofuels like solid, gaseous and liquid fuels that can be obtained from this biomass[2-4]. Solid biofuels are mainly wood, charcoal and fibrous matters. Fossil fuels such as wood and charcoal are extensively used as a primary fuel domiciliary purpose that is cooking. From sugar cane processing fibrous material is obtained and it is widely used for electrical power formation and preparation of steam [5]. Methane gas and producer gas are examples of gaseous biofuels and these are obtained subsequently from fermentation of animal wastes and from the pyrolysis [6] or gasification of wood and agricultural wastes. Liquid biofuels such as methanol, plant oils and the methyl esters are generally attributed as biodiesel [7]. Solid and liquid biofuels are used extensively as an energy inception because of their large prosperity, tremendous energy and low price. Coal and petroleum that is fossil fuel take million

of year to produce on the other hand biofuels are obtained very short time with appreciable yield. Although both are coming from bio materials [8].

Another important discussion comes how much we should use biofuels and fossil fuels because both are necessary in our daily life. The price of essential commodities including oil is soaring highly. In these circumstances biofuels can be most preferable alternative to fulfil the demand of human need using fuels in necessity. It takes the place of fossil fuels and the deteriorating fossil fuel then reserves. The result becomes as a way to mitigate the effects of climate change and to have a renewable, reliable source of energy. Biofuels are everlasting and renewable resource because they are continually replenished. Fossil fuels on the other hand are not perpetual and renewable, they drain out from our underground earth since they require millions of years to form [9]. So the burden comes to people to restore them for not having to face problematic situation due to lack of storage. It is blessing of science to have biofuel as an alternative. However, our viewpoint is to discuss the various types of biofuels and their comparative study for a better understanding to the general audiences to grow interest about this serious matter which may drive the future generation throughout the world.

Discussion:

Types of Biofuels

Primary biofuels are mainly fuel wood, wood chips and pellets, organic materials and are used generally for heating, cooking or electricity production in a crude appearance. Secondary biofuels which are obtained from cultured biomass and consist of liquid biofuels like ethanol and biodiesel that are extensively used in vehicles and industrial purpose.

There are mainly four types of biofuels. These are:

First generation biofuels:

First generation biofuels are biofuels which are on the market in substantial amounts today. The characteristic 1st-generation biofuels are sugarcane ethanol, starch-based or 'corn' ethanol, biodiesel and pure plant oil. The feedstock for producing 1st generation biofuels either consists of sugar, starch and oil bearing crops or animal fats that in most cases can also be used as food and feed or consists of food residues which were prepared from sugar, starch vegetable oil, or animal fats using usual technology like fermentation, distillation and trans esterification processes and these processes are well-settled scientifically though these processes have been used for hundreds of years in many uses, such as making alcohol.The most common and important first generation biofuels are given below [10].

1. Vegetable oil
2. Bio-alcohols (most commonly ethanol)
3. Bio-diesel

4. Bio-gas
5. Solid Bio-fuels

Like alcohol triglycerides of long chain fatty acids are attached to glycerol in vegetable oil [13]. Each triglyceride contains one glycerol and three long chain fatty acids. The method used to make biodiesel is called trans esterification [5,14] because it is a process of converting one type of ester into other.

***Advantages of vegetable oil**:*

- Biodiesel conversion from this biomass is very easy.
- It is widely accessible
- It can often be used directly in diesel engines with little modification

***Disadvantages of vegetable oil**:*

- It is a valuable feedstock.
- Use of unrefined oil can damage the engine through carbon deposition due to incomplete combustion.
- The replacement of old growth forest with oil palms increase carbon emission and consequently damages biodiversity.

Bio-alcohol i.e. ethanol is mainly obtained by fermentation of sugars and starches and butanol and propanol are formed as co-product. Ethanol is the most significant first generation biofuel which is well studied a renewable energy resource. Corn is the main source of the world's fuel ethanol and most of that corn comes from the United States [10]. The utilization of ethanol-blended fuels like E85 can reduce the net emissions of greenhouse gases by as much as 37.1%.

E10 (10% ethanol and 90% gasoline) ethanol-blended biofuels decreases greenhouse gases emission by up to 3.9%. The effects of ethanol come to results in an overall diminish in ozone formation, an important environmental alarm. It profits energy protection as it shifts the need for some foreign-produced oil to domestically-produced power sources. Ethanol burns more diffidently (more complete combustion). Ethanol reduces the quantity of high-octane additives. The fuel spills from ethanol are more simply biodegraded or diluted to non-toxic concentrations. Production of ethanol requires important energy and huge amounts of land. Fuels with more than 10% ethanol content are not well-matched with non E85-ready fuel scheme components and may cause corrosion of ferrous components. It can negatively affect electric fuel pumps by growing internal wear and undesirable spark generation. It is not compatible with capacitance fuel level gauging indicators. It may result in erroneous fuel quantity indications in vehicles that utilize the system.

Despite its comparatively high price as a food crop, soybean is still a most important feedstock for the manufacture of biofuel. In this case, rather than ethanol, soybean is used to produce biodiesel. Soybean is most likely the awful feedstock for biofuel production.

Biodiesel is very simple like the normal diesel fuel. Biodiesel is serene of mono alkyl esters of long chain fatty acids made from renewable lipid sources, such as vegetable oil or animal fats. It is comparatively less inflammable than the normal diesel. It is easy to use as a mixer with normal diesel fuel. Bio-diesel is biologically degradable and hence less hazardous for the environment. It does not contain sulphur which is mainly responsible for acid rain. Bio-diesel is suitable for catalytic convertor in many cases. The engines, in which bio-diesel is used as fuel, are generally long-lasting. Its refineries are relatively simpler and environmental-friendly. Biofuels are higher octane containing and lubricity scoring compounds than the uncontaminated petroleum-based diesel fuel. It can improve engine efficiency and operating life cycle of the machine.

Comparatively bio-diesel is more costly than the ordinary diesel fuel. It tends to trim down fuel economy. Bio-diesel is generally less appropriate for use in lower temperature. Bio-diesel cannot be transported through pipelines like normal diesel. It releases more nitrogen oxide during its combustion which may cause environmental pollution. There are only a few petrol stations which are offering biodiesel-fuel. It can merely be used in diesel-powered engines. Sometimes bio-diesel may be cause of flatten of internal fuel tubes of older vehicles to be defeated their lifelong qualities. It is more probable than the normal petroleum diesel to attract humidity.

Biogas is primarily used to produce electricity, and a very small number of projects produce bio-based compressed natural gas (CNG) to power natural gas vehicles. Methanogenesis is the process by which organic substrates are digested into methane in the absence of oxygen. Through a consortium of organisms, these organic substrates are hydrolyzed, fermented, and finally converted into biogas by methanogens. Biogas composition varies significantly depending on the substrate, but it is typically composed of 40%–65% methane, 30%–40% carbon dioxide (CO_2), and various impurities, including hydrogen sulfide (H_2S), ammonia, and siloxanes [15, 16]. Recent analyses have shown little to no H_2S (<5 ppm) present in biogas streams generated from agricultural residues (soybean residue, corn stover, miscanthus, and bagasse) [17]. Biogas produced from wastewater tends to have higher methane content (higher specific energy), while biogas produced in a landfill tends to have a higher percentage of CO2 (lower specific energy).

The term “solid biofuel” can be a speck deceptive because many people connect biofuels with superior calming and chemical processes. In fact, biofuels can be any renewable, biological material used as fuel. From the definition, it becomes clear that things like wood, sawdust, leaves, and even dried animal dung all constitute biofuels.

Advantage:

Generally, biofuels have some positive effects to be discussed like these are expected to have large financial crash especially for local performer. Biofuel production opens new market opportunities

and helps to expand agricultural products and thus new income showers on farmers enlarging the socio-economic condition. Consequently, in future agriculture will play a great role both in food production and also in energy provision. The increased feedstock production is expected to strongly contribute to the multi-functionality of the agricultural sector. Nevertheless, it is difficult to assess the real dimension of additional employment in production centre relating biomass and impact on local economy in the biomass sector. It is significant for ethanol dispensation than for manufacture of pure plant oil and biodiesel. This benefit for lipid derived fuels is particularly vital for small scale agricultural producer and SME's (small and medium-sized enterprises) [18].

Another advantage comes in the fermentation of sugar and starch-bearing plants, co-products as necessary supplement are produced in large quantities. Necessary supplements such as fodder, fertilizer, heat fuel, industrial raw material or as substrate for biogas plants can be used. An excellent example how co-products from ethanol production can be used is the bagasse, the fibrous residuals of sugar cane after pressing. In Brazil, bagasse is burned and the heat is used for the distillation process and for electricity generation. It's a good exemplification of biofuels advantage. Similarly, biodiesel and PPO known as lipid derived fuels are received in a lagged number. For instance, press cake from rapeseed oil extraction is a high value and protein enriched fodder. In biodiesel production glycerine is a valuable, usable co-product for industrial purposes [8].

Limitations:

The main source of first generation biofuels is the feedstock. The major component of feedstock is food crops such as corn and sugar beet. They create a hazard to food prices since the biomass are used for biofuels preparation. Prices for food and animal feeds which are the first generation biofuels have been increased due to several factors [19-22].

- More use of biofuels places a depressing contact on biodiversity and competition for water in some regions.
- Biomass for first generation biofuels requires lots of land to cultivate, and this provides only limited greenhouse gases fall.
- They also provide a small profit over fossil fuels in regards to greenhouse gases since they still require high amounts of energy to develop, accumulate, and procedure. Current production practice use fossil fuels for power.
- First generation biofuels are also a more costly alternative than gasoline, making it reasonably poor.
- Finally, biodiesel almost always comes from used oils from restaurant, as different to virgin oils, so the supply is limited by restaurants' oil utilize.

Second generation bio-fuels:

Second generation biofuels are the more developed industrial edition than that of first generation types, we can say that they're characteristically not imitative from food crops but this fuels are also produced from sustainable feedstock like first-generation fuels. Basically, these types of feedstocks are not generally used for human utilization. That is, second-generation feedstock does not come to use of human beings. Though it is a food crop but they are no longer useful for consumption. Second-generation biofuels are known as "advanced biofuels." because extraction of fuels from this source is very difficult. non-food feedstocks sources of biomass for 2nd generation biofuels include wood, agricultural residues, organic waste, food waste and specific biomass crops together with cellulosic, hemicelluloses or lignin [1]. This biofuels can either be blended with petroleum-based fuels combusted in existing internal combustion engines, and spread through existing infrastructure or is dedicated for the use in slightly adapted vehicles with internal combustion engines (e.g. vehicles for DME)[23]. This species holds plants together to formulate fuel. BTL-diesel (Biomass-to-liquids) and lignocelluloses ethanol [24] are the main sources in second-generation biofuel. Well known second generation Fischer-Tropsch fuels [25] are obtained by a group of chemical reactions that convert a mixture of carbon monoxide and hydrogen into liquid hydrocarbons. It was first envisaged by Franz Fischer and Hans Tropsch. Lignocellulos's process refers to plant waterless material that is forest material (biomass) [26A ,26B]. It is obtainable in large quantities raw material on the Earth for the production of biofuels, mainly bio-ethanol. It is composed of carbohydrate polymers (cellulose, hemicelluloses), and an aromatic polymer (lignin)[27]. Poplar trees are required to undergo a pre-treatment process, and a series of chemical reactions that crash lignin. Lignin is the ingredient of the cell walls of all dry earth plant. It is the second rich natural polymer in the world, surpass only by cellulose [28]. Lignin is the only polymer that is not collected of carbohydrate (sugar) monomers. Lignin is an aromatic functionality and unique in that sense it is the only large-scale biomass source for 2nd generation. It is collected of up to three different phenyl propane monomers depending on the species. Thermochemical or biochemical reactions which are the initial steps that unlock the sugars surrounded in fibres of the plant [29]. After the completion of the reaction, plant ethanol is obtained which is resembles that of 1st generation ethanol manufacture.

Furthermore, another second-generation biofuel is bio-SNG, a synthetic gas similar to natural gas [30]. Straw and other plant residue produces synthetic gas involving a several thermochemical stage. Synthetic gas is a mixture of carbon monoxide, hydrogen and other hydrocarbons [31]. Hydrogen is used as a fuel and the other hydrocarbons are used as for the production of gas oil. The Scheme 2 shows how 2nd generation biofuels are obtained.

Main types of second-generation biofuels:

a) Waste vegetable oil: Waste vegetable oil has no food value and it may help to reduce the environmental pollution. Some diesel engines are designed in such a way that the obtained biofuels from this biomass is used directly without blending or refining [32].

Advantages:

a) It doesn't release sulphur in the environment.

b) Since it is a used product and it doesn't perturb the arable crops.

c) Besides, it costs nothing in use of land.

Disadvantages:

a) This biomass can damage to diesel engines if it is not accurately purified before use.

b) It is difficult to collect because it is located in many points.

b) Grasses: Grass cultivation mainly depends on location. For example, Southeast Asia uses Myscanthus, whereas United States uses Switch grass.

Advantages:

a) This grass needs to be planted only once, because it is permanent.

b) This biomass grows on marginal land very quickly and yields of crops are obtained in a number of times a year [33].

c) Less fertilizer is required for cultivation.

d) This grass is used instantly without further processing as biomass.

Disadvantages:

a) The use of direct biomass sometimes comes good and then grasses turning into biodiesel are not favourable.

b) The process to turn grasses into alcohol is also complicated than others.

c) While they're easy to plant, their seedlings should be constantly secured from the much stronger species of weeds naturally grown around them.

d) Substantial humidity levels largely suit in their growing and they can't grow on arid soils.

e) None can make Crops to be dense enough within the first few year [34].

c) Seed crops: This biomass can be cultivated on the marginal land in a considerable amount but energy value of biofuels is very much less than the biofuels from soybeans biomass. Another difficulties has been achieved in growing such crops on farmland and that's' why its popularity has been reduced in a substantial amount.

d) Municipal waste: Now days this type of biomass is used for production of biofuels. It comprises all kinds of solid waste matter comes from human waste, grass, leaf clippings, landfill gas, etc.

The following fuels are obtained from the second-generation biofuels:

1. **Cellulosic Ethanol**: It is obtained via fermentation of sugars derived from the cellulose and hemicelluloses fractions of lignocellulosic biomass.
2. **Biobutanol**: It is prepared in a process like to ethanol but with different microorganisms. Presently the fuel yield is lower than that of ethanol, but biobutanol can be used as a call on replacement for gasoline without blending
3. **Biomass to Liquids (BtL) technology**: It is started to prepare with a synthesis gas (syngas) followed by Fischer-Tropsch process to gasoline, diesel, and jet fuel.
4. **Alcohol**: Methanol, Dimethyl Ether (DME) and mixed alcohols can also be prepared from syngas via catalytic synthesis. Alcohols are also obtained by fermentation of syngas by some specialized microorganisms [35].
5. **Biosynthetic Natural Gas (BioSNG)**: Any way renewable natural gas can also be obtained via gasification and then followed by catalytic methanation and purification. Biogas can be made by an anaerobic digestion with microorganisms. This gas is composed of mainly methane and carbon dioxide. It can then be used as compressed natural gas (CNG) or liquefied natural gas (LNG) in vehicles or injected into the existing natural gas cylinder [36].
6. **Hydrotreated Vegetable Oil**: It is a used as a diesel substitute that has very popular fuel properties like high cetane, non-aromatic and does not contain sulfur [37].
7. **Pyrolysis Oils (known as biocrude):** This is obtained by ash pyrolysis (rapid heating to about 1,000°F followed by rapid cooling). Refining and upgrading generate liquid fuels for transportation or stationary applications (boilers, turbines) [38].

Advantages:

The profit of second-generation biofuels is various and 2nd generation biofuels are to be better to 1st generation biofuels due to following reasons [39].

- They use a non-food feedstock (like lignocellulosic biomass materiel, such as earth crops residues, forest products residues, or fast-growing devoted energy crops). So, the second generation biofuels are different from first generation biofuels because they don't come directly from food crops like corn and soybean.
- The fuel is a call on replacement for conventional petroleum-based fuels, meaning there are no limits on blending, or they can be used as is (without blending) in existing vehicles.
- Second generation biofuels are more environmentally friendly and produces less greenhouse gases.

- They do not produce co-products like animal feeds.
- Less requirements of land are applicable here so the competition for land with other agriculture fields come to lessen, food fiber and water are also less required.

Disadvantages:

- Second generation fuels are not yet produced on commercial scale. Due to high production costs and this process is not proven technically.
- Current harvesting, storage and transport systems are in adequate for processing and distribution biomass in large scales.
- A requirement of clear and long-term policy frame work is to ensure that industry and financers can endow with assurance.
- Agricultural/forestry sector alters need to supply biomass feed stock from residues and crops imply a significant transfer in the current business model and as well as trade of feedstock and biofuel.
- The most favourable approaches and locations for 2nd generation facilities should be recognized that maximum GHG reductions while minimising cost and impacts on the environment and other agricultural markets. So the use of these fuels associated with less concern leading to food crisis in developing countries, or harmfully affecting consumer prices in developed nations.

Comparison between 1st and 2nd generation biofuels:

1st and 2nd generation biofuels may be submerged then second generation biofuels address many issues linked with 1st generation biofuels. They don't race between fuels and food crops since they come from distinct biomass. Second generation biofuels also generate higher energy yields per acre than 1st generation fuels. They allow for use of inferior quality land where food crops may not get proper support to grow. The technology is fairly immature, so it still has prospective of cost reductions and increased production efficiency as scientific advances take place surprisingly. However, some biomasses for second-generation biofuels still compete with land use since some of the biomass grows in the same climate as food crops. This leaves farmers and policy makers with the hard decision of which crop to grow. Cellulosic sources that grow alongside food crops could be used for biomass, such as corn stover (leaves, stalk, and stem of corn). However, this would deduct too many nutrients from the soil and would need to be replenished through fertilizer. In addition, the process to produce 2nd generation fuels is more elaborate than 1st generation biofuels because it requires retreating the biomass to release the trapped sugars. This requires more energy and materials.

The great advantage of these fuels is the vast range of feedstock that can be used for biofuel production, as well as the compact feedstock (e.g cellulose crops) costs. By using a holistic

approach, biofuels offer large economic advantages over fossil fuels, but direct cost comparisons are difficult. Negative externalities associated with fossil fuels tend to be feebly quantified, such as military expenditures and costs for health and environment. However, biofuels have the potential to generate many positive externalities, such as reduced greenhouse gas emissions, decreased air pollution, and job creation. At the same time biofuels decrease dependency from crude oil imports. As a result biofuels are more socially and environmentally desirable, usable liquid fuel, a fact that is often ignored in direct-cost calculations. Therefore, biofuels often seem uncompetitive although a biofuel market may actually provide long-term economic benefits when comparing environmental and social costs [40].

Third generation biofuels:

Algae fuel [11,12] or algae is the main source of third generation biofuels. It produces more than 30 times energy per acre than the land crops such as soybeans. Normally, algae are a various group of prokaryotic and eukaryotic organisms [41]. Algae can be classified either autotrophic or heterotrophic. For the growth of autotrophic algae, the following inorganic compounds such as CO_2, salts, and a light energy source are necessary. While the heterotrophs are non-photosynthetic that requires an external source of organic compounds such as nutrients as energy source [42]. Microalgae are very little in size and typically measured in a scale of micrometers. This species is generally grown at faster rate in water bodies or ponds and contains more lipids than macroalgae [43]. In case of algae the main advantage is the short harvesting cycle whereas for usual crops having harvesting cycle of once or twice in a year. Therefore, the foremost attention has been carried out on algal biomass for its relevance in biofuel area. The algae may be changed into different types of renewable biofuels and this can be categorized into three different ways [44]. However, biodiesel is obtained from diverse renewable lipid feedstocks and biomass. Monoalkyl esters of long chain fatty acids [fatty acid methyl esters (FAME)], i.e biodiesel may be used directly in various diesel engines [45].

The list of fuels that can be derived from algae includes:

- Biodiesel
- Butanol
- Gasoline
- Methane
- Ethanol
- Vegetable Oil
- Jet Fuel

Algae can be cultivated in a various method and it can be developed in any of the following ways.

a) Open ponds – This is the simple way in which algae is developed in the open-air ponds. Algae can be harvested simply and have low assets costs, but are less proficient than other systems. Other organisms can contaminate the pond so they are much concern even if from potentially damage having a fear to kill the algae

b) Closed-loop systems – This system is similar to open ponds, but it is not uncovered to the atmosphere and uses a sterile supply of carbon dioxide. It has large potential because it may be directly linked to carbon dioxide released into the atmosphere in every use.

c) Photo bioreactors – These are the most advanced and thus most difficult systems to implement, that comes with result in high capital costs. Their advantages in terms of yield and control, however, are unequaled. They are clogged systems [46].

Advantages:

(a) It has the capability to grow throughout the year; therefore, algal oil productivity is higher in touch relationship to the usual oil seed crops;

(b) There is a higher acceptance to high carbon dioxide content;

(c) The consumption rate of water is very a lesser amount of in algae cultivation;

(d) Necessity of herbicides or pesticides in algal farming is not needed;

(e) The expansion potential of algal species is very high in comparison to others;

(f) Different sources of wastewater containing nutrients like nitrogen and phosphorus can be utilized time to time for algal cultivation apart from providing any additional nutrient;

(g) It has the capability to grow under insensitive conditions like saline, brackish water, coastal seawater, which does not affect any conventional agriculture in producing [47].

h) They are biodegradable, so very naturally and comparatively safe to the environment if spill is one benefit of many biofuels over most of the other fuel types. Third generation biofuels are also called superior biofuels.

i) In algal biofuels like low land requirement for biomass production and high oil content with high productivity has been considered as the best resource, which can substitute the liquid petroleum fuel.

j) The high yield per acre (up to 10 times higher than with other biofuels), and the fact that algae do not compete for land or potable water with agriculture or forestry, as non-arable lands and non-potable water can be used are regarded as the two key advantages of algal biofuels.

k) One of the major benefits of algae is that they can use a diverse array of carbon sources. Most notably, algae might be tied straight to carbon emitting sources (power plants, industry, etc.) where they could directly switch emissions into usable fuel has been suggested. This means that no carbon

dioxide would be released from these settings and thus total emissions would be cut down considerably.

Disadvantages:

a) The higher agriculture development cost as compared to traditional crops.

b) High energy input is required for harvesting of algae and it is approximately about 20–30% of the whole cost of manufacture.

c) Several techniques such as centrifugation, flocculation, floatation, sedimentation, and filtration are generally used for harvesting and concentrating the algal biomass [48].

d) Although algae's are grown in waste water, need large amounts of water, nitrogen and phosphorus to cultivate.

Comparison between 2nd and 3rd generation biofuels:

Third generation biofuels are comparatively more energy intense than 1st and 2nd generation biofuels per area of harvest. They are cultured as low-cost, high-energy, and completely renewable sources of energy very resourceful to us. Algae are profitable in that it can grow in areas unsuitable for 1st and 2nd generation crops, which would lessen strain on using water and arable land used. It can be easily grown using sewage, wastewater, and saltwater, such as oceans or salt lakes. Due to this, a need to use water that would otherwise be used for human consumption is not necessary. However, further research still needs to be executed to further the removal process in order to make it financially competitive to petro diesel and other petroleum-based fuels. For an economic process in comparison to others, a cost-effective and energy efficient harvesting methods are required with low energy input. To Producing low-cost micro algal biofuels needs better biomass harvesting methods, high biomass production with high oil productivity through genetic modification, which will be the future of algal biology. Therefore, the standard algal harvesting technique in use, bio-refinery concept, advances in photo bioreactor design and other downstream technologies will further reduce the cost of algal biofuel production, which will surely be a competitive resource in the near future. The capital and operating expense of third-generation production are so high. So some sub-sectors are required for additional research and development to reach the level of being a sustainable process of consistent biofuel construction on an industrial scale, but the potential is highly talented [49].

Fourth generation biofuels:

Fourth generation biofuels will be based on raw materials that are essentially inexhaustible, cheap and widely available [1]. This type of biofuel depends on the conversion of vegoil and biodiesel into gasoline [10].

Advantages:

Fourth generation biofuels are more superior than third because these algae are obtained with elevated yield and along with high lipid contain. It has more CO_2 capture capability and high manufacture rate than other biofuels.

Disadvantages:

The major disadvantage of algae production is involved the high rate of initial investment. Research for algae production is now at its preliminary stage. The fourth-generation biofuel research has been started from 2006 and significant result has not been published yet in peer-review journals.[50]

Conclusion:

First generation biofuels illustrate a step toward cleaner, renewable energy, but they lag behind gasoline due to energy density and economic factors. They also present an ethical dilemma moral dis-adjustment with regards to use of food crops, as there are millions of people starving and affliction causing by situation around the world. This is mainly to the point in countries with large populations where corn grown-up such as China, Brazil and Mexico (the 2nd, 3rd and 4th largest producers of corn, 1st, 5th and 11th largest country populations, respectively). Some benefits are also provided from second generation biofuels but the biomass requires adaptable steps and competes with food crops over arable land in some parts of the world. Third generation biofuels represent the most hope, but plenty of research still needs to be done to cut down production costs and make this type of fuel production commercially, economically practicable.

A renewable resource of energy it is having limitations and their technological progress refers good and bad effects. 1st generation biofuels lag behind as they come from biomass that is also a food source in world. This causes a problem when there is not enough food to feed everyone. 2nd generation biofuels come from non-food biomass, but still compete with food production for land use. Finally, 3rd generation biofuels present the best possibility to get an opportunity for alternative fuel because they don't compete relating with food. However, there are still some challenges in presenting them economically viable.

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