# Original Article: Use Bioethanol as a Clean and Cost-Effective Fuel

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## ABSTRACT

Ethanol made from non-food biological sources is called bioethanol. Ethanol or regular alcohol with the formula $C_2H_5$-OH can be made using inexpensive cellulosic sources, such as straw, wood chips, agricultural residues, whey, or relatively valuable carbon sources such as sugar beet molasses or sugarcane molasses. Or provided quite valuable carbon sources such as sugar and starch. Agricultural wastes are mainly composed of cellulose, the most abundant natural organic matter. It is estimated that ten trillion tons of it are generated every year on the earth's surface. It is estimated that biosynthesis generates ten trillion tons of it every year on the earth's surface. In this research study, while introducing the sources of bioethanol, we discussed its use as a green fuel in cars.

## Introduction

Ethanol can now be considered a reliable source of fuel. Ethanol can be produced in any country according to the resources of that country [1]. For example, in Iran, they get molasses, in the United States from corn, in Europe from potatoes and ethanol [2]. Oil and its related products cause a lot of damage to the environment and human health [3], and the treatment of diseases requires a lot of money, which harms the country's economy [4]. Even though factories and power plants are very few, their operation is straightforward to control. However, the number of cars in the world that use oil and gasoline fuels is vast, and it is impossible to control them, while the means of transportation. The leading cause of greenhouse gases and their dispersion in space [5]. Researchers, while studying these problems, the only possible solution is to reduce human dependence on oil and its products. It may have been a dream one day, but scientists have been using ethanol instead of fuel in cars for some time [6]. The combination of ethanol with oil in

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car fuel tanks helps reduce air pollution, but its high price is the main problem. Ethanol is currently sold at a very high price, and if different countries decide to implement this plan, a lot of subsidies should be given to ethanol so that people can use it [7]. By consuming ethanol fuel instead of fossil fuels, the amount of greenhouse gas emissions known to be the cause of global warming is reduced. Ethanol can be obtained from wheat, sugar, palm oil, or even edible oils obtained from fast-food restaurants [8]. Access to reliable energy sources is the most critical challenge facing the world's countries in the coming decades [9]. Due to the alarming situation in the country in the field of fuel supply of cars, which in addition to the need for continuous economic measures, has caused severe environmental problems on the one hand, and a vast and unprecedented volume of research and studies in various fields. In other countries, it is underway to use ethanol as a fuel for cars [10-15]. On the other hand, it is necessary to consider national measures to review and replace gasoline with ethanol [16].

### *Sources of Alcohol Production*

Currently, more than 98% of the ethanol produced in the world is obtained by the fermentation of sugars [17]. The sugar used can be extracted from various sources such as starches, sugars, agriculture, industrial effluents, and lignocellulosic sources [18]. The cost of ethanol production is susceptible to the price of raw materials, the cost of delivering it to the process department, and the composition of the raw materials [19]. Therefore, the success of ethanol production and its competition with gasoline can depend on the geographical location of the region, type of climate, production method, properties of agricultural products, and the type of waste [20]. A system based on the low cost of raw materials, easy access to raw materials, and the use of by-products may be economically justified [21-23].

### *Cellulose Sources*

With the advancement of technology, there is a global potential for the use of lignocellulosic materials and their conversion to alcohol through fermentation. Mass production of cellulosic materials from various carbohydrates is worldwide, and much research is being done on the industrialization of lignocellulosic materials and their conversion to ethanol. Of course, the technical and economic problems in hydrolysis to its constituent monosaccharides significantly impact the feasibility of ethanol production [24]. To be economical and influential on an industrial scale, special considerations such as comprehensive process development, product segregation, and recovery use of by-products must be considered. The crystalline and viscous nature of cellulose and its resistance to various hydrolysis methods and production of fermentable sugars has become the focus of research and development for the economical production of ethanol from cellulosic materials [25-29]. The amount of waste production and waste of agricultural products in the world is very high, and due to their composition, it has become a suitable source [30]. The return of these wastes to the soil paves the way for increasing fertility, controlling erosion, releasing the required materials for the soil, and stabilizing its structure [31]. The seasonality of these products and their dispersion increase costs [32]. One of the significant sources of cellulosic material in developed countries is household waste [33]. In 1980, the daily production of this waste in the United States was 28 × 1.5 tons, of which 58% was cellulose. In the United States and Canada, it is possible to commercially produce ethanol from municipal solid waste [34].

### *Environmental benefits of using ethanol*

1. *Reducing $CO_2$ emissions:* $CO_2$ from gasoline or any other fuel enters the atmosphere. This gas intensifies the greenhouse effect, while $CO_2$ from bioethanol fuel and produced in the fermentation process by plants planted to produce ethanol will be absorbed, and this is a great advantage for using bioethanol as a fuel that is not found even in clean fuels such as natural gas.

2. *Reduction of CO and CH emissions:* 10-E, 5-E, and 7-E fuels have been shown to reduce CO by 4-15% and CH by 2-7%.

*3. Reduced particulate matter (PM10) emissions:* Suspended particles less than 10 mm in diameter accumulate in the air sacs of six people and cause damage to the respiratory system and cancer. In ethanol-containing fuels, the emission of suspended particles is reduced by about 10%.

*4. Sulfur oxides (SOX):* If bioethanol is used as a pure fuel, it has no sulfur, so we have no acid, and less SOX is produced in ethanol-containing fuels.

*5. Nitrogen oxides (NOX):* This factor increases up to 10% in ethanol-containing fuels. As the amount of ethanol in gasoline increases, the amount of NOX decreases. This factor can be kept at the desired level by adjusting the engine and combustion temperature.

*6. Aromatics:* Ethanol does not contain any aromatics. Lead-free gasoline, on the other hand, are 45% aromatic.

*7. Aldehydes:* The amount of acetaldehyde in ethanol-containing fuels increases. This factor can be eliminated by using a catalytic converter.

*8. Increase in octane number:* Table (1) shows this.

*9. Alcohol safety:* Ethanol is safer than gasoline, ignites later, burns more easily against a flame, and produces less smoke than gasoline.

**Table 1:** Adding ethanol on increasing octane number [35]

| The rate of increase in octane number | Octan No. | Ethanol volume percentage added | Basic gasoline octane number |
|---|---|---|---|

## *Economic Justification for Using Bioethanol*

A study of the trend of gasoline replacement by ethanol in the world shows that while in 1975, world production of ethanol as a fuel was almost zero, in 2003, this amount reached about 30 billion liters. The most significant increase was in the United States and the lowest in Europe. Europe has not shown much interest in replacing gasoline with alcohol due to its economic policies, but it has tried hard to compensate for its delay and neglect in recent years. Also, it has begun to develop ethanol production as rapidly as possible. The former US president, in one of his speeches, emphasized the cessation of oil imports from the Middle East region until 2020 and the production of bioethanol as an alternative, while the former British Prime Minister before the summit of the eight industrialized countries in Moscow in July 2006, energy has been declared the most significant challenge is facing this country [36]. The United States and Brazil are the largest ethanol producers in the world. Currently, the United States produces about 19 billion liters a year, and Brazil alone more than 12 billion liters. Europe with about 500 million liters and Asia with 400 million liters are the following categories. Most of the ethanol produced in the United States is currently based on corn, but the country's main program is ethanol production from cellulosic material. It helped two major industrial enzyme companies, Novozyme and Genencore, improve industrial cellulose-digesting enzymes' performance. Iogen Canada also received $ 21.1 million from the Government of Canada, $ 46 million from Shell, and $ 24.7 million from Petro Canada to cover research costs for ethanol production from cellulose. In Canada alone, which is preparing to become the world's largest exporter of ethanol, the cellulose ethanol market is projected to reach more than $ 10 billion by 2012. There are currently 110 alcohol factories in the United States, 15 of which produce more than 200 million liters of alcohol per year. Another 30 plants are under construction with 6.7 billion liters of ethanol. The country is already ahead of its national ethanol production plan. While it was expected to reach an annual production of 7.5 billion gallons of ethanol by 2012, ethanol production is now approaching that level [37]. The expansion of ethanol production is expected to create about 240,000 new jobs, with a nearly $ 43 billion increase in household incomes. There are now more than 5 million E85-powered cars in the United States (fuel containing 85% alcohol and 15% gasoline), and the number of fuel stations in the country is 650, a threefold increase over 2004. Gives. General

Motors and Ford have now launched cars that use pure ethanol fuel [38-40]. Over 39 alcohol factories face many problems in our country and often suffer from equipment wear and tear, and all use molasses to produce alcohol. The oldest factory in Iran currently produces 6 million liters of alcohol per year, while the capacity of the newest, located near Ahvaz, is about 30 million liters per year. 76 million liters of gasoline per day in the country, of which 30 million liters are imported [41]. Compared to last year, gasoline consumption has increased by about 1 million liters per day [42]. The highest increase is related to the city of Tehran, with 400 thousand liters per day. One of the most critical challenges that ve now occupied the minds of men in government and parliament is how to provide the necessary costs to import this volume of gasoline in a sustainable, sustainably and sustainably. One of the solutions to many environmental problems and water pollution, soil, and especially the air in the country's cities, which is due to the density of cars, is clean fuels such as ethanol [43]. Only water and carbon dioxide are the fuel of ethanol, and the compounds sulfur, nitrogen, lead, aromatic compounds, and other carcinogens will be primarily removed from people's lives. Replacing even 5% of gasoline with ethanol, which is not a problem in current car engines, will reduce gasoline imports by 12.7%. At the same time, other countries have long-term plans to reduce their imports by even one percent. They run expensive. In addition, the favorable price of ethanol compared to gasoline should be considered [44]. Although the country's gas resources are considered a substitute for gasoline, it is clear that the economic justification for this is acceptable only in special substitutes for gasoline. The economic justification for this is acceptable only in particular circumstances. In addition, pollution from natural gas or CNG consumption is estimated even more than gasoline. In any case, it is necessary to start a national program in Iran to assess the effects of gasoline replacement by bio-ethane and, in line with research from other countries, to answer the following questions in the first place with accurate expertise:

1- The effects of this alternative on the domestic market and its economic justification.

2- Technological needs include necessary changes, albeit minor, in internal combustion engines, refueling stations, storage, and transportation of bioethanol.

3- The positive effects of the environment, abandoning gasoline consumption and turning to ethanol.

4- Study the country's carbon resources (including cellulose sources, molasses, starch, and whey) and conversion technologies of each and the required amounts of carbon sources.

5- Study of job creation, creation and development of bioethanol industry, how to allocate public and private financial resources, and its social effects. Investigating the international economic-political effects of gasoline substitution by bioethanol in the world, region, and country. It should not be overlooked that the country's ethanol production industries are among the oldest and only need to pay enough attention to their product, whose actual value the world is rediscovering. Developing a national ethanol program and harnessing the scientific potential of domestic research organizations .

**Table 2:** World ethanol programs [54]

| | |
|---|---|
| Fuel consumption containing a mixture of 25% ethanol, tax deduction | **Brazil** |
| Fuels containing 5% ethanol in the next 5 years | **Argentina** |
| Forcing 10% ethanol in fuel consumption in Bangkok | **Thailand** |
| All gasoline fuels must contain 5% ethanol | **India** |
| Optionally, fuels will contain up to 10% ethanol | **Australia** |
| A subsidy of 36 cents per liter of ethanol is paid | **United Kingdom** |
| In 2010, 5.75% of the fuel (in terms of energy) should be ethanol | **European Union** |
| It has been subsidizing ethanol production since 1992 | **Canada** |

## Discussion and Conclusion

Ethanol-burning cars reduce the impact on the car engine and increase energy efficiency. Pure ethanol has an octane number of 113, which after mixing with gasoline, can provide the required octane number of unleaded gasoline and allow more compression of internal combustion engines. Ethanol is also a moisture absorber and prevents gasoline from cooling too much in winter and eliminates the need for expensive and sometimes harmful fuel additives. In addition, ethanol has cleansing properties, making engine operation more manageable and smoother, and facilitating and cleaning fuel injection. Ethanol is not known as a toxic substance, and its inhalation is not dangerous. Its flammability is much lower than gasoline, and its storage, transport, and transportation are much safer than gasoline. Ethanol is a completely clean fuel, thus reducing all gasoline pollutants in proportion to the percentage mixed with.

Regarding reducing gases affecting the ozone layer and the Earth's atmosphere, in estimating the benefits of this economic and industrial development, it can be said that reducing environmental damage and greenhouse gas emissions prevents global warming. Employment is among the main achievements of this project. In addition, he will not leave the country to implement this currency plan. In addition, in our country, Iran, due to the potential sources of raw materials for the production of ethanol from sugarcane and beet molasses, starchy materials such as corn wheat, and disclose such as wood waste, agricultural waste, recycled paper from waste, etc. can be provided and according to the capacity of ethanol-producing factories at present. To begin with, it is possible to plan on the production of 60 million liters of pure ethanol per year for use in the transportation sector. Obviously, in case of creating suitable conditions and encouraging investors in this sector, considering the abundance and variety of raw materials for ethanol production in the country, the operation of ethanol factories under construction and completion of production will increase to the desired level.

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