TECHNOLOGY SCIENCE JOURNAL FOR KIDS

MARCH 2023

Can we use bacteria to make renewable rocket fuel?

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Abstract

LOWER READING LEVEL

NASA's space shuttle has to go really fast to reach outer space. In fact, it has to go about 300 times faster than a car going 60 mph (97 km/h)! Rockets need fuel with lots of energy to go that fast. We call these high-energy fuels. Airplanes and cargo ships use the same type of fuel.

Right now, these high-energy fuels are made using fossil fuels. When we burn fossil fuels, it causes climate change. It would be nice if we could make high-energy fuels more sustainable.

Some bacteria make molecules that have lots of energy. We wanted to know if we could use these molecules to make more sustainable high-energy fuels. We looked at DNA from bacteria. We also used some clever chemistry. And we made a new biofuel. It seems to have even more energy than the high-energy fossil fuels we have now!

Introduction

Do you know what we use **fossil fuels** for? You probably know we use gas (or petrol) for cars. If you live somewhere cold your family might use fossil fuels to heat your home. We need to use less fossil fuels to slow down **climate change** (Fig. 1). But they are everywhere! We even use fossil fuels to make things like crayons, toothpaste and plastics!

It might be tough, but we need to break up with fossil fuels. We do have some **sustainable** fuels already. We call them **biofuels**. We already use them to power specially adapted cars.

But it is very hard to find high-energy fuels that are sustainable. We use these types of fuels to power rockets and airplanes. These fuels are hard to make and they are dangerous. They are also expensive.

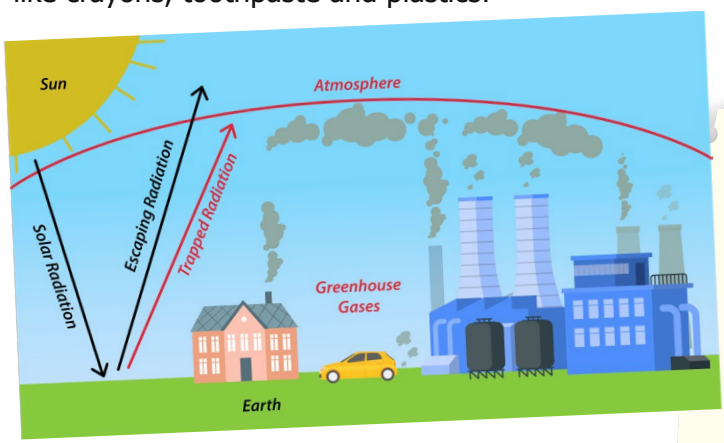

Figure 1:
Burning fossil fuels releases gases that trap heat in the atmosphere. This causes the average global temperature to increase and the climate to change.

When we burn fuels, we make energy. That energy comes from breaking apart the fuel **molecules**. In high-energy fuels, like jet fuel, many of the molecules look like rings. Rings contain a lot of energy. But molecules that look like triangles have the most energy. Just imagine trying to bend a straw into a triangle shape. You have to put a lot of work into keeping the shape. Otherwise it will spring back to being a straw.

Breaking ring-shaped or triangle-shaped molecules makes them release a lot of energy. But it's hard to make fuel with lots of these molecules in a lab. Luckily, some **bacteria** make molecules with this triangle shape. Bacteria use them to kill fungus. We call these molecules POP molecules.

We wanted to make high-energy fuels with POP molecules from bacteria. We call them **POP biofuels**. Can we make them in a safe and easy way? Can we make them quickly and sustainably for the future?

Methods

There are a lot of bacteria on our planet - over 30,000 different kinds! But very few of them can make POP molecules.

1. First, we had to find bacteria that make POP molecules.
2. So, we did some DNA detective work! We looked at the **DNA** of 7,762 different bacteria.
3. We found that some soil bacteria produce POP molecules on their own. But the bacteria were hard to grow in our lab.
4. So, we transferred the DNA that made POP molecules from the bacteria. Then we changed the DNA to make POP molecules in a different bacteria that was easier to grow.
5. Then we modified these POP molecules to turn them into high-energy POP biofuels.
6. Finally, we compared the POP biofuels to other fuels.

Results

- We discovered a new way to make POP biofuels from POP molecules.
- Our new POP biofuels are high energy. They can also be kept at room temperature. This means that they can be used for a lot of things, like fueling ships and airplanes.
- These POP biofuels might even be higher energy than the fuels we have now! (See Figure 2.)
- We found a new, sustainable, and safe way to make high-energy fuel – from bacteria!

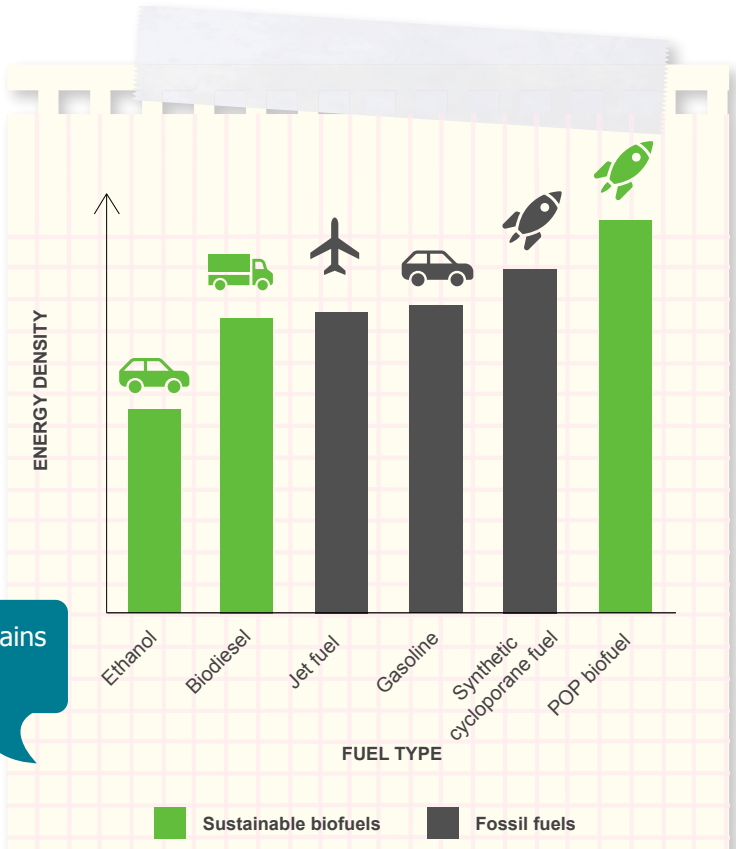

Figure 2:
Different types of fuels and the amount of energy they contain.

Discussion

The climate is changing because of fossil fuels. Scientists think the planet will warm by 2.5°C by 2100. Humans and the environment will both suffer. We need to stop using fossil fuels as fast as possible.

We need high-energy fuels to launch rockets and fly airplanes. Current biofuels don't have enough energy to help. Rocket launches today are rare. Going into space might be more common in the future. But flying is quite common now. If we can make high-energy biofuels, we could help slow climate change.

We made high-energy POP biofuels using bacteria! We can replace fossil fuels with more sustainable ones. This can help slow climate change. Next, we need to make more POP biofuels and put them to the test.

Conclusion

We depend on fossil fuels for so many things in our lives. We use them to fuel our cars and make the plastics that we use every day. It's a huge problem. Look around you. Maybe you're sitting on a plastic chair, or using a plastic pen. And what about the clothes you wear? Have a look at the label. Does it say nylon, polyester, or acrylic? These fibers are all forms of plastic, too.

One simple way to reduce fossil fuel use is to shop secondhand for things like clothes and furniture. Or why not organize a clothes swap with your friends? And of course, it always helps to walk, bike, or use public transportation instead of going by car whenever possible.

Glossary of Key Terms

Bacteria – a large group of microscopic living organisms. They only have one or a few cells. Some can cause harm to animals and humans. But many help us digest food and break down waste. They can also help fertilize plants and make medicines.

Biofuel – a fuel that is made from something living. This could be a plant or an animal, or even a bacteria. The most common biofuels are wood and corn. We also have biofuels we use to power specially adapted cars (ethanol and biodiesel).

Climate change – change in temperature and weather that happens over a long time period. Humans burn fossil fuels. This is a main contributor to climate change.

DNA (Deoxyribonucleic acid) – molecules inside cells. They carry information about how the cell works. It also has information about everything the cell can make.

Fossil fuel – molecules that contain lots of energy. They are made from plants and animals that decompose and get buried. After millions of years, they form molecules that can be burned for energy. Common fossil fuels are coal, natural gas, and oil.

Molecule – the smallest unit of a chemical compound. It is made of atoms or smaller molecules bonded together.

POP biofuel – fuel made by living things. They have lots of triangle-shaped molecules in them. POP fuels are a new type of high energy fuel made using bacteria instead of fossil fuel!

Sustainable – when people interact with the environment in a responsible way. People avoid harming the environment. And they don't use up resources. For example, they can use renewable energy.

Acknowledgment: This article's adaptation was supported by the GM Foundation.

Check your understanding

1. Why do we need high-energy fuels? Why would it be better if they were made in a sustainable way instead of made using fossil fuels?

2. There are not many bacteria that produce POP molecules. How did we find them? What did we have to do to work with them in our lab?

3. Our POP biofuels might have more energy than other high-energy fossil fuels. Why is this important?

4. Look around the room you are in. List as many objects as you can that are made from fossil fuels. How about things that rely on fossil fuels to work? Or needed fossil fuels to help make them?

5. With a partner or small group, brainstorm ways that your school can reduce its fossil fuel use. Then write a letter to your principal sharing your ideas!

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