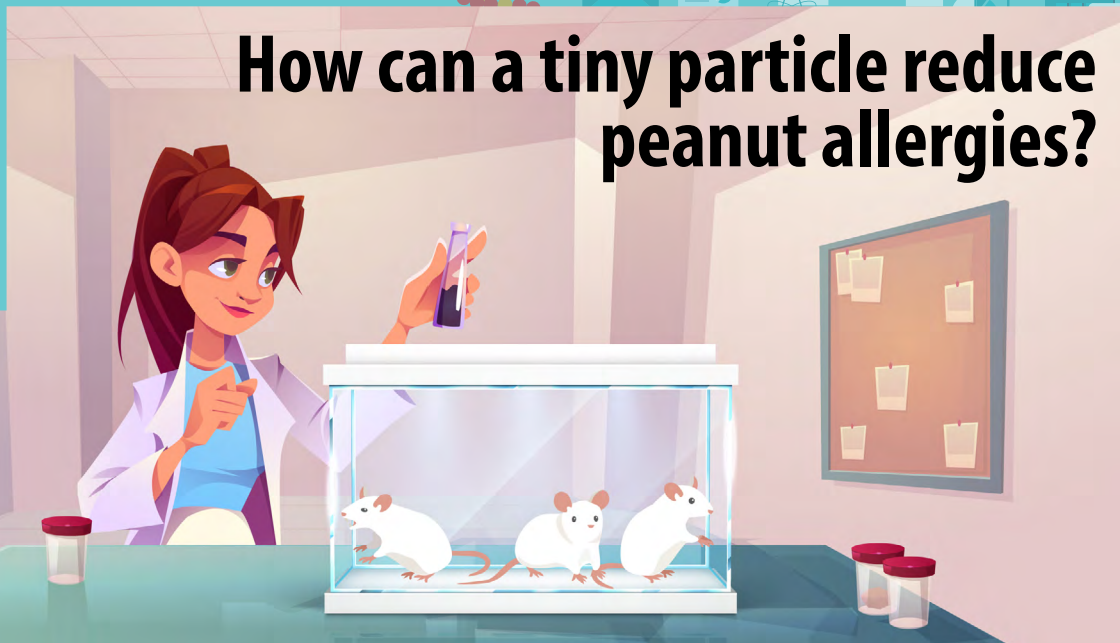


How can a tiny particle reduce peanut allergies?



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Abstract

LOWER READING LEVEL

Did you know that food can be harmful to certain people? That's because they have food allergies. Food allergies can be dangerous if they cause anaphylaxis. This is the body's reaction to the food. It can be so bad that it may become difficult to breathe. It can also cause a person to faint. Scientists wanted to figure out if they could use a special particle called messenger RNA (mRNA) to help. They hoped it could reduce the symptoms of anaphylaxis caused by this food. This mRNA would tell the body to make peanut

protein. It would also tell the body to make protective cells to decrease the allergic reaction.

The researchers designed a very tiny particle to take mRNA to the liver. They designed the mRNA to switch off allergic responses. They then collected data to determine if there were fewer symptoms of anaphylaxis. The tests showed that particles carrying mRNA could reduce the impact of peanut allergies. That means that mRNA could be an effective solution to allergies in the future.

Introduction

Many people need to be careful about what they eat because of food allergies. A **food allergy** is an **immune system** reaction that happens after eating certain foods. Your immune system is the part of your body that protects you from infections. **When you have a food allergy, the immune system thinks it needs to protect you from a specific food.** To do this, it produces **antibodies**. One type of antibody is **IgE**. The IgE goes to different cells in the body and tells them to make chemicals. These chemicals cause an allergic reaction. We call the foods that cause an allergic reaction **food allergens**. The most common food allergens include peanuts, tree nuts, milk, eggs, shellfish, fish, sesame seeds, soy, and wheat.

What can happen to someone with a food allergy? **Some people get pain in their belly or get hives on their skin.** Others experience **anaphylaxis**. Usually a person in anaphylaxis has trouble breathing. That is because their airways get smaller. Their **blood pressure** also decreases. This can cause them to become dizzy or faint. Anaphylaxis is very dangerous. It can occur seconds or minutes after interacting with a food allergen.

Scientists wanted to know if they could use **mRNA** to stop an allergic reaction. mRNA is a special particle in your body that carries a code. This code tells the **liver** to make a small piece of peanut protein. This protein then tells the body to



Common food allergens include peanuts, shellfish, eggs, and milk.

stop making antibodies. But how could mRNA get to the liver? The researchers wanted to send it there using a **nanoparticle**. The mRNA would then tell the body to make

protective **T-cells**. These T-cells then reduce the amount of IgE production. This stops the anaphylaxis.

Methods

Developing the Nanoparticle:

The job of the nanoparticle is to carry mRNA to the liver (Fig. 1). Scientists made the nanoparticle from four different chemicals. They also added **surface decorations** to the outside of the particle. These decorations made sure that the particle went to a special part of the liver. This part makes T-cells. The researchers also made a particle that did not contain the decorations.

Finally, the scientists developed the mRNA that the nanoparticle would carry. They placed this mRNA in the center of the nanoparticle.

Testing the Nanoparticle:

The researchers used three groups of mice. They fed them all peanut extract. This made them allergic to peanuts. Then

the scientists gave one group of mice the particles without the decorations. Another group received nanoparticles with decorations. The third group did not receive any treatment.

The scientists exposed all the mice to peanut extract. Then they observed them. They gave a score to describe the level of anaphylaxis the mice experienced. The researchers recorded how their body temperature changed. Body temperature goes down during anaphylaxis. The researchers also measured how certain chemicals changed. They focused on the amount of IgE, a peanut-specific IgE, and the T-cell levels.

They then repeated the experiment with one difference. The researchers gave the mice the peanut extract first. Then they gave them the nanoparticle treatment.

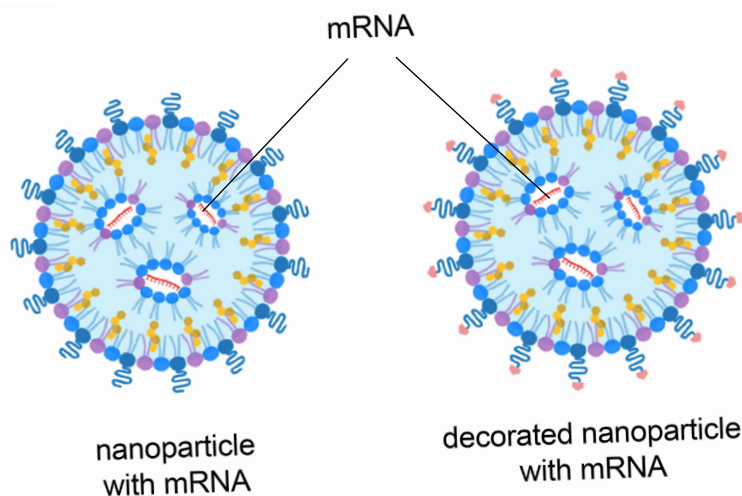


Figure 1:

The nanoparticles developed to reduce anaphylaxis from peanuts.

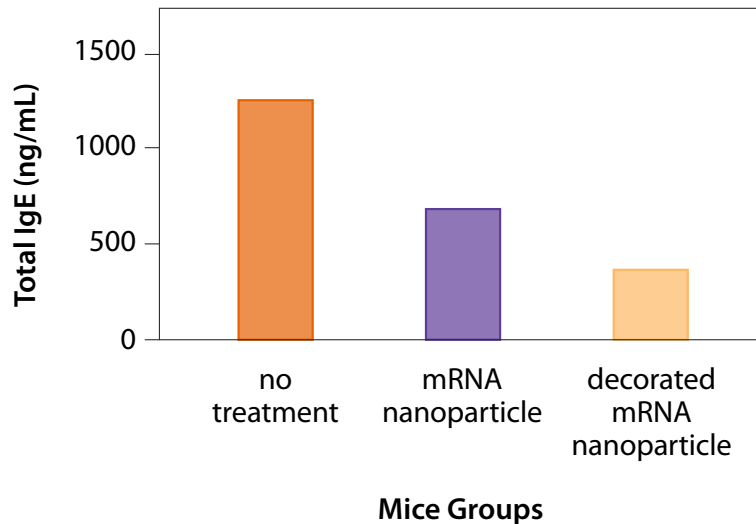
Results

The mice that did not receive the nanoparticle had high anaphylaxis scores. That is because it was hard for them to breathe. It was also hard for them to move. Their body temperature went down.

The mice that received the nanoparticle had low anaphylaxis scores. That is because they had fewer **symptoms**. They also did not show a change in body temperature. The mice treated with the decorated nanoparticles had the fewest allergy symptoms.

The levels of IgE changed. So did the levels of T-cells. The treated mice had lower levels of IgE. They had higher levels of T-cells. The researchers saw similar results when they gave the nanoparticles during the allergic reaction.

*Please see
Figure 2 on page 3*



Which group of mice had the lowest levels of IgE after exposure to peanuts?

Figure 2:

The total IgE levels in mice made sensitive to peanut protein. One group received no treatment, one received the mRNA-lipid nanoparticle, and one received the decorated mRNA-lipid nanoparticle.

Discussion

The nanoparticles helped reduce the mice's allergic reaction to peanuts! The treated mice had fewer symptoms of anaphylaxis. That is because the nanoparticles took the mRNA to the liver. This caused the formation of T-cells. The T-cells caused less IgE to form. That means there were fewer anaphylaxis symptoms. The decorated nanoparticles helped more than the non-decorated nanoparticles.

This research shows that nanoparticles carrying mRNA can help with allergies. They may be able to treat many types of allergies. They may also help treat more than one allergy at

the same time. This is important because many people have more than one food allergy.

But scientists need to do more research first. They need to figure out how long the effects of the treatment lasts. Then they can figure out how often people need to receive it. They also need to know how much mRNA to put in each nanoparticle to reduce symptoms.

Conclusion

Researchers are going to continue to explore nanoparticles and mRNA treatment of allergies. While they do, you can help prevent anaphylaxis in people with food allergies.

- Be aware of the ingredients in the foods you bring to different places. After you eat, clean up your space. Do not leave any food allergens behind.

- When providing food to friends at school, make sure you know if anyone has a food allergy. Label the ingredients in any foods you bring in. Then students can check for a food allergen.

Nuts are a common allergy, so many schools now have a no-nuts policy. This ensures that everyone can enjoy eating together while staying safe!

Glossary of Key Terms

Allergens - a substance that causes an allergic reaction.

Anaphylaxis - a severe reaction to an allergen that affects multiple body systems.

Antibodies - a substance produced in response to a substance from outside the body. Antibodies help protect the body.

Blood pressure - the measurement of how much force your heart uses to pump the blood through your body.

Food allergy - a condition in which an immune system reaction occurs after eating a certain food.

Hives - round bumps that form on the skin that are very itchy.

IgE - an antibody produced during an allergic reaction. It triggers the release of chemicals throughout the body.

Immune system - the body system that protects the body from infections and other illnesses.

Liver - an organ in your body that helps you digest your food, filter your blood, and make proteins.

mRNA - a particle that carries a special code to other parts of the body. This information is then used to make proteins that the body can use to produce protective immune responses.

Nanoparticle - a very tiny particle.

Surface decorations - extra substances placed on the outside of a nanoparticle.

Symptoms - a sign that a person may be experiencing a disease or condition. A runny nose is a symptom of a cold virus.

T-cells - a type of white blood cell that is part of the immune system. They protect the body against infection.

REFERENCES

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FARE: Toolkit for food allergies in the classroom

<https://www.foodallergy.org/resources/food-allergies-classroom>

Nemours KidsHealth: Food allergies

<https://kidshealth.org/en/kids/food-allergies.html>

Nanooze: Exploring the world of nanotechnology

<https://www.nanooze.org/>

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Check your understanding

1 Why do some people experience anaphylaxis from eating food?

2 What was the job of the mRNA in the nanoparticle that the researchers developed?

3 How did the anaphylaxis scores of the untreated mice compare to the treated mice? Why were they different?

4 Brainstorm a list of other things (besides food) that can cause allergic reactions.

5 With a partner, design a meal that you might share with friends and family. Identify which foods in the meal might be a concern for a person with food allergies. Brainstorm alternative foods that you could serve to prevent an allergic reaction.

6 Many countries use food labels to tell people if a product contains an allergen or if it was produced in a place that contained an allergen. Do you think that food labels are a good way to prevent anaphylaxis? Explain your answer.
