

Vaccine Ingredients:

A FUNCTIONAL GUIDE FOR HEALTHCARE PROFESSIONALS



What ingredients are in a vaccine?

Vaccine ingredients fall into six broad categories based on their role in the vaccine or how they are used during manufacturing. Each component contributes to the vaccine's safety, effectiveness, stability, or production.

ACTIVE INGREDIENTS

The antigen is the part of the vaccine that triggers the immune response. Antigens mimic an infection and train the immune system to recognize and fight the disease. Vaccine antigens can come from:

- Whole viruses or bacteria
- Parts of viruses or bacteria
- Toxins produced by bacteria
- Nucleic acids (such as those used in some COVID-19 vaccines)

ADJUVANTS Ex. aluminum salts, AS01, MF59

Adjuvants increase a vaccine's immunogenicity, helping the body develop stronger and more durable protection against disease. This is particularly beneficial for older adults, whose immune systems may become less responsive with age. Adjuvants can also reduce the amount of antigen needed in a vaccine and, in some cases, decrease the number of doses required to achieve effective protection.

OTHER TRACE COMPONENTS Ex. formaldehyde, cell culture materials

There are trace components left over from the manufacturing process. These may include substances such as egg proteins, yeast proteins, or formaldehyde used during production. They are present, if at all, in extremely small amounts.

STABILIZERS Ex. sugar, gelatin

Stabilizers help protect vaccine components during manufacturing, storage, and transport. They maintain potency by preventing degradation from temperature changes, light exposure, or storage conditions.

PRESERVATIVES Ex. historically thimerosal

Preservatives prevent contamination, particularly in multidose vaccine vials after opening, ensuring each dose remains safe. Most routine U.S. vaccines are supplied as single doses and do not contain preservatives, although there are some exceptions.

ANTIBIOTICS Ex. neomycin, streptomycin

Antibiotics may be used during vaccine manufacturing to prevent bacterial contamination. Vaccines do not contain antibiotics commonly associated with severe allergic reactions, such as penicillin, cephalosporins, or sulfa drugs.



Every vaccine ingredient has a purpose.

Framing vaccine ingredients by function rather than chemical name can make conversations with patients clearer, more accurate, and more reassuring.

Putting Ingredients into Context

When discussing vaccine ingredients with patients, context matters. The presence of an ingredient alone does not determine whether it is harmful—its purpose, dose, and route of exposure are equally important.

- **Dose matters.** As the saying goes, "*The dose makes the poison.*" Vaccine ingredients are used in very small amounts—often measured in micrograms (μg) or nanograms (ng)—for a specific purpose.
- **Many ingredients occur naturally.** For example, formaldehyde is produced by normal human metabolism, and aluminum is naturally found in food, drinking water, and breast milk.
- **Compare risks and benefits.** Vaccine ingredients are carefully selected, extensively studied, and continuously monitored. For recommended vaccines, the evidence consistently shows that the benefits of vaccination outweigh the known risks for the vast majority of people.

How are a vaccine's ingredients selected?

Vaccine ingredients are selected based on the type of vaccine and the immune response it is designed to create. At the center of every vaccine is the antigen—the part that teaches the immune system to recognize and respond to a specific pathogen. Additional ingredients may be included to help stabilize the vaccine, enhance the immune response, or prevent contamination, depending on the vaccine's formulation and intended use.

Are vaccine ingredients safe?

Vaccine ingredients are carefully evaluated during development, clinical trials, manufacturing, and ongoing safety monitoring. Safety depends on the ingredient's purpose, amount, and how it is used—not simply its presence.

How long do vaccine ingredients stay in the body?

Most vaccine ingredients are cleared within days to weeks, depending on their role. The antigen interacts with the immune system to build protection, while other components are processed and eliminated after serving their purpose.

Why do some vaccines contain aluminum?

Aluminum is used in some vaccines as an adjuvant to strengthen the immune response. The amount is very small, has been carefully studied for safety, and represents only a small portion of the aluminum we encounter throughout daily life from food, water, and the environment.

Do vaccines contain mercury?

Most vaccines do not contain mercury. Today, thimerosal—an ethylmercury-containing preservative—is used only in some multidose influenza vaccine formulations to prevent contamination. Unlike methylmercury, the type of mercury found in certain fish, ethylmercury is cleared rapidly from the body and does not accumulate. As a precautionary measure, thimerosal was removed from all routinely recommended childhood vaccines in the United States by 2001—not because evidence showed it was harmful, but to reduce overall mercury exposure in infants. Since then, extensive research has continued to find no evidence that thimerosal in vaccines causes autism or other neurodevelopmental disorders.

Are there fetal cells in vaccines?

No. Some vaccines are developed or manufactured using human cell lines that originated from fetal tissue obtained from elective abortions in the 1960s and 70s. These cell lines are maintained in laboratories and have been used for decades because they provide a consistent, reliable environment for growing viruses used in vaccine development, production and testing. During manufacturing, the vaccine undergoes purification steps that remove cellular material, so the final vaccine products do not contain fetal cells or fetal tissue.

Why is formaldehyde in vaccines?

Formaldehyde may be used during vaccine manufacturing to inactivate viruses or bacterial toxins. Although formaldehyde can be harmful at high levels, the amount and route of exposure determine risk. Only trace amounts remain in some vaccines—far less than the amount naturally produced through normal human metabolism. In fact, infants naturally have substantially more formaldehyde circulating in their bodies than they would receive from a vaccine.

Can mRNA vaccines alter DNA?

No, mRNA vaccines cannot change a person's DNA. mRNA delivers temporary instructions to cells to produce a specific protein that triggers an immune response. After the instructions are used, the mRNA is naturally broken down by the body. mRNA vaccines do not have the ability to enter the nucleus (where DNA is stored), convert RNA into DNA, or integrate genetic material into the genome.

References:

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All vaccines use the lowest amounts of ingredients to make a safe and effective vaccine.