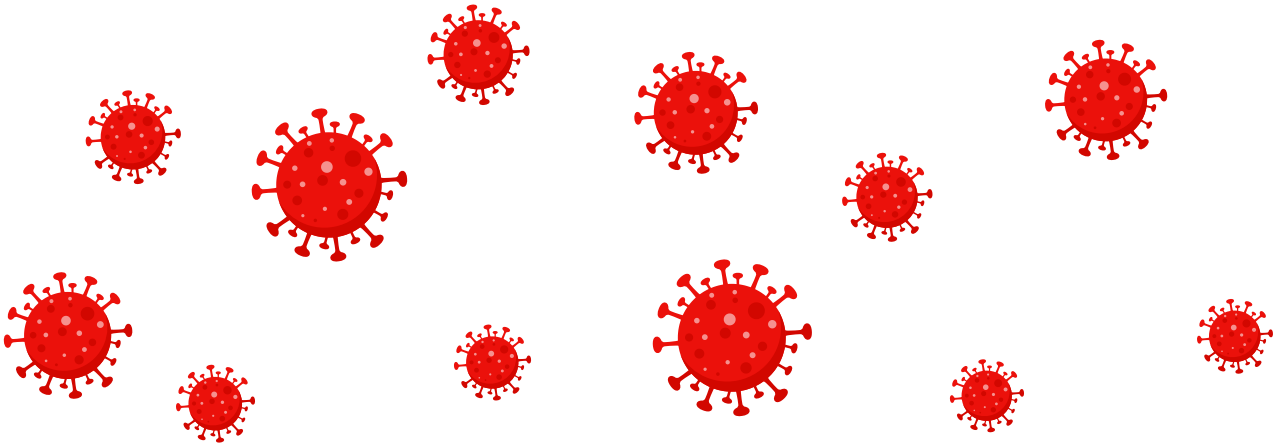
What's in vaccines?

A look at vaccine ingredients.

Vaccines are among the most effective tools we have when it comes to protecting against preventable diseases, and the ingredients they contain are essential to ensuring their safety and effectiveness. The ingredients in vaccines are present in very small quantities and undergo rigorous testing to demonstrate their safety before approval for use. In fact, many vaccine ingredients are found in the foods and drinks we ingest, and some ingredients are even naturally occurring compounds found in our bodies. This factsheet will explain what these ingredients are, what they do, and where else you can commonly find them.

Antigens

An antigen is the ingredient in a vaccine that causes your immune system to produce a protective response against a specific disease. Vaccine antigens are typically viruses or bacteria that have been weakened (attenuated) or killed (inactivated). The viral or bacterial antigen used in a vaccine stimulates your immune system to produce protective proteins called *antibodies*: proteins that specifically protect against the disease you are being immunized against. The antibodies produced in response to vaccination help protect you against that specific disease in the future.



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Live versus non-live vaccines

In general, vaccines can be categorized as "live" or "non-live" depending on if the virus or bacteria used is weakened or killed. Live vaccines use a weakened version of a virus or bacteria. Non-live vaccines use a killed version of a virus or bacteria, or parts/by-products of viruses or bacteria.

Because non-live vaccines do not contain a live virus or bacteria, it is impossible to become infected with said virus or bacteria from receiving these types of vaccines. On the other hand, live vaccines contain a weakened version of a virus or bacteria. While live vaccines can be used safely in people with healthy immune systems without causing infection, they are generally not recommended for anyone who has a severely weakened immune system—or for anyone who is pregnant.

Adjuvants

An adjuvant is an ingredient added to some vaccines to help produce a stronger and more effective immune response. It can also help improve the duration of protection, reduce the amount of antigen needed to make the vaccine and lower the number of doses required. This can be especially important for people who may not mount a strong immune response without it. For example, there are adjuvanted influenza vaccines available for use in Canada that are specifically designed to help both children 6-23 months of age and people 65+ produce a strong enough immune response to get better protection against influenza.
Adjuvants have been safely used in vaccines for decades, with aluminum-salt-based adjuvants in particular having a track record of safe use for over 70 years!

Table 1: Examples of adjuvants used in vaccines

Adjuvant	Other common locations
Aluminum salts	• drinking water • fruits and vegetables • breast milk and infant formula • antacids
MF59 (squalene oil and water mixture)	Squalene oil can be found: • naturally in your body • in some of our foods • in plants The squalene oil used in vaccines is derived from fish.

Stabilizers and emulsifiers

Stabilizers and emulsifiers are both added to vaccines to help maintain their quality and effectiveness. Emulsifiers specifically keep all the components within a vaccine evenly distributed throughout the vial. Stabilizers keep the antigen in the vaccine from deteriorating or being damaged by temperature changes that can occur during the manufacturing process, and subsequently during transportation and storage. They also help keep the vaccine components from sticking to the sides of the vial.

Table 2: Examples of stabilizers and emulsifiers used in vaccines

Stabilizer/emulsifier	Other common locations
Gelatin *stabilizer*	• marshmallows • gummy candies • yogurt • ice cream
Sorbitol *stabilizer*	• fruits and berries • chewing gum • sugar-free candies and soft drinks
Sugar (sucrose) *stabilizer*	• desserts and soft drinks • table sugar • sugarcane
Polysorbate 80 *emulsifier*	• canned foods • ice cream • shampoos and conditioners • makeup

Preservatives

Preservatives are added to vaccines to help prevent contamination with fungi and bacteria once the vaccine's vial has been punctured/opened. For this reason, preservatives are essential for use in multi-dose vaccine vials (vials that contain more than one vaccine dose). Multi-dose vials can be used to immunize multiple people, making them invaluable during mass immunization campaigns.

Table 3: Examples of preservatives used in vaccines

Preservative	Other common locations
Thimerosal *(also known as thiomersal)*	Please see the below section in this factsheet titled *Thimerosal: A closer look*.
Phenol	• mouthwash • lozenges • throat sprays

Thimerosal: A closer look

Concerns about the safety of thimerosal have been circulating for years, as thimerosal contains a type of mercury. However, the type of mercury present in thimerosal is completely safe for use and there is no evidence that its inclusion in vaccines is harmful.

Thimerosal contains ethyl mercury, which is an organic compound that your body breaks down and gets rid of quite quickly. It is commonly confused with methyl mercury, which is a type of mercury found in fish and shellfish that your body has a much harder time breaking down. Methyl mercury can be toxic if consumed in excessive amounts, but it is safe when eaten in moderation as recommended.

Because your body breaks down ethyl mercury quickly, the low doses of thimerosal present in multi-dose influenza vaccine vials are safe for use. There is also no evidence that the use of thimerosal in vaccines leads to autism.

In Canada, thimerosal is used only in multi-dose influenza vaccine vials.

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Residuals

Residuals are the tiny amounts of compounds that may remain in the vaccine after the completion of the vaccine manufacturing process. For example, some vaccines will have trace amounts of formaldehyde in them, as formaldehyde is used to inactivate (kill) viruses and bacteria for certain vaccines. The residuals found in vaccines are present in such minute quantities that they are safe for use and will not harm you.

Table 4: Examples of residuals found in vaccines

Residual	What it is used for	Other common locations
Formaldehyde	to inactivate (kill) viruses and bacteria for certain vaccines	Small quantities are present in your blood—more than you would find in any vaccine—as our bodies naturally produce formaldehyde.
Antibiotics	to prevent bacterial contamination during vaccine development	Antibiotics are a type of medication we take when we get sick with bacterial infections.
Yeast	Yeast cells are used to help grow the parts of the virus present in some vaccines.	• bread and bread products • grape skins • beer

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Residual	What it is used for	Other common locations
Egg protein	Chicken eggs or cells are used to grow viruses for certain vaccines (e.g., the influenza [flu] vaccine and the measles, mumps, and rubella [MMR] vaccine). The amount of egg protein present in routine vaccines in Canada is so small that people with egg allergies can safely receive these vaccines, including the MMR and influenza vaccines. Note: The yellow fever vaccine and certain rabies vaccines also contain egg protein, but in quantities that could lead to a reaction in people with an egg allergy. If you require either of these vaccines and have an egg allergy, please consult with a healthcare professional before you receive them.	Foods or drinks that contain eggs, such as: • desserts—many contain eggs • fresh pasta • some alcoholic beverages 

Is it true that human fetal cells are used to make some vaccines?

Yes, they are used to create some vaccines that protect against viruses such as rubella, varicella (chickenpox), and hepatitis A. We understand that this may be concerning, and we will discuss why fetal cells are used to make certain vaccines and why they are safe for use.

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Viruses need living cells to grow and reproduce, which is why they infect humans and animals. This is also why scientists use cells to grow viruses for vaccines. Different viruses grow best in different types of cells, so researchers study which cells are most suitable for each virus during vaccine production.

Scientists use fetal cell lines originally derived from four elective abortions performed between the 1960s and 1980s. These abortions were legal, voluntary, and the fetuses were not aborted for the purposes of vaccine creation; they were donated. Today, only the cell lines descended from those original cells—essentially their copies—are used. They act as eternal 'cell factories' and therefore no other new fetal cell lines from other abortions will be needed in the future.

Fetal cells were chosen as a medium in which to grow certain viruses for two main reasons. One, it made sense to see if viruses that infect humans could be grown in human cells. Two, and more importantly, fetuses develop in the womb, and the womb is considered a sterile environment. This means that the fetal cells used would not have been contaminated with any other viruses before being used to grow viruses for vaccines.

Once a virus has been grown in a fetal cell, the virus is then purified for vaccine development, whereby the fetal cell is stripped away so that only the virus remains. Microscopic traces of fetal DNA will remain in the vaccine (about one-trillionth of a gram), but the purification process damages them so significantly that they are harmless.

For more information on the history of fetal cell use to make vaccines, please see this short film from Medical History Productions, and this short video and questions-and-answers sheet from the Children's Hospital of Philadelphia.

Vaccines in Canada: Tested, safe, effective

Vaccines—and by extension their ingredients—are some of the most strictly regulated medical products in Canada. Before a vaccine is even considered for approval by Health Canada, it must go through rigorous testing to demonstrate that it is safe and that it works. Only vaccines that meet the highest standards set out by Health Canada are approved for use. Approved vaccines and their ingredients are continually monitored to ensure their safety.

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