5.2 Viruses and red blood cells: an interesting combination

Welcome! In this video we will see that we can use the interactions between viruses and RBCs or erythrocytes to learn more about the former. Let's talk about haemagglutination, haemagglutination inhibition, and haemadsorption. Let's start!

Many viruses (see the additional information), especially enveloped viruses, possess on their surface, molecules, called **haemagglutinins**, that can interact with the glycoprotein sialic acid on the surface of red blood cells of certain animal species. The result is that in the presence of these viruses cells are grouped or "agglutinate", preventing them from depositing by gravity at the bottom, If they are suspended in a liquid. An important detail is that the haemagglutinating ability is independent of the viral infectivity, i.e., it may also occur with inactivated viruses.

Making use of this observation, a diagnostic technique has been developed, that though it is not very precise, it is fast and inexpensive. It consists of combining the viruses diluted in saline solution, with erythrocytes and After 30 to 60 minutes at room temperature, observe the reaction. Haemagglutination is observed as a homogeneous turbidity distributed throughout the well. If there is no haemagglutination, a red button is formed at the bottom, as we can see here. We can quantify the amount of virus as "haemagglutinating units" or HAU, by making serial dilutions of virus that are added to a fixed concentration of erythrocytes (as we saw in the video of serum neutralization). Then the technique would continue as before. Typically 1 HAU equals 10 million PFU.

If we perform a haemagglutination test and get a positive result, we can conclude that we have a haemagglutinating virus, but we don't know which one it is. To identify it, we need to resort to specific entities, and what is more specific than antibodies? The test that combines haemagglutination and antibodies is called **haemagglutination inhibition test**.

In it, we first combine the problem viruses with specific antibodies against the viruses that we suspect that we may have, for example, antibodies anti-influenza virus. After incubation at 37°C for 30 minutes, we add a solution of erythrocytes and we let it incubate for another 30 minutes. If it's flu viruses, these antibodies will block them and surround them, preventing them from causing agglutination of the red blood cells. If, on the other hand, the viruses are not influenza there is agglutination.

Using this technique we can also determine the serum antibody titre against a particular virus. We will first prepare the dilutions of the serum as we saw in the video of neutralization and then we will add a known number of viruses to each dilution, continuing just as before. The titre of the serum is the highest dilution of it in which haemagglutination inhibition is complete.

The hemagglutination inhibition is a technique that is used, in addition to determining if a serum contains specific antibodies, also to characterize virus antigenically, establishing its subtype. This allows the selection of vaccine strains. We can see this in this example, in which the flu virus used for the vaccine resembles the circulating strain.

The **haemadsorption** is the adherence of red cells to a surface, for example, on infected cells. It only occurs in enveloped viruses, since the phenomenon requires that the haemagglutinins of the envelope of the virus are inserted in the membrane of the infected cell as the virus exits the cell by budding... and this only happens, of course, in enveloped viruses.

The diagnostic technique consists of incubating a cell culture infected with viruses (after we have removed the culture medium) with red blood cells in sufficient quantity to cover the cells. After incubating for 30 minutes at room temperature, we wash carefully to remove non-adherent cells and we observe under a microscope, comparing our sample with positive and negative controls.

If there erythrocytes are attached to the cells it will be indicative of viral infection. But we need to read it quickly, because it is a reversible phenomenon.

In this video we have seen techniques easy and fast, that do not require expensive equipment, and that employ erythrocytes, to establish the presence of certain viruses in samples or to the quantitate the amount of antibodies in the serum. I hope it will be useful for you.

Thank you for your attention.