

## Unit 5: Immunity and vaccination

### Student's notes

#### The immune system

This is made up of two parts that work together:

1. Cellular immunity
2. Antibodies

Any foreign material that enters the body be it a pathogen or any other cell deemed to be 'different', is called an **ANTIGEN** and starts off the immune response in the animal.

#### Immunity

Immunity consists of:

- i. **Innate** components and
- ii. **Induced** components

Both components have a CELLULAR response and a HUMORAL response

#### I. INNATE MECHANISM

##### A. Cellular response

Common cells in this response are neutrophils and macrophages.

They engulf pathogens by a process called phagocytosis.

- Neutrophils present in blood
- Macrophages present in milk and other bodily secretions.

##### What happens?

1. Macrophages see pathogen
2. Engulf it
3. Kicks off neutrophils reaction
4. Neutrophils keep on destroying pathogen
5. Macrophages hold pathogen and take it to the lymphocyte (white blood cell)
6. Lymphocytes will recognise it in future.

##### B. Humoral response

Consists of different types of proteins:

1. Complement - coats pathogen
2. Interferon - kills viruses and neutralises toxins
3. Lysozyme - kills bacteria.

## II. INDUCED MECHANISM

This mechanism also has **cellular** and **humoral** responses. Each cell or antibody is specific to an invading agent. The induced mechanism must have had prior exposure to the antigen.

### A. Cellular response

- Known as cell mediated immunity
- It consists of lymphocytes
- Lymphocytes produce antibodies
- Some lymphocytes have special features

#### For example:

T lymphocytes have killer T cells which recognise cancer cells.

B lymphocytes (plasma cells) have thousands of recognition sites on their surface.

T lymphocytes hold antigens and present them to the B lymphocyte which takes a 'fingerprint' of the antigen and stores it in its memory.

#### What happens?

1. Lymphocyte meets specific antigen
2. Single lymphocyte multiplies rapidly
3. These lymphocytes produce antibodies to neutralise antigen.

#### Case study

##### How many lymphocytes in a dairy Cow?

Dairy cow = 600kg in body weight

8 % of its weight is blood

8% of 600kg= 48kg

This is equal to 48 litres

7,000 white blood cells in every millilitre of blood

And 35 % of these WBC (white blood cells) are Lymphocytes

Therefore there are

2450 lymphocytes / ml of blood

**Total = 117,600,000 in the cow**

Lymphocytes can move through the blood vessels to lymph nodes and back looking for 'invader cells'.

### B. Humoral response

- Antibodies are large proteins
- Antibodies are produced by lymphocytes
- They neutralise invading cells.

Antibodies are very specific. They are sometimes only effective against 1 strain of a particular bacteria e.g. E. Coli antibodies fit the shape of the pathogen e.g. virus or bacteria.

It is then neutralised and the macrophages engulf it by phagocytosis.

## ANTIBODIES

Antibodies are acquired by the animal in two ways:

1. **Active**
2. **Passive**

### 1. Active immunity

Active immunity occurs when the animal produces antibodies either in response to natural challenges from disease, or as a result of vaccination. Once an animal has produced a specific antibody, it can produce more antibodies of the same type rapidly in response to an infection. This is why there are some diseases that tend only to be seen clinically once in a lifetime.

### 2. Passive immunity

This occurs when an animal receives antibodies from another source rather than producing its own. The protection from passive immunity doesn't last long (a few weeks) because the antibodies are gradually used or broken down by the animal.

Pregnant animals produce antibodies which are moved from the bloodstream to the colostrum (first milk). It is very important that newborn animals are given colostrum as their first feed because they can absorb antibodies from the gut into the blood stream at this stage. The colostrum will only contain antibodies to the diseases that the dam has been exposed. It is possible for specific antibodies to be collected from blood and given to animals that are suffering from diseases. This treatment may be effective when the animal would not have sufficient time to produce its own antibodies.

## Vaccines

Vaccines contain weakened strains of a disease causing organism (live vaccines), or attenuated (killed) disease causing organisms.

Vaccines are given so that the animal can develop an active immunity to a disease without suffering from the disease. Animals are given vaccines in several ways e.g. clostridial diseases by injection, orf by scratching the skin - scarification, lung worm vaccine as an oral dose.

The vaccinated animal will produce antibodies in response to the vaccine.

## Example

Clostridial vaccines - the primary course consists of an initial vaccination, then a booster after six weeks. This is followed by an annual booster to maintain protection and stimulate antibody production for the colostrums, so that the lamb gains passive immunity for the first few weeks of life.

## SPECIES DISEASES CONTROLLED BY VACCINES IN THE UK

**Cattle** - blackleg, tetanus, 'husk' (lungworm disease), rotavirus, infectious bovine rhinotracheitis (IBR), respiratory syncytial virus, pasteurellosis, enteritis, leptospirosis, mastitis, ringworm, BVD, PI3, coronavirus, salmonella, E coli

**Sheep and Goats** - clostridial diseases (8 different species including tetanus), pasteurellosis, ovine abortion (chlamydiosis and toxoplasmosis), louping ill, contagious pustular dermatitis (orf) footrot

