UNDERSTANDING BACTERIA AND ANTIBIOTICS

By Dr Rob Conradie

Bacteria

One often hears the terms “Gram-positive” and “Gram-negative” bacteria.

When samples are sent to a lab, the bacteriologist:-

- **Grows** the bacteria in the specimen submitted on a special growth medium (a jelly-like substance termed “agar”).
- **Stains** smears of the bacterial colony that grows, using a Gram stain procedure involving staining and decolorizing, using 4 reagents.
  The Gram-positive bacteria have a thick cell wall that stains blue.
  The Gram-negative bacteria have a much thinner cell wall and additional cell membrane that do not take up the blue stain but a red stain that makes them show up red.
- **Tests** further to identify the bacteria involved.
- Then tests the bacterial culture against the various **antibiotics** to determine which would be the most effective. (This test is called an Antibiogram).

Different antibiotics kill the bacteria in different ways but broadly speaking we have two basic modes of action.

The antibiotics affective against Gram-positive bacteria destroy the thick wall present in these bacteria.
The antibiotics effective against Gram-negative bacteria would target, in most cases, protein synthesis in the bacterial cell.

The most common bacteria we have found in **throat** swabs in the last 5 years, in order of prevalence are:-

- *Staphylococcus*: Gm **+**ve
- *Gallibacterium* (Pasteurella family): Gm **–**ve
- *Pelistiga europaea*: More or less confined to pigeons. Found originally in Belgium and Germany. Now found in S.A. Gm **–**ve
- *E. coli*: Gm **–**ve
- *Pseudomonas*: Gm **–**ve
- *Streptococcus:* Gm **+**ve
- Many other bacteria were found but less frequently. Most are significant. The bacteriologist guides us on whether the particular bacterium is pathogenic (causes disease) or not.

In many articles on respiratory infections in pigeons these bacteria listed above will often be collectively *called* Infectious Coryza.
This is not to be confused with the *true* Infectious Coryza seen in poultry, caused by a bacteria *Haemophylis coryza*.

In **Faecal** specimens the two most common bacteria found were:-

- *Salmonella*: Gm **–**ve. Every year about 50% of samples tested are positive for this bacterium.
- *E. coli*: Gm **–**ve. Many of the strains found were normal inhabitants of the gut.

Both Gram-positive and -negative are equally important. We get mild and severe bacterial infections caused by both groups.
Gram-negative bacteria are possibly more difficult to treat.

Antibiotics

An example of an antibiotic that would *only* treat Gram-positive bacteria is Penicillin first discovered in 1928. It had *no* effect on Gram-negative bacteria.
In 1943 Streptomycin was discovered. This antibiotic was *only* effective against Gram-negative bacteria.

The mixture of the two, called Penstrep originally, became the first broad spectrum antibiotic. It was a very effective product because bacteria had not had a chance to develop a resistance. At this stage every sick animal in the world would be given a Penstrep injection.

This original broad-spectrum antibiotic has over the years been replaced by our present, more effective antibiotics that cover Gram-positive and -negative bacteria to varying degrees.
Some are a little more effective against the Gram-positives and others a little more effective against the Gram-negatives.

Of the **Medpet** antibiotics we have:-

- Avivet (Amoxycillin) which covers Gm **+**ve and **–**ve bacteria very nicely. Antibiograms show that it can be very effective against many bacteria found in throat swabs. We feel it is being underused for respiratory infections.
  It is bacteriocidal (see below for explanation).
- Tylobiotic (Tylosin) covers both but more Gram-positive than Gram-negative bacteria. Also effective against Mycoplasma.
  Bacteriostatic (see below for explanation).
- Mediprim/Medicox combination (Trimethoprim/Sulphadimethoxazole) is our popular treatment of choice for Salmonella.
  Covers Gm **+**ve and **–**ve bacteria
  Very effective against some respiratory infections as well.
  As a matter of interest this antibiotic combination, called Bactrim or Septran in human medicine, was the most prescribed antibiotic in America in 2020.
  Bacteriostatic.
- Doxybiotic. Effective against Gm **+**ve and **–**ve bacteria, Chlamydia and Mycoplasma. Bacteriostatic. Reported to have anti-inflammatory properties.

It is not advisable to use any product beyond expiry date. In the case of Teteracyclines (Doxycycline, Chlortetracycline and Oxyteracycline) this is particularly important because they become toxic as they age.

- Medpet's Sulpha products (Avisol, Embazin) are Bacteriostatic antibiotics that are effective against both groups of bacteria but are not as effective as our more modern ones. These two products are used more as Coccidiosis treatments.

  All of the above, as with most modern antibiotics, **are broad-spectrum** - covering both Gm **+**ve and **–**ve bacteria to varying degrees.

Bacteriocidal vs Bacteriostatic antibiotics

Bacteriocidal antibiotics *kill* the bacteria. They are particularly effective in situations where the pigeon's immunity has been suppressed by virus conditions like Circovirus that have destroyed the lymphoid (tonsil) tissue of the body. The pigeon is unable to fight the infection. It is completely reliant on an antibiotic for the secondary infections that it would become susceptible to. An example of a bacteriocidal antibiotic that would work well in this type of case would be Avivet (Amoxycillin).
A person with Aids has no ability to fight secondary infections. A bacteriocidal antibiotic would be used in these cases as well.

Bacteriostatic antibiotics *inhibit the growth and multiplication* of the bacteria. The inactive bacteria left after a few days of treatment are not plentiful enough to cause ill health but stimulate the host's defence system allowing the host to develop immunity and produce antibodies against the bacteria, which are eventually destroyed by the pigeon's immune system.

A bacteriostatic antibiotic used at high doses and for longer periods of time can become bacteriocidal.

If a pigeon that is performing badly fails to respond to treatment, we test throat and faecal swabs as described in the first paragraph.
The recommended antibiotic is then used.
If an antibiotic is labelled as being effective against Staphylococcus, for example, it does not mean it is effective against all isolates of Staphylococcus.

It is for this reason that we do the antibiograms.