

Penam, oxapenam, carbapenam, monobactam, and cephem are beta-lactam subclasses of which the clinically relevant beta-lactam antibiotics are derived. The radicals joined to the core rings define the different antibiotics and also their antimicrobial activity, pharmacokinetic and toxicity.

The high reactivity of beta-lactam ring is responsible for the inherent allergenicity to beta-lactam antibiotics. It is estimated that six to eight percent of the population is allergic to these drugs. Hydroxyl or sulphydryl groups found in certain proteins react with the ring system, creating a covalent penicillin-protein conjugate that can induce an allergic response (Bousquet et al. 2008).

3.3 Classification and Spectrum of Activity

According to their beta-lactam core ring structure and chemical structure, beta-lactam antibiotics are classified into five important groups with a particular spectrum of activity.

3.3.1 Penicillins

Penicillins are included in the large group of penams. They possess a bicyclic core structure, 6-aminopenicillanic acid (6-APA), which is formed by condensation of L-cysteine and D-valine (Long et al. 2005). Due to the highly reactive nature of the beta-lactam ring, penicillins are susceptible to degradation under certain conditions such as acidity. This is because they must be protected from gastric acid pH when used by oral administration (Fernandes and Prudêncio 2013). The different penicillins are defined by the side chain in the 6-amino group (Figure 3.2).

Penicillins can be classified as natural (benzylpenicillin or penicillin G and phenoxymethylpenicillin or penicillin V) and semisynthetic penicillins, which in turn can be grouped into penicillinase-resistant (cloxacillin, dicloxacillin, nafcillin, oxacillin, temocillin) or extended-spectrum penicillins (including amoxicillin, ampicillin, and mecillinam that are aminopenicillins, ticarcillin that is a carboxypenicillin, and piperacillin that is a ureidopenicillin) (Fernandes and Prudêncio 2013).

3.3.1.1 Natural Penicillins

These penicillins are produced from a number of species of *Penicillium* spp. Penicillin G was the first antimicrobial agent commercialized and is still active against different bacteria.

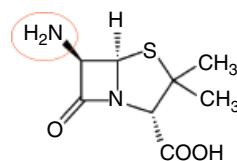


Figure 3.2 Molecule of 6-aminopenicillanic acid. Circle: amino group in position 6.