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Hot Topic

Why do arthropods secrete β-lactams?

Most currently used antibiotics are generated by bacteria or fungi, which illustrates the continuous war of the microbiological worlds [1]. Animal secretion of β-lactams, particularly penicillin, has only recently been discovered. Collembola springtails, particularly *Folsomia candida*, have been shown to produce penicillin (isopenicillin N and two cephamycin C) [2]. The origin of these β-lactams is unknown, but the non-ribosomal proteins synthetase encoding these β-lactams appears to be archaic and originates with genes secreted by fungi and bacteria in a deep and independent root. The identified genes consist of isopenicillin synthase (and isopenicillin is expressed) and cephamycin genes [2]. So, why do springtails produce β-lactams? There are several possible hypotheses. One hypothesis is that most arthropods carry endosymbiotic Wolbachia species, which we showed to be resistant to all β-lactams used and tested [3]; therefore, the secretion of β-lactams prevents colonization by bacteria that could compete with the Wolbachia symbiont. Indeed, tetracycline, which is active on Wolbachia, inhibits the growth of springtails [4]. Another hypothesis is that springtails and other soil-dwelling β-lactam-secreting arthropods play a special role in the rhizosphere by consuming many fungi. Fungi can secrete β-lactams (penicillin originates from the fungus Penicillium) and are naturally resistant to β-lactams. Springtails may prevent bacterial overgrowth by secreting β-lactams, allowing the growth of fungi on which springtails feed. The discovery that animals such as springtails can synthesize and export β-lactams and that most animals, including humans, carry β-lactamases [5] indicates that the role of β-lactams and β-lactamases is broader than once thought Fig. 1.

Fig. 1. Springtail (photograph by Jean-Michel Bérenger).

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None

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