Rodenticide resistance and environmental monitoring

No evidence of anticoagulant resistance in Barcelona's rats

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DOI: 10.20315/evmc.2025.168

Urban rodents, such as brown rat (*Rattus norvegicus*) and black rat (*Rattus rattus*), cause significant problems in cities and are the primary target of control efforts. Managing these synanthropic species remains a major challenge. Today, anticoagulant rodenticides are widely used worldwide to control rodent populations, including urban populations. However, despite their effectiveness, their use is sometimes compromised by the emergence of resistance. One of the best studied resistance mechanisms involves the enzyme vitamin K epoxide reductase (VKOR), the target of anticoagulant rodenticides. When anticoagulants inhibit VKOR, the resulting lack of bioavailable vitamin K disrupts the gamma-carboxylated of clotting factors, thereby affecting the coagulation. This leads to internal bleeding and, ultimately, death. Mutations in the Vkorc1 gene have been shown to confer resistance to anticoagulants in rats.

This study investigates the frequency of anticoagulant resistance genotypes in the Vkorc1 gene in rats from the Barcelona area. Brown rats undergoing rodenticide control programmes with alternating active ingredients were sampled from the sewage system between two periods: December 2016 to November 2017, when difenacoum and brodifacoum were used, and August 2021 to July 2022, when bromadiolone was used. Black rats, newly detected in Barcelona, were only sampled in the latter period as part of green space management. Exon 3 of the Vkorc1 gene was sequenced in both rat species, and Exon 1 was also analysed in black rats. Synonymous mutations, which do not lead to amino acid changes, were detected and showed no evidence of anticoagulant resistance. This suggests that the current approach in Barcelona, which uses the rotation of rodenticides and live traps as part of a broader surveillance and control strategy, has been effective in preventing the development of resistance. Future surveillance and control plans should consider diversifying methods to further improve rodent management. Implementing well-regulated control strategies and fostering community involvement in rodent management are key to maintaining rodenticide efficacy and minimising the risk of resistance.