Fighting the Bite – Sustainable Antivenom Production

E. C. Jappe and A. B. Jakobsen

DTU Chemistry, Technical University of Denmark | Copenhagen Business School

TACKLING THE WORLD'S MOST NEGLECTED TROPICAL DISEASE

Globally, more than 5.5 million people are bitten by venomous snakes per year, leading to 125,000 deaths and 4 times as many amputations. The problem is most prevalent in Sub-Saharan Africa in rural communities.

Current antivenoms are obtained from immunised horse blood and are, therefore, not compatible with the human immune system. The antivenoms cause severe side effects (incl. serum sickness and death) in up to 81% of patients due to their immunogenicity. Additionally, current antivenoms lack efficacy and it is estimated that more than 99% of the antibodies and other proteins in antisera are non-specific and have no therapeutic effect on the snake venom. Hence, large quantities of antisera are needed for administration to the patient in order to deliver enough of the 1% potent antibodies.

In addition to safety and efficacy issues related to current antivenoms, the production method for antivenom is highly unsustainable, both environmentally and economically. In order to treat all snakebite victims on a global level, it is estimated that 17,000 horses would be required annually. These horses need to go through a 1-1.5 year long immunisation protocol which, together with the very high costs of husbandry, constitutes a heavy financial burden. This results in prohibitively high priced antivenom for low-income markets such as sub-Saharan Africa. From an environmental point of view, current methods of production annually result in an astounding 200,000 tonnes of waste and more than 35,000 tonnes of CO_2 (equivalent to 1.65 million trees). As a result of the safety, efficacy and cost issues, less than 2% of all snakebite victims in Sub-Saharan Africa are receiving antivenom treatment.

SUSTAINABLE PRODUCTION ENABLES BROADER ACCESS TO ANTIVENOM

By using recombinant biopharmaceutical technology, we will replace current antivenoms with a more financially and ecologically sustainable alternative, based on recombinant humanised antibodies that specifically target the medically relevant toxins in snake venoms. This targeted therapy has the potential to be more efficacious and much safer, since humanised antibodies *are* compatible with the human immune system. Furthermore, using cost-competitive fermentation as the production method completely eliminates the need for production animals which substantially lowers the cost of production, and, in turn, reducing the cost of care by 90%. In Africa alone this will provide over 750 million people with access to antivenom; a drastic improvement compared to the current 10 million. Seeing this in a green perspective, our proposed solution has the potential to reduce production waste by 97% and to cut production time down to 4% of the current requirement.
The snake antivenom industry is ripe to enter the era of modern biopharmaceuticals – and we will make it happen.

REFERENCES

Brown, N. I. (2012). Consequences of neglect: analysis of the sub-Saharan African snake antivenom market and the global context. *PLoS neglected tropical diseases*, *6*(6), e1670.