

ningaloo

BIO SYSTEMS

ADVANCED BIOMANUFACTURING

Guiding Protein Assembly with Light to Improve Product Quality





EXECUTIVE SUMMARY

Optogenetics is no longer just ready for bioproduction —it lets us shape how proteins are made. By combining light-responsive and constitutive expression, we can tune the formation of biopharmaceuticals. Adjusting light intensity allows us to control the assembly of its components, and this demonstrates how optogenetics can move beyond expression to orchestrate the balance between correctly assembled and unintended protein forms on demand.



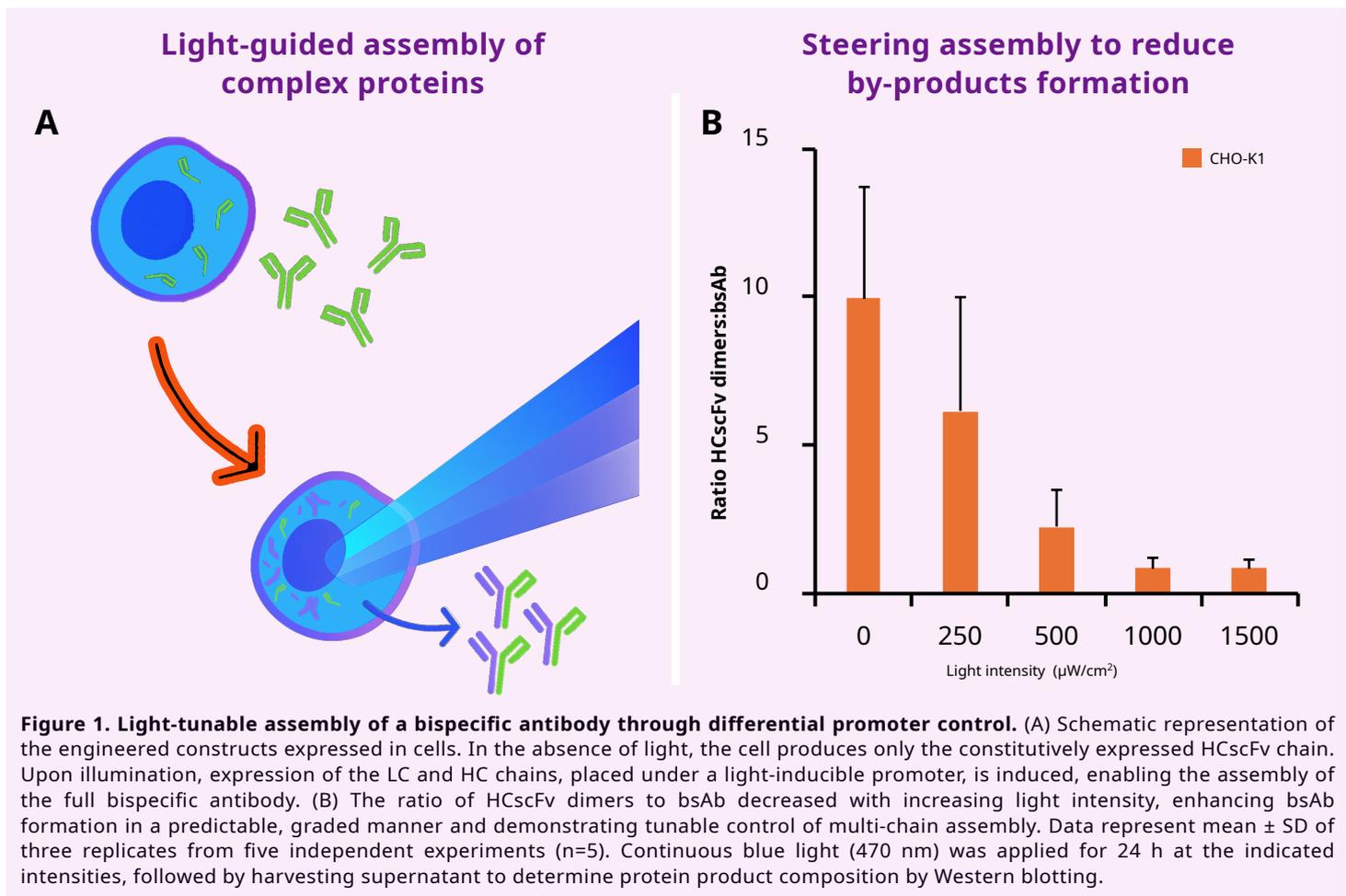
PROBLEM

Producing multi-chain biologics such as bispecific antibodies remains challenging. Static expression systems cannot adjust stoichiometry, and chemical inducers introduce cost and process variability. Achieving dynamic control over multi-chain assembly is critical for product quality and downstream processing simplification, yet current approaches offer limited tunability.



OPTIMIZING MULTI-CHAIN ASSEMBLY

We designed a system expressing a bispecific antibody construct with a knob-in-hole feature, where two chains (LC and HC) are under light-inducible control, while a third chain (HCscFv) is constitutively expressed. By varying light intensity, we were able to dynamically modulate the expression of LC and HC, which in turn influences the levels of fully assembled bsAb. This approach allows precise control of multi-chain protein assembly, providing a clear and adjustable output that can be realized by different light conditions.



CONCLUSION

We here demonstrate the potential of optogenetic expression control to optimize product quality in upstream bioprocessing of advanced biopharmaceuticals. Through precise light input adjustment, we can fine-tune the assembly of complex proteins while they are generated by the host cells. This represents an important step towards a platform for dynamic, responsive, and efficient bioproduction that can seamlessly adapt to changing process conditions, enhance product consistency, and unlock new opportunities to improve productivity while simplifying the purification of next-generation biologics.