

Research Statement

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RESEARCH FOCUS

I work on the delivery of **natural-product actives**, which are unusually difficult pharmaceutical objects: often potent, usually poorly soluble, frequently unstable, and almost always cleared faster than their activity warrants. The formulation is not a convenience for these compounds; it is the difference between a promising extract and a product.

TWO PROGRAMMES, ONE PROBLEM

Transdermal delivery of a turmeric flavonoid fraction. My Master's work developed a transdermal patch carrying a flavonoid-rich extract of *Curcuma longa* for acne. I ran the extraction and characterisation of the flavonoids, formulation optimisation, physicochemical characterisation of the patches, in vitro release, antimicrobial evaluation, skin permeation and safety assessment. The work produced a first-author paper in the *Journal of Pharmaceutical Innovation* and a **filed Indian patent** (No. 202421042057) — an unusual outcome for a Master's project, and one that taught me what an evidence package must contain before anyone outside the laboratory will act on it.

Nanocarrier co-delivery of shikonin. My doctorate at the Shanghai Institute of Materia Medica addressed the same class of problem at the nanoscale. Shikonin inhibits PKM2 and suppresses tumour glycolysis but is poorly soluble and rapidly cleared. I designed a **mesoporous polydopamine-based Pickering emulsion** carrying it alongside the BET inhibitor JQ1, holding both at a fixed ratio to the point of release. In triple-negative breast cancer models it suppressed primary tumour growth and lung metastasis through simultaneous **apoptosis**, blockade of **epithelial–mesenchymal transition** and blockade of **vasculogenic mimicry**. Published in *Acta Pharmacologica Sinica* 46(12):3314-3326, **joint first author, equal contribution formally recorded**.

WHAT I WOULD PROPOSE IN YOUR GROUP

1. Follicular and dermal routes for botanical actives. The skin is a forgiving place to demonstrate a natural-product delivery system: the endpoint is measurable, the safety burden is lower, and the route to a product is short. My patent work is the starting point rather than the conclusion — appendageal delivery, and controlling where in the skin a botanical fraction is deposited, is the part I did not finish.

2. Standardising the awkward part of natural-product formulation. A plant fraction is not a single molecule, and batch variability is the reason many promising extracts never become products. Building characterisation and release specifications that tolerate that variability is a genuinely useful and fundable problem.

3. Nanocarriers for poorly soluble natural actives, extending the doctoral work beyond oncology into the nutraceutical and cosmetic settings your group also works in.

CAPABILITY

Formulation design and optimisation across dosage forms — mesoporous carriers, Pickering emulsions, thermosensitive hydrogels, transdermal patches. Characterisation by DLS, zeta potential, TEM, SEM, HPLC, UV–Vis and fluorescence spectroscopy. Cell biology including culture, uptake, viability, apoptosis, flow cytometry, immunofluorescence, Western blot, RT-qPCR and ELISA. Complete murine in vivo work — ethics approval, dosing, monitoring, biodistribution, histopathology, organ toxicity — run independently. I have not worked in a GMP environment or on scale-up.

RECORD

Seven peer-reviewed publications, 324 citations, h-index 3 (Google Scholar, July 2026); three as first or joint first author. One filed Indian patent. Five national conference presentations. Doctorate funded throughout by the ANSO Young Talent and Belt and Road Government Fellowships.