Texts to Technology: Curcumin and Kadamba in Cancer Therapeutics

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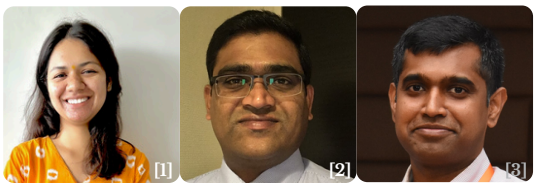

The exploration of the medicinal importance of Haridrā (Curcuma longa) and Kadamba (Anthocephalus cadamba) is deeply rooted in classical Indian texts. In Sushruta Samhita, Haridrā is identified as a key ingredient in formulations used to treat 20 types of Prameha.[1] In particular, in Cikitsasthana 6.17, 20, it even states that there is no Prameha (modern-day disorders such as diabetes mellitus and metabolic syndrome) that is incurable by Haridrā. In Ayurveda, the therapeutic effects of C. longa are well discussed in Dashemani Lekhaniya (emaciating), Kusthagna (anti-dermatosis), and Visaghna (anti-poisonous) texts.[2] Similarly, Kadamba is mentioned in several ancient Ayurvedic texts like Charaka Samhita, Astangahridaya, Harit Samhita, Chakaradatta, etc., establishing its long history of medicinal use. In our folklore, plant parts like fruit have been used for gastric irritability, fever, as a blood purifier; whereas the stem bark is known for antibacterial activity, and used for inflammation of the eye.[3]

All together, these verses and ancient literature position Haridrā and Kadamba not just as dietary or ritual substances but as core therapeutic agents in the Ayurvedic pharmacopeia, particularly in treating inflammatory, dermal, and wound-related conditions. The primary constituents of turmeric include a group of polyphenolic compounds called curcuminoids. These curcuminoids mainly include curcumin, demethoxycurcumin, and bisdemethoxycurcumin, and essential oils like turmerone and zingiberene.[4] The medicinal properties of the Kadamba tree are attributed to a diverse range of phytochemicals, particularly indole alkaloids, such as cadambine; triterpenes, and saponins like cadambagenic acid and quinovic acid, etc.

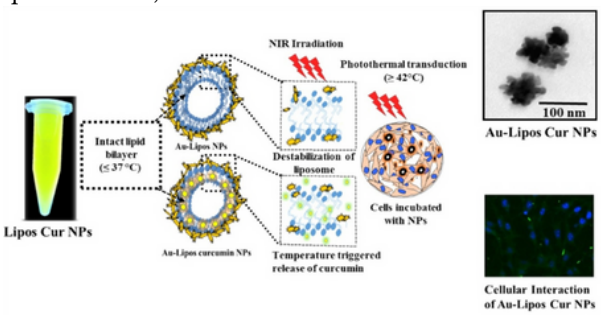

Fig 1. Schematic representation of NIR-triggered liposome–gold nanoparticle (Au-Lipos) hybrid entrapping curcumin for photothermal therapy of skin cancer. (Adapted from Singh et al., 2018)

In today's era, the challenge lies in translating these insights into clinically viable formulations. Curcumin, despite its potent activity, has poor aqueous solubility, which results in low systemic bioavailability. Numerous nanotechnology-based systems are being investigated to address these limitations. For example, Singh et al. (2018) have engineered a near-infrared-triggered liposome–gold nanoparticle hybrid entrapping curcumin. The lipid bilayer remains stable at physiological temperature, encapsulating curcumin. Upon near-infrared (NIR) irradiation, the gold nanoparticles convert light into heat (⩾42 °C), destabilizing the liposomal bilayer and triggering temperature-mediated release of curcumin. The overall system enhanced the curcumin delivery and also demonstrated synergistic tumor regression.[5]

Parallel studies have explored the potential of Kadamba (Neolamarckia cadamba) in advanced cancer therapies. Its chlorophyll-rich biomolecular fraction has been identified as a natural photosensitizer capable of harnessing light energy for photothermal and photodynamic mechanisms. Pemmaraju et al. (2018) investigated a polymeric nanosystem encapsulating Kadamba chlorophyll fractions, which, when combined with photothermal therapy, significantly enhanced cancer theranostic efficacy. This synergistic system not only improved bioavailability but also demonstrated selective tumor ablation, highlighting Kadamba as a promising plant-derived resource for nanomedicine-based cancer therapy.[6]

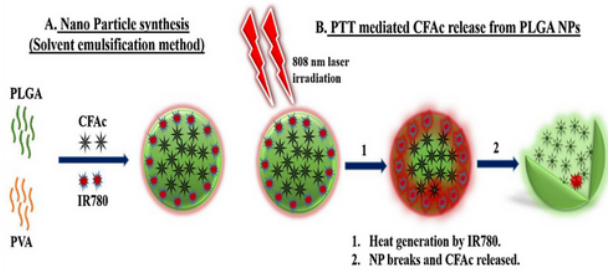

Fig 2. Schematic illustration of chlorophyll-rich biomolecular fraction (CFAc) from Anthocephalus cadamba loaded into PLGA nanoparticles for photothermal therapy (Adapted from Pemmaraju et al., 2018)

Thus, classical Ayurvedic references show Haridrā and Kadamba as potent therapeutic agents. Today, with advanced nanosystems as stated above we translate these ancient insights into clinically relevant cancer theranostics with enhanced bioavailability, selectivity, and therapeutic efficacy.

References

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