# IIT-H develops oil-based drug delivery system to fight fungal infections

*The new medication can even counter fungi that have developed resistance to conventional antifungal drugs*

Sangareddy: Indian Institute of Technology Hyderabad (IIT-H) researchers have developed essential oil-based drug delivery systems to treat fungal infections without running the risk of inducing drug resistance. This medication can even counter fungi that have developed resistance to conventional antifungal drugs.

Microorganisms such as bacteria and fungi have a remarkable capacity to evolve resistance to antimicrobial agents used to destroy them.

The research was led by Dr Mudrika Khandelwal, Associate Professor, Department of Materials Science and Metallurgical Engineering, IIT-H, and supported with funds by the Science and Engineering Research Board, Department of Science and Technology (DST), Government of India, and Corporate Social Responsibility (CSR) Grants from the American multinational conglomerate AT&T.

The Research Paper, co-authored with her Ph D student Shivakalyani Adepu, was published in the international peer-reviewed journal Materialia.

With the results of this work, the researchers are developing prototype antifungal hygiene products with the financial support from the Biotechnology Industry Research Assistance Council (BIRAC), set up by the Department of Biotechnology (DBT), Government of India, as an Interface Agency to strengthen and empower emerging Biotech enterprises.

Highlighting the need for developing alternate, non-resistance inducing treatment options for fungal diseases, Dr Mudrika Khandelwal said, “Given the prevalence of fungal infections such as vaginal infections, diaper rash, athlete’s foot, and nail fungus, caused by the Candida family of fungi, drug resistance can become life-threatening.”

The IIT-H team turned to natural products to solve this problem. The idea of using carriers for controlled release of drugs has been around and various types of carriers including polymeric microcapsules, nanoemulsions/colloids and hydrogels have been developed for various drugs.

Elaborating on this research, Ms Shivakalyani Adepu, PhD student, Department of Materials Science And Metallurgical Engineering, IIT- Hyderabad, said, “Herbal essential oils and their ingredients are a promising class of effective antimicrobials Thymol found in oregano oils, carvacrol found in thyme and eugenol found in clove oil, have excellent antimicrobial action against all types of Candida fungi. The problem with essential oils and their components is that they are sensitive to temperature, light, and pH, and decompose easily.”

A way to overcome this problem is to design a suitable carrier system that can protect the oils/active principles from these factors, and yet, release them in a controlled manner so that the antifungal action can be fully harnessed.

“Currently we are developing antifungal panty liners for mitigating vaginal candidiasis. The developed formulation can also be used as a transdermal patch /mucoadhesive patch to treat skin and mucocutaneous infections without inducing resistance in the fungal species,” added Dr Khandelwal.

The IIT-H team chose polylactic acid microcapsules to encapsulate the essential oil ingredients. Polylactic acid polymers are biocompatible and biodegradable and are already widely used in the medical field. The researchers found that using the microcapsules alone as the carrier could cause uncontrolled, burst release of the ingredients.

To delay the release of the active principles, the researches designed another level of protection. The polylactic acid microcapsules that contained the active substances were further incorporated into a secondary barrier made of nanofibrous bacterial cellulose. In addition to designing the double-barrier carrier system, the researchers also enhanced the anti-fungal activity of their formulation by using synergistic mixtures of thymol, carvacrol, and eugenol.

The researchers compared their double-barrier, triple-ingredient formulation with simple colloids of the ingredients and found that the latter suffered from a far more rapid decrease in activity compared to their design. Furthermore, their controlled-release design achieved 99.9 per cent fungistatic action within 12 hours, with only half the concentration of thymol, carvacrol, and eugenol as the colloidal samples, thus enabling small dosages for treatment.

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