Instituto Politécnico Nacional
"La Técnica al Servicio de la Patria"

Press Release No. 42
Mexico City, november 3rd, 2024

IPN Develops Smart Patch for Treating Chronic Wounds

- **Led by researcher Francisca Villanueva Flores from the IPN's Centro de Investigación en Ciencia Aplicada y Tecnología Avanzada (CICATA) Morelos Unit**
- **Made from natural materials, it serves as an alternative for patients who cannot regularly access medical care, such as elderly adults, bedridden individuals, or those with diabetic foot ulcers**
- **Aims to reduce complications from infected wounds and decrease healing time**

As the healing process for chronic wounds often progresses slowly, sometimes taking weeks, months, or even years for spontaneous closure in extreme cases, Francisca Villanueva Flores, a researcher from the Instituto Politécnico Nacional (IPN) Centro de Investigación en Ciencia Aplicada y Tecnología Avanzada (CICATA) Morelos Unit, has developed a smart patch that releases a 100% natural antiseptic agent to aid the healing of deep wounds.

In collaboration with María Esperanza Peralta Cuevas, a Biochemical Engineering student at the National Technological Institute of Mexico (TecNM) in Zacatepec, Villanueva Flores designed this material to help reduce complications from infected wounds and accelerate the healing process.

Dr. Villanueva Flores explained that, under normal circumstances, wound healing (involving the first two layers of skin) takes between 14 and 30 days. However, in chronic wounds, the prolonged process significantly impacts the quality of life of patients and their families, as continuous antiseptic care is required to promote healing.

The patch is a viable alternative for elderly patients, bedridden individuals, or those with diabetic foot ulcers who cannot regularly attend medical facilities for wound care.

The commercially available biopolymer, derived from brown algae, was chemically modified to anchor curcumin nanoparticles (a compound derived from turmeric) as the active ingredient. “The patch has a dual action; the biopolymer and the active ingredient both possess antifungal, bactericidal, and antiviral properties. Additionally, curcumin has wound-healing effects, which accelerate the process of capillary remodeling,” explained the IPN expert.

She detailed that the hydrogel in the patch reacts to changes in acidity levels (pH), which is why it is considered a smart material capable of detecting infectious processes, typically characterized by a specific acidity level.

In this way, she added, when an infection develops in a wound, typical conditions emerge (such as a drop in pH), which the hydrogel detects, opening the polymeric network and, as a result, releasing a higher concentration of the active ingredient (curcumin). This allows for more effective infection control.

Dr. Villanueva noted that creating the patch required numerous trials. To encapsulate the nanoparticles effectively, the polymer was chemically modified, kinetic release analyses were conducted, and a neural network model was developed to train algorithms using various experimental data, enabling simulations of the material's effects.

To ensure the device achieves the desired effects releases the active ingredient according to each patient's needs, and prevents side effects, the dosage will be optimized using artificial intelligence algorithms in collaboration with the Catholic University of Murcia (UCAM) in Spain.

Based on the test results, the next steps will include patent registration with the Mexican Institute of Industrial Property (IMPI). The team will also seek the most effective approach to scale the biological innovation for industrial production and make it accessible to the public, particularly in remote regions of the country, where access to clinics or hospitals is limited, making it difficult for patients to travel for regular wound care.

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