



**Specimens.** Mateo with a display of *Triatoma infestans*, the bug that carries the Chagas parasite.

CHAGAS DISEASE

## With Novel Paint, Chemist Aims To Vanquish the *Vinchuca*

Spanish chemist Pilar Mateo invented a clever way to package insect-control agents in paint; after a decade of trying, she's persuaded Bolivia to give it a test

**URUNDAYTI, BOLIVIA**—The old woman walks slowly toward the car with a toothless smile. “*Doctorita*,” she says. Pilar Mateo jumps from the SUV, launching a hug so tight the frail elder looks like she might break in two. As they walk back toward the cluster of faded colorful mud homes, a crowd emerges to greet *la Doctorita*, a Spanish chemist who invented a remarkable insecticidal paint that covers the village’s buildings. Mateo is one step away from sainthood for this region’s indigenous Guarani people. “She made the bugs disappear,” the old woman whispers in my ear.

Urundayti lies in the heart of the Gran Chaco—a vast dry forest region in Bolivia, Argentina, and Paraguay that’s ground zero for Chagas disease, endemic in the Americas. Infection often begins with a bite from a large beak-nosed bug known as the *vinchuca* (*Triatoma infestans*) that emerges at night to feed. Through its feces, it transmits the *Trypanosoma cruzi* parasite that causes Chagas, a slow-developing illness that can lead to extreme lethargy and even organ failure.

Thirty years ago, the *vinchuca* infestation covered 628 million hectares of South America. A continent-wide effort of massive and repetitive insecticide application has whittled that zone down to 12% of the initial area. (Worldwide, the disease affects more than

8 million people.) Bolivia has the globe’s highest Chagas infection rates, and the Bolivian Chaco remains the epicenter of transmission, with more than 80% of homes still infested in many villages. Ranging between 150 and 300 meters above sea level, the Chaco is prime *vinchuca* terrain because of its warm, dry climate. Entrenched poverty is partly complicit: The vector makes its home in the walls of mud or adobe huts and feeds on farm animals like the ubiquitous goats and chickens.

Research shows that shoddy and sporadic fumigation has resulted in a pesticide-tolerant bug population. “This region presents such deep challenges that traditional pesticide application methods don’t seem capable of overcoming them,” says David Gorla, director



**Hot zone.** With a family in Bolivia’s Chaco region.

of the Regional Center for Scientific Investigation and Technological Transfers of Anillaco, La Rioja (CRILAR) in Argentina and one of the continent’s primary *T. infestans* experts.

Mateo believes that her patented paint—Inesfly 5A IGR, sold through her company, Inesba in Valencia, Spain—is the solution. Studies published in 2008 and 2009 show it is effective for four to 20 times longer than traditional pesticide applications, and its microcapsule packaging of active agents reduces environmental and toxic risks.

For the past decade, she’s been trying to paint her way across the Gran Chaco region. But adoption of Inesfly has been slow, partly because it lacks the approval of the World Health Organization’s Pesticide Evaluation Scheme (WHOPES), the gateway to biocide use in the developing world. Mateo’s go-it-alone approach, some say, has been a factor, too. No large pharma company is helping escort Inesba through its trials; Mateo has ruled out such partnerships.

But Inesfly now seems poised for a debut. A version that targets the malaria-carrying *Anopheles gambiae* mosquito has cleared two of the four WHOPES stages in Africa, where it will soon undergo a test of its ability to reduce malaria infections. And after a decade of obstacles, WHOPES evaluations of the anti-Chagas formula may begin here in Bolivia within the year.

### The invention

Mateo’s odyssey began in Spain 2 decades ago when she read about a local hospital being closed because of a bug infestation. The young Ph.D. in chemical engineering and daughter of a paint factory owner had a thought: If walls are homes for many common pests, then walls could also be a first line of defense. Her initial attempts at mixing pesticides and water-based paint were disastrous. Residual activity was null, and toxic chemicals leached. Mateo wondered whether coating the active ingredients in a nanocapsule would enable slow release and minimize health risks. In 1995, she patented the “microcapsule” packaging, and Inesfly was born. “I thought I’d make a fortune ridding wealthy people’s homes of cockroaches and flies,” Mateo says.

But that changed when, in 1998, a Bolivian doctor named Cleto Cáceres showed up on her doorstep in Spain. “My entire village is dying of a disease called Chagas. Can you

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help?” Mateo recalls him saying. She hesitated: “I didn’t make the paint to save lives.” But Cáceres proved convincing. A year later, Mateo traveled to his Chaco homeland and was stunned to see that the Guarani were so tormented by the *vinchuca* in their homes that they slept outside to escape the nightly feeding frenzies. Mateo, now 53, remembers thinking, “My life has changed forever.”

When Mateo arrived in Urundayti in 2006, she recalls, “the WHO had said it would be impossible to eliminate the *vinchuca* here.” The village had been fumigated for several years, but the *vinchuca* kept returning. Mateo and residents painted home walls, fences, and community buildings later that year. The bugs left, and Urundayti is still *vinchuca*-free. Since 1998, approximately 7000 houses in the region have been painted with Inesfly. According to evaluations by SEDES Santa Cruz, the local office of Bolivia’s health ministry, areas formerly registering 90% infestation levels have gone to zero vector presence, often with one paint application. No painted communities have suffered reinfestation, the reports say.

No side effects or environmental complications have been reported, says Abraham Gemio, a scientist who joined Mateo’s company in 2006 and now manages its new paint projects and postpaint evaluations. “We can make history here in the Chaco,” says Gemio, arguably Bolivia’s most knowledgeable *T. infestans* scientist, who helped established Bolivia’s national Chagas program in 1980 and led it for 25 years before joining Mateo’s firm.

“The great advantage of this paint is that it solves the most important shortcomings in vector-control programs such as short residual activity,” says CRILAR’s Gorla, who has published papers on the paint in *Parasites & Vectors* and in the journal of the Oswaldo Cruz Institute in Rio de Janeiro. In natural conditions, Inesfly has a kill rate of 100% for at least 6 months and 22% for 34 months after application, according to his research.

A key to the paint’s effectiveness, researchers say, is the microcapsules’ inclusion of insect growth regulator (IGR) compounds such as pyriproxyfen and diflubenzuron, which prevent the insects from developing fully. These have no effect on humans but attack insects’ young and eggs, which insecticides rarely reach. As a long-term agent, IGR is better than pesticides alone, because it does not select resistant organisms for survival, says Jorge Méndez Galván, former director of vector-transmitted diseases for the Mexican government. João Carlos Pinto Dias, a renowned Chagas researcher at the Oswaldo

Cruz Institute with half a century of experience, adds that painted homes lead to “greater self-esteem among the poor and improved [living] conditions.”

### Into the labyrinth

With so many fans, why is Inesfly still relatively unknown? “In international meetings of Chagas experts, there’s a general feeling of skepticism,” says one expert who requested anonymity. “Everyone asks: If it works so well, then why hasn’t she gotten [WHOPES] approval?”

“The lack of approval is a commercial problem,” says Javier Lucientes Curdi of the University of Zaragoza in Spain, who’s been studying Inesfly’s potential for containment of insect-borne animal diseases for years.

According to Mateo, the reasons are numerous. First, WHOPES is a complex labyrinth that requires rigorous testing of each formulation at specified centers. Without a host country’s support—which Mateo lacked until recently—it is hard to launch a WHOPES review. And each evaluation can cost millions—a reach for Mateo’s 12-person company, which operates with \$1 million annually.

Inesba rarely charges more than cost of production for the paint (\$100 covers a standard Chaco house). The company earns most of its income from other products such as Inesba’s joint venture with Dow Chemicals Spain to microencapsulate agricultural pesticides, and a lice shampoo.

Revenues underwrite Inesfly, S.L. in Spain, an independent company that researches new uses for microcapsules. Inesba also supports Mateo’s foundation, Science and Knowledge in Action, which funds women’s empowerment and community-development projects worldwide. Though Mateo says she was apolitical earlier in life, she’s now a born-again revolutionary. She readily lambastes what she calls the elite, profit-driven pharmaceutical world and says that “the real solution” for eradicating diseases of poverty such as Chagas is to end global inequality—not distribute paint.

Chris Schofield, coordinator for the European Community–Latin America Network for Research on the Biology and Control of Triatominae (ECLAT) and honorary senior lecturer at the London School of Hygiene and Tropical Medicine, praises Mateo as “an excellent formulation chemist who has developed a splendid technology.” Yet he sees a risk

in her anticorporate stance: “It’s like if you develop a new medicine that you know works. Unless you partner with a large company with the resources to make it available throughout the world, it’s going to stay unknown.”

Mateo has focused on proving the paint’s safety, obtaining relatively benign toxicity ratings from laboratories in Latin American and Europe. But she says that for more than a decade, the Bolivian health ministry refused to expand the Inesfly painting test area. “We can’t go skirting international guidelines just because the paint seems like a good idea,” says Max Enriquez, director of Bolivia’s Chagas program, who says only WHOPES approval will lift his doubts.

Mateo was incensed. Frustrated by what



**Mixing it up.** Mateo and colleagues Franz Espejo (left) and Johnny Bauda prepare paint for use against *vinchuca* (below).

she calls “two-legged pests,” she took her case last year directly to President Evo Morales. Armed with stacks of scientific data, she convinced him within an hour of the paint’s worth. He has now authorized every indigenous Guarani home in the Chaco to be painted—and has demanded that the health ministry facilitate the initiation of WHOPES trials.

With this decision, the last piece of the WHOPES puzzle—a national sponsor for *vinchuca* control—has fallen into place. World Chagas experts and financial backing have been waiting in the wings: The trials, set to begin this year, will be led by Pedro Albajar Viñas, coordinator of the Chagas program of WHO’s neglected tropical diseases unit, in collaboration with ECLAT, Barcelona’s Hospital Vall d’Hebron, and Spain’s development agency, AECID, Mateo says.

Pinto Dias is deeply pleased: “I hope with all my heart that this product soon becomes available. ... As a witness to its effectiveness, I truly wish that others have a chance to use this important tool.”

—JEAN FRIEDMAN-RUDOVSKY

Jean Friedman-Rudovsky is a journalist in La Paz, Bolivia.

