

Name of Solution:

Green Nano -Antibacterial Technology: Chitosan encapsulated nanosilver entrapped cinnamaldehyde and thymol to combat multi-drug-resistant bacteria in poultry

Submitter: ICAR

Solution Overview: What is it, and what problem does it solve? Brief 2–3 sentence description.

Multi-drug resistant (MDR) pathogens, particularly *Escherichia coli* and non-typhoidal *Salmonella* spp. (NTS) are a major challenge in public health due to their apparent spread within poultry and their associated environments. With the limited antibiotic drug discovery pipelines, currently, non-clinical and clinical research is now invested in the identification of novel and non-conventional anti-infective adjunctive or preventive therapies. Though various phytochemicals alone or their combinations with antibiotics have been tried with success to address multi-drug resistant (MDR) pathogens, particularly *Escherichia coli* and non-typhoidal *Salmonella* spp. (NTS) in poultry; however, their long-term use may not be effective owing to the development of resistance, and also stability issues of the phytochemicals when administered alone. Hence, to improve the stability, bioavailability, and release of these phytochemical compounds, we identified a unique combination of encapsulated nanosilver-entrapped phytochemical molecules as a novel green strategy to address MDR pathogen-driven ailments and associated diseases in the poultry industry.

Key Features & Benefits: Main components and why it is useful? Bullet points summarizing methods, tools, and value added.

The unique features of the developed technology are as follows.

- The developed technology (compound) can be used for effective tackling MDR pathogens in poultry.

- Using this technology on poultry farms will ensure antibiotic residue free broiler birds
- The developed compounds (EAgT and EAgC) were found safe as per OECD 425 guidelines, and also stable at room temperature (9 months).
- The innovative product is intended for targeted delivery (released maximum >80% at alkaline pH i.e. in the intestine), hence dose required would be less and also it reduces overall production costs.
- No residues of compounds were found in vital organs and breast muscles of treated poultry ensuring consumer safety.
- The microbes may have a very rare or almost negligible chance of developing resistance against the developed product (EAgT and EAgC).
- The developed product can be used either as a therapeutic as well as from a preventive perspective to tackle MDR pathogens in the poultry industry..

Where It Works and Where It Can Work: Existing and potential target regions, agroecologies, or farming systems. Include examples if available

- The developed technology will be quite useful to poultry farmers and poultry industry in particular to tackle the menace of MDR pathogens by employing an eco-friendly: Green Nano -Antibacterial Technology
- The use of developed technology to raise poultry (broiler or Layer) will ensure antibiotic residue free poultry meat and eggs which is healthy and safe from consumer point of view.
- The developed technology can further be explored in Research and development wing of biopharmaceutical industry to explore its other potential.

Evidence & Impact: *What results has it shown? Stats, pilot outcomes, or testimonials*

The developed innovation has been studied for toxicological parameters as per OECD 425 guidelines and also validated in the field and was found to be safe and effective. In brief, the encapsulated compounds (EAgC, EAgT) derived from the present study were found to inhibit bacterial growth and improve survival rate with minimal toxicity in appropriate in vitro assays and in vivo models, with an improved feed conversion ratio (FCR) in poultry and leaving no residues of the innovated compounds in poultry meat which is crucial for food safety and consumer health. The innovative molecules are supposed to provide an appropriate delivery system at the targeted site, which means the compounds are designed to reach the specific sites where the targeted pathogens are often encountered. This approach not only reduces the required dose by also reduces overall production costs. To conclude, this innovative technology presents a promising green approach to inhibit bacterial growth, improve survival rates, and combat antibiotic resistance while maintaining food safety standards. It also emphasizes the potential

economic benefits and the possibility of developing a commercially viable product based on these innovations.

Scalability & Adoption Support: *Why it can be scaled and what's needed to adopt it? Low-cost, adaptable, partner-ready, etc.*

- It can be scaled up to any extent to address the menace of MDR pathogens in poultry production for producing wholesome and antibiotic residue free poultry meat and eggs.
- For its wider adaptation, cost effective instrumentation, financial support and trained manpower will be required.
- Already the technology has been licensed to two commercial firms viz.,
- M/s ITP Special Additives India Pvt. Ltd, Mumbai
- M/s Microbax (India) Ltd., Hyderabad

Partners & Contact Info: *Who's involved and how to connect? List of key contact and partners + email / phone.*

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