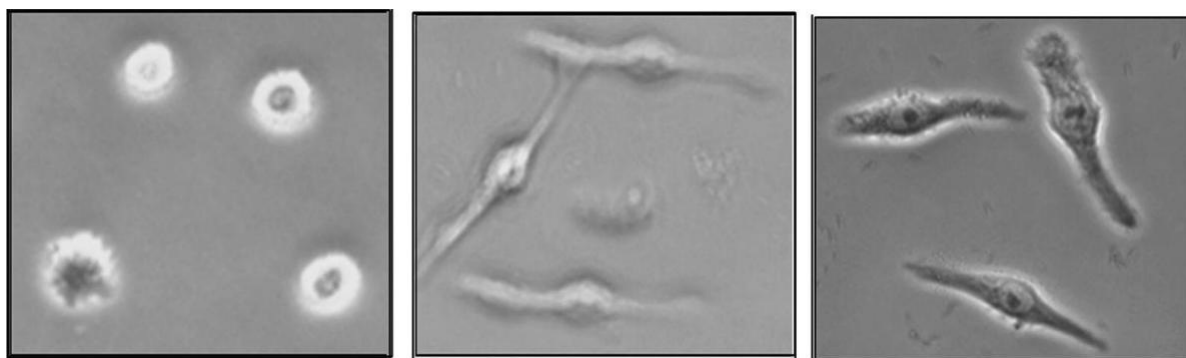


### **Patent granted to DBT-NII on vaccine against epsilon toxin of *Clostridium perfringens***

At DBT's National Institute of Immunology (NII), New Delhi, to meet the requirement of epitope based vaccine, the patent invention (Indian patent no 341670) identified the putative epitopes on the antigenic protein and synthesis of short oligonucleotides corresponding to these epitopes. This invention which has been developed at NII, New Delhi relates to the generation of a recombinant fusion protein comprising of epitopes from epsilon toxin and B subunit of heat labile enterotoxin (LTB) to make a subunit vaccine for *Clostridium perfringens* epsilon toxin. Subunit vaccine contains only the small domains of the epsilon toxin thereby abolishing the toxic effect of the toxin.



Various studies have suggested that the subunit vaccines elicit more potent antigen-specific response when using in combination with an adjuvant. Heat labile enterotoxin subunit B (LTB) of *E. coli* is known to be highly immunogenic and have been widely tested as oral immunogen and as immunogenic carriers of other antigens. Binding to receptors on mucosal epithelial cells, specifically microfold cell (M-cells) located above the Peyer's patch in the intestine, is thought to increase the uptake of the antigen across the mucosa and leads to an enhanced presentation of the antigen to the immune system.

Therefore, it may be of great interest that LTB fused epsilon toxin epitope/epitopes could generate strong protective immune. Fusion protein approach offers a novel, potentially inexpensive and versatile method to produce candidate subunit vaccine. Recombinant DNA techniques are valuable tools to make fusion proteins in bulk using bacterial expression system. Existing vaccine approaches do not direct the immunity towards the epitope that will certainly give the maximum protection. This problem could be circumvented if the epitopes

of epsilon toxin gene that stimulate a protective immune response are identified and the knowledge could thus be used to design epitope-based vaccine.

*C. perfringens* is a Gram positive anaerobe which is ubiquitous in the environment and is capable of forming heat resistant endospores. It is a causative agent of severe gastrointestinal diseases including enterotoxemia and enteritis in animals, and gas gangrene and food poisoning in humans. *C. perfringens* has been classified into five types (A to E) based upon the toxins they produce. *C. perfringens* type B and D produce Epsilon (ε) toxin and type D isolates are the etiological agents of highly lethal enterotoxaemia, particularly in sheep and goats.

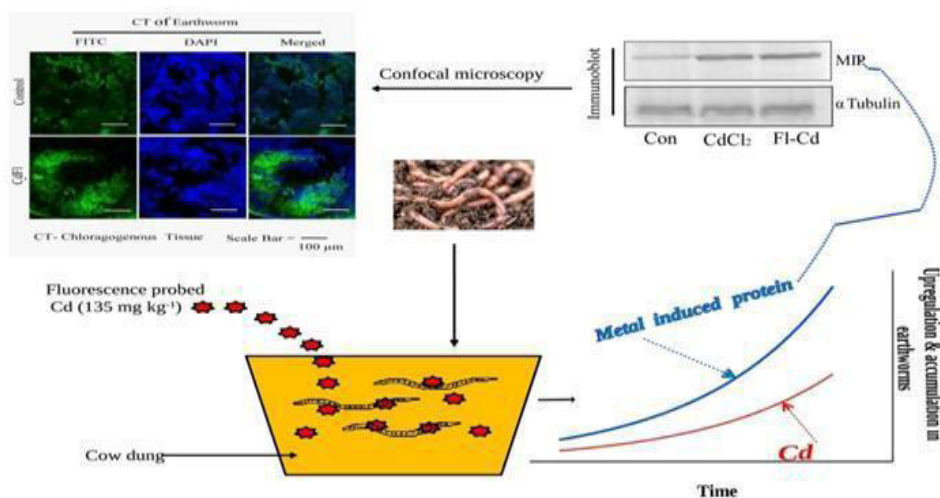
**Link:** <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6626085/>

**Link:** [https://vigyanprasar.gov.in/wp-content/uploads/vigyan\\_samachar\\_dbt\\_01B\\_28July2020.pdf](https://vigyanprasar.gov.in/wp-content/uploads/vigyan_samachar_dbt_01B_28July2020.pdf)

## Metal induced non-metallothionein protein in earthworm: A new pathway for cadmium detoxification in chloragogenous tissue

Investigation by Scientists at DBT's Regional Centre for Biotechnology (RGCB), Thiruvananthapuram demonstrated that expression of some non-MT metal induced proteins was responsible for such incongruity. After 60 days of exposure cadmium accumulation in earthworm intestines was significant. Immunofluorescence staining followed by confocal microscopy exhibited that MIP accumulates ingested cadmium in the intestinal region and eventually deposits the metal in the chloragogenous tissue. The N-terminal sequence of 15 amino acid residues was determined and after bioinformatic analysis, it was concluded that MIP is most probably a glutamic acid rich, novel cadmium binding protein.

To further validate the binding mechanism, paper chromatography and continuous variation experiments which evidenced that cadmium readily binds to glutamic acid were conducted. The present finding is the first *in-vivo* evidence of a non-metallothionein cadmium binding protein induced in the intestines of earthworm exposed to a cadmium rich environment.

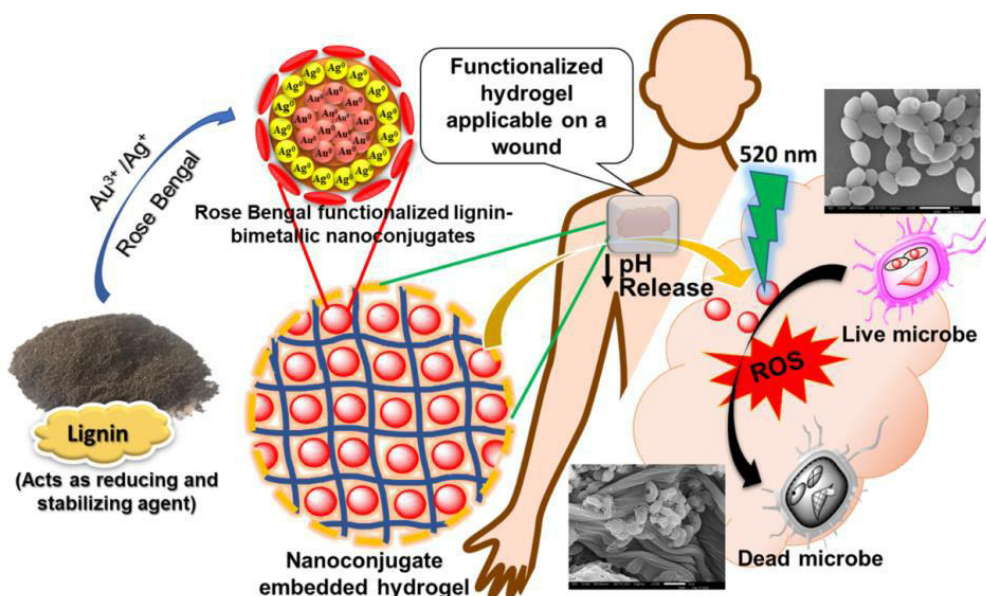


Earthworms neutralize toxic metals by a small (~13 kDa) cysteine rich metal binding protein, metallothionein (MT). Although the rate of metal accumulation and MT expression does not correlate well, and the reason behind such inconsistency has not yet been deciphered.

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## Development of agri-biomass derived lignin-bimetallic nanocomposite hydrogels with antimicrobial effects

Researchers at DBT's Center of Innovative and Applied Bioprocessing (DBT-CIAB), Mohali utilized agri-biomass derived lignin to synthesize silver-gold based photodynamic nanoconjugates. These nanoconjugates were used for the development of stable nanocomposite hydrogels. The developed hydrogels were tested for antimicrobial photodynamic efficacy and were found to perform complete microbial disinfection upon laser exposure. Interestingly, the team found that the developed antimicrobial hydrogels responded to micro-environmental pH and get activated only upon microbial exposure. This helps in pH triggered controlled release of the embedded nanoconjugates which in turn kills microbes.



Utilization of the developed hydrogels also assisted in better retention of nanoconjugates, sustaining their antimicrobial photodynamic efficacy for increased shelf life and long-term use. The developed hydrogels were also found to possess promising rheological as well transmittance properties. Simple and nontoxic methods were applied for the development of nanoconjugates and the corresponding hydrogels. All the aforementioned factors make the complete material to be scalable and cost-effective. The developed biocompatible nanocomposite hydrogels could be potentially applicable in controlled drug delivery, to develop antimicrobial nanocoatings as well as to construct wound dressings.

Recently emerging microbial infections and communal spread require rapid therapeutic as well as diagnostic solutions. Moreover, microbes are intense threat to human health. Fabrication of sustainable antimicrobial materials can be done using lignin, which is a naturally abundant polyphenol-rich biopolymer. This study has been recently published in the journal, *Biomacromolecules* published by American Chemical Society. (Impact Factor: 5.667, 2018)

**Link:** <https://pubs.acs.org/doi/abs/10.1021/acs.biomac.0c00695>

**Link:** [https://vigyanprasar.gov.in/wp-content/uploads/vigyan\\_samachar\\_dbt\\_02B\\_29July2020.pdf](https://vigyanprasar.gov.in/wp-content/uploads/vigyan_samachar_dbt_02B_29July2020.pdf)

## **DBT-NIAB scientists study desi cows to get a drug for TB**

Tuberculosis (TB) is one of the leading causes of death worldwide. There were about 10.0 million new cases and 1.5 million deaths globally in 2018. It is a leading killer of people with HIV and a major cause of deaths related to antimicrobial resistance (AMR). India has the highest burden of the disease with an estimated incidence of about 2.69 million cases.



It has been reported that a considerable proportion of human TB is caused by *Mycobacterium bovis*, the primary causative bacteria for TB in cows (Bovine TB or BTB). In other words, cows are a major reservoir of zoonotic TB. To make matters worse, TB in cattle is also caused by the human TB bacilli, *M. Tuberculosis*. TB in cattle and Zoonotic TB in humans presents a unique health challenge in India due to several reasons.

First, there is no vaccine available for BTB; second, the national BTB control programme is yet to be implemented; third, the inability to identify and differentiate *M. bovis* from *M. tuberculosis* based on routinely used clinical laboratory procedures prevents true estimation of the incidence of zoonotic TB in human; and fourth, *M. bovis* is naturally resistant to Pyrazinamide, one of the four drugs used in standard first-line anti-TB treatment regimen. This may preclude the patients from successful treatment and recovery, thereby increasing the chances of transmission and failure to eradicate TB disease completely. But, on the brighter side, India is also home to the largest cattle population in the world with an array of indigenous and crossbred varieties with enormous genetic variability. Several reports indicated that prevalence of TB is markedly greater in exotic and crossbred cattle compared to indigenous breeds. Hence, finding the key differences in the immune responses that makes an indigenous cow less susceptible to TB will have a huge impact for development of better biomarkers for diagnosis and development of effective vaccines against TB in both animals and humans.

The Department of Biotechnology's National Institute of Animal Biotechnology (DBT-NIAB), Hyderabad, has taken up a study to work on this hypothesis. The project intends to

employ a start-of-the art transcriptomic sequencing approach to differentiate the immune responses in indigenous cows in comparison to crossbred cows when they are exposed to TB Infection. The findings from this study will not only help discover a signature of protective immunity guiding to develop appropriate control strategies and vaccines for TB but also help in adopting effective cross breeding policy. Finally, this study will contribute significantly in the research towards control of TB at the animal source to reduce its transmission to humans and thus help to achieve the ambitious goal of zero TB death globally.

DBT has funded a project for a period of three years for this nationally important collaborative project between NIAB and West Bengal University of Animal and Fishery Sciences (WBUAFS).

**Link:** [https://vigyanprasar.gov.in/wp-content/uploads/vigyan\\_samachar\\_dbt\\_01S\\_24July2020.pdf](https://vigyanprasar.gov.in/wp-content/uploads/vigyan_samachar_dbt_01S_24July2020.pdf)

## **DBT-NABI researchers study effects of Anthocyanin-fortified coloured wheat**

It is well established that consumption of either anthocyanins or whole wheat has a positive impact on chronic diseases. Researchers at the Department of Biotechnology's National Agri Food Biotechnology Institute (DBT-NABI), Mohali, have recently studied the effect and the underlying mechanism of anthocyanins biofortified whole wheat on high-fat diet (HFD) induced obesity and its comorbidities.

Mice models were fed a high fat diet supplemented with isoenergetic white, purple, or black whole wheat for 12 weeks and then subjected to physiological, biochemical, and nutrigenomics studies (qRT-PCR and RNA-Seq analysis). Both black and purple wheats were found to reduce total cholesterol, triglyceride, and free fatty acid levels in serum, with the restoration of blood glucose and insulin resistance.

However, black wheat was better as it also significantly reduced body weight gain and fat pad, and significantly elevated the expression of enzymes related to fatty acid balancing,  $\beta$ -oxidation, and oxidative stress that support the biochemical and physiological positive outcomes.

Moreover, the transcriptome analysis of adipose and liver tissue reveals activation of multiple pathways and genes related to fatty acid- $\beta$  oxidation (*crat*, *acca2*, *lonp2* etc.), antioxidative enzymes (*gpx1*, *sod1*, *nxn11* etc.), along with balancing of fatty acid metabolism specifically in black wheat supplemented mice.

Taken together, the results suggest that the incorporation of colored wheat (especially black wheat) in the diet can prevent obesity and related metabolic complications. This work was published in Molecular Nutrition Food Research (<https://doi.org/10.1002/mnfr.201900999>)



## DBT-ILS study finds a way to beat breast cancer

The cancer research group at the Department of Biotechnology's Institute of Life Sciences (DBT-ILS), has come up with some important observations linking the promotion of tumorigenesis and progression in breast cancer. The group led by Dr Sandip Mishra has observed that a protein called MLN4924, which is an neddylation inhibitor, can be a novel and effective strategy for breast cancer treatment.



The scientists initially found for the first time that the estrogen related receptor beta ( $ERR\beta$ ) is down regulated primarily at the protein level in breast cancer. They then found that Neddylation inhibition by MLN4924 causes an increase in  $ERR\beta$  and a decrease in the proliferative potential and clonogenicity of breast cancer cells. They also confirmed that  $ERR\beta$  limits the proliferation and clonogenicity of breast cancer cells, hence delineating a molecular mechanism of  $ERR\beta$  down regulation and have indicated that MLN4924 can be used to restore the expression of  $ERR\beta$ . Restoration of ERR beta expression leads to inhibition of cancer growth and migration.

**Link:** [https://vigyanprasar.gov.in/wp-content/uploads/vigyan\\_samachar\\_dbt\\_01S\\_28July2020.pdf](https://vigyanprasar.gov.in/wp-content/uploads/vigyan_samachar_dbt_01S_28July2020.pdf)