INTERVIEWS | INTERVIEW

“Piper longum derived compounds can be used not only as standalone treatments but as adjuvant therapies along with conventional chemotherapeutic drugs”

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By **Sanjiv Das** | January 4, 2026



Prof. Bijesh Kumar Biswal

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The multi-institutional research team, led by **Prof. Bijesh Kumar Biswal, Associate Professor in the Department of Life Science at National Institute of Technology Rourkela (NIT Rourkela),** conducted a set of laboratory experiments to demonstrate the activity of Piperlongumine, a natural compound, as an alternative to chemotherapy. The research team found that it selectively kills colon cancer cells while leaving healthy cells unharmed. Prof Biswal reveals more about the research undertaken by him and his team. Edited excerpts;

Can you tell us about the timeline of the research?

Our research on Piper longum and its anticancer potential began shortly after the COVID-19 pandemic, around early 2021. The lockdown years were challenging for scientific work, but they also gave us time to think deeply about alternative treatment strategies, especially for cancers that often become resistant to chemotherapy. This idea marked the beginning of our journey with piperlongumine, the active compound naturally present in long pepper.

The work progressed through several stages. First, we screened the compound through laboratory-based assays to understand its basic anticancer activity. Then, over the next few years, we evaluated its therapeutic potency using a wide range of experiments. These included tests for cancer cell proliferation, metastasis, DNA damage, mitochondrial dysfunction, and the generation of reactive oxygen species. We even created tumour-mimicking 3D models to see how the compound behaves in conditions closer to real tumours. Each experimental setup gave us strong and consistent results.

We saw remarkable inhibitory effects on the growth and spread of colon cancer cells, including drug-resistant ones. By 2024, we had a solid scientific foundation, and the work moved into the manuscript phase. After a rigorous international peer review, our paper was officially published in BioFactors in October 2025. The publication marked the culmination of four years of careful experimentation, optimisation, and constant validation.

What are the features of long pepper or Piper longum, and how does it help target cancer cells in the colon?

Piper longum or long pepper, is a spice widely used across Indian households for centuries. Beyond its culinary role, it has been an important part of Ayurveda for treating respiratory, digestive, and inflammatory disorders. One of its major bioactive molecules is piperlongumine, which gives the spice its medicinal properties. What makes piperlongumine special is its natural ability to target pathways that cancer cells heavily depend on. Colon cancer cells, especially those that are drug-resistant, operate under high oxidative stress. Piperlongumine pushes this stress even further, overwhelming the cancer cells and leading to their breakdown. Normal cells, however, are not in such a stressed state and therefore remain largely unaffected. This selective targeting is what makes the compound incredibly promising. Moreover, long pepper is easily available, inexpensive, and part of traditional diets, which makes it a culturally rooted

and accessible foundation for future therapies.

Did you face any challenges while going in for the research?

Yes, there were several challenges, and overcoming them was part of the learning experience. The biggest hurdle was a lack of funding. Many assays required sophisticated instrumentation and costly reagents, and some studies, especially animal model trials, were financially out of reach at this stage. We are currently applying for government funding to expand the research into animal studies and prepare for clinical translation. Another major challenge was dose optimisation for piperlongumine. Finding the right dose that effectively kills cancer cells without harming normal cells required months of repeated trials, adjustments, and cross-validation. Maintaining cancer cell lines was also a demanding task.

We work with multiple cell lines, each with its own growth pattern, nutrient requirement, and incubation condition. Preventing pathogenic contamination and cross-contamination was a daily responsibility. But with strict protocols and a cautious approach, we managed to maintain high-quality, reliable cultures throughout the study. Despite these challenges, our team’s dedication kept the research moving forward, and the final outcome has made every effort worthwhile.

Can Piper longum be combined with chemotherapy drugs?

Yes, and this is actually one of the most impactful findings of our work. Colon cancer patients who undergo long-term chemotherapy often develop drug resistance, meaning the same treatment stops working over time. This is particularly common with drugs like oxaliplatin. In our study, piperlongumine was able to re-sensitise drug-resistant cancer cells, making them responsive to chemotherapy again. This means that Piper longum derived compounds can be used not only as standalone treatments but also as adjuvant therapies along with conventional chemotherapeutic drugs. In simple words, it can help chemotherapy work better in advanced stages of cancer. This combination therapy approach could significantly improve patient outcomes, especially for those with limited treatment options.

How does piperlongumine induce oxidative stress in colon cancer cells without harming normal cells?

Cancer cells live under extreme internal pressure because they grow uncontrollably and demand high energy. This makes them naturally prone to oxidative stress. Piperlongumine takes advantage of this weakness. It increases the stress level even further, pushing the cancer cells beyond their survival capacity and ultimately causing cell death. Normal cells, on the other hand, maintain balanced metabolism and have stronger antioxidant defenses. When exposed to piperlongumine, they can neutralise the mild increase in oxidative stress without undergoing damage. This selective mechanism is one of the biggest advantages of piperlongumine, it attacks where cancer cells are weakest while sparing healthy tissues.

What can be the potential side effects of Piper longum at therapeutic levels?

Since piperlongumine is a naturally occurring phytocompound, it generally shows low toxicity in scientific studies. However, like any therapeutic molecule, side effects cannot be ruled out without clinical trials. High doses may potentially cause irritation, mild gastrointestinal discomfort, or metabolic stress. But these possibilities must be validated in animal studies and human trials. The good news is that all our laboratory experiments suggest a much safer profile compared to conventional chemotherapy, which often causes hair loss, nausea, organ toxicity, and immune suppression.

How do you see the future of this research? Are you looking forward to receiving patents?

The future looks extremely promising. Our immediate goal is to move this research into pre-clinical animal models, which is a crucial step before applying for human trials. We are also exploring modified formulations of piperlongumine to improve its stability, bioavailability, and targeted delivery inside the body. Regarding patents, yes, once we develop a refined and clinically applicable formulation or a novel delivery system, we definitely aim to move toward patenting. Intellectual property protection will help us promote innovation, attract industrial collaboration, and ensure structured development into a clinical product. Overall, this research has opened a new path in natural-product-based cancer therapy, and we hope it leads to a real-world medical solution.

Any other research you are working on or would like to pursue?

Along with continuing this project on drug-resistant colon cancer cells, our team is actively exploring other phytocompounds with anticancer potential. We are studying their molecular mechanisms in different cancer models to find new, safer therapies. Additionally, some of our parallel research involves improvisation of therapeutic delivery systems, for example, nano formulations or targeted carriers that enhance the stability and bioavailability of natural compounds. This can make plant-based molecules more efficient inside the human body and help them reach cancer cells more precisely. These areas allow us to connect basic science with clinical innovation, contributing to therapeutics of healthcare.

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Read online: https://nuffoodsspectrum.in/interviews/23/23007/piper-longum-derived-compounds-can-be-used-not-only-as-standalone-treatments-but-as-adjuvant-therapies-along-with-conventional-chemotherapeutic-drugs.html

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