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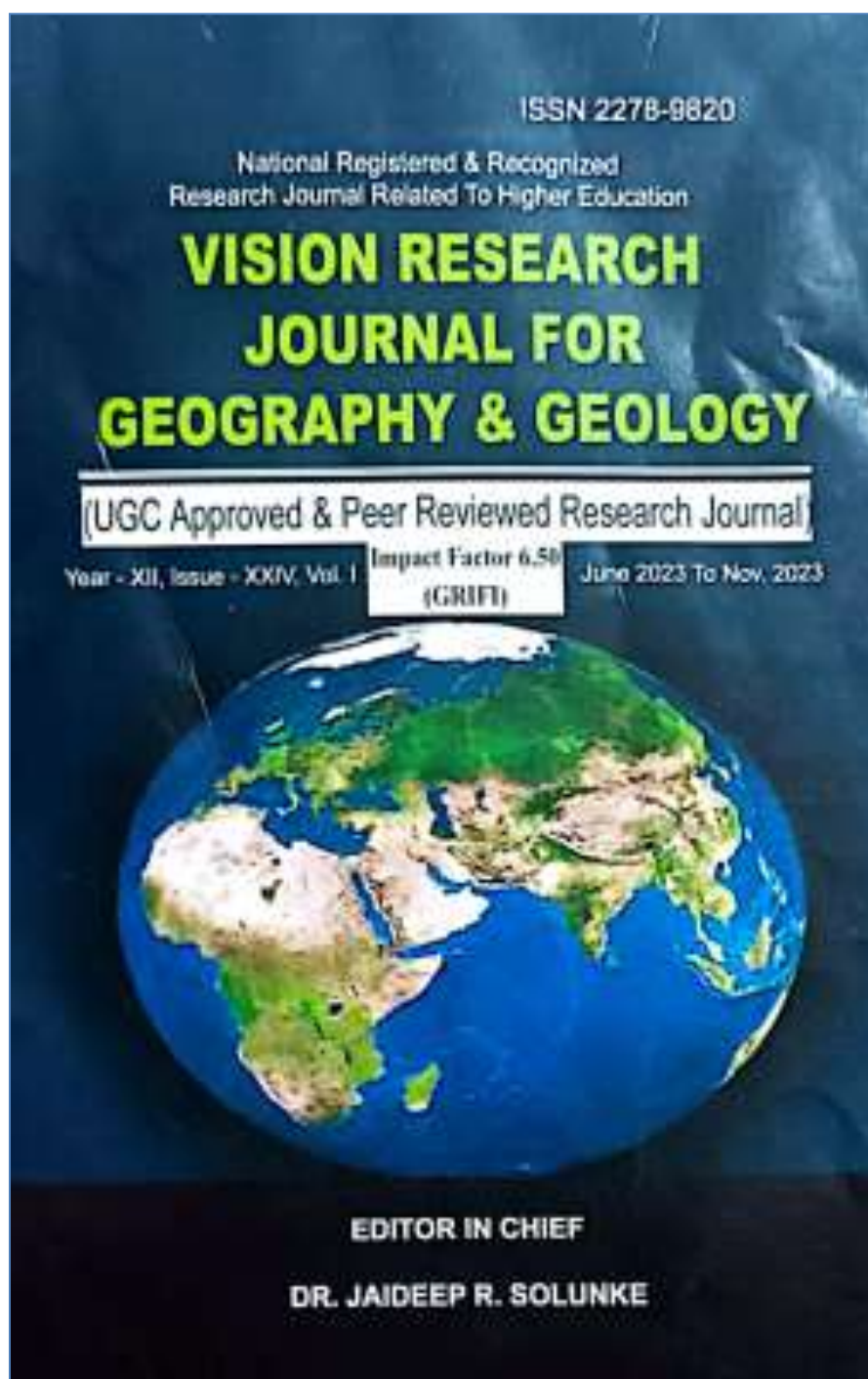


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Paper Author : Dr. Shahida Begam Mansuri



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Antimicrobial effect of a cyclic peptide Nostophycin isolated from wastewater cyanobacteria, *Nostoc calcicola*

Vaishali Gupta^{1*}, Deepak Vyas²

¹Government College, Bichhua, Dist. Chhindwara, Madhya Pradesh 480111, India, ²Department of Botany, Dr. Hari Singh Gour Central University, Sagar, Madhya Pradesh 470003, India

ABSTRACT

Different types of peptides are produced by cyanobacteria of the genus *Nostoc*, which are unique in structure and have a wide spectrum of biological activities. The objective of the study is to explore different habitats of organism and study antimicrobial activities to improve their pharmaceutical application and drug like properties by structure modification. A cyclic peptide nostophycin was isolated from *Nostoc calcicola* (MK506149) through freeze dried lyophilization method. Its structure has been elucidated using FT-IR, ¹H-NMR, ¹³C-NMR and LC-MS. Glycine, d-glutamine, l-phenylalanine, d-isoleucine, l-proline and a novel amino acid Ahoa are constituents of nostophycin. ¹H-NMR, ¹³C-NMR spectroscopy confirmed the number of protons and carbons, and characteristic peak determined the structure and fragmentation pattern through LC-MS. Nostophycin possess Ahoa instead of Adha which makes it different from microcystin. Nostophycin exhibits antimicrobial activity against *E. coli*, *S. aureus*, *C. albicans* and *A. niger*. Significant antifungal activity (9-52 µg/mL) and moderate antibacterial activity (concentration 15-52 µg/mL) were observed for nostophycin. In case of already known peptides, these molecules may be further exploited to improve pharmaceutical application and future drug development.

KEYWORDS: Ahoa, Cyclic Peptide, ¹H-NMR, ¹³C-NMR, LC-MS and Microcystins.

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INTRODUCTION

Cyanobacterial features conspicuous researchers due to their capability of synthesis of various bioactive compounds, diverse range of habitats, wide diversity and morphological variability. Cyanobacteria are gram negative, photosynthetic and ubiquitous bacteria, which known as a primary producers (Gademann & Portmann, 2006). Availability in the extreme environment and unique feature of cyanobacteria, considered it to be future pioneer for research (Kulasooriya, 2011; Potts, 1999; Scherer *et al.*, 1985; Scherer & Potts, 1989). According to Kalaitzis *et al.* (2009) cyanobacteria can produce immense range of bioactive compounds which help in survival in endurance and competitive ecological niche. Bioactive metabolites synthesized by *Nostoc* sp has been applied as a biofertilizer (Ghazal *et al.*, 2015; Win *et al.*, 2015), anticancer (Moore, 1996), antifungal (El-Sheekh *et al.*, 2014), antibacterial (Ploutno & Carmeli, 2000), antiviral (Botos & Wlodawer, 2003) and enzyme-inhibiting (Mazur-Marzec *et al.*, 2015). These bioactive compounds are explored and identified as peptides, alkaloids, terpenoids, fatty acid and lipopolysaccharides (Chorus, 2012; Dembitsky & Rezanka, 2005; Dittmann *et al.*, 2001; Nowruzi *et al.*, 2012; Parmar *et al.*, 2011). Allelochemicals influence their own growth potential,

other microbes in their vicinity, associated microorganisms, higher plants and animals. Cyanobacteria synthesize nitrogen storage material, new proteins, change pigmentation, excrete and store some other compounds, in response to environmental stress, temperature, pH, nutrient availability and light intensity (Mendes & Vermelho, 2013; Priya *et al.*, 2015; Singh, 2014).

High number of metabolites, lipid and lipid like compounds, peptides, oligopeptides and amino acid derivatives produced by different genera of the *Nostocaceae* family (Rezanka & Dembitsky, 2006). Nostocyclamide a macrocyclic peptide was first reported in *Nostoc* sp. (Jüttner *et al.*, 2001) and Nostophycin has been isolated from *Nostoc calcicola*, cyclic peptide with different amino acid including unusual amino acid (Fewer *et al.*, 2011). Extracts from various cyanobacteria have already been proved beneficial for *Triticum aestivum* (Jäger *et al.*, 2005) *Oryza sativa* (Saadatnia & Rishi, 2009), *Zea mays* (Saadatnia & Rishi, 2009), *Cucumis sativus*, *Cucurbita maxima* and *Solanum lycopersicum* (Shariatmadari *et al.*, 2011). Cyanobacteria are known to produce different allelochemicals that have the potential for multiple usages in various fields. Drug-like properties of peptide, combine effect of compounds, pharmaceutical applications of peptides can be improved and

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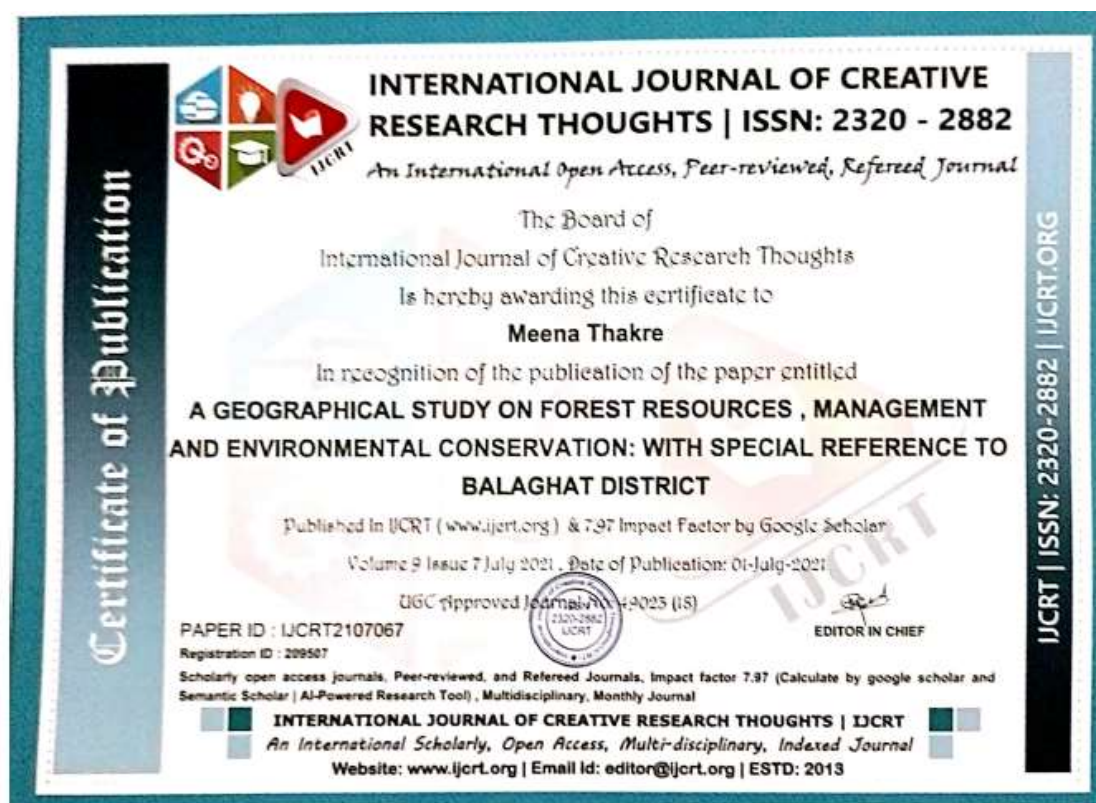
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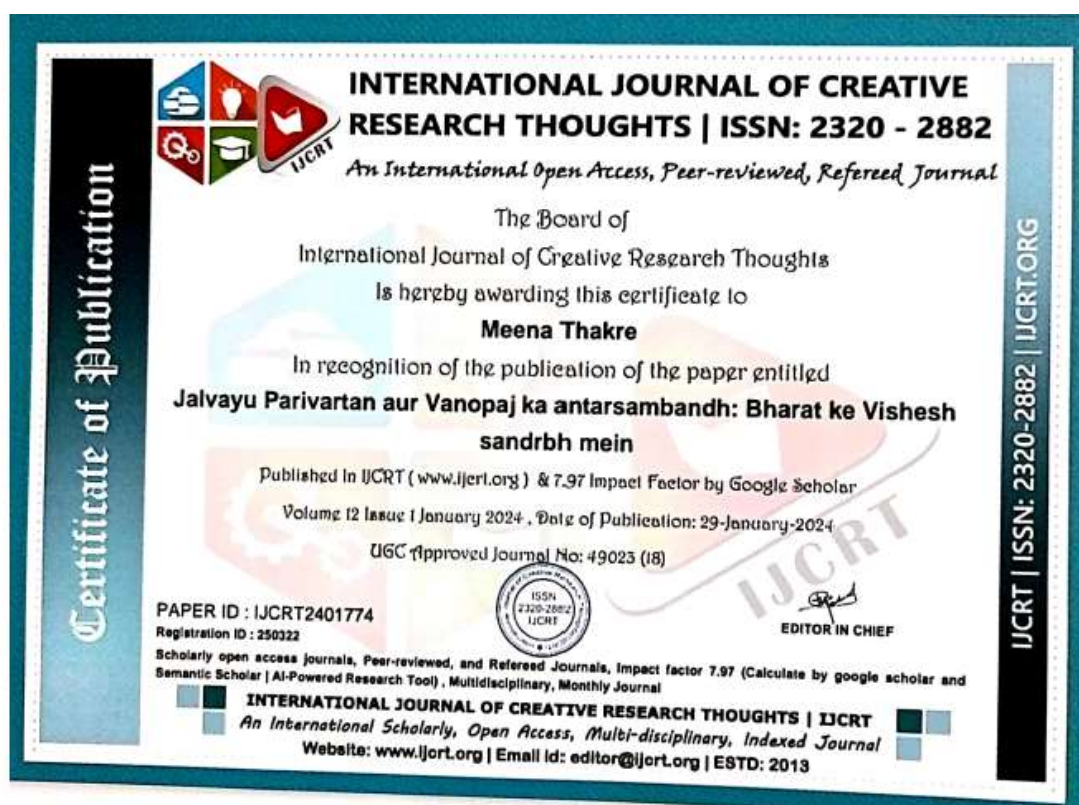


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मीना तारकर

सहायक प्राध्यापक, भूगोल विभाग, पास्तरीय महाविद्यालय, विठ्ठल, छिंदवाड़ा (म.प्र.)

सारांश: जैविक खेती कृषि की वह विधि है, जो संश्लेषित उर्वरकों एवं संश्लेषित कीटनाशकों के न्यूनतम प्रयोग पर आधारित है तथा जो भूमि की उर्वरा शक्ति को बनाए रखने के लिये फसल चक्र, हरी खाद, कम्पोस्ट आदि का प्रयोग करती है। सन् 1990 के बाद से विश्व में जैविक उत्पादों का बाजार काफी बढ़ता गया है। सघन खेती प्रणाली के खतरे बड़े चुनौतीपूर्ण रहे हैं क्योंकि इनसे पारिस्थितिकीय संतुलन पर भारी प्रभाव पड़ता है। इसी बात को ध्यान में रखकर आर्गेनिक या जैविक खेती पर आधारित प्रणाली के बारे में सोचा गया, जिसमें रासायनिक उर्वरकों के उपयोग की बजाय कार्बनिक पदार्थों को सड़ने-गलने से प्राप्त खाद का प्रयोग किया जाता है।

पारिभाषिक शब्दावली: जैविक खेती, जनसंख्या, पारिस्थितिकी, कीटनाशक आदि।

प्रस्तावना:

विश्व में बढ़ती हुई जनसंख्या एक बड़ी समस्या है, बढ़ती हुई जनसंख्या के साथ भोजन की आपूर्ति के लिए मानव द्वारा खाद्य उत्पादन की प्रतिस्पर्धा में अधिक उत्पादन प्राप्त करने के लिए अलग-अलग रासायनिक खादों, जहरीले कीटनाशकों का प्रयोग पारिस्थितिकी तंत्र, प्रकृति के जैविक और अजैविक पदार्थों के बीच आदान-प्रदान के चक्र को प्रभावित करता है, जिससे भूमि की उर्वरा शक्ति नष्ट हो जाती है, साथ ही वातावरण प्रदूषित भी होता है तथा मनुष्य की स्वास्थ्य पर बुरा प्रभाव पड़ता है। प्राचीन समय में मानव स्वास्थ्य के अनुकूल तथा प्राकृतिक वातावरण के अनुसार ही खेती की जाती थी, जिससे जैविक और अजैविक पदार्थों के बीच आदान-प्रदान का पारिस्थितिकी तंत्र निरन्तर चलता रहता था, जिसके परिणामस्वरूप जल, भूमि, वायु तथा पर्यावरण प्रदूषित नहीं होता था। भारत में प्राचीन समय से ही कृषि के साथ-साथ नौ फलन किया जाता था, जिसके प्रमाण हमारे ग्रंथों में प्रभु कुम्भ और बलराम हैं जिन्हें हम गोपाल एवं हल्धर के नाम से संबोधित करते हैं अर्थात् कृषि एवं गोपालन संयुक्त रूप से अत्यधिक लाभदायी था, जोकि प्राणी मात्र व वातावरण के लिए अत्यन्त उपयोगी था। परन्तु गोपालन धीरे-धीरे कम हो गया तथा कृषि में तरह-तरह की रासायनिक खादों व कीटनाशकों का प्रयोग होने लगा। जिसके फलस्वरूप जैविक और अजैविक पदार्थों के चक्र का संतुलन बिगड़ता जा रहा है और वातावरण प्रदूषित होकर, मानव जाति के स्वास्थ्य को प्रभावित कर रहा है। अब हम रासायनिक खादों, जहरीले कीटनाशकों के उपयोग के स्थान पर, जैविक खादों एवं दवाईयों का उपयोग कर, अधिक से अधिक उत्पादन प्राप्त कर सकते हैं जिससे भूमि, जल एवं वातावरण शुद्ध रहेगा और मनुष्य एवं प्रत्येक जीवजाली स्वस्थ रहेंगे। जैविक पदार्थों से बनी खाद के इस्तेमाल पर आधारित यह प्रणाली हमारे समाज में प्राचीनकाल से ही है। जैविक खेती में परम्परा नवसृजन और विज्ञान का सामन्वय करके परिवेश का साक्षात् लाभ उठाया जाता है और सभी सम्बद्ध पक्षों के बीच समुचित सम्बन्ध और अच्छे जीवन-स्तर को बढ़ावा दिया जाता है।

जैविक कृषि और सन्धियों

पूरे भारत में ग्रामीण अर्थव्यवस्था का मुख्य आधार कृषि है और कृषकों की मुख्य आय का साधन खेती है। हरित क्रांति के समय से बढ़ती हुई जनसंख्या को देखते हुए एवं आय की दृष्टि से उत्पादन बढ़ाना आवश्यक हो गया। अधिक उत्पादन के लिये खेती में अधिक मात्रा में रासायनिक उर्वरकों एवं कीटनाशक का उपयोग करना पड़ता है, जिससे सामान्य व छोटे कृषक के पास कम खेत में अत्यधिक लागत लग रही है और जल, भूमि, वायु और वातावरण भी प्रदूषित हो रहा है साथ ही खाद्य पदार्थ भी जहरीले हो रहे हैं। इसलिए इस प्रकार की उपरोक्त सभी समस्याओं से निपटने के लिये पिछले कुछ वर्षों से लगातार टिकाऊ खेती के सिद्धान्त पर खेती करने की सकारित की गई, जिसे प्रदेश के कृषि विभाग ने इस विशेष प्रकार की खेती को अपनाने के लिए बढ़ावा दिया, जिसे हम जैविक खेती कहते हैं।

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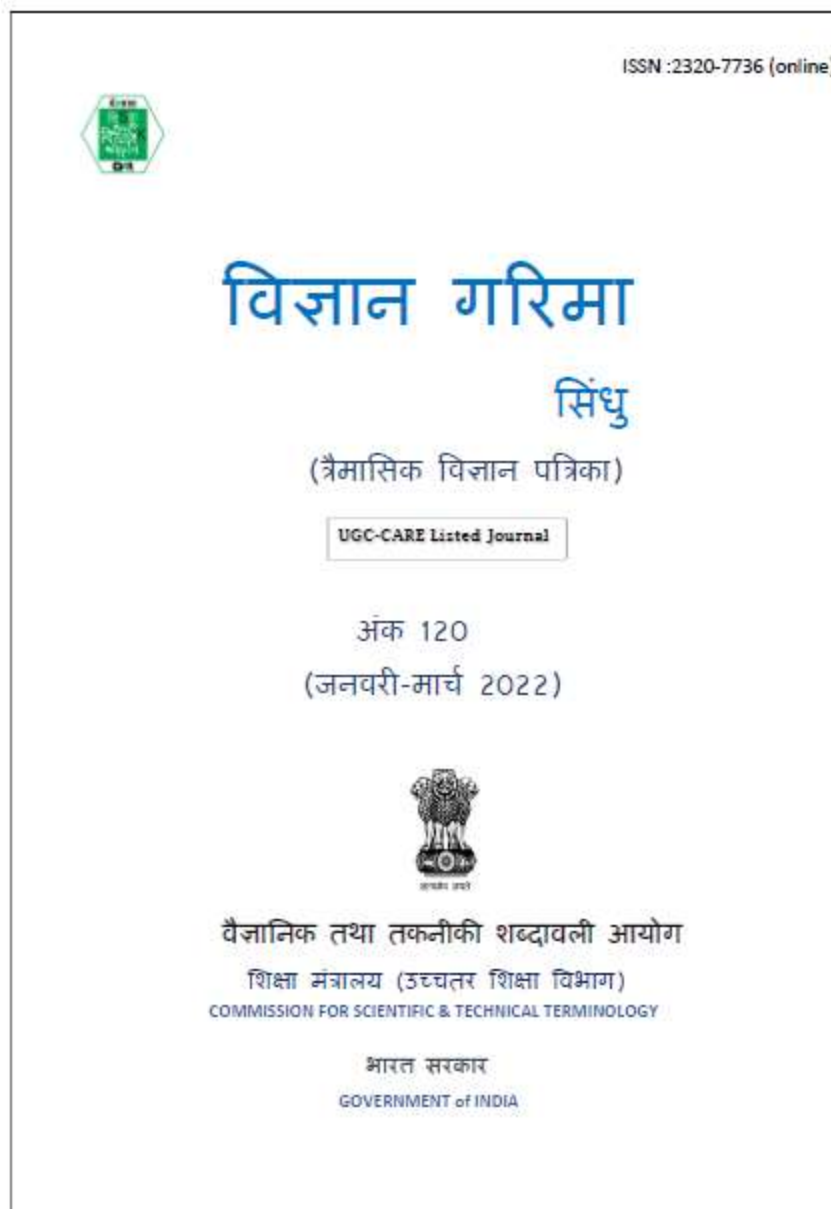
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"विज्ञान गरिमा सिंधु" पत्रिका में प्रकाशित लेखों में अभिव्यक्त विचारों, सुझावों, जानकारीयों आदि से वैज्ञानिक तथा तकनीकी शब्दावली आयोग, शिक्षा संवालय, भारत सरकार, या इस अंक के संपादक का सहमत होना आवश्यक नहीं है। यह पत्रिका वैज्ञानिक तथा तकनीकी शब्दावली आयोग द्वारा निर्मित शब्दावली के प्रचार प्रसार के साथ हिंदी में वैज्ञानिक तथा तकनीकी लेखन को प्रोत्साहित करने के लिए वैज्ञानिकों के रूप में प्रकाशित की जाती है।

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