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School of Life Sciences
KBC North Maharashtra University, Jalgaon

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Principal
Dr. D. R. Patil

Date: 15/08/2018

To,
The Director,
School of Life Sciences,
KBC North Maharashtra University, Jalgaon

I am writing to highly recommend **Department of Microbiology and Biotechnology, R. C. Patel Arts, Commerce and Science College, Shirpur** for the research collaboration opportunity with **School of life Sciences, Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon**.

Many Researchers working in The Department of Microbiology and Biotechnology have a profound understanding of Life Sciences, as evidenced by their multiple publications. Their innovative approach and ability to think critically have significantly contributed to our on-going research projects.

Please feel free to contact me if you require any further information. I am confident that Department of Microbiology and Biotechnology will be an invaluable asset to your research collaboration.

Sincerely,

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Journal of Basic Microbiology

METHOD PAPER

A simple, rapid and sensitive plate assay for detection of microbial hyaluronidase activity

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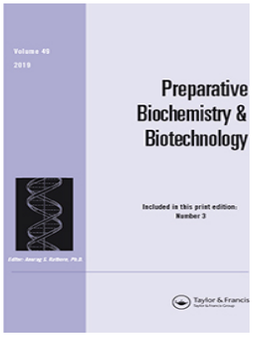
Hyaluronidase (hyase) is a glycosidase enzyme that predominantly degrades hyaluronic acid (HA) having important applications in many biotechnological processes and therapeutics. Several assay methods have been proposed to screen hyase producing microorganisms; however, they rely on unique reagents and sophisticated instruments, which are expensive and could be unavailable in general laboratories. In the present studies, a rapid, simple, sensitive, highly reproducible, and cost-effective qualitative plate assay has been developed for the screening of hyase producing microorganisms. The routinely used plate assay method of Richman and Baer requires a special chemical cetylpyridinium chloride and long incubation period of 20 h; but still, the zones of clearance are not very clear and distinct. While, the present method requires an incubation period of only 1 h and the distinct zones of clearance appear with Gram's iodine within 1 min of time. This method does not require any special medium, unlike previously reported methods. Moreover, use of commonly available Gram's iodine makes this method suitable for many researchers. The results of the assay method were validated by TLC, zymographic analysis and determining the growth of isolates in minimal medium containing HA as a sole carbon source.

KEYWORDS
Gram's iodine, hyaluronidase, plate assay

Hyaluronidase (hyase) is a glycosidase enzyme that predominantly degrades a polymeric substrate hyaluronic acid (HA), with restricted ability to degrade chondroitin, chondroitin sulphate, dermatan sulphate and other related glycosaminoglycans [1]. This enzyme is widely distributed in mammalian tissues and organs, venoms (snakes, lizards, fishes, bees, wasps, scorpions, and spiders), body fluids (blood, tears, seminal fluid), invertebrate animals (leeches, crustaceans), and microorganisms including bacteria and fungi [2]. Several species of microorganisms have been reported to produce enzyme hyase viz. *Micrococcus, Streptococcus, Peptococcus, Propionibacterium, Streptomyces, Staphylococcus, Bacteroides, Clostridium* etc. [3], whereas a few fungal strains of *Penicillium* spp. are also reported for the production of enzyme hyase [4]. For many years, hyases are widely utilized in many streams like orthopaedia, oncology, surgery, ophthalmology, gynecology, dermatology, and internal medicine [5]. Since 1940, the isolation and identification of new hyaluronidases with novel properties continues because of its crucial roles in fertilization [6], cell migration and differentiation, embryonic development, wound healing [7], inflammation, growth and metastasis of tumor cells [8].

Several assay methods have been proposed by researchers across the world for the detection of hyase activity, but all pose some drawbacks. The assay methods are

Abbreviations: CPC, cetylpyridinium chloride; HA, hyaluronic acid; Hyase, hyaluronidase; TLC, thin layer chromatography.



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Steroidal fraction of *Carissa carandas* L. inhibits microbial hyaluronidase activity by mixed inhibition mechanism

Sandip Patil, Bhushan Bhadane, Leena Shirsath, Ravindra Patil & Bhushan Chaudhari

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Steroidal fraction of *Carissa carandas* L. inhibits microbial hyaluronidase activity by mixed inhibition mechanism

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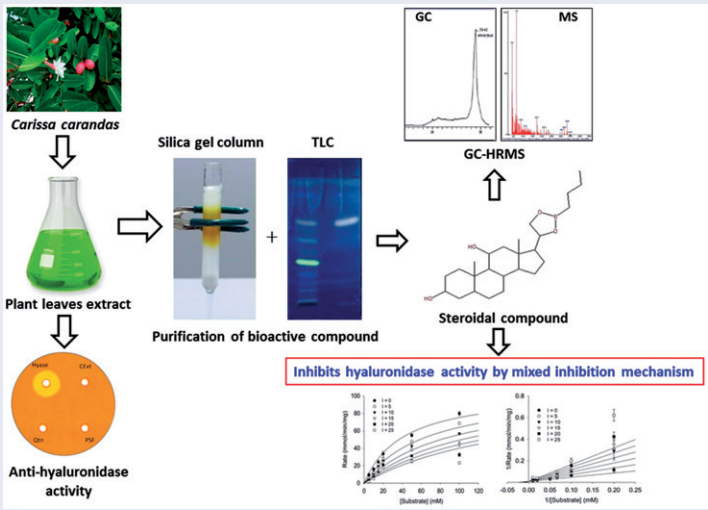
ABSTRACT

Hyaluronidase (hyase) is a hyaluronic acid (HA) depolymerizing enzyme produced by many pathogenic bacteria as a virulence factor to establish and spread infections. Present studies established that a steroidal fraction (SF) isolated from leaves of *Carissa carandas* act as a strong hyase inhibitor. The kinetic parameters involved in the inhibition of hyase by purified SF were studied and compared with standard hyase inhibitor quercetin. The purified SF showed the highest inhibition with an IC50 of 5.19 mM in comparison with a standard inhibitor, quercetin (IC50 8.63 mM). The inhibition constant (Ki) of purified SF determined by Dixon plot was 8.32 mM, which was significantly lower than that of quercetin standard. The kinetic behavior of enzyme hyase revealed to be more complex than classical competitive and uncompetitive inhibition where inhibitor affects both Km and Vmax. The inhibitor (I) favored the binding to the enzyme–substrate (ES) complex where Km value appeared to decrease (Kmapp $<$ Km). The inhibitor also leads to decrease in the apparent maximum velocity of the enzyme–substrate reaction (Vmaxapp $<$ Vmax). These results signpost toward mixed nature of inhibition of enzyme hyase by purified SF. Anti-hyaluronidase activity by a bioactive metabolite from *C. carandas* has not been reported so far and has high therapeutic potential against spread of pathogen and its toxins in the host.

KEYWORDS

Carissa carandas; hyaluronidase inhibitor; inhibition constant; mixed inhibition; steroidal fraction

GRAPHICAL ABSTRACT



Introduction

Microbial hyaluronidases (hyase, EC 4.2.2.1) are the glycosidase enzymes capable of depolymerizing hyaluronic acid (HA) present in the extracellular matrix. Hyases degrade HA by cleaving the β-1, 4-glycosidic bond between N-acetyl-D-glucosamine and D-glucuronic acid to produce disaccharide units.[1] A wide variety of microorganisms produce enzymes capable of depolymerizing HA. They are ubiquitously distributed in nature and are found in mammals, invertebrate animals, animal venoms, pathogenic fungi, bacteria and also bacteriophages.[2]

In humans, a ground substance present in connective tissues provides a line of defense against pathogenic bacteria. The viscous nature of such a substance usually acts as a

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A halotolerant hyaluronidase from newly isolated *Brevibacterium halotolerans* DC1: Purification and characterization

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ABSTRACT

An enzyme hyaluronidase (hyase) producing halotolerant bacterium was isolated from dental caries and identified as *Brevibacterium halotolerans* DC1. Higher growth and hyase production were observed in nutrient broth fortified with hyaluronic acid at pH 7.0, temperature 37 °C, 120 rpm upon 48 h of incubation. Hyase was purified using salt precipitation, DEAE cellulose ion exchange, and Sephadex G-100 gel filtration chromatography. The enzyme was purified to 13-fold with 67.19% recovery of activity and 26.37 U/mg of specific activity. SDS-PAGE and zymography revealed it to be near to homogeneity showing a relative molecular weight of about 43 kDa that was confirmed by MALDI-TOF MS. This hyase was very active and stable at pH 7.0 and temperature 40 °C. The presence of metal ions Ca^{2+} and Mg^{2+} increased its activity while Zn^{2+} and Cu^{2+} severely inhibited it. Being stable at 2 M NaCl, hyase exhibited its halotolerant nature. This enzyme showed wide substrate specificity where hyaluronic acid (HA) was the best substrate. The kinetic studies revealed that K_m and V_{max} were 91.3 μg/mL and 306.2 μg/mL/min respectively. This is the first report of hyaluronidase from a halotolerant *Brevibacterium* spp. which can find applications under high salinity.

1. Introduction

The hyaluronidase (hyase) is a glycosidase enzyme that predominantly degrades a polymeric substrate hyaluronic acid (HA), with restricted ability to degrade Chondroitin, Chondroitin sulfate, Dermatan sulfate and other related glycosaminoglycans [1]. The worldwide interest in hyase research has been increased tremendously owing to its great importance in medical, physiological, biological and commercial field [2]. These enzymes are widely distributed in mammalian tissues and organs, the venoms (snakes, lizards, fishes, bees, wasps, scorpions, and spiders), body fluids (blood, tears, seminal fluid), invertebrate animals (leeches, crustaceans), and microorganisms including bacteria, yeast and fungi [3]. For many years, hyases are widely utilized in many streams like orthopaedia, oncology, surgery, ophthalmology, gynecology, dermatology and internal medicine [4]. The isolation and identification of new hyaluronidases with novel properties continues since 1940; due to comprehension of its crucial role in biological processes including fertilization [5], cell migration and differentiation, embryonic development, wound healing [6], inflammation, growth and metastasis of tumor cells [7].

Bacterial hyaluronidases (hyaluronate lyase, EC 4.2.2.1) are the glycosidase enzymes that specifically cleave the β,1-4 glycosidic linkage in substrate hyaluronic acid (HA) [1]. Many pathogenic bacteria can establish and spread infections at the mucosal or skin surface by producing the enzyme hyase as their potential virulence factor [8]. The microorganisms capable of producing enzyme hyase include various species of *Streptococcus*, *Staphylococcus*, *Peptostreptococcus*, *Propionibacterium*, *Streptomyces* and *Clostridium* [9–12]. While it has also been reported in different species of *Candida*, including *C. albicans, C. krusei, C. tropicalis, C. parapsilosis,* and *C. guilliermondii* [13]. The causative agent of syphilis - *Treponema pallidum* and *Treponema pertenue* are also reported to produce hyase [14]. The veterinary pathogens, *S. uberis* and *S. dysgalactiae* that cause mastitis have also shown the synthesis of enzyme hyase [15,16]. Recently, hyases were reported as important virulence factors of Group B *Streptococcus* (GBS) involved in ascending vaginal infections in pregnant women leading to increased fetal injuries, preterm birth defects and fetal demise [17,18].

The hyase production process is greatly influenced by various physical parameters (pH, temperature, incubation period, inoculum size and agitation rate) and nutritional parameters (carbon and nitrogen sources). The optimization of these physical and nutritional parameters for hyase production plays a crucial role in improving the yield of an enzyme [19]. The purification of extracellular microbial hyase from heterogeneous protein mixture could be accomplished by salt precipitation (Ammonium sulfate), solvent precipitation (Acetone, Ethanol) followed

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Microbial Hyaluronidase: Its Production, Purification and Applications

16

Sandip P. Patil, Kiran S. Dalal, Leena P. Shirsath, and Bhushan L. Chaudhari

Abstract

Hyaluronidase (hyase) is an enzyme from glycosidase family that degrades hyaluronic acid (HA) and other associated glycosaminoglycans. It precisely cleaves the β,1–4 glycosidic linkages in hyaluronic acid substrate. Generally pathogenic Gram-positive bacteria produce hyases; where enzyme serves as virulence factor that facilitate the spreading of bacteria in host tissues by degradation of hyaluronic acid present in connective tissues. The optimization of nutritional and physical parameters for hyaluronidase synthesis carries high importance in enzyme yield improvement. The purification of extracellular microbial hyase from a protein mixture could be achieved by a series of purification steps like solvent and salt precipitation, membrane technology and various chromatographic methods. The present chapter summarizes hyase production, purification and its applications. The interest in hyaluronidase is increasing due to its various applications.

Keywords

Hyaluronidase · Hyaluronic acid · Production · Purification · Characterization

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Reuterin: A Broad Spectrum Antimicrobial Agent and Its Applications

20

Kiran S. Dalal, Sandip P. Patil, Girish B. Pendharkar, Dipak S. Dalal, and Bhushan L. Chaudhari

Abstract

Probiotic bacteria play a vital role in living animals including human health by helping in the digestion of foods and boosting the immune system. Hence, microbes with better properties are of interest. Some probiotic bacteria produce specific substances that can inhibit or inactivate other organisms which compete for nutrients and space. The β-hydroxypropionaldehyde (3-HPA) known as reuterin is produced by *Lactobacillus reuteri*. It has broad antimicrobial activity against potentially harmful microorganisms without adversely affecting the beneficial gut flora. Its production occurs under the anaerobic condition where the enzyme glycerol dehydratase facilitates the conversion of glycerol to reuterin by removing water molecules. The structure of reuterin contains both hydroxy and aldehyde functional groups. Reuterin is a low molecular weight water-soluble compound resilient to proteolytic and lipolytic enzymes, and remains active at a varied pH and hence finds applications in industries. This chapter focuses on reuterin production, stability, antimicrobial activity, and its applications.

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Potential Source of Compounds of Commercial and Therapeutic Applications

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Inhibitory kinetics and mechanism of pentacyclic triterpenoid from endophytic *Colletotrichum gigasporum* against pancreatic lipase

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ABSTRACT

The burden of obesity is increasing all over the world. Except for Orlistat, no effective anti-obesity drug is currently available. Therefore, a search for the new anti-obesity compound is need of time. This study demonstrates macromolecular interaction and inhibitory effect of pentacyclic triterpenoids (PTT) on pancreatic lipase (PL). In the present study PTTs from endophytic *Colletotrichum gigasporum* were found to show significant inhibitory activity against PL with IC_{50} of 16.62 ± 1.43 μg/mL. The PTT isolated through bioassay-guided isolation showed a dose-dependent ($R^2 = 0.915$) inhibition against porcine PL and the results were comparable with the standard (Orlistat). Based on inhibition kinetic data, the gradual increase in $K_{m\ (app)}$ with increasing PTT concentration indicated that the mode of interaction of PTT with PL was a competitive type, and it directly competed with the substrate (*p*NPB) for the active site of PL. *In vivo* studies in Wistar rats at the oral dose (100 mg/kg body weight) of PTT significantly decreased ($p < 0.05$) incremental plasma triglyceride levels as compared to group B and TG absorption was down-regulated up to 49.18% *vis a vis* group D animals. The isolated PTT was identified as lupeol based on chromatographic and spectral data. The endophytic isolate was identified as *Colletotrichum gigasporum* based on morphology and ITS gene sequencing. The present study indicated that PTT had the potential to be used as a natural PL inhibitor in the treatment of obesity and the isolated endophyte can be a valuable bioresource for it.

1. Introduction

Obesity has been a major health concern worldwide in recent decades. Excessive energy intake, physical inactivity, and low energy expenditure are important contributors leading to the accumulation of fat in the body. Diverse gastrointestinal lipases including pancreatic lipase (PL) play important role in lipid digestion. Among all, PL is the most important lipolytic enzyme in humans that carry out the hydrolysis and absorption of over 70% of total dietary fats [1]. Because of its key role in lipid metabolism, PL has been the key target for synthetic anti-obesity drugs including Orlistat. Several studies have been conducted in the search of potent PL inhibitors of synthetic and natural origin compounds in the past few decades [2].

However, prolonged application of synthetic drugs has various side effects such as liver toxicity, oily stools, fecal urgency, flatulence, and abdominal distention [3]. Therefore, there is a need to explore natural products for new, effective, and safe anti-obesity compounds.

Natural products from ethnomedicinal plants and microorganisms have provided effective therapeutic drugs and lead compounds for the treatment of many metabolic diseases. The World Health Organization (WHO) estimates that 80% of the people of developing countries rely on traditional medicines, mostly plant-derived drugs for their primary health needs. Several studies have demonstrated that natural products of plant and microbial origin hold the promise for new PL inhibitors with minimum adverse effects. For example, inhibitors like platycodin D from the fresh roots of *Platycodon grandiflorum* has shown potent PL Inhibitory potential in an *in vivo* study [4]. PL inhibitors with various scaffolds (such as flavonoids, panclicins, triterpenoids, phenolics, β-lactones, and triacylglycerol analogs) have been identified from microbial, plants, and marine sources [5].

Medicinal plants harbor a hidden treasure of diverse microbial communities- the endophytes in their internal tissues. Endophytes include both; fungi and bacteria but fungi being more ubiquitous, diverse, versatile, and widespread microorganisms that colonize the plants growing in various geo-climatic conditions [6]. The endophytic microflora of medicinal plants is a cheap source of diverse bioactive compounds with varied bioactivities [7]. Endophytes have the unique property that they can produce the same and rare secondary metabolites as their plant host. For example, the bark of *Terminalia arjuna* (Combretaceae), a widely studied Indian medicinal plant known for its antioxidant and cardioprotective role, was found to be rich in many

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REVIEW

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Ethnopharmacology, phytochemistry, and biotechnological advances of family Apocynaceae: A review

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The family Apocynaceae is one of the largest and important families in angiosperm. Several members of this family have medicinal properties and have been in the treatment of various ailments. Most of them are consumed as food by tribal people whereas a few plants are used as source of poison. Members of family Apocynaceae are rich in alkaloids, terpenoids, steroids, flavonoids, glycosides, simple phenols, lactones, and hydrocarbons. Other compounds such as sterols, lignans, sugars, lignans, and lactones have been isolated and systematically studied. Few studies have reported antioxidant, anti-inflammatory, antimicrobial, and cytotoxic activities of crude extracts as well as single compound(s) isolated from various members of the family Apocynaceae. *Holarrhena antidysenterica*, *Rauvolfia serpentina*, *Carissa carandas*, and *Tabernaemontana divaricata* are the extensively studied plants in this family. The present review provides a detailed outlook on ethnopharmacology, phytochemistry, and biological activities of selected members of this family. Moreover, it also covers the biotechnological advances used for large-scale production of bioactive compounds of therapeutic interest along with plant tissue culture-based approaches for conservation of this medicinally valuable family.

KEYWORDS

Apocynaceae, alkaloids, terpenoids, steroids, flavonoids, anti-inflammatory, cytotoxic, conservation

1 | INTRODUCTION

Apocynaceae is one of the largest families in the plant kingdom. Robert Brown (1810) separated Asclepediaceae from Apocynaceae for a practical reason. Due to the taxonomic conflict between the families Asclepediaceae and Apocynaceae, there is variation in exactly how many species or genera belong to Apocynaceae family. Endress, Liede-Schumann, and Meve (2014) reported a revised and recently updated classification for the Apocynaceae family. According to this updated classification, family Apocynaceae consists of 424 genera with more than 4,600 species distributed in five subfamilies such as Rauvolfioideae, Apocynoideae, Periplocoideae, Secamonoideae, and Asclepiadoideae.

The plants of family Apocynaceae are native throughout India, Pakistan, China, Bangladesh, and Sri Lanka (Mahmood, Meer, Munir, Nazar, & Naveed, 2011). Apocynaceae members are the shrubs, woody, or herbaceous plants containing milky latex. Most of the plants of this family are rich in alkaloids and have immense medicinal importance. Several species are also widely grown ornamentally. Some members of Apocynaceae are consumed by people in the rural area as a food and some others are used as a poison (Aiyambo, 2010). The plants of Apocynaceae have been used worldwide for medicinal applications, and hence, they are included in different traditional systems of medicine such as Indian, Chinese, and Thai (Bhat, Hegde, & Hegde, 2012). In the present review, we have made an attempt to provide information about habitat, medicinal uses, phytochemistry, and pharmacology of some widely studied species of family Apocynaceae. The recent biotechnological advances to produce bioactive compounds of plant origin are also highlighted. Thus, there are significant possibilities of finding the novel bioactive compounds with medicinal and pharmacological properties from various members of the family, and it will yield to new sources of lead compounds for future applications.

2 | HABITAT

Apocynaceae plants show naturalized distribution, and birds and human activities have led to their dispersal. The members of this family are distributed in the tropical, subtropical, and temperate zones. The plants of this family are mainly trees and shrubs; however, subshrubs and, rarely, herbs are also found. *Alstonia scholaris* (R. Br.) is distributed throughout the tropics and rainforests of West

Research Article

Microbial transformation of crop residues into a nutritionally enriched substrate and its potential application in livestock feed

Ravindra H. Patil[1] · Mohini P. Patil[1] · Vijay L. Maheshwari[2]

Received: 30 November 2019 / Accepted: 22 May 2020 / Published online: 29 May 2020

Abstract
Bioconversion of three different agro-residues (groundnut shells, pigeon pea husk and wheat straw) was studied using endophytic fungi with a view to increasing the nutritive value and to evaluate its feasibility as poultry feed. An endophytic fungal isolate obtained from *Celastrus paniculatus,* effectively biotransformed selected agro-residues in solid state fermentation. After 21 days incubation, isolate CPL-1significantly altered the nutritional values of all tested agro-residues. Cellulose, hemicellulose, and lignin content were significantly reduced ($P < 0.05$) whereas, total carbohydrates were significantly increased in the biotransformed waste as compared to untreated residues. Of the three agro-residues studied, the groundnut shells were found to have maximum carbohydrate content (13.92 ± 0.7 g/100 g) after the treatment. Similarly, the total crude protein and total nitrogen contents of the treated waste were also significantly improved ($P < 0.05$) as a function of treatment with the isolate CPL-1 with their highest contents (24.95 ± 1.4 and 15.53 ± 1.2 g/100 g, respectively) recorded in the treated groundnut shells. The isolate CPL-1 was identified as *Colletotrichum* spp. based on the morphology. The tannins and phytate contents were found to be significantly lower ($P < 0.05$) in the processed wastes. Application of treated agro-residues in poultry diets revealed that the biotransformed groundnut shells and pigeon pea waste can be added up to 20 and 10%, respectively to the commercial poultry diet used in the study without any adverse effects. The results showed that the treated residues of groundnut shells can be used as a partial substitute to the conventional poultry diets as they are rich in enzyme phytase and other nutrients and have good digestibility.

Keywords Bioconversion · Agro-residues · Endophytic fungi · Crude protein · Poultry diet

1 Introduction

Feed is the most important factor in the poultry business which constitutes around 70% of the total production cost [1]. A number of ingredients are used to formulate the poultry diet. It mainly uses maize and soybean meal as the carbon and protein source, respectively. Several countries use other grains such as wheat, sorghum, canola and sunflower meal as well as animal-derived protein ingredients like fish and meat meal [2]. Mineral supplements play a vital role in the development of poultry. Poultry, being the monogastric animal, cannot fully assimilate the inorganic supplements which are provided in the form of calcium and phosphorus supplements that includes dicalcium phosphate, rock phosphate and bone meal [3]. The increasing cost and decreasing feed production are the major hurdles in the progress of poultry industry in the developing countries. Moreover, diversion of food grains such as maize and sorghum from feed market to ethanol production has dramatically increased their cost globally [4, 5]. Therefore, there is the urgent need to use alternative feedstuffs and look into the possibilities of bioconversion of agro-residues into feed in a sustainable way. Globally, 140 billion metric tons of lignocellulose biomass

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Chapter 6

Protease Inhibitors and Their Applications: An Overview

Kiran R. Marathe*, Ravindra H. Patil†, Kishor S. Vishwakarma*, Ambalal B. Chaudhari* and Vijay L. Maheshwari*,[1]

*School of Life Sciences, North Maharashtra University, Jalgaon, Maharashtra, India

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Chapter Outline

INTRODUCTION

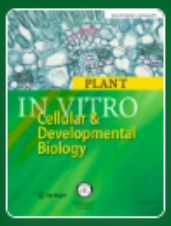
Biochemical reactions in living systems are catalyzed by a series of enzymes and are tightly controlled by specific protein and nonprotein enzyme inhibitors. Enzyme inhibitors bind to an enzyme and arrest its catalytic action [1], which make them useful tools in the study of enzyme structures and reaction mechanisms and their applications as therapeutics in medicine and biocontrol agents in agriculture [2–6]. Proteases play a major role in the posttranslational processing of proteins, protein catabolism, and various pathological processes, and therefore, they become a natural target for protease inhibitors (PIs). Several natural, specific, and selective PIs are now known as major regulating proteins to control proteolytic activity in all life forms [7]. PIs find diverse applications in diagnostics and therapeutics, to treat various microbial

Studies in Natural Products Chemistry, Vol. 62. https://doi.org/10.1016/B978-0-444-64185-4.00006-X

Quercetin and silver nitrate modulate organogenesis in *Carissa carandas* (L.)

Micropropagation | Published: 28 September 2018

Volume 54, pages 600–6



Vijay L. Maheshwari

Department of Biochemistry, School of Life Sciences, North Maharashtra University, Jalgaon, MS, 425 001, India

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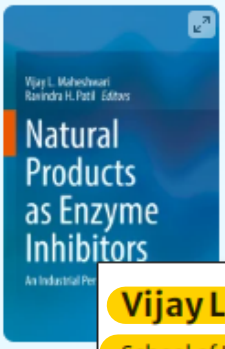
Bhushan S. Bhadane, Vijay L. Maheshwari & Ravindra H. Patil

Abstract

An *in vitro* organogenesis protocol for *Carissa carandas* L. was developed using an auxin transport inhibitor (quercetin) and silver nitrate ($AgNO_3$), an inhibitor of ethylene action, in association with cytokinins in the culture medium. This protocol produced the maximum number of shoots from aseptic seedling-derived shoot apex explants of *C. carandas*. The highest rate of shoot multiplication was recorded on MS medium containing 2.0 mg L^{-1} 6-benzylaminopurine; 0.5 mg L^{-1} kinetin, and 0.75 mg L^{-1} quercetin at after 4 wk of culture. Similar results were obtained when MS medium fortified with 2.0 mg L^{-1} BAP, 0.5 mg L^{-1} kinetin, and 1.5 mg L^{-1} $AgNO_3$ was used. However, successful rooting was achieved on quarter strength MS medium with 0.5 mg L^{-1} indole-3-acetic acid. In this study, an inhibitor of auxin transport and ethylene action maximized shoot multiplication in medium fortified with cytokinins. The established rapid micropropagation method could be used to conserve elite genotypes of *C. carandas*



Natural Products as Enzyme Inhibitors

An Industrial Perspective

Book | © 2022

Vijay L. Maheshwari

School of Life Sciences, KBC North Maharashtra University, Jalagon, India

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Over

Editors: Vijay L. Maheshwari, Ravindra H. Patil

- Overviews the latest research on naturally occurring enzyme inhibitors and their applications in various fields
- Explains the usefulness of enzyme inhibitors in human health and in agriculture industry
- Explains the commercial benefits of naturally occurring enzyme inhibitors in sustainable agriculture

About this book

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KBCNMU

KBCNMU Summer Research Aptitude Cultivation Workshop June 2020

For Under Graduate Students of KBCNMU Affiliated Colleges

Knowledge and Innovations are going to be the twin agents of change in present century. Basic research is the mother of all the applied research and technological innovations. To motivate the young talented Students of Under Graduate Programme of KBCNMU affiliated colleges, University has launched KBCNMU Summer Research Aptitude Cultivation Workshop.

Objectives of the Workshop:

- To motivate the young students to pursue career in basic and applied research
- To familiarize them with research culture, activities, modern and sophisticated instruments and facilities on campus.
- To inculcate research aptitude, analytical and independent thinking abilities.

Eligibility and Selection Process :

- Student should be a regular and meritorious student of the college with demonstrable inclination towards research.
- He / She should be a student of S.Y.B.Sc. With no backlogs of previous years (F. Y. and Sem.-I of S.Y.B.Sc.)
- Each of the affiliated science college can provide names of up to 3 students by selecting among the interested students.
- Applications of the 03 short listed students by the respective college shall be uploaded on University Website through the link of Summer Workshop - 2020 on or before 26th February 2020. Hard copy of the form duly recommended by Principal is to be submitted on or before 11th March 2020.
- The University will screen all the applicants and select the required number. Names of the selected students shall be made available on website.

Activities :

- Lectures by Scientists / Academicians on Frontier topics in Physics, Chemistry, Computer Science, Engineering and Technology, Mathematical Sciences, Life Sciences shall be arranged.
- Demonstration of Sophisticated Facilities.
- Industry / Campus visit tour.
- Screening of Scientific Movies.
- Exploration of Mobile Science Exhibition Unit.

Proposed Intake for the Workshop :

- 50 students

Duration of the Workshop:

10 days : June 1-10, 2020

- Free Lodging and Boarding for the shortlisted students by KBCNMU.
- The details are available on University website (www.nmu.ac.in).

Workshop coordinators

Prof. S. T. Bendre
(stbendre@nmu.ac.in)

Dr. H. L. Tidke
(hltidke@nmu.ac.in)

Prof. Mrs. R. S. Bendre
(rsbendre@nmu.ac.in)

Dr. Mrs. Nita A. Patil
(nitaapatil@gmail.com)

Prof. D.S. Patil
(dspatil@nmu.ac.in)

Activity Cordiated by :
Cillage Based Area Development Programme (CADP)

Kindly Display

Apply online on or before: 26th February 2020

KBCNMU Summer Research Aptitude Cultivation Workshop, June 2020

(for undergraduate students of affiliated colleges)

Knowledge and innovations are going to be the twin agents of change in present century. Whereas, the former strengthens the thought process, the latter transforms it into products/services. Basic research is the mother of all the applied research and technological innovations. It also provides vent to one's imagination and creativity. To motivate the young talented students studying in the graduate program of affiliated colleges towards this fascinating world of research and innovation, it is necessary to provide a suitable eco-system and carefully cultivate and nurture research aptitude in them. With this brief background, the aims/objectives of the program are -

Objectives:

1. To inculcate research aptitude, analytical abilities and independent thinking abilities among graduate students.
2. To familiarize them with research culture, activities, modern & sophisticated instruments and facilities on campus.
3. To attract and motivate the young students to pursue career in basic and applied research.

Eligibility and Selection Process:

- Student shall be a regular and meritorious student of the college with demonstrable inclination towards research.
- He/she should have appeared for S. Y. B. Sc. Examination with no backlogs of previous examinations.
- Each of the affiliated science college can provide names of up to 3 students by selecting among the interested students.
- Names of the shortlisted students shall be uploaded by the respective colleges online on University Website along with a form on a link to be made available separately.
- The University will screen all the applicants and select the required number. Names of the selected students shall be made available on website.

Duration : 10 days (June 1-10, 2020)

No. of students : 50

Activities on Campus:

- Lectures by Scientists/Academicians on frontier topics in Physics, chemistry, computer science, mathematics/statistics, engineering and technology, Life sciences etc. shall be arranged for students
- Demonstration and visit to various facilities on campus
- Industry tour(s)/visit
- Screening of scientific movies/videos
- Exploration of Mobile Science Exhibition Unit

Time Line:

- Announcement of summer school for undergraduate students on website. : 01/02/2020
- Link and form to be made available for shortlisted Students : 01/02/2020 to 26/02/2020
- Hard copy submission : 11/03/2020
- Screening, final selection and uploading the list of selected students. : 11/04/2020
- Selected students arrive on campus : 31/5/2020 (Sunday)
- Workshop duration : 1/06/2020 to 10/06/2020

- Each participant shall be given a certificate by the University after completion of the workshop
- University shall make lodging and boarding arrangements for the students on campus
- No student shall be allowed to leave the workshop in the middle for any reason
- Students shall have to submit a feedback form after the completion of workshop

Workshop Co-ordinators

Prof. S T Bendre (stbendre@nmu.ac.in), Mob. 9422276961
Dr. H. L. Tidke (hltidke@nmu.ac.in), Mob. 9168595997
Prof. D. S. Patil (dspatil@nmu.ac.in), Mob. 9518738599
Prof. Mrs. R. S. Bendre (rsbendre@nmu.ac.in), Mob. 9422209335
Dr. Mrs. Nita A. Patil (nitaapatil@gmail.com), Mob. 9405672075

Activities

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NORTH MAHARASHTRA UNIVERSITY, JALGAON
SUMMER RESEARCH APTITUDE CULTIVATION WORKSHOP
01-10 JUNE, 2018
REGISTRATION FORM

Registration ID :-	**13**		
Name :-	**Patil Rahul Kailas**		
Date of Birth :-	**16/12/1997**	Gender :-	**Male**
Email ID :-	**rkpatil1612@gmail.com**	Mobile No. :-	**8007253664**
Adhar No. :-	**991895437825**	T.Y. B.Sc Specilization:-	**Computer Science**
HSC [%] :-	**76**	F.Y. B.Sc [%] :-	**94**
College / Institution Name :-	**R.C.PATEL ARTS, COMMERCE & SCIENCE COLLEGE,SHIRPUR**		
Address for communication :-	**At Post: Dhamane, Tal: Sindkheda, Dist: Dhule**		
Curricular Activities :-	**Participated in district levelDrawing competetion and secured IInd position**		
Carried Out Specific Activities / Project / Social Relevance Project :-	**NO**		
Statement of Purpose for the Participation :-	**Interested in doing research**		

Why do you want to participate in this Workshop (Three reasons) :-

Reason 1	**To utilize vacation time for learning purpose**
Reason 2	**Intersted in doing research**
Reason 3	**Want to learn new things**

Important Note:-

1. Principals are requested to collect the Registration Form of Summer Research Aptitude Cultivation Workshop upto 24th March 2018.
2. Principals are requested to verify the details of all the applicants and shortlist only 03 (Three) applicants of your College and submit the documents of shortlisted candidates on or before 6th April 2018 to Prof. S. T. Bendre, Co-ordinator,RGSTC,School of Physical Sciences, North Maharashtra University, P. O. Box No. 80, Umavi Nagar, Jalgaon - 425001 (M.S.) India

Instructions for Students:-

1. Students are requested to take the print out of the system generated Registration Form and submit the same alongwith attested photocopies of HSC, F.Y. B.Sc. and Sem-I of S.Y. B.Sc. marksheets to the Principal of your Collgege on or before 24th March 2018.
2. The list of short listed candidates will be published on North Maharashtra University Website by 28th April 2018.
3. No querries will be entertained once the final list of selected candidates is published on the University website.

Date :- 26/02/2018	**Signature of Applicant**	**Seal &Signature of Principal**

'A' Grade
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(3rd Cycle)

NORTH MAHARASHTRA UNIVERSITY, JALGAON
SUMMER RESEARCH APTITUDE CULTIVATION WORKSHOP
01-10 JUNE, 2018
REGISTRATION FORM

Registration ID :-	**5**		
Name :-	**Patil Nikita Jagdish**		
Date of Birth :-	**07/07/1999**	Gender :-	**Female**
Email ID :-	**nikitajp99@gmail.com**	Mobile No. :-	**7758833178**
Adhar No. :-	**206167664582**	T.Y. B.Sc Specilization:-	**Microbiology**
HSC [%] :-	**54.**	F.Y. B.Sc [%] :-	**91.**
College / Institution Name :-	**R.C.PATEL ARTS, COMMERCE & SCIENCE COLLEGE,SHIRPUR**		
Address for communication :-	**At post: Vikhran Tak: Shirpur, Dist: Dhule PIN: 425427**		
Curricular Activities :-	**Participated in Microbioolympiad Participated in poster competition and disease awareness camp in**		
Carried Out Specific Activities / Project / Social Relevance Project :-	**NO**		
Statement of Purpose for the Participation :-	**Would like to interact university faculty**		

Why do you want to participate in this Workshop (Three reasons) :-

Reason 1	**Interested in doing research**
Reason 2	**Want to utilize the vacation time for learning.**
Reason 3	**Would like to interact university faculty**

Important Note:-

1.	Principals are requested to collect the Registration Form of Summer Research Aptitude Cultivation Workshop upto 24th March 2018.
2.	Principals are requested to verify the details of all the applicants and shortlist only 03 (Three) applicants of your College and submit the documents of shortlisted candidates on or before 6th April 2018 to Prof. S. T. Bendre, Co-ordinator,RGSTC,School of Physical Sciences, North Maharashtra University, P. O. Box No. 80, Umavi Nagar, Jalgaon - 425001 (M.S.) India

Instructions for Students:-

1.	Students are requested to take the print out of the system generated Registration Form and submit the same alongwith attested photocopies of HSC, F.Y. B.Sc. and Sem-I of S.Y. B.Sc. marksheets to the Principal of your Collgege on or before 24th March 2018.
2.	The list of short listed candidates will be published on North Maharashtra University Website by 28th April 2018.
3	No querries will be entertained once the final list of selected candidates is published on the University website.

Date :- 23/02/2018	**Signature of Applicant**	**Seal &Signature of Principal**

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(3rd Cycle)

NORTH MAHARASHTRA UNIVERSITY, JALGAON
SUMMER RESEARCH APTITUDE CULTIVATION WORKSHOP
01-10 JUNE, 2018
REGISTRATION FORM

Registration ID :-	**4**		
Name :-	**Ingale Krupa Nitin**		
Date of Birth :-	**26/02/1999**	Gender :-	**Female**
Email ID :-	**ingalekrupa26299@gmail.com**	Mobile No. :-	**9657216103**
Adhar No. :-	**795214542413**	T.Y. B.Sc Specilization:-	**Microbiology**
HSC [%] :-	**64.**	F.Y. B.Sc [%] :-	**96**
College / Institution Name :-	**R.C.PATEL ARTS, COMMERCE & SCIENCE COLLEGE,SHIRPUR**		
Address for communication :-	**New Mhada Colony, Mirch Ground, Vanjola road, Bhusawal, Dist: Jalgaon**		
Curricular Activities :-	**Participation in Microbiolympiad in 2016, 2017** **Participated in poster competetion in 2017**		
Carried Out Specific Activities / Project / Social Relevance Project :-	**No**		
Statement of Purpose for the Participation :-	**Interested in doing research**		

Why do you want to participate in this Workshop (Three reasons) :-

Reason 1	**Utilize the vackation time for learning**
Reason 2	**Intersted in doing research**
Reason 3	**Want to learn new thingd**

Important Note:-

1. Principals are requested to collect the Registration Form of Summer Research Aptitude Cultivation Workshop upto 24th March 2018.
2. Principals are requested to verify the details of all the applicants and shortlist only 03 (Three) applicants of your College and submit the documents of shortlisted candidates on or before 6th April 2018 to Prof. S. T. Bendre, Co-ordinator,RGSTC,School of Physical Sciences, North Maharashtra University, P. O. Box No. 80, Umavi Nagar, Jalgaon - 425001 (M.S.) India

Instructions for Students:-

1. Students are requested to take the print out of the system generated Registration Form and submit the same alongwith attested photocopies of HSC, F.Y. B.Sc. and Sem-I of S.Y. B.Sc. marksheets to the Principal of your Collgege on or before 24th March 2018.
2. The list of short listed candidates will be published on North Maharashtra University Website by 28th April 2018.
3. No querries will be entertained once the final list of selected candidates is published on the University website.

Date :- 23/02/2018	**Signature of Applicant**	**Seal &Signature of Principal**

।। अंतरी पेटवू ज्ञाज्योत ।।

'A' Grade
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North Maharashtra University, Jalgaon

NMU Summer Research Aptitude Cultivation Workshop - 2018

(1-10th June, 2018)

Certificate

This is to certify that Ingale Krupa Nitin has participated in **NMU Summer Research Aptitude Cultivation Workshop 2018,** organized by North Maharashtra University, Jalgaon during 1-10th June, 2018.

Prof. (Mrs.) R. S. Bendre	**Dr. H. L. Tidke**	**Prof. S. T. Bendre**
	Coordinators	

Prof. P. P. Patil
Vice Chancellor