



Dolphin (P.G.) Institute of Biomedical & Natural Sciences

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3.3.1 Number of research papers published per teacher in the Journals as notified on UGC CARE list during the academic year 2018-19.

This is to certify that documents from page number 2 to 39 are digitally attested.



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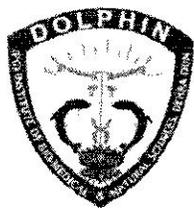
Total number of research papers published per teacher in the Journals notified on UGC website for year 2018-19.

Summary sheet

Sr. No.	Title of paper	Name of the author/s	Department of the teacher	Calendar Year of publication	ISSN number
1	Isolation, Characterization, Synthetic modification and evaluation of antioxidant potential of Berberine from roots of <i>Berberis aristata</i>	Sushil Choudhary, Versha Parcha, Diviya Jyoti Singh and Deepak Kumar	Pharmaceutica l Chemistry & Chemistry	2019	0973- 3507
2	Plant Based Synthesis of Silver Nanoparticles from <i>Ougeinia oojeinensis</i> Leaves Extract and their Membrane Stabilizing, Antioxidant and Antimicrobial activities	Deepak Kumar, Shefali Arora, Abdullaha, Mohd Danish	Pharmaceutica l Chemistry & Chemistry	2019	2214- 7853
3	Age, growth and length-weight relationship of <i>Cirrhinus mrigala</i> (Hamilton, 1822) from Yamuna River, Dehradun, Uttarakhand, India	Beena Joshi Bhatt, Shagolsem Aruna Chanu and Simeon Valleygate	Zoology	2019	0972- 0030
4	Fenugreek (<i>Trigonella foenum-graecum</i> L.) A potential source of dietary fibres and steroidal sapogenin (Diosgenin)	Naveen Chandra Pant, Rakesh Dhoundiyal, Manoj Kumar, Upendra Dwivedi, JP Singh and Sanjeev Agrawal	Agriculture	2018	2349- 8528
5	CuO nanoparticle mediated elicitation of polyphenols and antioxidant activity in chicory (<i>Cichorium intybus</i> L.)	Lenin Laishram, Naveen Chandra Pant, Oinam Surjit Singh, Rakesh Dhoundiyal, Karishma Joshi and CS Pandey	Agriculture	2018	2349- 8528
6	Seed Priming- Quality enhancement technique	Vineeta Pandey and Parul Punetha	Agriculture	2018	2394- 1227
7	Genetic variability and genetic divergence for seed yield and its	Shailendra Tiwari, Naveen Chandra Pant, Anuj Gupta,	Agriculture	2018	2349-

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Sr. No.	Title of paper	Name of the author/s	Department of the teacher	Calendar Year of publication	ISSN number
	component characters in grain amaranth (<i>Amaranthus hypochondriacus</i> L.) germplasm	Upendra Dwivedi, Jitendra Kumar Meena, CS Pandey, Rakesh Dhoundiyal and Arun Bhatt			8528
8	Studies on correlation and path coefficient analysis for yield and yield related traits in Indian mustard (<i>Brassica juncea</i> L. Czern and Coss.) under timely and late sown conditions	Anuj Gupta, Naveen Chandra Pant, Upendra Dwivedi, Shailendra Tiwari, CS Pandey, Rakesh Dhoundiyal, KN Maurya and OP Verma	Agriculture	2018	2349-8234
9	Effect of CuO nanoparticles on polyphenols content and antioxidant activity in Ashwagandha (<i>Withania somnifera</i> L. Dunal)	Oinam Surjit Singh, Naveen Chandra Pant, Lenin Laishram, Manisha Tewari, Rakesh Dhoundiyal, Karishma Joshi and CS Pandey	Agriculture	2018	2349-8234
10	Evaluation of Micronutrients in Fenugreek (<i>Trigonella foenum-graecum</i> L.): A Viable Alternative for Micronutrient Supplementation	Naveen Chandra Pant, Manisha Tewari, Rakesh Dhoundiyal, C.S. Pandey, J.P. Singh and Sanjeev Agrawal	Agriculture	2018	2319-7692
11	Transformation of some major nutrients in tea garden soils of North Bengal	Khanda A, Choudhary NB, Barman U, Mukherjee P, Pandey CS and Mukhopadhyay PK	Agriculture	2018	2349-8528
12	Integrated nutrient management for sustainable yield in rice-potato-groundnut cropping system.	Khanda A, Choudhary NB, Roy M and Mukhopadhyaya P	Agriculture	2018	2349-8528
13	Effect of protein supplement on growth performance of Buffalo calves.	Sanjeev Kumar, Manoj Kumar Bansala, Deepak Sharma, Jagdeep Kumar, Hitash Singh, Rajkumar and D S Sahu	Agriculture	2018	2349-8234
14	Pretreated animal and human waste as a substantial nutrient source for cultivation of microalgae for biodiesel	Vinod Kumar, Akshay Kumar and Manisha Nanda	Biotechnology	2018	0944-1344

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	production				
15	Production of biodiesel and bioethanol using algal biomass harvested from fresh water river	Vinod Kumar, Manisha Nanda, HC Joshi, Ajay Singh, Sonal Sharma, Monu Verma	Biotechnology	2018	0960-1481
16	Synergistic dynamics of light, photoperiod and chemical stimulants influences biomass and lipid productivity in <i>Chlorella singularis</i> (UUIND5) for biodiesel production	Vinod Kumar, Rajat Kumar, Deepa Rawat & Manisha Nanda	Biotechnology	2018	2468-0842
17	Integrated approach for extracting fuel, chemicals and residual carbon using pine needles	Vinod Kumar, Manisha Nanda, Manu Verma, Ajay Singh	Biotechnology	2018	2190-6815
18	The effect of ultraviolet radiation on growth, biomass, lipid accumulation and biodiesel properties of microalgae.	Vinod Kumar, Manisha Nanda, Sanjay Kumar, Pankaj K Chauhan	Biotechnology	2018	1556-7036
19	Analysis of phytochemical constituents of the methanolic extracts of leaves of <i>Aconitum heterophyllum</i> using Gas chromatography-mass spectroscopy (GC-MS) Technique	Kamraj Sing Tomar, Shalini	Biotechnology	2018	2229-3566
20	Mineral composition of <i>Berberis aristata</i> DC roots	Ankita Sati, Sushil Chandra Sati, Jagmohan Singh Negi, OP Sati	Pharmaceutica I Chemistry & Chemistry	2018	2229-7928
21	Simultaneous Determination of Losartan Potassium in Pharmaceutical Products by Reversed Phase High Performance Liquid Chromatography	Raju Chandra, Abhishek Saini, Ashwani Sanghi, Ganesh Pandey, Deepak Kumar	Pharmaceutica I Chemistry & Chemistry	2018	0975-1556

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22	Observation on temperature variation in Alpine zone of Uttarakhand: A case study of Tungnath	Shailesh Pd. Vashist, Tahir Nazir, R K Pathak and S Nautiyal	Forestry	2018	0974-6382
23	Natural Regeneration study of four Rhododendron Species in Western Himalaya	Shailesh Pd. Vashist, Tahir Nazir, R K Pathak and S Nautiyal	Forestry	2018	0974-6382
24	Phytodiversity and stand characters of six Oak (<i>Quercus leucotrichophora</i> A. camus) forests in Garhwal Himalaya, Uttarakhand, India	Vikaspal Singh, Sunil Prasad and Dhanpal Singh Chauhan	Forestry	2018	1314-3905
25	Effect of Stand Structure and aspect on the regeneration of banj oak (<i>Quercus leucotrichophora</i> A. Camus) Forest along disturbance in Garhwal Himalaya, Uttarakhand, India	Vikaspal Singh, Dhanpal Singh Chauhan and Sabyasachi Dasgupta	Forestry	2018	1406-9954
26	Inventory of Traditional Knowledge on Medicinal Flora of Jardhar Village Ecosystem (Tehri Garhwal), Uttarakhand, India	Arti Kalaa and Sas Biswas	Forestry	2018	2250-1770
27	Antimicrobial Activity of Some Diaminobenzophenone Derivatives	Shefali Arora, Ajay Pratap, Shailey Singhal, Kanchan Deoli Bahukhandi, Shilpi Agarwal, Deepak Kumar	Pharmaceutica I Chemistry & Chemistry	2018	0976-044X
28	A review on Phytopharmacological Activity of <i>Plumeria</i> species	Shefali Arora, Kanchan Deoli Bhaukhandi, Shailey Singhal, Mamta Latwal, Tanuja Uniyal Sati, Deepak Kumar	Pharmaceutica I Chemistry & Chemistry	2018	2320-0924
29	Membrane Stabilizing and Antioxidant Activity of Ougeinia	Deepak Kumar, Ashwani Sanghi, Raju Chandra, Shefali Arora,	Pharmaceutica I Chemistry &	2018	0975-

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	oojeinensis Seed Extracts and Their Fatty Acid Composition	Gaurav Tiwari, and Vaishali Mishra	Chemistry		8585
30	Membrane Stabilizing and Antioxidant activity of Myrica esculenta leaves extracts	Deepak Kumar, Ashwani Sanghi, Shefali Arora, Gaurav Tiwari, Raju Chandra, Shekhar	Pharmaceutica I Chemistry & Chemistry	2018	2413-4910
31	Bio-inspired dechlorination of polyvinyl chloride	Ritu Singh, Deepak Pant	Pharmaceutica I Chemistry & Chemistry	2018	0263-8762
32	Effect of smart phone on cervical muscle endurance, disability and range of motion	Depte Warikoo, Stuti Mittal and Vishal Warikoo	Physiotherapy	2018	2249-555X

Supporting documents

Isolation, Characterization, Synthetic Modification and Evaluation of Anti-Oxidant Potential of Berberine from Roots of *Berberis aristata*

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Abstract-Roots of plant *Berberis aristata* has been approved to have antioxidant potential which is probably due to presence of alkaloid compound Berberine in the roots, rhizomes, and stem bark with a long history of medicinal use in both Ayurvedic and Chinese medicine. Beside antioxidant activity Berberine extracts and decoctions have demonstrated significant antimicrobial activity against a variety of organisms including bacteria, viruses, fungi, protozoan's, several disorders including metabolic, neurological and cardiological problems. In search of new antioxidant compounds in the present study, attempts has been made to isolate Berberine, an antioxidant compound from *Berberis aristata* acting as lead compound on which synthetic modifications were carried out to get better antioxidant properties. Berberine was isolated from the roots of *Berberis aristata*. The alkaloidal nature of Berberine was determined with the help of Dragendorff and Wagner's reagents. Its melting point was measured to be 145°C. Co-TLC of the compound with a market sample of Berberine showed similar Rf value. Spectral data is well comparable to spectral data of authentic sample. Berberine was subjected to derivitization to study structure activity relationship firstly by demethylation at position 9 and 10 and then converting to diacetoxy and dibenzoxy derivatives. Synthesized compounds were characterized on the basis of spectral data. All the newly synthesized derivatives along with isolated berberine were evaluated for their antioxidant potential as compared to standard ascorbic acid. From the studies, it could be observed that berberine has very good

antioxidant activity (DPPH Radical Scavenging Activity 61% which is comparable to the standard drug Ascorbic acid (DPPH Radical Scavenging Activity, 97.2% @250(µg/ml). 9,10- diacetoxy berberine (3) has comparable effect (60% antioxidant activity) while other derivatives showed decrease in activity as compared to berberine. Increase in dose also caused no betterment in results, however 9,10-dibenzoxy derivative(4) at dose of 500(µg/ml) had marked effect of 78% DPPH Radical Scavenging property.

Keywords: Berberine, Isoquiniloline, Antioxidant, DPPH Radical Scavenging.

Introduction

Plants containing pharmacologically active constituents have been used by man since the dawn of History. Plant drugs offer cure for many diseases which do not find lasting remedies in modern medicine. If used judiciously, drugs of plant origin have better compatibility with human system as the compounds occurring in plants already have biological functions and may have more biologically relevant chemistry to human system, hence lesser side effects. Remarkable diversity in chemical structures and biological activities of the naturally occurring secondary metabolites which make them important as direct use as therapeutic agents, utility as biochemical and molecular probes and utility as prototype lead compounds for the development of new synthetic or semi synthetic drugs. The initial step in the discovery of a new drug is the lead identification. In search of lead identification from natural sources which may



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Plant Based Synthesis of Silver Nanoparticles from *Ougeinia oojeinensis* Leaves Extract and their Membrane Stabilizing, Antioxidant and Antimicrobial activities

Deepak Kumar^{a*}, Shefali Arora^b, Abdullah^c, and Mohd Danish^c

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^bDepartment of Chemistry, University of Petroleum and Energy Studies, Dehradun, Uttarakhand, India.

Abstract

The present investigation demonstrates the formation of silver nanoparticles by the reduction of the aqueous silver metal ions during exposure to the ethanol extract of *Ougeinia oojeinensis*. The silver nanoparticles obtained were characterized by colour change reaction, UV–visible spectrum, and scanning electron microscopy. The characteristic absorption peak at 450–500 nm in UV–Vis spectrum confirmed the formation of silver nanoparticles. The colour intensity at 450–500 nm increased with duration of incubation. The size of nanoparticles synthesized varied from 5 to 100 nm. Membrane stabilizing activity was done by hypotonic solution induced hemolysis. Ethanol extract showed 79.87 % activity where as AgNPs showed mild membrane stabilizing activity. The antioxidant activity of AgNPs were investigated by DPPH method. Here both ethanol and AgNPs showed mild antioxidant activity. Antibacterial and antifungal activities were performed by well diffusion method against. AgNPs showed remarkable activity against bacterial and fungal strains.

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Keywords: *Ougeinia oojeinensis*; AgNPs; Antioxidant; Membrane Stabilizing; Antimicrobial.

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AGE, GROWTH AND LENGTH-WEIGHT RELATIONSHIP OF *CIRRHINUS MRIGALA* (HAMILTON, 1822) FROM YAMUNA RIVER, DEHRADUN, UTTARAKHAND, INDIA

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ABSTRACT : The scales for the present investigations were collected from Yamuna River, Dehradun, Uttarakhand, from the months of March 2018 to May, 2019. In total, scales were collected from 191 fishes. The age ranges from 1 to 4+ years in examined material. The sample was ranged between 23cm to 50.9 cm length and 110 to 1030 g weight of *Cirrhinus mrigala* obtained from the various sampling sites. The minimum and maximum values of Condition factor (K) were observed between 0.99 to 1.19. The fishes show a linear but not directly proportional body: scale relationship. The minimum value of scale radius to annulus was 3.8mm and length at the time was 181.6 mm, while the maximum value of scale radius to annulus was recorded 27 mm and the length at that time was 458.1 mm (by back calculation method).

Key words : Age, growth, condition factor, scale radius, annulus, sampling.

INTRODUCTION

Knowledge of age and growth of a fish is an extremely useful part of population dynamics in fishing biology and fish management. Chogunovas (1963) has given a descriptive account of age and growth in fishes. This provides us the basic information of sexual maturity, harvestable size and spawning time, helping in catching fishes by using nets of desirable mesh and environmental conditions of the water body (Summer Felt and Hall, 1987). There are several hard parts, which are used for age determination like Scales, Opercula, vertebrae, frontal bones, Cleithra, Otolith and fin ray sections. Out of these, 'scale method' is most widely used because it can be used without sacrificing the fish (Jhingran, 1957, 1959; Jhingran and Khan, 1979 and Hamilton, 1822). Growth of fish is the change in length and width with increase of age as a result of metabolism of nutrition. Hence, age and growth are clearly related to one another. As the fish ages, it continues to grow but after attaining a particular size, its growth stops. Age and growth are the two attributes of primary importance in accessing fish population and their responses to various aspects of management measures (Mayank and Dwivedi, 2015 and Pathak *et al.*, 2015).

The study of length-weight relationship has its applied

value in fish biology and is widely used for the purpose of conversion of the equation of growth in length to growth-in weight for use in stock assessment models and estimations of biomass from length observations (Wootton, 1990). Length-weight relationship (LWR) is a useful tool in fish growth patterns or age determination (Peppe and Ofor, 2011).

Cirrhinus mrigala is known as 'Mrigal carp' or 'Mrigal' in English or 'Nain' in Hindi belonging to family Cyprinidae. It is a member of Indian major carp (Mayank *et al.*, 2016). *Cirrhinus mrigala* is a natural inhabitant of the Indus and the Ganga river systems (Chauhan *et al.*, 2007). It is commercially exploited from the Ganga and the Yamuna Rivers in group of Indian major carp (Mayank and Dwivedi, 2015; Pathak *et al.*, 2015). The natural distribution of *Cirrhinus mrigala* is in the freshwater of Northern India, Bangladesh, Burma and Pakistan.

The purpose of this study is to calculate the age of *Cirrhinus mrigala* by scales, establishing length-weight relationship and relationship between the scale size and growth.

MATERIALS AND METHODS

Collection of samples : The material for the present investigations was collected from Yamuna river,

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Fenugreek (*Trigonella foenum-graecum* L.) A potential source of dietary fibres and steroidal saponenin (Diosgenin)

Naveen Chandra Pant, Rakesh Dhoundiyal, Manoj Kumar, Upendra Dwivedi, JP Singh and Sanjeev Agrawal

Abstract

Soluble, Insoluble and total dietary fiber content along with diosgenin (steroidal saponenin) content of 25 fenugreek (*Trigonella foenum graecum*, L) genotypes from north India were evaluated, together with crude fiber and saponin content. The total dietary fiber content varied from 39.487±0.547 in UM-274 to 50.015±0.667 % in IC-143850. The genotype IC-143850 also showed, highest soluble dietary fiber content (i.e., 33.158±0.573 %), respectively. The diosgenin content within fenugreek genotypes varied from 7.153±0.388 in UM-265 to 17.822±0.602 mg g⁻¹ dry wt. in RMT-303. The genotypes under investigation showed significant difference (p ≤ 0.05) with respect to dietary fiber and diosgenin content. There was a significant (p ≤ 0.01) positive correlation (0.960) between total dietary fiber and soluble dietary fiber, similarly a significant positive correlation (0.891) was observed between total and insoluble dietary fiber within the genotypes. There was also a significant positive correlation between diosgenin and different dietary fiber constituents i.e., soluble, insoluble and total viz., (0.298, 0.444 and 0.375, respectively). Saponin and diosgenin content among the genotypes under investigation were also positively correlated (0.646). The findings of the present investigation clearly show variation in dietary fiber and diosgenin content and significant among fenugreek genotypes. These variations within the genotypes may be attributed to the genetic differences among the fenugreek genotypes.

Keywords: Pullulanase, galactomannans, diosgenin, dietary fibers

Introduction

Fenugreek (*Trigonella foenum-graecum* L.) also known as 'methi' is among the oldest medicinal herbs used by human beings. It is extensively grown in winter season throughout tropical and subtropical regions of India during for its seeds, tender shoots and fresh leaves. The seeds are rich source of alkaloids proteins, free unnatural amino acids (4-hydroxyisoleucine), dietary fiber, steroidal saponins and individual spirostanols and furastanol like diosgenin, gitogenin, yamogenin etc. These components have been identified as the main phytochemicals responsible for varying biological effects shown by fenugreek seeds. Fenugreek soluble fibers are an indispensable component due to their potential applications in functional foods and nutraceuticals. The soluble fiber from fenugreek seeds has been identified chemically as galactomannans. These are the biopolymers having β-D-mannan backbone to which varying degrees of D-galactosyl substituents are attached via 1, 6-glycosidic linkages. Adequate intake of dietary fiber is associated with significant lower prevalence of coroner heart disease, stroke, and peripheral vascular disease (Merchant *et al.* 2003); [17] other risk factors i.e., obesity, hypertension and diabetes etc., are also less prevalent in individuals with the adequate intake of dietary fiber (Lairon *et al.* 2005) [14]. Fibers particularly soluble fibers usually delay gastric emptying due to slow transit of food materials through the small intestine, whereas insoluble fibers has inverse effect. In the small intestine, dietary fibers have profound effect on a wide variety of gastrointestinal hormones that serve as a stimulus effecting release of insulin (Anderson *et al.*, 2009) [4]. Dietary fibers are also known to bind bile acids and significantly increase excretion of bile acids and cholesterol from the body (Kirby *et al.* 1981) [12]. Fermentable fibers in the colon increase bacterial load thereby acting as prebiotics increasing growth health-promoting bacteria. The physiological effects of total dietary fiber i.e., soluble and insoluble derived from food have a significant effect on

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CuO nanoparticle mediated elicitation of polyphenols and antioxidant activity in chicory (*Cichorium intybus* L.)

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Abstract

The present study on effect of CuO nanoparticles on *Cichorium intybus* L. significantly enhanced the polyphenols content in treated plants at 10 and 20 DAT. Higher total phenol content i.e., 28.171±0.125 and 30.759±1.730 mg gallic acid equivalents g-1 extract, was observed 20 DAT in shoots and roots of treated plants, respectively. Higher flavonoid content i.e., 9.450±0.220 and 12.878±0.648 mg quercetin equivalents g-1 extract was also observed at 20 DAT in both shoots and roots of treated plants. The tannin content at 20 DAT in shoots and roots of treated plants also differed significantly w.r.t shoots and roots of control at 10 and 20 DAT, respectively. The shoots and roots of treated plants showed significantly ($p \leq 0.05$) higher total antioxidant activity at 10 DAT. The total antioxidant activity within shoots showed a significant ($p \leq 0.01$) positive correlation (0.938) with total antioxidant activity observed in roots of *Chicorium*. Phenol and flavonoid content within the roots showed a positive correlation with total antioxidant activity within the roots i.e., 0.241 and 0.384, respectively. Highest scavenging of DPPH radical was observed within shoots and roots of treated plants at 10 DAT, and it differed significantly ($p \leq 0.05$) w.r.t corresponding activity at 20 DAT. DPPH radical scavenging within shoots showed a significant positive correlation ($p \leq 0.01$) with corresponding activity in roots (0.939). DPPH radical scavenging activity within roots showed a negative correlation with total phenol, flavonoid and content within the roots (i.e., -0.453, -0.348 and -0.415, respectively) as observed by lower IC50 values of the extracts. Thus the results clearly show that CuO nanoparticles significantly enhanced polyphenols and corresponding antioxidant activity in *Cichorium*.

Keywords: Polyphenols, flavonoids, tannins, DPPH

Introduction

Chicory (*Cichorium intybus* L.) also known as Kasni is a traditional medicinal plant and has been used as a therapeutic agent since ancient times. Its therapeutic properties were even recognized by Greeks and Romans. The herb is widely used in many traditional system of medicine including ayurvedic, unani system of medicine. Recently many known therapeutic effects of the plant have recently been confirmed by various researchers. The plant is a valuable source of several studies phytochemicals including coumarins, flavonoids, anthocyanins, fructans, and sesquiterpene etc., (Norbaek *et al.*, 2002; Innocenti *et al.*, 2005; Shah *et al.*, 2012; Montefusco *et al.*, 2015). Plant parts specially roots and leaves are frequently used as antipyretic, diuretic and laxative. The plant is known to possess antibacterial activity (Petrovic *et al.*, 2004) and have potential hypoglycemic and hypolipidemic properties. It has been used widely used as a traditional treatment for diabetes mellitus in India (Pushparaj *et al.*, 2007). It is also used as an appetizer as well as in the treatment of chronic hepatic failure, jaundice and skin diseases (Ghaderi *et al.*, 2012), apart from widely used for its anti-inflammatory and anti-ulcerogenic properties.

Enhancing levels of phytochemicals in plants is a crucial step in the development of bioprocesses for their production within plants. Bioactives derived from the plants are important source valuable therapeutic drugs. Nanoparticle mediated elicitation of secondary metabolites within plants have been the subject of debate as at higher concentration they exhibit toxic effects within the plants. Thus the present investigation was planned with lower concentration of CuO nanoparticles and their effect on polyphenols as the secondary

Seed priming: quality enhancement technique

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High germination and uniform plant stand establishment is essential to maintaining profitable yields. Improvement in plant stand establishment can be obtained by seed quality enhancements. These are value-added treatments that improve the germination, seedling growth or facilitate the delivery of seeds and other material required at the time of sowing. The purpose of these treatments is to shorten the time between planting and emergence. Seed enhancement through priming has led to great improvements in farmer's ability to achieve above goal in the field and under controlled environment.

Seed priming is the process of controlled hydration of seeds to a level that permits pre-germinative metabolic activity to proceed but prevents actual emergence of the radicle. During seed priming, the uptake of water occurs in three phases. (1) Phase I: seed hydration process related to passive imbibition of dry tissues associated with water movement first occurring in the apoplastic spaces; (2) Phase II: activation phase associated with the re-establishment of metabolic activities and repairing processes at the cell level and (3) Phase III: initiation of growing processes associated to cell elongation and leading to radicle protrusion. Phases I and III both involve an increase in the water content while hydration remains stable during Phase II. It is commonly considered that before the end of Phase II, germination remains a reversible process: the seeds may be dried again and remain alive during storage and able to subsequently re-initiate germination under favourable conditions.

TYPES OF PRIMING

Several methods of seed priming have been developed in order to invigorate seeds and alleviate the environmental stresses. A common feature of water-based priming techniques which distinguishes them from other pre-sowing treatments, is partial seed pre-hydration and the activation of early germination events in seed. Priming efficiency is affected by many factors such as chosen priming technique and strongly depends on treated plant species. Physical and chemical factors such as osmotica, water potential, priming agent, duration, temperature, presence or absence of light and aeration. Seed condition also influence priming success and determine germination rate and time, seedling vigour and further plant development.

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Genetic variability and genetic divergence for seed yield and its component characters in grain amaranth (*Amaranthus hypochondriacus* L.) germplasms

Shailendra Tiwari, Naveen Chandra Pant, Anuj Gupta, Upendra Dwivedi, Jitendra Kumar Meena, CS Pandey, Rakesh Dhoundiyal and Arun Bhatt

Abstract

The research was conducted during Kharif (2013) at Crop Improvement Research Block of Uttarakhand University of Horticulture and Forestry, Ranichauri Campus with 54 diverse genotypes of grain amaranth. The 54 genotypes including four checks viz., Annapurna, Durga, PRA-2 and PRA-3 were planted in an augmented design during under rainfed condition. Genetic variability and genetic divergence was studied for characters viz., days to 50% flowering, days to maturity, plant height, inflorescence length, spikelet length, number of spikelets per plant, stem thickness, 1000 seed weight and seed yield per plant. Analysis of variance revealed that differences among the entries were highly significant for days to 50% flowering, days to maturity, plant height (cm), inflorescence length (cm), spikelet length (cm), number of spikelets per plant, stem thickness (mm) and non significant for 1000 seed weight (g) and seed yield per plant (g). Adjusted mean for earliest flowering (63.20 days) and maturity (128.00 days) minimum in Durga. The maximum plant height (148.00 cm) was noticed in IC-95339. The genotype IC-82625 recorded highest seed yield per plant (46.69 g). Using the Non-hierarchical Euclidean cluster analysis, the 54 genotypes were grouped into eight different non-overlapping clusters. The highest inter cluster distance was observed between cluster III and cluster VIII (67.39) followed by cluster IV and cluster VII (64.30) suggesting wide diversity among these groups. Considering cluster mean and genetic distance, crossing between genotypes of cluster IV (IC-82625 and IC-95247) with cluster VIII (Durga) were likely to recombine the genes for high seed yield in temperate conditions mid hills of Uttarakhand.

Keywords: amaranthus, correlation, path coefficient analysis

Introduction

Amaranth belongs to the family Amaranthaceae and genus *Amaranthus*. There are two chromosome groups in Amaranth, $n=16$ and $n=17$. The species with $n=16$ are *A. hypochondriacus* and *A. caudatus* and with $n=17$ are *A. tricolor*, *A. spinosus*, *A. viridis*, *A. cruentus* and *A. bilatum*. *Amaranthus* species have different centre of domestication and origin, being widely distributed in North America, Central America, and the South America Andes, where the greatest genetic diversity is found (Sun *et al.* 1999; Xu and Sun, 2001). It is estimated that there are 87 species of *Amaranthus*: 17 in Europe, 14 in Australia and 56 in America (Mujica and Jacobsen, 2003)^[10]. The production of *Amaranthus* (Ramdana) in Uttarakhand is cultivated in a wide range of soils and under diverse climate conditions. The production and productivity of amaranthus crops is approximately 2939 mt and 4.840 quintal per ha from approximately 6072 ha area reported by Khamgonkar *et al.* 2013. Grain amaranth is an important multifarious-utility cash crop of the higher hills where, it is grown mainly as a pure crop. Amaranth seed is having protein (15-18%) and contains respectable amounts of lysine (Marx, 1997)^[9], and methionine, two essential amino acids that are not frequently found in grains. Favorable composition of grain amaranth flour helps in prevention of certain disease like heart condition, diabetes, brain stroke etc. Also, the high content of fiber and starch has a positive effect on digestion disorder (Peterka *et al.* 2001)^[15]. Amaranth is one of the most important underutilized crops for Himalayan agriculture and is often considered as 'minor crops'. However, it was once grown more widely or intensively.



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Studies on correlation and path coefficient analysis for yield and yield related traits in Indian mustard (*Brassica juncea* L. Czern & Coss.) under timely and late sown conditions

Anuj Gupta, Naveen Chandra Pant, Upendra Dwivedi, Shailendra Tiwari, CS Pandey, Rakesh Dhoundiyal, KN Maurya and OP Verma

Abstract

Two sets of field experiments were conducted at Genetics and Plant Breeding Research Farm of Narendra Deva University of Agriculture and Technology Kumarganj, Faizabad (U.P.), India during Rabi 2014-15 with 30 diverse genotypes of Indian mustard including three checks (Kranti, Vardan and RGN-73) to assess the correlation and path coefficients for yield and yield related traits under timely (TS) and late sown (LS) conditions. The genotypes were evaluated for thirteen quantitative characters viz., days to 50% flowering, days to maturity, plant height (cm), number of primary branches plant⁻¹, number of secondary branches plant⁻¹, length of main raceme (cm), siliqua on main raceme (cm), seeds siliqua⁻¹, 1000-seed weight (g), biological yield plant⁻¹ (g), harvest index (%), oil content (%) and seed yield plant⁻¹ (g). Seed yield plant⁻¹ showed highly significant and positive association with biological yield plant⁻¹ followed by harvest index, siliqua on main raceme, length of main raceme, 1000-seed weight and secondary branches plant⁻¹ both, under timely and late sown conditions. On the other hand plant height possessed highly significant and positive association with seed yield plant⁻¹ only under timely sown condition. Path analysis identified biological yield plant⁻¹ followed by harvest index, as major direct contributors towards seed yield plant⁻¹ (both under timely and late sown conditions), while plant height emerged as most important indirect yield component under timely sown condition. Secondary branches plant⁻¹ (at genotypic level) and Plant height (at phenotypic level) showed maximum indirect effect on seed yield plant⁻¹ via, biological yield plant⁻¹ under late sown condition. The characters mentioned above should be given due consideration at the time of selection to develop stable high yielding genotypes in Indian mustard to sustain the production and productivity.

Keywords: Indian mustard, correlation, path coefficient analysis

Introduction

Rapeseed-mustard is the third important oilseed crop in the world after soybean (*Glycine max*) and palm (*Elaeis guineensis* Jacq.) oil. It has 38 to 42% oil & 24% protein. Oil is used in Northern India for cooking and frying purposes. India ranks first in the world in area and production for groundnut, castor, sesame and niger while second in safflower, rapeseed-mustard and third in linseed. Planting time is the single most important variable affecting the seed yield of rapeseed and mustard. Sowing time of sarson and rai must be completed in the first fortnight of October. Yield is a complex trait and is dependent on many other ancillary characters which are mostly inherited quantitatively. The components which have positive correlation with yield can be used in the indirect selection for yield and may act as an alternate mode of selection for yield improvement. When indirect associations become complex path coefficient analysis is the most effective means to find out direct and indirect causes of association among the different variables. Path coefficient analysis (Wright, 1921)^[20] can be used to discriminate between realistic (general) and inflated (environmental) correlations. Hence, the knowledge of direct and indirect effects of different components on yield of rapeseed-mustard is of prime importance in selection of high yielding genotypes and knowledge of association of various yield components associated with traits of economic importance would help suitable selection criterion which could be used in future breeding programs.

Materials and Methods

The present investigation was carried out at Research farm of Genetics and Plant Breeding, N.D. University of Agriculture and Technology, Kumarganj, Faizabad (U.P.), India during Rabi 2014-15. Geographically, this place is situated between 26.47°N latitude and 82.12°E

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Effect of CuO nanoparticles on polyphenols content and antioxidant activity in Ashwagandha (*Withania somnifera* L. Dunal)

Oinam Surjit Singh, Naveen Chandra Pant, Lenin Laishram, Manisha Tewari, Rakesh Dhoundiyal, Karishma Joshi and CS Pandey

Abstract

In the present investigation CuO nanoparticles significantly enhanced the polyphenols content in treated plants at different dates of sampling. Highest total phenol content i.e., 27.215±0.73 and 26.455±0.365 mg gallic acid equivalents/g extract, was observed 20 days after treatment in shoots and roots of treated plants, respectively. No significant difference ($p \leq 0.05$) in flavonoid content within shoots of treated plants was observed 15 and 20 DAT, respectively. Highest flavonoid content i.e., 23.076±5.128 mg quercetin equivalents/g extract was observed in roots of treated plants 20 days after treatment. Significantly higher tannin content was also observed in roots of treated plants 20 DAT. Higher total antioxidant activity i.e., 55.797±1.924 and 56.811±3.012mg ascorbic acid equivalents/g extract was observed in shoots and roots of treated plants, respectively 20 days after treatment. Higher DPPH radical scavenging activity as observed by lower IC₅₀ values i.e., 336.234±5.187 and 473.88±8.834 µg/ml in shoots and roots of treated plants, respectively was observed 20 days after treatment. Total antioxidant activity in shoots showed a significant ($p \leq 0.05$) positive correlation with phenol and tannin content within the shoots i.e., 0.618 and 0.693, respectively. Total antioxidant activity in roots also showed significant positive correlation with total phenol, flavonoid and tannin content within roots i.e., 0.416, 0.683 and 0.891, respectively. DPPH radical scavenging activity within shoots (-0.888) and roots (-0.851) showed a significant negative correlation with total phenol and flavonoid content in shoots and roots, respectively. Thus the findings of the present investigation clearly shows, the elicitation effect of CuO nanoparticles in *Withania somnifera* L.

Keywords: antioxidants, phenol, flavonoids, DPPH

Introduction

Ashwagandha (*Withania somnifera* L. Dunal) is an important medicinal crop cultivated in India. It is mentioned as an important drug in ancient Ayurvedic literature. The genus *Withania* belongs to solanaceae and consist of 26 species. Two species of the genus, *Withania somnifera* L. Dunal and *W. coagulans* Dunal occurs in India (Alam *et al.*, 2016) [1]. The species has been under domestication since long in Central India. In India the plant is grown throughout dry subtropical and temperate regions in the states of Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Uttar Pradesh, Haryana and Punjab extending to Himachal Pradesh and Jammu and Kashmir from plains upto a height of about 1700 m. It is mainly cultivated in MP, Punjab and some adjoining villages of Rajasthan (Shrivastava and Sahu, 2013) [18]. Alkaloids and withanolides are the major group of active principles, isolated and characterised from *Withania somnifera*. Withanolides are steroidal lactones and the leaves are of plant are characterised by the presence of various substituted steroidal lactones of the withanolide group. Withaferin-A is the major withanolides, isolated to which the curative, viz., antibacterial, anti-tumour and anti-inflammatory properties of leave are attributed to withanolide-D possessing marked anti-tumour property (Devi *et al.*, 1993) [7] against Sarcoma and Ehrlich ascites carcinoma and withanolide-E possessing immune suppressive activity are the major withanolides isolated from the plant (Jain *et al.*, 2012) [9]. Ashwagandha is widely used in Indian systems of medicine and Homeopathy to cure diseases like leprosy, nervous disorders, intestinal infections and rheumatism. The berries and seeds are diuretic and are also used for treating chest complaints. Studies have shown that ashwagandha is effective in the treatment of osteoarthritis, inflammation, stroke, and tardive dyskinesia. Ayurvedic practitioners have used the roots of this plant for centuries with success to treat health conditions (Umadevi *et al.*, 2012) [21]. Ashwagandha is used to calm the mind, relieve weakness and nervous exhaustion, build sexual energy and promote healthy sleep. The herb is



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Evaluation of Micronutrients in Fenugreek (*Trigonella foenum-graecum* L.): A Viable Alternative for Micronutrient Supplementation

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ABSTRACT

Dietary antioxidants (total ascorbate, α -tocopherol and total carotenoids) and micronutrient (iron, calcium, zinc, copper and manganese) content of 25 fenugreek (*Trigonella foenum-graecum* L.) genotypes were evaluated under the present investigation. Higher α -tocopherol and total carotenoid content i.e., 43.08 ± 1.542 mg α -tocopherol/100 g dry wt. and 4.890 ± 0.047 g carotenoids/100 g dry wt. was observed in RMI-305. The genotype RMI-143 showed highest iron, calcium and manganese content i.e., 184.11 ± 1.639 , 781.20 ± 4.790 and 25.65 ± 0.693 μ g/g dry wt., respectively. Total ascorbate content within fenugreek genotypes under investigation showed a positive correlation with α -tocopherol and total carotenoid content (i.e., 0.114 and 0.061, respectively). It also showed a significant ($p < 0.05$) positive correlation with manganese (0.298) and iron content (0.062) among the genotypes. α -tocopherol content within fenugreek genotypes also showed a significant ($p < 0.01$) positive correlation (0.328) with total carotenoid content another important lipid-soluble antioxidant. The iron content within the fenugreek genotypes showed a significant ($p < 0.01$) positive correlation with other micronutrients viz., calcium, zinc and manganese (i.e., 0.408, 0.502 and 0.299, respectively). A positive correlation was also observed between iron and total ascorbate, α -tocopherol content (i.e., 0.062 and 0.213, respectively) within the genotypes. Similarly other mineral elements viz., calcium, zinc, copper and manganese, respectively also showed a positive correlation with each other in general. The findings of the present investigation clearly show significant variation in dietary antioxidants and micronutrients among the fenugreek genotypes under investigation. Thus the genotypes with higher dietary antioxidants and micronutrient content viz., RMI-305, Pant nagara, RMI-143, Pusa early bunching, IC-066843, GM-2 and HM-355 could be utilized as a valuable source of dietary micronutrients and may serve as potential functional food to combat micronutrient malnutrition along with other favourable health promoting affect.

Keywords

Ascorbate, α -Tocopherol
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Transformation of some major nutrients in tea garden soils of North Bengal

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Abstract

The intensity of land uses increase without passable and unprejudiced apply of chemical fertilizers and with less or no use of organic manure have caused severe decrease in fertility status of tea garden soils. Sixteen soil samples (0-30cm) from four farmers' field (Small tea garden) located at Malabari village, in Naxalbari block under Darjeeling district of West Bengal were collected. Most of the soils were acidic in reaction and the pH ranged from 5.19 - 6.30. Oxidizable organic carbon was found to vary from 0.61% - 1.24%. Lime requirement of the soils were estimated by SMP buffer method and found to be varying between 1.9 to 4.2 ton/acre. The laboratory incubation study was conducted with application of lime, vermicompost and their combination. Vermicompost application in general showed higher availability of nitrogen and phosphorus than lime application. Effect of liming was found to be superior over the vermicompost application with respect to sulphur availability in different soils. Combined effect of lime and vermicompost on availability of nitrogen, phosphorus and sulphur were much higher than their individual application. Maximum benefit of availability of nitrogen, phosphorus and sulphur were recorded on 60th day of incubation followed by 90th day and minimal availability at 30th day of incubation.

Keywords: tea garden, soil physico-chemical properties, nutrient transformation

Introduction

Tea (*Camellia sinensis* L.) is a perennial evergreen plant growing in an extensive range of soil types derived from various parent material in tropical, subtropical and temperate climate (Eden, 1976)^[1]. India contributes about 27% of the world's tea demand in terms of domestic and international requirements. Cultivation of tea for quite long years in a particular garden leads to the loss of desired yield due to deterioration in soil quality (Dang, 2000)^[2].

Nutrient management has greater importance particularly to sustain yield potential and improvement of soil health. In a given locality, however, soil characteristics as well as nutrient parameters play an important role for better tea production (Sarwar *et al.*, 2011)^[3].

Among the three major nutrients nitrogen has received considerable importance and attention in the past as compared to P and K. S are also assuming importance for plantation crops. The role of phosphorus in improving tea productivity did not receive adequate attention, though regional responses were reported (Sen, 1964)^[4]. Primary reason for the variability in response of phosphorus may be attributed to the variation in the inorganic and reductant soluble phosphate, as well as organic and total phosphate in the soils (Bhattacharya and Dey 1978)^[5]. The iron and aluminum fractions in acid tea growing soils also make up the slowly available pool of soil phosphorus. The dynamics of organic matter in soil seems to play a dominant role in this regards (Sanyal 2002)^[7].

Sulphur is a vital nutrient for tea. Generally sulphur availability in tea soil is low (Natesonnet, *et al.* 1989)^[8] and is largely influenced by organic matter status. There is a positive correlation between the available S in soil and the organic matter content (Ghosh *et al.* 1994, Verma 1997)^[10, 9]. Therefore, there is a need to critically examine the effect to different doses of S on yield of tea and to identify the suitable sources of S for tea, together with the effect of S application in tea soil.

The present study was initiated to evaluate the effect of liming and application of organic amendment on the availability of nitrogen, phosphorus and sulphur in small tea garden soils

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Integrated nutrient management for sustainable yield in rice-potato-groundnut cropping system

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Abstract

The effect of seven different organic treatment in combination with inorganic fertilizer on crops in rice-potato-groundnut cropping sequence from an ongoing long-term fertility experiment at Gayespur (Central Research Farm, BCKV). The experimental conditions of different treatment combinations allowed building up the organic matter status and different nutrient levels with addition of different organic and inorganic sources of nutrients and bio-fertilizers. The present study has taken advantages of an established experimental set up and selected some relevant portions rice-potato-groundnut crop rotation. The objective of the present set of experiment is to study the combined effect of inorganic N, P, K fertilizer and FYM as organic source along with ZnSO₄ and bio fertilizer (*Azospirillum*, *Azotobacter* and PSB) on the status of organic carbon, total nitrogen and availability of N, P, K, Zn and S in soil.

Keywords: Integrated nutrient management, sustainable yield, rice-potato-groundnut, cropping system

Introduction

In the present world, most important challenges is to protect natural resources, including soil and water, for increasing food production while we have to protect the environment. Long-term food security will maintain a proper balance in-between the increasing crop production, maintaining of soil health and environmental sustainability. Decreasing soil fertility is a major constraint for higher crop production in West Bengal due to lower organic matter content as well lower application of organic matter in intensively cultivated soils. The increasing uses of high analysis NPK fertilizers have no doubt remarkably increased the food production but it has also brought with it problem particularly those of sulphur and zinc in soils.

Besides nitrogen, phosphorus, potassium fertilizer elements, deficiencies of zinc and sulphur is very common in rice, potato and groundnut crops in many parts of West Bengal as well as in India (Tandon, 1991)^[12]. Nambiar (1997)^[9] viewed that integrated use of organic manure and chemical fertilizers would be quite promising not only in providing greater stability in production, but also maintaining better soil fertility status. The long-term research of Bangladesh Rice Research Institute (BRRI) also revealed that the application of dung manure @ 5 t ha⁻¹ y⁻¹ improved soil resources from degradation (Bhuiyan *et al.*, 1994)^[11].

Materials and Methods

In order to develop nutrient management package in rice based cropping system in alluvial soils (Entisols), soil and plant samples were periodically collected from experimental sites of the Central Research Farm, Gayeshpur, Nadia. The period of investigation for the present study was Kharif and Rabi season of 2012 and summer 2013. There were seven treatment combinations consisting with inorganic fertilizer (Urea, SSP, MOP, Zinc Sulphate) applied with or without organic manure / crop manure (FYM, Vermicompost, Neem cake, *Dhaincha* as green manure, burning of crop residue after harvesting each crop) and bio fertilizer (*Azospirillum*, *Azotobacter* and PSB). The treatment details are given in (Table 1). The fertilizer were use as per recommended dose for rice (*Gobinobhog*): 80 - 40 - 40, potato (*Kufri Jyoti*): 200 - 150 - 150, groundnut (TAG - 24): 20 - 40 - 40. Soil samples were analysed for the determination of organic carbon, total nitrogen and available potassium as described by Jackson (1973)^[13], available nitrogen by Bremner and Keeney (1966)^[6], available phosphorus by Hesse (1971)^[14], available sulphur (Tabatabai and Brmner, 1972)^[10] and DTPA - extractable zinc by Lindsay and Norvall (1978)^[18]. Plant samples were analysed for the determination of total nitrogen, total phosphorus and total potassium as described by

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Effect of protein supplementation on growth performance of Buffalo calves

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Abstract

Twelve growing buffalo calves, weighed about 141 kg, were selected from Livestock Research Center of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, for this experiment. Growing buffalo calves were placed on three dietary treatments i.e. recommended plane of nutrition, improved village practice and grazing treatments. These animals were placed on dietary treatments, in a group of 4 for 6th fortnights. Significantly different body weight gain during 1st, 5th and 6th fortnights and cumulative body weight gain at the end of 5th and 6th fortnights were recorded. The cumulative body weight gain recorded on recommended plane of nutrition, improved village practice and grazing treatments were respectively 26.250±3.734^a kg, 38.300±2.572^b kg and 31.375±1.785^{ab} kg. The higher weight gain on improved village practice treatment was due to higher amount of barseem included in the diet as to meet the dry matter requirements of the animals. DCP utilization efficiency was better on grazing treatment during 6th fortnight and it was due to restriction in the fodder available for grazing. The most important is feeding cost for gain (Rs/Kg) was significantly and drastically lower on grazing treatment which indicates that waste land, bank of the rivers, road sides and railway track sides can be utilized for grazing for low cost production.

Keywords: feed, growth performance, buffalo calves

Introduction

Protein is the most important constituents of animal diets having vital role in their growth, production, and reproduction. Nutrient requirements recommended by NRC (2001) [15] are widely adopted to formulate diets for ruminant animals around the world. Nevertheless, the nutrient requirement equations presented by NRC were based on cattle (*Bostaurus*). But question arises about the use of these feeding standards to formulate diets for buffalo (*Babulus bubulis*). Buffalo is an important animal species for beef production system in several parts of the world, particularly in tropical and subtropical regions of the globe. Cost-effective production of quality beef and milk from buffalo depends upon accurate information about its own energy and protein requirements. Ludri and Razdan (1980) [9] reported that dietary protein intake level of 40% less than that recommended by NRC (1976) [14] level of crude protein (CP) showed no adverse effect on digestibility of nutrients and a positive nitrogen balance was observed. Baruah *et al.* (1988) [4] studied the feed intake, nutrient utilization and growth in male buffalo calves fed different levels of protein reported that level of energy significantly affected the gain in body weight. They also observed that 75% protein feeding than NRC has no significant effect on growth response. Adaptation to the nutrient requirement standards recommended for cattle by National Research Council (NRC) (2001) [15] for buffalo does not seem wise, unless proved by the research. The present study was conducted to investigate the effect of feeding different levels of protein and energy on growth response of male calves. As feed supplies to the animals are closely tied to the local cropping pattern, variation in feeding regimes are observed from region to region. In the Northern part of the country, wheat straw (bhusa) is more intensively utilized while paddy straw feeding is common in Eastern and Southern regions and part of the Western region, particularly in coastal areas. Sorghum stovers are fed in the Western regions and in parts of the Southern region. Feeding millet and pulse straw is also observed in certain localities (Badve, 1991) [13].

The use of agro-Industrial by-products, either as individual concentrates or as a part of balanced concentrate mixture, is a widely observed practice all over the country. In places, farmers mix by-products with conventional feed ingredients like brans and oilcakes, sprinkle some water on the mixture and feed animals at the time of milking. Salt or mineral mixture are often added to such feeds. It has been generally observed that concentrates are fed only to lactating animals.

Pre-treated animal and human waste as a substantial nutrient source for cultivation of microalgae for biodiesel production

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Abstract

The use of human and animal wastes for fertilization of aquaculture ponds has been practiced for thousands of years. In the present work, we have used the excreta (human urine, poultry waste, cow dung, and urine) as a nutrient source for the cultivation of *Chlorella singularis*, *Micractinium pusillum*, and *Chlorella sorokiniana* strains of microalgae. Different solid wastes were treated with 60 mM H₂SO₄ for the extraction of nutrients. After treatment, the supernatant of different solid wastes and liquid waste were diluted 5, 10, 15, and 20% to be used as a media for the cultivation of microalgae. *Chlorella sorokiniana* was able to grow in all concentration of excreta media. The maximum growth rate 140 ± 3.1 mg/L/day and lipid production (45.5 ± 2.3 mg/L/day) was obtained in 20% poultry. Among the different excreta media used for cultivation of microalgae, poultry media displayed the best results and thus, should be used for large scale cultivation of microalgae.

Keywords Microalgae · Excreta · Poultry waste · Human urine · Biodiesel

Introduction

Extensive research has been done for the development of biodiesel from microalgae. Nutrients are needed for the growth of microalgae. A significant challenge that needs to be addressed is optimization of algal biomass and lipid production technologies for developing a cost-effective commercial scale biodiesel (Wrede et al. 2014). Keeping in view the abovementioned facts the present study focuses on investigating animal, bird, and human excreta as a low-cost sustainable nutrient supply for algal biomass production.

Rapid growth of population has generated large amount of human and animal wastes (Talyan et al. 2008). Human and animal generate significant quantities of excreta as solid and liquid waste that can be used as fertilizer (Benetto et al. 2009; Remy and Jekel 2008; Tidåker et al. 2007a; Tidåker et al. 2007b). From the ancient time, human and animal excreta

were used for soil fertility. Composted excreta are used as an organic fertilizer. Solid and liquid wastes are good sources of carbon, nitrogen, phosphorus, potassium, magnesium, and other micronutrients (Kelleher et al. 2002). The cultivation of microalgae without added chemicals using excreta is gaining rapid attention. The recycling of carbon, nitrogen, and phosphorus from wastewater and excreta for growing algae makes this process economically effective (Miranda et al. 2015). This leads to significant reductions in the overall costs for biodiesel production (Zhou et al. 2011). The present investigation aims to use animal, bird, and human excreta as a source of nutrient for microalgae growth and lipid production.

Materials and methods

Isolation of microalgae and culture conditions

The *Chlorella singularis* strain UUIND5 (Gen Bank accession number KY745895) and *Micractinium pusillum* strain UUIND4 (Gen Bank accession number KY484922) isolated earlier by our group from fresh water were used in this study.

Apart from the above mentioned two microalgal species, one waste water novel microalgae was also isolated for this study. For this purpose, waste water samples were collected from the mess outlets of the Uttarakhand University Dehradun.

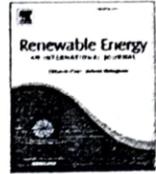
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Production of biodiesel and bioethanol using algal biomass harvested from fresh water river



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ABSTRACT

In this study, an integrated biomass conversion concept of producing liquid biofuels from fresh water macroalgal biomass was investigated. The algal biomass was collected from the Song river, Dehradun, Uttarakhand, India and processed under laboratory. 0.650 g dry wt m⁻² of algal biomass was harvested from the freshwater river. The collected algal biomass contained mainly 2 macroalgae species. Lipid extraction was done by soxhlet extraction method using chloroform: methanol (2:1) as solvent. 18.6% of lipid was obtained from macroalgae biomass. Blends of algae biodiesel with, butanol and diesel fuel (ASB25D70 and A10B30D60) were prepared by inline blending method on a volume basis. Oil extracted algal biomass was further hydrolyzed for release of fermentable sugar. The theoretical yield of conversion of fermentable sugars to bioethanol was estimated and found to be 61.0%.

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1. Introduction

With a large area, abundant freshwater resources, complex topography and diverse climates, India is one of the countries with greatest diversity of algal resources. There are diverse and abundant freshwater algae in India. Macroalgae have diverse biomass (oxygen-containing organic components and inorganic minerals) applications as a source of food and biofuels [1]. The majority of research focuses on marine macroalgae (seaweed) and no significant production of freshwater macroalgae exists [2]. Freshwater macroalgae viz., *Cladophora*, *Enteromorpha*, *Hydrodictyon*, *Microspora*, *Mougeotia*, *Oedogonium*, *Rhizoclonium*, *Spirogyra*, *Tribonema*, *Ulothrix*, *Vaucheria* and *Zygnema* are biological resource for various valuable compounds such as protein, carbohydrates and lipids [3]. Macroalgae can form dense floating mats on water surfaces. This allows for efficient and cost-efficient biomass harvesting as compared to dewatering an equivalent biomass of suspended microalgae. Limited research has been done on freshwater macroalgae as a biofuels feedstock [4]. So in this study we have used mixed macroalgal biomass for the production of liquid biofuels (biodiesel and bioethanol).

Cellulose and hemicellulose can be hydrolysed into simple sugars either enzymatically or by acid hydrolysis for producing bioethanol. The success of the bioethanol production from algal biomass mainly depends on the amount of its carbohydrate contents [5]. R. Trivedi et al., [6] reported about 11% of cellulose in macroalgal biomass which can be further hydrolyzed to simple sugar. The hydrolysis product being a six carbon sugar can be easily fermented to ethanol [7].

This study has two specific objectives, which are as listed as follows: The first is extraction of lipids from mixed algal biomass. Second is to convert the lipid extracted algal biomass into fermentable sugars for the production of bioethanol.

2. Materials and methods

2.1. Materials

All solvents and reagents used in this study were HPLC grade. Standard for TLC (Triolein) was acquired from Sigma Aldrich (St. Louis, MO, USA). Cellulase enzyme was purchased from Sigma Aldrich (St. Louis, MO, USA).

2.2. Water measurements and harvesting of algal biomass

Algal biomass was collected from freshwater Song river.

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ARTICLE

Synergistic dynamics of light, photoperiod and chemical stimulants influences biomass and lipid productivity in *Chlorella singularis* (UUIND5) for biodiesel production

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Abstract Microalgae have emerged as a potential alternative for the production of many useful compounds like protein, carbohydrate and lipid. Lipid-rich microalgae are important and rich source for alternative energy production. In order to commercially utilize microalgae for energy production, the lipid productivity should be enhanced. Keeping in view the above-mentioned potentials of microalgae, in the present study, we have attempted to display the role of chemical stimulants and light in the growth and lipid production of the microalgae *Chlorella singularis* (UUIND5). During the present investigations, effect of varying photoperiods and different types of lights and chemical stimulants, viz. CaCl₂ and kinetin on growth rate and lipid production, was studied. The maximum growth rate recorded was 166 ± 0.3 mg/L/d, when 0.80 g/l CaCl₂ and 0.5 mg/l kinetin were added to Bold's basal medium. *C. singularis* was then cultivated in this medium for 14 days under sunlight +LED (10-h sunlight + 14-h LED light) at photoperiod 24-h light/0-h dark. The maximum lipid yield 30.2% of dry wt. was obtained under sunlight +LED. Further, the gas chromatography analysis also showed the presence of fatty acid methyl esters (FAME). FAMEs profile was analyzed according to ASTM D6751 specification. Thus, it was concluded that sunlight +LED at 24-h light/0-h dark (100 μmol photons m⁻² s⁻¹) photoperiod with CaCl₂ and kinetin is an

effective strategy to boost lipid productivity in *C. singularis* (UUIND5).

Keywords *Chlorella singularis* · Microalgae · Light · CaCl₂ · Kinetin

Introduction

Rapid rise in fossil fuel demand throughout the world is increasing fossil fuel depletion and carbon emissions leading to global climate change. This has intensified the discovery of the alternative fuels. Among the different options available for alternative energy production, microalgae are currently attracting wide interests. This is because by photoautotrophic mechanism microalgae convert CO₂ into biomass, lipid (fatty acid) and protein. The total lipid content in microalgae varies from 10 to 70% of dry algae biomass from species to species and has 20–40 times more productivity than oil crops [1–3]. For the growth of microalgae, light is an important factor. Excessive intensity may cause photo-oxidation, and low intensity decreases the growth [4]. Various artificial lights are used by the researchers to increase the production capacity. Development of light-emitting diode (LED) light presents an enormous potential for improving microalgae growth. The light duration itself is an important factor for microalgae [5]. For industrial-scale production of microalgae, the ratio between the cost of energy and the biomass productions is an important factor for lowering per unit cost of biodiesel. For this, preference is given to outdoor cultivation where light energy comes directly from the sun [6]. But sunlight has certain drawbacks such as changing day and night cycles in summer and winter [7, 8]. UV radiations are another growth-limiting factor for

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An integrated approach for extracting fuel, chemicals, and residual carbon using pine needles

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Abstract

The present study describes an integrated method that can be used to sequentially extract five economically important fractions viz., essential oil, organic acids, resin, cellulose, and residual carbon from biomass of pine needles. It is a simple but very effective approach which can give consistent yields from the residual biomass with every successive extraction step. For example, aqueous extracts 0.2 ± 0.5 ml/g, essential oil 0.03 ± 0.1 ml/g, resin 64.125 ± 0.2 mg/g, and 302.20 ± 04 mg/g of sugar and 1 ± 0.3 g of residual carbon. Sugars were further fermented under optimized conditions for the production of ethanol (18.2 ± 0.4 g/l). These yields were compared to direct processing of the individual components. Residual carbon obtained after hydrolysis was used for the preparation of activated carbon. This combined ethanol production and chemical extraction approach may provide a compelling model for a biorefinery and increasing commercial viability.

Keywords Pine needles · Essential oil · Organic acids · Resin · Residual carbon

1 Introduction

Lignocellulosic materials such as agricultural and forest residues are available to a large extent in India. These materials have been considered non-food-based feed stocks for biofuels production [1–3]. According to Uttarakhand Renewable Energy Development Agency (UREDA), over 4500 ha of forest was gutted due to wildfires. The major reasons for forest fires in Indian Himalayas region are the highly flammable material of dry pine needles. In Uttarakhand, dry pine needles act as fuel for fire hazard. Nearly 15.9 million tons of pine needles is produced by Indian Himalayas region (Uttarakhand, Himachal Pradesh, and Jammu and Kashmir) every year [4]. Himalayan subtropical pine (*Pinus roxburghii*) forests are found in India, Nepal, Bhutan, and Pakistan. In India, pine forests covers about 0.5 million km²

area [5]. The pine needles are also very harmful to animals and can lead to abortion in cattle [6]. It is also lethal to certain microbes which are beneficial for agriculture [7, 8]. Soluble phenolic compounds found in pine needles are responsible for its slow decay and decrease the soil fertility [9]. Pine needles also affect the groundwater table as it hinders water absorption by the soil [6]. In India, dry pine needles are also consumed by several cement companies as direct fuel. Various researchers have worked on the production of methane from pine needles [6, 10]. Pine needles have more than 68.5% holocellulose, 4.56% extractives, and 31.0% lignin [11]. Cellulose content of pine needles (41%) is comparable to softwood (42%), and lignin content (35.1%) is high as compared to both softwood (28%) and hardwood (20%) [12]. Essential oil of pine needle components include α -terpineol (30.2%), linalool (24.47%), limonene (17.01%), anethole (14.57%), caryophyllene (3.14%), and eugenol (2.14%) [13]. Pine needle aqueous extract contain 76.92% organic acids in which 25.20% is acetic acid, 18.19% hexadecanoic acid, and 16.44% 2-methoxy-4-vinylphenol [14]. Singh et al. [15] converted pine needles by enzymatic saccharification into sugar for fermentation. Bisht et al. [5] converted pine needles into briquettes. Gosh and Gosh [8] used pine needles for the production of lactic acid by fermentation.

There are many methods available for treating dye wastewater such as ozonation, membrane filtration, ion-exchange, etc. [16]. Among these methods, adsorption is

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The effects of ultraviolet radiation on growth, biomass, lipid accumulation and biodiesel properties of microalgae

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ABSTRACT

The effect of UV light on growth, biomass, lipid accumulation and biodiesel properties of microalgae was studied. A Microalgae strain *Chlorella sorokiniana* UUIND6 was cultivated for 14 days as under LED light (Control) and microalgae were exposed to UV light (280–320 nm) in the middle of the photoperiod for 3 days. The growth rate of microalgae was analyzed by spectrophotometer and cell counting, while oil accumulation was analyzed by improved Nile red method. Results showed that microalgae under UV light treated algal cells showed less growth. FAMES profile of UV treated algal cells mainly contains hexadecanoic acid (C16), stearic acid (C18) fatty acids. PUFA found in very less amount in UV treated cells as compared to control.

Keywords

Biodiesel; *Chlorella sorokiniana*; lipid; microalgae; UV

Introduction

The depletion of the ozone layer in the stratosphere means that increased amounts of UV radiation (UV-R) reach the earth's surface (Karentz and Bosch 2001). India is close to the equator, thus faces high fluxes of UV radiation with sunlight (Ganapathy et al. 2017). In this context, the aim of this approach was to study the effects UV light stress on microalgae.

Light is a crucial factor for microalgae growth. Excessive intensity may lead to photooxidation and photoinhibition, while low light levels will become growth-limiting (Loera-Quezada, Angeles, and Olguín 2011). Due to this, the light intensity at which culture growth becomes saturated is an important factor in determining the light utilization efficiency (Teo et al. 2014). The spectrum of UV radiation reaching the earth's surface has been divided into lower energy (UV-A, 320–400 nm), higher energy (UV-B, 280–320 nm) and UV-C (254–280 nm) regions.

Microalgae are a diverse group of photosynthetic microorganisms. They convert carbon dioxide into various valuable compounds including biofuels, foods, feed, pharmaceuticals and biologically active compounds (Mata, Martins, and Caetano 2010). Microalgae have 20–40 times more productivity than oil crops (Li et al. 2011) and some of them can accumulate lipid up to 80% of dry biomass weight (Spolaore et al. 2006). Therefore, microalgae have great potential to be a major source for renewable biofuel production (Li et al. 2011). Biodiesel is seen as the alternative renewable energy because it is sustainable with less harm to the environment (Reijnders 2006).

The present study investigates the effect of UV light UV-B (280–320 nm) on *Chlorella sorokiniana* UUIND 6 growth and lipid content. In addition, the lipids were then transesterified to biodiesel and the fatty acid methyl esters (FAMES) were identified.

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Research Article

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ANALYSIS OF PHYTOCHEMICAL CONSTITUENTS OF THE METHANOLIC EXTRACTS OF LEAVES OF *ACONITUM HETROPHYLLUM* USING GAS CHROMATOGRAPHY-MASS SPECTROSCOPY (GC-MS) TECHNIQUE

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ABSTRACT

Aconitum heterophyllum is herbal constituent of alpine pastures of Central Himalaya, has been used as a traditional medicine. The present study was conducted to check the GC-MS analysis of the *Aconitum heterophyllum* leaves methanolic extracts. The GC-MS analysis of the methanolic extract showed the presence of 60 compounds from *A. heterophyllum* by comparison of their retention indices and mass spectra fragmentation patterns with those stored on the GC-MS computer library. The major compound identified were 2-Butenedioic acid (2E)- (10.99%), Cholestanol, 2-fromyl-3-benzyl- (10.58%), Phytol isomer (10.06%) with retention time 28.45, 46.35 and 26.98 minute respectively. The minor compound identified were 2,5-Dihydroxy-2,5-Dimethyl-3-Hexyne (0.19%), Hexanoic acid, 2-Methyl- (0.17%), Razoxane (0.14%) with retention time 18.33, 18.07 and 17.56 minute respectively. The study summarizes the information concerning the phytochemical constituents present in methanolic leaves extracts. These constituents may be responsible for pharmacological activities.

KEYWORDS: *Aconitum heterophyllum*, Gas chromatography, Mass spectroscopy, Butenedioic acid, Hexanoic acid

INTRODUCTION

Plants, as the source of medicine, have been playing an important role in the health services around the globe³. About three quarters of the world's population relies on plant and their extracts for health care. A good number of our population particularly those living in rural areas depend largely on herbal remedies for the treatment of different types of diseases. It indicates the importance of the individual plants in the health care system¹.

Aconitum heterophyllum is herbal constituent of alpine pastures of Central Himalayas, ranging altitude, 3500 m to 4000 m. *Aconitum* is the botanical name of the genus commonly known as aconite, monkshood etc. The genus *Aconitum* belongs to the family Ranunculaceae and is widely distributed in the alpine and sub-alpine regions of the tropical parts of Northern hemisphere. The genus *Aconitum* has marked its key position in the field of research. The indiscriminate exploitation has reduced the species towards rarity, so endangering its survival. Many species of this genus have been listed in the Red Data Book, due to which many conservation programs came into existence these includes many *in-situ*, *ex-situ/in-vitro* mode of conservation. Phytochemical analysis as well as molecular facts of medicinal plant species of this genus has been and is being explored in many research institutes globally⁴. *Aconitum heterophyllum* wall. Ex Royle commonly known as *Atis* is one of the most important medicinal plants of family Ranunculaceae. The herb has been characterized with the presence of blue and yellow coloured spur bearing flowers and the height of the plant is up to 1m to 1.8 m. It has been used as traditional medicines to cure various ailments, stomach febrifuge, dyspepsia, abdominal pain, analgesic and diabetes⁷. Aconite, a diterpenoid alkaloid and a principle biologically active compound, is used as a life-saving drug in Ayurvedic and Unani system of medicines. The flavonoids a

major group of natural products from genus *Aconitum* following the alkaloids, have previously been isolated and characterized from its various species². It has been established that the curing of various disease from the extracts of traditional medicinal plants have been attributed to the presence of polyphenolic compounds. The flavonol glycosides have previously been identified from the antioxidant bioassay-guided fractionation of aqueous extracts of *Aconitum* herbs and it has also been established that some caffeoyl glycosides of quercetin, a catechol grouping polyphenolic, have been identified to have more antioxidant potential compared to quercetin and dihydroquercetin⁵.

Due to its high cost as well as availability, the chance for adulterating leaves of *Aconitum heterophyllum* with substandard products is high. Thus, to avoid adulteration, standardization of this valuable herbal drug is the need of the hour. In the present study an attempt has been made to standardize the original and authenticated leaves of *Aconitum heterophyllum* by phytochemical constituents and GC-MS analysis.

MATERIALS AND METHODS

Plant collection, identification and authentication

Vegetative plants of *Aconitum Hetrophyllum* were collected from forest nursery Deoban chakrata (District Dehradun, Uttarakhand). One plant specimen of *Aconitum Hetrophyllum* was submitted to Taxonomy Division, Botanical Survey of India Dehradun for authentication and accession No. 1155367 was obtained. A herbarium sample of the material is stored in the Herbarium, Taxonomy Division, Botanical Survey of India Dehradun Uttarakhand India.

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Mineral Composition of *Berberis aristata* DC Roots

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Abstract: The mineral elements present in roots of *Berberis aristata* DC collected from three different altitudes were determined by Inductively Coupled Plasma Mass Spectrometry (ICP-MS). The concentration of total 5 macro elements (Li, Na, Mg, K and Ca) and 8 micro elements (Cr, Mn, Fe, Ni, Zn, Mo, Ag and Pb) were determined. The overall concentration of K was found to be highest, whereas the level of Ag was lowest. The highest concentrations of Na, Mg, K, Ca, Fe, Ag and Pb were found to be 7.8 ± 0.26 , 1.48 ± 0.11 , 9.93 ± 0.20 , 9.83 ± 0.10 , 9.19 ± 0.19 , 0.044 ± 0.009 and 1.68 ± 0.29 ppb respectively. The study reports that the mineral contents were well within the permissible range for medicinal uses.

Key words: *Berberis aristata*, Inductively Coupled Plasma Mass Spectrometry, mineral elements and altitudinal variation.

Introduction

Medicinal plants are being used in oriental medicine for the treatment of various ailments ranging from the common cold to cancer ¹. *Berberis aristata* DC locally known as Kingore is one of the traditional medicinal plants from Ayurvedic system and its herbal formulations are used to treat malaria, bleeding, fever, skin and eye infections, jaundice, diarrhea, diabetes and hepatitis for a long time ². The traditional Indian and Chinese medicinal systems reveal that almost every part of this plant has some significant medicinal value. Its roots, stem, bark, leaves, rhizomes and fruits are used in many classical Ayurvedic preparations like Rasaut, Darvyadi kvatha, Darvyadi leha, Darvyadi taila, Rasanjana, Dasanga lepa and many more.

Extracts obtained from the plant find application in pharmaceuticals, nutraceuticals and cosmetic preparations ³.

To understand the pharmacological actions of medicinal plants, elements present in them are important ^{4,5}. Elements play significant roles in chemical, biological, biochemical and enzymatic reactions of the living being which helps in the formation of active organic components ⁶. The normal concentration of trace elements in various tissues depends on the absorption and dietary concentration. Healthy organism contains a number of essential mineral elements. Most of the trace elements act as catalysts in various enzyme system functions. So, their roles range from being weak ionic enzymatic co-factors to highly spe-

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Simultaneous Determination of Losartan Potassium in Pharmaceutical Products by Reversed Phase High Performance Liquid Chromatography

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ABSTRACT

Objective: Method validation is an important aspect for the determination of pharmaceutical products. A well validated method play an important role in the control of quality of the products. So this purpose the proposed study have been done regarding develop a validated method for losartan potassium. **Methods:** A reversed phase high performance liquid chromatographic method used on isocratic mode. **Results:** The chromatographic separation of losartan potassium was obtained using a C₁₈ column by isocratic elution at the 25°C column temperature. The green solvent (methanol and water, 30:70 v/v) was used as a mobile phase. The analysis was performed at the flow rate 1.0 ml/min. A well defined peak was detected at 273 nm. The retention time of active ingredients losartan potassium was obtained in 7 min. The limit of detection and limit of quantification was calculated 0.03 and 0.09 µg/ml, respectively. A Good results was obtained with respect to linearity R²=0.998. The mean recoveries in inter-day and intra-day were calculated 98.85 % and 99.4 % with CV value 1.38 and 2.24 respectively. **Conclusion:** The method was validated according to ICH guidelines. This method is very efficient for the analysis of losartan potassium at 25 °C.

Keywords: RP-HPLC, Losartan potassium, recoveries.

INTRODUCTION

Losartan potassium generally used in the treatment of hypertension, heart failure and heart attacks and it is also prevent to the complications of diabetes. It is angiotensin converting enzyme inhibitor. Chemically it is 2-butyl-4-chloro-1-{{2-(1H-tetrazol-5-yl)methyl}-1H-Imidazol-5-yl)methanol and the empirical formula is C₂₂H₂₂ClKN₆O^{1,2}.

The literature survey has been shown various analytical methods for the estimation of losartan potassium active ingredients using high performance liquid chromatography methods³⁻⁵. The proposed study has been done according to ICH guidelines⁶⁻⁸.

MATERIALS AND METHODS

Preparation of mobile phase

A methanol / water mobile phase was prepared in the ratio of methanol: water (30:70, v/v). The mobile phase were filtered through a 0.45µm nylon membrane and degassed by sonication.

Preparation of Losartan potassium stock solution

A 100 µg/ml stock solution was prepared, 10 mg losartan potassium was mixed with methanol and make up it to 100

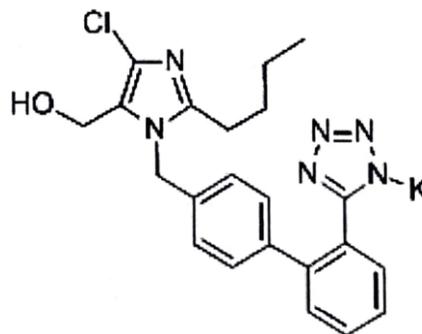


Fig.1: Chemical structure Losartan Potassium

ml. The stock solution was filtered with 0.45 µm nylon filter membrane and degassed by sonication.

Preparation of sample solution

The 10 tablets of Losartan potassium were weight and crushed by mortar and pestle. The crushed tablets were mixed well, and then an equivalent amount of 10 mg was transferred in to a small conical flask and extracted with methanol ratio. The extract was filtered into a 100 ml

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OBSERVATIONS ON TEMPERATURE VARIATION IN ALPINE ZONE OF
UTTARAKHAND: A CASE STUDY OF TUNGNATHShailesh Pd Vashist^{1*}, Tahir Nazir², R.K. Pathak³ and S. Nautiyal⁴¹Department of Botany D.A.V. P.G. College Dehradun²Deptt. of forestry Dolphin P.G collage Dehradun Uttrakhand, India.³D.A.V. P.G collage Dehradun⁴Ex. Head Plant physiology Forest research Institute Dehradun Uttrakhand

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Abstract: The metrological data for maximum, minimum and soil temperature was recorded at 3600 mt. altitude during 2015-16 for Ph.D. programme under the topic "Phenological response of four Rhododendron species with reference to climate change" and compared with the data recorded for same parameters at the same altitude and place collected during June to September, 1979 by High Altitude Plant Physiology Research Centre Srinagar. In weekly temperature recording it is observed that the maximum air temperature has increased from 2 to 4 °C as well as the minimum temperature has also decreased up to 2 to 3°C within a span of 35 years. However, soil temperature has shown the increase of about 2 to 3 °C. It indicates that though the variation in mean temperature does not increase significantly but the difference between maximum and minimum temperature has increased drastically. This clearly indicates that the variation in temperature which is responsible for all the metabolic processes in plants and plays a significant role in plant adaptation has significantly increased in both sides. Which means that plants has to face both extreme low as well as high temperatures, which may cause loss of those species which has low adaptation potential to these temperature extremes.

Keywords: Alpine Zone, Metrological data, Temperature, Uttarakhand

INTRODUCTION

In today's scenario the subject of climate change continues to be a topic of hot debate at global conventions, world summits & International Conferences. Change in climate is not an endemic phenomenon which restricted to a particular region instead of that its spreading globally which is a big alarm to the mankind and needs a continuous vigilant.

Many evidences have been gathered to depict that climate change is taking place. The main reason behind this is the continuous emission of green house gases into the atmosphere through anthropogenic activities. Over the past 100years the global average temperature has increased by approximately 0.6°C and is projected to rise at a rapid rate. The third assessment report from the IPCC projects that the earth's average surface temperature will increase by 1.4 to 5.8 °C between 1990 and 2100, if no major efforts are undertaken to reduce the emission of green house gases.

Climatic conditions determine where individual species of plants can survive and reproduce. The species in an ecosystem are in general strong adapted to the long prevailing climatic pattern but many of them are vulnerable to modest changes due to low adaptation potential.

In the present study site Tungnath where the five species of Rhododendron are exist as a dominant

vegetation of this region showed many indications of the change in the phenology like bud break, flowering and reproduction may be because of the change in climatic condition. To find out the changes in temperature both air and soil, rainfall/snowfall and light intensity, the metrological data of these parameters was recorded round the year at weekly interval during 2009 -10 and presented in this paper. Since, the temperature data of 1979 from June to September was available; this was considered to find out the temperature variation within the interval of 30 years at the same place and altitude.

MATERIALS AND METHOD

The present study was carried out at 3600 mt. altitude above mean sea level at Chandrashilla, Tungnath area of District Rudraprayag, Uttarakhand. The metrological data was collected 2015 - 16 at weekly interval and compared with the metrological data record available for the same place from June to September 1979 collected by High Altitude Plant Physiology Research Centre Srinagar Garhwal. The maximum - minimum air temperature and soil temperature were recorded by using maximum - minimum thermometer and soil thermometer for soil temperature. The observations of air and soil temperature during 2015-16 are given in Fig. 1 (a, b, c) however; the comparison of this data available from June to September is given in Fig. 2(a, b, c).

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NATURAL REGENERATION STUDY OF FOUR RHODODENDRON SPECIES IN WESTERN HIMALAYA

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Abstract: Regeneration patterns of species population can address climate change by adaptive evolution or by migrating association to survive in their favorable climate and finally decided to particular forest future. The main aim is to study to know the regeneration status of *R. arboreum*, *R. barbatum*, (2800 masl.) *R. campanulatum*, (3200 masl.) and *R. anthopogon* (3800 masl.) along the altitudinal gradient. In this paper we examined the status of regeneration potential of tree and bushy species in temperate forest, sub-alpine forest, and alpine forest at Kedarnath Wildlife Sanctuary, Tungnath-Chopta in Western Himalaya. To seedling population and distribution, we examine regeneration status in 80 random plots in study area. Total four species of rhododendron genera belonging to Ericaceae family out of which 28 seedlings of *R. arboreum*, 12 seedlings of *R. barbatum*, 23 seedlings of *R. campanulatum* and 33 seedlings of *R. anthopogon* were found in the forest. On the basis of importance value index *R. arboreum* followed by *R. anthopogon* have been found in good regeneration phase in comparison to other two species in the study area. Whereas, *R. barbatum* was found in poor regeneration phase in the study area. *R. campanulatum* and *R. anthopogon* were found above the treeline indicating that the climatic conditions were favourable for their growth. The height, diameter and density of the species differed along the elevational gradient and showed a species specific trend. Regeneration Potential of *R. anthopogon* (33 seedlings) was high in comparison to other three species followed by the second high regeneration potential i.e. *R. arboreum* (28 seedlings). Whereas, regeneration potential of *R. campanulatum* (23 seedlings) was higher in compare to *R. barbatum* (12 seedlings).

Keywords: Kedarnath Wildlife Sanctuary, Regeneration status Treeline, Elevation gradient, Density

INTRODUCTION

Natural regeneration is the process by which juvenile plants and coppice that have established naturally replace plants which have died or have been killed. Over time following a disturbance, the growth of naturally regeneration will reestablished canopy trees. Natural regeneration system exploit existing seed and seedling banks and circumvent the problem of obtaining healthy planting stocks. *R. arboreum*, *R. barbatum*, *R. campanulatum*, *R. anthopogon* and *R. lapidotum* naturally occur in Western Himalaya, at Tungnath- Chopta region of Kedarnath Wildlife sanctuary. Western Himalaya, although dry and less dense as compared to the Eastern Himalaya, is still one of the rich floristic regions of India (Meher-Homji, 1978). These all Rhododendron species is an ornamental shrub or trees with delicate different colour flower (*R. arboreum* colour- pinkish red, *R. barbatum*- deep red, *R. campanulatum*- violet whitish, *R. anthopogon* - yellow). *R. arboreum* and *R. barbatum* found in study area at 2800 to 3000mt., *R. campanulatum* found at sub alpine region 3100m. to 3400m. and at alpine region *R. anthopogon* found 3500 to 4000m. these all four species grows in temperate, sub temperate and alpine region. The mother plant of *R. arboreum* and *R. barbatum* was found in tree habitat, *R. campanulatum* was in creeper bushes habitat, found near tree line and *R. anthopogon* was in small

bushes habitat. The limitation of its popularity may be its regeneration difficulty. Natural regeneration is also decreased by forest fire. The most likely to survive in moist, sheltered sites where the root have access to mineral soil (Cross, 1981; Shaw, 1984; Tabbush & Williamson, 1987). The regeneration of Rhododendron species is an endangered because of human's disturbance, local communities cut majority of mother plants of Rhododendron for fuel which is playing important role in the decreased of Rhododendron species. Whereas, these plants are generally avoided by grazing animals, thus giving Rhododendron a significant advantage over native vegetation (Cross, 1981; Shaw, 1984; Tabbush & Williamson, 1987). The regeneration of *R. arboreum* and *R. barbatum* is also affected by big trees of *Q. semicarpifolia* and *Taxus baccata* because shadow of big trees and frost play important role to decrease the regeneration of Rhododendron species because frost cause cold injury in new seedlings. Dense canopy of trees decreased the regeneration of *R. arboreum* and *R. barbatum*. Proper management, such as thinning of canopy areas should improve growth and establishment of the new generation.

Rhododendrons are the prominent marker flowering species of Himalayan region and best indicator for climate change studies. To study the impact of climate change on the vegetation structure and phenology of *Rhododendron* species, our research work started in Chopta-Tungnath area of

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**PHYTODIVERSITY AND STAND CHARACTERS OF SIX
OAK (*QUERCUS LEUCOTRICHOPHORA* A. CAMUS)
FORESTS IN GARHWAL HIMALAYA, UTTARAKHAND,
INDIA**

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Abstract

A plant quantitative investigation was carried out at six oak (*Quercus leucotrichophora* A. Camus) dominated stands in different locations of Gahrwal Himalaya. A total of 28 tree species with 17 families, 41 shrub species with 21 families and 50 herb species with 22 families were observed in all studied oak stands. In tree layer maximum 15 genera were recorded in Chaurangikhal oak stand and minimum number of genera (11) was found in Chadrabadani, Diwalikhal and Ghuttu oak stand. For shrub layer highest number of genera (25) was observed in Ghuttu oak stand and lowest (18) – for Chadrabadani, Chaurangikhal and Makku oak stands. Herb layer showed maximum 32 genera, found at Ghuttu oak stand and minimum genera (15) – at Chandrabadani oak stand. Comparatively *Quercus leucotrichophora* have greater values of density, basal area and Important Value Index (IVI) among all studied oak stands to the rest of associated dominant tree species. Highest density (823.6 plant·ha⁻¹) and IVI (170.8) for *Quercus leucotrichophora* was observed at Diwalikhal oak stand, while, lowest density (176.7 plants·ha⁻¹) and IVI (126.3) was found at Makku and Chaurangikhal oak stands, respectively.

Key words: altitudinal range, basal area, density, Important Value Index, sapling, seedling.

Introduction

Plant diversity analysis is an important part for determining the quantitative information, species composition, regeneration, species richness, etc., of a forest stand. Forest diversity is the main source of livelihood of rural mass with different needs as well as various ecosystem services. Oaks in the Himalayan region are intimately

linked with subsistence hill agriculture as they protect soil fertility, watershed and local biodiversity. They also supply fodder, leaf litter, firewood and timber. They are also one of the most over-exploited species and fail to regenerate adequately either in disturbed or undisturbed natural habitat (Shrestha 2003). Oaks dominate the canopy in many temperate forests of the Himalayan region. In comparison to

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Effect of stand structure and aspect on the regeneration of banj oak (*Quercus leucotrichophora* A. Camus) forest along disturbance in Garhwal Himalaya, Uttarakhand, India

SCOPOS
SNIP 0.243
SJR 0.331

Vikaspal Singh^{1*}, Dhanpal Singh Chauhan² and Sabyasachi Dasgupta³

Singh, V., Chauhan, D.S., Dasgupta, S. 2018. Effect of stand structure and aspect on the regeneration of banj oak (*Quercus leucotrichophora* A. Camus) forest along disturbance in Garhwal Himalaya, Uttarakhand, India. - Forestry Studies | Metsanduslikud Uurimused 68, 33-39. ISSN 1406-9954. Journal homepage: <http://mi.emu.ee/forestry.studies>

Abstract. A study was conducted in an oak forest, to find out the relationship of stand structure, aspect and regeneration of species. Among all disturbance stands the density of banj oak *Quercus leucotrichophora* A. Camus individuals was peaked at 40-50 cm and 50-60 cm diameter at breast height (DBH) classes and low tree density was observed with the increasing DBH classes. North aspect showed higher density for most of girth classes as compared to south facing aspect. Among all the stands, low seedling density was recorded in undisturbed stand at south facing aspect as compared to the moderately and highly disturbed stands. The tree density of *Q. leucotrichophora* was higher in the undisturbed stand followed by moderately disturbed and highly disturbed stand. But in case of seedling density the higher density were observed at undisturbed and highly disturbed stand in both of the aspects.

Key words: disturbance, north aspect, south aspect, tree density, seedling density.

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Introduction

Lack of sufficient regeneration is a major problem of mountain forests (Krauchi *et al.*, 2000). Most studies on subalpine forest have reported poor recruitment in under stories of undisturbed old-growth forests (Coates, 2002; Mori & Takeda, 2004). Regeneration through seeds depends on production, dispersal and germination of seeds, and establishment and growth of seedlings. Several factors such as resource availability, pollination success, production of flowers, fruits

and leaves, genetic makeup, age and size of plant affect the seed production (Winn & Werener, 1987).

Stand structure is the physical arrangement and characteristics of the forest and is a highly visible and described component (Stone & Porter, 1998). Oliver & Larson (1990) define forest stand structure as the physical and temporal distribution of trees in a stand and include within the distribution of the species, vertical and horizontal spatial patterns, size of trees or tree parts, tree age or combinations. In the context of

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Inventory of Traditional Knowledge on Medicinal Flora of Jardhar Village Ecosystem (Tehri Garhwal), Uttarakhand, India

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Abstract

The paper emphasizes on the vegetation affluence and communities' traditional knowledge as a wealth in terms of its use for ethno-medicine and ethno-veterinary aspects. About 50 species belonging to 33 families were documented from Jardhar village of Tehri district, Uttarakhand where in the epoch of urbanization, new technologies are fascinating attention of people, nonetheless somewhere in folk societies' old aged people still practicing their ethno-botanical knowledge in sustainable manner, which is unique to our culture and society. The understanding, socialism with nature and its sustainable use through traditional management system by our elderly demonstrates the depth of indigenous traditional knowledge (ITK) and seek the attention for its preservation. Jardhargaon village is the earliest and largest unique ecosystem with traditionalism and socio-economic setup with cultural influences making the site diverse. This is pretty small but interesting data that can be a significant step towards conservation of non timber forest produce in Himalayan region. With this, it should be documented as it is necessary for future generations to know the extraordinary bonding along with the nature of the Himalayan communities. so that they can be use this valuable time tested knowledge.

Keywords: Ethno-medicine; Materia Medica; Indigenous Traditional Knowledge (ITK), Questionnaire; Participatory Rural appraisal (PRA)

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Introduction

For our existence we are reliant on the nature, fulfill our basic requirements, and it is possibly the ancient science since evolution of man (Vaughan and Geissler, 1997). So, the relationship of people and nature is as human evolution or long before the development of world-wide cultures and communities (Guiney et al., 2009; Nisbet et al., 2013; Seymour, 2016). Over the time, on the basis of understanding and experience on nature, humans developed the facts of the old style, which is accepted as, Traditional Knowledge (Singh et al., 2016). Thus, traditional knowledge has been the base of over all

the communities survived. Just about 75% of the world's populations willingly depend on the nature for health protection using traditional medicines (UNDP, UNEP, World Bank and WRI, 2000). In ancient history of civilization, beginning culture of Africa, China, Egypt and Indus valley shows the sign of herbal medicines have been used by indigenous communities (Edwards et al., 2012; Sen et al., 2017) in these areas.

In developing countries, almost 80% of population reliant on the native medicinal plants to cure the elementary disease (WHO, 2002; Calixto, 2005) where nearby 50,000 of flowering plants are used as medicinal

Research Article



Antimicrobial Activity of Some Diaminobenzophenone Derivatives

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ABSTRACT

Heterocyclic chemistry offers an example for the lack of distinct demarcations; in fact, it pervades the plurality of the other chemical disciplines. Heterocycles are inextricably woven into the life processes. More than 90% of new drugs contain heterocycles and the interface between chemistry and biology, at which so much new scientific insight, discovery and application is taking place is crossed by heterocyclic compounds. Benzimidazole derivatives of 3, 4-diaminobenzophenone derivatives (IV) & (V), have been synthesized after the synthesis of 4-isothiocyanato-3-methylbutanal (CIT), a reagent. All the synthesized derivatives have been screened with various bacterial and fungal strains viz. *Escherichia coli*, *Salmonella typhi*, *Pseudomonas neumoniae*, *Bacillus cereus*, *Candida albicans*, *Penicillium chrysogenum*, *Saccharomyces cerevisiae*, *Aspergillus niger*. After the antimicrobial studies, it was found that compound (IV) & (V) can act as a standard drug against fungal strain *Aspergillus niger*, *Candida albicans*, *Saccharomyces cerevisiae*, as these showed more inhibition zone than the standard drug Ketoconazole respectively. Compound (IV) & (V) showed very good activity against fungal strains *Penicillium chrysogenum* respectively.

Keywords: 3, 4-diaminobenzophenone acid, antibacterial activity, antifungal activity.

INTRODUCTION

The research have shown that most of the heterocycles contain considerable biological actions such as antibiotic, antifungal, anti-inflammatory, antiviral, anticancer, anticonvulsant, anthelmintic, antihistamine, antidepressant activities. Lactum antibiotics are useful and frequently prescribed an antimicrobial agent that share a common structure and this class includes Penicillin G which is active against susceptible gram-positive cocci¹. An Antifungal drug is a medication used to treat fungal infection such as athletes' foot, ringworm, candidiasis serious systemic infection such as *Cryptococcal meningitis* & others. The azoles antifungal include two broad classes i.e. imidazole and triazoles which inhibit the cytochrome. The anticonvulsants are a diverse group of pharmaceuticals used in the treatment of epileptic seizures. The heterocyclic compounds mostly used in the anticonvulsant are barbitone, phenobarbital, nimetazepam, lorazepam. Taking into account that compound bearing a thiazole, pyridyl and indol moieties possess a wide spectrum of biological activities which is related their capacity to transfer electrons to scavenge reactive oxygen species presence of NCS linkage, this properties are responsible for antibacterial, anticonvulsant, fungicidal, and antiviral activities.

The heterocycles nucleus is one of the most important and well known heterocycles which is a common and integral feature of a variety of natural products and Medicinal agents. Heterocycles nucleus is present as a

core structural component in an array of drug categories such as antimicrobial^{2,10}, anti-inflammatory¹¹, analgesic¹², anticancer¹³, antiviral¹⁴, anti-neoplastic¹⁵, antihypertensive¹⁶, ant malarial¹⁷, local anesthetic¹⁸, ant anxiety¹⁹, antidepressant²⁰, antihistaminic²¹, antioxidant²², ant-tubercular²³, anti-Parkinson's²⁴, antidiabetic²⁵, antiobesity²⁶ and immunomodulatory agents²⁷ etc. The thiazole are the heterocyclic compounds which have the five member ring containing nitrogen & sulphur. The biological activities of 1,3,4-thiazole derivatives have been investigated by Sondhi et.al.²⁸

Heterocycles play an important role in biochemical processes because the side groups of the most typical and essential constituents of living cells, DNA and RNA, are based on aromatic heterocycles. The presence of heterocycles in all kinds of organic compounds of interest in biology, pharmacology, optics electronics and material sciences and so on is very well known. Between them, sulfur and nitrogen-containing 3 heterocyclic compounds have maintained the interest of researchers through decades of historical development of organic synthesis. The grounds of this interest were their biological activities and unique structures that led to several applications in different areas of pharmaceutical and agrochemical research or, more recently, in material sciences. The present studies are an attempt to review the pharmacological activities of reported for heterocycles in the current literature with an update of recent research findings on this nuclei.

A REVIEW ON PHYTOPHARMACOLOGICAL ACTIVITY OF *PLUMERIA* SPECIES

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Kanchan Deoli Bhaukhandi**
Shailey Singhal***
Mamta Latwal****
Tanuja Uniyal Sati*****
Deepak Kumar*****

Abstract

“Green medicines are safer and healthier than synthetic ones” with this code, the plants are widely exploited in the tradition medicines. Due to greater advances in understanding the mechanism of action of herbs, plants gain the acceptance from the medical profession for the positive influence on health and quality of life. Phytopharmacological studies from plant origin have tremendous therapeutic values. Natural products are effective in the treatment of various infectious diseases while simultaneously regulates many of the side effects. Therefore the present review was undertaken to validate scientifically the therapeutic role of all the species of *Plumeria*.

Keywords:

Plumeria;
Phytochemical activity;
Pharmacological value;
Plants

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1. Introduction

Natures play a very important roles as medicinal agents for thousands of years and renowned as one of the important systems of alternative and complementary medicines. Herbs or higher plants offers vital and appreciable roles in the

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Membrane Stabilizing and Antioxidant Activity of *Ougeinia oojeinensis* Seed Extracts and Their Fatty Acid Composition.

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ABSTRACT

In the present study different extracts of seeds of *Ougeinia oojeinensis* were prepared and evaluated their membrane stabilizing and antioxidant effects. The Fatty acid composition was also estimated. All extract were tested for presence of phytoconstituents i.e., alkaloid, carbohydrate, sterols, proteins, amino acids, saponin, and phenolic compounds in different extracts. Membrane stabilizing effect was studied by hypotonic solution induced haemolysis of erythrocyte. Antioxidant activity was studied by DPPH method at a different concentration. GCMS analysis was done for petroleum ether extract with the help of Perkin Elmer Clarus-500 model coupled with CLARUS-500 Mass spectrometer. Phytochemical analysis showed that methanol extract was the richest extract for the tested phytoconstituents. Methanol extract showed the presence of alkaloid, carbohydrate, saponin, protein, amino acids and phenolic compounds. Different fatty acids were present in petroleum ether extract which was analyzed by GCMS. Maximum membrane stabilizing activity of seeds of *Ougeinia oojeinensis* showed in Methanol extract (81.41 ± 1.28) at a concentration of 1000 $\mu\text{g/ml}$ in comparison to standard drug aspirin. From antioxidant studies, methanol extract showed maximum antioxidant activity (91.31 ± 1.31) at a concentration of 1000 $\mu\text{g/ml}$ than other extract in comparison to standard drug ascorbic acid. From above studies it could be concluded that methanol extract showed maximum membrane stabilizing and antioxidant activities.

Keywords: *Ougeinia oojeinensis*; anti-inflammatory; antioxidant; DPPH; erythrocyte membrane stabilization; aspirin; ascorbic acid.

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Membrane Stabilizing and Antioxidant Activity of *Myrica esculenta* Leaves Extracts

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Abstract: In the present study, different extracts of leaves of *Myrica esculenta* were prepared and evaluated their membrane stabilizing and antioxidant effects. All extract were tested for presence of phytoconstituents i.e., alkaloid, carbohydrate, sterols, proteins, amino acids, saponin, and phenolic compounds. Membrane stabilizing effect was studied by hypotonic solution induced haemolysis of erythrocyte and Antioxidant activity was studied by DPPH method at a different concentration. From the study, Phytochemical analysis showed that methanol extract was the richest extract for the tested phytoconstituents. Maximum membrane stabilizing activity of leaves of *Myrica esculenta* showed in Methanol extract (61.11 ± 1.10) at a concentration of 1000 $\mu\text{g/ml}$ in comparison to standard drug aspirin. From antioxidant studies, methanol extract showed maximum antioxidant activity (91.36 ± 1.27) at a concentration of 1000 $\mu\text{g/ml}$ than other extract and comparison to standard drug ascorbic acid. From above studies it could be concluded that methanol extract showed maximum membrane stabilizing and antioxidant activities.

Keywords: *Myrica esculenta*; erythrocyte membrane stabilization; anti-inflammatory; antioxidant; DPPH; aspirin; ascorbic acid.

INTRODUCTION

Traditional herbal medicine and their preparations have been widely used in developing and developed countries from many years because of their natural origin, lesser side effects and non-toxic in nature [1]. Many herbal drugs from plants origin have been widely used medicinally in different countries [2].

The presence of secondary metabolites in plants is found to be active principles of many drugs [3]. The plant phytoconstituents are the best source of variety of medicinal agents. There is increase in demand of phytoconstituents from all over of world for the treatment of diseases [4].

Inflammatory diseases are increasing all over the world. These are activated in disease condition and it involves complex array of enzyme activation, mediator release, fluid extravasations, cell migration, tissue breakdown and repair which are aimed at host defence [5].

Oxidation reaction involved in many processes and producing harmful product such as free radicals or reactive oxygen species. These free radicals in human being initiates many chain reaction and cause damage to the cell results in problems like asthma, cancer, cardiovascular diseases, liver diseases, muscular

degeneration and other inflammatory processes. An anti-oxidant inhibits these chain reactions of free radicals by removing free radicals and inhibits other oxidation agents [6, 7]. Antioxidants are the agent that protects cell damage caused by free radicals by termination of chain reactions of free radicals [8]. There is an increasing interest all over the world for searching medicinal plants for anti-inflammatory and antioxidant activities. Hence, the present study was aimed for exploring the membrane stabilizing and antioxidant activities of *Myrica esculenta* leaves.

MATERIALS AND METHODS

Collection & Identification of leaves of *Myrica esculenta*

Leaves of *Myrica esculenta* were collected from Raxaul, Bihar, India. Plant materials were authenticated by Dr. Vidit Tyagi, Botanist (Dept. of Botany, Dolphin PG Institute of Biomedical & Natural



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IChemE

Bio-inspired dechlorination of poly vinyl chloride

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ABSTRACT

Production of PVC through petroleum may involve chlorine as an element for the activity on microscopic (i.e., atomic or molecular) level and the same mechanism may involve for its dechlorination. Oxychlorination assisted pyrolysis is an important reaction towards the synthesis of PVC and the reverse reaction is possible for its degradation. Ethylene carbonate (EC) with hydroxyethyl carbamate (ED) supports the microbial susceptibility of PVC. EC with ED can be synthesized through an inexpensive route of using ethylene glycol (EG) with urea. *Pseudomonas* sp. and *Aspergillus* sp. are found to be responsible microbe for the resultant dechlorination. This approach provides a novel hybrid combination for PVC dechlorination and proposes EC-ED combination as a new green bio-inspiring reagent.

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1. Introduction

Poly vinyl chloride (PVC) production through petroleum requires chlorination and consequent recovery of petroleum from PVC involves dechlorination process. Dechlorination/chlorination can be broadly directed from the Principal of microscopic reversibility as a general guideline for the production and degradation of PVC to petroleum. Degradation of polyolefines to olefinic monomers involved microscopic reverse of metal alkyl bond in Ziegler-Natta polymerization.

It showed the close relationship between the olefin insertion and β -alkyl elimination. The above principle must be taken into account while analyzing copolymerization systems with some additional reactions and provided new routes for equilibrium with dissociative electron transfer (Dufaud and Basset, 1998; Szymanski, 2013; Savéant, 2000). Chlorine insertion and removal through oxychlorination and pyrolysis vis-a-vis are the microscopically derived steps for PVC production and degradation.

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Physiotherapy

EFFECT OF SMART PHONE ON CERVICAL MUSCLE ENDURANCE, DISABILITY AND RANGE OF MOTION.

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ABSTRACT The smartphone has become a necessity for most people accompanied by questions about its impact, both positive and negative, on consumers and on broader society. This study is designed to analyze the profile of the craniocervical area in teenagers by using the smart phone addiction proneness scale (SAPS). In this study, endurance, disability level and R.O.M were measured in high users compared to low users smart phone group. There was a significant difference between the two groups in regards to the deep cervical muscle endurance and level of disability and R.O.M of cervical region. Based on the result, this study shows that heavy smartphone use may produce considerable stresses on the cervical spine, thus changing the cervical muscle endurance and disability level around the neck. Therefore, individuals should make an effort to look at their phones with a neutral spine and to avoid spending hours hunched over their screens.

KEYWORDS :

INTRODUCTION

The mobile phone has rapidly become an established part of daily life. While this new information and communication technology is convenient and popular, during its adoption, various social issues have arisen, including excessive use or even dependence. The smartphone has become a necessity for most people. Smartphones are used for both communication and entertainment purposes, such as messages, music, media, internet access, photos, and games.

One recurring concern involves Internet and mobile phone "addicts", whose use of the technologies has become excessive and out-of-control and severely disrupts their lives. The use of cellular phones has skyrocketed in recent years, with more than 929.37 million subscribers in India as of May, 2012. Smartphone represent a more sophisticated version of the overarching category of mobile phone. Among many technology related addictions, smartphone addiction is newer and more serious today.

Neck pain is a significant health problem not only for adults but also for the young. The use of visual display terminals such as Smartphone for long hours can cause improper postures such as forward head posture and the subsequent increases in cervical lordosis and thoracic or lumbar kyphosis cause round shoulders and decreases in vital capacity and thoracic cavity.

Patients with acute cervical pain mostly show changes in the cervical Range Of Motion (ROM), muscle endurance, and proprioception.

Many previous studies have focused on psychological problems, such as subjective symptoms of physical problems or stress. Few studies have focused on muscle fatigue according to the cervical flexion angle. Therefore this study intend to compare the endurance, neck disability index (NDI) and range of motion (ROM) of individuals according to the time spent using smart phones.

The purpose of this study is, therefore, to define the effect of smart phone addiction on cervical function. This study is designed to analyze the profile of the craniocervical area and measure the cervical range of motion using goniometer method after identifying smart phone addiction in teenagers using the smart phone addiction proneness scale (SAPS). Teenagers are found to be most affected by smartphone addiction.

METHODOLOGY

A total number of 90 subjects were selected from different communities in and around Dehradun.

This Cross sectional study was done with convenient sampling

INCLUSION CRITERIA:

- Age group between 15 to 30
• Individuals using smart phones from 2 years or more
• Individuals spending more than 4 hours per day using smart phones.
• Individuals having pain indicated by VAS

EXCLUSION CRITERIA

- Abnormal neurological findings
• Congenital abnormalities
• History of severe surgeries
• Any open wound around neck

OUT COME MEASURE

- Cranio cervical flexion test (CCFT) value
• Neck disability (NDI) Score
• ROM scores

After collecting the written consent forms information regarding the demographic data was collected and subjects filled the Smart phone addiction scale (SAPS). A questionnaire on Smartphone addiction status was used to evaluate the subjects. The participants were divided into either the heavy user group or the control group according to their responses on the of Smart phone addiction scale (SAPS). The questionnaire consists of a total of 15 questions. After calculating the total score the patients were categorised in high user group and low user group. After that Subjects were taught how to perform the CCFT by the proper demonstration.

The cervical spine was supported in a neutral, which was determined visually by maintaining a horizontal plane between the forehead and the chin. The pressure biofeedback unit was placed between the plinth and the posterior aspect of neck just below the occiput and inflated to a base line of 20mmHg. Each subject was instructed to perform the neck cranio flexion movement flexion movement at 5 different pressure levels (22, 24, 26, 28, and 30mmHg) and to hold each level for 10 seconds. A 30 second rest period was provided between each level. The testing procedure ended when the subjects could not hold a specific pressure level for 10 seconds or the maximum level of 30 mmHg was achieved.

DATAANALYSIS

Data analysis was done using SPSS version 22. Descriptive analysis was done to check the mean for SAPS, CCFT score and NDI, ROM score. Paired t test was used to compare the CCFT, NDI and SAPS values of high user group and low user group.