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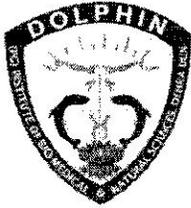
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3.3.1 Number of research papers published per teacher in the Journals as notified on UGC CARE list during the academic year 2021-22.

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Supporting documents



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Functional Status and Quality of Life of Judokas Due to Knee Injury

Deptee Warikoo¹, Harshita Raghu², Lovish Gupta³

¹HOD, Department of Physiotherapy, DIBNS, Dehradun, India; ²Researcher DIBNS, Dehradun, India; ³Researcher DIBNS, Dehradun, India.

ABSTRACT

Introduction: Judo, is a primarily a sport. The objective is to master the opponent. This is mainly done by applying pressure to arm joints or to the neck to cause the opponent to yield. This format of play leads to a ligament tear due to a direct blow to the knee, either from a fellow athlete or the judo mats. Injuries mainly occur due to a poorly executed throw or bad falling technique. The knee usually buckles and pain is severe. This knee injury affects the players badly.

Objectives: To find the percentage of knee injury and affection on functional status and quality of life of judokas.

Methods: Based on inclusion and exclusion criteria 100 subjects were enrolled for the study of purposive sampling. Judokas filled the set of questionnaire about knee injury and osteoarthritis outcome score.

Results: Data was meaningfully assorted through calculation of mean, median and standard deviation. Value of mean is 55.48, median is 56 and standard deviation is 26.976.

Conclusion: The conclusion of the study is that 51% of the players have mild effect on their functional status and quality of life due to knee injury during their practice session followed by moderate 45% and only 4% of population has severe effect on their functional status and quality of life during and after their practice sessions.

Key Words: Functional status, Quality of life, Disability, Physiotherapy, Practice session and Judokas.

INTRODUCTION

According to Burdick D¹ **Judo**, Japanese **jūdō**, is system of unarmed combat, now primarily a sport. Techniques are generally intended to turn an opponent's force to one's own advantage rather than to oppose it directly.

Judo is a highly technical sport based on the principle of "maximum efficiency with minimum effort". A judo fight starts with the opponents both standing, attempting to throw each other off balance. After a throw, judokas transition to ground-fighting, the so-called "*ne-waza*".²

Judo was appointed as a sport that has a prominent relative risk of injury compared to other sports as stated by Parkkari J et al.³

According to Buschbacher RM et al.³, it is plausible to reason that more training should correlate with lower injury incidence. A recent study of karate injuries found that injury

incidence increased with competitor rank, and with number of years practicing, as stated by Destombe C et al.⁴

In two studies on the Korean

Olympic team judokas, the knee was frequently injured,⁵ with 20% of the injuries occurring in the trunk, especially in the lumbar and thoracic spine. According to Witkowski et al. the injuries occurred mainly during training, not during competition. They found that 30% of the injuries occurred in the lower limbs (most at the knee), and 20.7% of injuries in the trunk and shoulder combined. Cynarski WJ⁷ stated that Judo injuries mostly affect body extremities, especially the knee (up to 28%), shoulder (up to 22%) and hand/fingers (up to 30%). There is high prevalence of anterior cruciate ligament injuries (ACL) in judokas has been reported, there has been very little research concerning events preceding the injury as stated by the Koshida Set al.⁸

Corresponding Author:

Deptee Warikoo, Dolphin PG Institute of Biomedical and Natural Sciences, Manduwala Near Suddhowala, Dehradun, Uttarakhand 248007, India; Phone: 09897741500; Email: deptee.pt@gmail.com

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EFFECT OF SENSORIMOTOR INTEGRATION TRAINING ON BALANCE, NEUROMUSCULAR CONTROL AND REACTION TIME IN ELDERLY.

Ritika Mani

Researcher, Department Of Physiotherapy, Dibns, Dehradun.

Deptee Warikoo*

Hod, Department of Physiotherapy, Dibns, Dehradun. *Corresponding Author

Sunil Bhatt

Asst Professor, Department Of Physiotherapy, Dibns.

ABSTRACT

Background: SMT (sensorimotor training) is a form of exercise aiming to decrease the muscle imbalance by maximizing the sensory input coming from three sites in the body where there is a large number of proprioception (the foot, sacroiliac joint, cervical spine). The purpose of study is to check the effect of SMT on neuromuscular control, balance and reaction time using three levels i.e. stable surface, unstable surface and sand in elderly population.

Method: The study was an experimental study with a sample size of 30 elderly subjects of age group 60-80 years. They had performed exercises in three levels i.e. in stable then foam then sand. They were assessed using SOT test, test for neuromuscular control and reaction time.

Conclusion: The study shows that the sensorimotor training which is given in three levels i.e., in stable surface, foam and sand are effective in improving balance, increasing neuromuscular control and decreasing reaction time in elderly for decreasing risk of fall and improving quality of life in elderly.

KEYWORDS : Sensorimotor training, reaction time, neuromuscular control.

INTRODUCTION:

The most important factors underlying morbidity in the elderly population are injurious falls and the restriction of activity as a result of falls. Approximately 25 % to 35% of community dwelling persons older than 60 to 65 years of age fall at least once a year and approximately 40% to 50% of fallers experience two or more falls.¹

Aging induces decrease in balance, neuromuscular control and reaction time. Balance is considered a key component in many activities of daily living such as quite standing or walking. The maintenance of posture and ability to move about the environment depend on orientation and balance.² Sixty five percent of individuals older than 60 years of age experience loss of balance, often on a daily basis.³

Sensory information has an important influence on balance activity in elders and the integration of visual, vestibular and somatosensory information is necessary to generate appropriate balance responses.⁴ Maintenance of postural balance requires an active sensorimotor control system.⁵ Early studies of sensorimotor skills indicate that reaction time become slower with advancing age.⁶ The ability to react quickly and appropriately is important for maintaining balance and avoiding a fall when exposed to a postural challenge or threat. There is a 25% increase in simple reaction time from the twenties to the sixties, with further significant slowing beyond this age. Age-related slowing of reaction time becomes more significant during demanding cognitive tasks and more complicated movement responses such as stepping. Increased simple reaction time is an independent risk factor for falls in populations of older people.⁷

SMT (sensorimotor training) is a form of exercise aiming to decrease the muscle imbalance by maximizing the sensory input coming from three sites in the body where there is a large number of proprioception (the foot, sacroiliac joint, cervical spine) which in turns increases the nervous system ability to generate a fast and optimal muscle firing pattern, increase dynamic joint stability and improve motor control. SMT emphasizes motor control through progressive challenges to sensory motor system through static, dynamic and functional situations to restore normal motor programs.⁸ It may also be a helpful tool at the beginning of a strength training intervention.

Sensorimotor training had a great impact on the neuromuscular system at the initiation of force production.⁹ It is well documented that improvements in force production capacity can be achieved either by enhancement of the muscular protein mass or by adaptation in the neural control of the muscle.¹⁰ Sensorimotor training is highly efficient for attaining increased proprioceptive input to the neuromuscular system or for processing information of the proprioceptive system more appropriately.¹¹ The gain in neuromuscular activation may arises from enhanced reflex contributions acting on a spinal level and there is gain in neural drive, induced by the training itself.¹² SMT shows

improvement in reaction time because there is increase in rate of force production during exercise in elderly.¹³

Unstable surfaces such as foam wobble board, air filled rubber bags, sand all reduce or effectively remove the person's foot contact with the solid surface.¹⁴ The underlying theory is that balancing on such surfaces will lead to heightened proprioception when foot is on the solid surfaces during normal activities.¹⁵ Research on age related changes in balance control has shown an increase in body sway during quite stance both with eyes open or eyes close.¹⁶ Greater muscle activity and body movement are observed when standing on an unstable surface.¹⁷

METHODOLOGY

Subjects were randomly selected from the community who volunteered to participate in the study. Thirty subjects participated in the study based on inclusion and exclusion criteria. Subjects were recruited from the community of Premnagar, Manduwala, Selaqui and Suddhowalla, Dehradun, Uttarakhand.

Study Design

Experimental study.

Inclusion Criteria

- 1- Age above 60
- 2- Can walk independently for 15 meters.
- 3- Not undergoing or have taken physiotherapy treatment within last one year.

Exclusion Criteria

- 1- Stroke patients
- 2- Psychiatric patient
- 3- Those having hearing difficulty
- 4- Unstable cardiac arrest
- 5- Complete blindness
- 6- Degenerative muscle disease
- 7- Those using walking aids

Instrumentation Of Data Collection

- 1- Foam of 4 inch.
- 2- Horizontal chest panel
- 3- Mask (for blind condition)
- 4- Visual conflict dome
- 5- Stopwatch
- 6- Switch board.
- 6- Sand box of 3 inch.

Outcome Measure

1. SOT test (Sensory organisation balance test)
2. Neuromuscular control (NMC) measure by checking the ability of doing switch on and off with foot as many times as possible in

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PATIENTS' SATISFACTION FOR PHYSIOTHERAPY CARE IN VARIOUS HEALTH CENTRES IN DEHRADUN

Alhaz Mansuri	Researcher DIBNS, Dehradun.
Richa Agrawal	Assistant Professor, Department of Physiotherapy, DIBNS, Dehradun.
Deptee Warikoo*	HOD, Department of Physiotherapy, DIBNS, Dehradun. *Corresponding Author
Mrinal Patel	Physiotherapist, Dehradun.
Avani Kacha	Physiotherapist, Dehradun.

ABSTRACT **INTRODUCTION:** Patient and health practitioners have been found to have differing views of health and progress in rehabilitation. Thus, the importance of patient centred care has been recognized in physiotherapy. The expert physiotherapist recognizes the importance of gaining an understanding of the social and psychological context of the patient's world rather than just focusing on the diagnostic process. The patient satisfaction can also be used as benchmarks for ensuring the delivery of quality physiotherapy services in health facilities. The present study aimed to investigate patient satisfaction with the physiotherapy treatment received at physiotherapy centers.

METHODS: A cross-sectional observational study was conducted on 100 patients receiving physiotherapy treatment at various health centres at Dehradun. The patients' satisfaction was evaluated using a MedRisk Instrument for measuring satisfaction in physiotherapy care (MRPS). Descriptive analysis for overall satisfaction was done.

RESULTS: The majority of patients were satisfied with the treatment received. Overall 87% patients were highly satisfied & 13% were moderately satisfied.

CONCLUSION: Study provides baseline information about the level of patients' satisfaction with Physiotherapy service among various health centres at Dehradun. Most of the patients were satisfied with physiotherapy care and also in terms of internal factors, external factors and Global Measures'. Such a high level of satisfaction may mean that the physiotherapy service is of good standard or that patient expectations of care are low.

KEYWORDS : Patient satisfaction, MRPS, Physiotherapy.

INTRODUCTION

Patient satisfaction is an important indicator of quality of care provided to the recipient of health service. As health care provision has become patient-centred, patient satisfaction has emerged as a critical outcome of care. Evaluation of patient satisfaction with physiotherapy care provides specific and objective feedback to clinicians about the services they provide.

Patients who report high satisfaction are more likely to continue the relationship with the health care practitioner by seeking additional care when needed and adhere to recommended treatment plans.⁽¹⁾ Patient satisfaction is a multidimensional phenomenon, which includes the following factors: (1) patient-related factors; (2) physiotherapist-related factors; and (3) other factors.⁽²⁾ There also appears to be sex-related differences in satisfaction, with females reporting more satisfaction than males.⁽³⁾

Patients treated by the same practitioner over time are more likely to report satisfaction than those who receive care from multiple therapists.⁽⁴⁾ Another determinant of satisfaction is the process of care. Key process variables that result in a high level of satisfaction are adequate duration,⁽⁵⁾ treatment frequency,⁽⁶⁾ appropriate follow-up,⁽⁷⁾ continuity of care,⁽⁸⁾ mode of treatment, and patient involvement in decision making.⁽⁹⁾

Higher satisfaction is reported when the treatment process is more consultative. However, some patients prefer less involvement considering the physiotherapist as the "expert".⁽¹⁰⁾ This highlights the need for physiotherapists to tailor their approach accordingly. The extent to which a patient is prepared for treatment appeared to affect his/her level of satisfaction too; patients prepared in advance may collaborate with the physiotherapist.⁽¹¹⁾

Lower satisfaction level may be associated with an increase in the waiting time for treatment, inadequate waiting area facilities, a low level of faith in the therapist health facility, and ineffective communication with the patient about his/her disease condition.⁽¹²⁾ Factors such as catering to the patients' expectations of symptomatic pain relief and providing self-management exercise also contribute to satisfaction.⁽¹³⁾

physical therapy practice.⁽¹⁴⁾ Measures of patient satisfaction have been used as indicators of quality of care as a means of identifying patients who have a higher or lower likelihood of compliance with treatment program, and as a benchmark upon which to assess market competitiveness.⁽¹⁵⁾ A useful property of a patient satisfaction measures the ability to discriminate between different factors affecting satisfaction.⁽¹⁶⁾

Patient satisfaction has not been closely monitored in physiotherapy and limited research data exist in this area of allied health services. By actively seeking patient input, the importance of the patient to the success of the physiotherapist patient interaction is highlighted and the benefit of adopting a patient centred approach in physiotherapy is reinforced.

METHODOLOGY

A cross sectional observational study was conducted to measure the level of satisfaction in patients who received physiotherapy treatment at various health centres at Dehradun. Participants were recruited by a convenient sampling technique after completion of physiotherapy session based on inclusion and exclusion criteria.

The instrument used to measure the patients satisfaction with care was modified MRPS (instrument for measuring satisfaction into physical therapy care). It has shown good psychometric properties.⁽¹⁷⁾ This scale was used for obtaining data from consenting subjects, who regularly visited various health centres at Dehradun. Total 100 patients were surveyed for this study. Data was collected by using interview methods in participant language as most of the patients were from rural areas and can't read and understand English questions. After that all the patients recruited were explained the individual questions and were asked to rate them on a 5-point likert's scale.

The MedRisk Instrument for Measuring Patient Satisfaction with Physical Therapy Care has 12 items. Items 1 to 3 represent the external factor, while items 4 to 10 represent the internal factor. Items 11 and 12 are global measures of satisfaction.

Participants were instructed to complete a 1 to 5 rating scale for each



THE EFFECTIVENESS OF GASTRO-SOLEUS STRETCHING PROGRAM IN GIRLS WEARING HIGH HEELS

Dr. Nidhi Rawat Student Researcher, DIBNS, Dehradun.

Dr. Keerty Mathur Assistant Professor, DIBNS, Dehradun.

Dr. Deptee Warikoo* HOD, Department of Physiotherapy, DIBNS, Dehradun. *Corresponding Author

Dr Kritika Shukla PD, GenPact, Delhi.

ABSTRACT **Introduction:** High heeled shoes (HHS) are no mere accessories of the feet, but an essential part of a woman's fashion that reflects her personality. High heels are a major source of chronic lower limb pain. Changing from flat footwear to high heels induces chronic muscle shortening associated with discomfort, fatigue, reduced shock absorption, and increased injury risk.

Objectives: Purpose of study is to study the effect of stretching (manual and self) over gastro-soleus muscle in girls wearing high heels and to prepare effective protocol for muscle tightness in girls wearing high heels.

Methods: Based on inclusion and exclusion criteria 40 subjects were enrolled for the study. The subjects were divided into two group-A (for control group) & group- B (self control group). Group A received passive stretching and Group B received Active Stretching. Ankle goniometry was used to assess the score.

Results: The results showed that there is significant difference between the pre and post values in both soleus and Gastrocnemius.

Conclusion: The study depicted that passive stretching has a significant effect on muscle shortening due to high heels than active stretching.

KEYWORDS : Muscle tendon Unit, stretching, goniometry

INTRODUCTION

Wearing high heels (HH) places the calf muscle-tendon unit (MTU) in a shortened position. As muscles and tendons are highly malleable tissues, chronic use of HH might induce structural and functional changes in the calf MTU.¹

Concerns regarding the potential impact of high heels on women's health have been expressed in medical circles for over 50 years² and in 2001 podiatrist William Rossi declared footwear to be the primary cause of foot disorders.³ Studies have shown that wearing HH can lead to slower self-selected walking speed, shorter step length, and smaller stance phase duration, while it increases ankle plantar flexion, knee plantar flexion, anterior pelvic tilt, and trunk extension.⁴

Wearing high heels places the calf MTU in a shortened position as muscles and tendons are highly malleable tissue chronic use of high heels might induce structural and functional changes in the calf MTU. It is worthy to note that substantial bodily adjustments have been observed due to wearing HH, e.g., change in the neuromuscular activation pattern, shortening of the gastrocnemius muscle fascicle muscles, increase in the Achilles tendon stiffness, and higher muscle activity of the soleus, tibialis anterior, and medial gastrocnemius.⁵

The tightness typically lessens with increasing activity (eg, walking, running).

Consequently, any change in the contractile behaviour of the plantar flexor muscle induced by long term use of high heels might indirectly also effect tendon mechanical properties. Zollner et. Al.⁷ in their study concluded that raising the heel by 13 cm reduces the length of the muscle-tendon unit by 12 mm or 3%.

Stretching is frequently utilized as a conservative treatment for muscle tightness. The implementation of a routine stretching program targeted at the gastrocnemius musculotendinous unit has an impact on Achilles tendon tightness and ankle dorsiflexion flexibility.⁸

The study aimed to identify the effect of stretching (manual and self) over gastro-soleus muscle in girls wearing high heels and to prepare effective protocol for muscle tightness in girls wearing high heels.

METHODOLOGY

Study design:

This study is a survey type study which intended to find the effect of Stretching (manual and self) in the girls wearing high heels.

Sampling Technique:

A sample of 40 subjects (from community i.e. group-a & group-b 20-20 in each group) 20-30 years of age girls wearing heels randomise control sampling method, they were collected from community. All subjects signed a consent form & were ready to take part in the study. The subjects were given the instructions regarding the procedure & the subjects who full fill the inclusion criteria & were ready to actively participate were selected.

Source of data:

subjects were collected among Students of various colleges and working Ladies in Dehradun.

ELIGIBILITY

INCLUSION CRITERIA

1. This include Normal young girls (age 20-30years)
2. Subject had to have worn high heels with a minimum level of heel height of 5 cm at least 5 times a week in daily life.
3. Capable to understand the instructions given by researcher.

EXCLUSION CRITERIA:

1. If any type of injury, like fracture in lower extremity.
2. Pain or other inflammatory signs around the concerned region.
3. Muscle adhesion
4. Spasm
5. Pregnant lady

PROCEDURE

The subjects were introduced to the study followed by signing of consent form, general assessment regarding the socio-demographic data (name, gender, age, education level, post medical history, & personal history, family history) were gathered in participants assessment form were divided into two group-A (for control group) & group- B (self control group) for comparison & total 20 number of subjects data was collected in each group i.e. group-'A' & group-'B' so overall sample size was 40. The subjects were assigned a number to maintained the confidentiality of subjects & then the proper assessment was used to assess the tightness of muscle, than the ranges of joint was noted down pre and post stretching & the score was collected. Group A received Passive stretching while Group B was taught self stretches.

The data was collected; Ankle goniometer was used to assess the score & was collected by the primary investigator & entered into data collection form.

RESULTS

Paired t-test was applied to compare the data, ROM score in between



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Hitesh Singh
ICAR- Indian Veterinary
Research Institute, Mukteswar
Campus, Nainital, Uttarakhand,
India

Manoj Kumar Bansala
Assistant Professor,
Département of Agriculture,
Dolphin PG Institute of
Biomedical and Natural Sciences,
Dehradun, Uttarakhand, India

Jagdeep Kumar
Department of Agriculture,
Uttar Pradesh Government,
India

Somnath
Department of Agriculture,
Uttar Pradesh Government,
India

Raj Kumar
Assistant Professor,
School of Agricultural Sciences,
IIMT University, Meerut,
Uttar Pradesh, India

Nazim Ali
Department of Animal
Husbandry, College of
Veterinary and Animal Sciences,
Sardar Vallabhbhai Patel
University of Agriculture &
Technology, Meerut,
Uttar Pradesh, India

Corresponding Author:
Manoj Kumar Bansala
Assistant Professor,
Département of Agriculture,
Dolphin PG Institute of
Biomedical and Natural Sciences,
Dehradun, Uttarakhand, India

Effect of feeding probiotics on body weight gain and economics importance in broiler chicks

Hitesh Singh, Manoj Kumar Bansala, Jagdeep Kumar, Somnath, Raj Kumar and Nazim Ali

Abstract

One hundred twenty, one-day-old male broiler chicks (Cobb 400 strain), were randomly assigned to 4 treatments (30 birds/treatment). Treatment groups were; Control group in Standard ration, probiotic in Standard ration 0.1% (treatment 2), probiotic in Standard ration 0.2% (treatment 3) and probiotic in Standard ration 0.3% (treatment 4). Chicks were reared for 42 days. Body weight, feed consumption and feed conversion were weekly determined. Probiotic have been used in poultry industry for decades to promote growth and protect animals from diseases, followed by various side effects. In efforts of searching for a better alternative, probiotic is of extensive attention. The results of this study indicated that feed consumption for the entire period (up to 6 weeks) were significantly ($P < 0.05$) increased in the treatments 1 and 4, when probiotic was added at a rate of 0 and 0.3%, compared with the other treatments (2 and 3). Body weight gain for the entire period (up to 6 weeks) were significantly ($P < 0.05$) increased in the treatments 2, 3 and 4, when probiotic was added at a rate of 0.1, 0.2 and 0.3%, compared with the other treatments (1). These birds also had a significantly ($P < 0.05$) higher feed conversion ratio than others and finally the lowest feed cost per kg of body weight was observed in the group containing probiotic.

Keywords: probiotics, growth performance

Introduction

In India, there is a huge gap between demand and availability of poultry feeds in general and energy feeds in particular. The unusually high price of grain in these days has induced the poultry farmers to find ways for their substitutes i.e. traditionally groundnut cake, fish meal, wheat and maize grain. Maize is used as a main energy source in poultry diets. (Raman *et al.* 2010)^[1]. The poultry meat production is estimated to be about 2.47 million tonnes. The current per capita availability of eggs is around 55 eggs per year. Exports of poultry products are currently at around 457.82 crore in 2011-12 as per the report of Agricultural and Processed Food Products Export Development Authority (APEDA) Annual Report 2012-13^[18].

Probiotics have been defined as "Live microorganisms (bacteria or yeasts), which when ingested or locally applied in sufficient numbers confer one or more specified demonstrated health benefits for the host" (Anil *et al.*, 2007)^[2].

He suggested that *Lactobacilli* in yogurt could have a positive effect on the intestinal micro flora, which meant a lot to human health and longevity. The poultry industry during the past two decades has been one of the most dynamic and ever expanding sectors in the world^[3] (Alkhalaf *et al.*, 2010)^[13]. For about fifty years, antibiotics have been used as feed additives in poultry industry to promote animal growth and protect animal against infection of pathogenic microorganisms (Ferket *et al.*, 2002)^[4].

However, with increasing problems brought by abuse of antibiotic, such as antibiotic resistance, there are bans on sub therapeutic antibiotic usage in the poultry industry in Europe (Edens 2003)^[5]

Methods and Materials

Four commercial probiotic products obtained from research cooperation base of Sardar Vallabhbhai Patel University of Agriculture & Technology Meerut Probiotic were used in this study.



Effect of Different Sowing Dates in Varieties on Growth and Yield of Hybrid Fodder Dual Purpose Maize (*Zea mays*) Crop in Doon Valley Condition in Uttarakhand

Saugandh Limbu, Manoj Kumar Bansala, Virendra Kumar and Joshep Reang

Dolphin (P.G) Institute of Biomedical And Natural Science Manduwala, Dehradun-248007, Uttarakhand

Email : bansalamanoj87@gmail.com

Abstract

The experiment was laid out in split plot design with three replication having main plot/ factor of three sowing date ($SD^1 = 24^{\text{th}}$ february, $SD^2 = 6^{\text{th}}$ march, $SD^3 = 16^{\text{th}}$ march) and sub plot of varieties (V1=Nutra Shakti777, V2=Derby-1209, V3=Nutra Early, V4=2026 Maize, V5=MH 108099, V6=456 Maize). The subplot size was 5m × 3m. Experimental result indicate that plant height(151.91cm), dry matter accumulation (493.44gm), no of leaves (12.13), no of ears(1.62), yield attributes such as ear length (22.56cm), grain rows /ear (13.73), grains/row (24.29), 1000 grain test weight (215.83gm), shelling percentage(39.77%) and yield as ear yield (6547.85kg/ha), grain yield (2467.78kg/ha), stover yield (6507.76kg/ha), total biological yield (11332.07kg/ha) were observed in $SD^1 = 24^{\text{th}}$ february. Among 6 different varieties, plant height(169.03cm), dry matter accumulation (453.27gm), no of leaves (12), no of ears(1.60), yield attributes such as ear length (23.13cm), grain rows /ear (13.33), grains/row (24.85), 1000 grain test weight (202.56gm), shelling percentage(41.12%) and yield as ear yield (6048.75kg/ha), grain yield (2536.39kg/ha), stover yield (5679.17kg/ha), total biological yield (11431.83kg/ha) was recorded by variety V1=Nutra Shakti777. It is concluded from the result that sowing in the month of february and variety Nutra Shakti 777 gave a higher grain yield and yield traits of maize.

Key words : *Zea mays*, varieties; sowing dates; grain yield; growth parameters.

Introduction

Maize (*Zea mays*) is a staple food in many parts of the world, with the total production of maize surpassing that of wheat and rice. Maize is also known as king of cereals due its high production potential and adaptability. Overall in the global statically data, India falls under 6th in global maize production, while Asian production of maize is dominated by china, followed by India whereas USA is 1st in global ranking. Maize does well in wide range of climatic conditions; it is grown in the tropical as well as temperate region. February is best month for sowing of maize within the time of 20th february in the time period of zaid season.. In case of late sowing due to warm air, there is possibility of silk and pollen grain dry which hinders grain formulation. Optimum temperature for good germination of maize seed requires range from 15°C to 25°C. The month of february is the best months for sowing of maize as it's fulfill all the criteria for zaid season maize. Grain of maize has high nutritive value containing 66.2% starch, 11.1% protein, 7.12% oil and 1.5% minerals. Moreover, it contains 90 mg carotene, 1.8 mg niacin, 0.8 mg thiamin and 0.1 mg riboflavin per 100 g grains. Maize oil is used as the best quality edible oil. Green parts of the plant and grain are used as livestock and poultry feed, respectively. Stover and dry leaves are used as good fuel.

Plant variety is usually affected by crop environment, which influence crop growth and yield. Maize varieties have great impact on yield. Hybrid varieties produce more

than double than local varieties. Cultivation of hybrid varieties along with proper date of sowing can increase production of maize. Selection of proper date of sowing in the maize field is important to ensure maximum utilization of climate and environment by the crop and to reduce unnecessary loss. Optimizing of sowing date depend on the variety is among the most important agronomic practices to increase crop production. Two important components of maize cropping systems are plant variety and planting date. Proper selection of these components can help in improving maize yields. The release of genetically superior hybrids, reduction of row spacing, higher plant densities, increased use of chemical fertilizers, improved cultural practices and better weed and pest management can be attributed largely to optimum output of yield and growth of crop (Dwyer *et al.*, 1991). Yield can be increased to a greater extent through high yielding varieties, appropriate time of planting and with good agronomic practices. Planting dates and varieties selection are the major factors affecting maize production in addition to soil fertility, temperature regimes and irrigation. For optimization of yield, planting at an appropriate time is very critical. Maize that are cultivated in all around season is influenced by the environmental changes (temperature, rainfall etc.), different varieties associated with different sowing dates and the wider the deviation from the optimum sowing date the greater will be yield loss. Considerable yield and its parameter



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Tenzin Dorjee
M.Sc. Agronomy, Dolphin (PG)
Institute of Biomedical &
Natural Sciences, Dehradun,
Uttarakhand, India

Jitendra Kumar Meena
Assistant Professor, Department
of Agriculture, Dolphin (PG)
Institute of Biomedical &
Natural Sciences, Dehradun,
Uttarakhand, India

CS Pandey
Associate Professor, Department
of Agriculture (HOD), Dolphin
(PG) Institute of Biomedical &
Natural Sciences, Dehradun,
Uttarakhand, India

Corresponding Author:
Jitendra Kumar Meena
Assistant Professor, Department
of Agriculture, Dolphin (PG)
Institute of Biomedical &
Natural Sciences, Dehradun,
Uttarakhand, India

Effect of various concentrations of organic and inorganic nutrients on growth of cowpea [*Vigna unguiculata* (L.)] under valley conditions of Dehradun

Tenzin Dorjee, Jitendra Kumar Meena and CS Pandey

Abstract

An agronomic investigation was conducted during 2020 at Agriculture Research Farm, Dolphin (P.G) Institute of Biomedical and Natural Sciences, Dehradun. The aim of study was to study the effect of organic and inorganic nutrients on growth of cowpea. The experimental plot was laid out in a randomized block design with 7 treatments and 3 replications. It was of 3.0 m x 2.0 m² size with spacing of 30 cm x 20 cm per bed. The experiment was conducted using treatments T1 (Control), T2 (75% RDF + 25% Vermicompost), T3 (75% RDF + 25% vermicompost + 25% Neem cake), T4 (75% RDF + 25% Neem cake), T5 (75% RDF + 25% FYM), T6 (50% RDF + 25% Neem cake) and T7 (100% RDF). The experimental data revealed that the observations taken during 30, 45, 60, and 90 DAS among all the treatments (T3) i.e. 75% RDF + 25% vermicompost + 25% Neem cake showed maximum plant growth among most of the treatments at different growth intervals i.e. plant height, number of leaves, number of branches, number of plants per bed and dry matter accumulation per plant, whereas minimum plant growth was recorded under treatment (T1) control.

Keywords: RDF, vermicompost, FYM, neem cake, N:P:K, growth attributes of cowpea

1. Introduction

Cowpea (*Vigna unguiculata* L.) also known as lobia is an important food legume and grown throughout India for its long green vegetable pod, seeds, and foliage for fodder. Cowpea is an annual herbaceous legume crop from genus *Vigna*, family "Fabaceae" chromosome no 2n = 22. It is used both for human consumption and for cattle feed. Due to its tolerance for sandy soil and low rainfall, it is an important crop in the semiarid regions across Africa and Asia. It requires very few inputs, as the plant's root nodules are able to fix atmospheric nitrogen, making it a valuable crop for poor farmers and well suited to intercropping with other crops. Cowpea being a legume crop does not require much nitrogen except in small quantities at the beginning of its life cycle. Nitrogen is an essential element for proper plant growth and development. Nitrogen is an essential constituent of compounds like amino acid, protein, nucleic acid, enzymes, and alkaloids (Anuja *et al.* 2014). Phosphorus is an important plant nutrient. It is associated with several vital functions like seed germination, flowering cell division, synthesis of fat, starch, and in almost every biochemical activity). Potassium is the third macronutrient required for plant growth, after nitrogen and phosphorus. In drought, Potassium plays an active role in the maintenance of turgidity in plant cell and regulates stomata function. The productivity of cowpea is very low, due to poor crop management practices and its cultivation in poor and marginal lands. In recent years, crop cultivation requires the use of chemical fertilizers, but it is expensive for people who do not have capacity to buy fertilizer. Therefore, the current trend is to explore the possibilities of supplementing organic fertilizer like FYM, Vermicompost, and neem cake, etc. along with the use of inorganic fertilizers to reduce the cost and increase the soil fertility and productivity. FYM seems to act directly for increasing cell permeability and hormonal growth action by combination of all these processes. It supplies nitrogen, phosphorous, potassium, and micronutrients like Fe, S, and Zn, etc. in available form to the plants through biological decomposition, improve physical, chemical properties, and health of soil such as aggregation, aeration, permeability, water holding capacity, slow release of nutrients, increase cation exchange capacity. FYM contains 0.50% N, 0.17% P₂O₅ and 0.55% K₂O. (Gaur *et al.* 1992). Vermicompost is a potential source due to the presence of readily available plant nutrients, growth-enhancing substances and many beneficial microorganisms like nitrogen-fixing, P solubilizing, and cellulose decomposing organisms. Vermicompost is a rich mixture of major



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Ashutosh Shukla
A.N.D.U.A. & T., Kuanimganj,
Ayodhya, Uttar Pradesh, India

Narender Kumar
Dolphin (P.G.) Institute of
Biomedical & Natural Sciences,
Dehradun, Uttarakhand, India

Ramesh Chand
A.N.D.U.A. & T., Kuanimganj,
Ayodhya, Uttar Pradesh, India

Management of root knot nematode (*Meloidogyne incognita*) in brinjal crop using various formulations of *Parthenium hysterophours* in micro-plot condition

Ashutosh Shukla, Narender Kumar and Ramesh Chand

Abstract

Role of *Parthenium hysterophours* on population built-up of *Meloidogyne incognita* on brinjal was studied. The observations recorded revealed that, number of galls soil population, egg population, total root population, total nematode population and multiplication factor of nematode was significantly lower in all the treatment in comparison to treated check. The highest soil population, egg population, total root population, total nematode population, multiplication factor and number of galls was recorded (1938.5), (577.50), (183.75), (78045.25), (15.60) and (173.50) respectively in untreated check with the minimum (536.70), (93.60), (36.25), (9932.75), (1.98) and (25.75) in treated check respectively. Among the *Parthenium* and compost treatments the most effective treatment for the management of root knot nematode *Meloidogyne incognita* was *Parthenium* leaf compost @ 7.5% + compost. It was followed by *Parthenium* leaf compost @ 5% + compost, *Parthenium* leaf compost @ 7.5%, *Parthenium* leaf compost @ 5% + compost, *Parthenium* leaf compost @ 5%, *Parthenium* compost @ 5% and compost @ recommended dose in ascending order for the management of root-knot nematode, *Meloidogyne incognita*. highest multiplication rate 15.60 in untreated check, 11.58, 9.70, 8.86, 8.18, 7.44, 5.95 and 3.98 with the minimum (1.98) in compost @ the recommended dose, *Parthenium* compost @ 5%, *Parthenium* leaf compost @ 5%, *Parthenium* compost @ 5% + compost, *Parthenium* leaf compost @ 7.5%, *Parthenium* leaf compost @ 5% + compost, *Parthenium* leaf compost @ 7.5% + compost and treated check respectively.

Keywords: compost, gall, *Meloidogyne*, nematode, *Parthenium*, root knot

Introduction

Root-knot nematode, *Meloidogyne* spp. Goeldi; 1892 by various Nematologists have been reported as one of the important noxious nematode problem causing enormous yield losses. Ranges from 28.3 to 47.5 in tomato, 26.5 to 50.0 in brinjal, 19.7 to 33.3 in chilli and 60 to 90 per cent in bitter gourd under Indian condition. The recorded economically important species of genus, *Meloidogyne* are *M. incognita*, *M. javanica*, *M. arenaria* and *M. hapla* are known to be associated with vegetables, fruits, spices, condiments, pulses and cereal crops but the disease severity always remain high in most of the above said crops except to that of cereal crops. Among various approaches known so far the management of plant parasitic nematode below economic injury level, cultural practices are not generally advised to follow because of time limit, economic pressure on land and other inherent difficulties (Jatala 1985)^[1]. Likewise nematicides are also not being used primarily due to their unfavorable cost benefit ratio and their non availability. Although quick results can be obtained with the application of nematicides, even then they are not over whelmed because of their residual effect on human health and ground water contamination. The growing awareness regarding the use of various nematicides for the management of plant parasitic nematodes have further accentuated the problem and emphasized the need to address the problem by exploring other eco-friendly options. Keeping in view the above facts and for keeping the use of nematicides to the bare minimum one, such an emerging situation have made the scientist to review the strategies of nematode management by incorporating other possible ecologically safe control measures like exploitation of the allelopathic properties of certain wild weeds.

Materials and Methods

In order to study the role of *Parthenium hysterophours* in management of *Meloidogyne incognita* on brinjal a total of nine treatments i.e. *Parthenium* leaf compost @ 7.5% (T1),

Corresponding Author:
Narender Kumar
Dolphin (P.G.) Institute of
Biomedical & Natural Sciences,
Dehradun, Uttarakhand, India



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Nareender Kumar
Department of Agriculture,
Dolphin (PG) Institute of
Biomedical & Natural Sciences,
Dehradun, Uttarakhand, India

Samir Kumar Biswas
Department of Plant Pathology,
C. S. Azad University of
Agriculture and Technology,
Kanpur, Uttar Pradesh, India

Ashutosh Shukla
Department of Agriculture,
Phonics Group of Institutions,
Roorkee, Uttarakhand, India

Corresponding Author:
Ashutosh Shukla
Department of Agriculture,
Phonics Group of Institutions,
Roorkee, Uttarakhand, India

Integrated disease management (IDM) approaches for management of *Alternaria* blight disease in linseed (*Linum usitatissimum* L.) caused by *Alternaria lini* Dey

Nareender Kumar, Samir Kumar Biswas and Ashutosh Shukla

Abstract

The management of the disease can be done through fungicides, bio-agents and plant extract but Integrated Disease Management (IDM) strategy has proved better as compare to other strategies. IDM practice also significantly increased the shoot and root length of linseed plant than untreated treatment (check). The maximum shoot (62.48 cm) and root (14.25 cm) length, seed yield (1370.70 kg/ha) and minimum disease severity (19.19% on leaves and 14.78% on buds) were recorded in treatment T₄ treatment (ST with *T. harzianum* + two foliar sprays Propiconazole). The maximum cost: benefit ratio 1:5.26 was calculated in treatment T₇, followed by 1:4.21 in T₃ treatment.

Keywords: Bio-agents, chemicals, IDM, cost benefit ratio

Introduction

Linseed (*Linum usitatissimum* L.) is considered as a founding crop as it is cultivated among the first domesticated plants which began its cultivation in Mesopotamia (Zohary and Holf, 1993; Smith, 1995)^[40, 35].

Flax seed is the source of omega-3 fatty acids which are nutritionally important because they reduce the risk of cardio vascular disease (Hurteau, 2004)^[15]. Flax seed protein was effective in lowering plasma cholesterol and triglycerides (Bhathena *et al.*, 2002)^[5]. Flax seeds, which also contain dietary fibre is therefore a promising food to help decrease the risk of lifestyle related diseases (Fukumitsu *et al.*, 2008)^[13]. The antioxidant activity of the flaxseed has been shown to reduce the total cholesterol (Bierenbaum *et al.*, 1993)^[7] as well as platelet aggregation (Allman *et al.*, 1995)^[2]. Linatine antibiotic can also be obtained from seeds of linseed (Gill, 1987)^[14].

Flax seed is also an important source of both soluble and insoluble fibers, which are very important for effective digestion. Soluble fibre also serves as an effective cholesterol lowering agent (Jhala and Hall, 2010)^[16].

Linseed is adversely affected by number of fungal diseases. Among these *Alternaria* blight caused by *Alternaria lini* Dey is a major disease which causes huge amount losses in terms of quality and quantity of fiber and seed. The disease was first reported by Dey (1933)^[12] from flower bud at Kanpur, Uttar Pradesh in 1933^[12] (Kolte and Fitt, 1997)^[17]. Later, Siddiqui (1963)^[26] reported the occurrence of *Alternaria* blight on linseed at IARI, New Delhi and other parts of the country. The fungus was named as *Alternaria lini* after the first report of this disease by Dey in the year 1933^[12]. Arya and Prasad (1952)^[3] recorded a severe outbreak of the disease at Delhi in the year 1949 and reported that the pathogen was identical with *Alternaria brassicae* (Berk) Sacc. var. *macrospora* (Broun) in morphology, pathogenicity and physiology. The disease appears on all the aerial parts of the plant. In India, *Alternaria* blight was previously designated as minor disease but now become a major problem in different parts of the country (Chauhan and Shrivastava, 1975)^[9].

Arya and Prasad (1952)^[3] reported that *A. lini* was identical with *A. brassicae* (Berk) Sacco. In morphology, pathogenicity and physiology. The pathogen is perpetuated in seed and also soil through infected plant debris. The management of disease can be done through cultural *i.e.*, crop rotation (Rani and Sudini, 2013)^[24], changing in sowing date (Singh and Singh, 2004b, Singh *et al.*, 2008, Singh *et al.*, 2015)^[12, 28, 34], destruction of plant debris (Rani and Sudini, 2013)^[24], soil solarization (Patel *et al.*, 2014)^[21], use of resistant cultivars (Ramakant *et al.*, 2008)^[23], chemical (Holi and Meena, 2015), biological management (Bhoye *et al.*, 2011, Biswas *et al.*, 2015)^[6].

A Review of prevalence of *Glucose 6-phosphate dehydrogenase (G6PD)* deficiency in India

Gyanendra Awasthi¹, Deepali Joshi² and D.k.Awasthi³

1: Dept of Biochemistry, Dolphin (PG) Institute, Dehradun (UK)

2: Dept of Agriculture, Shivalik Institute of professional Studies, Dehradun (UK)

3: Dept of Chemistry, JNM (PG) College, Lucknow (UP)

Abstract: *Glucose 6-phosphate dehydrogenase (G6PD)* deficiency is one of the commonest human enzymopathies, caused by inherited mutations of the X-linked gene *G6PD*. *G6PD* deficiency makes red cells highly vulnerable to oxidative damage, and therefore susceptible to hemolysis. Over 200 *G6PD* mutations are known: approximately one-half are polymorphic and therefore common in various populations. Some 500 million persons with any of these mutations are mostly asymptomatic throughout their lifetime; however, any of them may develop acute and sometimes very severe hemolytic anemia. The present review deals with current scenario of *G6PD* deficiency in India.

Glucose is the main source of energy for the red cell, which is metabolized by two major routes; the glycolytic pathway and the hexose monophosphate (HMP) shunt. *Glucose-6-phosphate-dehydrogenase (G6PD)* is an X-linked enzyme that catalyses the first step in the HMP pathway of glucose metabolism and it produces NADPH, which is required for the maintenance of reduced glutathione (GSH). GSH is essential for protecting red cells from oxidative damage. (Beutler E;1994) Hence, this enzyme is important in red cell metabolism and its deficiency renders the red cell extremely vulnerable to any kind of oxidative stress. The major clinical manifestations of this disorder are drug induced haemolytic anaemia and/or neonatal jaundice and a small proportion of *G6PD* deficient individuals have chronic non-spherocytic haemolytic anaemia (Class I *G6PD* deficiency) (Beutler E;1996).

THE ENZYME

STRUCTURE

The *G6PD* monomer consists of 515 amino acid subunits with a calculated molecular weight of 59,256 daltons. The active enzyme exists as a dimer. (Wrigley NG *et al*;1972, Rattazzi MC;1968) and contains tightly bound NADP (De Flora A *et al*;1974, Morelli A *et al*;1976) Aggregation of the inactive monomers into catalytically active dimers and higher forms requires the presence of NADP (Kirkman HN and Hendrickson EM;1962). Thus, NADP



Review article

The Impact of extremophilic Enzyme: Widely Application in Industrial uses

Lekha Singh^{1,2}, Gaurav Sharma^{1*}, Gyanendra Awasthi², Lokendra Kumar³

¹School of Applied Sciences, Suresh Gyan vihar University, Jaipur.

²Department of Biochemistry, Dolphin PG Institute of Biomedical and Natural Science, Dehradun.

³Department of Microbiology, PM College of education karsua, Aligarh

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Extremophiles
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Abstract

Some areas to be restricted have not detected bacterial life. Over the past year, the bacterial communities have become increasingly aware that they are exposed to very different conditions, such as temperature, pH, pressure, and salt. These microorganisms are termed Extremophiles. These Extremophiles produce biocatalysts and their function under Extreme conditions. Several novel applications of their biocatalyst are unique properties in the different industrial processes. At present, only a small percentage of these earth's resources are used. An extremophile is a new development in agriculture and production but the development is also related to the production and integration of genes into larger forces, increasing the number of enzyme-induced changes in chemicals, food, pharmaceuticals, and other industrial applications.

Introduction

Extremophiles are the organisms which survive in extreme environmental condition. We study them on earth is to better understand the wide range of the

condition under which life evolve and survive. It helps us to understand some different environmental extremes. For biotechnology and industrial application, more than 300 different enzymes have

*Corresponding author's e-mail addresses: gaurav.sharma@mygyanvihar.com

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Graphitic bio-char and bio-oil synthesis via hydrothermal carbonization-co-liquefaction of microalgae biomass (oiled/de-oiled) and multiple heavy metals remediations

Krishna Kumar Jaiswal^a, Vinod Kumar^{a,*}, Ravikant Verma^b, Monu Verma^c, Arvind Kumar^b, Mikhail S. Vlaskin^{d,*}, Manisha Nanda^e, Hyunook Kim^c

^a Algae Research & Bio-Energy Laboratory, Department of Chemistry, Uttarakhand University, Dehradun, Uttarakhand 248007, India

^b Department of Ecology and Environmental Sciences, Pondicherry University, Puducherry 605014, India

^c Department of Environmental Engineering, University of Seoul, Seoul 130743, South Korea

^d Joint Institute for High Temperatures of the Russian Academy of Sciences, 13/2 Izhorskaya St, Moscow 125412, Russia

^e Department of Biotechnology, Dolphin (P.G.) Institute of Biomedical and Natural Sciences, Dehradun 248001, India

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ABSTRACT

Thermochemical transformation of microalgae biomass into graphitic bio-chars entices as proficient bio-adsorbents for heavy metal contaminants. This study explores the synergistic impact of *Chlorella sorokiniana* on biomass generation and wastewater remediation in high rate algae pond (HRAP). Biomass produced was applied for hydrothermal carbonization-co-liquefaction (HTCL). The structural and morphological characteristics of HTCL products (i.e. bio-chars and bio-oils) have been systematically studied by XRD, Raman, FTIR, elemental analyzer, SEM, BET, and ¹H NMR spectroscopy. The crystallite size of the graphite 2H indexing planes was to be 4.65 nm and 14.07 nm in the bio-chars of oiled biomass (MB-OB) and de-oiled biomass (MB-DOB), respectively. The increase in the I_D/I_G ratio of MB-DOB indicated the highly disordered graphitic structure due to the appearance of carbonyl, hydroxyl, and epoxy functionalities in the line of high C/N and low C/H ratio. Also, the multiple heavy metals remediation of MB-DOB revealed better efficiency as ~100% in 720 min. The kinetics analysis shows the correlation coefficient of pseudo-second-order is well fitted compared to the pseudo-first-order. The Langmuir adsorption model signifies the adsorption of heavy metal ions in a monolayer adsorption manner. The study proposes the microalgae bio-char potential for multiple heavy metals remediation alongside bio-oils.

1. Introduction

Microalgae are photosynthetic organisms similar to single-celled plants with habitats for various aquatic environments (Malavasi et al., 2020). They deal with the conversion of environmental CO₂ into O₂ in the presence of sunlight or artificial light and generate a large amount of biochemical components enriched with cellular energy (Jaiswal et al., 2020). Microalgae offer essential ecosystem and biomass services for diverse eco-friendly applications. They possess a rapid growth rate with notable biomass production and ensure the ability to grow in various types of wastewaters without competing with traditional agro-activities (Salama et al., 2017). In addition, the alarming threat to the existing ecosystem is due to industrialization and urbanization, as it discharges

toxic heavy metals, wastes containing nitrogen, phosphorous, and others, as well as the release of CO₂ severely (Chowdhury et al., 2016). In this case, the concept of microalgae cultivation using many types of wastewaters (municipal, industrial, dairy, etc.) has been deliberated as a suitable scientific solution for renewable and sustainable developments (Jaiswal and Prasath, 2016; Cai et al., 2019; Sutherland and Ralph, 2019).

Recently, microalgae have received a lot of attention to the profitable cultivation of microalgae and energy-efficient biomass conversion technologies for biofuels for a variety of reasons (Choudhary et al., 2020). Despite enormous literature, experts endure the innovative and integrative design to develop cost-effective, biomass production processes, remediation of toxic metal contamination, wastewater

* Corresponding authors.

E-mail addresses: vinodkdbhatwalia@gmail.com (V. Kumar), vlaskin@inbox.ru (M.S. Vlaskin).

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Microalgal Cd resistance and its exertions on pigments, biomass and lipid profiles

Manisha Nanda^a , Bhavna Chand^a, Tripti Bisht^a, Vinod Kumar^b , and M. S. Vlaskin^c 

^aDepartment of Biotechnology, Dolphin (PG) Institute of Biomedical & Natural Sciences, Dehradun, India; ^bAlgal Research and Bioenergy Lab, Department of Chemistry, Uttaranchal University, Dehradun, India; ^cJoint Institute for High Temperatures of the Russian Academy of Sciences, Moscow, Russia

ABSTRACT

This study highlights freshwater oleaginous microalgae as efficient vectors for development of eco-friendly environmental solutions. An effective hybrid approach has been presented here for cadmium tolerance complementing with enhanced lipid productivity in four freshwater oleaginous microalgae viz., *Chlorella singularis*, *Chlorella sorokiniana*, *Chlorella minutissima* and *Scenedesmus abundans* that can be utilized for bioremediation as well as biofuel generation. All the microalgae displayed considerable resistance to cadmium under in-vitro culture conditions. The identified microalgae presented here can be used for both, Cd contaminated wastewater treatments as well as lipid reservoirs for biofuel production as indicated by their cadmium optimum growth concentration and Maximum Tolerable Concentration (MTC). The biomass and lipid accumulation was not inhibited by Cd, instead it increased under the influence of lower concentrations of cadmium. However, very high concentrations of Cd (>300 mg/L) inhibited both biomass and lipid yield. A decrease in all the photosynthetic pigments was recorded in the presence of Cadmium (Cd) at various concentrations. The GC-MS based lipid profiles indicated the dominance of SAFA and MUFA under the stress of Cd.

KEYWORDS

Cd stress; heavy metal; lipid analysis; maximum tolerable concentration; TAGs

Introduction

Heavy metal pollution as well as exhaustion of fossil fuels are a primary environmental concern worldwide. This is demanding the identification and development of environment friendly processes and resources. Microalgae based hybrid approaches are the best environment friendly solutions for biofuel production and as well as heavy metal containing waste treatment (Fatima and Kumar 2020). Cadmium (Cd) is the most widely known toxic and hazardous heavy metal environmental pollutant that leads to a number of appalling illnesses in humans including cancer and liver damage (Nordberg 2009). Cd toxicity is one of the major environmental concerns globally that has attracted the attention of various researchers to tackle it by utilizing microbial flora such as fungi, bacteria, lignocellulosic materials

and microalgae (Iqbal et al. 2005; Ghoneim et al. 2014).

Heavy metals discharge into water bodies leads to serious aquatic life loss and environmental problems. In order to manage and survive under this stress many microalgae have evolved different mechanisms which include lipid accumulation as a defense mechanism against toxic heavy metals. Microalgae are an efficient vector for removal of heavy metals from water bodies as well as development of biofuels. Microalgae have come up as a conceivable reserve for bioremediation and biofuels. Microalgae can be cultivated using simple nutritional requirements and can be utilized for multiple purposes (e.g., Bioremediation, biofuel production). Lower concentrations of many heavy metals are known to enhance lipid accumulation in many microalgae as a defense mechanism. In-fact some researchers



Algae-based sustainable approach for simultaneous removal of micropollutants, and bacteria from urban wastewater and its real-time reuse for aquaculture

Vinod Kumar^{f,g,*}, Krishna Kumar Jaiswal^a, Monu Verma^{b,f}, Mikhail S. Vlaskin^c, Manisha Nanda^d, Pankaj Kumar Chauhan^e, Ajay Singh^a, Hyunook Kim^{b,*}

^a Algae Research and Bioenergy Lab, Department of Chemistry, Uttarakhand University, Dehradun 248007, India

^b Department of Environmental Engineering, The University of Seoul, Seoul 130-743, Republic of Korea

^c Joint Institute for High Temperatures of the Russian Academy of Sciences, 13/2 Izhorskaya St, Moscow 125412, Russia

^d Department of Biotechnology, Dolphin (P.G.) Institute of Biomedical and Natural Sciences, Dehradun 248001, India

^e Faculty of Applied Sciences and Biotechnology, Shoolini University, Solan, HP, India

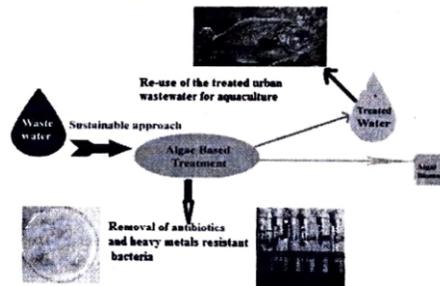
^f Algae Research and Bioenergy Lab., Department of Chemistry, Uttarakhand University, Dehradun, 248001, India

^g Department of Environmental Monitoring and Forecasting, Ecological Faculty, RUDN University, Moscow, 117198, Russia

HIGHLIGHTS

- A novel microalga, *Pseudochlorella pringsheimii* was used to remove micropollutants and bacteria from wastewater.
- Reduction in the level of total coliforms to an undetectable count in 5 days
- High algal biomass with enhanced lipid content was obtained.
- Reuse of treated wastewater for fish aquaculture

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ABSTRACT

Freshwater consumption by humans has reached its peak, magnifying a dearth to freshwater availability across the world. The rising demand for freshwater has led to an interest in using purified wastewater for reuse. In this study, a novel microalgal strain *Pseudochlorella pringsheimii* – Ind-Jiht-1 was assessed in a pilot-scale for phyco-mitigation of various pollutants in the raw urban wastewater, including heavy metals as well as antibiotics resistant bacteria. The results appeared promising; the technology achieved an 83.2% reduction in COD, 66.7% in alkalinity and 69.6% in hardness. Moreover, almost complete reductions in total bacterial and total coliforms could be achieved. Three isolates viz., IS-2, IS-9 and IS-10, which were in the raw wastewater, could be obtained even after the 14-days microalgal-treatment of the wastewater. IS-2 was the most dominating bacterial species and able to thrive in urban wastewater even after the treatment. The treated wastewater was used to cultivate the sucker fishes. Bodyweight of the fishes was measured for evaluating their growth rates. The average survival rates of the sucker fish in the raw wastewater and treated wastewater were 0% and 84%, respectively. Results confirm that the algae-based technology not only reduces the micropollutants and bacteria from urban wastewater but also offers a platform for reuse of treated water for low-cost fish cultivation.

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* Corresponding authors.

E-mail addresses: vinodkhatwalia@gmail.com (V. Kumar), h_kim@uos.ac.kr (H. Kim).

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Hydropyrolysis of freshwater macroalgal bloom for bio-oil and biochar production: Kinetics and isotherm for removal of multiple heavy metals



Krishna Kumar Jaiswal^a, Vinod Kumar^{a,b,c,*}, Mikhail S. Vlaskin^d,
Manisha Nanda^e, Monu Verma^{f,**}, Waseem Ahmad^a, Hyunook Kim^{f,**}

^a Algae Research and Bioenergy Laboratory, Department of Chemistry, Uttarakhand University, Dehradun, Uttarakhand, 248007, India

^b Peoples' Friendship University of Russia (RUDN University), Moscow, 117198, Russia

^c Department of Environmental Monitoring and Forecasting, Ecological Faculty, RUDN University, Moscow, 117198, Russia

^d Joint Institute for High Temperatures of the Russian Academy of Sciences, 13/2 Izhorskaya St, Moscow, 125412, Russia

^e Department of Biotechnology, Dolphin (P.G.) Institute of Biomedical and Natural Sciences, Dehradun, Uttarakhand, 248007, India

^f Water-Energy Nexus Laboratory, Department of Environmental Engineering, University of Seoul, Seoul, 02504, Republic of Korea

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ABSTRACT

In this study, hydropyrolysis was carried out using sodium carbonate to convert the green algal bloom into bio-oil, biochar, aqueous solution, and gases. The effect of supercritical conditions (400, 450, 500 °C) on the product yield, bio-oil composition, and structure, and functionalities of the biochar was determined. The high yield of biochar and bio-oil was reported at 400 °C. A significant reduction in bio-oil and increment in hydrocarbon content was reported on the elevation of temperature from 450 °C to 500 °C. After that, kinetic and isotherm analysis was investigated simultaneously to remove four heavy metals viz. Cu(II), Ni(II), Co(II), and Cd(II) from the mixture solution. Results show that kinetics data follow a pseudo-second-order kinetics model and adsorption isotherm is in better agreement with the Langmuir model, not with the Freundlich model. The maximum adsorption capacity was found 10.90, 5.74, 5.80, and 16.28 mg/g with the biochar prepared at 500 °C for Cu(II), Ni(II), Co(II), and Cd(II) metals, respectively. The current investigation provided a promising way for the utilization of freshwater algal bloom biomass for renewable products and simultaneously heavy metal removal from the water.

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1. Introduction

Marine and freshwater microalgae are essential components of the water ecosystem and a good source of biomass (Bird et al., 2011). Macroalgae are multicellular organisms approximately growing up to 60 m in freshwater (Demirbas and Fatih, 2010). Macroalgal biomass is a good source of biologically active compounds like chemicals, nutraceuticals, food, feed, fertilizers, etc.

* Corresponding author at: Algae Research and Bioenergy Laboratory, Department of Chemistry, Uttarakhand University, Dehradun, Uttarakhand, 248007, India.

** Corresponding authors.

E-mail addresses: vinodkhatwalia@gmail.com (V. Kumar), mkvcyitr@gmail.com (M. Verma), h_kim@uos.ac.kr (H. Kim).

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Integration of microalgal bioremediation and biofuel production: A 'clean up' strategy with potential for sustainable energy resources

Manisha Nanda^{a,*}, Bhavna Chand^a, Sunaina Kharayat^a, Tripti Bisht^d, Nisha Nautiyal^a, Sandhya Deshwal^b, Vinod Kumar^{c,d,**}

^a Department of Biotechnology, Dolphin (PG) Institute of Biomedical & Natural Sciences, Dehradun, 248007, India

^b Polymer, Plastics and Composites Division, CSIR-Central Building Research Institute, Roorkee, 247667, India

^c Department of Life Sciences, Graphic Era (Deemed to Be University), Dehradun, Uttarakhand, 248002, India

^d Department of Environmental Monitoring and Forecasting, Ecological Faculty, RUDN University, Moscow, 117198, Russia

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ABSTRACT

Oleaginous microalgae are being used extensively worldwide for the development of integrated sustainable environment technologies. Microalgae can be used to remove environmental pollutants and simultaneous extraction of biofuels from the same culture. Microalgae have also evolved different intracellular and extracellular mechanisms to resist the toxic effects of different environmental pollutants that stimulate lipid accumulation. The advancements in microalgae omics with the use of recent tools like ¹H-NMR spectroscopy, GC-MS, FTIR spectroscopy, ICP-MS, LC-MS can provide deep insights towards understanding the various underlying mechanisms to resist environmental stresses. They are a promising candidate towards Green Bioremediation and Biofuel production.

1. Introduction

The exhaustion of fossil fuels along with the rising demands worldwide needs the development of sustainable energy sources that can intercept the future energy crisis. With the advancements in the field of science and technology, multipurpose approaches are preferred in order to get the most out of the efforts utilized for the development of a process. Microalgae are aquatic organisms that have come up as a potential candidate for environment friendly technologies. Removal of environmental pollutants using sustainable methods is one of the thrust areas of research always. Microalgae can be used to remove environmental pollutants and simultaneous extraction of biofuels from the same culture. They are a promising candidate towards Green Bioremediation technologies. Researchers globally, have very well recognized the benefits of microalgae for bioremediation as well as biofuels [1,2].

The uncontrolled and unaware discharge of various pollutants due to various anthropogenic activities is contributing each day towards the persistence of the environmental pollutants in the aquatic environments and water bodies. The traditional wastewaters systems are not very efficient in removing these contaminants completely therefore some

amount of these pollutants are becoming persistent in the aquatic environments. Microalgae are also being explored and utilized by various researchers for bioremediation purposes of these environmental pollutants from different effluent. Moreover, these are simultaneously being explored for biofuel production in order to develop integrated systems [3–5]. These wastewaters also contain nutrients that can be utilized for microalgae cultivation. If the process parameters for cultivation of microalgae on wastewater are properly optimized the microalgae can be further utilized to treat wastewaters. This will also help in cost cutting on growth medium for microalgae cultivation. So, this will serve the dual purpose of bioremediation of wastewater as well as an economic growth medium for cultivating microalgae biomass that can be harvested to extract biofuels (Fig. 1). In order to increase biomass productivity and cost reduction for biofuel production in microalgae, selection of efficient cultivation and harvesting methods is required [6]. For decreasing the cost of biofuel production it is very necessary to cut down the cultivation cost and hence the use of wastewater for cultivating microalgae can serve this purpose with the added advantage of removal of pollutants from it. The use of wastewater for cultivation of microalgae has been very well documented [7]. However the key areas requiring focus for the

* Corresponding author.

** Corresponding author. Department of Life Sciences, Graphic Era (Deemed to be University), Dehradun, Uttarakhand, 248002, India.
E-mail addresses: manisha1083@gmail.com (M. Nanda), kumarvinod.ls@geu.ac.in (V. Kumar).

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Review

Microalgae with a truncated light-harvesting antenna to maximize photosynthetic efficiency and biomass productivity: Recent advances and current challenges

Vinod Kumar^{a,b,s}, Nishesh Sharma^c, Krishna Kumar Jaiswal^{a,d}, Mikhail S. Vlaskin^e,
Manisha Nanda^f, Manoj Kumar Tripathi^g, Sanjay Kumar^h

^a Algae Research and Bio-energy Laboratory, Department of Chemistry, Uttarakhand University, Dehradun, Uttarakhand 248007, India

^b Peoples' Friendship University of Russia (RUDN University), Moscow 117198, Russian Federation

^c Department of Biotechnology, Uttarakhand University, Dehradun, Uttarakhand 248007, India

^d Institute for Water and Wastewater Technology, Durban University of Technology, Durban 4001, South Africa

^e Joint Institute for High Temperatures of the Russian Academy of Sciences, 13/2 Izhor'skaya St, Moscow 125412, Russian Federation

^f Department of Biotechnology, Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehradun, Uttarakhand 248007, India

^g Agro Produce Processing Division, ICAR–Central Institute of Agricultural Engineering, Bhopal, Madhya Pradesh 462038, India

^h Department of Life Sciences, Graphic Era (Deemed to Be University), Dehradun, Uttarakhand 248002, India

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ABSTRACT

Microalgae and the associated biomass have been advocated for various eco-friendly applications. Although, microalgae are a good source of biofuels, metabolites, and value-added products, their commercial cultivation suffers from limited biomass yield due to inefficient photosynthetic efficiency. Minimizing the light-harvesting antenna size of the photosystems has been recognized as an effective mechanism to enhance photosynthetic efficiency and overall biomass productivity in microalgal cultures. Several strategies including mutagenesis, through UV radiations and chemical mutagenesis, genetic engineering, and DNA insertional mutagenesis have been employed to obtain mutant strains possessing a regulated antenna with a regulated limited number of light-harvesting molecules. However, there are still a number of challenges associated with antenna mutants that need to be addressed. This review highlights the recent developments in truncated antenna mutants of microalgae, aiming to increase the photosynthetic efficiency and biomass productivity of the respective cultures.

1. Introduction

Microalgae are considered primary oxygen producers and are known to play an important role in maintaining ecological balance and energy [1,2]. Recently, the cultivation of microalgae has gained importance due to its photosynthetic productivity. Microalgae have been recognized to have a rapid growth rate compared to terrestrial crops/plants. The general growth of microalgae species can be evaluated with their ability to transform the energy of solar photons into biomass production, subsequently, the formation of metabolites, including lipids [3,4]. The literature available on different species of microalgae provides information on the different applications of microalgae ranging from

wastewater treatment, pigment production, synthesis of compounds including hydrocarbons, polysaccharides, CO₂ fixation (Calvin-Benson cycle), etc. [5,6]. The applications mentioned above mainly include the design of a photobioreactor (PBR) for the cultivation of microalgae. PBRs have gained importance for the cultivation of microalgae, as they provide absolute control over the cultivation conditions in PBR and comparison with high light intensity [7]. However, the actual fitness of natural or genetically modified microalgae strains can be assessed when grown in large-scale open ponds for environmental risk assessment [8, 9].

Algae, like higher plants, exhibit inherent cellular mechanisms for using solar energy (light) for the photosynthesis process. Microalgae

Abbreviations: PBR, photobioreactor; UV, ultraviolet; Chl a, chlorophyll a; Chl b, chlorophyll b; LHPC, light-harvesting protein chlorophyll; PSI, photosystem I; PSII, photosystem II; TAM, truncated antenna mutants; EMS, ethyl methanesulfonate; MMS, methyl methanesulfonate; ISR, intracellular spectral repositioning; eGFP, green fluorescent protein; NPQ, non-photochemical quenching; GMA, genetically modified algae; GMO, genetically modified organisms; RC, reaction center.

* Corresponding author at: Algae Research and Bio-energy Laboratory, Department of Chemistry, Uttarakhand University, Dehradun 248007, India.

E-mail address: vinodkhatwalia@gmail.com (V. Kumar).

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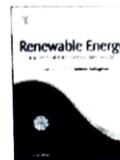
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Review

Effect of catalyst and temperature on the quality and productivity of HTL bio-oil from microalgae: A review



Nishesh Sharma^a, Krishna Kumar Jaiswal^{b,c}, Vinod Kumar^{d,e,*}, Mikhail S. Vlaskin^f,
Manisha Nanda^g, Indra Rautela^a, Mahipal Singh Tomar^h, Waseem Ahmad^b

^a Department of Biotechnology, Uttarakhand University, Dehradun, 248007, India

^b Algae Research and Bio-energy Laboratory, Department of Chemistry, Uttarakhand University, Dehradun, Uttarakhand, 248007, India

^c Institute for Water and Wastewater Technology, Durban University of Technology, Durban, 4001, South Africa

^d Department of Life Sciences, Graphic Era (Deemed to Be University), Dehradun, Uttarakhand, 248002, India

^e Peoples' Friendship University of Russia (RUDN University), Moscow, 117198, Russian Federation

^f Joint Institute for High Temperatures of the Russian Academy of Sciences, 13/2 Izhorskaya St, Moscow, 125412, Russia

^g Department of Biotechnology, Dolphin (P.G.) Institute of Biomedical and Natural Sciences, Dehradun, Uttarakhand, 248007, India

^h Department of Food Process Engineering, National Institute of Technology, Rourkela, Odisha, 769008, India

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ABSTRACT

Algae biomass has been recognized as one of the most suitable, efficient, and reliable feedstocks for bio-oil production. Among the different processes, hydrothermal liquefaction (HTL) is emerging as an effective technology for the valorization of various types of wet or dry biomass. Several factors, including temperature, retention time, and catalyst, significantly influence the overall efficiency of HTL products. The temperature -280 ± 40 °C is reported to be the most suitable range to achieve maximum bio-oil. Both homogeneous and heterogeneous catalysts have been used to improve bio-oil yield. For several advantages, heterogeneous catalysts are the preferred choice due to improved bio-oil generation, easy recovery, and uses. The eco-friendly approach and the reduction of heteroatoms in bio-oils make heterogeneous catalysts an ideal choice to be fortified. Alkaline catalysts have been considered most suitable to improve HTL yield. Variations in temperature and catalysts not only influence the yield of the bio-oil but also influence the characteristics of the bio-oil (e.g. high heating value, oxidative stability, gaseous emission, etc.) simultaneously. This review reveals interesting features including HTL temperature vs. yield, catalysts vs. yield, and the effect of wet and dry biomass on bio-oil properties, and finally, observations, remarks/limitations are presented for future studies.

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* Corresponding author. Department of Life Sciences, Graphic Era (Deemed to Be University), Dehradun, Uttarakhand, 248002, India.
E-mail address: vinodkhatwalia@gmail.com (V. Kumar).



Micro-pollutant Pb(II) mitigation and lipid induction in oleaginous microalgae *Chlorella sorokiniana* UUIND6

Manisha Nanda^a, Krishna Kumar Jaiswal^{b,c}, Vinod Kumar^{d,e,f}, Mikhail S. Vlaskin^f, Pankaj Gautam^d, Vivekanand Bahuguna^g, PK Chauhan^h

^a Department of Biotechnology, Dolphin (PG) Institute of Biomedical & Natural Sciences, Dehradun, Uttarakhand, 248007, India

^b Algae Research and Bio-energy Laboratory, Department of Chemistry, Uttarakhand University, Dehradun, Uttarakhand, 248007, India

^c Institute for Water and Wastewater Technology, Durban University of Technology, Durban, 4000, South Africa

^d Department of Life Sciences, Graphic Era (Deemed to Be University), Dehradun, Uttarakhand, 248002, India

^e Peoples' Friendship University of Russia (RUDN University), Moscow, 117198, Russian Federation

^f Joint Institute for High Temperatures of the Russian Academy of Sciences, 13/2 Izhorskaya St, Moscow 125412, Russian Federation

^g Department of Biotechnology, Uttarakhand University, Dehradun, Uttarakhand, 248007, India

^h Faculty of Applied Sciences and Biotechnology, Shoolini University, Solan, Himachal Pradesh, 173229, India

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ABSTRACT

Green oleaginous microalgae are good candidates for the integration of heavy metal bioremediation with the generation of biofuels. To be effective, this requires a comprehensive understanding and optimization of the metal concentration that generates maximum growth along with a high yield of lipids from microalgae cells. This work follows the aforementioned strategy and involves the use of oleaginous microalgae *Chlorella sorokiniana* for lead mitigation and biodiesel production. The short-term effects (IC₅₀ value at 96 h of culture) and the long-term effects (pigments and biomass) of the exposure of lead (Pb) to the growth and biochemical compositions (pigments, proteins, carbohydrates, and lipids) of microalgae have been also determined. *Chlorella sorokiniana* has a high half-maximal inhibitory concentration (IC₅₀ value and higher metal bioconcentration factor (BCF) for Pb (II), which represents that this strain can be considered as a lead (Pb) hyperbioaccumulator. FTIR analysis revealed a reduction in proteins and carbohydrates under the influence of Pb while an increase in lipids has been recorded. The lipid profile based on ¹H NMR and GC-MS has been followed for the quality analysis of the biodiesel produced that indicated altered lipid profiles under stress by Pb and elevated levels of SFA and MUFA.

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1. Introduction

Heavy metal pollution is the most important problem and causes adverse effects on human health and ecology. Metals play an imperative role in cellular growth as essential elements (Dao and Beardall, 2016a). Heavy metals discharged into water bodies cause severe loss of aquatic life and environmental problems (Jaiswal et al., 2021). Pb is a non-essential heavy metal that creates alterations in the cell (Srivastava and Majumder, 2008). Environmental levels of lead (Pb) have increased due to the use of Pb in lead-acid batteries, lead-based paint and recreational shooting, etc. High concentrations

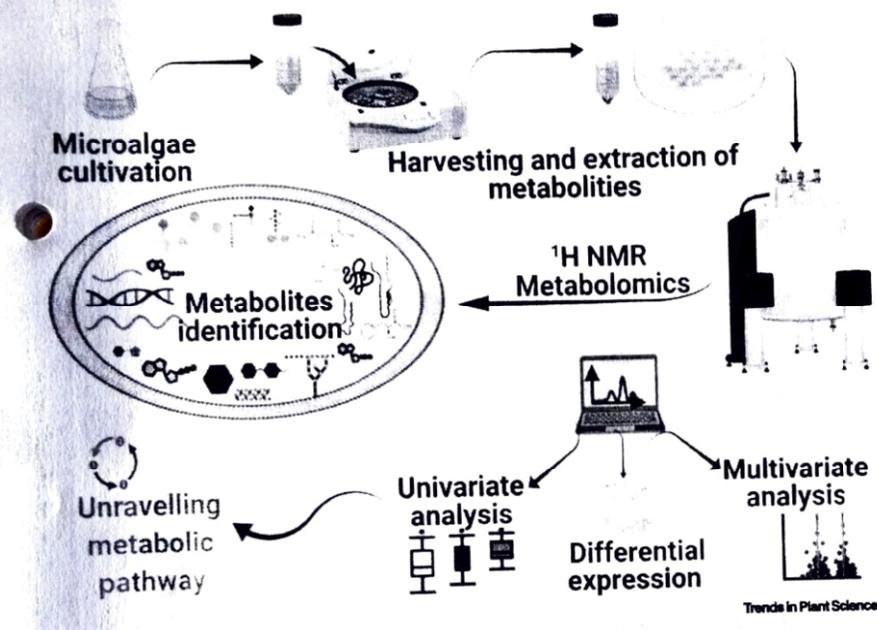
* Corresponding author at: Department of Life Sciences, Graphic Era (Deemed to Be University), Dehradun, Uttarakhand, 248002, India.

E-mail address: vinodkumar@gtu.ac.in (V. Kumar).

¹H NMR-based metabolomics and lipidomics of microalgae

Manisha Nanda¹, Vinod Kumar^{2,3,*}, Neha Arora⁴, Mikhail S. Vlaskin⁵ and Manoj K. Tripathi⁶

¹Department of Biotechnology, Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehradun 248007, Uttarakhand, India
²Department of Life Sciences, Graphic Era (Deemed to Be University), Dehradun 248002, Uttarakhand, India
³Peoples' Friendship University of Russia (RUDN University), Moscow 117198, Russian Federation
⁴Patel College of Global Sustainability, University of South Florida, Tampa, FL 33620, USA
⁵Joint Institute for High Temperatures of the Russian Academy of Sciences, Moscow 125412, Russian Federation
⁶Agro Produce Processing Division, ICAR-Central Institute of Agricultural Engineering, Bhopal 462038, Madhya Pradesh, India



ADVANTAGES:

¹H NMR based metabolomics and lipidomics allows rapid and easy screening of high-yielding novel microalgal strains.

Nondestructive and nonbiased detection of large number of metabolites.

Allows identification and characterization of novel compounds and metabolic pathways that are unique to microalgae

Involves minimal sample preparation with easy recovery and reproducibility.

It can be used for both targeted and untargeted analysis. Lipidomics has been prioritized for detection of small molecules

Provides better understanding of the metabolic pathways involved in the biosynthesis of different microalgal products which can be helpful in re-designing strategies based on 'Algomics' for enhanced production of microalgal metabolites.

CHALLENGES:

Overlapping of chemical shifts due to multiple peak detection.

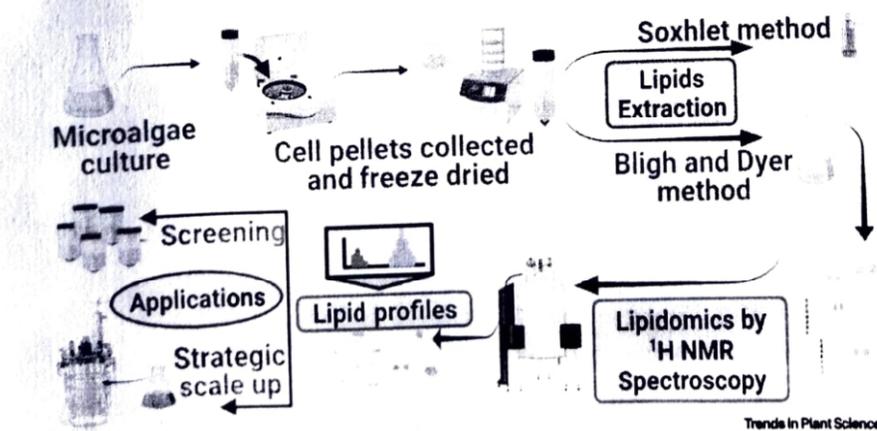
Baseline shifts caused by proteins and polysaccharides might overlap with small signals or result in overestimation of metabolites.

2D NMR (*J*-resolved spectra) is required for accurate identification of metabolites.

To facilitate maximization of metabolite identification, development of public databases specific to microalgae is imperative.

Combining NMR with mass spectrometry (MS) will be essential to improve the biomarker discovery and detection of unknown compounds.

¹H NMR-based metabolomics and lipidomics is a robust, nondestructive, reproducible, and high-throughput technique that allows rapid identification and quantification of large numbers of metabolites without requiring any prior information about the source organism (i.e., microalgae). It is an effective tool to identify and decipher complex alterations in the microalgae in response to different environmental stressors. ¹H NMR data can be processed using spectral databases and statistical software for identification and quantification of differentially expressed metabolites and lipids. This knowledge can then be leveraged to enhance the desired metabolite and/or lipid in the target microalgal strain(s).



*Correspondence: vinodkumar@bnu.ac.in (V. Kumar).





The potential of nuclear magnetic resonance (NMR) in metabolomics and lipidomics of microalgae- a review

Bhawna Bisht^a, Vinod Kumar^{b,*,1}, Prateek Gururani^d, Mahipal Singh Tomar^c, Manisha Nanda^f, Makhail S. Vlaskin^g, Sanjay Kumar^h, Anna Kurbatovaⁱ

^a Department of Post-Harvest Process and Food Engineering, G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

^b Department of Life Sciences, Graphic Era (Deemed to Be University), Dehradun, Uttarakhand 248002, India

^c Peoples' Friendship University of Russia (RUDN University), Moscow, 117198, Russian Federation

^d Department of Biotechnology, Graphic Era (Deemed to Be University), Dehradun, Uttarakhand 248002, India

^e Department of Food Process Engineering, National Institute of Technology, Rourkela, India

^f Department of Biotechnology, Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehradun, Uttarakhand 248007, India

^g Joint Institute for High Temperatures of the Russian Academy of Sciences, 13/2 Ishorskaya St, Moscow 125412, Russian Federation

^h Department of Environmental Monitoring and Forecasting, Ecological Faculty, RUDN University, Moscow, 117198, Russia

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ABSTRACT

Microalgae biotechnology has made it possible to derive secondary bioactive metabolites from microalgae strains that have opened up their entire potential to uncover a wide range of novel metabolic capabilities and turn these into bio-products for the development of sustainable bio-refineries. Nuclear Magnetic Resonance Technology (NMR) has been one of the most successful and functional research technology over the past two decades to analyse the composition, structure and functionality of distinct metabolites in the different microalgae strains. This technology offers qualitative as well as quantitative knowledge about the endogenous metabolites and lipids of low molecular mass to offer a good picture of the physiological state of biological samples in metabolomics and lipidomics studies. Henceforth, this review is aimed at introducing the metabolomics and lipidomics studies into the field of NMR technology and also highlights the protocols for the isolation and metabolic measurements of metabolites from microalgae that should be redirected to resource recovery and value-added products with a systematic and holistic approach for scalability or sustainability.

1. Introduction

By 2050, more than 10 billion people in the globe have now experienced the most significant traces of developing challenges, taking into account the unpredictable future of food, energy, severe weather, shifting climatic conditions and a scarcity of cultivable land [1]. However, the remarkable growth in biological and biomedical research and the adoption of new tooling techniques in the field of the "omics" has earned an important role. Increased diversity and understanding of microalgae responses and the biotic and abiotic stress adaptation has recently been achieved in "algal-omics" approaches, such as transcriptome, proteome, lipidomics and metabolomics. This omic interferences not only explains the basic molecular mechanisms that are responsible for the adaptability of the microalgae strains to the environment but also shows a paradigm shift towards the development of

new pathways and genetic targets for the development of new strains through extensive research of all components and biomolecules such as total DNA including all genes, protein and metabolites within the cell which has helped in unlocking cell metabolism and physiology of microalgae as a multi-user utility in the areas of feed stocks, industrial biotechnology, biofuel, and biomedical applications to its full potentiality.

Microalgal biotechnology has been one of the most severe routes for such problems that has started to emerge in the middle of the last century [2]. Microalgal biotechnology has emerged that allows the continuous development of microalgae on a commercial scale due to its enormous biodiversity of bioactive components in various applications [3]. The key reasons that could accelerate the economic development of microalgae are: (a) raising the volume of low-cost algal biomass feed-stocks, (b) effective methods of extraction for new metabolites. (c)

* Corresponding author. Department of Life Sciences, Graphic Era (Deemed to Be University), Dehradun, Uttarakhand 248002, India.
E-mail addresses: vinod@bse.gerau.ac.in, vinodkumar@bse.gerau.ac.in (V. Kumar).

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Chemosphere



Impact of pyrene (polycyclic aromatic hydrocarbons) pollutant on metabolites and lipid induction in microalgae *Chlorella sorokiniana* (UUIND6) to produce renewable biodiesel

Krishna Kumar Jaiswal^{a, *}, Vinod Kumar^{b, c, d}, Mikhail S. Vlaskin^{e, f}, Manisha Nanda^a^a Algae Research and Bio-energy Laboratory, Department of Chemistry, Uttarakhand University, Dehradun, Uttarakhand, 248007, India^b Institute for Water and Wastewater Technology, Durban University of Technology, Durban, 4000, South Africa^c Department of Life Sciences, Graphic Era (Deemed to Be University), Dehradun, Uttarakhand, 248002, India^d Peoples' Friendship University of Russia (RUDN University), Moscow, 117198, Russian Federation^e Joint Institute for High Temperatures of the Russian Academy of Sciences, 13/2 Izhorokaya St, Moscow, 125412, Russia^f Department of Biotechnology, Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehradun, Uttarakhand, 248007, India

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Transesterification

ABSTRACT

Pyrene (polycyclic aromatic hydrocarbon), an anthropogenic organic pollutant prevalent in various ecological units, receives more attention for bioremediation and energy transformation using microalgae. In this study, we have used pyrene pollutant (50–500 ppm) to evaluate the half-maximal inhibitory concentrations (IC₅₀) of *Chlorella sorokiniana* and the impact on metabolites as well as the induction of lipid biosynthesis to produce renewable biodiesel. Pyrene concentration at 230 ppm (IC₅₀) caused half-maximum inhibition for the 96 h incubation. The harvest in the stationary stage (day 16) for *C. sorokiniana* revealed a biomass generation of 449 ± 7 mg L⁻¹ and 444 ± 8 mg L⁻¹ dcw in the control medium and pyrene IC₅₀ medium, respectively. An insignificant decline in biomass generation (1.2%) was observed due to the stress effect of the pyrene IC₅₀ medium on metabolic biosynthesis. Although contrary to biomass generation, IC₅₀ of pyrene assisted to induce lipid biosynthesis in *C. sorokiniana*. The improvement in lipid biosynthesis was observed as ~24% higher in pyrene IC₅₀ compared to the control medium. The chemical composition of the microalgae biomass, metabolites, and lipids was examined using FTIR spectra. The extracted lipid was transesterified to produce biodiesel via methanolic-H₂SO₄ catalysis. The renewable biodiesel obtained was evaluated using FTIR and ¹H NMR spectra. The transformation efficiency of the lipid of *C. sorokiniana* in biodiesel was calculated as ~81%. This research offers the incentive in lipid biosynthesis in microalgae cells using pyrene for the production of renewable and sustainable ecological biofuels along with bioremediation of pyrene.

1. Introduction

Polycyclic aromatic hydrocarbon (PAH) contaminations emanate in sediments and aquatic bodies as a result of natural or anthropogenic activities in urbanized environments. It possesses lower biodegradability and higher persistence (Chakrabarti et al., 2019; Madhavi et al., 2020; Premnath et al., 2021). PAH is associated with pyrolysis and incomplete combustion of organic elements of fossils fuels such as coal, oils, as well as woods (Rengarajan et al., 2018; Kunal et al., 2019). The aquatic ecosystem has been susceptible to the accumulation of PAH pollutants from sewage, atmospheric deposition, and hydrocarbon spills.

Specifically, PAHs have been identified as general causes of the deterioration of aquatic ecosystems and pose a serious threat to human health and the environment (Chakrabarti et al., 2019; Kollipati et al., 2020; Agusti, 2020). PAH and its degradation intermediates have the potential to generate toxic, mutagenic, carcinogenic, and teratogen effects in fishes and humans (Chakrabarti et al., 2019). The effect of PAH on fish health has been a subject of increasing attention in many countries. Moreover, the removal and transformation of PAH have been considered by various approaches, including solvent extraction, thermal destruction, photocatalytic remediation, chemical remediation, phytoremediation, etc., in which chemical and biological remediation has been preferred due to

** Corresponding author.

* Corresponding author. Department of Life Sciences, Graphic Era (Deemed to Be University), Dehradun, Uttarakhand, 248002, India.
E-mail addresses: kumar.krishna@uetd.ac.in (V. Kumar), vlaskin@phs.ru (M.S. Vlaskin).

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Production of high value-added biomolecules by microalgae cultivation in wastewater and anaerobic digestates of food waste: a review

Review Article · Published: 03 September 2021

Volume 13, pages 9625–9642 (2021) | [View article](#)

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[Vinod Kumar](#) , [Krishna Kumar Jaiswal](#), [Mahipal Singh Tomar](#), [Vishal Rajput](#), [Shuchi Upadhyay](#),
[Manisha Nanda](#), [Mikhail S. Vlaskin](#), [Sanjay Kumar](#) & [Anna Kurbatova](#)

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Abstract

Waste material generated from food sources contributes a significant percentage of the waste generated worldwide. However, it is believed that about two-thirds of food is wasted globally. Anaerobic digestion methods have established important prospects in the field of food waste treatment. Obviously, it can produce significant amounts of energy and can remove a significant proportion of the organics. Microalgae represent a promising option for recycling waste nutrients from different types of food waste that can reduce the cost of producing different value-added products. The process of cultivating microalgae in anaerobic digestate from food waste fulfills the two objectives of environmental policy, i.e., treatment and recovery. This review focuses on the cultivation of microalgae in wastewater from the anaerobic digestate of food waste and the extraction of different value-added products from the biomass of microalgae.



Bio-remediation capacity for Cd(II) and Pb(II) from the aqueous medium by two novel strains of microalgae and their effect on lipidomics and metabolomics

[Manisha Nanda](#)^{a,1}, [Krishna Kumar Jaiswal](#)^{b,1}, [Vinod Kumar](#)^{c,d}  , [Monu Verma](#)^e, [Mikhail S. Vlaskin](#)^f, [Prateek Gururani](#)^g, [Hyunook Kim](#)^e, [Mohamed Fahad Alajmi](#)^h, [Afzal Hussain](#)^h

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Abstract

Microalgae have been the subject of recent research as a sustainable feedstock for the large-scale production of metabolites for commercial purposes. This study presents a green bio-remediation approach towards heavy metal contaminations and biomass production for biofuels in microalgae metabolomics and lipidomics approaches. Two novel microalgae, *Chlorosarcinopsis bastropiensis* and *Polyedriopsis spinulosa*, were isolated during the study and subjected to Pb(II) and Cd(II) pollutants. The isolated microalgae strains have shown a varied behavior towards cell growth, pigment accumulation, and lipids profiles during the impact of short-term (96h) and long-term (14 d) heavy metal tolerance. Cell viability and IC₅₀ value (397.75 mg/L for *C. bastropiensis* and 490.16 mg/L for *P. spinulosa*) have indicated higher tolerance towards Pb(II) in both microalgae. FTIR analysis of microalgal biomass has revealed insignificant differences during long and short-term heavy metal toxicity, clearly indicating the bio-tolerance for Pb(II) and Cd(II) in both microalgae. Principal component analysis has revealed the expression of metabolites (such as glycine, proline, valine, isoleucine, linoleic acid, glucose, sucrose, etc.) under heavy metal stress. ¹H NMR analysis has demonstrated the prominent expression of metabolites under heavy metal stress. ICP-MS-based studies do not reflect the correlation between cellular tolerance and bioaccumulation of each heavy metal by both microalgae. Lipidomics based on ¹H NMR has revealed an increase in unsaturated fatty acids under the impact of heavy metals. Therefore, this study offers a sustainable bioremediation technique for heavy metal contaminants and biomass production with significant enhancement of metabolites and lipid components for biofuels and/or other commercial applications.

Graphical abstract



Original Research Article

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Implications of bacterial multi-metal tolerance for mitigation of heavy metal pollutants from wastewater

Manisha Nanda¹, Vinod Kumar^{2*}

¹Department of Biotechnology, Dolphin (PG) Institute of Biomedical & Natural Sciences, Dehradun-248007, India

²Department of Life Sciences, Graphic Era (Deemed to Be University), Dehradun, Uttarakhand, 248002, India

³Department of Environmental Monitoring and Forecasting, Ecological Faculty, RUDN University, Moscow, 117198, Russia

*corresponding author e-mail address: manisha1083@gmail.com

ABSTRACT

This study presents the determination of multiple heavy metal tolerance in bacteria and its efficacy in bioremediation of heavy metal pollutants from wastewater. The objectives involved analyses of heavy metals (Cd, As, Hg, Cu and Co) using ICPMS in industrial wastewater samples. This was followed by the isolation of bacteria tolerant to heavy metals and in vitro adaptation for discrete heavy metals environment in minimal media. The ICPMS data revealed that the selected bacterial isolates were quite efficient in mitigation of the pollutant heavy metals. A reduction of approximately 55% was recorded for Cd. Lower reductions for As were recorded i.e., up to 29%. Reductions upto 45%, 53% and 57 % were recorded for Hg, Co and Cu respectively. The results indicate that the efficiency of a particular bacterium in removing different heavy metals from the same wastewater sample varies. Also, the potential in removing a particular heavy metal by the different bacteria also varies. The statistical analyses of the bioremediation experiments clearly indicate that bacteria can effectively remove heavy metals from industrial wastewaters under laboratory conditions.

Keywords: Heavy metal tolerance; ICPMS; Maximum Tolerable Concentration (MTC), Bioremediation; multi metal tolerance; Microbial Bioremediation

1. INTRODUCTION

Heavy metal pollution is an alarming environmental concern rendering the aquatic environments unsuitable for life. Rapid industrialization and the uncontrolled discharge of industrial effluent is leading to the inherent persistence and bioaccumulation of these metal pollutants in different ecosystems. The toxicity of the heavy metals even at very low concentrations is well known to cause serious health issues and diseases in all forms of life (Vardhan et al., 2019; Rani et al., 2015).

The expansions in environmental biotechnology have projected bacterial bioremediation to be the most promising strategy for the treatment of contaminated wastewaters. However the success of the strategy lies in the selection of a suitable bacterial candidate as well as the development of an effective methodology according to the presented conditions (Verma and Kuila, 2019). Bioremediation using microorganisms capable of tolerating polluted environments and capable of biotransformation/bioaccumulation of heavy metals are now being employed for wastewater treatments (Igiri et al., 2018; Kapahi and Sachdeva, 2019).

Bacteria are among the most abundant microorganisms that have acquired tolerances to the diverse types of heavy metals

(Chen et al., 2019; Yetunde Mutiat et al., 2018). Different bacterial species have evolved and adopted different molecular mechanisms to resist the heavy metal contaminants persisting in different environments. The genetic determinants of heavy metal resistances in bacteria have been found on both chromosomes and plasmids (Nanda et al., 2019). The bacterial cell wall has a significant contribution in heavy metal biosorption /bioaccumulation as it is the first cellular structure that interacts directly with the metal ions. Bacterial cell walls are structured with several functional groups e.g. amine gp., hydroxyl gp., and carboxyl gp. that allow them to be efficient biosorbents for metal cations (Rani and Goyal, 2009; Vijayaraghavan, K and Yun, 2007; Kang et al., 2007). The origin of a bacterial population determines a significant role in the successful development and application of a bacterial biosorption technology (Kamala-Kannan and Lee, 2008).

In view of the degradative capacity of indigenous microbes the present study was planned to develop a better understanding of the bacterial diversity which exists in nature to deal with toxic heavy metals such as Cadmium (Cd), Arsenic (As), Mercury (Hg), Copper (Cu), Cobalt (Co). These bacteria shared the common

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DECOLORIZATION OF DYES DIRECT RED 31 (DR 31); DIRECT BLUE 71 (DB 71) AND DIRECT BLACK 19 (DB 19) BY NEWLY ISOLATED *Bacillus* sp. DM1

Gulati Deepti^{1*}, Gunwant Monika²

¹Associate Professor, Department of Biotechnology, Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehra Dun-248007, Uttarakhand, India

²Department of Biotechnology, Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehra Dun-248007, Uttarakhand, India

email id: deepti_gulati01@yahoo.co.in

ABSTRACT

In this study, the decolorization potential of novel *Bacillus* sp. DM1 isolated from textile effluents was evaluated. Decolorization of direct red 31 dye was 89% (± 1.20); direct blue 71 dye was 90% (± 0.84) and direct black 19 dye was 81% (± 0.39) after 24 hours at 100 ppm concentration. It took 48 hours for nearly complete decolorization of red and blue dyes and 72 hours for black dye. Dextrose showed 97% (± 0.91) decolorization of blue dye, sucrose 95% (± 1.11) decolorization of black dye and lactose 98% (± 1.35) decolorization of red dye. Yeast extract showed 94% (± 0.80) and 97% (± 0.43) decolorization of black and red dye respectively, whereas sodium nitrate showed 95% (± 0.73) decolorization of blue dye. pH 7 and temperature 35°C was found optimum for decolorization of the dyes. 7% inoculum size for red and blue dye and 8% for black dye were optimum.

Keywords: *Bacillus* sp., Bioremediation, Direct black, Direct blue, Direct red, Effluent treatment

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MICROBIOLOGICAL QUALITY OF SPICES MARKETED IN UTTARAKHAND, INDIA

Deepti Gulati^{1*}, Nababrata Das²

¹Associate Professor, Department of Biotechnology, Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehra Dun-248007, Uttarakhand, India

²Department of Biotechnology, Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehra Dun-248007, Uttarakhand, India

Email : deepti_gulati01@yahoo.co.in

ABSTRACT

A total of 100 spice samples were investigated for the detection and enumeration of total aerobic mesophilic bacteria, thermotolerant coliforms (TC), *Bacillus cereus*, *Staphylococcus aureus* and *Salmonella spp.* All enumerations were performed according to the International Commission on Microbiological Specifications for Foods (ICMSF). For the total aerobic mesophilic bacteria counted 15% samples were acceptable, 80% were of marginal quality and 5% did not show any mesophilic count. 21% samples did not show any TC, 66% samples were acceptable whereas 13% were found unacceptable according to the limit set by ICMSF. Out of the total, 31%, 89% and 50% samples showed *Salmonella spp.*, *B. cereus* and *Staphylococcus aureus* contamination respectively. Mechanical drying, cleaning, microbiological reduction treatment, irradiation, should be applied to spices to reduce microbial load and improve the safety of spices.

Keywords: *Bacillus cereus*, Mesophiles, *Salmonella spp.*, *Staphylococcus aureus*, Thermotolerant coliforms



Physiological Performances of Cluster Bean Varieties in eCO₂ Concentration under Free Air Concentration Enrichment System.

Sonali Mehrotra*² and K.P. Tripathi¹

¹Department of Botany, Dolhin (PG) Institute of Biomedical and Natural Sciences, Manduwala, Chakrata Road, Dehradun, Uttarakhand, INDIA.

²Life Science Dept, Uttarakhand Technical University, Chakrata Road, Suddhuwala, Dehradun, Uttarakhand, INDIA.

*Email id corresponding author : sonali.mehrotra412@gmail.com

Eight Cluster bean (*C₄*) cultivars 1066, 936, 1031, 986, 1002, 471, 1033, 197 were grown in pots experiment and were screened for physiological performances under elevated CO₂ [e[CO₂] = 550±20ppm] and ambient CO₂ [a[CO₂] = 420±20 ppm] for their better adaptative strategies under Free Air Carbon dioxide Enrichment (FACE). Among eight cultivars plant height, plant fresh wt., dry wt. were found to increased and affected significantly under e[CO₂] and were reported highest in 936 (+42.12), 197 (+11.31), 936 (+2.35) and lowest in 1033 (+16.27), 1033 (+4.28), 1033 (+0.77) plant varieties respectively. Among yield parameters seed no./pod, seed/plant and seed weight were estimated and were also found affected significantly, increased and were estimated highest in 1066 (+6.7), 1066 (+91.2), 1066 (+4.90) to lowest in 936 (+3.2), 471 (+20.8), 197 (+2.50) respectively. Total Chlorophyll almost doubles, affected significantly being highest in 986 (+136.05) and least in 197 (+53.13). Physiological parameters includes Photosynthetic rate, Stomatal Conductance, Transpiration, Vapour pressure density, Water use efficiency, Internal CO₂ were also found significantly affected and were highest in 1066 (+29.4), 197 (+0.195), 1002 (+9.55), 1022 (+10.90), 936 (+25.4), 1066 (+392) and lowest in 986 (+19.2), 1033 (+0.19), 936 (+6.60), 1033 (+5.4), 1033 (+18.2), 1033 (+302). Among all cultivars on an average overall 1066 and 1002 *Cyamopsis* varieties were found to be showing higher yield, enhanced chlorophyll content, higher photosynthetic rate. Thus it can be inferred that higher synthesis of chlorophyll concentration promotes higher photosynthetic rate which is the chief cause of increased leaf area and higher carbon dioxide fixation at growing regions of plants. Increased leaf area and higher carbon dioxide fixation promote increased yield parameters in 1066 and 1002 thus both varieties were depicting better adaptive potential under e[CO₂] and can serve as a boon to grow under e[CO₂] and enhanced future food security in India.

Keywords : e[CO₂], a[CO₂], FACE

INTRODUCTION

Global climate changes are the challenges for future plant physiologist and plant biologist. It comprises of high temperature, rising CO₂ emission, rising ozone concentration, drought stress, high precipitation rate etc. Empirical records justifies that foremost among them is rising atmospheric carbon dioxide that is uniquely uniform globally, contributes highly in global climate changes and stimulates photosynthesis, biomass and yield of major staple food crops.

Cluster bean or guar bean (*Cyamopsis tetragonoloba*) is a major annual, summer legume, industrial crop cultivated in Indian field, contributing about 80% of world production

due to its rich galactomannan content in seed endosperm and as a fodder (by product) for animal feeding. Guar is extensively drought tolerant, nitrogen fixation ability by its symbiosis bacterial association, thus cultivated for crop rotation and as valuable cash crop of the world. Infact its valuable nature lies in its seed endosperm comprising of rich source of Galactomannan-1,2 (Guaran), a reserve polysaccharide comprising mannose backbone with galactose side groups branching networks.

Guar is a major kharif crop, covering growing belt geographic area from Haryana to Gujarat in west. The total estimated guar production is 55,81,216 hectare in 2015-2016 of which Rajasthan contributed 47,86,781 hectare field and rest by Punjab, Haryana and Gujarat. Thus, keeping all this features in mind guar production should be speeded up to

Research Article

Consumption Pattern Of Fuelwood And Fodder In Western Nayar Watershed At Pauri District Of Garhwal Himalaya, Uttarakhand, India

Kailash S Puspwan¹, Vikaspal Singh², Baikunth N Pandey¹¹ Department of Botany, Government PG College, Lansdowne, Pauri Garhwal, Uttarakhand, India.² Department of Forestry, Dolphin (PG) Institute of Biomedical and Natural Sciences, Manduwala, Dehradun, Uttarakhand, India.*Corresponding Author: vikaspals@gmail.com

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ABSTRACT

Fuelwood and fodder consumption pattern was studied in natural resource-based three villages of Western Nayar Watershed at Pauri district of Uttarakhand, India. It was observed that Fuelwood collection in the villages started during October and finished by April end. Extensive Fuelwood collection and storage were in February, March, and April. The occasional collection was also found around the year except during rains. It was assumed that the inhabitants on average collect Fuelwood for about 180 days/year. The total green fodder consumption in Khaira village during summer was found 27.076 ± 5.873 kg/day/household from the forest, 6.892 ± 2.089 kg/day/household from the agriculture field. Total dry fodder consumption was found maximum for Khaira village during summer was 9.620 ± 2.634 kg/day/household from the forest and 7.046 ± 2.642 kg/day/household from the agriculture field.

KEYWORDS: Fuelwood, Fodder, Season, LPG**1. INTRODUCTION**

The Himalayan landscape comprises forests and pastures where agriculture and other land uses are distributed as patches. The economy is agrarian. Which is still at the subsistence level. A typical hill village is characterized by agriculture as the main occupation and dependence on forest for daily fuel and fodder requirements [1]. The majority of inhabitants are, thus, engaged in agriculture. The agriculture pattern in this region is very complex. Terraced slopes cover about 80% of the hill agricultural land and are completely dependent on the rain. The remaining 20% area lies in the valleys and plains and is irrigated. Agriculture of the region is interlinked with farming, animal husbandry, and natural resources [2,3].

Fuelwood is the primary resource collected from the nearby forest by the rural population in Garhwal Himalaya. In valley zone 55 to 65 percent, in lower Himalaya belt 78 to 84 percent and higher Himalaya belt 84 to 98 percent of the rural population depends upon Fuelwood for their energy requirements [4]. One common feature is that the collection of Fuelwood and fodder from the forest is the responsibility of women and they have to walk a long distance for collection. This has an undesirable impact on home life and particularly the care of the children in addition to the continued destruction of forests in the neighborhood [5].

In the Garhwal part of Himalaya, most of the total human population is rural and because of geographical inaccessibility, it has very low connectivity with other areas of the country [6]. This inaccessibility of the area and deprived socio-economic status of locals are responsible for the total dependence of local inhabitants on nearby forest areas for their Fuelwood and fodder demands [7,8]. The rising anthropogenic pressure of humans and cattle in these forests has become a serious problem for their sustainability as they are the main source of timber, fuel-wood, fodder, and other non-timber forest products.

Among the natural resources of Uttarakhand, forests are the most important, both economically and environmentally [9]. Due to the

collection of a huge amount of firewood, forests near the villages are subjected to rapid degradation and overexploitation. A very small fraction of firewood comes from the agriculture fields [10].

1.1. STUDY AREA

This district falls partly in the Gangetic plains and a major part in the Himalayan. The Pauri Garhwal district situated between 29° 45' to 30° 15' Latitude and 78° 24' to 79° 23' E Longitude. The three villages viz. Ghandalu, Kyar, and Khaira of the Western Nayar Watershed in district Pauri Garhwal were selected for the study. The village Ghandalu (Altitude: 1700m) lies in the micro watershed Kandul in Dwarikhil Block. The village Khaira (Location: Altitude: 900m) lies in the micro watershed Bisgaddikhil in Jaharikhil Block (Figure 1).

2. MATERIALS AND METHODS

The socio-economic study is based on the survey methods using interviews of people of different age groups and gender and filling questionnaires. It also involved the approach of Participatory Rural Appraisal (PRA) by interaction with villagers, understanding them, and learning from them. The quantity of Fuelwood and fodder consumption was estimated by the weight survey method. The Fuelwood was weighed and left in the kitchen to be burnt and was weighed again after 24 hours to determine the actual Fuelwood consumption. The average consumption per day was calculated according to family size viz. 1-5, 6-7, and more than 8 persons in a family. Similarly, the fodder was weighed and left in an animal shelter and was weighed again after 24 hours to find the actual fodder consumption.

3. RESULTS**3.1. FUELWOOD FUEL CONSUMPTION**

EFFECT OF DIFFERENT DOSES OF NITROGEN AND PHOSPHORUS FERTILIZERS ON NITROGENASE ACTIVITY IN NODULE OF *ALBIZIA LEBBECK BENTH.*

Rashmi T. Chamoli, *Vikaspal Singh and A.K. Uniyal

Dolphin (PG) Institute of Bio-medical and Natural Sciences, Department of Forestry,
Dehradun, 248007, Uttarakhand, India

*Author for Correspondence: vikaspals@gmail.com

ABSTRACT

Different levels of Nitrogen and phosphorus fertilizers were applied in combination with a low and suitable dose of nitrogen to observe the Nitrogenase activity in the nodules of *Albizia lebeck* plants under pot culture condition in the nursery. The maximum number of nodules per plant was recorded in the month of September. The highest number of nodules per plant was recorded in N 40 + P 100 kg/ha treatment during September and the lowest value in the control treatment. The nodular nitrogenase activity was recorded from July to September and further followed a decline until December. With the onset of spring, nitrogenase activity increased with the formation of new nodules from March onwards. In nitrogenase activity a large and small peak was recorded in the month of September and April/May respectively. N40+P100 treated plants performed best over others in respect of nodular nitrogen activity. No activity was observed from December to February. On the basis of relative comparison of different doses of nitrogen and phosphorus on individual plants, it was observed that in most of the treatments low nitrogen and phosphorus doses i.e., N40+P100 showed comparatively higher biomass compared to higher doses. The best results were recorded in N40 + P100 Kg/h treatments.

Keywords: Nitrogenase, Nodule, Nitrogen & Phosphorus Fertilizer

INTRODUCTION

A continuous tree growth depends upon the availability and maintenance of nitrogen pool and its efficient use. Nitrogen is generally known as an important element, center to plant growth, because of its role in the metabolism of various vital substances viz. Proteins, amino acid, nucleic acids, vitamins and other growth regulating substances. Nitrogen fixation is the major route by which gaseous nitrogen is introduced into the ecosystem and the ability to carry out this process is confined to certain groups of micro organisms (Dalton, 1980). Total Global biological nitrogen fixation is approximately 17.2×10^7 tons/year. This figure is approximately three times that of industrially fixed N, which clearly demonstrates the significance of biological nitrogen fixation in the biomass production and natural cycle (Ishizuka, 1992). The relative contribution of symbiotic or associative nitrogen fixing system to the total global level has been assessed to be in the order of 70% symbiotic as compared to 30% in non-symbiotic nitrogen fixing systems (Paul, 1988).

Nitrogen is a key element required for plant growth. The symptoms of soil N deficiency ranges from poor yield to crop failure. Traditionally, soil N deficiency has been addressed by applying fertilizers. It is well-recognized fact that the nitrogenous fertilizers have been largely responsible for the enhancement of grain production after Second World War and subsequently for the success of the Green Revolution in Asia. Although, the possible benefits that can be realized by the application of fertilizer as a basal dose have not been fully appreciated in indigenous species (Mishra and Chauhan, 1997). However, there is still a wide gap in fertilizer consumption per unit area of land between the developing and developed countries (Danso, 1992).

Low fertility is one of the major problems in establishing vegetation on the degraded barren land. Since nitrogen is generally deficient in these soils therefore, the reforestation can be accomplished either increasing the input or using such species which can utilize atmospheric nitrogen apart from soil nitrogen,



(REVIEW ARTICLE)

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Gregarious flowering in *Dendrocalamus strictus* (Roxb.) Nees in Mussoorie Hills, Uttarakhand, India

Chandrima Debi ^{1,*}, Sas. Biswas ² and Kahkashan Naseem ³

¹ Forest Research Institute, Dehradun, Uttarakhand, India.

² Department of Forestry, Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehradun, Uttarakhand, India.

³ IFS, Mussoorie Forest Division, Mussoorie, Uttarakhand, India.

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Abstract

Dendrocalamus strictus (Roxb.) Nees has started flowering and synchronous flowering can be observed in the hillslopes and roadside of Mussoorie and vicinity areas. The synchronous flowering of *D. strictus* was observed in few locations along hillslopes of Mussoorie – Dehradun roadway. The GPS locations of the site are 30024'55" N and 7804'41"E, 30024'52" N and 7804'43" E and 30024'49" and 7804'43" E at an elevation of around 1130 msl. The bamboo clumps were overladen with flowers showing synchronous flowering.

Keywords: Bamboo flowering; Monocarpic; Flowering cycle; Remote sensing; Germplasm Bank

1. Introduction

Dendrocalamus strictus (Roxb.) Nees is one of the most important bamboo species and contributing about 53% of the total bamboo area in India. *D. strictus* is one of the important bamboo species in Uttarakhand and dominantly found in deciduous forests along hill slopes, ravines, and alluvial plains of north and central India. Recently, this species has started flowering and synchronous flowering can be observed in the hillslopes and roadside of Mussoorie and vicinity areas. It is a significant phenomenon depicting monocarpic flowering where the plant dies after flowering.

Bamboo flowering is an intriguing botanical phenomenon for botanists and foresters and the reasons behind the long flowering intervals are still unclear. *D. strictus* shows gregarious or sporadic flowering with flowering cycle of 25-45 years. The inflorescence in this species is a large branching panicle with florets in heads. Fertile florets are intermixed with smaller sterile ones. There are six stamens. The ovary is stipitate and turbinate. The style is long, and the stigma is bifid and plumose. *D. strictus* is anemophilous (1). Flowering occurs when bamboo reaches its maturity stage, i.e. the synchronous flowering of *D. strictus* was observed in few locations along hillslopes of Mussoorie – Dehradun roadway. The flowering started in the month of February -March and can be still observed in the site. The GPS locations of the site are 30024'55" N and 7804'41"E, 30024'52" N and 7804'43" E and 30024'49" and 7804'43" E at an elevation of around 1130 msl. The bamboo clumps were overladen with flowers showing synchronous flowering (Fig. 1-4).

There are various reports of synchronous or gregarious flowering of different bamboo species in different parts of India, but there are few reports of synchronous bamboo flowering in Uttarakhand. Earlier in the year 2015, *Dendrocalamus strictus* flowered in the foothills of Nainital district in Ramnagar forest division of Kumaon zone in Uttarakhand. In the year, 2019-2020, Ringal flowering was observed in Mussoorie and adjacent areas. In the past, there were few reports of the gregarious flowering in *D. strictus* was reported by (2,3).

* Corresponding author: Chandrima Debi
Forest Research Institute, Dehradun, Uttarakhand, India.

ANALYTICAL ANALYSIS OF OPEN SOURCE SOFTWARE USAGE IN INDIA

¹ Amit Sanotra, ² Dr. Sanjay Kumar

¹ Research Scholar, Computer Science, Shri Venkateshwara University, Uttar pardesh
Email:

² Research Guide, HOD, Department of Mathematics, Dolphin Institute Dehradun
Email:

Abstract

This paper reviews the recent activities of Open Source Software (OSS) adoptions by governments, education sectors, and businesses in India. It looks at their motivation and focuses on the selected developments of OSS. Typical applications will be discussed as well as consequences from using OSS.

Keywords: *Open Source Software, Applications, Businesses, Operating System, India*

1. Introduction

Synonymous concepts are also treated as Open Source Software (OSS), Free Software, Free Open Source Software (FOSS), and Free/Libre Open Source Software (FLOSS) [1]. However, we can clearly say that they are very unique when we look at their corresponding licensing terms. Usually, free software is licenced under the GNU General Public License (GPL), while OSS may use either the GPL or any other licence that requires software that may not be free to be integrated [2]. In order to distinguish between the two separate versions and maintain the specific sense of free software/FOSS/FLOSS, it is also more fitting to refer to FOSS or FLOSS rather of the more common word 'open source'. We would like to note that, if possible, we used terminology unique to either free software or OSS in this paper where such distinction is needed.

As most OSS is open to access and change without licence costs, many, including government, corporations, and non-profits, are desirable for use. It can be hard to determine or pick the correct OSS,

though. The overwhelming range of accessible OSS programs is one of the specific difficulties of assessing OSS. On a free hosting platform like SourceForge.net, anybody can build an OSS project. This weak entry threshold suggests that many development designs for OSS are quite insensitive (3). Another problem is that there is very no evidence of OSS programs (4). It can be hard to calculate the product range of an OSS without detailed justification and user instructions that typically accompany professional applications.

The main benefits offered are the balance of the complexities of testing OSS software. The best benefit is that for research, the operating system is accessible, which is crucial in deciding if the programme is of good performance and is sustainable. Another benefit is that many OSS programs have public key sectors to their problem monitoring system, which may provide useful insight into how rapidly the project is growing, when bugs are detected and corrected, and how long it takes to solve problems.

It can be very difficult to pick the right OSS for a particular issue or a series of specifications. Any of the problems are due to the fact that there is no commonly agreed set of standards to be used in appraisal, and that many OSS programs are primarily designed to resolve a specific issue. The appraisal is also always carried out in an ad hoc fashion, using whatever parameters are applicable to the analysts. [5]. This style of methodology leads to assessments that are not formal or consistent within or within organizations and are not reproducible, which may slow down the progress of projects in turn. Another recognized concern is that,

Formula refining through composite blend of soya, alfalfa, and wheat flour; A vegan meat approach

Aditi Sharma¹ | Kritika Rawat¹ | Priyanka Jattan¹ | Pradyuman Kumar² |
Ozlem Tokusoglu^{3,4} | Pankaj Kumar⁵ | Halil Vural⁶ | Ajay Singh¹ 

¹Department of Food Technology, Mata Gujri College, Fatehgarh Sahib, India

²Department of Food Engineering and Technology, SLIET, Longowal, India

³Engineering Faculty, Department of Food Engineering, Celal Bayar University, Manisa, Turkey

⁴Dokuz Eylül University Techn.Dev.Zone, DEPART Technopark, SPILINNOVA LLC, Balçova, Turkey

⁵Department of Microbiology, Dolphin (PG) Institute of Biomedical & Natural Sciences, Dehradun, India

⁶Engineering Faculty, Department of Food Engineering, Hacettepe University, Beytepe Campus, Ankara, Turkey

Correspondence

Ajay Singh, Department of Food Technology, Mata Gujri College, Fatehgarh Sahib, Punjab 140406, India.
Email: ajay3singh@gmail.com

Abstract

Present project involves the formula development by way of standardization for vegan meat through Central Composite Rotatable Design (CCRD) of Response Surface Methodology (RSM) of Design Expert 12 (DX-12). Soya chunks, alfalfa sprouts, and wheat flour were used as base ingredients. Preliminary experimental screening to fix the levels of these base ingredients were the basis to work ahead for formula refining through numerical optimization by way of RSM. The optimization tactics were revealed against a given set of responses viz: physico-chemical (polyphenol, % crude protein) and sensory properties (mouthfeel and texture, color and appearance and overall acceptability) as dependent variable. Obtained product with (75.35%) soya, (1.25%) alfalfa, and (22.73%) wheat flour were evaluated for their crude protein, fiber, polyphenol, antioxidant level, water holding capacity, hardness, chewiness, and springiness as 26.13, 7.88, 0.52, 7.03, 3.962%, 1500 g, 2812 g, and 0.60 g, respectively.

Practical applications

Vegan meat analogue obtained herewith is also competitive in its sensory preferences in alongwith embedded high protein, elevated fiber and antioxidant potential features too. Fortified alfalfa seeds boost it with meaty flavor thus proven to be competitive among commercial demand. Least fat utilization put it in another healthier trait owe to be a better option for obese and calorie conscious patients. Thus in nutshell, stated combination was ideal in terms of textural and sensory attributes as meat mimic.

1 | INTRODUCTION

Meat is the source of premier quality protein consisting of all essential amino acids in it, needed for healthy growth of an individual. Beside its healthily attributes, it also works to impart characteristic functional properties in food which cannot be mimicked by any other means (Xiong, 2005). Despite its adoption as a human diet, it is one of the major drivers of global environmental change in terms to reduce greenhouse gas emissions, land and water pollution, animal cruelty, and outbreaks minimization (corona virus, swine flu, and bird flu). Furthermore, elevated demand of foods through higher consumption pattern hit it globally with hike in purchase prices. In contrast with all this, novel alternatives viz; meat proxies (cultured

meat, plant-based meat alternatives) and novel protein substitutions (like algae) receive increasing attention and are in trend nowadays (Van der Weele et al., 2019). A tremendous rise in the development of meat analogue with simulated sensory and nutritional distinctiveness is the way to have a healthy life.

Vegan meat is also known as meat analogue, faux meat, mock meat, or imitation meat which is a plant-based product resembling or corresponding to the aesthetic qualities and/or chemical characteristics of a specific kind of meat. Simply, it is defined as one which completely excludes food from an animal origin. Plant based proteins are cheap and a substitute for animal protein that eliminates the risk of transferring food-borne zoonotic diseases. Another significant reason for developing vegan meat is the vast exploitation

MASS CLONAL PROPAGATION OF *MUCUNA PRURIENS* (*FABACEAE*) AND AN ASSESMENT OF ITS PHYTOCHEMICAL PROPERTIES

NEHA SAINI, NAVEEN GAURAV, ARUN KUMAR, HEM CHADRA PANT,
INDRA RAUTELA AND PANKAJ KUMAR*

Department of Biotechnology, Shri Guru Ram Rai Univesity, Patel Nagar, Dehradun, 248001,
Uttarakhand, India [NS, NG, AK, HCP].

Department of Biotechnology, School of Applied and Life Sciences (SALS), Uttaranchal University,
Dehradun-248007, Uttarakhand, India [IR].

Department of Microbiology, Dolphin (PG) Institute of Biomedical and Natural Sciences, Manduwala,
Dehradun, 248007, Uttarakhand, India [PK].

[*For Correspondence: E-mail: guptapankaj23@gmail.com]

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Review Article

ABSTRACT

Mucuna pruriens, an essential remedial plant growing in the bushes, hedges and dry deciduous forests throughout India. It is thoroughly used in traditional homoeopathic medicine system of India for the treatment of male virility and neurological diseases. It is documented that *M. pruriens* comprises L-3,4-dihydroxy phenylalanine (L-DOPA) a neurotransmitter precursor, used for the cure of Parkinsons disease. Although all plant parts such as leaf, stem, seed and root of *Mucuna* have been promulgating to possess medicinal properties and these properties has been evaluated in various contexts, comprising for its aphrodisiac, anti-epileptic, antivenom, anti-diabetic, anti-neoplastic and anti-microbial activities. Traditional techniques of propagation of this plant are restricted to seed therefore germination rate and viability of seeds are very poor and also constitute problems because of allergic characteristics that give rise uncurbed itching, the contemporary methods of asexual propagation are Micropropagation that has manifest to be advantageous for in vitro propagation for *Mucuna pruriens* for commercial utilization of valuable plant-derived drugs. Seeds restrain a wide range of phytochemical elements such as alkaloids, glycosides, saponins, reducing sugars, and tannins, which lay out a path to explore it for its wider applications. In this review process of micropropagation and phytochemical properties of *M. pruriens* are summarized.

Keywords: *Mucuna pruriens*; aphrodisiac; Parkinsons disease, anti-epileptic.

Process parameter optimization for development of beer: Star fruit fortified approach

Harsha Pal¹ | Ramandeep Kaur² | Pankaj Kumar³ | Manju Nehra⁴ | Kritika Rawat¹ | Nishant Grover⁴ | Ozlem Tokusoglu⁵ | Loveleen Kaur Sarao⁶ | Sandeep Kaur⁷ | Tanu Malik⁸ | Ajay Singh¹ | Rajan Swami⁹

¹Department of Food Technology, Mata Gujri College, Fatehgarh Sahib, India

²Department of Food Science and Technology, Punjab Agricultural University Ludhiana, India

³Department of Microbiology, Dolphin (PG) Institute of Biomedical & Natural Sciences, Dehradun, India

⁴Department of Food Science and Technology, CDLU, Sirsa, India

⁵Department of Food Engineering, Engineering Faculty, Celal Bayar University, Manisa, Turkey

⁶Department of Plant Breeding and Genetic, Punjab Agricultural University, Ludhiana, India

⁷Department of Agriculture, Maharishi Markandeshwar University, Ambala, India

⁸Centre of Food Science and Technology, CCS Haryana Agriculture University, Hisar, India

⁹MMCP, MMU Mullana, Ambala, India

Correspondence

Ajay Singh, Department of Food Technology, Mata Gujri College, Fatehgarh Sahib, India.
Email: ajay3singh@gmail.com

Abstract

Star fruit (*Averrhoacarambola*) persist functional compounds therefore present investigation aims at the utilization of Star fruit to improve the nutritional value of beer. Beers were prepared by fortification of star fruit juice at 5.0%, 7.0%, and 10% level and compared with control. The prepared beers were assayed for proximate, physicochemical, bioactive, and sensory properties. The juice addition had a nonsignificant ($p \leq .05$) effect on density and specific gravity whereas, total soluble solids increased and pH, alcohol, and carbon dioxide content decreased. A significant ($p \leq .05$) increment was observed in total phenolic content and antioxidant activity. In total, 10% star fruit fortified beer showed the highest overall acceptability. FTIR spectroscopy was used to identify the functional bonds in beer samples. The highest peak of alcohol groups was observed in the control sample, which decreased as the juice level increased. Hence, star fruit acts as a valuable fortification compound for preparing beer with high nutritional value and improved sensory characteristics.

Highlights: 1. The present investigation is a laboratory laden approach to optimize the process parameters and formulation proportion for the production of fruit beer

2. The selection of star fruit is advantageous here to have fruit-flavored beer induced with health attributes

Novelty impact statement: Beer itself is a good source of antioxidants, due to fermentation the bioavailability of nutrients gets increased. With the addition of star fruit juice, the alcohol and carbon dioxide content decreased. On fortification of beer with star fruit, its nutritional and sensory properties will get enhanced as star fruit is rich in antioxidants and polyphenols, therefore it can serve as a therapeutic beverage to elderly people.

1 | INTRODUCTION

Globally, beer is the most consumed alcoholic beverage and is traditionally prepared from barley malt, yeast, hops, and water (Pires & Brányik, 2015). Since ancient times, beer is well known for its nutritional and medicinal value and contains a good amount of minerals

(such as phosphorus, calcium, magnesium, and potassium) and B complex vitamins (Zhao & Zhao, 2012). Various studies reported that the consumption of beer (up to 400 ml per day for men and 200 ml per day for women) reduces the occurrence of cardiovascular diseases and maintains cholesterol and glucose metabolism in the body (Giacosa et al., 2016).

Research & Reviews: Journal of Dairy Science and Technology

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Strain Improvement of *Lactobacillus casei* Strain Shirota for Production of Bacteriocin and Its Utilization as a Biopreservative

Gaurav Yadav, Gauri Singh, Ashok Singh, Pankaj Bhatt

Abstract

Food is a great concern for humans as well as for animals; also because as we buy vegetables and fruits from the market and after some days with or without refrigeration, they start getting spoiled. To minimize the spoilage and make them preserve for a long period, we did this research on preservation of vegetables and fruits using *Lactobacillus casei* isolated from the Yakult and testing in vitro against spoilage causing bacteria and fungi, which was isolated from the spoiled fruit and vegetables. Induced mutation, i.e. physical mutation and chemical mutation (Ethidium bromide and Acrylamide mutation) were performed on the *Lactobacillus casei* with different chemicals and different time exposure to increase bacteriocin productivity. In 30 min of UV exposure, best results were obtained (zone size 32 mm) and 60 µl (5 min exposure zone size 17.5 mm) of EtBr and Acrylamide (zone size 25 mm) give the best zone of inhibition against spoilage causing microorganisms.

Keywords

Biopreservation, Ethidium bromide, Physical mutation, Bacteriocin

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CURRENT ISSUE



TITLE: CINNAMON: A CLINICAL APPROACH AS MULTIFARIOUS NATURAL REMEDY WITH ABSOLUTE IMMUNITY

Shefali Arora^{a*}, Mahak Gusain^a, Ravi Gunupuru^a, Rohit Kaushik^b, Pushpendu Sinha^b
and Deepak Kumar^c

^{a*}Department of Chemistry, University of Petroleum and Energy Studies, Dehradun,(UK)
India

^b Department of Chemical Engineering, University of Petroleum and Energy Studies,
Dehradun,(UK)

^c Dolphin(PG) Institute of Biomedical and Natural Sciences, Dehradun (UK), India

*Corresponding Author's Address: Energy Acres, PO Bidholi, Via Prem Nagar, Dehradun-
248007 (Uttarakhand), India

Ph.: +91-135-2102549; Fax: +91-135-2776095; Email id: shefali.arora@ddn.upes.ac.in

ABSTRACT

Plants are the oxygen support for our planet and all living things. They can be considered as "mothers of medicine". As mothers take care of a child, Plants do the same for all human beings and animals. Medicinal plants have therapeutic properties that produce a beneficial pharmacological effect on the animal and human body. In recent years plants are surveyed as new drugs and gain attention to the discovery of new bioactive compounds. Hippocrates quoted "Let thy food be thy medicine, and thy medicine shall be thy food". The flavor, aroma, taste, and nutritional properties make the Cinnamon offers a wide range of health benefits. The present study explores the connection between the Cinnamon plant and medicine, our food, modern science.

Keywords: Cinnamon, essential oil (EO), Cinnamaldehyde, COVID-19.

Introduction

Cinnamon is an ancient spice, belonging to the family Lauracea. It comes from the bark of Cinnamomum genus. It is native to Sri Lanka, Myanmar, Malabar Coast of India, South America, Caribbean, Southeast Asia and the West Indies (Pie et al., 2014). People have been used this spice since 2000BC in Ancient Egypt. In Egypt, it was more valuable than gold and was sought for religious and embalming purposes. Ancient Hebrews used Cinnamon in religious ceremonies and in the preparation of holy anointing oil as mentioned in the Bible. Cinnamon commonly known as 'Dalchini' and in Sanskrit 'Twak'. Its tree is scattered all over the world and around 250 species have been identified. The Cinnamon tree is small evergreen tree and grows in moist well drained soil with aromatic bark of 6-8 m in height and rarely reaches more than 15 meter. Its leaves are commonly known as 'Tejpatra'. Cinnamon has quite popular as a healing agent. The dry inner bark of a cinnamon spice is brown in colour with delicately fragrant aroma and a warm sweet flavour. Its bark is used as culinary spice. Dalchini is made by cutting the stems of cinnamon trees and its inner bark is extracted and the woody parts was removed. When the woody parts dries, it converted in strips that curl



Greener Approach to Metallic Nanoparticles: A Review

S. Arora^{†*}, M. Latwal*, K. D. Bahukhandi**, D. Kumar***, T. Vemulapalli**, S. Egutoori** and N. A. Siddiqui**

*Department of Chemistry, University of Petroleum and Energy Studies, Dehradun (UK), India

**Department of Health Safety & Environment, University of Petroleum and Energy Studies, Dehradun (UK), India

***Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehradun (UK), India

[†]Corresponding author: S. Arora; shefali.arora@ddn.upes.ac.in

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Plant metabolites

ABSTRACT

Nanoscale based materials are gaining more attention due to their unique physical, chemical and thermodynamic properties. Nowadays the "Green" nanoparticle synthesis has attracted more attention as it is using environmentally acceptable solvent systems which act as eco-friendly reducing and capping agents. This review focuses on a detailed analysis of the bio-production of metal nanoparticles by a biological agent, the various factors affecting the morphology, size, and yield of metal nanoparticles. This the role of plant metabolites, and the experimental procedure in the synthesis of nanoparticles. This review also gives a platform for the role of natural plant biomolecules involved in the bio-reduction of metal salts during the nanoparticle synthesis, interaction of nanoparticles with various biomolecules. biological application and future directions are discussed as a step towards making a pollution-free environment.

INTRODUCTION

The "green" synthesis of metallic nanoparticles has received increasing attention due to the development of eco-friendly technology in material science. Preparation of nanoparticles via chemical procedure also produces a very high amount of hazardous by-products so the investigation of new chemical and physical methods has to be developed. Thus, there is a need for 'green chemistry' that includes a clean, cheap, nontoxic and environment-friendly method of nanoparticle synthesis (Mukherjee et al. 2001). The plants that can be used for the production of nanoparticles could be a better option in comparison to other environmentally benign biological processes as they eliminate the elaborate and conventional process of maintaining cell cultures (Gour et al. 2019). Biosynthetic methods for the production of nanoparticles would be more useful if nanoparticles were synthesized extracellular using plants or their extracts and in a controlled way in terms of their size, dispersity and shape. Biogenic synthesis of nanoparticles with controlled morphology needs more attention, as the biogenic synthesis of nanoparticles is carried out by using biological means like bacteria (Husseiny et al. 2007), fungi (Kumar et al. 2007), actinomycetes (Ahmad et al. 2003a), lichens (Shahi et al. 2003), algae (Chakraborty et al. 2009), etc. The biogenic entities are found to secrete a large amount of proteins which are found to be responsible

for the metal-ion reduction and morphology control (Thakkar et al. 2010). Progress in the field of nanotechnology has been rapid and with the development of innovative synthesis protocols and characterization techniques (Sharma et al. 2009). But most of the synthesis methods are limited to the synthesis of nanoparticles in small quantities and poor morphology. Using plant extract is cheaper than microorganisms as it does not require culture preparation or maintenance of aseptic conditions. The synthesis of nanoparticles using microbes (Kathiresan et al. 2010) and plant extracts cost mainly depends on the many aspects like the metal particles and isolate the chemicals added as the precursor for the nanoparticle synthesis.

Metal nanoparticles have marvellous applications in the area of catalysis, optoelectronics, diagnostic biological probes and display devices, medicine, agriculture and industry. They have been used in the drug delivery system, biomedical devices, biosensors, optics, solar batteries, semiconductors etc. Synthesis of nanoparticles using biological entities has great interest due to their unusual optical (Lin et al. 2000), chemical (Krolikowska et al. 2003), photoelectrochemical (Ahmad et al. 2003b) and electronic properties (Chandrasekharan et al. 2000). The most effectively studied nanoparticles today are those made from noble metals, in particular Ag, Pt, Au, Zn, Cu, Fe, Ni, U, Zr, Se, Te, Ni and

**EFFECT OF METHANOL EXTRACT AND ITS FRACTIONS OF LEAVES
OF *OUGEINIA OOJEINENSIS*
ON DIFFERENT BIOLOGICAL ACTIVITIES**

Deepak Kumar*¹, Ashwani Sanghi², Shefali Arora³, Abdullah¹, Mohd. Danish¹ and Aditya Swarup⁴

¹Department of Pharmaceutical Chemistry, Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehradun, Uttarakhand, India.

²Department of Biochemistry, Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehradun, Uttarakhand, India.

³Department of Chemistry, University of Petroleum and Energy Studies, Dehradun, Uttarakhand, India.

⁴Department of Pathology, Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehradun, Uttarakhand, India.

***Corresponding author:** Dr. Deepak Kumar, Department of Pharmaceutical Chemistry, Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehradun, Uttarakhand, India.
Email: deepsingh2304@gmail.com