MEMORANDUM OF UNDERSTANDING (MOU)

BETWEEN

Dolphin (PG) Institute of Biomedical & Natural Sciences, Dehradun

And

Centre of Aromatic Plants (CAP), Selaqui

This MOU is entered into on the 10 day of, December 2019 by and between Dolphin (PG) Institute of Biomedical & Natural Sciences situated at Dehradun (Uttarakhand) (hereinafter called DIBNS), an institute affiliated by H.N.B. Garhwal Central University, Srinagar (Garhwal).

and

Centre of Aromatic Plants, Selaqui, an R&D Institute of Govt. of Uttarakhand engaged promote conservation, cultivation, processing, quality assessment; and development market linkages on aromatic plants. (Hereinafter called CAP) Herbal Research and Development Institute situated at Industrial Estate, Selaqui, Dehradun (Uttarakhand).

The aforesaid institutions are hereinafter referred to individually as *institute* and collectively as *institutes*.

1. Objectives of the MOU

The objectives of the MOU are:

1. To promote and enhance research interest between DIBNS & CAP.
2. To promote research/continuing education activities, technical support related to microbiological and biotechnological work will be provided by DIBNS and technical support regarding chemical analysis will be provide by CAP.
3. Academic support to DIBNS in terms of field visits, exchange of knowledge by CAP.

2. Technical Areas of Collaboration

1. Research activities related to aromatic oil/extract/products etc.
2. Research collaboration for joint projects.
3. Short term academic programs, seminars and workshops.

Principal
Dolphin (P.G.) Institute of
Biomedical & Natural Sciences,
Manduwala, Rehra Dun

Director
Centre for Aromatic Plants (CAP)
Department of Horticulture, Govt. of Uttarakhand
Selaqui, Dehradun

3. Proposed Modes of Collaboration

DIBNS and CAP propose to collaborate through the following:

a) Cooperation and promotion of education and training in Aromatic and Herbal Plants.

A specific plan will be worked out by the institutes depending upon availability of resources. A specific agreement will be entered into for each activity.

4. Terms and Conditions

1. Both institute support each other in collaborative research projects.

2. Microbiological and Biotechnological techniques will be carried out at DIBNS without charging any amount.
3. For continuing education and field trips for DIBNS teachers and students, the financial arrangements will be made at by DIBNS.

4. The faculty members and students of DIBNS can use the library facility of CAP for short-time with prior permission.

5. This MOU may be amended, renewed and terminated by mutual written agreement of the *institutes* at any time.

6. Either *Institute* shall have the right to terminate this MOU upon 60 days prior written notice to the other *Institute.*

5. Confidentiality

a) The DIBNS and the CAP agree to hold in confidence all information/data designated by the *institutes* as being confidential which is obtained from either *institute* or created during the performance of the MOU and will not disclose the same to any third party without written consent of the other *institute*.

b) The above confidential clause under this MOU excludes the information/data possessed by either *institute* before entering into this MOU or independently developed and/or information already available through public domain.

6. Duration of MOU

This MOU, unless extended by mutual written consent of the *institutes*, shall expire in Five years after the effective date specified in the opening

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Dolphin (P.G.) Institute of Bio Medical & Natural Sciences, Manduwala, Dehra Dun

Director
Centre for Aromatic Plants (CAP)
Department of Horticulture, Govt. of Uttarakhand
Selaqui, Dehradun

paragraph. However, on review, the MOU shall be extended for another two years by mutual consent.

7. Coordinators

Both Institutes will designate persons who will have responsibility for co-ordination and implementation of this agreement.

8. Intellectual Property Rights

The intellectual property rights (IPR) that arise as a result of joint research and collaborative activity under the agreement will be worked out on a case to case basis and will be consistent with officially laid down IPR policies of the two institutes.

9. Signed in Duplicate

This MOU is executed in duplicate with each copy being an official version and having equal legal validity. By signing below, the *institutes,* acting by their duly authorized officers, have caused this Memorandum of Understanding to be executed, effective as of the day and year first above written.

On behalf of	On behalf of
Dolphin (PG) Institute of Biomedical & Natural Sciences, Manduwala Dehradun (Uttarakhand)	Centre of Aromatic Plants, Selaqui
Principal	Director

Principal
Dolphin (PG) Institute of Bio-Medical & Natural Sciences, Manduwala, Dehra Dun

Director
Centre for Aromatic Plants (CAP)
Department of Horticulture, Govt. of Uttarakhand
Selaqui, Dehradun

List of Events/Activities under MOU/Linkage

S. No.	MOU	Title of Event/Activity	Date
1.	Centre of Aromatic Plants (CAP), Dehradun	Publication with Centre of Aromatic Plants, Dehradun	2022
2.		Visit to entre of Aromatic Plants, Dehradun	23-05-2022
3.		Educational trip to entre of Aromatic Plants, Dehradun	31-12-2022

Dolphin (PG) Institute of Biomedical & Natural Sciences,

V.P.O.-Manduwala, Chakrata Road, Dehradun – 248 007 (Uttrakhand) India

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Event Report	
Title	Publication with Centre of Aromatic Plant, Dehradun
Name of the Activity	MOU-Publication
Dept.By	Department of Microbiology
Research Articles	1. Meena Kafaltiya, Hema Lohani, Ujjwal Bhandari, S. Zafar Haider, Nirpendra Chauhan, Tripti Malik Ahuja, Shailja Pant & Neeta Joshi, Chemical Composition, Antioxidant and Antimicrobial Potential of the Essential Oils from Aerial Parts of *Tagetes patula* L. at Different Phenological Stages, Journal of Essential Oil Bearing Plants, 2022, 25:3, 495-507, DOI: 10.1080/0972060X.2022.2086827. 2. Meena Kafaltiya, Hema Lohani, S. Zafar Haider, Nirpendra Chauhan, Tripti Malik, Neeta Joshi & Shailja Pant, Phenological Stage Specific Variations in Chemical Compo-sition, Antioxidant and Antimicrobial Properties of the Essential Oils of Aerial Parts of *Monarda didyma* L. Cultivated Under Doon Valley Climatic Conditions of Uttarakhand, India, Journal of Essential Oil Bearing Plants, 2022, 25:5, 1042-1053, DOI: 10.1080/0972060X.2022.2152738
Research Articles attached.	

Journal of Essential Oil Bearing Plants

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Article

Phenological Stage Specific Variations in Chemical Composition, Antioxidant and Antimicrobial Properties of the Essential Oils of Aerial Parts of *Monarda didyma* L. Cultivated Under Doon Valley Climatic Conditions of Uttarakhand, India

Meena Kafaltiya [1]*, Hema Lohani [2], S. Zafar Haider [2], Nirpendra Chauhan [2], Tripti Malik [3], Neeta Joshi [4], Shailja Pant [3]

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[2] Centre for Aromatic Plants (CAP), Industrial Estate, Selaqui-248011, Dehradun, Uttarakhand, India

[3] Department of Microbiology, Dolphin P.G. Institute of Biomedical & Natural Sciences, Dehradun, Uttarakhand, India

[4] Department of Chemistry, Pandit Lalit Mohan Sharma PG College, Shri Dev Suman University Rishikesh, Dehradun, Uttarakhand, India

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Received 08 June 2022; Received in revised form 16 November 2022; Accepted 19 November 2022

Abstract: This study aims to evaluate the variations in yield of essential oil, chemical constituents, antimicrobial and antioxidant potential of *Monarda didyma* L. (aerial parts) at three different phenophases, namely vegetative stage, full blooming and maturity (seed setting) stages. The essential oil content ranged from 0.62-0.75% in whole aerial parts, with the highest yield in the full flowering (0.75 ± 0.042%), followed by pre flowering (0.70 ± 0.033%) and seed setting (0.62 ± 0.052%) stages. Linalool was found as the major compound followed by γ-terpinene, thymol methyl ether, p-cymene and thymol in the oils during different phenophases of plant. Linalool was maximum in vegetative (pre flowering) stage (60.15 ± 1.56%) as compared to full blooming (44.32 ± 2.55%) and seed setting (46.49 ± 1.63%) stages respectively. γ-Terpinene, the second major constituent was found to be maximum in full blooming stage (21.06 ± 3.06%) as compared to the other stages, and showed cogent variations in percent composition of γ-terpinene during different phenological stages. In thymol methyl ether content, significant variation was observed during all three phenophases of plant. The antioxidant (DPPH assay) activity showed that *M. didyma* oil has maximum activity at seed setting stage. The maximum antimicrobial activities in oil was active at vegetative phase of plant against bacteria and yeast *i.e.*, *Bacillus* sp., *E. coli, L. monocytogens, P. aeruginosa, S. aureus, C. albicans* and revealed favourable values of MIC (0.5% to1% v/v) and MBC/MFC (0.5 to 2% v/v) against bacterial and yeast cultures.

Keywords: *Monarda didyma* L., essential oil, phenological stages, linalool, γ-terpinene, thymol, antimicrobial, antioxidant.

DOI: 1080/0972060X.2022.2152738

Journal of Essential Oil Bearing Plants

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Article

Chemical Composition, Antioxidant and Antimicrobial Potential of the Essential Oils from Aerial Parts of *Tagetes patula* L. at Different Phenological Stages

Meena Kafaltiya [1]*, Hema Lohani [2], Ujjwal Bhandari [2], S. Zafar Haider [2], Nirpendra Chauhan [2], Tripti Malik Ahuja [3], Shailja Pant [3] and Neeta Joshi [4]

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Received 15 February 2022; Received in revised form 24 May 2022; Accepted 27 May 2022

Abstract: The current study aims at determining the variability in composition, antibacterial and antioxidant properties of the essential oils extracted from aerial parts of *Tagetes patula* at different phenological stages of plant growth i.e., the vegetative, full blooming and seed setting stages. The maximum average yield of hydrodistilled essential oils was obtained as 0.083 ± 0.003% (seed setting), 0.068±0.007% (full flowering) and 0.059±0.005% (pre flowering). (*Z*)-*β*-ocimene was found to be most abundant compound of essential oil of *T. patula*, and *α*-terpinolene, piperitenone, limonene and propanedinitrile, dicyclohexyl were found as major compounds in oil extracted at different phenological stages of plant. Contribution of (*Z*)-*β*-Ocimene was highest in full flowering stage (18.27±3.14%) as compared to other two stages where its amount ranged from 12.03-17.17 %. α-Terpinolene the second major component was found highest in the pre-flowering stage (13.86±1.15 %) compared to other stages. Significant variation was observed in the percent content of piperitenone during all three phenological stages The antioxidant (DPPH radical scavenging) assay showed that *T. patula* oils have maximum activity at the pre-flowering stage. Antibacterial activities of the essential oils were observed at the pre-flowering stage against different bacteria; i.e., *Bacillus* sp., *Escherichia coli, Listeria monocytogenes, Pseudomonas aeruginosa, Staphylococcus aureus* and exhibited promising values of MIC (0.125 % v/v -0.5 % v/v) and MBC (0.25 v/v to 1% v/v) against bacterial cultures.

Keywords: *Tagetes patula* L., Essential oil, Phenological stages, (*Z*)-*β*-Ocimene, Antibacterial, Antioxidant.

Introduction

Tagetes patula L. (Asteraceae), commonly known as 'French Marigold' or 'Genda' is a well-known member of genus *Tagetes* [1]. In India, major states growing genus *Tagetes* are Maharashtra, Karnataka, Gujarat, Haryana, Uttar Pradesh, Jammu and Kashmir, Andhra Pradesh, Chhattisgarh, Puducherry, Andaman Nicobar, Arunachal Pradesh, West Bengal, and Tamil Nadu [2]. The plant is herbaceous, branched, glabrous,

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Event Report	
Title	Activity under MOU (Centre for Aromatic Plants (CAP), Dehradun)
Name of the Activity	Visit to Centre for Aromatic Plants (CAP), Dehradun
Date	23.05.2022
Venue	Centre for Aromatic Plants (CAP), Dehradun
Organized By	Department of Microbiology
Resource Person	-
No. of Participants	09
Course Objective	Awaking students regarding medicinal and aromatic plants cultivation in the experimental farms.
Course Outcome	Students were demonstrated the techniques of steam distillation and essential oil extraction, the field Distillation Units (FDUs)

Photographs

Group photograph of Students participating in the visit to Centre for Aromatic Plants (CAP), Dehradun on 23 May 2022

HOD/Event Coordinator

Head of Institution

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Event Report

Title	Educational Trip to Centre of Aromatic Plants
Name of the Activity	Educational Trip
Date	30-12-2022
Venue	Centre of Aromatic Plants
Organized By	Department of Agriculture
Resource Person	-
No. of Participants	30 Students 04 Faculties
Course Objective	This educational trip was designed to give our students a chance to make familiar with cultivation techniques for different aromatic plants, viz. Lemon grass, Palmarosa, Damask rose, Geranium, Citronella, Bach and Juhi, etc
Course Outcome	The students had the chance to learn about the distillation and oil extraction techniques from Aromatic Plants. No product is useful without efficient and effective marketing strategies. Marketing techniques with future prospects of products were explained in detail.

Photographs

One Day workshop on Intellectual Property Right-an Overview

EVENT COORDINATOR: **HEAD OF DEPARTMENT:**