3.5.1 Number of Collaborative activities for Research, Faculty exchange, Student exchange/ internship during the year 2021-22

Sl. No.	Title of the collaborative activity	Name of the collaborating agency with contact details	Name of the participant	Year of collaboration	Duration	Nature of the activity
1	Internship	Padmashri Dr. Vitthalrao Vikhe Patil Sahakari Sakhar Karkhana Limited, Pravaranagar	Lodha Sanshi Santosh	2022	11/03/2022to 26/03/22	Training Programme
			Gawade Jaysrhi Vittal	2022	11/03/2022to 26/03/22	Training Programme
			Nimase Shital Bandu	2022	11/03/2022to 26/03/22	Training Programme
			Wani Tejas Prakash	2022	11/03/2022to 26/03/22	Training Programme
			Dhepe Mahesh Suresh	2022	11/03/2022to 26/03/22	Training Programme
			Harde Mahesh Rajendra	2022	11/03/2022to 26/03/22	Training Programme
			Gavhane Mahesh Sanjay	2022	11/03/2022to 26/03/22	Training Programme
			Wabale Shrikant V	2022	11/03/2022to 26/03/22	Training Programme
2	Internship	Pravara Sahakari Bank Loni	Nalkar Rutuja Nanasaheb	2022	17/05/22 to 21/05/22	Training Programme
			Anap Gayatri Sanjay	2022	11/04/2022 to 02/05/2022	Training Programme
			Pawar Rohini Bhimraj	2022	18/05/22 to 28/05/22	Training Programme
3	Research	Arts, Science and Commerce College Rahata, Dist.- Ahmednagar	Dr. Vijay A. Kadnor	2019	20/09/2019 to 20/09/2024	Research Publication

Principal
Arts, Commerce and Science College,Satral
Tal- Rahuri, Dist- Ahmednagar- 413711

Department of Commerce

Collaborative Internship Activity - 2021-22

Collaborative activity	Name of Institute	No of Participant	Remark
Internship	Padmashri Dr Vittalrao Vikhe Patil Sahkari Sakhar Karkhana Ltd. Pravaranagar.	8	Successfully Competed

List of Student List

(3 Girls 5 Boys)

Sr.No	Name of the participant	Year of collaboration	Duration (From-To)	Nature of the activity
1.	Lodha Sanshi Santosh	2021-22	11/03/2022to 26/03/22	Internship
2.	Gawade Jaysrhi Vittal	2021-22	11/03/2022to 26/03/22	Internship
3.	Nimase Shital Bandu	2021-22	11/03/2022to 26/03/22	Internship
4.	Wani Tejas Prakash	2021-22	11/03/2022to 26/03/22	Internship
5.	Dhepe Mahesh Suresh	2021-22	11/03/2022to 26/03/22	Internship
6.	Harde Mahesh Rajendra	2021-22	11/03/2022to 26/03/22	Internship
7.	Gavhane Mahesh Sanjay	2021-22	11/03/2022to 26/03/22	Internship
8.	Wabale Shrikant V	2021-22	11/03/2022to 26/03/22	Internship

HOD
H.O.D.
Department of Commerce
Arts,Commerce & Science College,Satral

Principal
Principal
Arts, Commerce and Science College,Satral
Tal- Rahuri. Dist- Ahmednagar- 413711

Registration No. G-254, date 31-12-48
TAN No. PNEP 09169 G
PAN No. AAAAP0848 A
VAT No. 27140410666 V/C
GSTIN No. 27AAAAP0848A1ZZ

Padmashri Dr. Vitthalrao Vikhe Patil Sahakari Sakhar Karkhana Limited

Post Office : Pravaranagar - 413712
Tal. Rahata, Dist. Ahmednagar.
Maharashtra State (India)

Phone : 252301 to 252304 - P'nagar
Fax : (02422) 253397 - P'nagar
E-mail : pravarasugar@rediffmail.com

HR/21-22/ 06

Date:-01/04/2022

CERTIFICATE

This is to certify that, **Lodha Sakshi Santosh.** had successfully completed inplant training in our karkhana during the period 11/03/2022 to 26/03/2022.

She has completed In Plant training in Marketing & Management on our karkhana. Her performance during the training period has been good.

This certificate is being issued to him as per her own request.

MANAGER H R

INTERNSHIP COMPLETION CERTIFICATE

To,

The Principal,

Arts, Commerce & Sci. College,

Satral, PIN-413711

Subject: Internship Completion Certificate .....

Dear Madam/ Sir,

I am happy to inform you that following students of your college have successfully Completed the 'Sixty Hours Internship Programme' in this organisation.

Sr. No.	Name of the student	Roll No.	Aadhar No.	Special Subject
1.	Gowade Jayashri Vitthal		508755169432	Marketing
2.				
3.				
4.				
5.				
6.				
7.				
8.				

These students have been provided with adequate exposure and necessary hands- on training pertaining to their special subject.

I am confident that these students will perform effectively in similar type of organisations.

I wish them every success in future endeavors.

Thank you.

Sincerely,

Name & Signature

(Authorised Signatory)

Padmashri Dr. Vitthalrao Vikhe Patil Sah. Sakhar Karkhana Ltd. Pravaranagar Reg.No. 254 Dt.31/12/48

Registration No. G-254, date 31-12-48
TAN No. PNEP 09169 G
PAN No. AAAAP0848 A
VAT No. 27140410666 V/C
GSTIN No. 27AAAAP0848A1ZZ

Padmashri Dr. Vitthalrao Vikhe Patil Sahakari Sakhar Karkhana Limited

Post Office : Pravaranagar - 413712
Tal. Rahata, Dist. Ahmednagar.
Maharashtra State (India)

Phone : 252301 to 252304 - P'nagar
Fax : (02422) 253397 - P'nagar
E-mail : pravarasugar@rediffmail.com

HR/21-22/ 07

Date:-01/04/2022

CERTIFICATE

This is to certify that, **Nimase Shital Bandu.** had successfully completed inplant training in our karkhana during the period 11/03/2022 to 26/03/2022.

She has completed In Plant training in Marketing & Management on our karkhana. Her performance during the training period has been good.

This certificate is being issued to him as per her own request.

MANAGER H R

Registration No. [illegible]-254, date 31-12-48
TAN No. PNEP 09169 G
PAN No. AAAAP0848 A
VAT No. 27140410666 V/C
GSTIN No. 27AAAAP0848A1ZZ

Padmashri Dr. Vitthalrao Vikhe Patil Sahakari Sakhar Karkhana Limited

Post Office : Pravaranagar - 413712
Tal. Rahata, Dist. Ahmednagar.
Maharashtra State (India)

Phone : 252301 to 252304 - P'nagar
Fax : (02422) 253397 - P'nagar
E-mail : pravarasugar@rediffmail.com

HR/21-22/ 10

Date:-01/04/2022

INTERNSHIP COMPLETION CERTIFICATE

To,

The Principal,

Arts, Commerce & Sci. College,

Satral, PIN-413711

Subject: Internship Completion Certificate .....

Dear Madam/ Sir,

I am happy to inform you that following students of your college have successfully Completed the 'Sixty Hours Internship Programme' in this organisation.

Sr. No.	Name of the student	Roll No.	Aadhar No.	Special Subject
1.	Dhepe Mahesh Suresh	09	372657414065	Business Administration
2.	Harde Mahesh Rajendra	20	680061187650	Business Administration
3.	Wabale Shrikant Vishwanath	60	348015521927	Business Administration
4.	Wani Tejas Prakash	66	898080927613	Marketing & Management
5.	Londhe Tanvi Haribhau	30	917830994577	Marketing & Management
6.	Lodha Sakshi Santosh	28	833419543422	Marketing & Management
7.	Gawade Jayashri Vitthal	16	508755149432	Marketing & Management
8.	Nimse Shital Bandu	41	599084680764	Marketing & Management

These students have been provided with adequate exposure and necessary hands- on training pertaining to their special subject.

I am confident that these students will perform effectively in similar type of organisations.

I wish them every success in future endeavors.

Thank you.

Sincerely,

Name & Signature

(Authorised ignator

Registration No. G-254, date 31-12-48
TAN No. PNEP 09169 G
PAN No. AAAAP0848 A
VAT No. 27140410666 V/C
GSTIN No. 27AAAAP0848A1ZZ

Padmashri Dr. Vitthalrao Vikhe Patil Sahakari Sakhar Karkhana Limited

Post Office : Pravaranagar - 413712
Tal. Rahata, Dist. Ahmednagar.
Maharashtra State (India)

Phone : 252301 to 252304 - P'nagar
Fax : (02422) 253397 - P'nagar
E-mail : pravarasugar@rediffmail.com

HR/21-22/ 10

Date:-01/04/2022

CERTIFICATE

This is to certify that, **Dhepe Mahesh Suresh.** had successfully completed inplant training in our karkhana during the period 11/03/2022 to 26/03/2022.

He has completed In Plant training in Business Administration on our karkhana. His performance during the training period has been good.

This certificate is being issued to him as per his own request.

MANAGER H R

Registration No. G-254, date 31-12-48
TAN No. PNEP 04169 G
PAN No. AAAAP0848 A
VAT No. 27140410666 V/C
GSTIN No. 27AAAAP0848A1ZZ

Padmashri Dr. Vitthalrao Vikhe Patil Sahakari Sakhar Karkhana Limited

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Tal. Rahata, Dist. Ahmednagar.
Maharashtra State (India)

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Fax : (02422) 253397 - P'nagar
E-mail : pravarasugar@rediffmail.com

HR/21-22/ 11

Date:-01/04/2022

CERTIFICATE

This is to certify that, **Harde Mahesh Rajendra.** had successfully completed inplant training in our karkhana during the period 11/03/2022 to 26/03/2022.

He has completed In Plant training in Business Administration on our karkhana. His performance during the training period has been good.

This certificate is being issued to him as per his own request.

MANAGER H R

Registration No. G-254, date 31-12-48
TAN No. PNEP 09169 G
PAN No. AAAAP0848 A
VAT No. 27140410666 V/C
GSTIN No. 27AAAAP0848A1ZZ

Padmashri Dr. Vitthalrao Vikhe Patil Sahakari Sakhar Karkhana Limited

Post Office : Pravaranagar - 413712
Tal. Rahata, Dist. Ahmednagar.
Maharashtra State (India)

Phone : 252301 to 252304 - P'nagar
Fax : (02422) 253397 - P'nagar
E-mail : pravarasugar@rediffmail.com

HR/21-22/ 12

Date:-01/04/2022

CERTIFICATE

This is to certify that, **Gavhane Mahesh Sanjay.** had successfully completed inplant training in our karkhana during the period 11/03/2022 to 26/03/2022.

He has completed In Plant training in Business Administration on our karkhana. His performance during the training period has been good.

This certificate is being issued to him as per his own request.

MANAGER H R

Registration No. G-254, date 31-12-48
TAN No. PNEP 09169 G
PAN No. AAAAP0848 A
VAT No. 27140410666 V/C
GSTIN No. 27AAAAP0848A1ZZ

Padmashri Dr. Vitthalrao Vikhe Patil Sahakari Sakhar Karkhana Limited

Post Office : Pravaranagar - 413712
Tal. Rahata, Dist. Ahmednagar.
Maharashtra State (India)

Phone : 252301 to 252304 - P'nagar
Fax : (02422) 253397 - P'nagar
E-mail : pravarasugar@rediffmail.com

To,

The Principal,

Arts, Commerce & Sci. College,

Satral, PIN-413711

Subject: Internship Completion Certificate .....

Dear Madam/ Sir,

I am happy to inform you that following students of your college have successfully Completed the 'Sixty Hours Internship Programme' in this organisation.

Sr. No.	Name of the student	Roll No.	Aadhar No.	Special Subject
1.	Wabale Shikant Vishwanath	60	348015521927	B. Administration

These students have been provided with adequate exposure and necessary hands- on training pertaining to their special subject.

I am confident that these students will perform effectively in similar type of organisations.

I wish them every success in future endeavors.

Thank you.

Sincerely,

Name&Signature

(AuthorisedSignatory)

Padmashri Dr. Vitthalrao Vikhe Patil S. S. K. Ltd. • R.No G/254 Dt. 31/12/1948 Pravaranagar • Tal. Rahata

रजि.नं. : जी.२५४, ता.३१/१२/४८ पॅन नं. : एएएपी ०८४८ ए व्हॅट टिन नंबर : २७१४०४१०६६६ व्ही
ईसीसी नं. : एएएपी ०८४८ एएक्सएम ००१ टॅन नं. : पीएनईपी ०९१६९ जी सीएसटी टिन नंबर : २७१४०४१०६६६ सी

पद्मश्री डॉ. विठ्ठलराव विखे पाटील सहकारी साखर कारखाना लिमिटेड

मु.पो.प्रवरानगर - ४१३ ७१२
ता.राहाता, जि. अहमदनगर
महाराष्ट्र राज्य (भारत)
रेल्वे स्टेशन - बेलापूर (एन.)

दुरध्वनी : २५२३०१ ते २५२३०४ प्रवरानगर
फॅक्स : (०२४२२) २५३३९७ - प्रवरानगर
E-mail : pracarasugar@rediffmail.com
pravarasugar@yahoo.com

GSTNo.:27AAAAP0848A1ZZ
PAN No.:AAAAP0848A

0.W.No/593/ 22/06/2020

MEMORANDUM OF UNDERSTANDING

BETWEEN THE TWO INSTITUTIONS:-

1. *THEPRINCIPAL,ARTS, COMMERCE AND SCIENCE COLLEGE, SATRAL, TAL- RAHURI, DIST- AHMEDNAGAR-413711.*

AND

2. *PADMASHRI DR.VITTALRAO VIKHE PATIL SAHAKARI SAKHARI KARKHANA LIMITED.*
TAL: RAHATA DIST : AHMEDNAGAR MAHARASHTRA STATE (INDIA)
PIN CODE : 413712

WITNESSETH THAT:

WHEREAS, DEPARTMENT OF COMMERCEofARTS, COMMERCE AND SCIENCE COLLEGE, SATRAL, TAL- RAHURI, DIST- AHMEDNAGAR-413711 and*PADMASHRI DR.VITTALRAO VIKHE PATIL SAHAKARI SAKHARI KARKHANA LIMITED. TAL: RAHATA DIST : AHMEDNAGAR MAHARASHTRA STATE (INDIA)*
PIN CODE : 413712 desire to promote the enrichment of their teaching and learning, research and discovery and engagement missions; and

WHEREAS, DEPARTMENT OF COMMERCE ofARTS, COMMERCE AND SCIENCE COLLEGE, SATRAL, TAL- RAHURI, DIST- AHMEDNAGAR-413711 and*PADMASHRI DR.VITTALRAO VIKHE PATIL SAHAKARI SAKHARI KARKHANA LIMITED. TAL: RAHATA DIST : AHMEDNAGAR MAHARASHTRA STATE (INDIA)*
PIN CODE : 413712 desire to strengthen and expand the mutual contacts between the two organizations; and

WHEREAS, DEPARTMENT OF COMMERCE ofARTS, COMMERCE AND SCIENCE COLLEGE, SATRAL, TAL- RAHURI, DIST- AHMEDNAGAR-413711 and*PADMASHRI DR.VITTALRAO VIKHE PATIL SAHAKARI SAKHARI KARKHANA LIMITED. TAL: RAHATA DIST : AHMEDNAGAR MAHARASHTRA STATE (INDIA)*

PIN CODE : 413712 desire to provide for a vibrant collaboration between the two organizations on the terms and conditions hereinafter set forth;

NOW THEREFORE, it is mutually agreed as follows:

I. **Scope of Agreement -** The Agreement, shall include, but not be limited to, the following types of collaboration:

A. Seek mutual advice and support in planning and executing programs promoting excellence in respective areas of research and education.

B. Assist in Student, Teacher training regarding Sericulture, Horticulture, Soil and water analysis.

C. Placement assistance.

D. Collaborative Research and Discovery, Learning and Teaching, and Engagement.

E. Encourage the faculty members and scientist of either institute to attend lectures, seminars, workshops and conferences in the respective areas of interest.

F. Share the library and scientific literature facilities mutually by giving access to library and other resources of either institute to the scientist/students/research personnel of other institute.

G. Other mutually agreed educational programs.

II. **Definitions** – As used herein the terms "host organization" and "home organization" shall have the following meanings

A. Host organization – the organization accepting the faculty member/scientist or student.

B. Home organization – the organization providing the faculty member/scientist or student.

Period of Agreement – This MOU shall remain in force for Five years from the date of the last signature. Prior to the expiration date, this agreement may be reviewed for possible renewal for a further Five-year period. Either party may terminate this MOU by providing 60 days advance written notice to the other party.

III. In this case. Personnel already participating in the exchange shall serve out their terms under the conditions specified at the time of their appointment.

IV. **Activities Under This Agreement** – It isexpected that activities taking place under this agreement will be initiated primarily in coordination with their respective administrative units concerned with such activities. All activities undertaken must conform to the policies and procedures in place at each institution.

V. **Planning and Management of Activities** – Each distinct collaboration program or activity will be described in separate Activity Agreement drawn up jointly by the collaborating units, and signed by the heads of these units. Such agreements will

specify the names of those individuals on each institution responsible for the implementation of the program.

VI. Funding of Activities - Activity Agreement's should make financial costs and obligations explicit. Collaborating units are encouraged to work together to identify and secure any outside funding which may be needed. Projects requiring funding must be approved by both institutions.

VII. Limitation and Warranties:

- Each party shall ensure that the other is not put to any liability for any act of the respective party under this MoU.
- Each party represents that they have full power and authority to enter into this MOU in general.

VIII Commercials:

The training, field visit shall be conducted at the host facility in a time bound manner as per availability and schedule at host facility.

IX General:

- Both the parties may receive information proprietary to other party (the "Confidential Information") in the course of performance of their obligations under this MOU. Confidential Information is not meant to include any information which (a) is publicly available (b) is rightfully received by the parties from third parties without accompanying secrecy obligations; (c) is already in either party's possession and was lawfully received from sources other than the parties or (d) is independently developed by the parties. The two bodies understand and acknowledge that the Confidential Information is valuable and confidential and agrees that it will at all times be kept in trust, to be disclosed only to such persons as have a "need to know" the same for the effective implementation of this MOU and that it will only be used by the parties for the benefit of others.
- Both the parties understand and agrees that all written or other tangible data and documentation developed or procured by the other party in performing its obligations under this MOU, whether in printed or electronic form, belongs to other party and that other party will have all rights, title and interest therein.
- Both parties shall not use the name and brand of the other party in any advertisement or make any public announcement without the prior written approval of the other.
- Any and all disputes or differences arising out of or in connection with this MoU or its performance shall, so far as it is possible, be settled by negotiations between the Parties amicably through consultation & understanding.

X. **Indemnification:**

Both the parties shall indemnify and hold each other harmless from and against any claim, loss, liability, or expense, including, but not limited to, damages, patent and trademark infringement, costs and attorneys' fees, arising out of or in connection with any acts or omissions of their agents or employees.

NON-DISCRIMINATION – WHEREAS, DEPARTMENT OF COMMERCE of ARTS, COMMERCE AND SCIENCE COLLEGE, SATRAL, TAL- RAHURI, DIST- AHMEDNAGAR-413711 and, agree that no person shall on the grounds of race, color, national origin, gender, sexual orientation, or creed be excluded from participation under the terms of this Agreement.

XII **Modification** – The terms of this Agreement may be changed or modified only by written amendment signed by authorized agents of the parties hereto.

IN WITNESS THEREOF, WHEREAS, DEPARTMENT OF COMMERCE of ARTS, COMMERCE AND SCIENCE COLLEGE, SATRAL, TAL- RAHURI, DIST- AHMEDNAGAR-413711 and*PADMASHRI DR.VITTALRAO VIKHE PATIL SAHAKARI SAKHARI KARKHANA LIMITED. TAL: RAHATA DIST : AHMEDNAGAR MAHARASHTRA STATE (INDIA) PIN CODE : 413712* have executed this Agreement as of the date first above written.

FOR, PRAVARA RURAL EDUCATION SOCIETY'S ARTS, COMMERCE AND SCIENCE COLLEGE, SATRAL, TAL-RAHURI, DIST- AHMEDNAGAR-413711

AUTHORIZED SIGNATORY NAME:

PRIN. SINGAR JAYSHREE R.

DESIGNATION: PRINCIPAL

I/C PRINCIPAL
Art,Commerce & Science Collage
Satral,Tal. Rahuri, Dist. A'Nagar

Date: 15/06/2020

Arts Commerce & Science College Satral Tal.Rahuri Dist A'Nagar

FOR, KRISHI VIGYAN KENDRA, BABHALESHWAR, TAL: RAHATA,DIST:AHMEDNAGAR, PIN-413737

AUTHORIZED SIGNATORY NAME: Mr. Dhone. P. R.

DESIGNATION: MANAGING DIRECTOR
Padmashri Dr. Vitthalrao Vikhe Patil
Sah. Sakhar Karkhana Ltd; Pravaranagar

Date: 22/06/2020

Department of Commerce

Collaborative Internship Activity - 2021-22

Collaborative activity	Name of Institute	No of Participant	Remark
Internship	Pravara Sahkari Bank Ltd Songaon Tal : Rahuri Dist : Ahmednagar	3	Successfully Competed

Student List

(Boys :- 1 Girls – 2)

Sr.No	Name of the participant	Year of collaboration	Duration (From-To)	Nature of the activity
1	Nalkar Rutuja Nanasaheb	2021-22	17/05/22 to 21/05/22	Internship
2	Anap Gayatri Sanjay	2021-22	11/04/22 to 02/05/22	Internship
3	Pawar Rohini Bhimraj	2021-22	18/05/22 to 28/05/22	Internship

HOD
H.O.D.
Department of Commerce
Arts,Commerce & Science College,Satral.

Arts, Commerce & Science College ACSC SATRAL Tal. Rahuri, Dist. Ahmednagar

Principal
Arts, Commerce and Science College,Satral
Tal- Rahuri, Dist- Ahmednagar- 413711

PRAVARA SAHAKARI BANK LTD.
(SCHEDULED BANK)

प्रवरा बँक
EST.1974
REG.NO.132

H. O. LONI : 413736, TAL. : RAHATA, DIST. : AHMEDNAGAR. (MAH.)
TEL. : (02422) 273450, 273471, 273516-17-18, 273715-16 FAX : (02422) 273715
E-Mail:psb_ho@rediffmail.com

Sangam Branch

HR/21-22/

Date :- 25 MAY 2022 /2022

CERTIFICATE

This is to certify that, Nalkar Rutuja Nanasaheb had successfully completed Banking training in our Bank during the period 17-05-2022 to 21-05-2022.

She has completed Banking training in Marketing Managment on our Bank. Her performance during the training period has been good.

This certificate is being issued to him as per her own request.

MANAGER H. R.

प्रवरा सहकारी बँक लिमिटेड

प्रवरा बँक
EST.1974
REG.NO.132

PRAVARA SAHAKARI BANK LTD.
(SCHEDULED BANK)

H. O. LONI : 413736, TAL. : RAHATA, DIST. : AHMEDNAGAR. (MAH.)
TEL. : (02422) 273450, 273471, 273516-17-18, 273715-16 FAX : (02422) 273715
E-Mail:psb_ho@rediffmail.com

PRAVARA SAHAKARI Sayane Branch

HR/21-22/

25 MAY 2022
Date :- / /2022

CERTIFICATE

This is to certify that, **Anap Gayatri Sayaji** had successfully completed Banking training in our Bank during the period 11-04-2022 to 02-05-2022.

She has completed Banking training in Business Administration on our Bank. Her performance during the training period has been good.

This certificate is being issued to him as per her own request.

MANAGER H. R.
प्रवरा सहकारी बँक लिमिटेड
बाबाधिकारी
लोणी ता. राहाता

प्रवरा सहकारी बँक लि. (शेड्युल्ड बँक)
PRAVARA SAHAKARI BANK LTD. (SCHEDULED BANK) Songaon, Branch

A/P-Songaon, Tal- Rahuri, Dist-Ahmednagar, PIN-413711

Internship Certificate

This is Certify that,

Miss. Mohini Bhimraj Pawar has been Successfully Completed Internship in our Pravara Sahakari Bank, Songaon Branch, Account and Cash Department he was completed 60 Hour internship in our Computer Department from 18/05/2022 and completed it on 28/05/2022.

प्रवरा सहकारी बँक लिमिटेड
शाखाधिकारी
सोनगाव शाखा

Authorize Signature & Stamp

Pravara Sahakari Bank Ltd.
Songaon Br.

प्रवरा बँक
EST.1974
REG.NO.132

PRAVARA SAHAKARI BANK LTD.
(SCHEDULED BANK)

H. O. LONI : 413736, TAL : RAHATA, DIST. : AHMEDNAGAR. (MAH.)
TEL. : (02422) 273450, 273471, 273516-17-18, 273715-16 FAX : (02422) 273715
E-Mail:psb_ho@rediffmail.com

Ref.No. 43/6 HRD/2020-21/ Date : 22/06/2020

MEMORANDUM OF UNDERSTANDING

BETWEEN THE TWO INSTITUTIONS:-

1. *THEPRINCIPAL,*
   ARTS, COMMERCE AND SCIENCE COLLEGE, SATRAL,
   TAL- RAHURI, DIST- AHMEDNAGAR-413711.

AND

2. *PRAVARA SAHAKARI BANK LTD. (SCHEDULED), LONI, TAL.RAHATA,*
   DIST.AHMEDNAGAR, MAHARASHTRA (INDIA), PIN CODE : 413736
   TAL: RAHATA DIST : AHMEDNAGAR MAHARASHTRA STATE (INDIA)
   PIN CODE : 413712

WITNESSETH THAT:

WHEREAS, DEPARTMENT OF COMMERCE of**ARTS, COMMERCE AND SCIENCE COLLEGE, SATRAL, TAL- RAHURI, DIST- AHMEDNAGAR-413711** and***PRAVARA SAHAKARI BANK LTD. (SCHEDULED), LONI, TAL.RAHATA, DIST.AHMEDNAGAR, MAHARASHTRA (INDIA), PIN CODE : 413736***desire to promote the enrichment of their teaching and learning, research and discovery and engagement missions; and

WHEREAS, DEPARTMENT OF COMMERCE, of**ARTS, COMMERCE AND SCIENCE COLLEGE, SATRAL, TAL- RAHURI, DIST- AHMEDNAGAR-413711** and***PRAVARA SAHAKARI BANK LTD. (SCHEDULED), LONI, TAL.RAHATA, DIST.AHMEDNAGAR, MAHARASHTRA (INDIA), PIN CODE : 413736***desire to strengthen and expand the mutual contacts between the two organizations; and

WHEREAS, DEPARTMENT OF COMMERCE of **ARTS, COMMERCE AND SCIENCE COLLEGE, SATRAL, TAL- RAHURI, DIST- AHMEDNAGAR-413711** and***PRAVARA SAHAKARI BANK LTD. (SCHEDULED), LONI, TAL.RAHATA, DIST.AHMEDNAGAR, MAHARASHTRA (INDIA), PIN CODE : 413736***desire to provide for a vibrant collaboration between the two organizations on the terms and conditions hereinafter set forth;

NOW THEREFORE, it is mutually agreed as follows:

I. **Scope of Agreement -** The Agreement, shall include, but not be limited to, the following types of collaboration:
   A. Seek mutual advice and support in planning and executing programs promoting excellence in respective areas of research and education.
   B. Assist in Student, Teacher training regarding Sericulture, Horticulture, Soil and water analysis.
   C. Placement assistance.

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E-Mail:psb_ho@rediffmail.com

D. Collaborative Research and Discovery, Learning and Teaching, and Engagement.
E. Encourage the faculty members and scientist of either institute to attend lectures, seminars, workshops and conferences in the respective areas of interest.
F. Share the library and scientific literature facilities mutually by giving access to library and other resources of either institute to the scientist/students/research personnel of other institute.
G. Other mutually agreed educational programs.

II. **Definitions** – As used herein the terms "host organization" and "home organization" shall have the following meanings

A. Host organization – the organization accepting the faculty member/scientist or student.
B. Home organization – the organization providing the faculty member/scientist or student.
Period of Agreement – This MOU shall remain in force for Five years from the date of the last signature. Prior to the expiration date, this agreement may be reviewed for possible renewal for a further Five-year period. Either party may terminate this MOU by providing 60 days advance written notice to the other party.

III. In this case. Personnel already participating in the exchange shall serve out their terms under the conditions specified at the time of their appointment.

IV. **Activities Under This Agreement** – It isexpected that activities taking place under this agreement will be initiated primarily in coordination with their respective administrative units concerned with such activities. All activities undertaken must conform to the policies and procedures in place at each institution.

V. **Planning and Management of Activities** – Each distinct collaboration program or activity will be described in separate Activity Agreement drawn up jointly by the collaborating units, and signed by the heads of these units. Such agreements will specify the names of those individuals on each institution responsible for the implementation of the program.

VI. **Funding of Activities** - Activity Agreement's should make financial costs and obligations explicit. Collaborating units are encouraged to work together to identify and secure any outside funding which may be needed. Projects requiring funding must be approved by both institutions.

VII. **Limitation and Warranties:**

- Each party shall ensure that the other is not put to any liability for any act of the respective party under this MoU.
- Each party represents that they have full power and authority to enter into this MOU in general.

VIII **Commercials:**

The training, field visit shall be conducted at the host facility in a time bound manner as per availability and schedule at host facility.

IX **General:**

- Both the parties may receive information proprietary to other party (the "Confidential Information") in the course of performance of their obligations under this MOU. Confidential Information is not meant to include any information which (a) is publicly available (b) is rightfully received by the parties from third parties without accompanying secrecy obligations; (c) is already in either party's possession and was lawfully received from sources other than the parties or (d) is independently developed by the parties. The two bodies understand and acknowledge that the Confidential Information is valuable and confidential and agrees that it will

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at all times be kept in trust, to be disclosed only to such persons as have a "need to know" the same for the effective implementation of this MOU and that it will only be used by the parties for the benefit of others.

- Both the parties understand and agrees that all written or other tangible data and documentation developed or procured by the other party in performing its obligations under this MOU, whether in printed or electronic form, belongs to other party and that other party will have all rights, title and interest therein.
- Both parties shall not use the name and brand of the other party in any advertisement or make any public announcement without the prior written approval of the other.
- Any and all disputes or differences arising out of or in connection with this MoU or its performance shall, so far as it is possible, be settled by negotiations between the Parties amicably through consultation & understanding.

X. **Indemnification:**
Both the parties shall indemnify and hold each other harmless from and against any claim, loss, liability, or expense, including, but not limited to, damages, patent and trademark infringement, costs and attorneys' fees, arising out of or in connection with any acts or omissions of their agents or employees.

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XI. **NON-DISCRIMINATION – WHEREAS, DEPARTMENT OF COMMERCE** OF **ARTS, COMMERCE AND SCIENCE COLLEGE, SATRAL, TAL- RAHURI, DIST-AHMEDNAGAR-413711** AND **PRAVARA SAHAKARI BANK LTD. (SCHEDULED), LONI, TAL.RAHATA, DIST.AHMEDNAGAR, MAHARASHTRA (INDIA), PIN CODE : 413736** agree that no person shall on the grounds of race, color, national origin, gender, sexual orientation, or creed be excluded from participation under the terms of this Agreement.

XII **Modification** – The terms of this Agreement may be changed or modified only by written amendment signed by authorized agents of the parties hereto.

IN WITNESS THEREOF, WHEREAS, DEPARTMENT OF COMMERCEof***PRAVARA SAHAKARI BANK LTD. (SCHEDULED), LONI, TAL.RAHATA, DIST.AHMEDNAGAR, MAHARASHTRA (INDIA), PIN CODE : 413736***have executed this Agreement as of the date first above written.

FOR, PRAVARA RURAL EDUCATION SOCIETY'S ARTS, COMMERCE AND SCIENCE COLLEGE, SATRAL, TAL- RAHURI, DIST-AHMEDNAGAR-413711

FOR, *PRAVARA SAHAKARI BANK LTD. (SCHEDULED), LONI, TAL.RAHATA, DIST.AHMEDNAGAR, MAHARASHTRA (INDIA), PIN CODE : 413736*

PRAVARA SAHAKARI BANK LTD.

(SCHEDULED BANK)

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TEL. : (02422) 273450, 273471, 273516-17-18, 273715-16 FAX : (02422) 273715
E-Mail:psb_ho@rediffmail.com

AUTHORIZED SIGNATORY NAME:

PRIN. SINGAR JAYSHREE R.

DESIGNATION: PRINCIPAL

I/C PRINCIPAL
Art,Commerce & Science Collage
Satral,Tal. Rahuri, Dist. A'Nagar

Art Commerce & Science College Satral Tal.Rahuri Dist.A'Nagar

Date: 22/06/2020

AUTHORIZED SIGNATORY NAME:

DESIGNATION: Deputy General Manager

Pravara Sahakari Bank Ltd. Loni H.O.

Date: 22/06/2020

भारतीय गैर न्यायिक

एक सौ रुपये Rs. 100

रु. 100 ONE HUNDRED RUPEES

सत्यमेव जयते

भारत INDIA

INDIA NON JUDICIAL

राष्ट्र MAHARASHTRA ◐ 2019 ◐ VT 119331

उपकोषागार कार्यालय, राहाता
पू. क्रमांक
18 SEP 2019
उपकोषागार अधिकारी, राहाता

MEMORANDUM OF UNDERSTANDING

Preamble:

The Arts, Science and Commerce College, Rahata affiliated to Savitribai Phule Pune University, Pune-7, covered under section **2** (f) and **12** (B) of the UGC Act, **1956** was established in 1997 with a vision of education for the upliftment of rural masses. The college lies in pleasant picturesque campus scattered over 21 acres with excellent state of art, pollution free environment, eco-friendly campus and outstanding infrastructural facilities. The NAAC has accredited the college with 'B++' grade. College is playing vital role in rural area and as a result, we have received the 'Best Rural College Award' from Savitribai Phule Pune University in the year 2013. The college is also honored with the 'Best College Award' in the academic year 2011-12 by Student Welfare Board of Savitribai Phule Pune University.

Arts, Commerce and Science College, Satral Tal-Rahuri Dist-Ahmedngar affiliated to Savitribai Phule Pune University, Pune-7, covered under section **2** (f) and **12** (B) of the UGC Act, **1956** was established in the year **1998.** At present the college is running undergraduate and post-graduate programmes in the three disciplines i.e., Arts, Science and Commerce. Recently the college was re-

जोडपत्र -२ / Annexure-11 बँक

खालील शिक्का प्रतिज्ञापत्रा व्यतिरिक्त वापरण्यात येणाऱ्या मुद्रांकावर उमटवावा.

दस्ताचा प्रकार / अनुच्छेद क्रमांक (Nature of document /Article No.)	खरेदीखत / साठेखत / गहाणखत
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दुसऱ्या पक्षकाराचे नांव (Name Of The Other Party)	-
हस्त असल्यास त्यांचे नाव व पत्ता (If Through other person then Name & Address)	शि PP
मुद्रांक शुल्क रक्कम (Stamp Duty Amount)	-
मुद्रांक विक्री नोंद वही अनुक्रमांक / दिनांक (Serial No. / Date)	20 SEP 2019
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परवानाधारक मुद्रांक विक्रेत्याची सही व परवाना क्रमांक तसेच मुद्रांक विक्रीचे ठिकाण / पत्ता	उगले STP/96/1राहाता जुने तहसिल कार्यालय

ज्या कारणासाठी ज्यांनी मुद्रांक खरेदी केला त्यांनी त्याच कारणासाठी मुद्रांक खरेदी केल्यापासून ६ महिन्यात वापरणे बंधनकारक आहे.

accredited with B++ rating and 2.8 CGPA from NAAC, the college received the Best College Award from the Savitribai Phule Pune University.

MoU is been signed between Shirdi Sai Rural Institute's Arts, Science and Commerce College Rahata, Dist. Ahmednagar (MS) and Arts, Commerce and Science College, Satral Tal-RahuriDist-Ahmedngarto explore, extend and strengthen the functional relationship between two institutes.

More specifically both the institutes agree to the following types of collaboration:

- Seek mutual advice and support in planning and executing programs promoting excellence in respective areas of research and education.
- Assist in Student, Teacher Training, and Student exchange, Faculty exchange programme.
- Placement assistance.
- Collaborative Research and Discovery, Teaching and Learning and Engagement.
- Encourage the faculty members and scholars of either institute to attend lectures, seminars, workshops and conferences in the respective areas of interest.
- Share the library and literature facilities mutually by giving access to library and other resources of either institute to scholars/students/research personnel of other institute.
- Other mutually agreed educational programs.

The two institutions will mutually decide upon the terms and conditions including financial support for the implementation of the above task.

We re-affirm our commitment and our willingness to make a consistent effort to ensure that it is implemented effectively and efficiently.

This MoU will be in force for five years from date of sign. After completion of five years, it may be extended after mutual concern of both the institution.

Signed on behalf of Arts, Science and Commerce College Rahata

for PRINCIPAL
Art's, Science & Commerce College
Rahata, Dist. Ahmednagar

Date- 22/09/2019

Signed on behalf of Arts, Commerce and Science College, Satral Tal-Rahuri Dist-Ahmednagar

I/C PRINCIPAL
Art,Commerce & Science College
Satral,Tal.Rahuri,Dist.Ahmednagar.

Date- 22/09/2019

Arts, Commerce & Science College ACSC SATRAL Tal. Rahuri, Dist. Ahmednagar

Arts, Science & Commerce College RAHATA Tal. Rahata

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PUMICE@SO_3H CATALYZED ULTRASOUND MEDIATED SYNTHESIS OF POLYHYDROQUINOLINE DERIVATIVES.

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[b]*Department of Chemistry , A. C. S. College, Satral, Ahmednagar, MS-413711, India.*
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Abstract:
A sustainable and convenient protocol is developed for the synthesis of polyhydroquinoline derivatives under ultrasound irradiation at 45°C in the presence of pumice anchored sulfonic acid (Pumice@SO_3H) as a recoverable catalyst. These polyhydroquinolines were synthesized from aldehydes, dimedone, ethylacetoacetate and ammonium acetate by Hantzsch reaction. The attractive features of the present protocol are green approach, good yield, recovery of catalyst, easy work-up procedure and simple purification of product whereas the catalyst offers simple preparation, high catalytic activity, inexpensive, easy to use, recyclability and stability.

Keywords:
Pumice@SO_3H, polyhydroquinolines, ultrasound irradiation, dimedone, etc.

Introduction:

Pumice stone obtained due to volcanic eruptions has many advantages such as abundance, availability, large surface area, low cost, non-homogeneous nature, and excellent stability. Also due to the remarkable properties such as high porosity and high adsorption capacities have gained much interest in the field of catalysis. In recent years, the volcanic pumice converted into variety of supported active catalytic materials such as pumice@SO_3H[i, ii], Pd–Ag catalysts supported on pumice[iii], Pumice-modified cellulose fiber[iv], Volcanic based hybrid nanocomposite[v], Pumice supported Pd catalyst[vi], Immobilization of TiO_2 on pumice stone[vii], iron-coated pumice[viii, ix], pumice-supported Pd–Cu catalysts[x], etc.

Multi-component reactions (MCRs) are a constructive approach to synthesize heterocyclic compounds with diverse structures. In MCRs, more than two components reacts together in single step to produce a targeted heterocyclic system without isolation of any intermediate. Due to this, requires short time, reduce energy requirement, reduce quantity of precursors, and are useful to increase atom economy. The Hantzsch reaction is one of the most important examples of multicomponent reaction which is used for synthesis of polyhydroquinoline derivatives[xi, xii]. The polyhydroquinoline derivatives is of great attention due to their various activities such as anti-cancer, anti-diabetic, anti-hypertensive, anti-inflammatory, anti-microbial, anti-

tubercular, anti-tumor, bronchodilator, calcium channel blockers, cardiovascular agents, geroprotective, hepatoprotective, neurotropic, and vasodilator[xiii-xxii] etc. These versatile activities have encouraged researchers to design sustainable and convenient catalytic materials for the synthesis of heterocyclic compounds containing polyhydroquinoline moiety. Some illustrations of drugs with 1,4-dihydropyridine framework are outlined in **Fig. 1**.

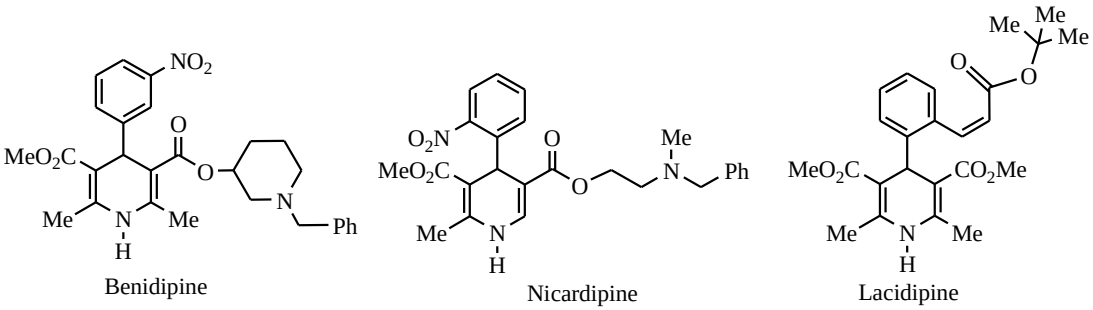


Fig.1. some drugs containing 1,4-dihydropyridine framework

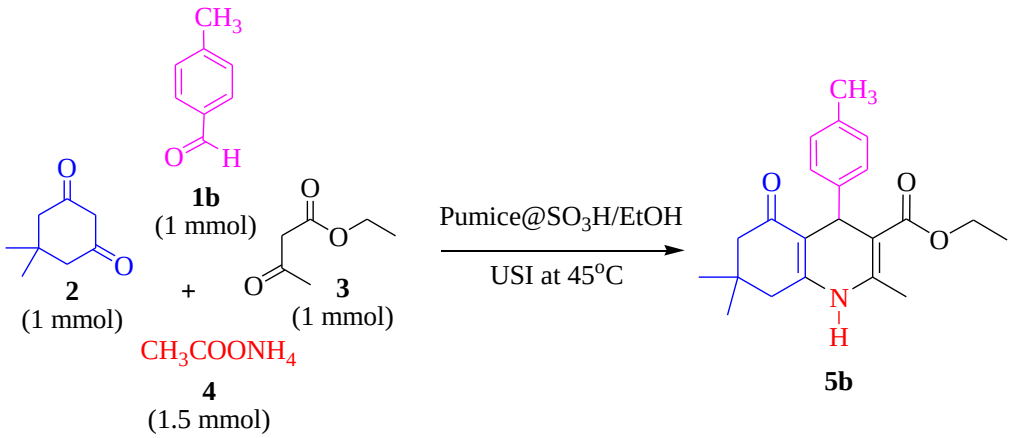
Recently, numerous protocols have been developed for the synthesis of polyhydroquinolines from aromatic aldehyde, dimedone, ethylacetoacetate and ammonium acetate such as nano-materials[xxiii], metal oxide supported materials[xxiv], magnetic materials[xxv], ionic liquids[xxvi], amino acids[xxvii], solar thermal energy[xxviii], Zeolite[xxix], microwave[xxx], and ultrasound[xxxi] etc. Also various bronsted acidic catalyst are used such as Fe_3O_4/SiO_2-OSO_3H[xxxii], silica sulfuric acid[xxxiii], nicotinic acid[xxxiv], Acetic acid[xxxv], Aluminized polyborate[xxxvi], PPA-SiO_2[xxxvii], SBA-15/SO_3H[xxxviii], SBA-15@Glycine[xxxix], PMO-ICS-$PrSO_3H$[xl], BINOL-phosphoric acid[xli], Carbon-based Solid acid (CBSA)[xlii], COF-SO_3H [xliii], Fe_3O_4@FSM-16-SO_3H [xliv], *p*-TSA[xlv], [MSAIM]HSO_4[xlvi], [Pyridine-SO_3H]Cl[xlvii], Caffeine-H_3PO_4[xlviii], ascorbic acid[xlix], Fe_3O_4@PEO-SO_3H[l], etc.

The ultrasound (US) assisted synthesis is well developed method used for the synthesis of variety of heterocyclic compounds. It proceeds through the development and adiabatic collapse of the transient cavitations bubble. It is used as a green approach that helping to reduce high energy requirements. The US approach provides smooth and cleaner reactions procedure with increasing yields in presence of various catalytic processes [li-lvii].

In continuation of our environmentally benign work [lviii-lxii] and on the application of pumice@SO_3H catalysts[i, ii], here we report a convenient green approach for one-pot synthesis of polyhydroquinolines in the presence pumice anchored sulfonic acid as a bronsted acidic catalyst with good catalytic activity and recyclability.

Results and Discussion:

In order to choose the better reaction condition a model reaction (**Scheme 1**) of *p*-methyl benzaldehyde, dimedone, ethyl acetoacetate and ammonium acetate was carried out in presence of catalyst pumice@SO_3H with and without catalyst and solvent. The reaction did not proceed to any extent in absence of catalyst with and without solvent during stirring at room temperature (**Table 1, Entry 1-3**). Also the negative result was obtained with pumice@SO_3H catalyst at room temperature in presence water and ethanol as well as without solvent under ultrasound irradiation (**Table 1, Entry 4-6**). The reaction proceeds smoothly with catalyst pumice@SO_3H in presence of ethanol as solvent at 45°C under ultrasound irradiation with excellent yield (**Table 1, Entry 7**).



Scheme 1. Model reaction for synthesis of Polyhydroquinoline (**5b**) derivative

Table 1: Optimization of reaction condition for the synthesis of polyhydroquinoline (**5b**)

Entry	Catalyst / Solvent	Reaction Condition	Time in hrs.	Yield [b] in %
1	90 mg pumice@SO_3H / Solvent free	Grinding	0.5	No reaction (NR)
2	90 mg pumice@SO_3H / H_2O	Stirring at RT	3	NR
3	90 mg pumice@SO_3H / EtOH	Stirring at RT	3	NR
4	90 mg pumice@SO_3H / H_2O	USI at RT	3	NR
5	90 mg pumice@SO_3H / H_2O	USI at 45°C	3	NR
6	90 mg pumice@SO_3H / EtOH	USI at RT	3	Trace
7	90 mg pumice@SO_3H / EtOH	USI at 45°C	1.5	80

[a]Reaction condition: **1b** (0.120gm, 1mmol), **2** (0.140gm, 1mmol), **3** (0.130gm, 1mmol), **4** (0.107gm, 1.5mmol),
pumice@SO_3H (90 mg), [b]Isolated Yield

Table 2: Optimization of quantity of catalyst for the synthesis of polyhydroquinoline (**4b**)

Entry	Pumice@SO_3H Catalyst (mg)	Time (hrs)	Yield[b] (%)
1	40	2	25
2	60	2	45
3	80	2	70
4	90	1.5	80
5	90	1.5	80

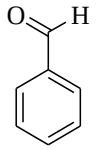
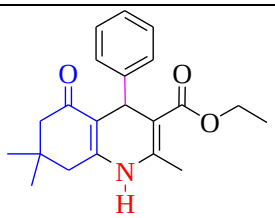
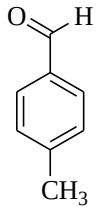
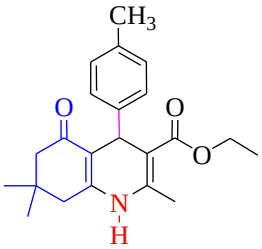
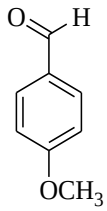
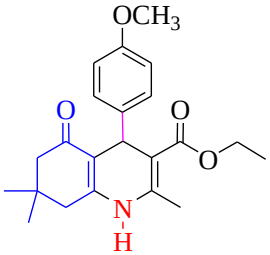
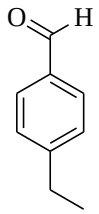
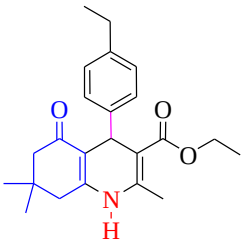
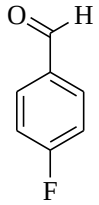
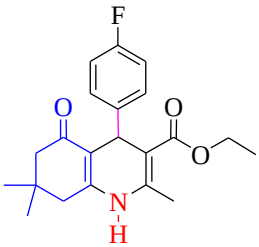
[a]Reaction condition: **1b** (0.120gm, 1mmol), **2** (0.140gm, 1mmol), **3** (0.130gm, 1mmol),
4 (0.107gm, 1.5mmol), USI at 45°C, [b] Isolated Yield

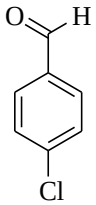
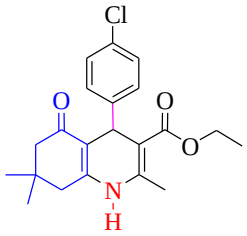
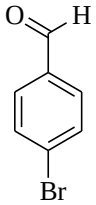
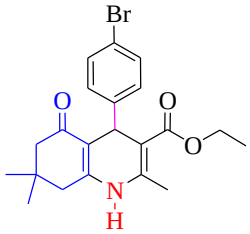
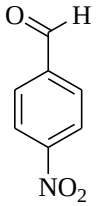
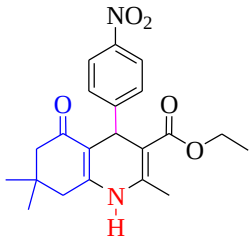
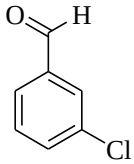
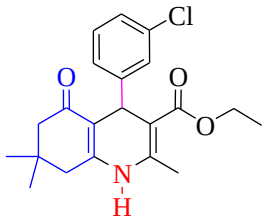
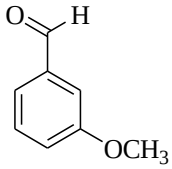
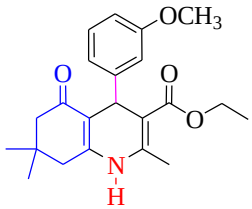
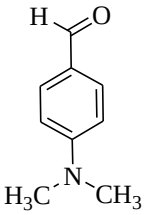
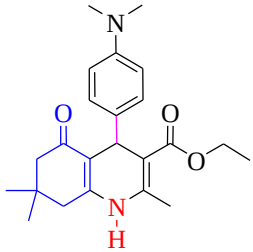
The model reaction was then studied for different amount of catalyst to optimize the amount of catalyst required (**Table 2**). It was found that further increase in the amount of catalyst, there was no significant improvement in the yield of the product.

This outcome enhanced our attention to study the scope, generality and relevance of this protocol for the synthesis of Polyhydroquinoline (**5a-k**) derivatives. The series of Polyhydroquinoline were synthesized using diverse aromatic aldehydes under above optimized

conditions with good yield (74-86%) as mentioned in **Table 3**. The protocol worked very well with aldehydes containing electron deficient and electron rich substituent.

Table 3: Data of synthesized Polyhydroquinoline (**5a-k**) derivatives

Entry	Aldehyde	Product	Time (hrs)	Yield (%)	M.P. (°C)	
					Observed	Reported
1		 **5a**	1.5	85	214-216	217–219[35]
2		 **5b**	1.5	80	252-256	260–262[35]
3		 **5c**	2.0	78	257-260	258–260[35]
4		 **5d**	1.5	80	220-224	--
5		 **5e**	1.5	79	182-184	185–186[35]

6		 **5f**	2.0	82	240-242	245–246[35]
7		 **5g**	2.0	78	250-252	254–256[35]
8		 **5h**	2.0	75	238-240	240–242[35]
9		 **5i**	1.5	80	204-206	205–206[35]
10		 **5j**	1.5	76	192-194	198–200[35]
11		 **5k**	1.5	80	236-238	228–231[29]

[a]Reaction condition: **1a-k** (0.120gm, 1mmol), **2** (0.140gm, 1mmol), **3** (0.130gm, 1mmol), **4** (0.107gm, 1.5mmol), USI at 45°C

After the completion of the reaction, the catalyst used has been recovered by heating the reaction mixture up to the boiling. The resultant hot solution was filtered at hot condition to separate the catalyst. The recovered catalyst was washed with dichloromethane 2-3 times and dried to reuse. The recycled catalyst was reused under the optimal conditions in three cycles of the similar transformation (**Fig. 2**). The formation of Pumice@SO_3H catalyst was proved by spectral studies such as FT-IR, XRD, SEM, TEM and EDS etc. which are reported in our previous work[i]. Here the evidences of recyclability study are provided. The FT-IR, XRD and EDS spectra of the recycled pumice@SO_3H catalyst after third cycle did not show any significant change in catalytic activity.

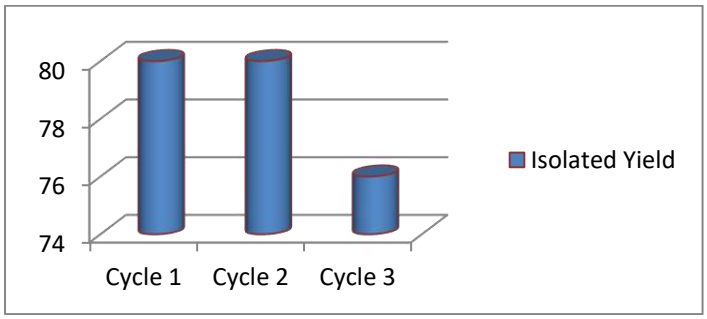


Fig. 2. Reusability of the pumice@SO_3H for the synthesis of Polyhydroquinoline (**4b**)

In the FT-IR spectrum of the recycled pumice@SO_3H (**Fig. 3**), the broad band at 3414.35 cm^{-1} is appeared due to O-H group in sulfonic acid. Also the important bands at 1637.32 cm^{-1} and 1111.05 cm^{-1} are appeared due to the S=O and Si–O–Si respectively. These significant bands indicate that, the recovery of -SO_3H group in the recycled catalyst.

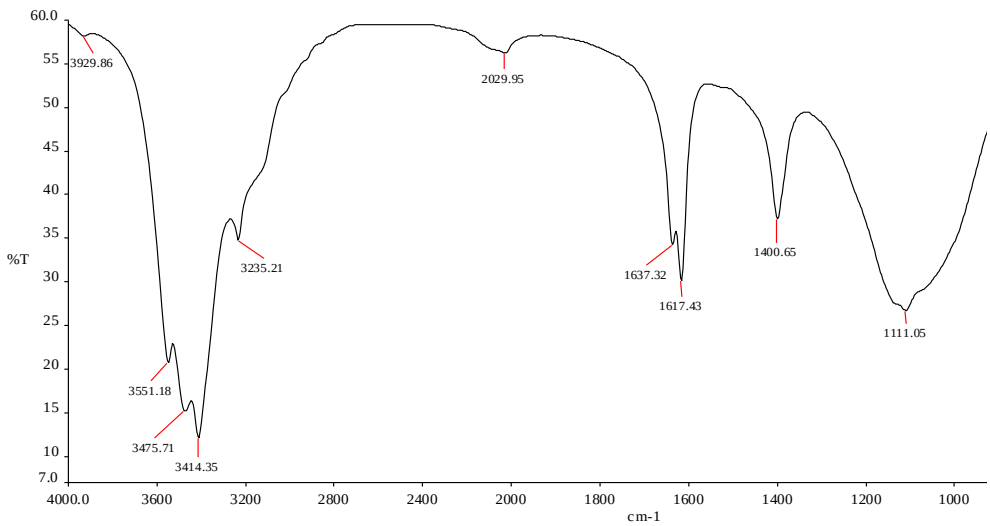


Fig. 3. IR Spectrum of Pumice@SO_3H catalyst

The nature of XRD (**Fig. 4**) and EDS (**Fig. 5**) of recycled catalyst was precisely matched with the reported catalyst. It showed that, the recycled catalyst did not show any variation in composition.

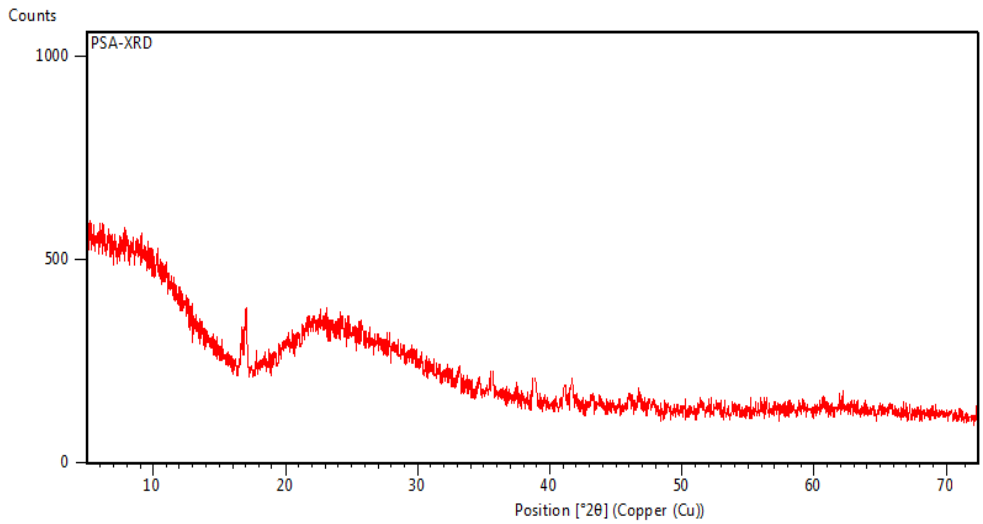


Fig.4. XRD of Pumice@SO_3H catalyst

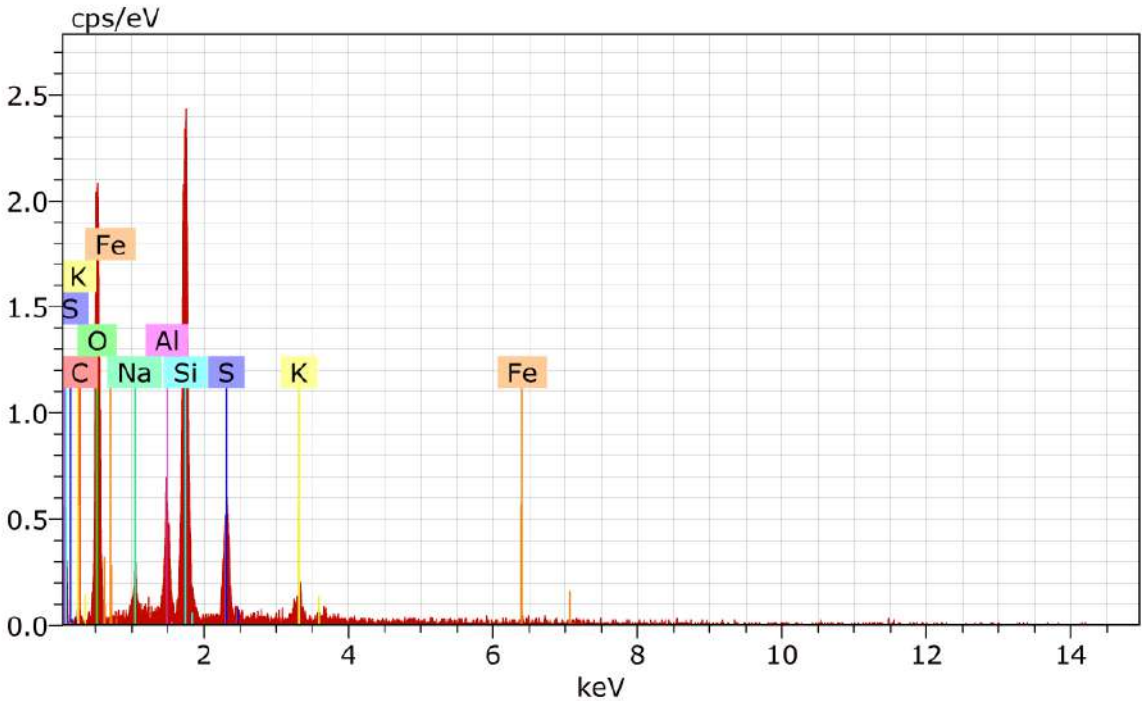


Fig.5. EDS of Pumice@SO_3H catalyst

The comparative study of different protocols for synthesis of polyhydroquinolene derivatives is illustrated in **Table 4**. While the plausible mechanism involved in Pumice@SO_3H promoted synthesis of polyhydroquinolines is shown in **Scheme 4.**

Table 4: Comparative study of different protocols for synthesis of polyhydroquinolene (**5b**)

Entry	Catalyst	Reaction Condition	Quantity of Catalyst in gm	Time in min	Yield (%)	Reference
1	Silica Sulfuric acid	Solvent free/60°C	0.080	50	92	33

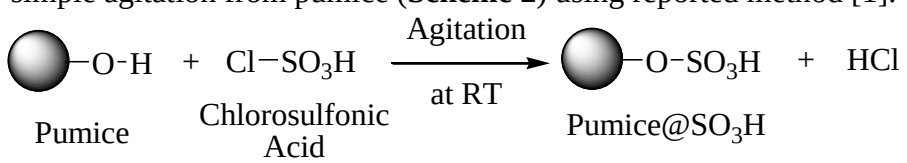
2	Nicotinic acid	Solvent free/80ºC	0.1	07	92	34
3	PPA-SiO_2	Solvent free/80ºC	0.030	60	90	37
4	PMO-ICS-$PrSO_3H$	Reflux/EtOH	0.020	20	95	40
5	CBSA	Solvent free/90ºC	0.020	35	88	42
6	COF-SO_3H	Solvent free/90ºC	0.020	10	95	43
7	Pumice@SO_3H	EtOH/USI, 45ºC	0.090	90	80	Present work

Experimental:

Melting points were recorded in an open capillary and are uncorrected. Infra Red spectra were recorded on a Perkin-Elmer FTIR spectrophotometer. The ^{1}H-NMR and ^{13}C-NMR spectra were recorded on a BRUCKER AVANCE NEO 500MHz NMR Spectrometer in $CDCl_3$ using Tetramethyl silane as a reference compound. Mass spectra were recorded on a Finnigan Mass spectrometer. TLC was carried out by Al-plates pre-coated with silica gel to check the purity of the compounds.

Preparation of pumice anchored sulfonic acid (pumice@SO_3H) catalyst

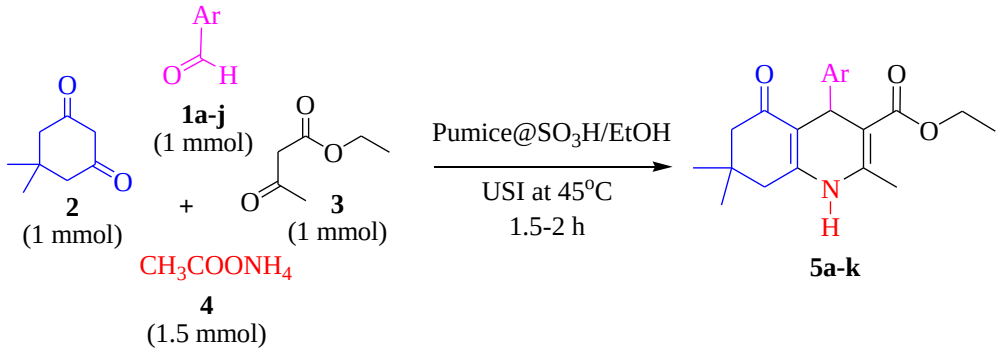
In the present work, the catalyst pumice anchored sulfonic acid (pumice@SO_3H) has been prepared by simple agitation from pumice (**Scheme 2**) using reported method [1].



Scheme 2: Preparation of pumice anchored sulfonic acid (pumice@SO_3H) catalyst

General procedure for the synthesis of polyhydroquinoline derivatives (5a-k)

A mixture of aldehyde **1** (1 mmol), 5,5-dimethylcyclohexane-1,3-dione **2** (1mmol), ethyl acetoacetate **3** (1 mmol), ammonium acetate **4** (1.5 mmol) and 90 mg of pumice based sulfonic acid was taken in a 100 mL round bottom flask containing 15 mL of ethyl alcohol. The resulting reaction mixture was subjected for ultrasound irradiation at 45ºC temperature for appropriate time (**Scheme 3**). The progress of the reaction was studied using TLC. After the completion, the reaction mixture was heated up to the boiling. The resultant hot solution was filtered at hot condition to separate the catalyst. The recovered catalyst was washed with dichloromethane 2-3 times and dried to reuse. After the separation of catalyst, cool the mother liquor, the solid polyhydroquinoline thus obtained. It was dried and in some cases it was purified by recrystallization using hot ethanol.



Scheme 3: Synthesis of Polyhydroquinoline (**5a-k**) derivatives

Discussion of Spectra:

5b: ethyl 1,4,5,6,7,8-hexahydro-2,7,7-trimethyl-5-oxo-4-*p*-tolylquinoline-3-carboxylate

^{1}H NMR (500 MHz, $CDCl_3$): 0.93 (s, 3H, -CH_3), 1.05 (s, 3H, -CH_3), 1.21 (t, 3H, -CH_3), 2.20 (s, 3H, -CH_3), 2.12-2.24 (m, 4H, -CH_2-x2), 2.31 (s, 3H, -CH_3), 4.06 (q, 2H, -OCH_2-), 5.01 (s, 1H, -CH-), 6.66 (s, 1H, NH), 6.99 (d, 2H, *J*=8Hz, Ar-H), 7.18 (d, 2H, *J*=8Hz, Ar-H); ^{13}C NMR (125 MHz, $CDCl_3$): 195.75, 167.58, 148.79, 144.27, 143.56, 135.38, 128.60, 127.87, 112.05, 106.14, 59.78, 50.81, 40.91, 36.14, 32.67, 29.45, 27.19, 21.04, 19.26, 14.24; MS (ESI) : m/z = 354.2110 [M+H].

5c: ethyl 1,4,5,6,7,8-hexahydro-4-(4-methoxyphenyl)-2,7,7-trimethyl-5-oxoquinoline-3-carboxylate

^{1}H NMR (500 MHz, $CDCl_3$): 0.93 (s, 3H, -CH_3), 1.06 (s, 3H, -CH_3), 1.20 (t, 3H, -CH_3), 2.13-2.30 (m, 4H, -CH_2-x2), 2.35 (s, 3H, -CH_3), 3.73 (s, 3H, -OCH_3), 4.07 (q, 2H, -OCH_2-), 4.99 (s, 1H, -CH-), 6.26 (s, 1H, NH), 6.73 (m, 2H, Ar-H), 7.20 (m, 2H, Ar-H); MS (ESI) : m/z = 370.2005 [M+H].

5d: ethyl 4-(4-ethylphenyl)-1,4,5,6,7,8-hexahydro-2,7,7-trimethyl-5-oxoquinoline-3-carboxylate

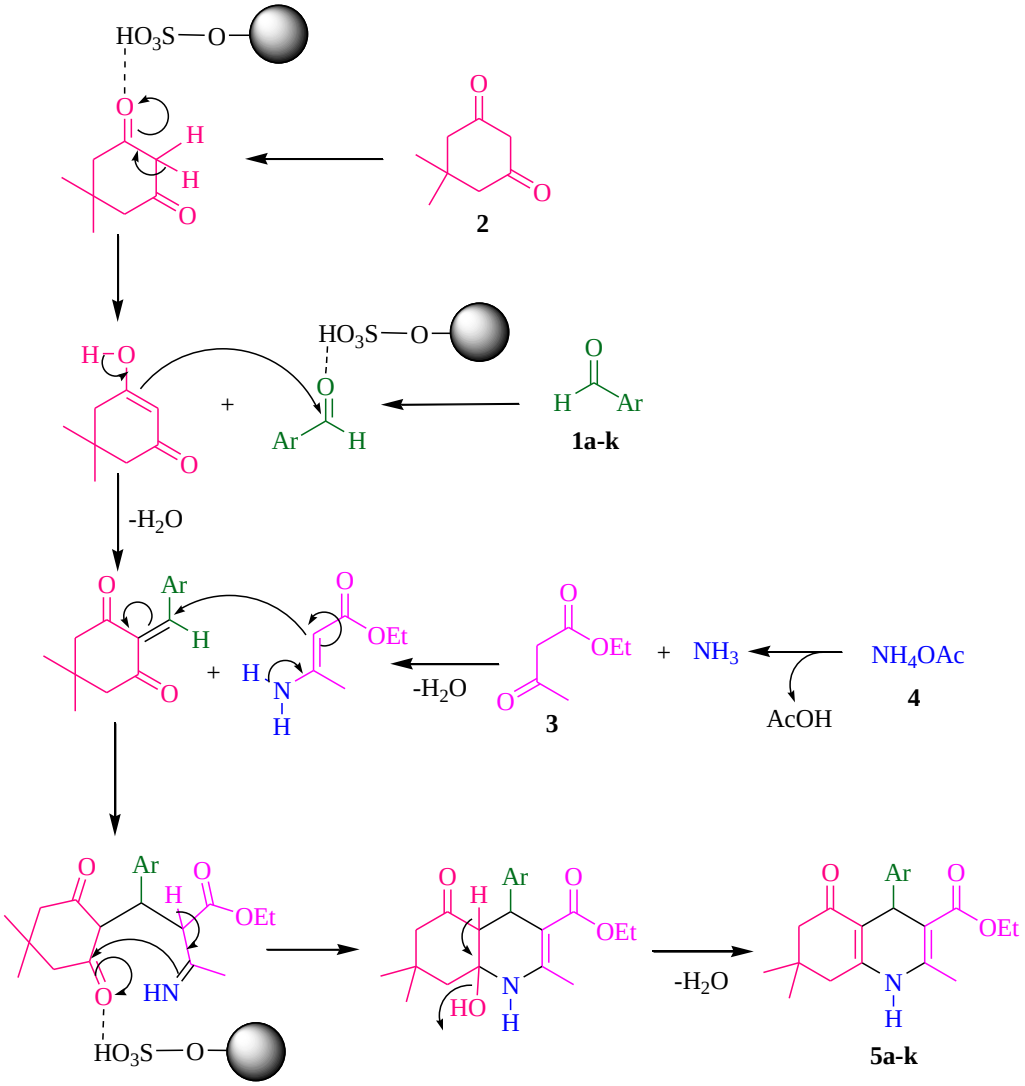
^{1}H NMR (500 MHz, $CDCl_3$): 0.95 (s, 3H, -CH_3), 1.06 (s, 3H, -CH_3), 1.17 (t, 3H, -CH_3), 1.21 (t, 3H, -CH_3), 2.13-2.29 (m, 4H, -CH_2-x2), 2.32 (s, 3H, -CH_3), 2.55 (q, 2H, -CH_2-), 4.06 (q, 2H, -OCH_2-), 5.02 (s, 1H, -CH-), 6.41 (s, 1H, NH), 7.01 (d, 2H, *J*=8Hz, Ar-H), 7.19 (d, 2H, *J*=8Hz, Ar-H); ^{13}C NMR (125 MHz, $CDCl_3$): 195.69, 167.58, 148.49, 144.39, 143.37, 141.68, 127.87, 127.35, 112.16, 106.25, 59.79, 50.79, 41.03, 36.10, 32.71, 29.41, 28.40, 27.28, 19.32, 15.35, 14.23.

5f: ethyl 4-(4-chlorophenyl)-1,4,5,6,7,8-hexahydro-2,7,7-trimethyl-5-oxoquinoline-3-carboxylate

^{1}H NMR (500 MHz, $CDCl_3$): 0.92 (s, 3H, -CH_3), 1.07 (s, 3H, -CH_3), 1.18 (t, 3H, -CH_3), 2.13-2.32 (m, 4H, -CH_2-x2), 2.36 (s, 3H, -CH_3), 4.05 (q, 2H, -OCH_2-), 5.02 (s, 1H, -CH-), 6.29 (s, 1H, NH), 7.16 (m, 2H, Ar-H), 7.23 (m, 2H, Ar-H); MS (ESI) : m/z = 374.1595 [M+H].

5k: ethyl 4-(4-(dimethylamino)phenyl)-1,4,5,6,7,8-hexahydro-2,7,7-trimethyl-5-oxoquinoline-3-carboxylate

^{1}H NMR (500 MHz, $CDCl_3$): 0.95 (s, 3H, -CH_3), 1.04 (s, 3H, -CH_3), 1.24 (t, 3H, -CH_3), 2.12-2.25 (m, 4H, -CH_2-x2), 2.33 (s, 3H, -CH_3), 2.85 (s, 6H, -$N(CH_3)_2$), 4.06 (q, 2H, -OCH_2-), 4.96 (s, 1H, -CH-), 6.58 (d, 2H, *J*=8.5Hz, Ar-H), 6.64 (s, 1H, NH), 7.15 (d, 2H, *J*=8.5Hz, Ar-H); ^{13}C NMR (125 MHz, $CDCl_3$): 195.84, 167.77, 148.94, 148.56, 143.18, 136.02, 128.61, 112.38, 112.24, 106.43, 59.71, 50.84, 40.85, 40.75, 35.38, 32.65, 29.49, 27.28, 19.28, 14.30; MS (ESI) : m/z = 383.2254 [M+H].



Scheme 4: Pluasible mechanism for the synthesis of Polyhydroquinolines

Conclusion:

In summary, we have discovered a sustainable and convenient protocol for the synthesis of polyhydroquinoline derivatives using pumice anchored sulfonic acid (Pumice@SO_3H) as an efficient catalyst under ultrasound irradiation. The attractive features of present protocol are green approach, good yield, recovery of catalyst and easy work-up procedure whereas the catalyst offers simple preparation, high catalytic activity, inexpensive, easy to use, recyclability and good stability.

Abbreviations:

MCRs	= Multicomponent Reactions,
Pumice@SO_3H	= Pumice supported sulfuric acid,
NR	= No Reaction,
RT	= Room Temperature,
SF	= Solvent Free,
USI	= Ultrasound Irradiation.

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