LEMBAR
HASIL PENILAIAN SEJAWAT SEBIDANG ATAU *PEER REVIEW*
KARYA ILMIAH : JURNAL ILMIAH

Judul Karya Ilmiah (Artikel)	:	Synthesis, characterization and selectivity of molecularly imprinted polymer (mip) glucose using polyeugenol as a functional polymer
Jumlah Penulis	:	2 Orang Penulis ke : 2
Nama Penulis	:	Muhammad C. Djunaidi, **Yayuk Astuti**
Identitas Jurnal Ilmiah		
a. Nama Jurnal	:	Rasayan Journal of Chemistry
b. Nomor ISSN	:	0974-1496
c. Volume, No, Bulan, Tahun	:	12, 2, April, 2019
d. Penerbit	:	Rasayan Journal
e. DOI artikel (jika ada)	:	http://dx.doi.org/10.31788/RJC.2019.1225120
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   Artikel yang dimuat, dibahas dan disusun secara lengkap
b. Ruang lingkup dan kedalaman pembahasan:
c. Ruang lingkup penelitian ini tentang MIP glukosa menggunakan polieugenol sbg polimer fungsional hasil sintesis kemudian dikarakteriasi dan diujikan. Data yang disajikan dibahas dengan detil dan lengkap, kurang disertai referensi pendukung
d. Kecukupan dan kemutahiran data/informasi dan metodologi: Kualitas dan kuantitas pustaka baik, sebagian besar tahun terbit kurang dari 10 th (50%). Metodologi disajikan detil sehingga bisa diulang peneliti lain.
e. Kelengkapan unsur dan kualitas penerbit: Kualitas terbitan baik, hanya ada beberapa gambar yang kurang jelas.
f. Indikasi Plagiasi: Tidak ada
g. Kesesuaian bidang ilmu: Sesuai dengan bidang ilmu penulis

Semarang,
Reviewer 1

Drs. Gunawan, M.Si., Ph.D
NIP. 196408251991031001

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d. Kelengkapan unsur dan kualitas penerbit (30%)	12					11
Total = (100%)	**40**					**34**
Kontribusi Pengusul (Penulis Anggota)	**40%x40=16**					**40%x34=13,6**

Komentar Peer Review:

a. Kelengkapan dan kesesuaian unsur: Artikel telah sesuai dengan template, terdiri dari pendahuluan, metode, hasil dan pembahasan, kesimpulan serta referensi.
b. Ruang lingkup dan kedalaman pembahasan: Ruang lingkup adalah sintesis polimer selektif. Pembahasan sederhana dan bagian pendahuluan cukup singkat.
c. Kecukupan dan kemutahiran data/informasi dan metodologi: Data yang diberikan cukup memadai, 50% dari total referensi sudah merupakan yang terkini atau 5 taun terakhir saat artikel terbit.
d. Kelengkapan unsur dan kualitas penerbit: Penerbit Rasayan Journal berasal dari India dan sudah terindeks scopus.
e. Indikasi Plagiasi: Tidak ada
f. Kesesuaian bidang ilmu: sesuai bidang penulis

Semarang,
Reviewer 2

Dr. Ahmad Suseno, M.Si.
NIP. 196408181999031001

Unit kerja :
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c. Kecukupan dan kemutahiran data/informasi dan metodologi (30%)	11,5	10	10,75
d. Kelengkapan unsur dan kualitas penerbit (30%)	11	11	11
Total = (100%)	**38**	**34**	**36**
Kontribusi Pengusul (Penulis Anggota)			**40%x36=14,4**

Semarang, April 2020

Reviewer 2

Dr. Ahmad Suseno, M.Si.
NIP. 196408181999031001

Unit kerja :
Departemen Kimia FSM Undip

Reviewer 1

Drs. Gunawan, M.Si., Ph.D
NIP. 196408251991031001

Unit kerja :
Departemen Kimia FSM Undip

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c. Kecukupan dan kemutahiran data/informasi dan metodologi (30%)	12	10,75
d. Kelengkapan unsur dan kualitas penerbit (30%)	12	11
Total = (100%)	**40**	**36**
Kontribusi Pengusul (Penulis Anggota)		**40%x36=14,4**

Semarang, April 2020

Reviewer 2

Dr. Ahmad Suseno, M.Si.
NIP. 196408181999031001

Unit kerja :
Departemen Kimia FSM Undip

Reviewer 1

Drs. Gunawan, M.Si., Ph.D
NIP. 196408251991031001

Unit kerja :
Departemen Kimia FSM Undip

Source details

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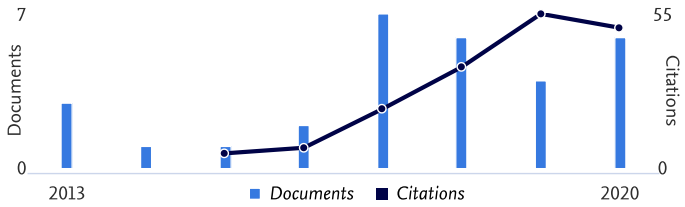

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Rasayan Journal of Chemistry Open Access
Volume 12, Issue 2, April-June 2019, Pages 809-821

Synthesis, characterization and selectivity of molecularly imprinted polymer (MIP) glucose using polyeugenol as a functional polymer (Article) (Open Access)

Djunaidi, M.C., Astuti, Y.

Department of Chemistry, Faculty Sciences and Mathematics, Diponegoro University, Central Java 50278, Indonesia

Abstract

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Research on the synthesis of Molecularly Imprinted Polymer Glucose was undertaken by using polyeugenol as a functional polymer and Polyethylene Glycol Diglycidyl Ether (PEGDE) as a crosslinker agent. Polieugenol generated from eugenol then was tied with glucose template and crosslinked with PEGDE (Polyethylene Diglicidil Glycol ether) with a mole ratio of 1:1. Analysis of the results of the polymerization and crosslinking was performed using IR, GPC, NMR and XRD. Optimization of the adsorbent was conducted by varying the template concentration, the particle size of the adsorbent and eluent type. Glucose was analyzed by 3,5 dinitrosalicylic acid method. The selectivity of the MIP adsorbent was compared to Non-Imprinting Polymer and tested against fructose molecule. A characterization of MIP Glucose consisted of a chemical resistance test, re-use and selectivity. It is expected that MIP glucose adsorbs glucose more than NIP either in glucose solution or glucose solution mixed with fructose. The result was MIP adsorbent adsorbed glucose more than NIP but did not adsorb fructose otherwise NIP. The results obtained shows that MIP Glucose was resistant to any kind of organic acids (acetic acid), inorganic acids (HCl, HNO_3) and NaOH. Reuse of MIP Glucose as the adsorbent shows slightly decreased ability to adsorbed glucose when using ethanol, but tended to be stable when using demineralized water as a released solvent. MIP Glucose selectivity was seen in HPLC analysis. © RASĀYAN.

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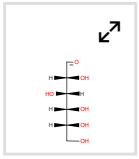
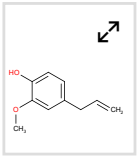
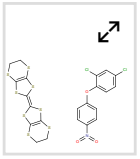
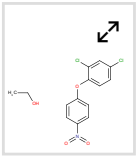
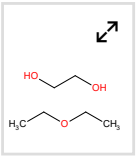
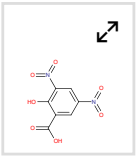

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Fructose | MIP glucose | Polyeugenol | Selectivity

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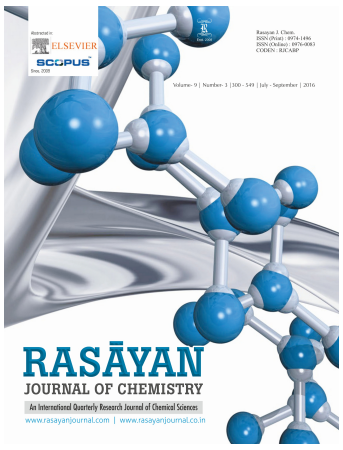

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Keywords: P and K-recovery, Struvite (K), Surface Response Methodology (SRM), Citric Acid, XRPD Rietveld Analysis

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PIPERIDINE MEDIATED SYNTHESIS OF PRENYLATED CHALCONES AND 8-SUBSTITUTED -2, 5-DIHYDRO-2-(4-TOLYBENZO)-5-(3-METHYLBUT-2-ENYLOXY) PHENOL-1, 5- BENZOTHIAZEPINES AND ITS DERIVATIVES AS ANTI CANCER AGENTS

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Keywords: 8-Substituted-2, 5-Dihydro-2-(4-tolybenzo)-5-(3-methybut-2-enyloxy) phenol-1, 5 Benzothiazepines, Benzothiazepines Derivatives, Prinyloxy Chalcones, Anti Cancer Activity

DOI: http://dx.doi.org/10.31788/RJC.2019.1224078

CHEMICAL ANALYSIS AND CYTOTOXIC ACTIVITY OF NHEXANE FRACTION OF Zanthoxylum acanthopodium DC. FRUITS

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SYNTHESIS, CHARACTERIZATION AND SELECTIVITY OF MOLECULARLY IMPRINTED POLYMER (MIP) GLUCOSE USING POLYEUGENOL AS A FUNCTIONAL POLYMER

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KNO3/ACE: A COST-EFFECTIVE MATERIAL FOR SYNTHESIS OF (2E,4E)-1,5-DIPHENYLPENTA-2,4-DIEN-1-ONE AND (E)-3-PHENYL-5-STYRYL-1H-PYRAZOLE

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Rasayan J. Chem, 12 (2), 833 - 838 (2019)

Keywords: Lagoon, OCM Sensor, Chlorophyll-a, Suspended Sediments, Monitoring, Bio-optical Algorithm.

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STABILITY INDICATING DETERMINATION OF DARUNAVIR WITH HPLC IN BLOOD PLASMA SAMPLES

— Manchuru Vanaja and J. Sreeramulu

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Keywords: Darunavir, blood plasma samples, tablets dosage form, method validation, antiretro viral drug product.

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INVESTIGATION ON THE MINERALOGICAL PHASE OF ANCIENT BRICK SAMPLES OF KATHMANDU VALLEY (NEPAL) USING XRD AND FTIR ANALYSIS

D. B. Ghale[1], N. B. Bohara[1], N. Duwal[2] and J. Bhattarai[1,*]
[1]Central Department of Chemistry, Tribhuvan University, Kirtipur, Kathmandu, Nepal
[2]St. Xavier College, Thapathali, Kathmandu, Nepal
*E-mail : bhattarai_05@yahoo.com

ABSTRACT

The total eight clay brick samples including five archaeologically importance samples from different historical sites and three samples from more than a century old buildings of Kathmandu valley were collected and their mineralogical phases were characterized using X-ray diffraction and Fourier transform infrared spectroscopic methods in this study. Mineralogical phases existed in these archaeological and ancient clay bricks are identified as quartz, feldspars, spinel, muscovite, margarite and hematite in accordance with the powder diffraction standard files. The degree of the disappearance of feldspars phase and appearance of the spinel phase in all the brick samples is found to be different indicating that the firing temperature applied to produce these brick specimens should not be same. The firing temperature applied for the production of the eight clay brick samples should be in the range of 900°-1000° C. Most of the archaeological clay brick samples used in this study should be produced by firing at the high-temperature comparison with those brick samples used in old buildings of Kathmandu valley.

Keywords: Archaeological brick, Characterization, X-ray diffraction, FTIR, Quartz, Feldspars

INTRODUCTION

Brick is one of the men made the oldest structural materials and it has been widely used all most all countries of the world mainly due to easy availability of its raw materials in the world. It was reported that different properties of the clay bricks depended on the mineralogy of the clay materials used to manufacture it, the manufacturing process and firing temperature[1]. The fired clay bricks are extremely durable and hence, there have been numerous archaeological masonry buildings standing for centuries as a testimony of the survival of the clay-based fired bricks. In general, clay bricks are classified into various groups based on their mineralogy. Previous research works also reported that the main factors to manufacture such type of bricks are clay raw material types and the firing temperature during their production that affects the quality and durability of bricks.[2-5]

The clay brick is used extensively in the construction industry all over the world. The global brick production is estimated at about 1.5 trillion annually[6] and Asian countries only account about 89-90 % of the global production, i. e., about 1.35 trillion bricks[7]. The clay brick production in Kathmandu valley is estimated more than 3.3 billion units[8] and with increasing demands of the clay bricks for the construction industry, bricks quality and cost become more important nowadays. The brick manufacturing techniques were depended on the supervisors and it was considered as the hereditary gifted knowledge passed on to generations from their forefathers[9]. This is the main reason that the knowledge about the ancient ceramic materials and their application techniques which were so successfully used in the past has now disappeared without any documentation in our part of the world. Furthermore, the mineralogical phase characterization of the historical bricks provides valuable information for restoration purposes to formulate new specific bricks using available raw materials. The clay brick is mostly homogeneous, harder and stronger due to the ceramic bond from the sintering phase of the silica and alumina clay

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constituents. It is reported that the brick was used as a fundamental building material since the Mesopotamian, Egyptian and Roman period[10]. It is known that the properties of the archaeological clay brick rely essentially on the properties of the brick units, which depend on the quality of the raw materials used, together with the manufacturing process technology. Numerous historical brick buildings have been existed until the 21st century, which testifies to the strength of such ancient brick materials along centuries of rain storms, snow, thaw-freezing cycles, high temperatures and human-induced deterioration. A large number of studies have been reported about the ancient brick structures and materials to foster their cultural and economic importance as well[11-19].

The archaeological clay bricks preservation has given rise to considerable interest of scientists, architects, engineers and archaeologists recently, because the archaeological masonry needs to be restored with the substitution of bricks when they damage. A good characterization of such archaeological clay brick specimens gives us a possibility to predict advance the chemico-mineralogical phases, physico-sintering and mechanical behavior of the newly formed building system. To learn about the historical understanding is not just to analyze and preserve such archaeological objects but also to investigate and understand the knowledge and skills used to produce and use them[20].

It was reported that the firing temperature was one of the key controlling factors of the physicomechanical properties of the bricks, not so much affected by firing time[21]. The physicomechanical properties of the bricks vary with their mineralogical phases and the degree of densification at high firing temperatures and so on. The mineralogical phase composition of the clay raw materials used for brick production is one of the main quality indicators of its final products. Hence it is considered that the mineralogical phase analysis of the clay-based bricks is one of the widely accepted tools for the approximate estimation of their firing temperature range, physico-sintering properties and durability so on. In this context, the main objectives of the present research work were to characterize the mineralogical phases developed in the ancient brick samples collected from historical sites of Kathmandu valley using X-ray diffraction (XRD) and Fourier transform infrared (FTIR) spectroscopic methods and also to understand the knowledge and skills used to produce these brick samples.

EXPERIMENTAL

Total eight clay brick samples including five archaeological brick samples from different historical sites and more than a century old three brick samples used in ancient buildings of Kathmandu valley were collected to carry out their mineralogical phase characterization in the present study. The detail descriptions of these eight clay brick sample specimens are summarized in Table-1.

Table-1: Description of the Clay Brick Samples

S. No.	Sample Name	Location of Brick Sampling Site	Brick Types
1	CTB-1	Ghanta Ghar (Clock Tower) Building	Historical
2	DTB-2	Dharaharaa (Kathmandu Tower) Building	Historical
3	BDB-3	Basantpur Darbar Square	Historical
4	RTB-4	Balgopaleshwor Temple (Ranipokhari)	Historical
5	BTB-5	Baghbhairav Temple (Kirtipur)	Historical
6	TOB-6	Tripureshwor	Ancient
7	POB-7	Patan (Mangal bazaar)	Ancient
8	KOB-8	Kirtipur (Panga)	Ancient

A small broken piece of each brick samples was thoroughly hand grounded in an agate mortar to make a fine powder for XRD and FTIR analyses as described elswhere[22]. Mineralogical phase characterization of the clay brick samples was carried out at Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur using XRD analysis on a D8 Advanced Diffractometer (Bruker, Germany) with CuKα radiation (λ = 0.15418 nm) at a scanning rate of 2º/minute in 2θ mode between 10° and 70° as described elswhere[22, 23]. The powder form of the brick sample was loaded in a sample holder in a random orientation to minimize the preferred orientations of the clay materials for XRD analysis. Mineralogical phases present in the selected eight brick powders were identified from their basal spacing (d-spacing) in accordance with Joint Committee for Powder Diffraction Standards (JCPDS) database files[24]. The

prepared powder form of each brick sample was loaded in an XRD sample holder in a randomly orientated way to minimize preferred orientations of clay minerals. In addition, FTIR spectra of these eight archaeological and old brick samples were recorded in a wide range of wave number from 400 to 4000 cm^{-1} by using both the FTIR-A217053 at NAST and the IR-Tracer-100 (Shimadzu, Japan) in Central Department of Chemistry, Tribhuvan University, Kirtipur to know their mineralogical compositions.

RESULTS AND DISCUSSION

The use of XRD patterns of the ceramics like brick bodies is one of the relatively easy methods to identify their mineralogical phases, although several factors make complication for accurate phase identification from overlapping the peak values[25,26]. XRD patterns of the powder form of five different archaeological brick samples of different historical sites and three ancient (more than a century old) brick samples of local buildings collected from different parts of Kathmandu valley are shown in Fig.-1 and 2, respectively. The common mineralogical phases present in all eight clay brick samples are quartz, feldspars, spinel and hematite in CTB-1, RTB-4, BTB-5 brick samples including muscovite type of mica mineral phase in samples of BDB-3, TOB-6, POB-7 and KOB-8 (Fig.-1 and 2) and the mineralogical phase of margarite specially in the brick samples of DTB-2 and BDB-3 (Fig.-1) with the help of the corresponding JCPDS database files[24]. The disappearance of feldspars diffraction peaks and appearance of the alumina-rich spinel phase is comparatively more pronounced in four archaeological brick samples of CTB-1, DTB-2, BDB-3 and BTB-5 (Fig.-1) than other three ancient brick samples of TOB-6, POB-7 and KOB-8 (Fig.-2) including one archaeological brick sample of RTB-4 (Fig.-1).

These results indicated that the firing temperature of these eight brick samples should not be the same. Furthermore, XRD patterns of three old brick samples of TOB-6, POB-7 and KOB-8 (Fig.-2), and one archaeological brick sample of BDB-3 (Fig.-1) show clearly the muscovite type of mica minerals with a residual form of quartz, feldspars and less amounts of spinel phase including hematite, although remaining other four archaeological clay brick samples have developed well-formed alumina-rich spinel phase in additions of residual quartz, feldspars and hematite. These results revealed that four archaeological clay brick samples except BDB-3 sample should be produced by firing at higher temperature range as a comparison with other remaining four clay brick samples as mentioned above.

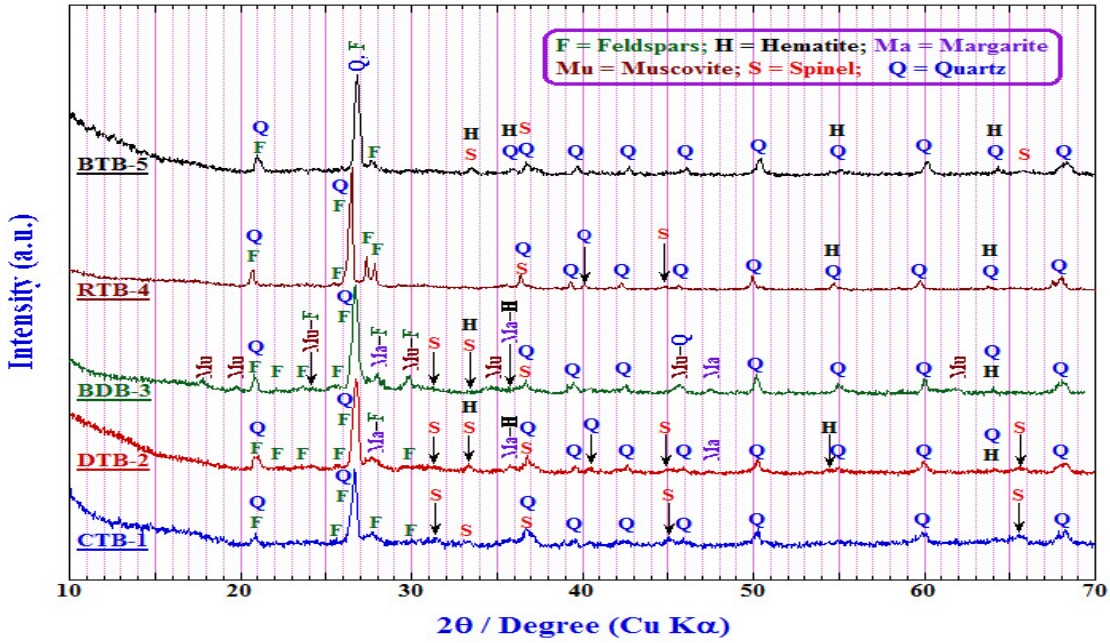

Fig.-1: XRD Patterns of the Archaeological Brick Samples from Different Historical Sites of Kathmandu Valley

An alumina-rich spinel and primary mullite phases were developed at above 900°C and about 1000–1100°C, respectively, while such phases were completely diminished by forming a well-shaped mullite

crystals at 1200°C or high firing temperatures.[27-29] However, these eight brick samples used in this study did not show the development of even primary mullite phase from XRD analysis. Consequently, it can be said that all the analyzed archaeological and ancient bricks might be produced at the firing temperatures between 900° to 1000°C. The development of miner phases due to the impurities like hematite, calcite and dolomite so on in ceramic raw materials were reported a negative effect on the physico-sintering and mechanical properties of the fired clay bodies[30-36]. The XRD peak for hematite is mostly due to the impurity of iron oxide and no sign of the presence of calcite and dolomite phases in all eight archaeological and ancient clay brick samples indicates that the worsening of the mechanical properties of these brick samples generally expected mostly due to the presence of undesirable phase of hematite only in these brick samples. It is significant to mention here that the presence of hematite in ceramic bodies of tile samples showed the adverse effects in their physicomechanical properties like water absorbtivity, apparent porosity, bulk density and flexural strength[30].

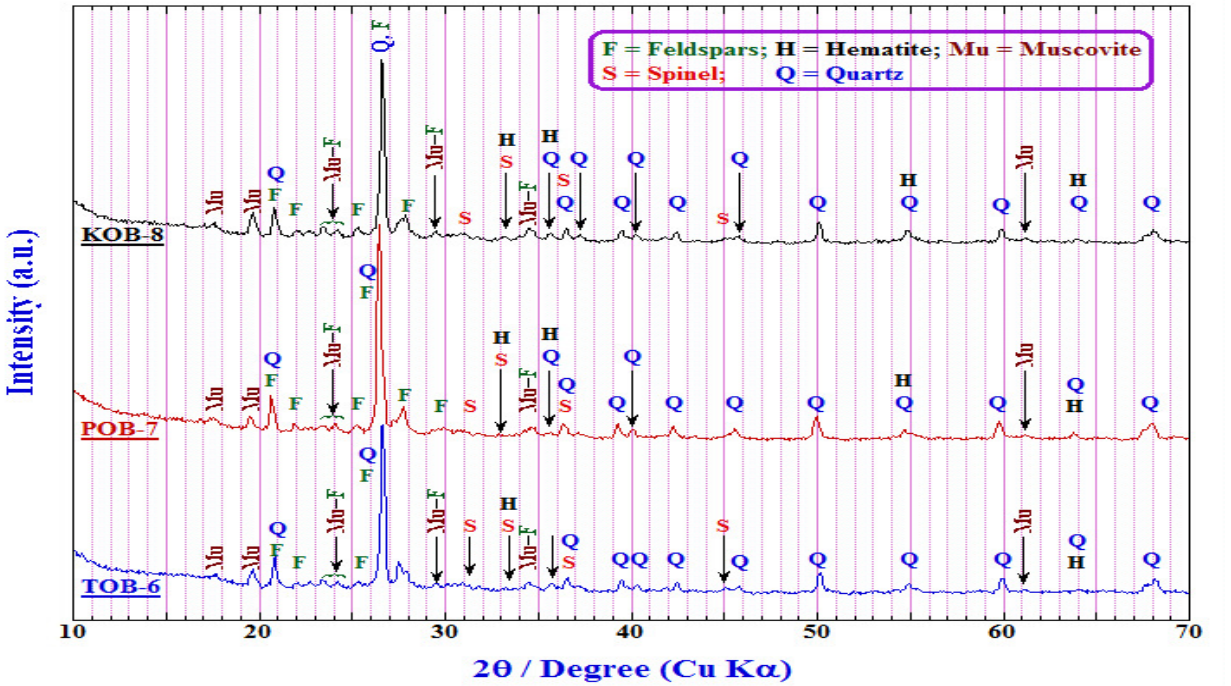

Fig.-2: XRD Patterns of a Century Old Brick Samples Collected from Different Parts of Kathmandu Valley

Figure-3 shows the recorded FTIR spectra of the six selected brick samples for their mineralogical phase characterization. The peak between 3800 and 3400 cm^{-1} for the archaeological and ancient brick samples except for one sample (i. e., DTB-2) is disappeared as sown in Fig.-3(b). A very broad absorption peak at 3470 cm^{-1} is clearly observed for the brick sample DTB-2 which is assigned to OH stretching vibration of hydroxide in the brick sample. This absorption band region is accompanied by an absorption band at 1640 cm^{-1} assigned to O-H bending and this FTIR peak is found to be more pronounced for the DTB-2 sample than other five brick samples as shown in Fig.-3.

It was reported that a broad band near 3420-3480 cm^{-1} represents to the OH stretching vibration along with a weak and medium absorption band at 1620-1650 cm^{-1} is typical absorbance band due to the presence of adsorbed water molecule.[37-39] However, the absorption bands in these two wavelength regions are nearly diminished, because the broadening of the FTIR spectra of the brick samples should generally be influenced by the firing temperature applied during their production and hence it can be assumed that the firing temperature used to produce the brick sample of DTB-2 should be lowered than that of other brick samples analyzed in this study. The FTIR absorption peak at 2955 cm^{-1} particularly for the brick samples BDB-3, TOB-6 and KOB-8 as depicted in Fig.-3(c), 3(e) and 3(f), respectively, indicated that these three brick samples should contain a small amount of organic matters which is appeared to diminish by firing at about 1000 °C or high temperature. The similar observation was reported in previous research works also[40]. The strong band at 1015–1054 cm^{-1} attributed to the Si–O stretching vibration of the

tetrahedral sheet of the fired brick samples.[39-41]

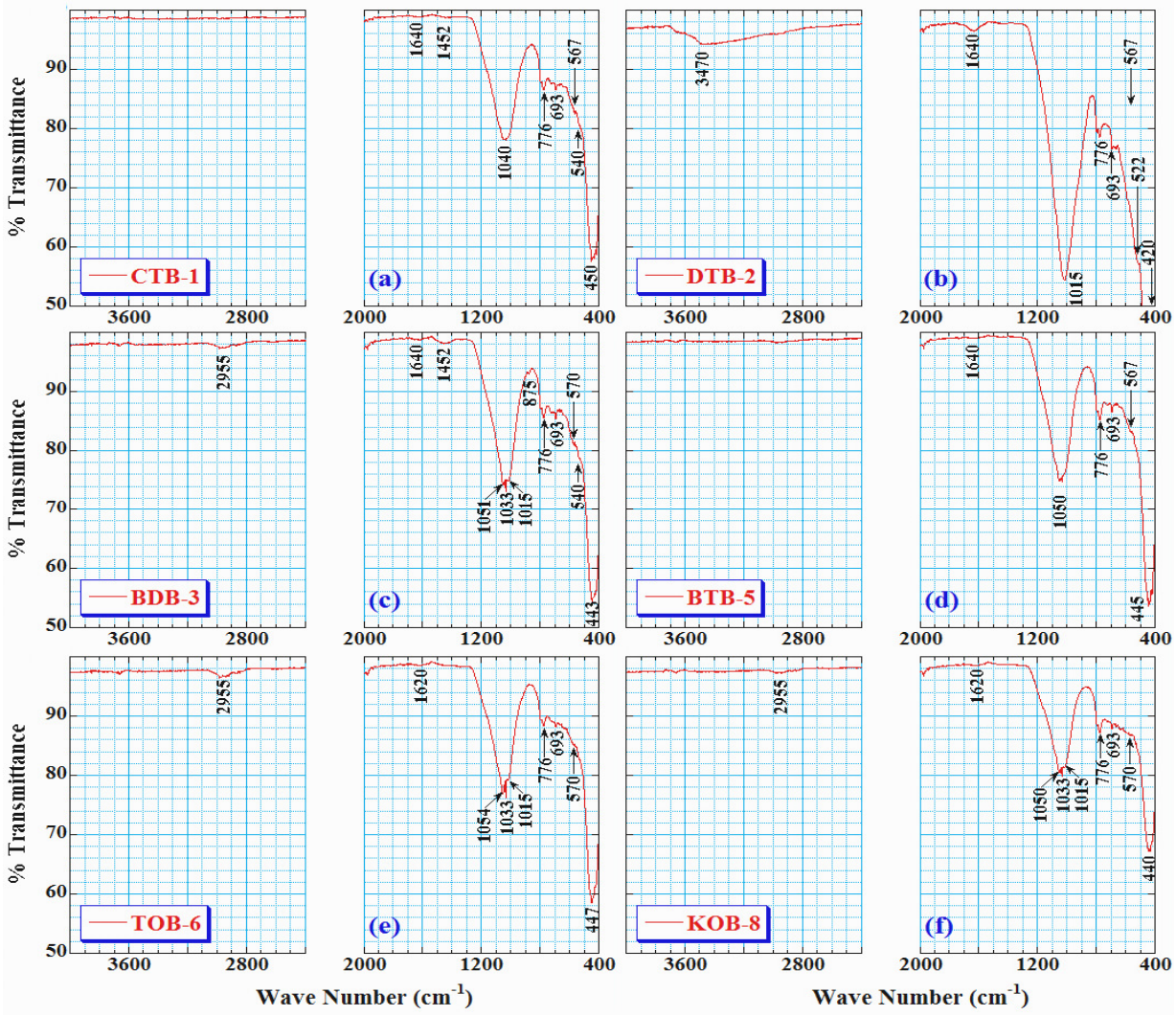

Fig.-3: FTIR Spectra of Four Archaeological (a-d) and Two Ancient (e and f) Brick Samples of Kathmandu valley

The FTIR spectra of all these six archaeological and ancient clay brick samples show that the absorption peaks at 796-776, 693 and 420–450 cm^{-1} are mainly of quartz. It is meaningful for mentioning here that the previous research work was reported an FTIR absorption peak chosen at around 779 cm^{-1} to be more suitable for quantitative amounts of quartz in clay bodies[42]. On the other hand, the presence of feldspar can be explained by Si–O–Al compounded vibrations at 775–780 cm^{-1} and these assignments are in good agreement with that previously reported results[43]. Similarly, there is a weak and very broad absorption peak in the range of 550–545 cm^{-1} in all the brick samples analyzed here indicated that the fired bricks available in Kathmandu valley contain trace amounts of hematite. The similar result of the FTIR absorption peak at 540-550 cm^{-1} due to the presence of hematite in the fired ceramic bodies was reported in previous works also.[22,23,44]

CONCLUSION

The mineralogical phases of five archaeological bricks from five different historical places and more than century-old three ancient brick samples of Kathmandu valley were characterized using their XRD patterns and FTIR spectra analysis in this study. Following conclusions are drawn based on the results and discussion.

i. Mineralogy phases in the analyzed brick samples are found to be composed mainly of quartz, feldspars, spinel with muscovite, margarite and hematite from XRD and FTIR analyses.

ii. The disappearance of diffraction peaks of feldspars and appearance of the alumina-rich spinel phase in all eight brick samples indicated that the firing temperature of these bricks should be around 900°-1000° C.

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ONE POT SYNTHESIS OF PYRAZOLO PHTHALAZINE DIONE DERIVATIVES UNDER MICROWAVE IRRADIATION

S. R. Kolsepatil[1], A. V. Sapkal[2], S. Chandole[3] and D. L. Lingampalle[1,*]
[1]Department of Chemistry, Vivekanand College, Aurangabad, (Maharashtra), India
[2]Department of Chemistry, Vasantrao Naik College, Aurangabad, (Maharashtra), India
[3]Department of Chemistry, S.G.B. College Purna (Jn.) Parbhani, (Maharashtra), India
*E-mail: lingampalle@vivekanandcollege.edu.in

ABSTRACT
In this method, we have reported the catalytic ability of boric acid as a green, eco-friendly catalyst for one-pot four component condensation reaction of phthalic anhydride, Monohydrate hydrazine, Malononitrile and substituted aromatic aldehyde was reported. The major synthetic protocol is the use of inexpensive, nontoxic, avoiding the use of harmful organic solvent, short reaction time, mild condition reaction, simple procedure, excellent yield and environmentally benign.
Keywords: Multicomponent Reaction, Green Synthesis, Pyrazolo Phthalazine Dione, Microwave Irradiation.

INTRODUCTION

Multicomponent condensation reactions (MCR) are more important in the synthesis of heterocyclic molecules. In presence of phthalazine and pyrazole heterocyclic ring system or fused ring with a different heterocyclic moiety, are in a number of pharmacologically emphasis molecules. In many cases, use of the classical method for the synthesis of heterocyclic compounds, however, these are simply no longer reaction time acceptable by current environmental and safety standard. All these reasons, the various possibilities offered by microwave synthesis are attractive high yield, fast or minimum time and environmentally benign are important advantages.

Nitrogen-containing bridgehead hydrazine heterocyclic compounds have attracted prominent interest due to their pharmacological properties, biological activities and clinical applications[1,2,3,4,5,6]. The pyrazolo phthalazine derivative expands in nature and their applications of biologically active pharmaceuticals, functional materials as well as agrochemicals.[7-10] Pyrazolo phthalazine dione derivatives show various biological activities such as Anticonvulsant[11], Cardiotonic[12], vasorelaxant[13], Cytotoxic[14], Anticancer[15], Antifungal[16], Anti-inflammatory[17], Antiviral[18], Antitumor[19], Anticoagulant[20], Antibacterial[21]and Ant hypoglycemic activity[22]. To develop a simple method for synthesis of pyrazolo phthalazine dione is important in organic synthesis.

Earlier reports revealed that one-pot four component synthesis of pyrazolo phthalazine dione derivatives have been prepared by using different catalytic system such as Et_3N[23] ,AL-KIT-6[23], [bmim] Br/PTSA[24], [bmim]OH[25], $NiCl_2.6H_2O$[26], $InCl_3$[27], CAN[28], [(DBU)CH_3COO] [29], CuI NPs[30],$Zn(OAc)_2$[31] and $NiFe_2O_4$[32]. However, these strategies show different disadvantages related to green synthesis. The present method has less drawbacks such as short reaction time, use of a cheap catalyst and easy workup procedure.

Herein, we report the use of a catalyst as a boric acid non-toxic, inexpensive, easily available catalyst, for organic transformations to give excellent yield because of new numerous advantages associate with ecofriendly compound. The synthesis of pyrazolo phthalazine dione derivatives by one-pot four component condensation reaction of phthalic anhydride, Monohydrate hydrazine, substituted aromatic aldehyde and malononitrile (Scheme-1).

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TANNIN AND ANTIOXIDANT STATUS OF FERMENTED AND DRIED *Sorghum bicolor*

Tolulope Dorcas Olawole[1], Anuoluwa Tenifayo Olalere[1], Oladipupo Alaba Adeyemi[1], Ogi Okwumabua[2] and Israel Sunmola Afolabi[1,*]

[1]Department of Biochemistry, College of Science and Technology, Covenant University, Ota, 100122, (Ogun) Nigeria

[2]Department of Pathology & Population Medicine, Midwestern University, Glendale, 85305, (Arizona) USA

*E-mail : afolabisunmola@yahoo.com

ABSTRACT

The effects of some processing and extraction techniques on the tannin content and antioxidant activities of *Sorghum bicolor* (Linn) were evaluated. The ethanolic, methanolic and water extracts from the sorghum seeds were assessed after being fermented, or oven-dried for 0 (OVD-0), 30 (OVD-30) and 60 (OVD-60) mins, along with those of the chaff collected after fermentation, and the unprocessed sorghum (control). Tannin, total flavonoids, total phenol, polyphenol contents and 2, 2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging analysis were determined. All the processing techniques combined with the extraction methods significantly reduced ($p<0.05$) the tannins. OVD-30 combined with methanol extraction, and all the oven-drying techniques combined with aqueous extraction significantly increased ($p<0.05$) the flavonoids contents. Flavonoids levels in other methanol extracts and the ethanol extracts of sorghum seeds subjected to oven-drying methods were reduced significantly ($p<0.05$). The amount of phenolic extracted with both ethanol and methanol significantly increased ($p>0.05$) during the period of oven-drying. The phenolic contents in the seeds were reduced significantly ($p<0.05$) when extracted with an aqueous solution. The amount of polyphenols was increased significantly ($p<0.05$) by ethanol extraction when treated with air-drying (OVD-0). The DPPH scavenging activity was increased significantly ($p<0.05$) by the processing methods when subjected to either aqueous or methanolic extraction. Fermentation and oven-drying are a highly effective method of reducing the anti-nutritional factors of sorghum. Therefore, the therapeutic values of the processed sorghum seeds may be improved during consumption.

Keywords: Food, Processing, Fermentation, Drying, Anti-nutrients, Antioxidant

INTRODUCTION

Sorghum (*Sorghum bicolor (Linn.)* Moench) belongs to the Poaceae family and is the fifth (5^{th}) amongst the most vital cereal such as wheat, rice and barley. It is one of the most well-known and widely cultivated crops worldwide. Currently, different types of species of the grain have been described. These include sweet sorghum, grass sorghum, grain sorghum, forage sorghum, biomass sorghum, sorghum-Sudan grass hybrids (*Sorghum bicolor x Sorghum bicolor var. sudanense*), Sudan grass (*Sorghum bicolor ssp. drummondii*) and broomcorn[1,2]. Sorghum is mostly found in the sub-tropical and tropical region of all continents apart from Antarctica. Sorghum can easily adapt to warm, hot and even dry agro-ecologies. It is the cheapest source of energy, providing above 80 % of energy for human and animals especially in the developing countries. Countries like USA, China, India, Nigeria, Mexico, Argentina, Sudan and Egypt are the top of the global production chart of sorghum[3,4]. Sorghum is usually consumed either after it has been processed into flour or as a grain during preparation of traditional meals such as bisi (popped sorghum), ugali (fermented porridge), uji (unfermented porridge), buns (fermented or unfermented dough), chapatti (flat bread), pombe (alcoholic beverage) and a non-alcoholic beverage, known as togwa[5].

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CONCLUSION

Processing of sorghum seeds with the aid of fermentation or oven-drying techniques effects modifications on biomolecules present in the plant food leading to the depletion of anti-nutrients, enhancement of the antioxidant status and health benefits. Also, optimal antioxidant benefits can best be attained when the sorghum seeds are extracted with ethanol; when either the sorghum seeds are subjected to air-drying or the chaff is extracted with methanol; and when the seeds are fermented and combined with extraction using aqueous solution. The fermented sorghum seeds are most suitable for dietary purposes since the seeds are usually processed with water for consumption. The two previous treatments are recommended for pharmacological and medicinal purposes.

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MODELING AND OPTIMIZATION OF THE ORANGE LEAVES OIL EXTRACTION PROCESS BY MICROWAVE-ASSISTED HYDRO-DISTILLATION: THE RESPONSE SURFACE METHOD BASED ON THE CENTRAL COMPOSITE APPROACH (RSM-CCD MODEL)

Tan Phat Dao[1,2], Duy Chinh Nguyen[1], Thien Hien Tran[1], Phan Van Thinh[3], Vu Quang Hieu[1], Dai Viet Vo Nguyen[4], Trinh Duy Nguyen[1,5,6,*] and Long Giang Bach[1,5,7,]**

[1]NTT Hi-Tech Institute, Nguyen Tat Thanh University, Ho Chi Minh City, 70000, Vietnam
[2]Faculty of Chemical Engineering and Food Technology, Nguyen Tat Thanh University, Ho Chi Minh City, 70000, Vietnam
[3]Dong Nai Technology University, Bien Hoa City, Dong Nai Province, Vietnam
[4]Faculty of Chemical and Natural Resources Engineering, Universiti Malaysia Pahang, Malaysia
[5]Graduate University of Science and Technology, Vietnam Academy of Science and Technology, Ha Noi, Vietnam
[6]Department of Chemical Engineering, Pukyong National University, Busan, 608-739, Republic of Korea
[7]Department of Imaging System Engineering, Pukyong National University, Busan 608-737, Republic of Korea
*E-mail: ndtrinh@ntt.edu.vn, blgiang@ntt.edu.vn

ABSTRACT

Although being a by-product after the harvest, orange leaves could be used to produce essential oil through extraction. Application of the essential oil extracted from orange leaves is diverse ranging from food flavoring to cosmetics. This study aimed to develop optimal conditions for microwave assisted hydro-distillation of essential oil from orange leaves. The selected optimization method is Response Surface Methodology in conjunction with the central composite experiment design. The factors that were varied for the production of the orange leaves oil extraction were material-to-water ratio, extraction time, and microwave power. Accordingly, a statistical model was established and Analysis of variance (ANOVA) was carried out to identify the set of factors that gives the highest essential oil yield. Optimization results revealed optimal conditions as follows, material and water ratio of 3.46:1 (mL/g), extraction time of 100.47 min and operating power of 471.58 W. These conditions correspond to the essential oil yield of 0.43% with 92.1 % reliability. In addition, we also analyze the produced essential oils by gas chromatography-mass spectrometry (GC-MS). The GC-MS results revealed that major components of essential oil were Sabinene (30.556 %), Cis-Ocimene (10.139 %), and D-Limonene (9.682 %).

Keywords: Orange Leaves Oil, Microwave-assisted Hydro-distillation, Response Surface Methodology, GC-MS.

INTRODUCTION

Extraction technology plays a crucial role in the sustainability of the agro-food industry and the processing industry [1-4]. Nowadays, consumers tend to use products of natural origin which is health-beneficial and causes no side effects when taken accordingly.

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coefficients (R^2 = 0.9378, Adj. R^2 =0.8819) and the significance of the lack of fit ($p > 0.05$). This study serves as the precursor for the production of industrial scale by discovering optimal conditions of orange leaf oil extraction. In addition, not only did the MAHD method give very high oil yield, but the results of GC-MS also showed that the beneficial components existed in very high content in the essential oil.

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