e-ISSN: 2319-9849
p-ISSN: 2322-82

Research and Reviews: Journal of Chemistry

Health Hazards of Silicagel

Shiva kumar S[1]*,Sowjanya.P[2] and Subhashini D[3]

[1]Department of Chemistry, National Institute of Technology Warangal, Telangana, India
[2]Department of Pharmaceutical Analysis, Dr. C.S.N Institute of Pharmacy, Bhimavaram, Andhra Pradesh, India
[3]Department of Biotechnology, SASTRA University, Thanjavur, Tamil Nadu, India

Commentary

Received: 21/04/2015
Revised: 08/04/2015
Accepted: 05/05/2015

*For Correspondence
Department of Chemistry,
National Institute of Technology
Warangal, Telangana, India.
Email:sonnaila4488@gmail.com

Keywords: Silica gel, Synthetic chemistry, Hazardous nature, silicosis.

ABSTRACT

Synthetic chemistry is one of the subdicipline of organic chemistry involving synthesis of chemical compounds. One main element in the synthetic chemistry discipline is purification of the synthesised chemical mixtures. There are many ways to purify the chemical compounds but most preferred one is the chromatographic technique. Chromatography is technique of separating and analysing the components of a mixture of liquids or gases by selective adsorption on to the medium like paper, alumina, silica gel and more.

Out of all medium most preferred one is silica gel. Due to its amorphous and porous nature used for achieving a desired separation of certain molecular sizes. Due to silica gel's polarity, non-polar components tend separate mixtures very cleanly.

But the question is it good to use silica gel to its maximum extent? Answer is NO. It causes lot of hazards to the human body. Most of the researchers from developing and poor countries use silica gel manually without knowing its Hazardous nature.

.

INTRODUCTION

Synthetic chemistry is a Brach of organic chemistry, involving synthesis of chemical compounds with various techniques. Purification of synthesized compounds with chromatography technique based on adsorption principle involving silica gel as a medium is a challenge due to silica gel hazardous nature [1-24].

Silica gel is a granular, vitreous, porous form of silicon dioxide made synthetically from sodium silicate. Silica gel is tough and hard. It is more solid than common household gels like gelatin or agar. It is a naturally occurring mineral that is purified and processed into either granular or beaded form.

There are three types of Silica gel.

Type A - clear pellets, approximate pore diameter: 2.5 nm, drying and moisture proof properties are often used as catalyst carriers, adsorbents, separators and variable-pressure adsorbent.

Type B - clear white pellets pore diameter: four.5-7.0 nm, liquid adsorbents, drier and fragrance carriers, conjointly could also be used as catalyst carriers, cat litter.

Type C - clear, micro-pored structure, stuff for preparation of colloid cat litter. Additionally dried and screened, it forms macro-pored silica gel which is used as drier, adsorbent and catalyst carrier.

Silica gel's high specific surface area (around 800 m2/g) permits it to take up water easily, creating it helpful as a drier (drying agent) [25]. Silica gel is usually represented as "absorbing" wetness, which can be applicable once the gel's microscopic structure is unnoticed, as in silica gel packs or different product. But with chemicals, silica gel removes wetness by adsorbing onto the surface of its varied pores instead of by absorption into the majority of the gel.

e-ISSN: 2319-9849
p-ISSN: 2322-82

Discussion

In chemistry, silica gel is used in chromatographic techniques as a stationary medium [26]. In column chromatography, the stationary phase is most often composed of silica gel. Different types of silica gel differing in particle sizes are used for achieving a desired separation of certain molecular sizes in chemical mixtures. Based on the polarity difference the silica gel is capable of separating the chemical mixtures.
The hydroxyl (OH) groups on the surface of silica can be functionalized to afford specialty silica gels that exhibit unique stationary phase parameters. These so-called functionalized silica gels are also used in organic synthesis and purification as insoluble reagents and scavengers.
Chelating groups have also been covalently bound to silica gel. These materials have the ability to remove metal ions selectively from aqueous media. Chelating groups can be covalently bound to polyamines that have been grafted onto a silica gel surface producing a material of greater mechanical integrity. Silica gel is also combined with alkali metals to form an M-SG reducing agent.
Considering the above properties of silica gel researchers are inclined to use silica gel. In developed countries vast expansion of technology has bought sophisticated instruments for purifications of chemical mixtures involving silica gel. But developing and poor countries not in a position to afford such expensive instrumentation are adapted to the techniques involving usage of silica gel manually.

Due to the amorphous nature of silica it easily enters in to respiratory system of Human and causes lot of effects. Inhaling finely divided crystalline silica dust can lead to silicosis, bronchitis, or cancer , as the dust becomes lodged in the lungs and continuously irritates them, reducing lung capacities[27-40]. Studies of workers with exposure to crystalline silica have shown 10-fold higher than expected rates of lupus and other systemic autoimmune diseases compared to expected rates in the general population [41-51].

In the body crystalline silica particles do not dissolve over clinically relevant periods. Silica crystals inside the lungs can activate the NLRP3 inflammasome inside macrophages and dendritic cells and thereby result in processing of pro-Interleukin 1 beta into its mature form [52-62]. Chronic exposure to silica may thereby account for some of its health hazards, as interleukin-1 l s a highly pro-inflammatory cytokine in the immune system [63-77]. This effect can create an occupational hazard for people working with sandblasting equipment, products that contain powdered crystalline silica and so on. Children, asthmatics of any age, allergy sufferers, and the elderly can be affected in much less time. Amorphous silica, such as fumed silica is not associated with development of silicosis, but may cause irreversible lung damage in some cases [78].

Considering above all as aspects it may not be a good idea to use silica gel as a regular lab chemical without taking safety precautions.

REFERENCES

1. Han J (2012) Eco-Catalysis Leads the Way to Green Synthetic Chemistry. Organic Chem Curr Res 1:e114.
2. Agatonovic-Kustrin S, Morton DW, Yusof AP (2015) Thin-Layer Chromatography - Bioassay as Powerful Tool for Rapid Identification of Bioactive Components in Botanical Extracts. Mod Chem appl 3:e120.
3. AL-Jammal MKH, Al Ayoub Y, Assi KH (2015) Development and Validation of Micro Emulsion High Performance Liquid Chromatography (MELC) Method for the Determination of Nifedipine in Pharmaceutical Preparation. Pharm Anal Acta 6:347.

4. Wang SW, Duan LR, Cao W, Xie YH, Yuan JN, et al. (2015) Simultaneous Quantitative Determination of Nine Bufadienolides in Traditional Chinese Medicinal Toad Skin from Different Regions of China by High-Performance Liquid Chromatographyâ€“Photodiode Array Detection.Pharm Anal Acta 6:345.
5. Yan L, Xie A, Wang Z, Zhang W, Huang Y et al. (2015) Pharmacokinetics of Cycloserine in Rats by HPLC-MS/MS. Med chem 5:104-107.
6. Steiner WE, English WA (2015) Emerging Trends in Gas Chromatography and Mass Spectrometry Instrumentation for Analytical & Bioanalytical Techniques. J Anal Bioanal Tech 6:e118.
7. Shuijun Li (2015) Standardization of LC-MS/MS in Clinical Laboratory. J Chromatogr Sep Tech 6:e128.
8. Black SM, Muneem S, Miller-Tuck D, Kassim PA (2015) Quantitative Analysis of L-Abrine and Ricinine Spiked into Selected Food Matrices by Liquid Chromatography-Tandem Mass Spectrometry. J Chromatogr Sep Tech 6:265.
9. Dare M, Jain R, Pandey A (2015) Method Validation for Stability Indicating Method of Related Substance in Active Pharmaceutical Ingredients Dabigatran Etexilate Mesylate by Reverse Phase Chromatography. J Chromatogr Sep Tech 6:263.
10. Silva MLS (2015) Comprehensive Analysis of Phytopharmaceutical Formulations â€“An Emphasis on Two-Dimensional Liquid Chromatography. J Chromatogr Sep Tech 6:262.
11. Klein DM, Pandey G, Blackwell B, Sperry K (2015) Determination of Drugs and Metabolites in Raw Wastewater Using Liquid Chromatography-Mass Spectrometry. J Forensic Res 6:268.
12. Wu PS, Kuo YT, Chen SM, Li Y, Lou BS (2014) Gas Chromatography- Mass Spectrometry Analysis of Photosensitive Characteristics in Citrus and Herb Essential Oils. J Chromatogr Sep Tech 6:261.
13. Jamil NAM, Rashid NMN, Rahmad N (2014) Liquid Chromatography MS/MS Responses on Lentinan for Structure Characterization of Mushroom Polysaccharide β-D-Glucan. J Chromatogr Sep Tech 6:260.
14. Ghahramani MR, Garibov AA, Agayev TN (2015) Determination of Radiochemical Purity of Radioactive Microspheres by Paper Chromatography. J Chromatogr Sep Tech 6:258
15. Singh A, Tandon S, Sand NK. (2014) Active Ingredient Estimation of Clopyralid Formulation by Reversed Phase HPLC. J Chromatogr Sep Tech 6:257.
16. Myron P, Siddiquee S, Azad SA, Yong YS. (2015) Tributylamine Facilitated Separations of Fucosylated Chondroitin Sulfate (Fucs) by High Performance Liquid Chromatography (HPLC) into its Component Using 1-Phenyl- 3-Methyl-5-Pyrazolone (PMP) Derivatization. J Chromatogr Sep Tech 6:256.
17. Suen SY (2015) Mixed Matrix Membranes for Adsorption Application. J Chem Eng Process Technol 6:e119.
18. Raymond LW (2014) Physiologic Strain during Treadmill Electrocardiography in the Medical Evaluation of Candidates for Hazardous Materials Duty, with and without Added Heat Stress. Emerg Med (Los Angel) 4:224.
19. Hideharu Shintani (2014) Hazardous Effect Free From Decontamination. Chem Sci j 5:e103.
20. Malik A (2014) Hazardous Cocktails: Challenges and Innovations in Bioremediation. J Bioremed Biodeg 5:e156.
21. Jining L, Chen T, Deling F, Lei W, Linjun Z, et al. (2014) Ranking and Screening Hazardous Chemicals for Human Health in Southeast China. Organic Chem Curr Res 3:126.
22. Zibe-Piegel VP, Boerngen-Lacerda R (2013) How to Detect Early Harmful and Hazardous Substance Use in Workplace: A Qualitative Study. J Alcoholism Drug Depend 1:104.

23. Hairston IS (2012) Sleep and Hazardous Drinking in the Elderly: A Clarion Call for Increased Clinical and Translational Research. J Addict Res Ther 3:e109.
24. Cecaro M (2013) Chemical Hazard in Work Place and Mass Media. J Mass Communicat Journalism S1:004.
25. Amin Shafieia, S Alireza Movahedi Naeinib (2014) assessing plant available potassium of illitic loess soils possessing high specific surface area and weak aggregation. Intl journal of plant,animal and environmental sciences 4.
26. Huang H, Zhou Y, Zhou J, Feng Y (2014) Preparation and Characterization TiO2 Microspheres for the Liquid Chromatography Stationary Phase. J Chromatograph Separat Techniq 5:237.
27. Bhagwan D. Aggarwal (2013) Lactate Dehydrogenase (LDH) as a marker enzyme to detect silica-exposure induced cytotoxicity in agate workers. International Conference on Biomarkers & Clinical Research,Philadephia.
28. Ishiura Y, Fujimura M, Kasahara K (2014) Eosinophilic Bronchial Disorders Presenting Chronic Cough; Atopic Cough, Cough Variant Asthma and Non-Asthmatic Eosinophilic Bronchitis. J Genet Syndr Gene Ther 5:217.
29. Kholjigitova M (2014) Clinico- Immunological Parallels in Chronic Obstructive Bronchitis in Adolescents. J Pulm Respir Med 4:206.
30. Zang G, Thomas A, Liu Z, Chen D, Ling H, et al. (2013) Preventing Breast Cancer Growth by Cationic Cecropin B. Biol Syst 2:112.
31. Ranade SC, Chou L, Wang T, Harris AHS, Girod S (2015) Prevalence of Cancer in Female Plastic Surgeons in the United States. J Womenâ€™s Health Care 4:229.
32. Bourton EC, Hussain H, Plowman PN, Harvey AJ, Parris CN (2015) Radiosensitivity of Human Breast Cancer Cell Lines Expressing the Breast Tumor Kinase (Brk). J Cancer Sci Ther 7:095-101.
33. Hoffman-Ruddy B, Miller S, Silverman E, Lewis V, Ho H, et al. (2015) The Contagious Head and Neck Cancer: The Role of Human Papillomavirus HPV. J Women's Health Care 4:226.
34. Narayanan NK, Tiwari AK, Kunimasa K, Ashby CR, Narayanan B (2014) Potential Role of Natural Dietary Compounds in the Modulation of Metabolomic Fingerprints of Cancer. Metabolomics 5:e131.
35. Maute L, Wicht J, Bergmann L (2015) The Dual PI3K/mTOR Inhibitor NVPBEZ235 Enhances the Antitumoral Activity of Gemcitabine in Human Pancreatic Cancer Cell Lines. J Integr Oncol 4:133.
36. Muelbert M, Maria CecÃlia FA, Gonzalez MC, Leonardo PS, Silvana PO (2015) Fruit and Vegetable Consumption in Patients with Gastrointestinal Cancer. J Nutr Food Sci 5:356.
37. Del Corso G (2015) Micro RNA as Biomarkers of Head and Neck Cancers. J Integr Oncol 4:132.
38. Allam AR, Sridhar GR, Suresh BM, Vamsidhar E, Gunna K (2008) Computational Analysis of Mutations in Colon Cancer Genes Reveals a Possible Role of Micro Satellite in Mutagenesis. J Proteomics Bioinform S1: S041-S045.
39. Appa RA, Sridhar RG, Vamsi TMN, Ram Babu SS, Ravi SN, et al. (2008) Study of Microsatellites Role in BRCA2 Gene Causing Pancreatic Cancer and Breast Cancer. J Proteomics Bioinform S1: S038-S040.
40. Shimodaira S, Higuchi Y, Koya T, Kobayashi T, Yanagisawa R, et al. (2015) Smoking Influences the Yield of Dendritic Cells for Cancer Immunotherapy. Pharmaceut Reg Affairs 4:133.
41. Adelowo OO, Bello MKN (2014) Systemic Autoimmune Diseases: Not So Rare in Black Africans. Rheumatology (Sunnyvale) 4:130.
42. Soo Jin L, June-K C, Taemoon C, Hyewon Y, Jin C P, et al. (2014) Multiglandular Autoimmune Diseases of the Thyroid, Salivary Gland, and Liver along with Atrophic Gastritis: A Case Report. Thyroid Disorders Ther 3:164.

43. Turiel M, Gianturco L, Galaverna S, Colombo C, Stella D, et al. (2014) Strategies for Early Identification 0f Atherosclerosis in Systemic Autoimmune Disease. J Cardiovasc Dis Diagn 2: 167.
44. Yang DH, Chen CH, Wei CC, Cheng YW (2014) Expression of Complement Receptor Type 1 on Erythrocytes in Autoimmune Diseases. J Mol Biomark Diagn 5:163.
45. Turiel M, Colombo C, Signorello MC, Gianturco L, Sarzi-Puttini, et al. (2013) Subclinical Cardiovascular Involvement in Autoimmune Diseases: Role of Coronary Flow Reserve. Immunome Res 9:072.
46. Zhang Y (2013) The Potential "Core" of Vitamin D Receptor and Vitamin D Hypothesis: Synthesis of Common Basis of Some Autoimmune Diseases and Associated Cancers via Autophagy. Clon Transgen 3:e106.
47. Zhang Y (2013) Emerging Vitamin D Receptor-Centered Patterns of Genetic Overlap across Some Autoimmune Diseases and Associated Cancers. J Genet Syndr Gene Ther 4:e123.
48. Zhang Y (2013) Genetic Basis of DAF-12/Vitamin D Receptor (VDR) in Autoimmune Immunity, Autoimmune Diseases and Associated Cancers. Clon Transgen 2:e105.
49. Abdulkareem IH (2013) The Role of Biological Agents in Immunotherapy. Metabolomics 3:116.
50. Yang J, Skepner J, Trocha M, Ghosh S (2013) Small Molecule Inhibitors Targeting the Th17 Cell Transcription Factor ROR?t for the Treatment of Autoimmune Diseases. J Clin Cell Immunol 4:e111.
51. Borgmann S (2012) Infectious Trigger of Anca-Associated Vasculitides and Other Autoimmune Diseases. J Bacteriol Parasitol 3:e112.
52. Decote-Ricardo D, Freire-de-Lima L, Morrot A, Freire-de-Lima CG (2015) Macrophage Polarization in Infectious Diseases. J Clin Cell Immunol 6:294.
53. Dutry I, Li J, Li PH, Bruzzone R, Peiris JSM, et al. (2015) The Effects of Macrophage Polarity on Influenza Virus Replication and Innate Immune Responses. J Clin Cell Immunol 6:297.
54. Foey AD (2015) Macrophage Polarisation: A Collaboration of Differentiation and Activation Signals as well as Monocyte Pre-Programming in Health and Disease?. J Clin Cell Immunol 6:293.
55. Venter G, Wijers M, Oerlemans FTJJ, Manjeri G, Fransen JAM, et al. (2015) Glycolytic Metabolism is Differentially Coupled to Proliferative Potential and Morphodynamic Capacity in RAW 264.7 And Mafb/C-Maf Deficient Macrophage Lineages. J Clin Cell Immunol 6:292.
56. Ahmed I, Ahmad U, Keong YY, Manna NA, Othman F (2014) Induction of Nitric Oxide and TNF-Î‘ in Newcastle Disease Virus (NDV) AF2240 Infected RAW 264.7 Macrophages and their Cytotoxic Activity on MDA-MB-231 Breast Cancer Cell Line. J Cancer Sci Ther 6:478-482.
57. Lewis M, Merched AJ (2014) Tumor-Associated Macrophages, Inflammation and Pathogenesis of Hepatocellular Carcinoma. J Mol Genet Med 8:132.
58. Isidro RA, Bonilla FJ, Pagan H, Cruz ML, Lopez P, et al. (2014) The Probiotic Mixture VSL#3 Alters the Morphology and Secretion Profile of Both Polarized and Unpolarized Human Macrophages in a Polarization-Dependent Manner. J Clin Cell Immunol 5:227.
59. Cui Hua Liu (2014) M. tuberculosis and Macrophages: Co-existence and Co-evolution. J Pulm Respir Med 4:e133
60. Kaminska B, Gabrusiewicz K, Sielska M (2011) Characteristics of Phenotype and Pro-Tumorigenic Roles of Glioma Infiltrating Microglia/Macrophages. J Neurol Neurophysiol S5.
61. Du Y, Yoo D, Paradis MA, Scherba G (2011) Antiviral Activity of Tilmicosin for Type 1 and Type 2 Porcine Reproductive And Respiratory Syndrome Virus In Cultured Porcine Alveolar Macrophages. J Antivir Antiretrovir 3: 028-033.
62. McCullough KC, Milona P, Démoulins T, Englezou P, Ruggli N (2015) Dendritic Cell Targets for Self-Replicating RNA Vaccines. J Blood Lymph 5:132.

63. Qi F, Xia Y, Zuo Z, Wu Y, Yang J, et al. (2015) Immune-Based Modulation of Adult Hippocampal Neurogenesis, Link to Systemic Th1/Th2 Balance. J Vaccines Vaccin 6:274.
64. Rivera-Amill V (2014) The Human Microbiome and the Immune System: An Ever Evolving Understanding. J Clin Cell Immunol 5:e114.
65. Rahmani S, Demmouche A (2014) Iron Deficiency Anemia in Children and Alteration of the Immune System. J Nutr Food Sci 4:333.
66. Turhan A (2014) Immune System Behavior during Herpesvirus Infection in Childhood. J Infect Dis Ther 2:e104.
67. Grazia RM, Fioranelli M (2014) The History of Low Dose Medicine Research Review of Preclinical and Clinical Studies with Low Dose SKA Cytokines Since 2009. Microinflammation 1:115.
68. Stamenkovic H, Saranac Lj, Djuric Z, Stankovic T, Kamenov B, et al. (2014) Immune System Behavior during Herpesvirus Infection in Childhood. J Infect Dis Ther 2:162.
69. Yeh LT, Chuang YP, Chen SJ, Chu CC, Sytwu HK (2014) Diabetic Animal Models with Infectious Diseases: Focus on the Dysfunction of Immune System. J Diabetes Metab 5:417.
70. Radic MZ and Bowlin GL (2014) Innate Immunity Response to Tissue Engineering Templates: The Determinant.JTissueSciEng5:e129.
71. Kumar A, Sharma N, Singh S, Sasmal D, Dev A (2014) "Oral Vaccine Antigen Induced Immune Response Signalling Pathways: Current and Future Perspectives". J Vaccines Vaccin 5:225.
72. Stefanini C, Colivicchi MA, Della Corte L, Ward RJ, de Witte P, et al. (2014) Ethane-β-Sultam Modifies the Activation of the Innate Immune System Induced by Intermittent Ethanol Administration in Female Adolescent Rats. J Alcohol Drug Depend 2:150.
73. Kallick Rush CA (2014) The Potential Relationship of the Ehrlichia to Immune System Dysfunction: Etiology and Pathogenesis. Rheumatology 4:128.
74. Carlsson RH, Hansen Ã…M, Kristiansen J, Nielsen ML, BlÃ¸nd M (2014) Workplace Re-organization and Changes in Physiological Stress Markers. Occup Med Health Aff 2:148.
75. Hsu HW, Lang CL, Wang MH, Chiang CK, Lu KC (2014) A Review of Chronic Kidney Disease and the Immune System: A Special Form of Immunosenescence. J Gerontol Geriat Res 3:144.
76. Vijay Kumar (2013) Tumor Microenvironment and Immune System: Sworn Enemies Living Together. J Blood Lymph S1:e001.
77. Shaw CA, Kette SD, Davidson RM, Seneff S (2013) Aluminum's Role in CNS-immune System Interactions leading to Neurological Disorders. Immunome Res 9:069.
78. Ralph A Pietrofesa BS, Turowski JB, Evguenia Arguiri BS, Milovanova TN, Solomides CC, et al. (2013) Oxidative Lung Damage Resulting from Repeated Exposure to Radiation and Hyperoxia Associated with Space Exploration. J Pulm Respir Med 3:158.