**Cite this:** *Org. Chem. Res*. **Year**, *Vol,* page-page.

**DISCOVERING A NEW METHOD FOR MAKING SALICYLIC ACID**

Author Full Name, *a*Sahar Isakhani,

*Bachelor’s student of Farhangian Urmia primary school*

|  |
| --- |
| *a Organic and Nano Group (ONG), Department of Chemistry, Iran University of Farhangian Alameh Tabatabai (CFU), Urmia, Iran* |
|  |
| Received: January 01, 202X; Accepted: June 01, 202X |
| **ABSTRACT: Salicylic acid, a versatile compound with various applications, can be synthesized in different ways. It is a colorless organic acid used in pharmaceuticals, skincare products, and as a precursor for other chemicals. Salicylic acid has anti-inflammatory properties and is commonly used in topical treatments for skin conditions like acne and psoriasis. It is also used in the production of aspirin and as a preservative in food and personal care items.There are three main methods of synthesizing salicylic acid. The Kolbe-Schmitt Reaction involves treating phenol with carbon dioxide to form sodium phenoxide, which then becomes salicylic acid. Salicylic acid can also be prepared by oxidizing salicylaldehyde using strong oxidizing agents or hydrolyzing methyl salicylate found in wintergreen oil. Salicylic acid is widely used in various industries. In pharmaceuticals, it is a key ingredient in aspirin and other pain relievers, as well as anti-acne treatments and medicated shampoos. It is commonly found in skincare products like cleansers and acne creams due to its pore-cleansing and exfoliating properties. Additionally, it serves as a preservative in food and personal care items to prevent bacterial and fungal growth. Although generally safe, salicylic acid can cause skin irritation and allergic reactions in some individuals. Using it as directed and discontinuing use in case of adverse reactions is important.Overall, understanding the synthesis and applications of salicylic acid allows for the development of innovative products and treatments in various industries.** |
| **Keywords**: Salicylic acid , Aspirin , Benzoyloxonium , Phenol , Methyl Salicylate |

**1. INTRODUCTION**

Salicylic acid, a versatile compound used in a variety of industries and products, can be synthesized in many ways. In this article, we will discuss the process of making salicylic acid, including its chemical properties, uses, and various synthetic methods. Understanding Salicylic AcidAlso known as 2-hydroxybenzoic acid, salicylic acid, or it is made of willow and birch bark. , a type of beta-hydroxy acid (BHA) that occurs naturally in plants such as wintergreen. It is a colorless film organic acid that is widely used as an indicator in the formulation of pharmaceuticals, skin care products and other chemicals.Salicylic acid has anti-inflammatory, analgesic and antipyretic properties, and let it be a simple introduction It is used to treat skin conditions such as acne, psoriasis and warts. It is also used to make aspirin (acetylsalicylic acid) and as a preservative in food and personal care products. Synthesis Method1. \*\*Kolbe-Schmidt Reaction\*\*: One of the most common methods for synthesizing salicylic acid is the Kolbe-Schmidt reaction. In this process, phenol is treated with carbon dioxide under basic conditions to form sodium phenoxide, which then undergoes a decarboxylation reaction to produce salicylic acid.2. \*\*From salicylaldehyde\*\*: Salicylic acid can also be prepared by neutralizing salicylaldehyde using strong oxidizing agents such as potassium permanganate and chromic acid. This method is used in a laboratory setting to synthesize small amounts of salicylic acid.3. \*\*Methyl salicylate\*\*: Methyl salicylate, a compound found in wintergreen oil, can be hydrogenated to produce salicylic acid. This process involves converting methyl salicylate to salicylic acid and methanol by treating it with a strong base such as sodium hydroxide. Industrial ApplicationsSalicylic acid is used in a wide range of industrial applications, including: . \ n- \*\*Chemical\*\*: Salicylic acid is the main ingredient in the manufacture of aspirin and other pain relievers. Also used in acne treatments and medicated soaps.- \*\*Skin Care Benefits\*\*: Salicylic Acid unclogs pores and tightens skin.- \* \*Benefits\*\*: Salicylic Acid Salicylic acid helps fight bacteria and fungi. It is used as a preservative in food and personal care products to prevent the growth of can cause skin irritation and allergic reactions. It is important to use salicylic acid products as directed and to discontinue use if side effects occur.In conclusion, salicylic acid is a beneficial compound with various applications in various industries. By understanding how salicylic acid is synthesized and used, researchers and manufacturers can maximize its potential to develop new products and treatments.

**2. PRODUCTION OF SALICYLIC ACID FROM BENZENE**

Phenol can be converted to Salicylic acid: When phenol reacts with carbon dioxide in the presence of a base such as, this reaction is called a Kolbe reaction. The final product is salicylic acid. The following reaction shows the formation of salicylic acid from phenol.



**3. PRODUCTION OF SALICYLIC ACID FROM BENZOYLOXONIUM**

****

If we react this material in the picture with hydroxyl, salicylic acid is easily created.(carboxylic acid)

**4. MAKING REACTION OF CARBOXYLIC ACID WITH HYDROXYL (BENZENE)**

After neutralizing the chemical in the picture above (3): In this study, we investigated the secondary formation of HO2 after the reaction of benzene + OH in N2 and O2 species at atmospheric pressure and room temperature in the absence of NO. After OH formation, HOx(=OH + HO2) and OH decay curves were measured using laser-induced fluorescence (LIF) technology. The total yield of HO2 in synthetic air was determined to be 0.69 ± 0.10 compared to results obtained using CO as the reference compound. HO2 is a direct product of the reaction of O2 with the adduct intermediate OH-benzene. The HO2 yield is slightly higher than the expected phenol product HO2 yield (~53%). This represents another minor channel for HO2 production in the absence of NO. The formation of various epoxides is considered in the literature. For the other compounds tested, the upper limits of HO2 yield were 0.10 (isoprene) and 0.05 (cyclohexane), respectively. Other experiments with low O2 concentration (0.06-0.14% in N2) showed rate constants of (2.4 ± 1.1) × 10−16 cm3 s−1 and (5.6 ± 1.1 ) × 10−12 cm3 s−1 for OH. Estimated -Benzenic additives react with O2 and O3. The electron dissociation rate of addition to benzene + OH was determined to be (3.9 ± 1.3) s−1. HO2 yields at low O2 are similar to those observed in synthetic air at O2 and O3 concentrations, indicating similar HO2 yields for the addition + O2 and addition + O3 reactions.( <https://doi.org/10.1039/C1CP20334G>)

After this step, Benzoyloxonium will have an additional hydroxyl functional group, which will be salicylic acid, and it will be made in one step.

**4. PRODUCTION OF SALICYLIC ACID FROM METHYL SALICYLATE**

****

Hydrolysis of Methyl Salicylate and Synthesis of Acetylsalicylic Acid: happens within the presence of base (rather than corrosive), the carboxylic corrosive and phenolic -Gracious bunches on salicylic corrosive are ionized and this compound exists as the sodium salt of salicylic corrosive, sodium salicylate. The response blend is along these lines acidifed utilizing sulfuric corrosive, which changes over this anion into the completely protonated corrosive, salicylic corrosive. The liquor is methanol. The salicylic corrosive, which is generally insoluble, could be a strong and can be separated and decontaminated by crystallization.

 As specified over, the phenolic hydroxyl gather, which is additionally acidic, would be ionized and exist as the sodium salt during the fundamental hydrolysis, rather like the carboxylic corrosive gather, but it isn't appeared ionized in this figure since we are concerned with the ester hydrolysis. As the taking after figure appears, the phenolic -Gracious, as well as the carboxylic corrosive bunch, will be protonated amid the fermentation step taking after the expansion of the sulfuric corrosive.

The hydrolysis of methyl salicylate will be performed utilizing the taking after setup.Get approximately 25 mL of crisply arranged 5 M NaOH (or, then again, you'll break down 5.0 g of sodium hydroxide pellets in 25 mL of water). Pour into a 100-mL circular foot carafe (continuously utilize a pipe; never pour chemicals through a ground-glass opening).Include 7.5 g (0.050 mol; 50 mmol) of methyl salicylate (a fluid) to the 100-mL round-bottomed carafe containing the NaOH. (a white strong may shape, but it'll break up rapidly when the blend is warmed.)Include ~3-4 bubbling stones to avoid bumping (which is the generation of a expansive gas bubble when warmed) or uneven bubbling.Join a reflux condenser to the best of the carafe and turn on the cooling water.Warm the response blend to bubbling employing a warming shelf. Permit the blend to reflux (with cooling) for approximately 20 minutes. The fluid blend ought to be ceaselessly bubbling for the whole reflux time.After a 20 min reflux, exchange the response blend to a 250-mL measuring utencil.Include 50 mL of DI water to the response substance in your measuring utencil.Either include a blending bar or energetically stirr the arrangement with a glass blending bar as you include acid in the following step.Carefully include sufficient 3 M H2SO4 to form the arrangement acidic to litmus paper (pHydroin paper) to a pH of 1.Note:It is best to include the corrosive gradually with stirring to blend the substance instead of fair pouring the corrosive into the beacker. Mixing and adding slowly ought to avoid sodium salicylate from getting to be entangled within the strong salicylic corrosive.You'll ought to add more than 25 mL of 3 M sulfuric corrosive (for case, you may require more than 20 mL fair to neutralize the NaOH utilized within the response).Strong salicylic corrosive ought to frame as the neutralization continues.After pHydroin paper appears a pH of 1, include 1-2 mL more of the 3M sulfuric corrosive to guarantee all the salicylic corrosive accelerates. The blend will be acidic, but as well much corrosive will not be a problem:Corrosive remains corrosive in corrosive!Cool the blend in an ice-water shower to almost 0oC. Let container remain within the ice bucket for around 15 min while allowing the gems to settle.The salicylic corrosive must must be a slurry some time recently you are doing the filtration. So, in the event that the solid isn't unreservedly streaming within the measuring utencil, include sufficient water so that the strong is suspended and a fluid slurry appearance.Collect the precious stones by vacuum filtration, employing a Büchner pipe and channel paper. The filtration can be conducted most effectively by tapping off most of the supernatant fluid through the Büchner pipe some time recently including the mass of gems.Carefully wash the measuring utencil with ice cold water, in the event that fundamental, to exchange all the precious stones to the pipe.Store the salicylic corrosive gems in an dissipating dish or container within the drying broiler until the another lab period. Since your collected precious stones from an corrosive arrangement, you cannot store your filter paper along with your chemical. (Copyright Donald L. Robertson (Date last modified: 11/14/2012))

**5. CONCLUSION**

Salicylic acid is an acidic substance that is used in the manufacture of exfoliating cosmetics, and its industrial production is very expensive and difficult, which requires advanced devices. It is hoped that better and convenient methods for the production of this substance will be discovered.

**Author(s) ID**

S.R: : 0009-0003-0488-1394

**Acknowledgements**

I appreciative to the Farhangian Alameh Tabatabai Urmia University,

for their partial support of this work**.**

**References**

1. Li Y, Zhang W, Dong H, et al. Salicylic acid in Populus tomentosa is a remote signalling molecule induced by Botryosphaeria dothidea infection. Scientific reports, 2018, 8(1): 1-9.

2. Zhang Y, Li X. Salicylic acid: biosynthesis, perception, and contributions to plant immunity. Current opinion in plant biology, 2019, 50: 29-36.

3. Dempsey D M A, Klessig D F. How does the multifaceted plant hormone salicylic acid combat disease in plants and are similar mechanisms utilized in humans?. BMC biology, 2017, 15(1): 1-11.

4. Zheng W, Yoo K H, Abd El-Aty A M, et al. Quantitative determination of carbasalate calcium derived metabolites, acetylsalicylic acid and salicylic acid, in six animal foods using liquid-liquid extraction method coupled with liquid chromatography-tandem mass spectrometry. Food chemistry, 2019, 278: 744-750.

5. Azerad, R. 2001. Editorial overview: better enzyme for green chemistry. Curr. Opin. Biotechnol. 12:533-534. [Google Scholar]

6. 2. Bertoni, G., F. Bolognese, E. Galli, and P. Barbieri. 1996. Cloning of the genes for and characterization of the early stages of toluene and o-xylene catabolism in Pseudomonas stutzeri OX1. Appl. Environ. Microbiol. 62:3704-3711. [PMC free article] [PubMed] [Google Scholar]

7. 3. Bertoni, G., M. Martino, E. Galli, and P. Barbieri. 1998. Analysis of the gene cluster encoding toluene/o-xylene monooxygenase from Pseudomonas stutzeri OX1. Appl. Environ. Microbiol. 64:3626-3632. [PMC free article] [PubMed] [Google Scholar]

8. 4. Burton, S. G., A. Boshoff, W. Edwards, and P. D. Rose. 1998. Biotransformation of phenols using immobilised polyphenol oxidase. J. Mol. Catal. B Enzym. 5:411-416. [Google Scholar]

9. 5. Byrne, A. M., J. J. Kukor, and R. H. Olsen. 1995. Sequence analysis of the gene cluster encoding toluene-3-monooxygenase from Pseudomonas pickettii PKO1. Gene 154:65-70. [PubMed] [Google Scholar]

10. 6. Byrne, A. M., and R. H. Olsen. 1996. Cascade regulation of the toluene-3-monooxygenase operon (tbuA1UBVA2C) of Burkholderia pickettii PKO1: role of the tbuA1 promoter (PtbuA1) in the expression of its cognate activator, TbuT. J. Bacteriol. 178:6327-6337. [PMC free article] [PubMed] [Google Scholar]

11. 7. Canada, K. A., S. Iwashita, H. Shim, and T. K. Wood. 2002. Directed evolution of toluene ortho-monooxygenase for enhanced 1-naphthol synthesis and chlorinated ethene degradation. J. Bacteriol. 184:344-349. [PMC free article] [PubMed] [Google Scholar]

12. 8. Chauhan, A., S. K. Samanta, and R. K. Jain. 2000. Degradation of 4-nitrocatechol by Burkholderia cepacia: a plasmid-encoded novel pathway. J. Appl. Microbiol. 88:764-772. [PubMed] [Google Scholar]

13. 9. Dolfing, J., A. J. van den Wijngaard, and D. B. Janssen. 1993. Microbiological aspects of the removal of chlorinated hydrocarbons from air. Biodegradation 4:261-282. [PubMed] [Google Scholar]

14. 10. Draths, K. M., and J. W. Frost. 1991. Conversion of D-glucose into catechol: the not-so-common pathway of aromatic biosynthesis. J. Am. Chem. Soc. 113:9361-9363. [Google Scholar]

15. 11. Draths, K. M., and J. W. Frost. 1995. Environmentally compatible synthesis of catechol from D-glucose. J. Am. Chem. Soc. 117:2395-2400. [Google Scholar]

16. 11a. Fishman, A., Y. Tao, and T. K. Wood. 2004. Toluene 3-monooxygenase of Ralstonia pickettii is a para-hydroxylating enzyme. J. Bacteriol. 186:3117-3123. [PMC free article] [PubMed]

17. 12. Fujita, Y., I. Mori, K. Fujita, S. Kitano, and T. Tanaka. 1985. A color reaction of 1,2-diphenols based on colored complex formation with phenylfluorone and iron (III) and its application to the assay of catecholamines in pharmaceutical preparations. Chem. Pharm. Bull. 33:5385-5392. [PubMed] [Google Scholar]

18. 13. Howe-Grant, M. (ed.). 1991. Kirk-Othmer encyclopedia of chemical technology, fourth ed., vol. 13. Wiley-Interscience Publishers, New York, N.Y.

19. 14. Johnson, G. R., and R. H. Olsen. 1997. Multiple pathways for toluene degradation in Burkholderia sp. strain JS150. Appl. Environ. Microbiol. 63:4047-4052. [PMC free article] [PubMed] [Google Scholar]

20. 15. Kadiyala, V., and J. C. Spain. 1998. A two-component monooxygenase catalyzes both the hydroxylation of p-nitrophenol and the oxidative release of nitrite from 4-nitrocatechol in Bacillus sphaericus JS905. Appl. Environ. Microbiol. 64:2479-2484. [PMC free article] [PubMed] [Google Scholar]

21. 16. Korte, J. E., I. Hertz-Picciotto, M. R. Schulz, L. M. Ball, and E. J. Duell. 2000. The contribution of benzene to smoking-induced leukemia. Environ. Health Perspect. 108:333-339. [PMC free article] [PubMed] [Google Scholar]

22. 17. Leahy, J. G., P. J. Batchelor, and S. M. Morcomb. 2003. Evolution of the soluble diiron monooxygenases. FEMS Microbiol. Rev. 27:449-479. [PubMed] [Google Scholar]

23. 18. Leahy, J. G., G. R. Johnson, and R. H. Olsen. 1997. Cross-regulation of toluene monooxygenases by the transcriptional activators TbmR and TbuT. Appl. Environ. Microbiol. 63:3736-3739. [PMC free article] [PubMed] [Google Scholar]

24. 19. Luu, P. P., C. W. Yung, A. K. Sun, and T. K. Wood. 1995. Monitoring trichloroethylene mineralization by Pseudomonas cepacia G4 PR1. Appl. Microbiol. Biotechnol. 44:259-264. [Google Scholar]

25. 20. Mitchell, K. H., J. M. Studts, and B. G. Fox. 2002. Combined participation of hydroxylase active site residues and effector protein binding in a para to ortho modulation of toluene 4-monooxygenase regiospecificity. Biochemistry 41:3176-3188. [PubMed] [Google Scholar]

26. 21. Newman, L. M., and L. P. Wackett. 1995. Purification and characterization of toluene 2-monooxygenase from Burkholderia cepacia G4. Biochemistry 34:14066-14076. [PubMed] [Google Scholar]

27. 22. Olsen, R. H., J. J. Kukor, and B. Kaphammer. 1994. A novel toluene-3-monooxygenase pathway cloned from Pseudomonas pickettii PKO1. J. Bacteriol. 176:3749-3756. [PMC free article] [PubMed] [Google Scholar]

28. 23. Oppenheim, S. F., J. M. Studts, B. G. Fox, and J. S. Dordick. 2001. Aromatic hydroxylation catalyzed by toluene 4-monooxygenase in organic solvent/aqueous buffer mixtures. Appl. Biochem. Biotechnol. 90:187-197. [PubMed] [Google Scholar]

29. 24. Pikus, J. D., J. M. Studts, K. McClay, R. J. Steffan, and B. G. Fox. 1997. Changes in the regiospecificity of aromatic hydroxylation produced by active site engineering in the diiron enzyme toluene 4-monooxygenase. Biochemistry 36:9283-9289. [PubMed] [Google Scholar]

30. 25. Robinson, G. K., G. M. Stephens, H. Dalton, and P. J. Geary. 1992. The production of catechols from benzene and toluene by Pseudomonas putida in glucose fed-batch culture. Biocatalysis 6:81-100. [Google Scholar]

31. 26. Sambrook, J., E. F. Fritsch, and T. Maniatis. 1989. Molecular cloning: a laboratory manual, 2nd ed. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y.

32. 27. Sanger, F., S. Nicklen, and A. R. Coulson. 1977. DNA sequencing with chain-terminating inhibitors. Proc. Natl. Acad. Sci. USA 74:5463-5467. [PMC free article] [PubMed] [Google Scholar]

33. 28. Shields, M. S., S. O. Montgomery, P. J. Chapman, S. M. Cuskey, and P. H. Pritchard. 1989. Novel pathway of toluene catabolism in the trichloroethylene-degrading bacterium G4. Appl. Environ. Microbiol. 55:1624-1629. [PMC free article] [PubMed] [Google Scholar]

34. 29. Shields, M. S., M. J. Reagin, R. R. Gerger, C. Somerville, R. Schaubhut, R. Campbell, and J. Hu-Primmer. 1994. Constitutive degradation of trichloroethylene by an altered bacterium in a gas-phase bioreactor, p. 50-65. In R. E. Hinchee, A. Leeson, L. Semprini, and S. K. Ong (ed.), Bioremediation of chlorinated and polycyclic aromatic hydrocarbon compounds. Lewis Publishers, Boca Raton, Fla.

35. 30. Smith, M. T. 1999. Benzene, NQO1, and genetic susceptibility to cancer. Proc. Natl. Acad. Sci. USA 96:7624-7626. [PMC free article] [PubMed] [Google Scholar]

36. 31. Stemmer, W. P. C. 1994. DNA shuffling by random fragmentation and reassembly: in vitro recombination for molecular evolution. Proc. Natl. Acad. Sci. USA 91:10747-10751. [PMC free article] [PubMed] [Google Scholar]

37. 32. Studts, J. M., K. H. Mitchell, J. D. Pikus, K. McClay, R. J. Steffan, and B. G. Fox. 2000. Optimized expression and purification of toluene 4-monooxygenase hydroxylase. Protein Expr. Purif. 20:58-65. [PubMed] [Google Scholar]

38. 32a. Vardar, G., and T. K. Wood. 2004. Protein engineering of toluene-o-xylene monooxygenase from Pseudomonas stutzeri OX1 for synthesizing 4-methylresorcinol, methylhydroquinone, and pyrogollol. Appl. Environ. Microbiol. 70:3253-3262. [PMC free article] [PubMed]

39. 33. Whited, G. M., and D. T. Gibson. 1991. Separation and partial characterization of the enzymes of the toluene-4-monooxygenase catabolic pathway in Pseudomonas mendocina KR1. J. Bacteriol. 173:3017-3020. [PMC free article] [PubMed] [Google Scholar]

40. 34. Yen, K.-M., and M. R. Karl. 1992. Identification of a new gene, tomF, in the Pseudomonas mendocina KR1 gene cluster encoding toluene-4-monooxygenase. J. Bacteriol. 174:7253-7261. [PMC free article] [PubMed] [Google Scholar]

41. 35. Yen, K.-M., M. R. Karl, L. M. Blatt, M. J. Simon, R. B. Winter, P. R. Fausset, H. S. Lu, A. A. Harcourt, and K. K. Chen. 1991. Cloning and characterization of a Pseudomonas mendocina KR1 gene cluster encoding toluene-4-monooxygenase. J. Bacteriol. 173:5315-5327. [PMC free article] [PubMed] [Google Scholar]

42. Articles from Applied and Environmental Microbiology are provided here courtesy of American Society for Microbiology (ASM)

43. https://byjus.com/question-answer/how-is-phenol-converted-to-salicylic-acid/

44. https://www.chemspider.com/Chemical-Structure.3474008.html?rid=6f41542f-79fe-48e3-8563-0b516780cd94&page\_num=0

45. William Reusch, Professor Emeritus (Michigan State U.), Virtual Textbook of Organic Chemistry

46. The Effect of Structure on the Course of Phosphoryl Chloride-Pyridine Dehydration of Tertiary Alcohols

47. Ronald R. Sauers

48. Journal of the American Chemical Society 1959 81 (18), 4873-4876

49. DOI: 1021/ja01527a028

50. Stereospecificity and regiospecificity of the phosphorus oxychloride dehydration of sterol side chain alcohols

51. Jose Luis Giner, Christian Margot, and Carl Djerassi

52. The Journal of Organic Chemistry 1989 54 (2), 369-373

53. DOI: 1021/jo00263a020

54. This article by the legendary chemist Carl Djerassi (who developed norethindrone, the first female contraceptive) describes the selectivity of POCl3-pyridine dehydration conditions in steroid synthesis. It also has a general procedure for POCl3-pyridine dehydration in the experimental section.

55. A general approach to linearly fused triquinane natural products. Total syntheses of (.+-.)-hirsutene, (.+-.)-coriolin, and (.+-.)-capnellene

56. Goverdhan Mehta, A. Narayana. Murthy, D. Sivakumar. Reddy, and A. Veera. Reddy

57. Journal of the American Chemical Society 1986 108 (12), 3443-3452

58. DOI: 1021/ja00272a046

59. This paper by Prof. Goverdhan Mehta (considered the ‘Indian E. J. Corey’) demonstrates the applicability of the POCl3-pyridine dehydration in natural product total synthesis.

60. The 3-methylcholestanols and their derivatives

61. D. H. R. Barton, A. da S. Campos-Neves and R. C. Cookson

62. J. Chem. Soc., 1956, 3500-3506

63. DOI: 10.1039/JR9560003500

64. This paper by Nobel Laureate Prof. Derek H. R. Barton has a POCl3-pyridine dehydration (see p. 3504-3505 in the experimental section).Using a Brønsted acid:

65. THE COMPOSITION OF BUTENE MIXTURES RESULTING FROM THE CATALYTIC DECOMPOSITION OF THE NORMAL BUTYL ALCOHOLS

66. William G. Young and Howard J. Lucas

67. Journal of the American Chemical Society 1930, 52 (5), 1964-1970

68. DOI: 1021/ja01368a030

69. While this would seem to be an easy thing to study today, with NMR and GC-MS, in the early days this was not so easy. The butenes were converted to dibromides, distilled, and then the three-component dibromide mixture analyzed by density, refractive index, and determination of the second-order rate constants with potassium iodide in acetone. Both Bill Young and H. J. Lucas contributed greatly to the development of chemistry in Southern California – H. J. Lucas was a professor of chemistry at Caltech, and Bill Young later became a professor of chemistry at UCLA, and was the advisor for Prof. Saul Winstein’s M.S. in chemistry (Prof. Winstein ended up joining Bill Young at UCLA after his PhD!).

70. The Dehydration of Secondary and Tertiary Alcohols

71. Albert L. Henne and Alfred H. Matuszak

72. Journal of the American Chemical Society 1944, 66 (10), 1649-1652

73. DOI: 1021/ja01238a012

74. An early paper that demonstrates the E1 nature of this reaction, by demonstrating that dehydration of various secondary and tertiary alcohols give products obtained through rearrangement.

75. Tracer studies on alcohols. Part II. The exchange of oxygen-18 between sec.-butyl alcohol and water

76. C. A. Bunton and D. R. Llewellyn

77. J. Chem. Soc., 1957, 3402-3407

78. DOI: 10.1039/JR9570003402

79. This paper provides experimental evidence that stronger acids favor elimination over substitution. As the Hammett acidity (-H0) of the medium increases, carbocation formation is increasingly favorable, which promotes elimination over substitution. Sulfuric acid and perchloric acid are much stronger acids than the hydrogen acids (HCl, HBr, HI), which explains why sulfuric acid is commonly used to make olefins from alcohols.

80. Reactions of n-butene and butan-2-ol in dilute acid. The elucidation of the mechanism and the intermediate in elimination from secondary alcohols and in the hydration of olefins

81. Joost Manassen and Fritz S. Klein

82. J. Chem. Soc., 1960, 4203-4213

83. DOI: 10.1039/JR9600004203

84. The authors use radiolabeling to study both the forward and reverse reactions (hydration of alkene and elimination of alcohol), to prove that they both go through a common carbocation intermediate.

85. The mechanism of the acid-catalyzed dehydration of 1,2-diphenylethanol

86. Donald S. Noyce, Donald R. Hartter, and Ralph M. Pollack

87. Journal of the American Chemical Society 1968, 90 (14), 3791-3794

88. DOI: 1021/ja01016a034

89. Copyright Donald L. Robertson (Date last modified: 11/14/2012)

90. Go To Experiment: [ChemDraw](https://home.miracosta.edu/dlr/211draw.htm) [1](https://home.miracosta.edu/dlr/211exp1.htm) [2](https://home.miracosta.edu/dlr/211exp2.htm) [3](https://home.miracosta.edu/dlr/211exp3.htm) [4](https://home.miracosta.edu/dlr/211exp4.htm) [5](https://home.miracosta.edu/dlr/211exp5.htm) [6](https://home.miracosta.edu/dlr/211exp6.htm) [7](https://home.miracosta.edu/dlr/211exp7.htm) [8](https://home.miracosta.edu/dlr/211exp8.htm) [9](https://home.miracosta.edu/dlr/211exp9.htm) [10](https://home.miracosta.edu/dlr/211exp10.htm) Return to [Chem211 Experiment Protocols Index](https://home.miracosta.edu/dlr/211exp.htm) Copyright Donald L. Robertson (Date last modified: 11/14/2012)

*91.* https://www.ebi.ac.uk/chebi/searchId.do?chebiId=CHEBI:16914#:~:text=Salicylic%20acid%20is%20an%20organic,of%20aspirin%20(acetylsalicylic%20acid

92.https://www.ebi.ac.uk/chebi/searchId.do?chebiId=31832

93.https://doi.org/10.1039/C1CP20334G

94.Sascha Nehr,a Birger Bohn,\*a Hendrik Fuchs,a Andreas Hofzumahausa and Andreas Wahnera

95.https://www.ebi.ac.uk/chebi/searchId.do?chebiId=CHEBI:16914#:~:text=Salicylic%20acid%20is%20an%20organic,of%20aspirin%20(acetylsalicylic%20acid).

96.https://www.sciencesnail.com/science/organic-synthesis-of-aspirin-from-benzene

97.https://www.chemspider.com/Chemical-Structure.13848808.html