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Greener and Novel Routes Towards the Synthesis of Ibuprofen

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ABSTRACT

The traditional method of manufacture of drug ibuprofen is that of six steps. But in greener method we have synthesized the same in only single step. The traditional method of manufacture of drug ibuprofen is that of six steps. But in greener method we have synthesized the same in only single step. The synthesis of the drug was from isobutyl benzene and 2-hydroxy propanoic acid. It is widely used as an important pain killer in therapeutic field.

Keywords : Drug, Greener Method, Ibuprofen, Pain killer,Therapeutic Field.

I. INTRODUCTION

Green Chemistry with its 12 principles would like to see changes in the conventional ways that were used for decades to make synthetic organic chemical substances and the use of less toxic starting materials. Green Chemistry would like to increases the efficiency of synthetic methods, to use less toxic solvents, reduce the stages of the synthetic routes and minimize waste as far as practically possible. In this way, organic synthesis will be part of the effort for sustainable development.1-3.

Green Chemistry is also interested for research and alternative innovations on many practical aspects of organic synthesis in the university and research laboratories of institutes. By changing the methodologies of organic synthesis health and safety will be advanced in the small scale laboratory level but also will be extended to the industrial large scale production processes through the new techniques. Another beneficiary of course will be the environment through the use of less toxic reagents, minimization of waste and more biodegradable by-products.[4-6]

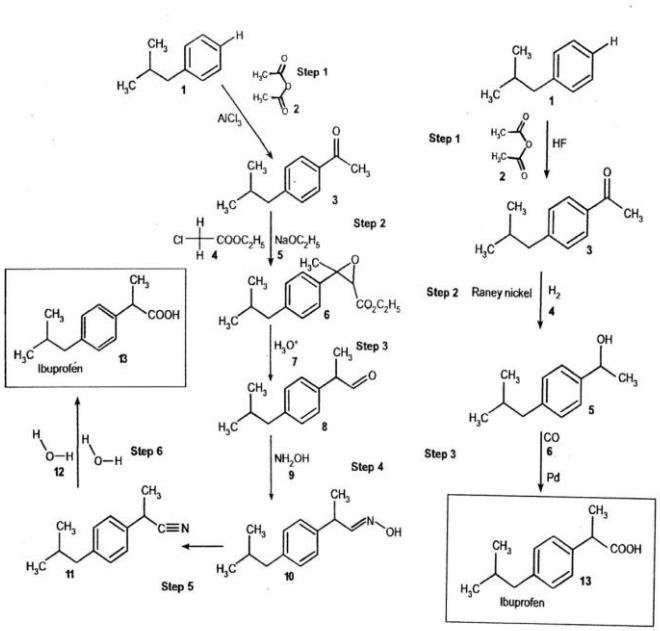
Every Green Chemistry research describe the big successes of the last decades in the field of new synthetic routes for industrial chemicals. The first is the synthesis of **Ibuprofen**, the second is the synthesis of **Adipic acid** (important starting chemical substance for Nylon and catehole and the third is the synthesis of **Maleic anhydrite** (starting material for polyesters and dyes).

The pharmaceutical industry is considered now as the most dynamic sector of the chemical industry for the 21st century. Sales of medicines and other pharmaceutical products have increased fourfold from 1985. The analgetic and anti-inflammatory drugs is a category of medicines which are produced in vast amounts every year. Some of the most important are: **Aspirin** (acetylosalicilic acid), **Acetaminophen** (Tylenol, paracetamol) and **Ibuprofen.** Ibuprofen belongs to non-steroidal anti-inflammatory drugs with very high sales. Ibuprofen. So in this context we have discovered a new greener one stepmethod of synthesis of ibuprofen. Drug.

II. Experimental Part

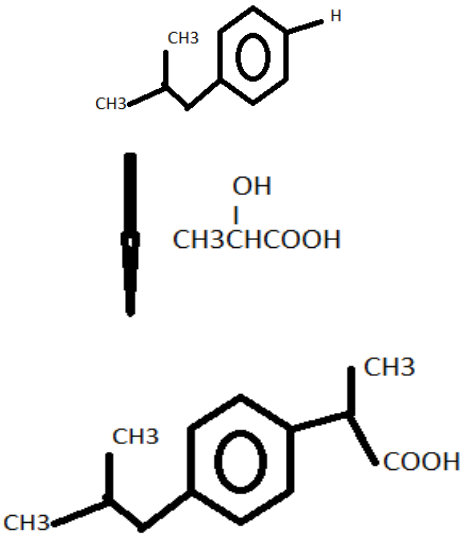
Ibuprofen was synthesized in 1960 by the pharmaceutical company Boot (England) and sold under the commercial name Aspro, Panadol and Nurofen. The synthesis of Ibuprofen was performed in six steps with the production of secondary by-products and waste. The main problem according to the scientists at the time was that this synthesis had a very "poor atom economy". [7]

The initial synthesis, observed under the "green" principles, had many disadvantages. The starting chemical could not be incorporated into the product, producing lots of by-products and waste. The six steps of the synthetic route were consuming chemicals and energy while lowering the yield of the final product.
In 1990 the company BHC after prolonged research on the subject discovered a new synthetic route with only three steps and increased efficiency. The atoms of the starting chemicals are incorporated into the products of the reactions and waste is minimized. In both synthetic routes the starting chemical is 2-methylpropylbenzene, which is produced from the petrochemical industry. The innovation in the new method was in the second step. Acatalyst of Nickel (Raney nickel) was used thus decreasing substantially the steps of the synthesis.[8]



In the old synthetic route, each step had a yield of 90% so that the final product came to be 40% yield compared to the starting chemical. This resulted in the increased production of by-products as waste. The drug was produced annually (only in Great Britain) in 3.000 tones and we understand that substantial amounts of chemicals were lost as waste. Energy also was lost by the low efficiency of the reaction method. In the "greener' method of three steps the final yield is 77%, whereas the Raney nickel catalyst (Nickel,O/Pt) can be recycled and reused. In the old synthetic route, the AlCl3 used as a catalyst had to be thrown away as waste. The energy requirements of the second method were much lower than the first.

There is only one step new greener synthesis of ibuprofen. In this step the starting material was refluxed with 2-hydroxy propanoic acid (alpha hydroxyl acid) at 120°c for ten hours and gave final product along with water, as side product. This synthesis covers 2nd and 4th principles of chemistry. This process does not require auxiliary solvents. In the greener method of one step the final yield was found to be 90%.,



The new synthetic route of Ibuprofen is a classic example of how Green Chemistry ideas can influence to the better the industrial synthetic methods, not only from the point of economic efficiency, but also

from the point of more effective science and technology methods.

III. RESULT, DISCUSSION AND CONCLUSION

Chemical industry is focusing from many years on some classic synthetic processes of important starting chemicals or crucial chemicals produced in high volume as intermediates in synthetic industrial reactions. The intention is to reduce the synthetic stages, to lower the energy use, toincrease efficiency with higher yields and to minimize waste. Also, renewable starting chemicals away from the traditional petrochemical supplies of raw chemicals is another desired innovation.

Organic chemistry chemicals are some of the important starting materials for a great number of major chemical industries. The production of organic chemicals as raw materials or reagents for other applications is a major sector of manufacturing polymers, pharmaceuticals, pesticides, paints, artificial fibers, food additives, etc. Organic synthesis on a large scale, compared to the laboratory scale, involves the use of energy, basic chemical ingredients from the petrochemical sector, catalysts and after the end of the reaction, separation, purification, storage, packaging, distribution etc. During these processes there are many problems of health and safety for workers in addition to the environmental problems caused by their use and disposition as waste.

Green chemistry, also called sustainable chemistry, is an area of chemistry and chemical engineering focused on the design of products and processes that minimize the use and generation of hazardous substances.[9] Whereas environmentalchemistry focuses on the effects of polluting chemicals on nature, green chemistry focuses on technological approaches to preventing pollution and reducing consumption of nonrenewable resources.[10-15]

It is, therefore, concluded that all the known processes of standard drugs and compounds can be renewed with green chemistry to get green product with fewer side effects, less toxicity, high yield, very few by productsand high potency. Further work on such type of greener methods may be environmentallyfriendly.

IV. SPECTRAL STUDIES

Ibuprofen- yield 60%, m.p. 76^0 c, IR [KBr, cm^{-1}]- 1750 (-COOH), 1580 (C-C of aromatic),3030 (aromatic CH),^{1}H-NMR- ($CDCl_3$, ppm)- 0.90(d, 5H), 1.51(d,3H),7.20-8.5(m, 4H), 2.45(d,2H), 3-72(q,1H), 7.11(d, 2H), 10.5(s, 1H), ^{13}C-NMR-(resonance, ppm) 181(1 signal of-COOH),140(2 signals of substituted benzene C),137 (2 signals of 4 unsustituted benzene C),45(1 signal of 2 benzylic C),30(1 signal 0f tertiary C),24(1 signal of 2 $–CH_3$), 17(1 signal of$–CH_3$), MS(m/z)207.

V. REFERENCES

[1]. Anastas PT, Warner JC. Green Chemistry: Theory and Practice. Oxford University Press, New York, 1998.

[2]. Warren D. Green Chemistry. A Teaching Resource. Royal Society of Chemistry, Cambridge, 2001.

[3]. Clark J, Macquarrie D. Handbook of Green Chemistry and Technology. Blackwell Publishing, Abingdon, Oxfordshire, 2002.

[4]. Poliakoff M, Licence P. Green Chemistry. Nature 450: 810-812, 2007.

[5]. Tundo P, Anastas PT (Eds). Green Chemistry: Challenging Perspectives. Oxford University Press, Oxford, UK, 2000.

[6]. Sheldon RA, Arends I. Green Chemistry and Catalysis. Wiley–VCH, Indianapolis, USA, 2006.

[7]. Royal Society of Chemistry (RSC). Ibuprofen- a case study in green chemistry. RSC publications, Cambridge, UK

(http://www.rsc.org/education/teachers/learnnet/ibuprofen/ibuprofen.pdf)

[8]. The BHC Company Synthesis of Ibuprofen. From Cann MC, Connelly ME. Real World Cases in Green Chemistry. American Chemical Society, Washington, DC, 2000. (http://alpha.chem.umb.edu/chemistry/orgchem/greensynthiboprufencasestudy.pdf

[9]. "Green Chemistry". United States Environmental Protection Agency. 2006-06-28. Retrieved 2011-03-23.

[10]. Sheldon, R. A.; Arends, I. W. C. E.; Hanefeld, U. (2007). "Green Chemistry and Catalysis". doi:10.1002/9783527611003. ISBN 9783527611003.

[11]. Clark, J. H.; Luque, R.; Matharu, A. S. (2012). "Green Chemistry, Biofuels, and Biorefinery". Annual Review of Chemical and Biomolecular Engineering 3: 183–207. doi:10.1146/annurev-chembioeng-062011-081014. PMID 22468603.

[12]. Cernansky, R. (2015). "Chemistry: Green refill". Nature 519 (7543): 379. doi:10.1038/nj7543-379a.

[13]. Sanderson, K. (2011). "Chemistry: It's not easy being green". Nature 469 (7328): 18. doi:10.1038/469018a.

[14]. Poliakoff, M.; Licence, P. (2007). "Sustainable technology: Green chemistry". Nature 450 (7171): 810–812. doi:10.1038/450810a. PMID 18064000.

[15]. Clark, J. H. (1999). "Green chemistry: Challenges and opportunities". Green Chemistry 1: 1. doi:10.1039/A807961G.