DRUGS AND HIGH-VALUE-ADDED MATERIALS FROM AGRICULTURAL LEFTOVERS

Pierre Vogel

Laboratory of glycochemistry and asymmetric synthesis (LGSA)
Swiss Federal Institute of Technology in Lausanne (EPFL)
Batochime, CH 1015 Lausanne, Switzerland
pierre.vogel@epfl.ch

With the future exhaust of petroleum and coal that represent our raw materials for material sciences, crop protecting agents and drugs, our civilization is confronted with the urgent need to find new sources of carbon containing raw materials. Vegetable biomass, generated from CO_2, H_2O and using sunlight as the energy source producing O_2 as a sub-product, is the best alternative to oil, gas and coal. Plants have to be used to feed men. To divert them into fuel and fine chemical production cannot be done at this moment, unless new plants are found that can have a better photochemical yield for the conversion of CO_2 into carbohydrates and other compounds, and would not require huge amount of water. Thus as long as one cannot grow biomass in the desert, only the leftovers (mainly straw) can be used as a sources of fuel and fine chemicals.[1] For many years our laboratory has developed synthetic methodology permitting to convert furans into high value added chemicals such as drugs. Furans (furan, furfural, (2-furan)methanol, 5-hydroxymethylfurfural, 2,5-dimethylfuran) are inexpensive, non-toxic compounds obtained by acidic treatment of straw (gold from garbage).[2] These products will substitute petroleum-derived chemicals that are now necessary for our civilization (energy, crop protection, health, materials, telecommunication, etc.). This presentation gives applications of our furan chemistry. We have demonstrated that furan, and its readily available derivatives, can be used to construct highly sophisticated compounds of biological interest such as anti-tumoral anthracyclines (combinatorial synthesis of polycyclic systems by tandem Diels-Alder additions[3]), sugar-like drugs (through the "naked sugar" methodology[4]) and polyketide antibiotics (starting from furan and (2-furan)methanol[5,6]). Enantiomerically pure compounds have been obtained from readily available leftovers such as tartaric acids (from wine) or from camphor derived from trees. The chemistry we have developed contributes toward sustainable development.

[1] Corma, A.; Iborra, S.; Velty, A. *Chem. Rev.* **2007**, *107*, 2411-2502.
[2] Chheda, J. N.; Huber, G. W.; Dumesic, J. A. *Angew. Chem. Int. Ed.* **2007**, *46*, 7164-7183.
[3] Vogel. P. *Anthracycline Chemistry and Biology I*, Topics in Current Chemistry 282, Springer, 2008, p. 187-214.
[4] Vogel, P. *Curr. Org. Chem.* **2000**, *4*, 455-480; *Organic Chemistry of Sugars*, Levy, D. E. ed., CRC Press, Boca Raton, FL. **2006**, 629-725.
[5] Gerber-Lemaire, S.; Vogel, P. *Eur. J. Org. Chem.* **2003**, 2959-2963.
[6] Favre, S.; Gerber-Lemaire, S.; Vogel, P. *Org. Lett*. **2007**, 9, 5107-5110.