Increasing the Atom Efficiencyfor the Sustainable Synthesis of Sorbitol Esters

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Topic: The Elements and the Periodic Table for Sustainable Chemistry

Abstract:

One of the greatest concerns about the exploitation of the elements of the Table is the achievement of the maximum efficiency and recovery of substrates, the implement of a cycle for their reuse and the guaranty of the complete sustainability of the processes. A clear example is the use of raw materials for fuel fermentation instead of non-reneweable feedstocks in the circular economy of carbon[1].

Nature has always been a source of inspiration for chemists, being the maximum exponent of sustainability, atom and energetic economy, specificity and non-hazardous synthesis. Enzymes are natural catalysts (i.e. biocatalysts) responsible for such efficiency, andthey have resulted to be essential tools for organic chemical synthesis[2].

This work presents a strategy for the single esterification of polyols (sorbitol) with free fatty acids (FFAs) to produce monoesters with surfactants properties. The sustainability of the process is guaranteed by the use of lipases as biocatalysts and ionic liquids (ILs) as solvents. Both tools are important to achieve the highest production and selectivity under soft energy conditions and to circumvent the problem of mutual immiscibility.Our data reveal the significance of the stoichiometry, the temperature, the methodology of incubation and the nature of the FFA in the yield and selectivity of the reactions. Finally, we have developed a smart and clean protocol for the purification of the products and the recovery of non-reacting substrates and solvent for setting a circular protocol of reuse.

Table 1. **Data resulted from the esterification of sorbitol (1 mmol) with different chain length FFAs**. As observed, homogenization of the medium with ultrasounds before incubation considerably improves the yield.

ENTRY	Tª (ºC)	Sorb:FFA Ratio	FFA	Yield (%)	Specificity (%)
Incubation with agitation					
1	70	2:1	Lauric Acid	61,6	95,5
2	70	2:1	Miristic Acid	**52,3**	100
3	70	2:1	Palmitic Acid	37	100
4	70	2:1	Oleic Acid	41,9	100
Incubation with Ultrasounds					
5	45	2:1	Lauric Acid	40,2	98
6	45	2:1	Miristic Acid	**36**	100
7	45	2:1	Palmitic Acid	18,3	100
8	45	2:1	Oleic Acid	16,4	100
Ultrasounds pretreatment plus Incubation with agitation					
9	70	2:1	Miristic Acid	**75,5**	100

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References

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