water

Supplementary Material

Degradation of Losartan in Fresh Urine by Sonochemical and Photochemical Advanced Oxidation Processes

John F. Guateque-Londoño [1,2], Efraím A. Serna-Galvis [1], Yenny Ávila-Torres [3,*] and Ricardo A. Torres-Palma [1,*]

1. Supplementary Texts

To determine the pseudo-first kinetic constant (k), Ln [LOS/LOS_0] vs. t (min) was plotted. The value of the slope corresponded to such constant. This kinetic constant was determined in the same way for each of the advanced oxidation processes studied in this work. For example, Figure S1 shows the determination of k for the sonochemical process and Table SM1 shows each of the constants of the degradation of losartan in the different processes of advanced oxidation in distilled water and urine (Table 1).

2. Supplementary Figures

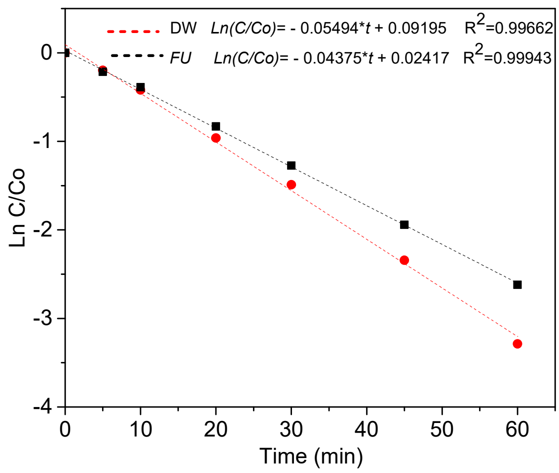


Figure S1. Determination of the kinetic constants for losartan degradation upon the sonochemical process. Ultrasound conditions: 106.3 W L^{-1}, 375 kHz.

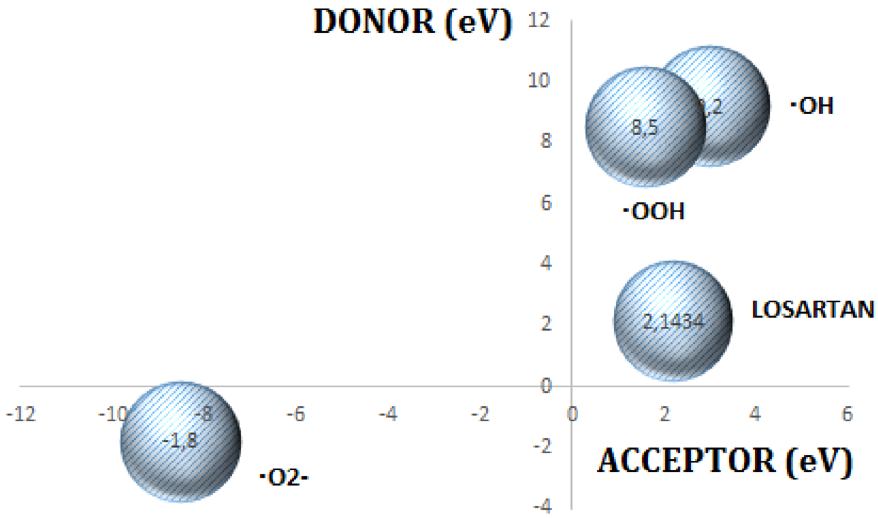


Figure S2. Donor-acceptor diagram (DAM) for the pharmaceutical losartan with respect to hydroxyl radical (·OH), hydroperoxyl radical (·OOH) and superoxide anion radical (·O_2^-).

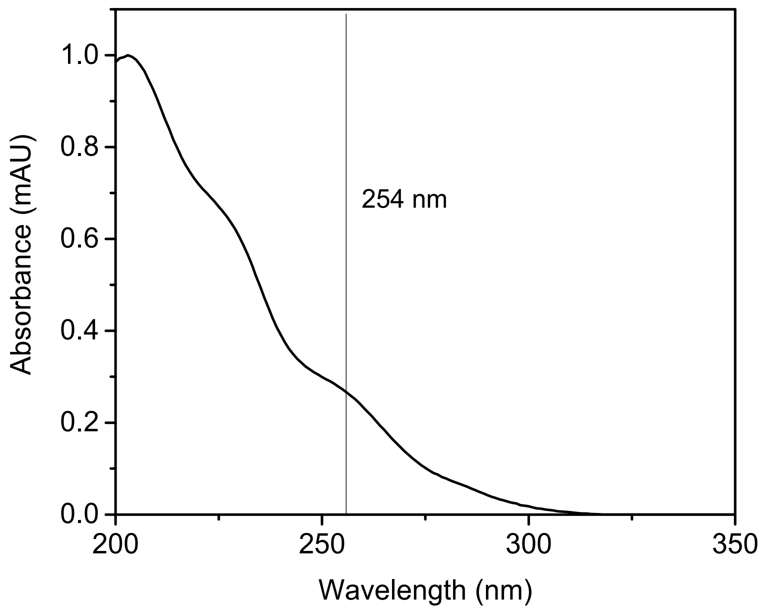


Figure S3. Absorption spectra of losartan. [LOS] = 43.38 μM, pH = 6.1.

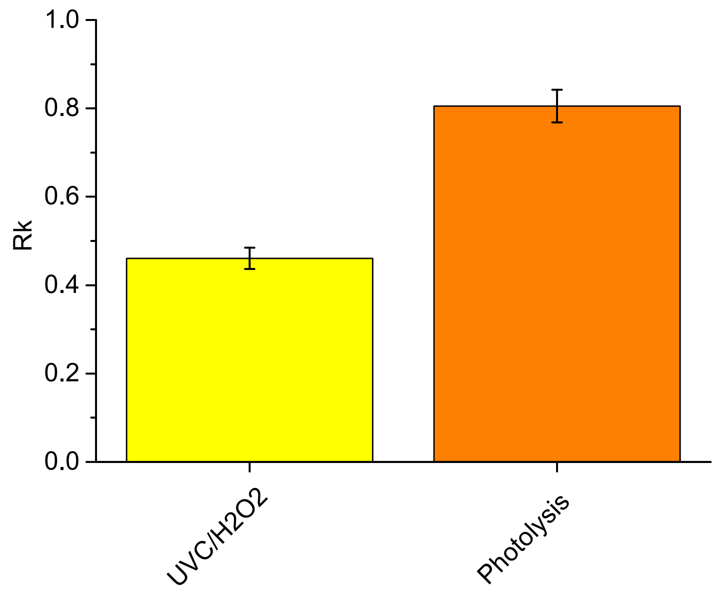
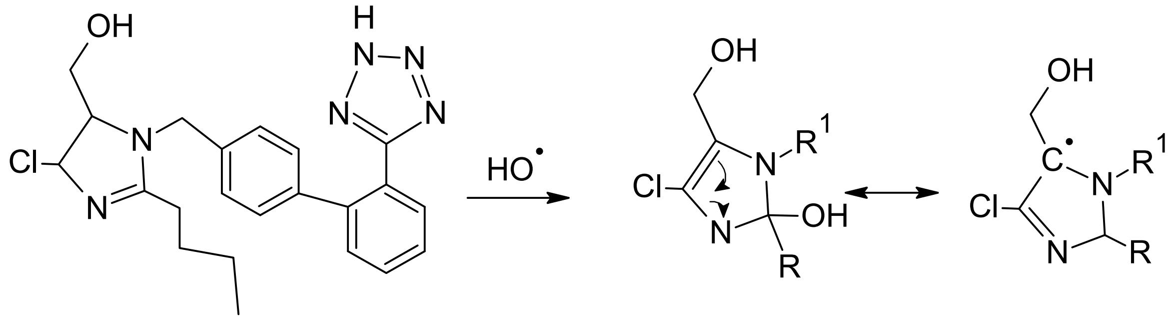
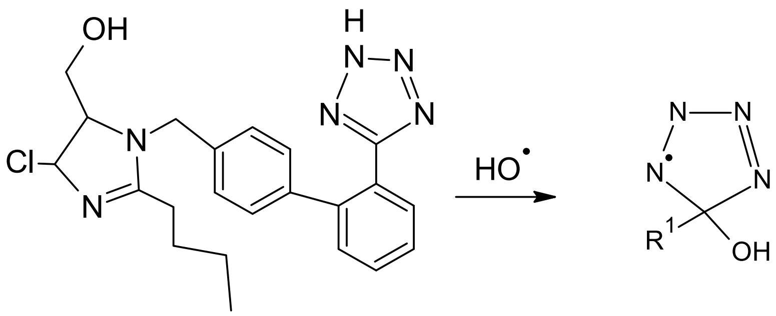


Figure S4. Comparison of Rk for UVC/H_2O_2 and UVC. Experimental conditions as indicated in Figure 1.



Note: R and R1 represent the other parts of the molecule.

Figure S5. Resonance hybrid for the product coming from the hydroxyl radical attack to the imidazole ring.

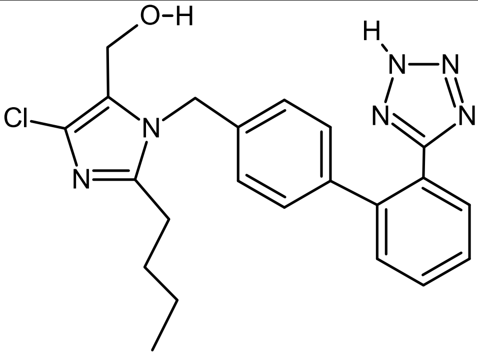
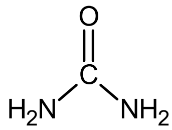


Note: R1 represents the other part of the molecule.

Figure S6. Product coming from the hydroxyl radical attack to the tetrazole ring.

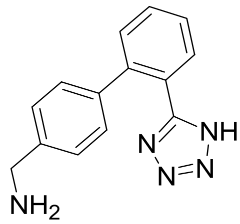
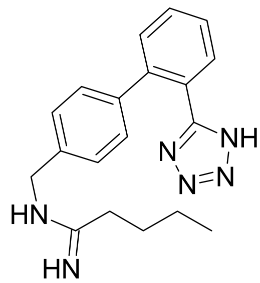
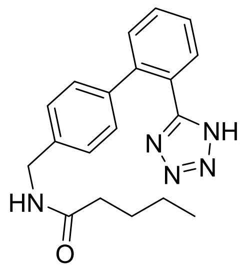
3. Supplementary Tables

Table S1. Log Kow of losartan and the components of urine*.

Compound	Structure	Log Kow
Losartan		4.01
Urea		-2.59
Sodium acetate	$C_2H_3NaO_2$	-0.22
Sodium sulfate	Na_2SO_4	-0.84
Ammonium chloride	NH_4Cl	-0.21
Sodium dihydrogen phosphate	NaH_2PO_4	-1
Potassium chloride	KCl	0.2
Magnesium chloride	$MgCl_2$	0.61
Calcium chloride	$CaCl_2$	-0.57
Sodium hydroxide	NaOH	-0.77

*Composition of urine was taken from Amstutz et al. [1].

Table S2. Primary transformation products of losartan during sonochemical treatment [2].

Product coming from	Name	Structure
	TP1	
Imidazole ring rupture	TP2	
	TP3	

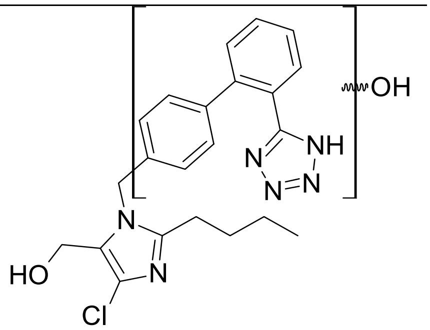
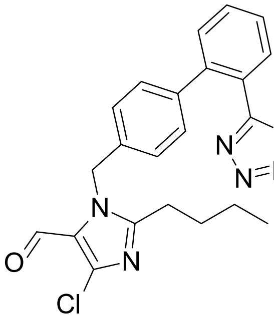
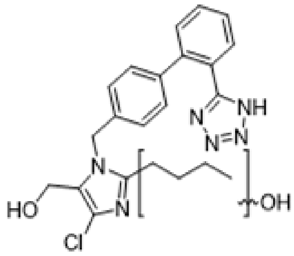
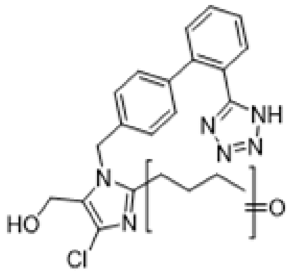
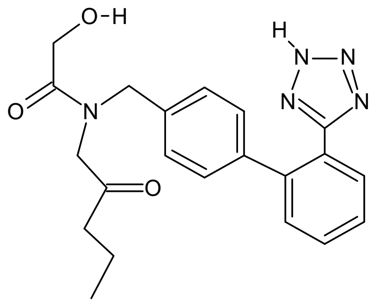
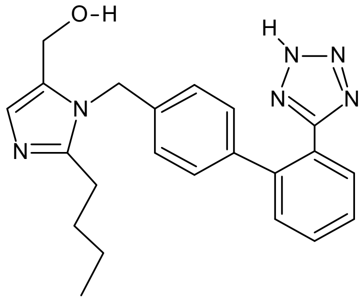
Biphenyl-tetrazole hydroxylation	TP4 (a-f) isomers	
Alcohol oxidation	TP5	
Alkyl chain oxidations	TP6	
	TP7	

Table S3. Additional products of losartan transformation by UVC/H_2O_2 and photo-Fenton (taken from supplementary reference [3]).

Product coming from	Name	Structure
Hydroxylation of carbon in the imidazole ring	TP8	
Chlorine removal	TP9	



Supplementary references

1. Amstutz, V.; Katsaounis, A.; Kapalka, A.; Comninellis, C.; Udert, K.M. Effects of carbonate on the electrolytic removal of ammonia and urea from urine with thermally prepared IrO2 electrodes. *J. Appl. Electrochem.* **2012**, *42*, 787–795, doi:10.1007/s10800-012-0444-y.
2. Serna-Galvis, E.A.; Isaza-Pineda, L.; Moncayo-Lasso, A.; Hernández, F.; Ibáñez, M.; Torres-Palma, R.A. Comparative degradation of two highly consumed antihypertensives in water by sonochemical process. Determination of the reaction zone, primary degradation products and theoretical calculations on the oxidative process. *Ultrason. Sonochemistry* **2019**, *58*, 104635, doi:10.1016/j.ultsonch.2019.104635.
3. Kaur, B.; Dulova, N. UV-assisted chemical oxidation of antihypertensive losartan in water. *J. Environ. Manag.* **2020**, *261*, 110170, doi:10.1016/j.jenvman.2020.110170.