

# Stabilisation of UHMWPE with vitamin E: chemical mechanisms

**P. Bracco**

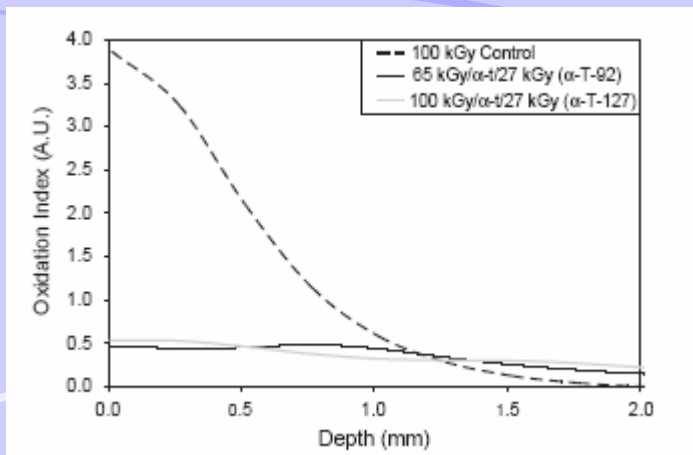
**Dipartimento di Chimica IFM and NIS Centre of  
Excellence**

**University of Torino, ITALY**

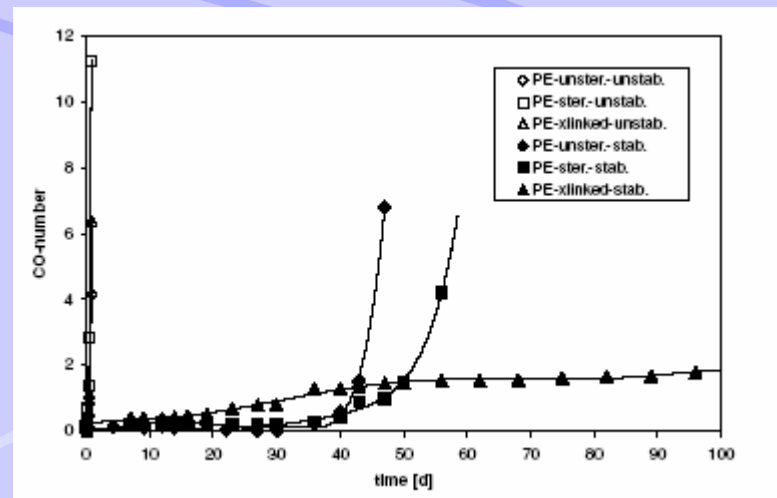


**“G.Ponzio” Chemical Library – Torino, 18th September 2003**

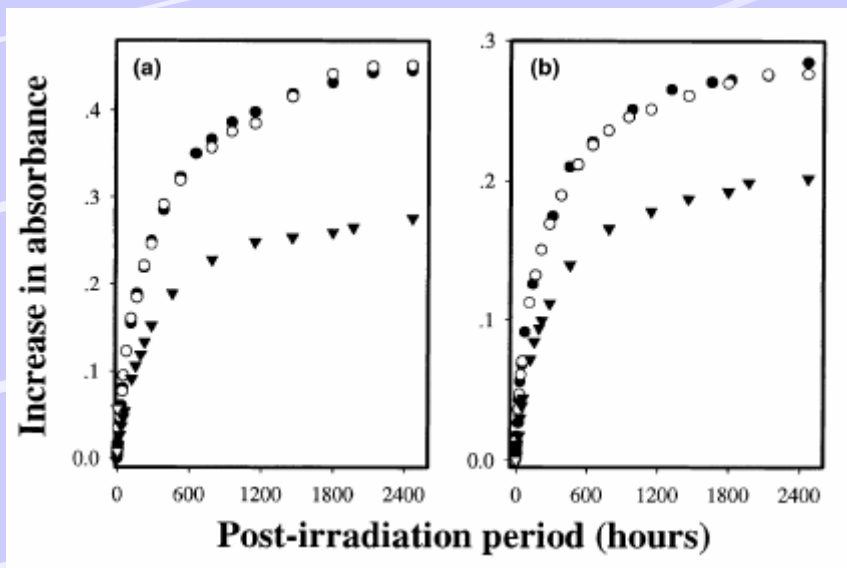




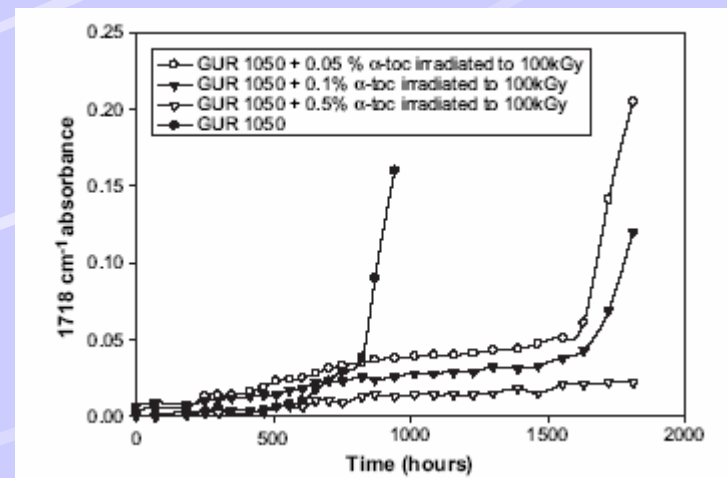
E. Oral et al. *Biomaterials* 25 (2004) 5515–5522



C.Wolf et al. *J Mater Sci: Mater Med* (2006) 17:1333–1340



J. Mallegol et al. *Nucl Instr and Meth in Phys Res B* 185 (2001) 283-293



P. Bracco et al. *Polymer Degradation and Stability* 92 (2007) 2155-2162



# CHEMICAL MECHANISMS?

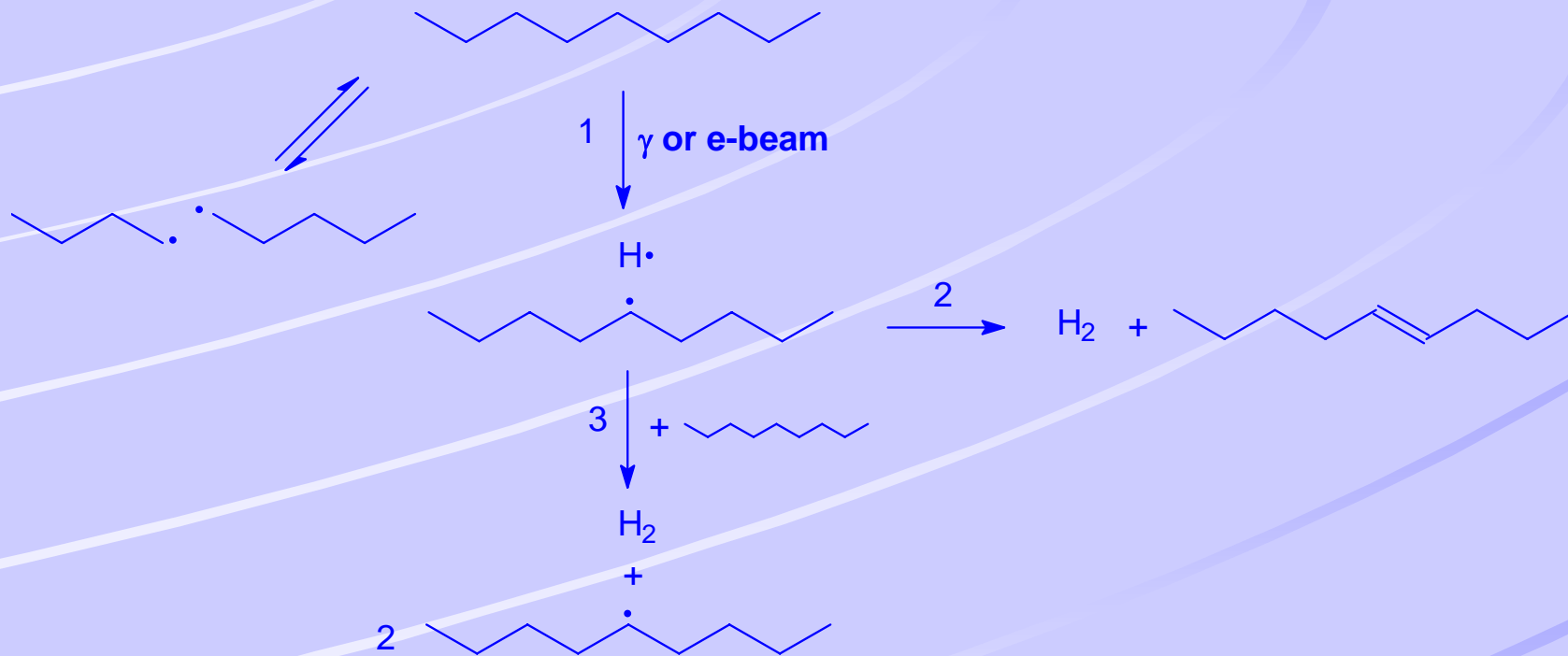
Al-Malaika et al. 1994, 1999, 2001;



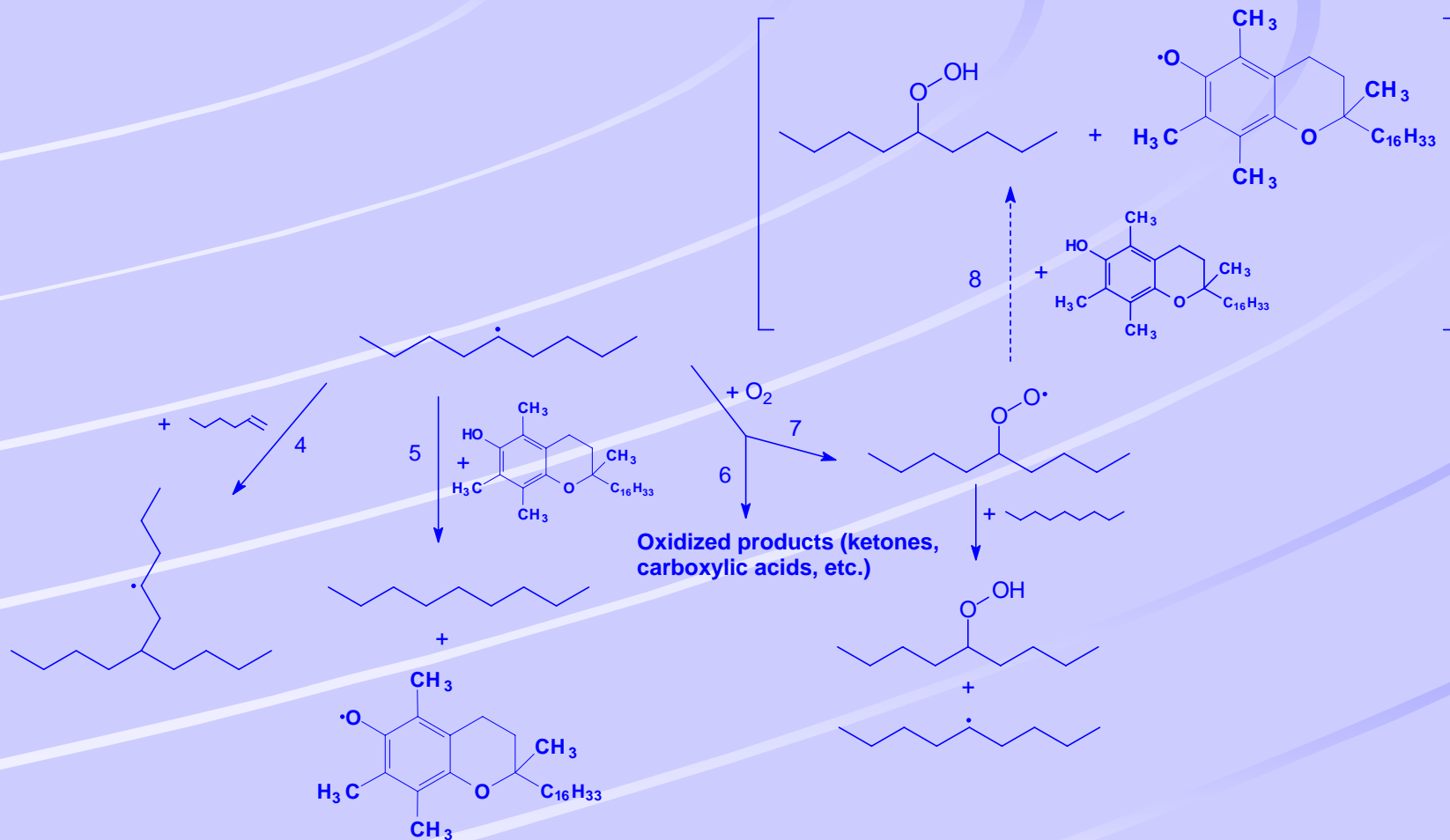
PROCESSING



# Radiation chemistry of UHMWPE: crosslinking, oxidation and stabilization



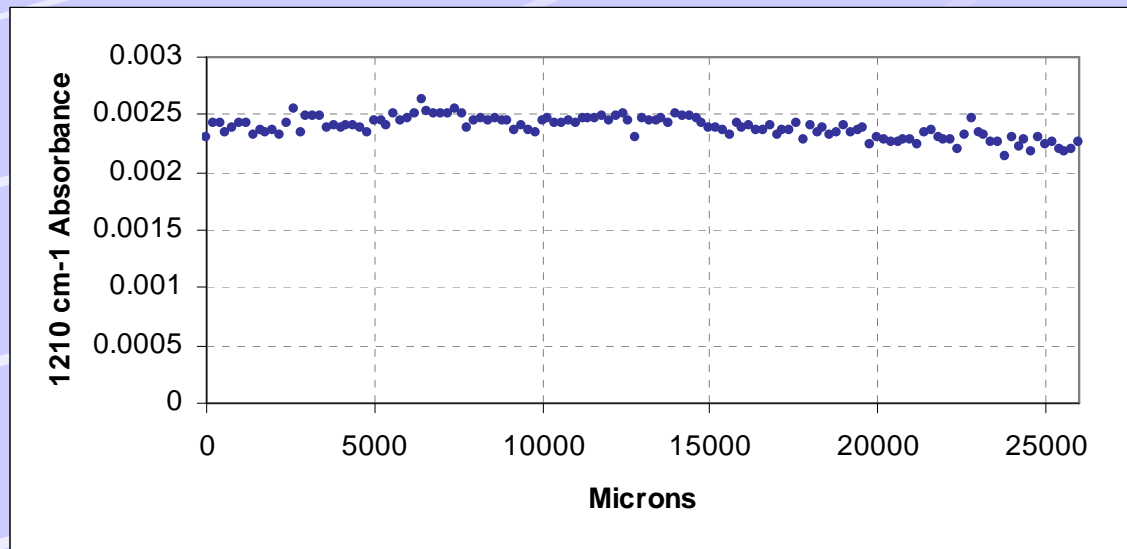
# Radiation chemistry of UHMWPE: crosslinking, oxidation and stabilization



# Experimental results

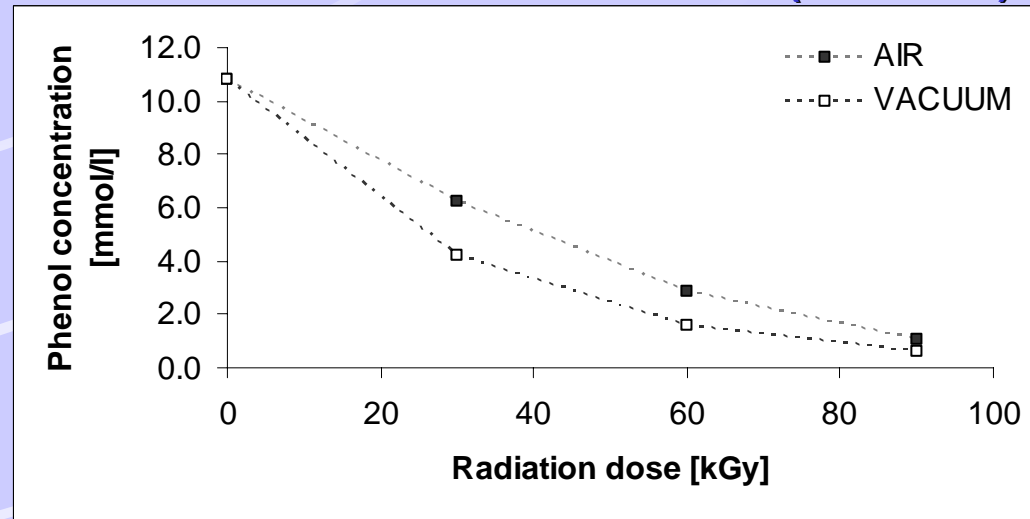
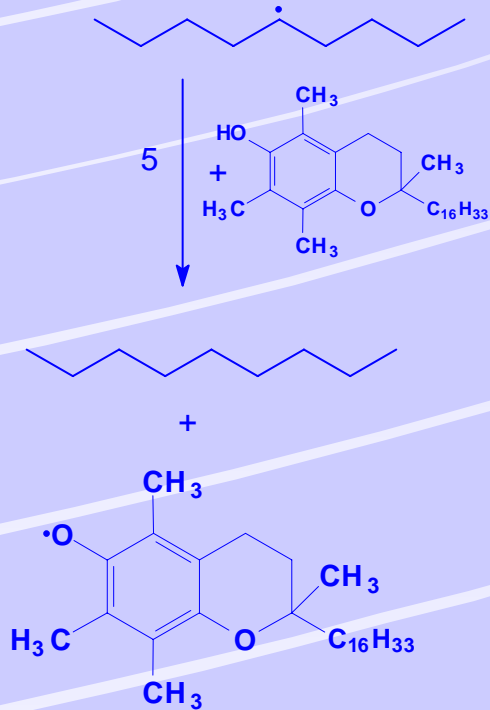
## Vitamin E-blended UHMWPE – 0.05, 0.1, 0.5% w/w

### Vitamin E distribution - UHMWPE + Vit E 0.1% w/w



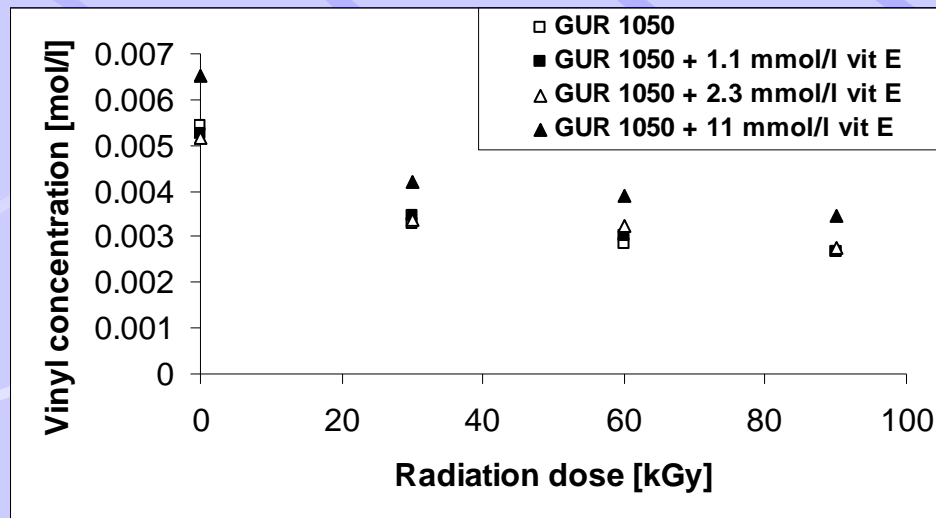
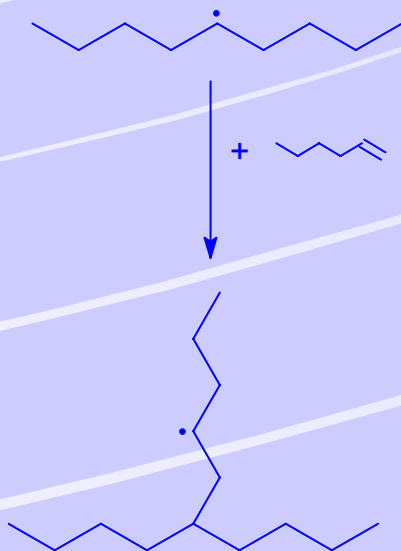
# Experimental results (I)

Phenol group concentration as a function of radiation dose - UHMWPE + Vit E 0.5% w/w (11 mmol/l)

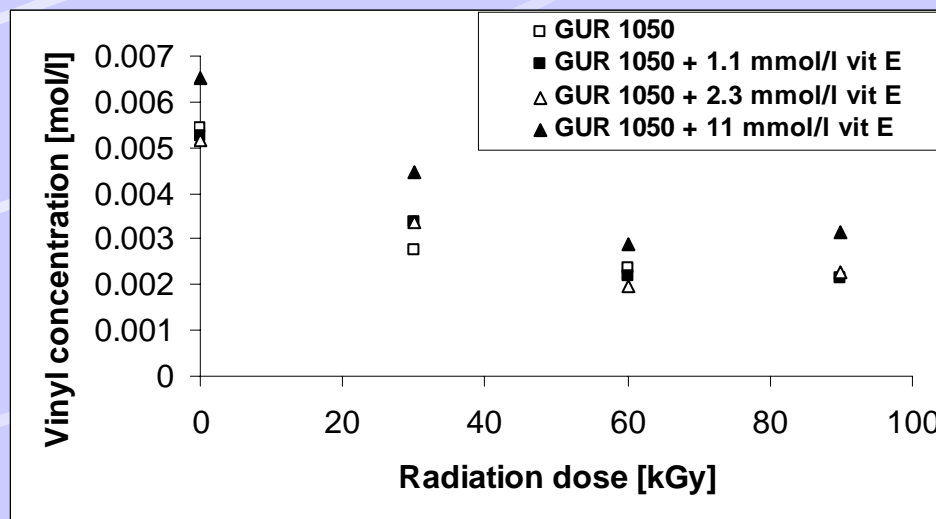




# Experimental results (II)



Irradiation in air

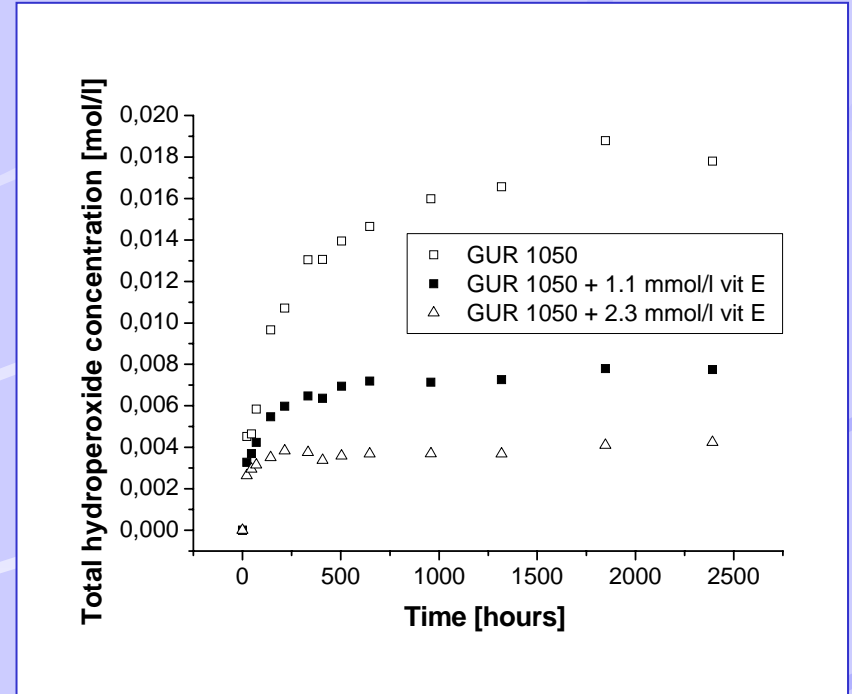
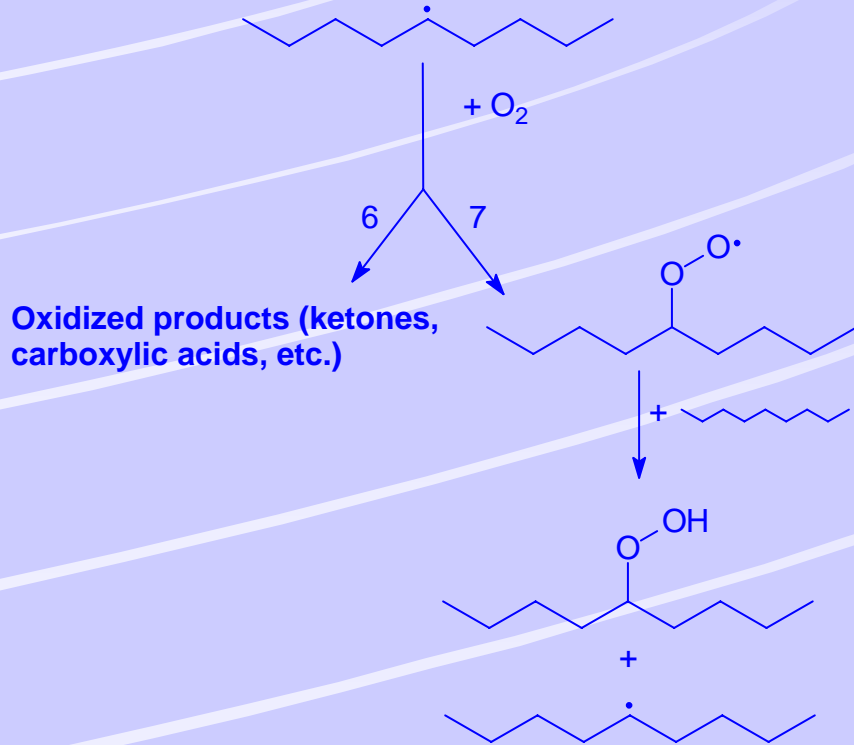


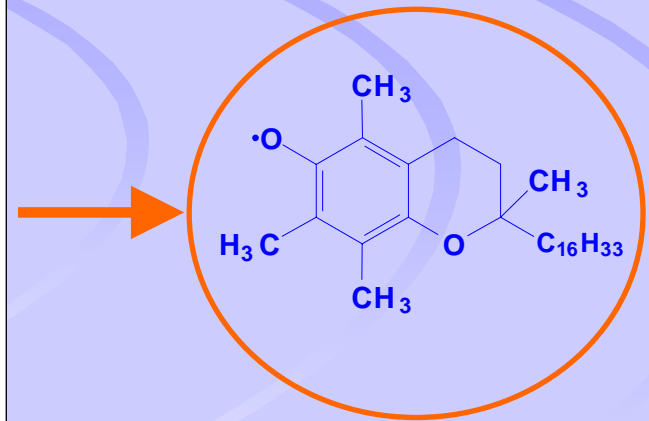
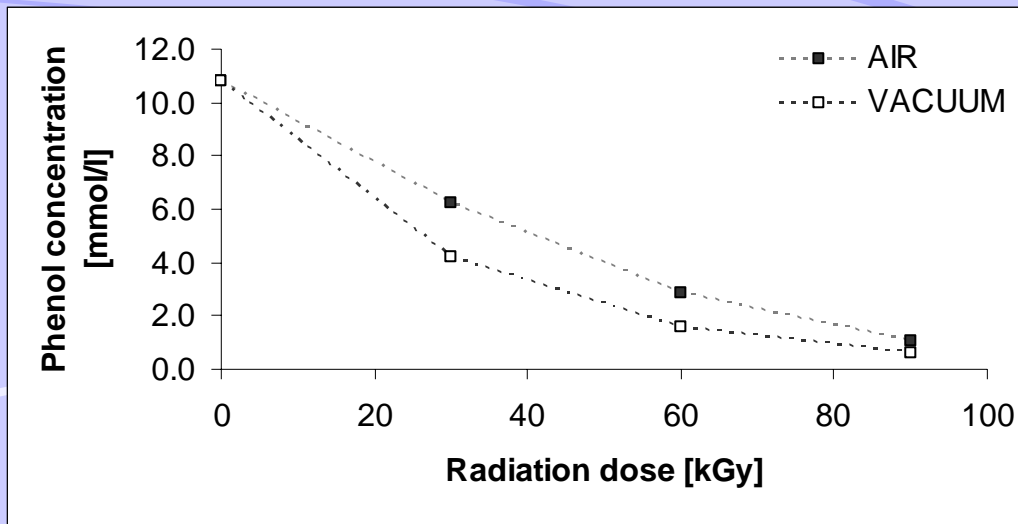
Irradiation in vacuum



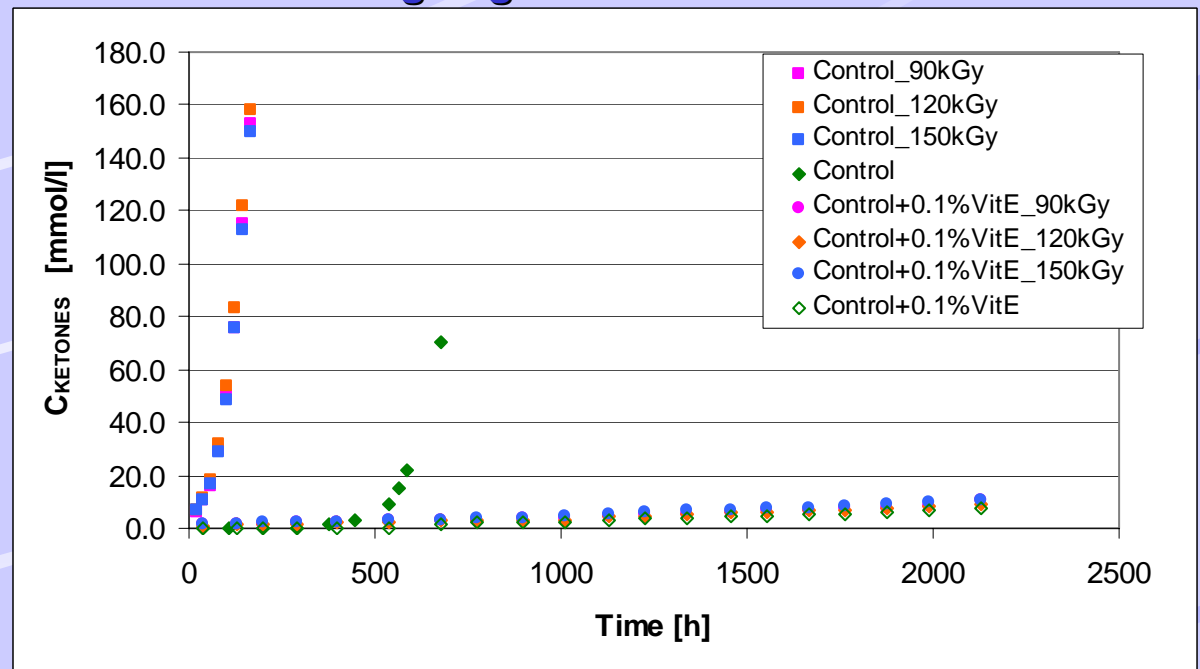
# Experimental results (III)

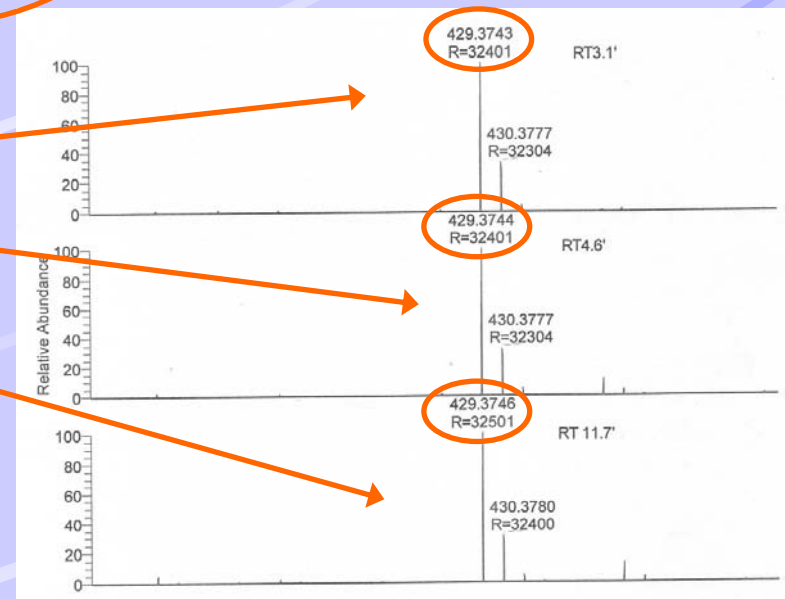
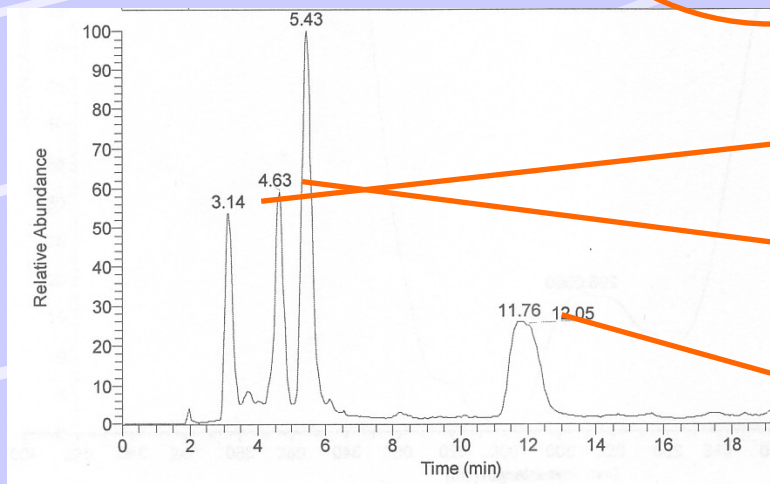
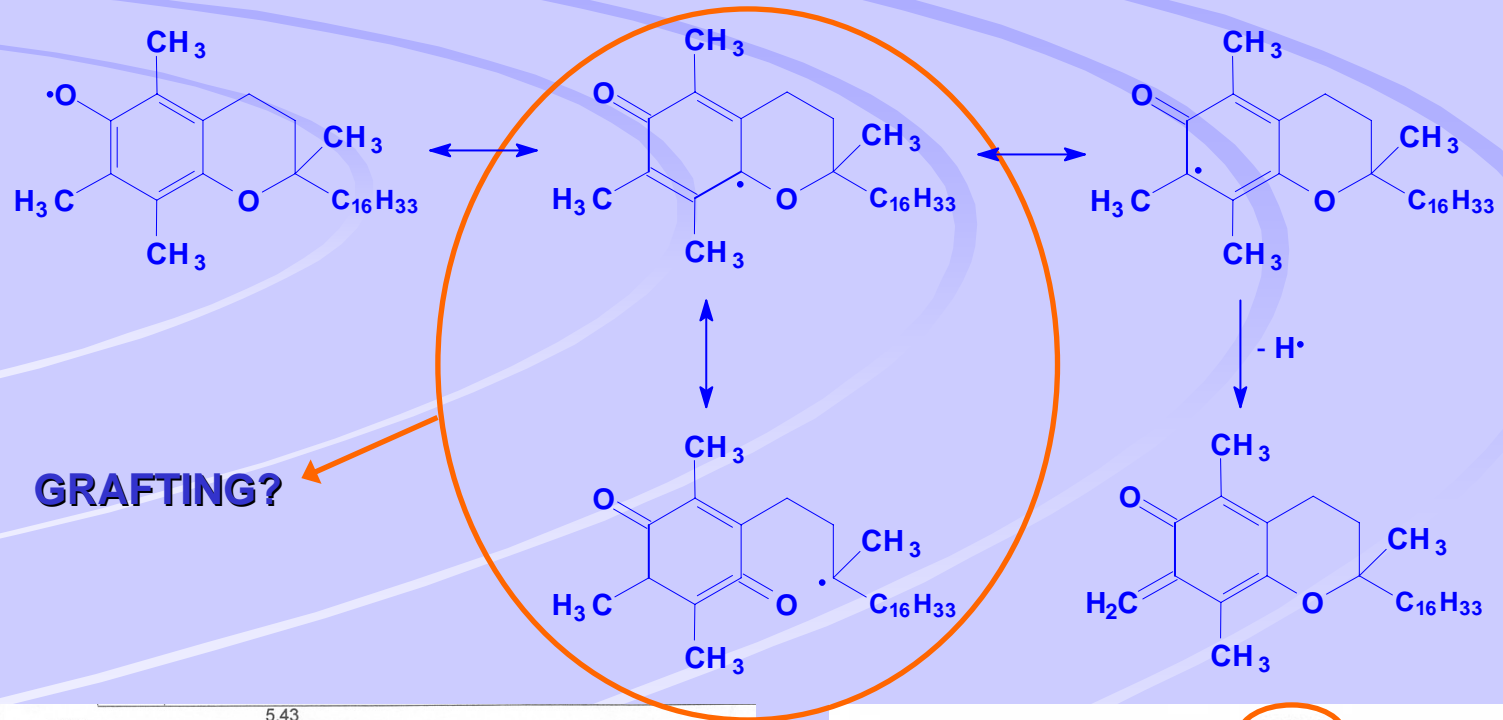
Real time ageing – Room temperature, dark





### Accelerated ageing in a ventilated oven at 90°C





HPLC-MS from UHMWPE+0.1% VitE irr 90kGy (cyclohexane extract)



## CONCLUSIONS

**Vitamin E is an excellent biocompatible stabilizer for UHMWPE. Blending of Vitamin E with UHMWPE powder results in a highly homogeneous distribution of Vitamin E in the polymer bulk.**

**The presence of Vitamin E in UHMWPE prior to irradiation slightly decreases the crosslinking efficiency.**

**Blending of Vitamin E with UHMWPE powder provides stabilization through all the following processing steps.**

**The transformation products of Vitamin E after irradiation are still able to provide an excellent stabilizing effect.**





**THANK YOU!**

