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THE PRESENCE OR ABSENCE OF ETHANOL IN RADIOLYTIC SYNTHESIS MEDIUM LEADS TO DIFFERENT KINDS OF HYBRID PAPAIN-GOLD NANOPARTICLES

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Gold nanoparticles are widely used for a plethora of applications, however, the short and long term environmental impacts of those nanoparticles when they reach the soil, rivers, and sea have just recently been taken into consideration. Novel synthetic routes have been developed without the use of toxic reducing or capping agents so that the products are biocompatible and environment-friendly, in the so-called Green Nanotechnology. One of these methods is the radiolytic synthesis using gamma radiation, which does not require the use of any reducing agent. Different conditions in the synthesis medium can lead to different products, therefore the aim of this study was to investigate the effect of the presence of ethanol on the nanoparticles generated via radiolysis using gamma radiation. The synthesis medium consisted on a mixture of NaAuCl4 (5 x 10-4 mol L-1), isopropanol (0.2 mol-1); and papain as a stabilizer and coating agent (1 mg mL-1), with or without the presence of 20% ethanol. The samples were irradiated with 10 kGy in a gamma multipurpose irradiator (60Co source) and stored at 4 ºC until use. Their hydrodynamic diameter and zeta potential was assessed with a Zetasizer Nano ZS90 device (Malvern Instruments UK), and images of transmission electron microscopy (TEM) were taken in order to observe the real size and morphology of the nanoparticles in a 40,000X magnification. The presence of ethanol indeed leads to different kinds of nanoparticles. Their hydrodynamic diameter was 8.773 ± 2.3 nm (papain-AuNPs without ethanol) and 9.976 ± 2.9 nm (papain-AuNPs with 20% ethanol), and their zeta potentials were 34.4 ± 4,2 mV and 25.3 ± 3.58 mV, respectively. The TEM images revealed that when ethanol is absent, the nanoparticles formed consist on a gold core (approximately 5 nm in diameter) with papain coating. When ethanol is present, though, the nanoparticles consist on a papain core (approximately 10 nm) decorated with smaller gold nanoparticles. In conclusion, both protocols lead to stable nanoparticles with good control of size, especially in the absence of ethanol, but according to the desired applications, ethanol can be useful for the generation of nanoparticles with higher enzymatic activity from papain, i.e. proteolytic and permeation-enhancing activities.