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Encapsulation of Glycosides from Extract *Plantago Major* in ZnO Matrices by Sol-Gel

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Abstract: Today burns are one of the 20 leading causes of disease, with high incidence. Males are the most affected with 52% and the age group most often is 1-4 years [1]. Therefore is necessary to provide a good choice of dressing (healing material that is painless during application) used like an aid in burns treatment, a dressing has to be cost effective, easy to use and accessible, with minimal side effects, antimicrobial and non- toxic. This investigation is focused to synthesize structures matrices of plants with activity pharmacological like chromogenic glycosides such catapol and aucubin who are presents in plantain leaves [2]. These glycosides have shown to have anti-inflammatory effects, bacteriostatic and healing in wounds and burns treatment. An important part is the characterization of the matrices by spectrophotometric analysis using UV-Visible, FTIR, XRD, SEM and EDS, showing that ZnO has a hexagonal crystal form type, the particle size is approximately of 200 nm average.

Key words: Encapsulation, nanomatrices of ZnO, *plantago major*, glycosides, SEM, sol-gel.

1. Introduction

Plantago major is a perennial herbaceous perennial with unbranched stems underground. Popularly known as “llantén mayor”, “llantén común” or “llantén grande”. Plantago is a nonculturable plant, easy to locate and regarded like weed. This plant common and easily to found in grassland areas, slopes, near crops and in roadsides.

Plantago major (shown in Fig. 1) has a hudge potential and it is useful for its anti-inflammatory, antibacterial, astringent and anti-hemorrhagic properties, also it is used to wound healing internal and external with bibliographic studies that corroborate the use of active ingredients to accelerate the healing process. Also it is known that the same specie contains tannins and allantoin who are auxiliary to early regeneration of skin [3].

Furthermore, we used a better extraction of active ingredients because only had reference of its traditional use by infusions. We used the Soxhlet extraction equipment for high performance obtained [4].

ZnO was used to form nanomatrices for being soluble in alcohol, in addition to its medicinal use is used for treating allergies, irritation and surface wounds having an astringent effect which protects against infections and accelerates the healing process [5].

We performed synthesis of nanomaterials by the

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sol-gel method; glycosides were encapsulated in ZnO matrices for three reasons: first because it is an alternative allows the use of the glycosides; second is to use the properties of the matrices, slow release and active principle and the third to increase the therapeutic effect of ZnO as matrices causing synergism.

Spectrophotometric techniques were used UV-Vis and FTIR for glycosides characterization, the study of zinc oxide in nano matrices with glycosides were also characterized by UV-Vis, FTIR and X-ray diffraction to determine its crystalline structure, in addition SEM to identify several structural features for subsequent application.

To determine the functionality of encapsulated extract ZnO and pharmacological activity, it was determined through an experimental animal model doing wounds in rats and applying nanomatrices for evaluating drug dosage and use as a dressing.

2. Experiments

The Using 10 g of crushed leaves and a No.44 mesh sieve, then placed in cartridges of porous filter paper and were closed, subsequently they entered into the Soxhlet and reflux. Extraction is performed at a constant temperature range of 65 °C to 70 °C with an alcohol-water mixture (7:3) 2 h. After returning the solvent to extract stops the process so that it retains the pharmacological effect and not decompose aucubin. The extract concentrated in a rotary evaporator to remove 60% of solvent.

Fig. 1 Plantago major [2].

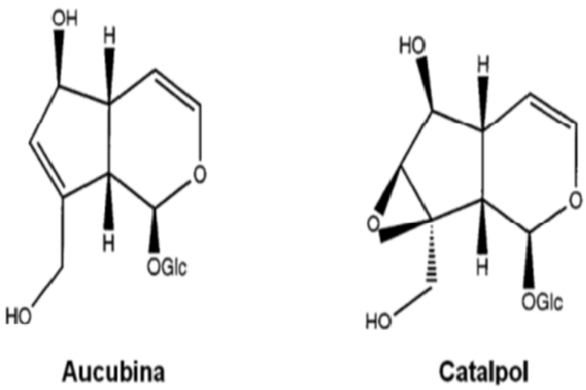

Fig. 2 Iridoid glycosides from P. major [6].

Subsequently 5 g of ZnO are weighed and dissolved by stirring with a mixture of 100 mL of EtOH and 6 ml distilled water until the mixture appears homogeneous, add 1 g of polyvinylpyrrolidone and the stirring is continued to doping with the extract and poured into the ball flask to performing the synthesis.

Take representative samples to work them into teams UV-Vis, FTIR, XRD and SEM previously prepared to the requirements of each studio.

3. Experimental Results

3.1 UV-Vis Spectrophotometry

The following Figs. 3 and 4 show the spectra of extract and nanomaterials observed at different wavelengths and different bands.

The value of Eg of aucubin/ZnO compared to ZnO is > 1%. Shifts to lower energy regions of the electromagnetic spectrum. Materials aucubin/ZnO and ZnO present a frequency in Hz [x1014] of 7.45 and 7.37 respectively; both have an absorbance in the zone

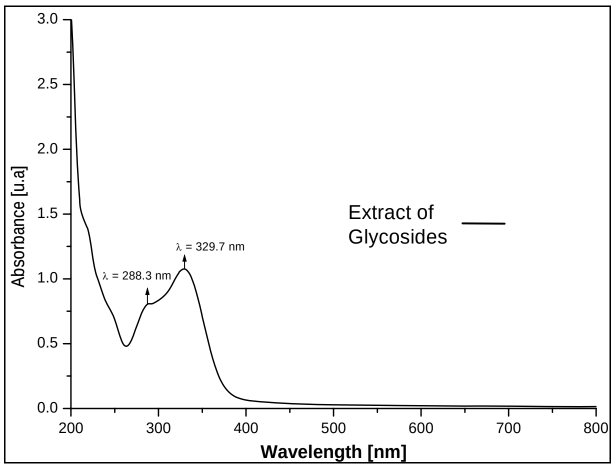

Fig. 3 UV-Vis spectrum of extract.

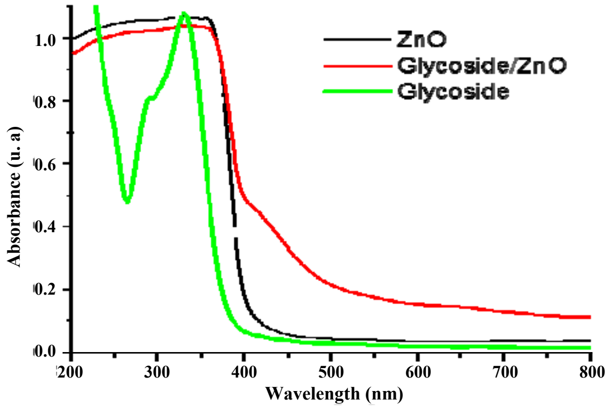

Fig. 4 UV-Vis spectrum of the nanomaterial ZnO/aucubin and ZnO.

limits of UV-Vis spectrum such is indicated in the next Table 1.

Aucubin extract has two absorption bands in the UV region. The maximum band is located at 329.7 nm (electronic transitions σ > σ*) of the single bonds between C-H and C-C of aucubin. The absorption band is least at 288.3 nm (electronic transitions n → π*) assigned to carboxylate functional groups and substituted phenyl.

3.2 DRX

In the study of X-ray diffraction is observed that the material aucubin / ZnO is crystal and corresponds to ZnO hexagonal, such shown in Figs. 5 and 6.

3.3 Infrared Spectroscopy (FTIR)

The spectrum infrared of aucubin it shown in Figs. 7 and 8. We have indicated several bands, one is located in 2088.6 cm^{-1} corresponds to the interaction of species C-H from benzene ring and in 1638.4 cm^{-1} presents the

Table 1 Optical and electronic properties of ZnO materials, aucubin / ZnO.

Materials	λ(nm)	E(eV)	υ (Hz)	Spectral region
ZnO	402.9	3.07	7.45	UV-Vis (violet)
aucubin /ZnO	407.1	3.04	7.37	UV-Vis (violet)

Table 2 Optical and electronic properties of the aucubin material.

Material	λ (nm)	E (eV)	υ (Hz)	Spectral region
Aucubin	329.7	3.75	9.1×10^{14}	UV(nearby)
	288.3	4.29	1.0×10^{15}	UV (far)

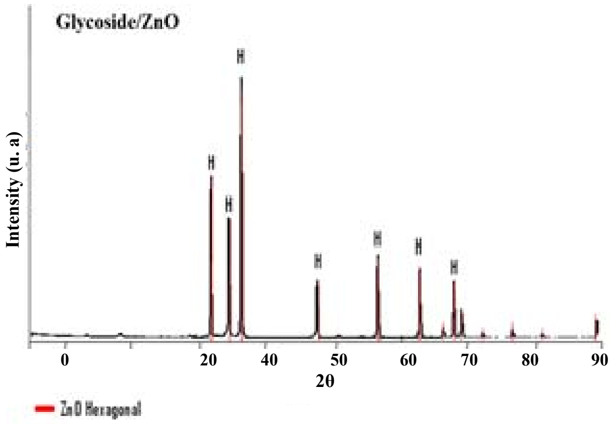

Fig. 5 Spectrum DRX of nanomaterial aucubin/ZnO.

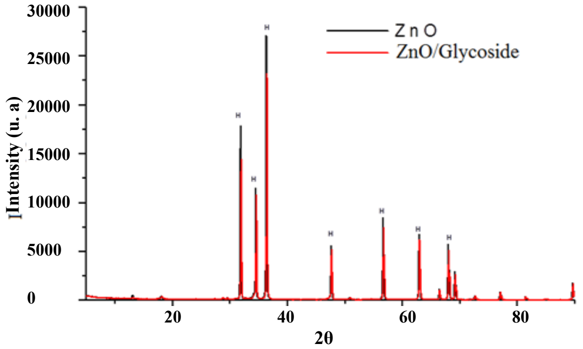

Fig. 6 Difference between spectra DRX of nano-material ZnO/glycoside and ZnO.

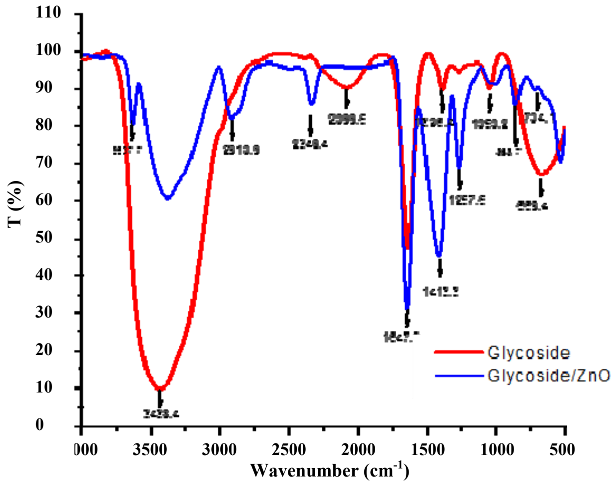

Fig. 7 Infrared spectrum of nanomaterial aucubin/ZnO and glycoside aucubin.

vibration mode C-C of the annular ring and vibration odes of OH-type bending. Towards 1,396.4 cm^{-1} is localized interaction of the double bond carbons of benzene ring. The absorption bands at 1,276.2 cm^{-1} and 1051.9 cm^{-1} are assigned to the ether group (nR-O-R)

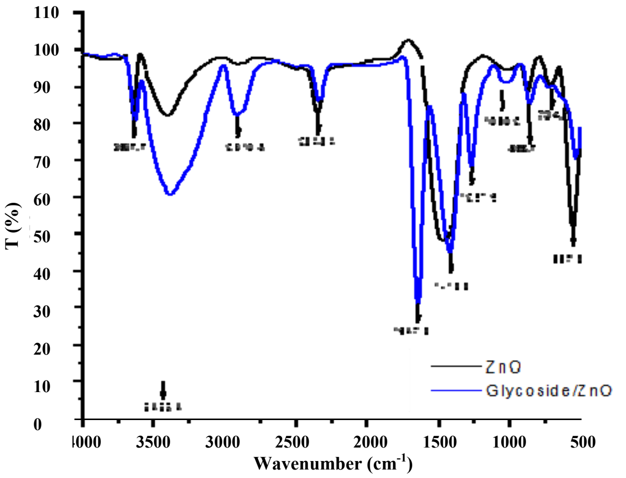

Fig. 8 Infrared spectrum of nanomaterial aucubin/ZnO and ZnO.

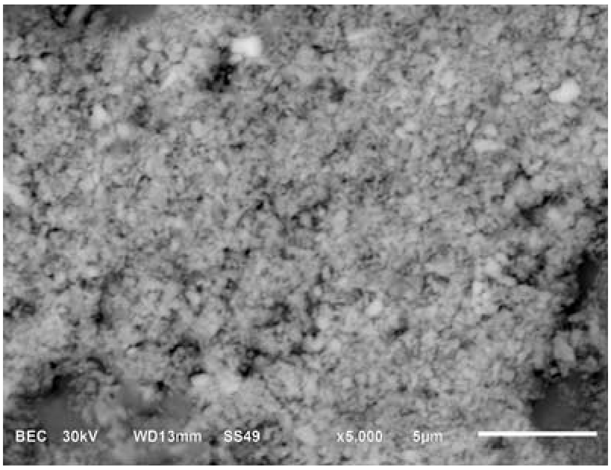

Fig. 9 Microscopy of nanomatrices at 5000x.

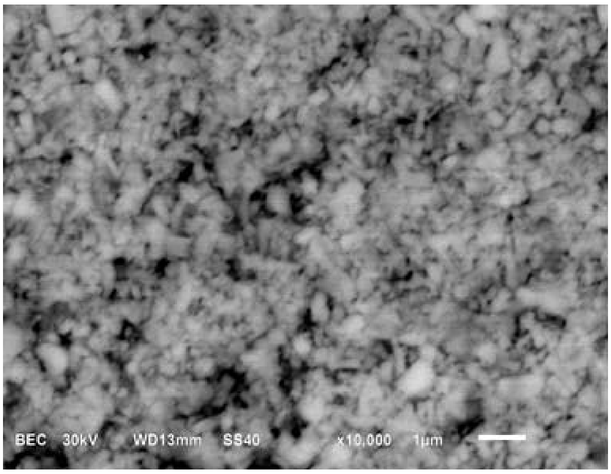

Fig. 10 Microscopy of nanomatrices at 10000x.

and in 669.4 cm^{-1} interaction is located species Csp2 with H out of plane.

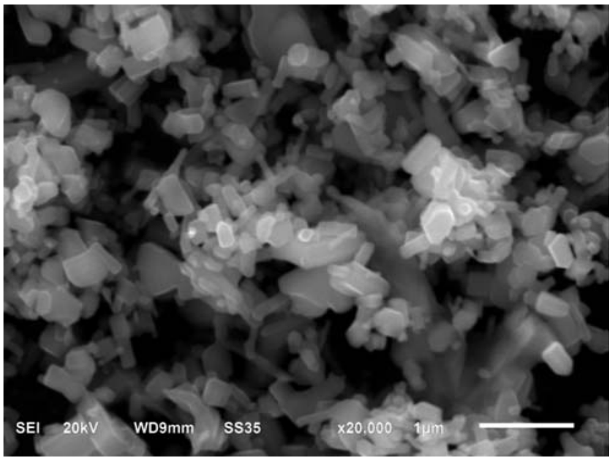

Fig. 11 Microscopy of nanomatrices at 20000x.

Table 3 EDS of ZnO/glycoside.

Element	Weight (%)	Atomic (%)
Zinc (Zn)	61.30	30.68
Oxygen (O)	30.69	62.78
Carbon (C)	8.01	6.54
Total	100.00	

Table 4 EDS of ZnO.

Element	Weight (%)	Atomic (%)
Oxygen (O)	28.12	61.51
Zinc (Zn)	71.88	38.4
Total	100.00	

3.4 Scanning Electron Microscopy (SEM)

The average particle size by SEM is about 200 nm and has a morphology uniform with elongated semi particle like shown in the following microscopies.

3.5 Energy Dispersive Spectroscopy (EDS)

The result for EDS, sample the percentage semi-quantitative of each element and atomic mass of materials present in the nanomaterial aucubin/ZnO. It shows a weight centesimal mass: 61.30 of Zn, 30.69 of O_2,and 8.01 of C. described in the Table 3. So different from the composition of only ZnO shown in Table 4.

4. Conclusions

According to the analysis applied especially SEM-EDS and FTIR we can establish aucubin like a glycoside present in the mesh of ZnO, by the presence of carbon and oxygen. Therefore these nanomaterials are ready to be applied on a wound injury model in rats to assess its healing activity.

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