Synthesis of $Ca(OH)_2$ nanoparticles using a renewable feedstock: Medical applications

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The agave bagasse is a byproduct generated in the mezcal and tequila industry (alcoholic beverage). Normally it is burned to reduce its volume, then a byproduct is generated in the form of ash, which can contaminate the water in rivers and lakes near the production places called "mezcaleras". It is known that 15-33 kg of agave are needed to produce one liter of mezcal or tequila [1-2]. Tequila production in the first 6 months of the 2008 was 8254 L per month, this information is given in order to have an idea of the mezcal production and consequently the huge amount of bagasse and ash produced [3].

This report details measurements of the A*gave salmiana* fiber transformation after the burning process in order to obtain $Ca(OH)_2$ nanoparticles. The wasted ash ($CaCO_3$) was heated at 950 ºC to obtain lime (CaO), then it was hydrolyzed to get hydrated lime ($Ca(OH)_2$) in the form of microcrystals and nanoparticles. The compounds were indentified using X-ray diffractrograms [4-5].

The use of calcium hydroxide, was introduced by Hermann in 1920 and has been used within the root canal system for the control of inflammatory root resorption after luxation and avulsion injuries. The high pH and antimicrobial properties of $Ca(OH)_2$, may account for its effectiveness as an intercanal inter-appointment medicament and an inhibitor of inflammatory root resorption [6].

Thermal (TGA), elemental (SEM) and morphological characterization (AFM) of the ash were done. The images obtained by scanning electronic microscope (SEM) showed all the morphological transformations of the samples through the whole process (**Fig. 1**). Experiments showed that 16% of ash was produced in the burning process of agave bagasse (450 ºC), and 66% of the ash remains after heating (950 ºC) in the form of calcium oxide.

In preliminary experiments the $Ca(OH)_2$ nanoparticles were compared with a commercial material used in endodontic procedures (root canal treatment), showing promising results (**Fig. 2**).

We have found calcium hydroxide nanoparticles (cylindrical) in the ash, which measure 800 x 28 nm (**Fig. 3**). These nanoparticles were obtained by taking advantage of the natural structure of A*gave salmiana* that grows in arid lands, which creates an easy way to produce nanoparticles in a sustainable way using renewable feedstock.

References

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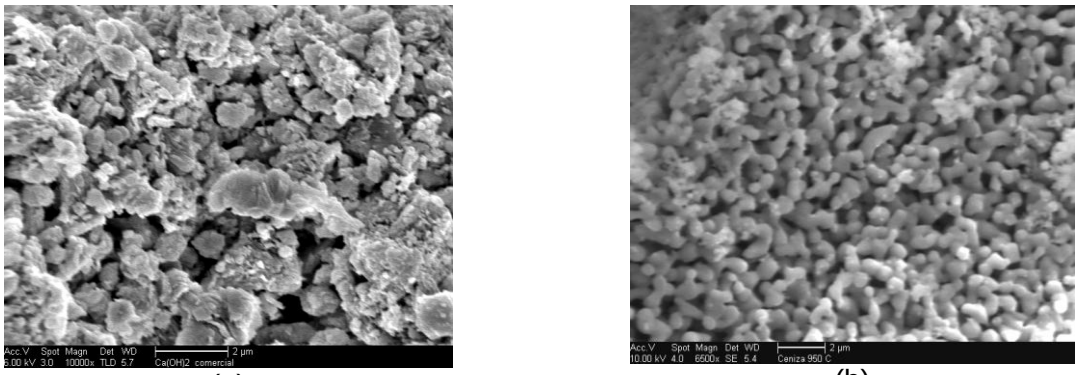

(a) (b)

Fig 1.- *A sample of commercial $Ca(OH)_2$ is shown in (a) while in (b) the $Ca(OH)_2$ made using ash is showing the structure of one fiber and its natural structure.*

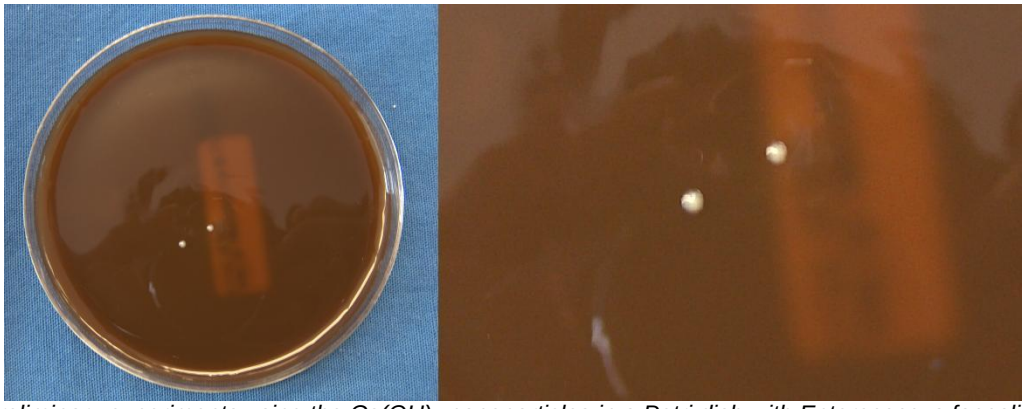

Fig 2.- *Preliminary experiments using the $Ca(OH)_2$ nanoparticles in a Petri dish with Enterococcus faecalis.*

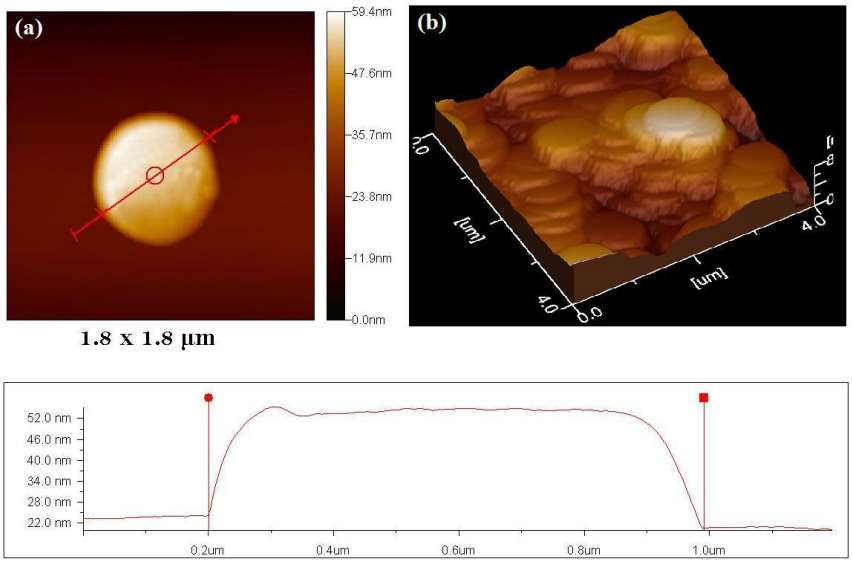

Fig 3.- *One isolated nanoparticle is measured using the AFM, where it can be seen the cylindrical form and the dimensions ∅800 nm x 28 nm (a). A 3D image of the nanoparticles showing the cylindrical shape (b).*