Abstract—Porous structures were conformed by pressing and heating of hydroxyapatite powders. Samples were obtained in the form of blocks with 47% porosity. An interval of pore sizes interconnected among 50-120 µm was obtained. The diametrical tensile stress of evaluated samples oscillated between 4 and 21 MPa, according to what has been reported for porous ceramics. The diffraction studies of x-ray of heated samples indicated an increase of hydroxyapatite crystallinity. The microstructure was studied by scanning electronic microscopy. Statistical techniques were employed to determine the certainty of the answer.

Keywords—hydroxyapatite, porous, blocks, preparation, characterization.

I. INTRODUCTION

The development reached by hydroxyapatite (HAp) ceramic as bone substitute is well known, for its high biocompatibility and good bioaffinity which stimulates the bone reconstruction. These ceramics, in the form of powders or blocks, dense or porous, are widely employed in certain surgical treatments that require bone substitution (Bucholz et al, 1987; Hench, 1991 and Jarcho, 1981).

The ideal artificial implant demands a good biocompatibility and excellent linking with the active bone. It needs also a certain resistance to mechanical load on the implanted bone. However, none of the materials developed so far contain all of these properties. The synthetic HAp, similar in composition to the inorganic part of the bone, presents good biocompatibility and osteoconductivity. But, their fragility is a restrictive condition which limit its use in areas not requiring high mechanical resistance (Abdel-Fattah et al, 1994; Radin and Ducheyne, 1994 and Zyman et al, 1998). The structure of dense bodies is stronger and very capable of uniting with bone but its use limited due to its high brittle character and low osteoconductivity. Despite its weak resistance, the porous HAp is considered as good substitute, due to its better osteoconductivity and quick colonization for the new bone (Boyn, 1987; Hench, 1991, Pilliar et al, 2001).

The biodegradation or bioresorption of implants materials is characterized by changes in their chemical and physical properties after being implanted. In case of the calcium phosphate ceramics, the physical changes include disintegration, lost of the mechanical strength and changes in the porosity; as long as the chemical changes include the formation of other phases and possible trans-

formation of these in the surface of the ceramic (Guillemain et al, 1987; Holmes et al, 1986 and LeGeros, 1993).

Material factors as the structural configuration of the HAp affect the biological answer of implants (Kent et al, 1986 and Schmitt et al, 1997). The porous HAp is more re-arsorbable and more osteoconductive than dense HAp, and it is used as implant material in many experimental and clinical assays (Boyne, 1987; Jarcho, 1981 and Tsuruga et al, 1997). HAp with wide porosity ranges has been used; although there is not general agreement with respect to size, forms, interconnection and classification of pores (El Deeb, 1988); although usually it accepts a size range of grain of 100-300 µm (Ohgushi et al, 1989 and Yamamura, 1992).

Several methods of inducing porosity in the ceramic of HAp have been described in the literature. The simplest methods involve the incorporation of volatile compounds, during the heating process. Materials, as naphthalene and calcium stereate have been used with this purpose. The porosity degree is controlled by the quantity of degradable material added. The pores in calcium phosphate blocks have also been conformed by the addition of hydrogen peroxyde (H2O2) to the powder, allowing the pores interconnection formed by the gases when escaping. The volume and size of the pores are controlled by the quantity of H2O2 added and the heating temperature.

In the present work, we study the influence of such parameters as the pressing pressure and temperature of thermal treatment in the physical mechanical properties of porous blocks of HAp using a variant (dry milling) of the traditional procedures reported in the literature (wet milling) and naphthalene as porogenic agent (Chang et al, 2001).

II. METHODS

2.1 Preparation of the HAp powder

The stoichiometric HAp was synthesized by the reaction between Ca(OH)2 and H3PO4, obtaining powders that later on were dried 100°C, milled in ceramic mortar and sifted until achieving a grain size among 150-250 µm.

2.2 Preparation of the blocks

The samples were prepared weighing the HAp and naphthalene as porogenic agent (BDH with particle size smaller than 250 µm) necessary to obtain the desired height and porosity (50 %) and mixed in a porcelain mortar, adding 4 drops of solution 1% of polyvinyl alcohol (BDH). The mixture was pressed in cylindrical