## PROPERTIES OF PLASTIC MATERIALS FROM SOY, CHICKPEA AND BEANS

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The valorization of renewable resources by their use as raw materials for non-alimentary industries constitutes an alternative that increases the added value of a cultivar, with the eventual economical advantage for our country.
On the other hand, the use of biodegradable materials helps to resolve the environmental problem of rubbish disposal.
The natural resins known as biopolymers employed in the manufacture of biodegradable plastics include those obtained from renewable resources such as starches, proteins, celluloses, pectins, and others as polyhydroxyalkanoates or aliphatic polyesters formed by lactic acid polymerization .
The present work focuses on the study of the properties of thermoplastics obtained by compression molding of derivatives of soy, chickpea and beans from the North West of Argentina.
The technological value of the application in study can be seen when the following aspects are taken into account:

- The laboratory process of compression molding utilized in the study can be easily scaled up to industrial scale
- The raw materials utilized included the agricultural wastes habitually ruled out
- Only natural or non-biodegradable additives were used, toxic substances were not necessary.

The use envisaged for these products is as packaging or devices for the food industry as well as matrices for the pharmaceutical industry.
The method employed for the plastic formation consists of the following main steps:

- The seeds kept at 4 °C were pulverized, ground in a mill and defatted by Soxhlet method.
- The vegetal tissue was homogenized; the starch and proteins filtered to separate the celluloses and the suspensions were purified and lyophilized.

Specimens for mechanical testing were prepared following the same techniques described elsewhere (1):

- A blend was formed by thoroughly mixing the vegetable derivatives together with glycerol, water and starch as plasticizers
- Compression and simultaneous heating was applied to the blend contained in a shallow matrix or mould

Mechanical properties measured were tensile strength at breakage (T, in MPa) and percent elongation at breakage (e %). The tests were performed after 48 h stabilization at constant temperature and relative humidity (% rh) of specimens.
Different conditions for the blend preparation and for the compression molding were studied regarding the effect on mechanical properties and water absorption capability of the products. Mechanical testing was performed according to ASTM Standard D-1708 or ASTM D- 638 while water absorption capability was measured as stated on ASTM Standard D-570.
A comparison was done of the influence of the ratio of amylopectin / amylose of the starches under study. Starch was purified in Biogel P6 (100-200 mesh) before analyzing its structural characteristics of the $\alpha$1,4 - $\alpha$1,6 linked glucopolysaccharide as described in a previous paper (2). In each case the starch employed was obtained from each specie studied and the amylose / amylopectin structure was considered. For comparison purposes, starches from other vegetal such as potato and rice that have different ratio of amylopectin / amylose were included in some of the blends.

### Material modifications

Two modifications were tried when preparing the blend, with the purpose of improving mechanical properties as well as decreasing the water absorption capability. The first variation consisted in the incorporation of boric acid as promoter of crosslinking.
The effect on mechanical properties of the plastics obtained after compression molding of some of the blends containing boric acid was a fall in water absorption capability. In other cases no effect was observed. Regarding mechanical properties, they were not affected by the addition of boric acid.
The second variation consisted in the irradiation of the blend with gamma beams from a Co –60 source to a total dose of 50 kGy. The irradiation was performed before the compression molding process. While the effect on mechanical properties was not important, in some cases an important decrease of water absorption was found.

### Applications

We are studying the preparation of plastics for the pharmaceutical industry and also for the food industry, in the form of films and absorbents.

### Biodegradability

We have recently begun the assessment of biodegradability of the materials obtained, utilizing methods based on the determination of carbon dioxide evolution and weight lost..

### References

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2-Salmoral ,E.M.,Cura,J.Pagano,E.,Lepek,V.Favret,E,Krisman,C.An.Asoc.Quim.Arg.81(2-3 ) (1993)179-187