Formaldehyde based resins prepared using tannin obtained from bark of *Terminalia arjuna* (Roxb.)

S Arasaretnam[1*], L Karunanayaka[2], P Manoharan[1]
[1] *Department of Botany. Faculty of Science, Eastern University, Sri Lanka, Chenkalady*
[2] *Department of Chemistry, Faculty of Applied Science, University of Sri Jayewardenepura*

Terminalia arjuna (Roxb.) is one of the major tannin yielding trees that grow abundant in Eastern province of Sri Lanka. In this study, the use of tannin obtained from *Terminalia arjuna* (Roxb.) for manufacture formaldehyde based resins were investigated. Five protocols were developed to isolate the tannin from the bark of *Terminalia arjuna*. Yields obtained from water, acetone and ethanol extractions were found to be 9.01 %, 4.01 % and 4.34 % w/w, respectively.

The tannin and bark from the *Terminalia arjuna* were liquefied with phenol in the presence of an acid catalyst (H_2SO_4) at different reaction time interval. The rate of liquefaction increased with the amount of sulphuric acid used as a catalyst. After 90 minutes, the amount of tannin residue remaining was 10 % and 5 % for 2.8 % and 5 % addition of sulphuric acid respectively for the tannin liquefaction. The amounts of the residue remaining after reaction with 5 % acid after 30 to 180 min were very similar, ranging from 5.1 % to 6 %. Based on these results, a reaction time of 90 minutes was selected for preparation of the liquefied tannin. After 90 min of bark liquefaction with 7.5 % acid the amount of residue was stabilised near 10 % for whole bark. In this case, the amount of residue remaining after reaction time of 120 and 180 minutes was not significantly different from 90 minutes. At the 2.5 % and 5 % levels of sulfuric acid, an appreciable amount of whole bark residue was found. Thus, the condition selected to liquefy bark for resin preparation was 7.5 % of sulfuric acid and 90 min reaction time.

Chemical structure of phenolated tannin, liquefied bark and prepared resins were identified with Fourier Transform Infra Red (FTIR). Reactions involving in liquefaction of tannin, bark with phenol were confirmed by significant change of absorption in FTIR spectra from that of tannin alone. FTIR spectrum of tannin sample give C-O stretching absorption peak at around 1000-1300 cm^{-1} significantly but in the case of liquefied tannin resins this peak is not significant. Thus these peaks may be used to confirm the hydrolysis of etherocyclic ring of tannin. FTIR of liquefied tannin sample give significant absorption different from the tannin alone. Tannin molecule exists well shaped and narrow absorption peak in the 1500 – 1700 cm^{-1} region but in the case of liquefied tannin the peak is broad and split. These signals may then be used as a tool to confirm whether phenol is bonded to the tannin structure.

The existence of strong hydrogen bond interaction between liquefied tannin formaldehyde resins were confirmed by FTIR spectra. The spectra were showed scale expanded infrared spectra in the -OH stretching region (3000-3500 cm^{-1}) for liquefied tannin formaldehyde resin. The liquefied tannin formaldehyde resin is characterised in the region by a split broad band at around 3000- 3300 cm^{-1}. Upon mixing with formaldehyde a second band is observed and could be assigned to hydrogen bonded hydroxyl group. FTIR spectrum of liquefied tannin formaldehyde resin give split strong peak at around 3000-3550 cm^{-1} but which appears as single strong peak in the liquefied tannin alone. It may indicate the hydroxyl group in the liquefied tannin–formaldehyde resins existing into two different types such as free hydroxyl and bonded hydroxyl group. The spectrum of liquefied tannin resin appears as absence of significance peak at around 1400 cm^{-1}. It is revealed that stretching frequency is changed due to C-H deformation occurring in the phenyl group of tannin molecule. It may give ideas on absorption different to liquefied tannin and liquefied tannin resin. Further studies are very important to confirm this cross linking reaction.

Shear strength of liquefied tannin and bark resins are not of much significant value due to semi liquid nature of prepared resins.

Present Address/es:
[1] Faculty of Science, Eastern University
[2] Department of Chemistry, Faculty of Applied Science, University of Sri Jayewardenepura

* arasan1976@yahoo.com Tel: 065-2240755