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Research article

Gum Arabic: An alternative mountant in wood histology

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Abstract: Gum Arabic (GA) was investigated for its suitability in wood histology in this study. About 2 g of the exudates was dissolved in 20 ml of water at room temperature to form a syrupy solution thick enough for cover slipping. A low-density wood was also prepared on a sliding microtome in order to get sections of about 20 microns. Sections were stained with Safranin stain and washed thoroughly with distilled water until the water became colorless, after which the specimens were gently lifted unto a clean slide and covered with two drops of GA solution. Another set of sections were also prepared through a normal procedure using Canadan balsam. The results showed that Gum Arabic dissolved at room temperature with little or without agitation forming a light yellowish-brown viscous solution. Sections prepared from GA were darker as Safranin stain was not leached therefore leading to more contrast being achieved among the wood features. Moreover, the results also showed that there was no distortion of any kind after mounting and embedding in GA: wood features were distinctly clear. The study showed that GA can be used as mounting medium during wood histology and can be used as a good alternative to the conventional mounting media to replace Canadan balsam and other synthetic media. Moreover, the use of GA as a mountant will reduce the period of time spent during wood histology procedure as some aspects such as dehydration and clearing are bypassed. Retention of stains within the specimen cells also indicated that contrast can be enhanced when GA is employed as a mountant. Wood micrographs showing slides prepared form GA are also presented in the study.

Keywords: Mountants, Gum arabic, Water, histology, Sections, Micrographs.

INTRODUCTION

A mountant is the solution in which specimens are embedded well after some operations like fixing, embedding, sectioning, staining, dehydrating and clearing (Dioni, 2002) have been achieved. It may be liquid, gum or resinous, soluble in water, alcohol or other solvents (Brown, 1997). Mounting media can be natural or synthetic. In either case, whether natural or synthentic, a good mountant must not react with the specimen; must be stable over time without crystallizing, darkening, or changing the refractive index. A good mountant should also be soluble in the medium in which the specimen was prepared (either aqueous or non-polar, such as xylene or toluene), and not causing the specimen stain to fade or leach. Also, an ideal mountant should be colourless, resistant to microorganism growth, able to protect sections from physical damage activities such as oxidation and changes in PH. Not only this, such mountants should set without cracking or shrinking, and should not shrink back from the edge of cover glass. In spite of these attributes, it is noteworthy that most of the mounting media used in wood histology are synthetic, and due to the real concern about the medical risks associated with the chemicals used in microscopy laboratories, exploring other alternative mounting media like gum arabic (GA) will reduce such hazards.

Gum arabic (GA) is a natural exudate derived from exudates of *Acacia senegal* (L.) Britton or *Acacia seyal* Delile trees which are known to grow in the sub-Sahara region of Sudan (Glu, 2002; Ballal *et al*., 2005). It readily dissolves in water to form solutions characterized by low viscosity, a property that has allowed its use in various applications (Dziezak, 1991). It is soluble in hot and cold water, glycerol and propylene glycol but not in ethanol and hydrocarbon solvents. The density ranges from 1.35 to 1.49 with a refractive index of about 1.47 (Wang *et al.*, 2005) in solid-state. It is nonflammable. Several solutions and brands of gum Arabic have been made in time past, among these are Apathy, Farrants, Variant, Chevalier, Davies, Hogg, Langerhaus, Martin, Robin I and Robin II. Others are Highman Landau Lillie and Ashburn (Carleton & Leach, 1938; Gray, 1954); the formulation and additives depend on application. Apart from its application in textile, pottery and cosmetics, gum Arabic is the most commonly used hydrocolloids in the food industry due to its excellent emulsifying properties in oil-in-water emulsion type products (Sanchez *et al*., 2002), and it has been used for various purposes ranging from thickening agent, and flavor stabilizer in both pharmaceutical and food industries. AS regards its toxicity, GA has been considered as a safe dietary fibre by the United States, Food and Drug Administration (FDA) since 1970 (Babiker *et al.,* 2012). Essentially, it is edible glue. Of course there is historic experience with other mountants such as Canadan balsam especially in the area of storage ability, but it is necessary to

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try other alternatives which possess all the afore-mentioned qualities and are still affordable. This study, therefore, investigated the use of gum arabic as an alternative to conventional mounting media with a view to making use of the exudates during slide preparation.

MATERIALS AND METHODS

Pellets of Gum Arabic (Fig. 1), exudates of *Acacia senegal*, were purchased from the northern part of Nigeria. A solution of gum Arabic was made by dissolving about 3 g of the raw exudates in about 2 cm^3 of water at room temperature and left overnight to form a thick syrupy solution after little agitation. Sectioning of *Tectona grandis* L.f. wood was performed using a microtome sliding machine (Reichert, Vienna, Austria); the sections were washed with distilled water, covered with safranin and mounted directly on a microscopic slide and embedded in a solution of GA and covered with a coverslip. The slides were examined under a Zeiss microscope (Standard 25) × 80 magnification, attached to a digital camera (SVP DC-12DX). The choice of wood species was informed on the low density of the wood

Figure 1. A pellet of gum Arabic.

RESULTS AND DISCUSSIONS

Micrographs from gum arabic (GA) and those from Canadan balsam were shown in (Figs. 2-4). Gum Arabic dissolved at a room temperature forming a light yellowish-brown thick viscous solution. Sections prepared from GA were darker; this is because Safranin stain was not leached in GA as seen from the micrographs, contrast was improved as a result. Sections mounted in Canadan balsam were lighter and features became more transparent due to leaching of Safranin stain during the process of dehydration. The process of dehydration is an important aspect of slide preparation when using any synthetic mountant or Canadan balsam (ASTM, 2007) as water is completely removed before clearing since water is not miscible with both the clearing agents and the mounting medium (often Canadan balsam), but the dehydration stage was bypassed because GA was miscible with water; specimens were only lifted from water after staining to a microscopic slide without using any clearing agent, and covered with the gum Arabic as the mountant is miscible with water. Therefore sections from GA are darker and more stain was retained to sustain contrast. Moreover, the results showed that there was no distortion of any kind after mounting and embedding in GA. Of course, some artifacts as a result of dirts appeared (as expected because the gum arabic was not purified) in some sections of the slide but were not enough to mar the images from slide.

CONCLUSION AND RECOMMENDATION

The study has shown that GA can be used as mounting medium during wood histology. Several brands of solution made from gum Arabic are available in the market depending on the application. The one prepared for this study was without any additives in order to see the interaction of the mountant with wood cells. Features were not distorted but were distinctly clear. GA can be used as a good alternative to conventional mounting media. Its use as a mountant will reduce the period of time spent during histology procedure as some aspects such as dehydration and clearing are bypassed. Retention of stains within the specimen cells is necessary as this enhances contrast among the features when GA is used. Therefore for effectiveness, GA can be purified to remove impurities in order to reduce or eliminate totally the issue of artifacts in sections.

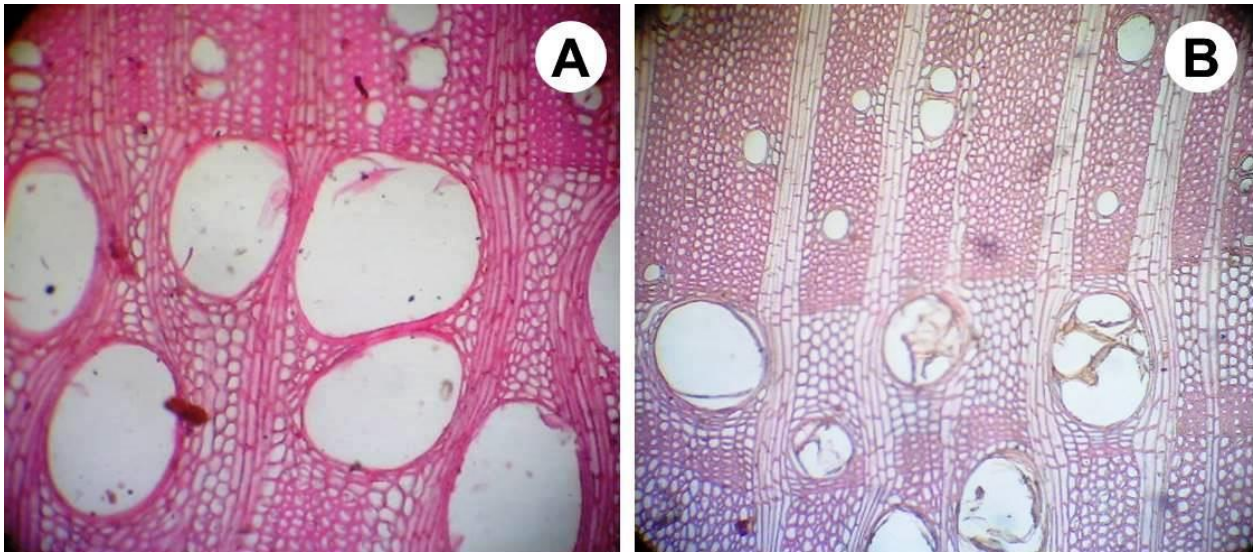

Figure 2. Transverse sections mounted in: **A**, GA; **B**, Canadan Balsam.

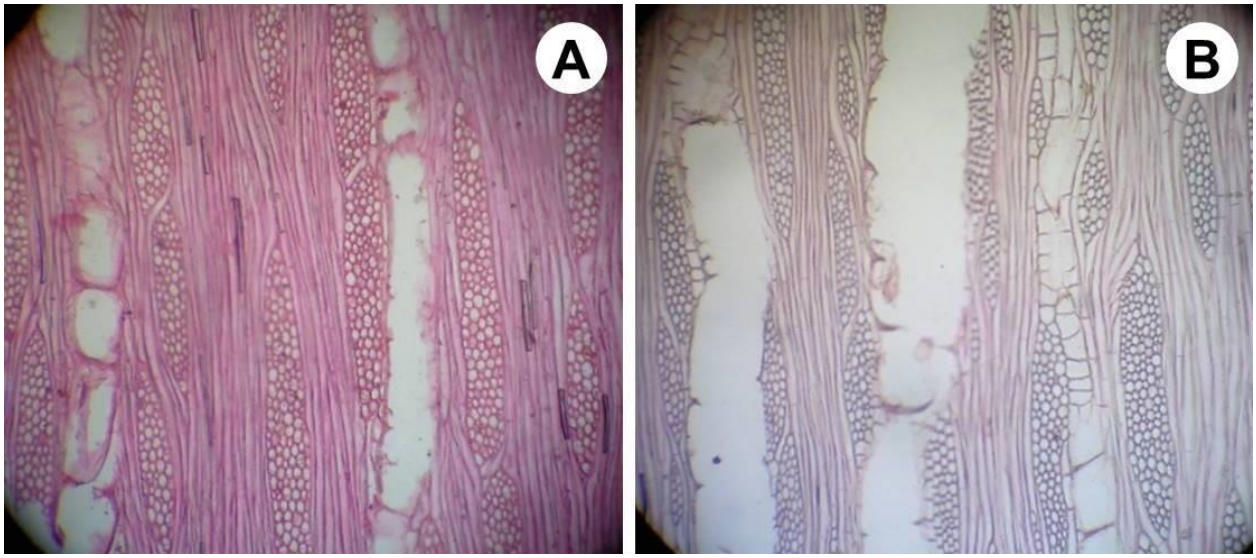

Figure 3. Transverse longitudinal sections mounted in: **A**, GA; **B**, Canadan Balsam.

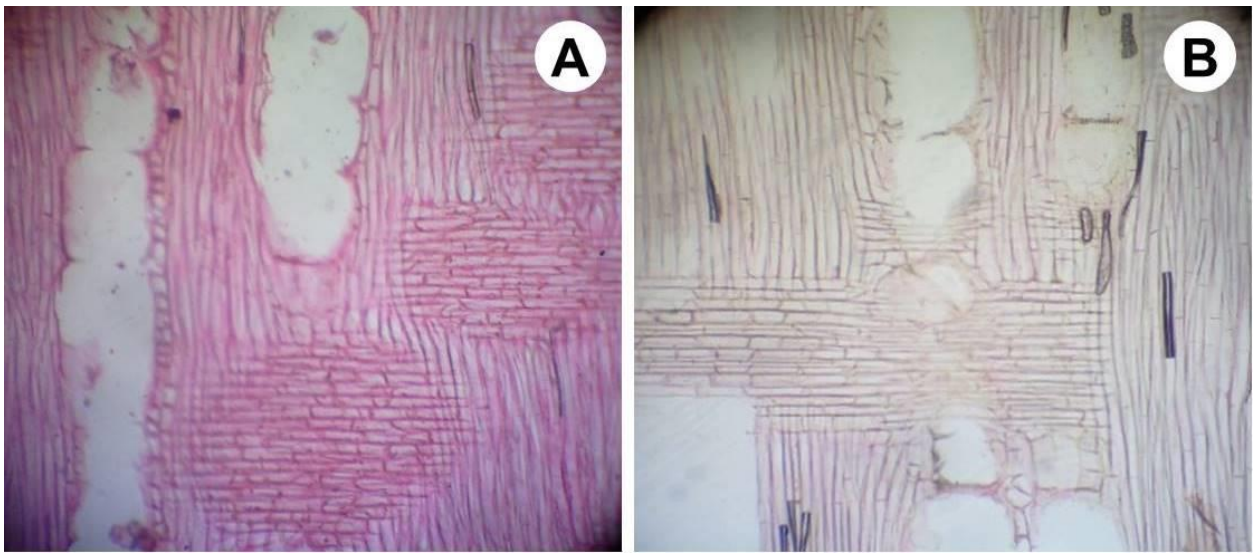

Figure 4. Radial longitudinal sections mounted in: **A**, GA; **B**, Canadan Balsam.

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