

<Short Communication>

Gum-Resinosis in *Mangifera indica*

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ABSTRACT: Gums, resins and gum-resins represent a variety of plant exudates that are highly prized and are extensively used in various industries. The usage of water soluble gums is growing at faster rate as they are excellent suspending agents, dispersants stabilizing agents, emulsifiers and gel forming agents. The gums are made up of carbohydrate polymers, composed of sugar units glycosidically condensed to form large molecules. Resins are non-volatile products, and oxidative products of terpenes or fatty acids, and are of greater commercial importance. They are soluble in water and contrasted with gums, soluble in organic solvents only.

Key Words: ATPase, Gum, *Mangifera indica*, Peroxidase, Resin, SDH

INTRODUCTION

Extensive studies on resin secreting system of various plants have been worked out including *Mangifera indica* L. However, the effect of injury on exudation of gum, resin, etc. has been reported in a few plants (Fahn 1979, Nair *et al.* 1981, Shah 1983). Hillis (1977) reported that gum ducts and resin pockets in the hardwoods are generally the result of damage of the cambium by the mechanical disturbance like abrading insects wounding. *M. indica* belonging to Anacardiaceae possesses a natural system to exudate resin. However, this plant does not exudate immediately in response to injury with a cesicl or cork borer.

A few histochemical changes associated with exudation of gum resinosis in *M. indica* due to injury as well as influence of climatic variation were studied from the bark of main trunk. This study aims to clarify the secretion mechanisms of resins.

MATERIALS AND METHODS

Using cesicl, injury was made in the bark of *M. indica*. Tissues collected at the site of injury and normal tissues were utilized to carry out histochemical tests to localize changes in both the tissues viz., starch insoluble polysaccharids, lipids, proteins (Jense 1962, Jayabalan and Shah 1986) histoenzymological changes viz., succinic acid dehydrogenase (SDH), peroxidase, glucose-6-

phosphate dehydrogenase (G-6-PDH), adenosine triphosphatase (ATPase) and lipase (Bancro 1975) were also studied *in situ*, in the epithelial cells surrounding the canals nearby the injury site and at the normal cell systems.

Occluded material in duct was normal and stained with starch (I₂-KI) and lipids (Oil Red O), separatively. Control sections to confirm the occlusion was treated in deionized water for 10 min. and subsequently deresinated and stained with Oil Red O (Jayabalan and Shah 1986).

RESULTS AND DISCUSSION

The yielding of more quantity of gum-resin was found to occur from March to May. A detailed study on the influence of climate on gum-resin exudation has not been done yet. The epithelial cells surrounding the canals located in normal regions showed quantitatively intensive starch content, intensive amounts of lipids and moderate protein contents (Table 1).

The intensity of the enzyme activity of succinic acid dehydrogenase, peroxidase, G-6-PDH, ATPase and lipase was moderate to intensive in normal tissues (Table 2). The epithelial cells of the injured tissue showed absence of starch, but the same site showed insensitive quantity of proteins and lipids (Table 1). SDH activity was found to be less at normal tissues than the injured ones (Table 2). Similarly peroxidase and G-6-PDH activity were

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Table 1. Localization of histochemicals present in the normal and injured tissues

S.No	Metabolites localized	Normal tissues		Injured tissues	
		Epithelial cells	Adjacent cells	Epithelial cells	Adjacent cells
1	Starch	+++	++++	- / +	+++
2	Lipids	+++	++	+++	+++
3	Proteins	++	++	+++	+++

- : Absent ; + : Low / feeble ; ++ : Moderate ; +++ : Intensive ; ++++ : More Intensive

Table 2. Localization of histoenzymes present in the normal and injured tissues

S.No	Metabolites localized	Normal tissues		Injured tissues	
		Epithelial cells	Adjacent cells	Epithelial cells	Adjacent cells
1	SDH	++	+++	++++	++++
2	Peroxidase	+++	+++	++++	++++
3	G-6-PDH	++	++	++++	++++
4	ATPase	++	++	+++	+++
5	Lipase	++	++	+++	++++

- : Absent ; + : Low / feeble ; ++ : Moderate ; +++ : Intensive ; ++++ : More Intensive

found to be enhanced in the injured tissues (Table 2). Intense G-6-PDH activity in the epithelial cells of resin duct compared with the normal duct was correlated with the increased amount of sugar (Jayabalan *et al.* 1995).

The intensive activity of peroxidase in the cytoplasm, nucleus of epithelial cells and localization of lipids in them was presumed to be involved in more resin secretion (Heslop-Horison 1972) in the normal duct.

Absence of low rate of exudation from December to February was associated with less amount of starch, moderate protein content and low activity of SDH—a marker enzyme of respiration. Comparative high rate of copious exudation from March to May was associated with the presence of less starch content and higher activity of G-6-PDH, which may be involved in breaking down of starch to fractional units and be released in the canal where resin was already released.

The intensive presence of protein and more intensive activity of SDH and lipase are found in resin canal nearby injured region (Table 1). The resin canals occluded with resin contents were attributed to the higher activity of enzyme lipase on lipids of epithelial cells of resin canals at injured region (Tables 1, 2). Lipids secreted into the resin canals get oxidized to form aromatic resin. Reduction in the amount of starch and higher quantity of protein indicates metabolic status of cells. And high rate of respiration in the epithelial cells of resin canals was proved by more intensive activity of peroxidase, SDH and ATPase from March to May. This result indicates that metabolically active cells use more starch for respiratory purpose and high energy production that could be used for increased synthesis and exudation of more amount of gum resin during this period.

In vitro studies on laticifer plants have revealed that biosynthesis of secondary metabolites (gum, resin, polysoprene) requires large amount of ATP (indicated by ATPase activity), mevolinic acid, availability of more carbohydrates and reducing power NADPH as evidenced by enhanced activity of G-6-PDH. Much importance has been given to ATP and NADPH concentrations as they are significant factors in regulating the incorporation of acetate into isoprene, terpene and fatty acids. In fact formation of acetate from mevolinic acid is dependent predominantly on the availability of ATP source in the formation of isoprene and terpene regulating pathways (Jayabalan *et al.* 1994). Enhanced mitochondrial function (as indicated by SDH activity) in the ducts, cells near at the injury sites represents higher rate of respiration and production of ATP molecules. Therefore, it provides additional energy that can be utilized for plant growth, for formation of secondary metabolites of isoprene and terpene compounds, etc. (Archer 1980), and for conversion of more amount of precursor mevolinic acid or isopentyl pyrophosphate into isoprene and terpene compounds (Archer 1980, Jayabalan *et al.* 1994). The major reserve food materials in the epithelial cells of resin ducts near injury site was higher than that of the normal cells. The exudates occluded in canal was gum resin as confirmed by the control tests. The sections stained by I₂-KI and starch after treatment in deionised water at 40° for 10 min. showed negative and positive results with Oil red O staining. The same sections stained with Oil red O after deresination imparted no colouration in both the epithelial cells of duct and adjacent cells (Jayabalan and Shah 1986). The results confirm that the secretory components are gum- resin (Jayabalan *et al.* 1994).

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