Ethephon enhances karaya gum yield and wound healing response: A preliminary report

Gum karaya (also known as gum ka-
daya) is the whitish dry exudate from
Sterculia urens (Sterculiaceae). It is one
of the least soluble gums used for many
industries such as petroleum and gas,
textile, paper and pulp, leather and al-
lied products, ammunition and explo-
sives, electrical appliances, adhesives,
confectionery, medicine, pharmaceuti-
cals and cosmetics. Karaya is also
known by the name Indian tragacanth as
it resembles gum tragacanth produced
by Astragalus sp. There is high demand
for export of gum karaya from India.
Yield of this gum has shown a pheno-
minal decrease from 6838 MT in
1975–76 to 461.3 MT in 1990–91. Dur-
ing this period the price has shot up from
Rs. 7491 per MT to Rs. 83,361 (ref. 1).

The tree has a thick bark (2–3.5 cm)
which appears whitish-pink on the out-
side. Lysigenously formed gum ducts
are present in the pith and cortex of the
young stem, but they are absent in the
secondary phloem and wood. However,
ducts are formed in the bark and wood
in mature trees as a result of injury.

Commercial tapping of karaya is done
by blazing, peeling or by making deep
cuts in the base of the hole with an axe.
These methods are wasteful and injuri-
ous to the trees, often leading to their
death. On account of crude tapping
methods, and over-exploitation, the
population of karaya trees has markedly
declined. In the absence of cultivation
of the trees in regular plantations, there
is grave concern about the loss of wild
germlasm of S. urens. Presently, the
Governments of Madhya Pradesh, Ra-
jasthan and Uttar Pradesh have imposed
a ban on tapping and collection of the
gum karaya to allow recovery and re-
generation of the trees.

As gum karaya is vital for tribal
economy and as its trade value is sub-
stantial, there is a pressing need to de-
velop a scientific and sustainable tap-
ing method to increase the yield and to
ensure the survival of the tapped trees.
Here we present a simple and safe
 technique for tapping, with a substantial
increase in the yield.

Seven trees of various sizes and ages
growing in a forest near Ghathi Village
along National Highway No.3 in MP
(about 25 km from Gwalior, India),
were selected for experimentation.
Using a hand drill, 10 holes each of 5 mm
diameter and 2–3.5 cm depth (based on
the thickness of the bark) were bored on
each tree around the stem at equal dis-
ance, about 1 m above the ground level.
The holes were angled towards the base
of the tree to prevent backflow of the
introduced solutions. Five consecutive
holes were treated with ethenep (2-
chloroethyl phosphonic acid) and the
other five (opposite to the treated holes)
were maintained as distilled water con-
trols. One ml of ethenep solution
(containing 190/285/390 mg of the active
compound per ml) or 1 ml of distilled
water was dispensed into each hole.

Gum produced in the control and
untreated holes was collected after 30 and
45 days of treatment and the data were
pooled. The ethenep treatment resulted
in an average increase of 20 times more
gum than the control (Table 1). The
total harvest from seven ethenep-
treated trees tapped once was about
1.5 kg of high-quality gum. There was a
marked difference in the yield among
individual trees, presumably due to het-
erozygosity.

Notably the control holes were com-
pletely dry after 30 days, while the
treated ones continued to secrete the
gum. Histological examination showed
that large gum ducts or cavities had been
formed in the secondary phloem and
wood, covering a radius of 2–3 cm around
each hole in ethenep-treated trees. By 45
days, a thick wound tissue had developed
at the injured regions which nearly re-
placed the damaged tissues.

Ethenep is conventionally used to
stimulate latex flow in para rubber
(Hevea brasiliensis), resin enhancement
in pines, gum exudation in Prunus,
Acacia senegal, Anogeissus latifolia,
Azadirachta indica, and increase the
production of kino in Eucalyptus,
gum-resinosins in Commiphora winteri
and Mangifera indica. Ethenep is a
nontoxic, environment-friendly, inex-
pensive and easily available plant
growth regulator (PGR) manufactured in
India and used extensively in agriculture
and horticulture. Safe tapping and the
use of ethenep for improving the
yield would ensure sustainable supply
of gum karaya.

We are conscious that the sample size
on which our observations are based is
small. Further detailed studies are being
conducted using larger number of trees
from separate populations in different
seasons to allow statistical assessment of
the efficacy of this method. A recent
trial with 17 trees has shown that gum
yield is high with ethenep treatment
even after 10 days. Efforts are being made
to standardize the protocol, optimize the
yield, and determine the long-term effects
on the trees. Yields need to be compared
with those from the traditional tapping
methods. A detailed investigation on sus-
tained yield, cost effectiveness, extent of
injury, and wound-healing response of the
trees is also being carried out to verify this
preliminary finding.

| Table 1. Yield of gum karaya from control and ethenep-treated trees |
|------------------|------------------|------------------|
| Distilled water control | Ethenep-treated |
| Total amount of gum collected per tree (g) | Amount of ethenep applied (mg) | Total amount of gum collected per tree (g) |
| a | 390 | 386.00 |
| 12.50 | 390 | 185.00 |
| 9.05 | 190 | 433.00 |
| a | 190 | 48.00 |
| 8.75 | 285 | 65.00 |
| a | 285 | 211.00 |
| 15.00 | 285 | 259.00 |
| 11.30 mean | 226.71 mean |

a. Gum was not noticed; probably the lump had fallen off before collection.
Occurrence of *Botryococcus* from the Lower Cretaceous rocks of Cauvery Basin, Tamil Nadu

*Botryococcus*, an oil-producing colonial green alga, is generally known to occur in Tertiary and Quaternary rocks of India. It is also reported from Permian sediments of India.

In course of drilling for groundwater in the area, about 1.2 km west and 1.3 km north of Kattarambakam village of Vannur taluk, South Arcot district, Tamil Nadu (Figure 1), carbonaceous shale, sandstone, coal and clay were encountered. The palynological studies of the carbonaceous shale samples revealed the presence of abundant green alga *Botryococcus*.

*Botryococcus* is well preserved, honey yellow to brownish yellow in colour and occurs either as solitary autospores or bodies of two to four chambered cups (Figure 2) or as multicup aggregates. The colonies are mostly botryoidal (Figure 2) or spheroidal in shape and range from 120 to 160 μm in diameter. The diameter of the two- or four-chambered cups ranges from 16 to 28 μm (Figure 2). Further, it is also noticed that some of the colonies appear as irregular lumps of varying dimensions (Figure 2). In the present assemblage the thimble (inner part of cup) invariably remained empty.

*Botryococcus* is known to thrive in fresh to brackish shallow waters with undisturbed conditions in the area of relatively low rainfall. The excellent state of preservation of all the developmental stages (i.e. autospores, two-to-four-chambered cups and multicup aggregates) is indicative of rapid burial of this algal bloom in quiet shallow oxygenated waters without much transportation.

The qualitative analysis of the associated miofloral assemblage revealed the presence of characteristic palynomorphs referable to *Aequiritridades* sp., *Microcachrydites* sp., *Dictyosporites speciosa*, *Cicatriciosporites australiensis*, *Appendicisporites tricornutus*, *Neorastrikia* sp., *Cooksonia* sp., *Gothamipollis*.