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

Gum karaya (also known as gum kadaya) 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 allied products, ammunition and explosives, electrical appliances, adhesives, confectionery, medicine, pharamaceuticals and cosmetics[1]. Karaya is also known by the name Indian tragacanth as it resembles gum tragacanth produced by *Astragalus* sp[2]. There is high demand for export of gum karaya from India. Yield of this gum has shown a phenomenal decrease from 6838 MT in 1975–76 to 461.3 MT in 1990–91. During 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 outside. Lysigenously formed gum ducts are present in the pith and cortex of the young stem[3], 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[4].

Commercial tapping of karaya is done by blazing, peeling or by making deep cuts in the base of the bole with an axe. These methods are wasteful and injurious 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 germplasm of *S. urens*. Presently, the Governments of Madhya Pradesh, Rajasthan and Uttar Pradesh have imposed a ban on tapping and collection of the gum karaya to allow recovery and regeneration of the trees.

As gum karaya is vital for tribal economy and as its trade value is substantial, there is a pressing need to develop a scientific and sustainable tapping 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 Ghatti 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 distance, 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 ethephon (2-chloroethyl phosphonic acid) and the other five (opposite to the treated holes) were maintained as distilled water controls. One ml of ethephon solution (containing 190/285/390 mg of the active compound per ml) or 1 ml of distilled water was dispensed into each hole.

Table 1. Yield of gum karaya from control and ethephon-treated trees

Distilled water control	Ethephon-treated	
Total amount of gum collected per tree (g)	Amount of ethephon 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.

Gum produced in the control and treated holes was collected after 30 and 45 days of treatment and the data were pooled. The ethephon treatment resulted in an average increase of 20 times more gum than the control (Table 1). The total harvest from seven ethephon-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 heterozygosity.

Notably the control holes were completely 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 ethephon-treated trees. By 45 days, a thick wound tissue had developed at the injured regions which nearly replaced the damaged tissues.

Ethephon is conventionally used to stimulate latex flow in para rubber (*Hevea brasiliensis*), resin enhancement in pines[5], gum exudation in *Prunus*[6], *Acacia senegal*[7], *Anogiessus latifolia*[8], *Azadirachta indica*[9,10] and increase the production of kino in *Eucalyptus*[11], gum-resinosis in *Commiphora wightii*[12] and *Mangifera indica*[13]. Ethephon is a nontoxic, environment-friendly, inexpensive and easily available plant growth regulator (PGR) manufactured in India and used extensively in agriculture and horticulture[14–16]. Safe tapping and the use of ethephon 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 carried out 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 ethephons 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 sustained yield, cost effectiveness, extent of injury, and wound-healing response of the trees is also being carried out to verify this preliminary finding.

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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*[1].

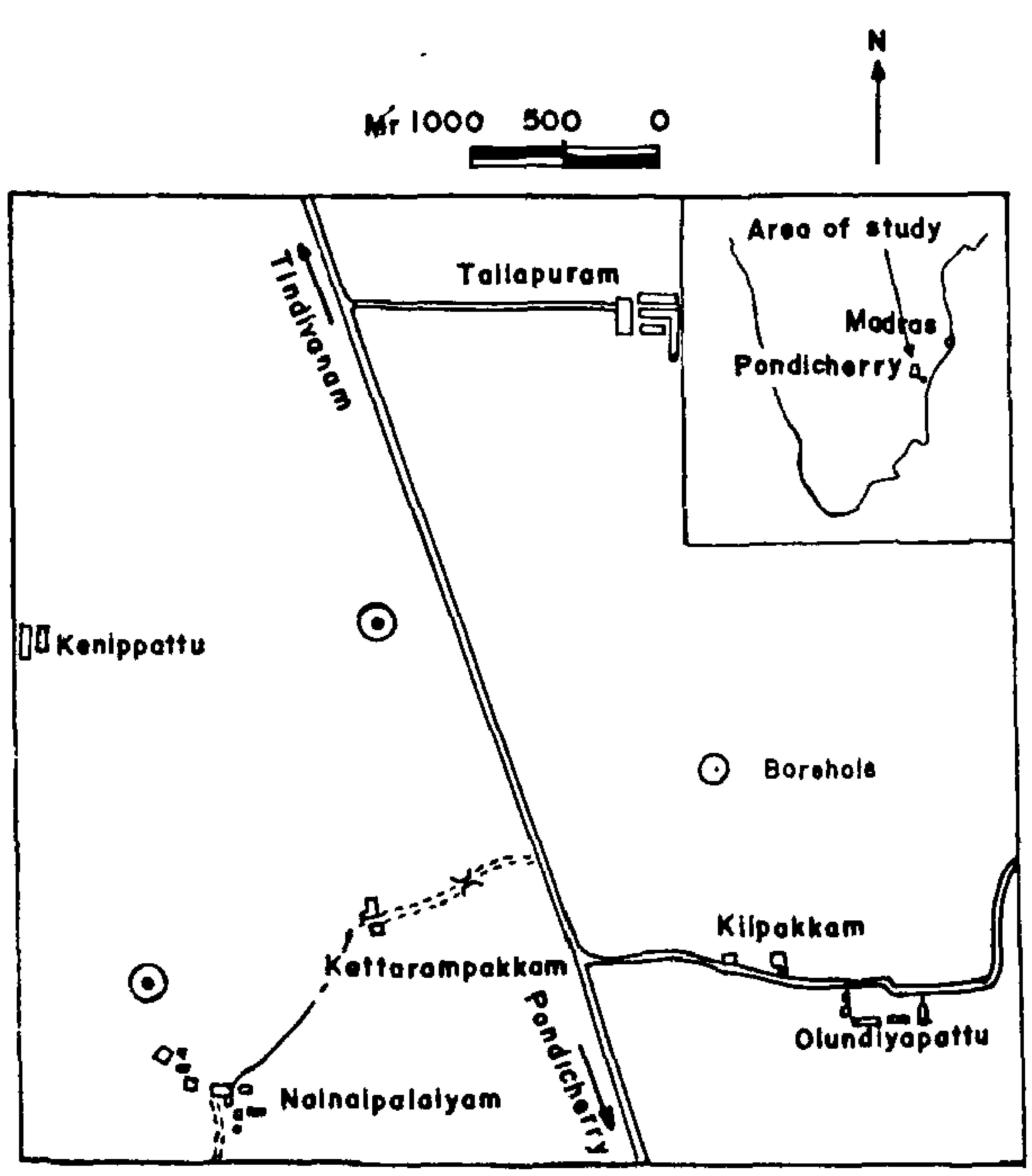

Figure 1. Location map of the study area.

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 know to thrive in fresh to brackish shallow waters with undisturbed conditions in the area of relatively low rainfall[2]. 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[2,3].

The qualitative analysis of the associated miofloral assemblage revealed the presence of characteristic palynomorphs referable to *Aequitriradites* sp., *Microcachryidites* sp., *Dictyosporites speciosa*, *Cicatricosisporites australiensis*, *Appendicisporites tricornitatus*, *Neoraistrikia* sp., *Cooksonites* sp., *Gothanipollis*