International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(4): 1430-1434

Received: 20-05-2020
Accepted: 22-06-2020

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Studies on analysis of *Ceiba pentandra* Gum

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DOI: https://doi.org/10.22271/chemi.2020.v8.i4m.9815

Abstract
GCMS (Gas Chromatography Mass Spectrometry), FTIR (Fourier Transformed Infra-Red Spectroscopy), physicochemical analysis of *Ceibapentandra* gum have been carried out. *Ceiba pentandra* exudate is brownish in colour, acidic and ionic gum. GCMS spectra of the gum indicated the presence Hellebrin, Glycine, Octadecane, Dasycarpidan, Octadecatrienoic acid, Tocopherol, Di isooctyl phthalate and Milbemycin. The FTIR spectrum of the gum indicated several functional groups, including –OH, N-H and C=C, C-Cl group.

Keywords: Kapok gum, analysis, GC-MS, FTIR

Introduction
India is rich centre of biodiversity and offers great potential for the sustainable utilisation of these natural resources by converting plant wealth into economic wealth. Their increased role in socio-economic development incentive design and livelihood support is already well appreciated; as a major part, around 80% of natural gums produced in our country is exported. There is a growing interest worldwide in natural gums particularly in food, pharmaceutical and cosmetics applications (Sao, 2012) [12].
Ceiba pentandra is avery large, deciduous tree up to 60 m tall, with roots spreading quite horizontally, 10 m or longer, in the upper 40 – 80 cm of the soil; bole branchless for up to 35 m, straight, usually cylindrical, up to 200-240 cm in diameter (Elumalai *et al.*, 2012)[7]. The tree has two main uses, being an important source of i) fibre and ii) timber. Apart from the above-mentioned uses, the Kapok tree exudates gum. However, *Ceiba pentandra* exudate gum has not been utilized due to lack of information about the quality and properties of the gum produced from it (Orwa *et al.*, 2009) [10]. Therefore, the main objective and aim of this study is to analyse the exudate gum and provide the properties present in it.

Materials and methods
Source of sample
The gum was obtained from the *Ceiba pentandra* tree in Forest College and Research Institute campus at Mettupalayam and also in Government Horticulture Garden in Kallar. Some mature trees were selected and incisions were made in order to get the gum exudates.

Tapping of gums
The gums were collected from the plant species by tapping during the day time. A small axe was used to break the outer bark. Tapping was carried out by driving an axe underneath the bark which was pulled back until the bark broke horizontally to give two broken ends. The cut was made about 4.0 to 8.0 cm wide. The bark was then carefully peeled along the length of the wounded trunk. Initially, gum was collected after 4 weeks of incision and later collected at an interval of 3 days at the rate of 30 g to 40 g. The gum exudates formed were 2.0 to 2.5 cm in width. They were collected and stored in a container.

Extraction and purification
The collected gum was hydrated using distilled water for 3days with intermittent stirring. Extraneous solution was filtered to separate gum and resin using a muslin cloth. The extracted gum solution was both dried and precipitated. Extraneous solution was filtered to separate gum and resin using a muslin cloth.

Finally, the powdered gum and supernatant liquid was taken for analysis.

Determination of colour

The colour of the gum was tested using Hunter lab colorimeter. The colour was detected using hunter lab values in terms of L, a & b.

Determination of pH

pH of 25% aqueous gum solution (w/v) was measured using a glass electrode pH meter. This was done by shaking a 1% w/v dispersion of each gum sample in water for 5 mins and the pH was determined using a pH meter. The pH meter was set to neutral at room temperature of 28 °C and electrode was immersed into the gum solution and the reading was recorded(Anoop *et al*., 2010)[4].

Determination of solubility in various solvents

The separated gum was evaluated for solubility in water, acetone, chloroform and ethanol (Anoop *et al*., 2010) [4]. One g sample of the gum was added to 50 ml of each of the above mentioned solvents and left overnight.

Determination of percentage yield of the purified gums

The dried, precipitated and purified gum(s) obtained from the crude dried exudates were weighed and the percentage yield was expressed using the weight of the crude gum(s) as the denominator.

FTIR analysis

FTIR analyses of the gums were carried out using a Scimadzu FTIR-8400S Fourier Transform Infra-red Spectrophotometer. The sample was prepared and the analysis was done by scanning the sample through a wave number range of 400 to 4,000 cm^{-1}.

GC-MS analysis

The analysis was carried out on a GC clarus 500 Perkin Elmer system comprising of a AOC20i Auto sampler and Gas Chromatograph interfaced to a Mass Spectrometer (GC-MS) in Tamilnadu Agricultural University, Coimbatore. The instrument employed the following conditions: a column Elite-1 fused silica capillary column (15 × 0.25 mm ID × 1 µmdf, composed of 100% Dimethyl poly dioxane), operating in electron impact mode at 70 eV. Helium (99.999%) was used as carrier gas with an injector temperature of 250 °C; an ion-source temperature of 280 °C. The oven temperature was programmed from 110 °C ending with a 9 min isothermal at 280 °C. Mass spectra were taken at 70 eV; a scan interval of 0.5 seconds and fragments from 40 to 450 Da. The total GC running time was 34 min.

Results

Properties of Kapok Gum

From the study, it is evident that the colour lab values are L: 30.5;a: 8.20;b:10.30 and denote that colour value ranges from yellowish-orangeto reddish brown. The studied gum was soluble in cold and hot water but insoluble in acetone, chloroform and ethanol. Solubility of the gum in hot water was 74%. The pH of the gum is 5.18. The measured properties are presented in Table 1.

Table 1: Properties of Kapok Gum

S. No.	Parameters	Values	
1.	pH	5.18	
2.	Colour	L	30.5
		a	8.20
		b	10.30
3.	Solubility (%)	74	

FTIR analysis

The peaks obtained from the analysis are identified from the FTIR spectra which are presented in Figure 1. The broad band occurring at wavelength of 3336.85 cm-1 was due to the stretching of amide and alcohol group (i.e N-H and O-H stretch). The peak obtained at wavelength 2960 $cm^{-1}$and 2870 cm-1 is due to stretching modes of O-H bonds of acid group. The peak obtained strong C=C stretch and N-H bend is due to the presence of alkene group and amide group respectively, which were found at the wavelength of 1637.56 cm^{-1}. The spectral peak from the wavelength of 1381 cm^{-1} due to the bending of C-F group. The peak obtained strong C-Cl stretch is due to the presence of halide group at the wavelength of 669.30 cm^{-1}. The broadband occurs at the wavelengths 599.86 cm^{-1} and 553.86 $cm^{-1}$was due to the stretching of halide group (i.e. C-Br stretch). Finally, the weak vibrations at the wavelengths 491.85cm^{-1}, 468.70 cm^{-1},410.84 cm^{-1} were due to the stretching of C-I halide group. Table 2. Represents the spectral beaks and the group which represent them.

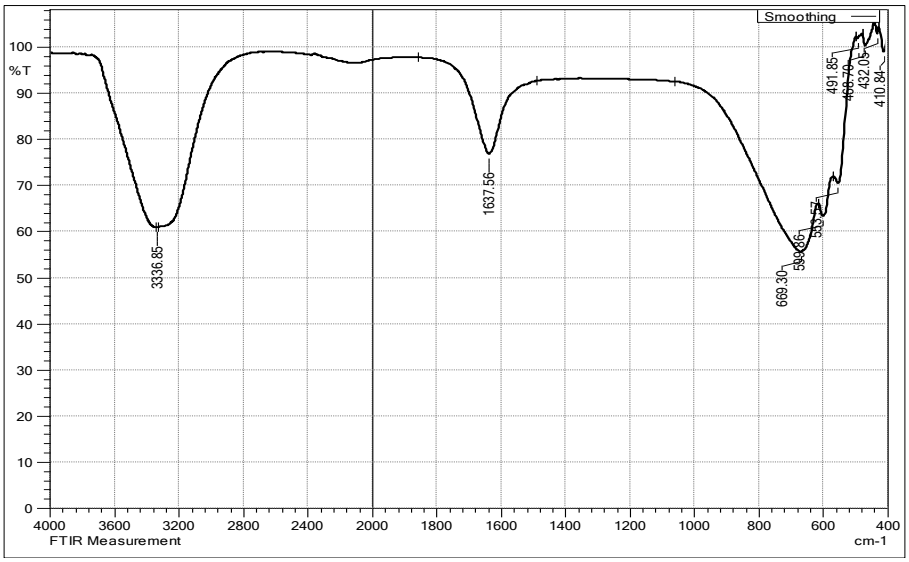

Fig 1: FTIR spectra of Kapok gum

Table 2: List of major compounds present in Kapok gum

S. No.	RT	Probability	Name	Formula	Area (%)	Molecular weight	Figure no.
1.	33.12	33.10	Bufa-20,22-dienolide, 3-(acetyloxy)-5,14-dihydroxy-19-oxo-, (3á,5á)-	$C_{26}H_{34}O_7$	34.34	458	A
2.	30.47	15.39	Octadecane, 3-ethyl-5-(2-ethylbutyl)-	$C_{26}H_{54}$	5.5	366	B
3.	16.61	8.17	Dasycarpidan-1-methanol, acetate (ester)	$C_{20}H_{26}N_2O_2$	5.4	326	C
4.	18.67	34.05	9,12,15-Octadecatrienoic acid, 2-phenyl-1,3-dioxan-5-yl ester	$C_{28}H_{40}O_4$	5.9	440	D
5.	32.29	25.39	(+)-ç-Tocopherol, O-methyl-	$C_{24}H_{33}FO_6$	5.3	436	E
6.	24.83	23.13	Diisooctyl phthalate	$C_{24}H_{38}O_4$	4.7	390	F
7.	25.17,	26.18	Glycine	$C_{36}H_{69}NO_6Si_3$	3.5	695	G
8.	17.88	22.36	Milbemycin b,	$C_{33}H_{46}ClNO_7$	0.7	603	H

Table 3: FTIR spectra of Kapok gum

Peak (cm^{-1})	Intensity (%)	Type of Vibration	Functional group
3336.85	60.89	Stretch	N-H amide
		Stretch, H – bonded	O-H alcohol
2960	94.03	Stretch	O-H acid
2870	97.26	Stretch	O-H acid
1637.56	76.88	Stretch	C=C alkene
		Bending	N-H amide
1381	93.16	Bending	C-F halide
669.30	55.65	Stretch	C-Cl halide
599.86	63.32	Stretch	C-Br halide
553.86	70.50	Stretch	C-Br halide
491.85	101.96	Stretch	C-I halide
468.70	100.26	Stretch	C-I halide
410.84	98.96	Stretch	C-I halide

GC-MS analysis

From this GC-MS spectrum, it is evident that the spectrum of *Ceibapentandra* gum consists of eight dominant peaks which denote the chemical compounds present in the *Kapok* gum sample. The concentrations of active constituents of the gum sample, associated retention time, probability, compound name, chemical formula, area and molecular weight of the compounds were identified from the spectrum presented in Figure 2.

They are Bufa- 20,22 - dienolide, 3-(acetyloxy)-5,14-dihydroxy-19-oxo-(3á,5á), Octadecane, 3-ethyl-5-(2-ethylbutyl), Dasycarpidan-1-methanol, acetate (ester), 9,12,15-Octadecatrienoic acid, 2-phenyl-1,3-dioxan-5-yl ester, (+)-ç-Tocopherol, O-methyl, Diisooctyl phthalate, Glycine, Milbemycin. The common name of these compounds are Hellebrin, Glycine, Octadecane, Dasycarpidan, Octadecatrienoic acid, Tocopherol, Di isooctyl phthalate and Milbemycin.

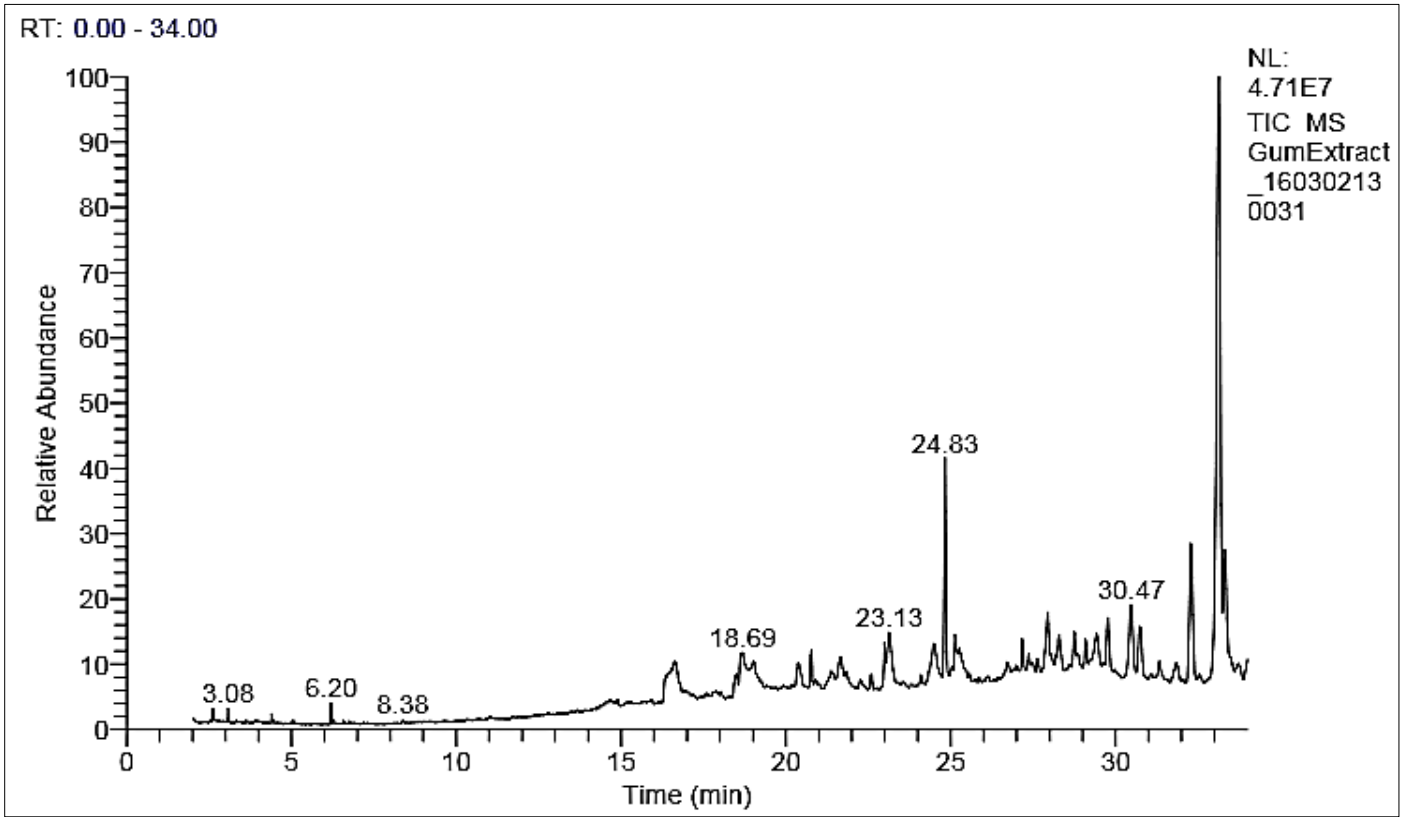

Fig 2: GC – MS spectra of Kapok gum

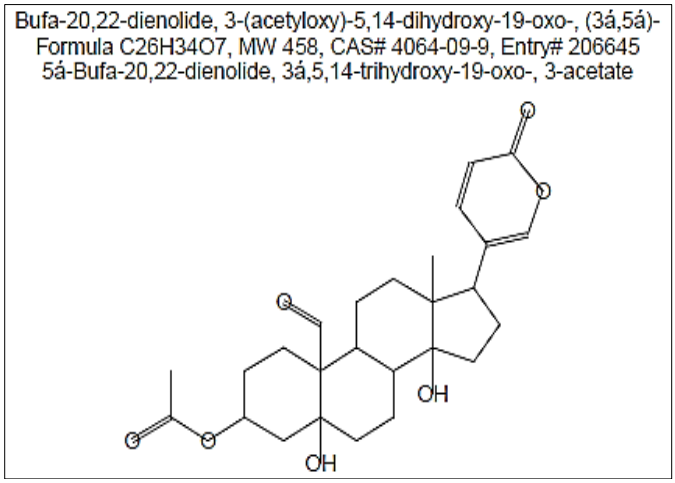

Fig-A

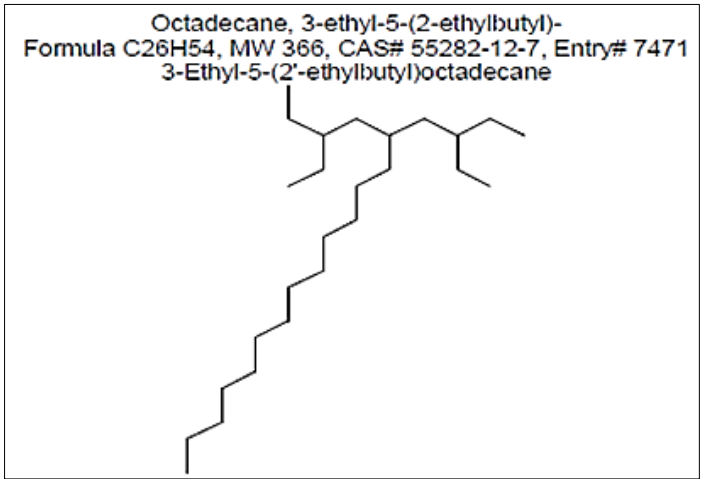

Fig-B

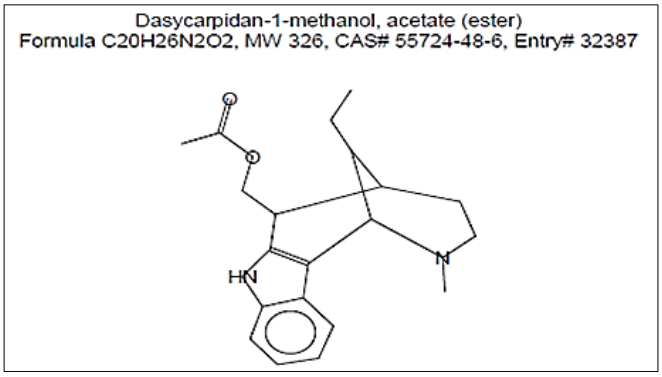

Fig-C

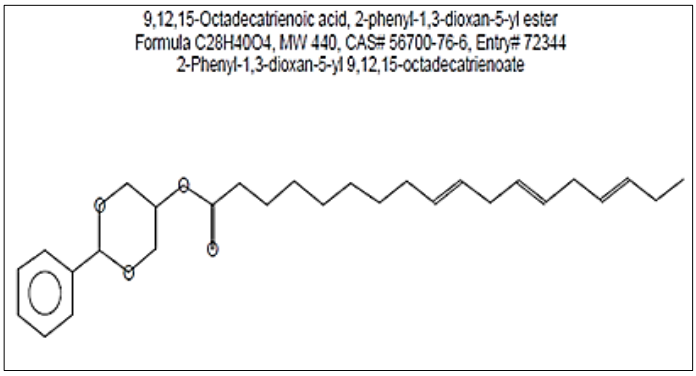

Fig-D

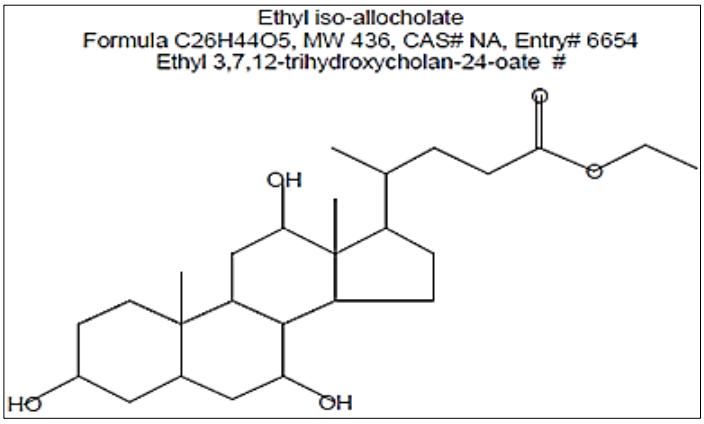

Fig-E

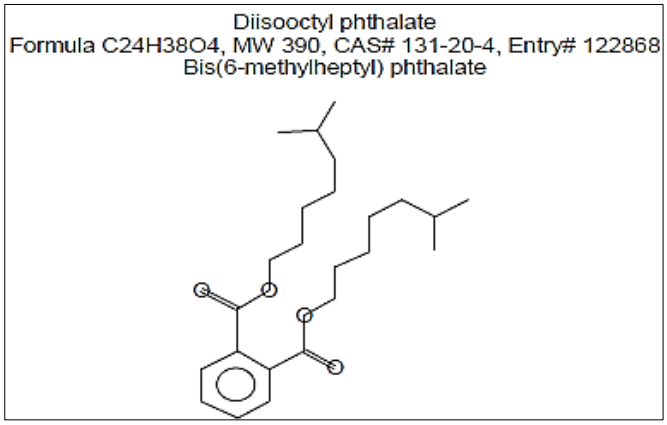

Fig-F

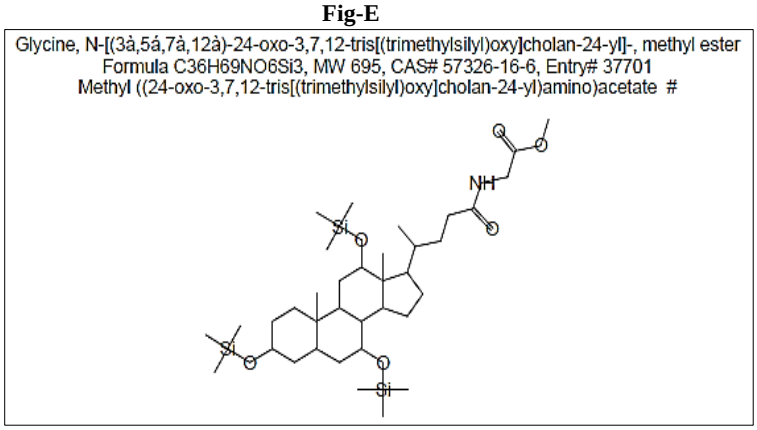

Fig-G

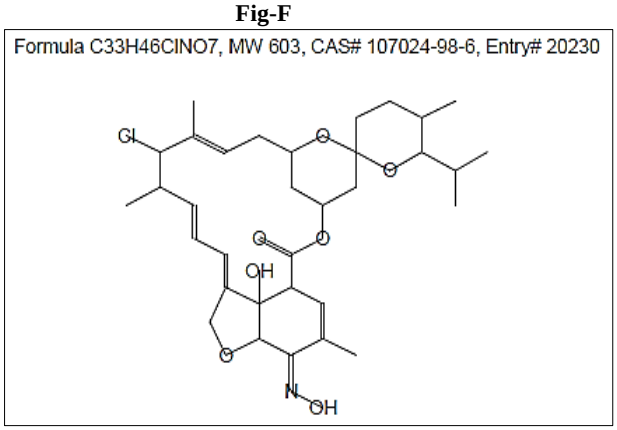

Fig-H

Discussion

The *Kapok* gum is found to be acidic in nature as the pH is 5.18. The studied gum was soluble in cold and hot water but insoluble in acetone, chloroform and ethanol indicating that the gums are ionic because it dissolves in water, which has a high dielectric constant.

From the results obtained from the FTIR study, it can be seen that the FTIR spectrum of the gum consists of several amide (N-H amide) and halide (C-Cl, C-Br, C-I halide) stretching which occurred in the wave number range of 410.84 cm^{-1} to 3336.85 cm^{-1}. The FTIR spectrum of *Kapok* gum revealed the occurrence of nine prominent peaks, which include those that are typical for proteins. It can be seen from the GC-MS study, that each of the identified compounds had characteristic numbers and nature of peaks which indicates that this gum is not poisonous and can therefore be recommended to be used in food and pharmaceutical industries as reported elsewhere.

Conclusion

Thus the studies on properties of the *Kapok* gum inferred that the gum may be suitable for application in pharmaceutical, cosmetics, polymer, food and other industries.

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