International Journal of ChemTech Research
CODEN (USA): IJCRGG ISSN: 0974-4290
Vol.8, No.5, pp 61-64, 2015

National conference on Nanomaterials for Environmental [NCNER-2015]
19th & 20th of March 2015

Synthesis of fluorescent carbon dots from mango peels

Disha Kukreja[1], Janet Mathew[1], R. Lakshmipathy[2], N.C. Sarada[1]*

[1]Environmental and Analytical Chemistry Division, School of Advanced Sciences, VIT University, Vellore-14, Tamil Nadu, India
[2]Centre for Material Science, KCG College of Technology, Karapakkam, Chennai-97, India

Abstract : Carbon dots (C-dots) are a new promising type of biocompatible & multicolor luminescent nanoparticles. The water soluble and fluorescent C-dots were prepared from low cost agricultural waste such as mango peels, through low temperature carbonization process. The prepared C-dots possessed small particle size and strong blue luminescence. The synthesized C-dots were characterized with the help of analytical techniques such as DLS, UV-Visible, FT-IR & Fluorescence instruments. These results suggest that mango peel a abundant low cost agricultural waste is a useful source for synthesis of C-dots with applications.
Key Words: Carbon-dots; Mango peel; Fluorescence;

1 **Introduction**:

Carbon dots, one of the latest allotropes of carbon are the new class of small carbon nanoparticles, which exhibit photoluminescence properties [1]. These dots can replace quantum dots in semiconductor devices and nano devices because of their high water solubility, small size (<10nm), intense brightness, high photo stability, low cytotoxicity and good biocompatility [2, 3]. On the other hand, quantum dots are generally toxic and detrimental to the environment [4]. The previously reported methods have many drawbacks such as the use of chemicals, high temperature and low product yield. Another disadvantage is the use of expensive instruments [2, 5]. So, there is a need for some alternative methodologies.

Mango (*Mangifera indica* L., family Anacardiaceae) is a delicious fruit grown in almost all tropical and subtropical regions of the world. Currently, with about 27 million ton production annually mango ranks 5th in production among the major fruit crops. The edible part (the pulp), which makes up to 33%–85% of the fresh fruit, is processed for products such as juices, nectars, concentrates, jam, jelly powders, fruit bars, and dried mango products. During the processing of mango, peel, which is 7%–24% of the total fruit weight, is generated as a by-product/waste. The peel serves no commercial purpose, which is discarded as a waste thus becoming a source of pollution. The purpose of this study is to convert the waste into useful form and hence mango peel was selected for the synthesis of C-dots through low temperature carbonization. This method is extremely environment friendly as it doesn't involve any chemicals. The materials used for the synthesis are cheap, easily available & biowaste. The obtained C-dots are water soluble, highly fluorescent and have been used for antimicrobial activity.

2 Materials and Methods

2.1 Synthesis of Carbon dots

The fresh mango peels were collected from local fruit market and washed several times under tap water to remove dirt and other sediments present in the peel. The washed peels were later dried in the sunlight for 24 h to remove the moisture content. The dried peels were carbonized at 220^0 C for 2 h in furnace in presence of air. 1 gram of carbonized peels was accurately weighed and dispersed in 100 ml ultrapure water and sonicated for 15 minutes for homogenous dispersion. The dispersed solution was later filtered using whatmann filters (Grade-I) and then, the filtered solution was centrifuged and resultant supernatant containing luminescent C-dots were characterized by various analytical techniques.

2.2 Characterization techniques

The UV-VIS spectral analysis was recorded by a JASCO V-670 spectrometer. The fluorescence spectra were obtained by using a HITACHI F-7000 fluorescence spectrometer. FT-IR spectra were recorded by an IR Affinity-1(shimadzu). The Zetasizer version 7.10 (malvern instrument) was used to determine the particle size.

3. Results and Discussion

Agro waste material, rich in carbon content such as mango peel was selected for the synthesis of Carbon dots. The synthesis of carbon dots was carried out at low temperature. The fluorescent property was studied.

3.1 Characterization of C-Dots.

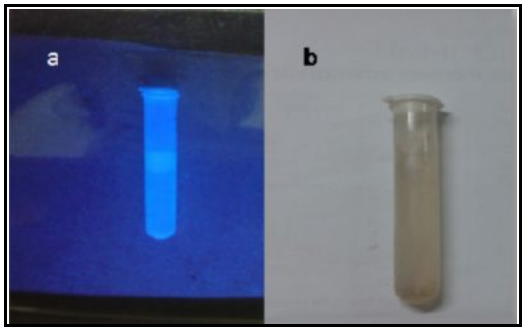

Fig. 1 Carbon dots synthesized from mango peel waste (a), In presence of UV light (b) in absence of UV light

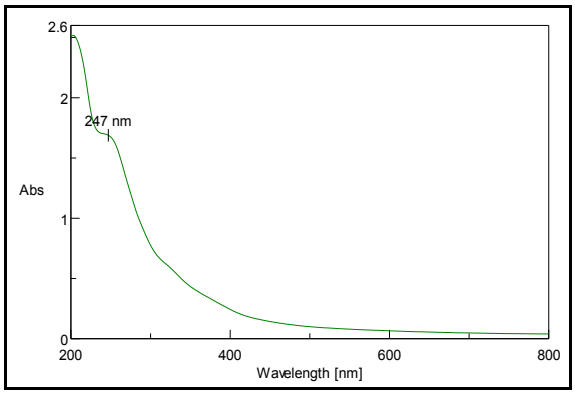

Fig 2: UV- Visible absorption spectrum of C-dots (mango peel).

The C-dots synthesized from mango peels were investigated for its fluorescent property in presence of UV light. The supernatant solution prepared from mango peels were placed in UV chamber and checked for fluorescence emission at 354nm. The solution exhibited blue fluorescence at 354 nm confirming the presence of carbon dots (Fig 1a). In the absence of UV light, pale yellow colour was observed (Fig 1b). Further, UV-VIS spectral analysis was carried out for the synthesized C-dots and maximum absorption peaks were observed at

247 nm for mango peel (Fig 2). The peak observed at 247 nm can be attributed to π-π* electron transitions of the C-dots. The result showed consistency with previous reports on the synthesis of c-dots[2].

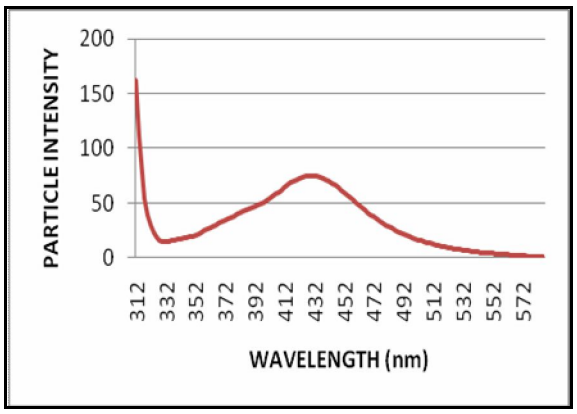

Fig 3: Fluorescence emission spectra of C-dots (mango peel)

The fluorescent c-dots obtained from mango peel exhibit fluorescence emission band at 430 nm when excited at 300 nm (Fig 3). The obtained results were conformable with literature reports [5].The emission property of C-dots may be due to size of C-dots, the availability of sp^2 sites and the aromatic conjugated structure.

FT-IR spectroscopy was used for the identification of functional groups present on the surface of C-dots. A drop of C-dots containing solution was placed on freshly prepared KBr disc and scanned between 4000-400 cm^{-1} for 32 scans. The FTIR spectra of C-dots are represented in Fig.4. The FTIR spectra showed strong peaks at 3329.14 and 1631 cm^{-1} corresponding to the symmetrical and asymmetrical stretching of –OH molecules of water. No other peaks were observed depicting the absence of other organic molecules or contaminants in prepared samples.

In order to measure the particle size of the prepared C-dot samples, DLS analysis was carried out. The particle size obtained from DLS was found to be in the range of 40-60 nm for C-dots (Fig 5).This confirms that C-dots prepared from mango peel are in nano range.

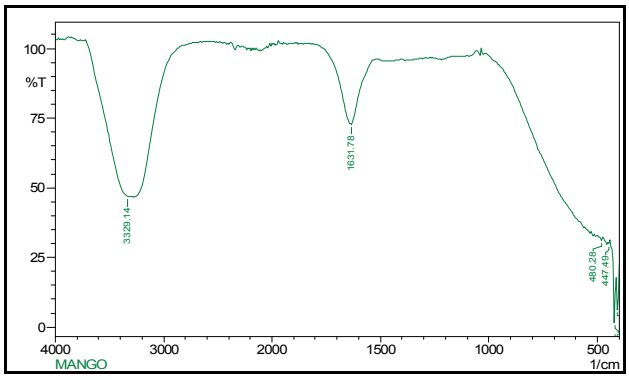

Fig 4: FTIR spectra of C-dots synthesized from Mango peels

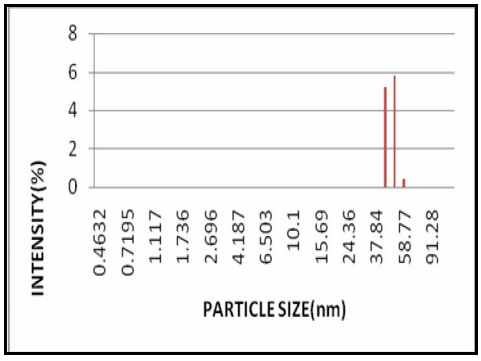

Fig 5: Particle size distribution of c-dots (mango peel).

4. Conclusion

The agricultural waste (mango peels) selected and investigated for the synthesis of carbon dots. One step, simple and low temperature carbonization method was adopted for the synthesis of c-dots which exhibits bright blue fluorescence. This confirms the synthesis of carbon dots. Particle size of carbon dots were found to be between the range of 40-60 nm for c-dots of mango peel. From the above observations, it can be concluded that mango peels are good source for synthesis of carbon nanoparticles.

5. Acknowledgement

We would like to acknowledge the staff and technicians of school of advanced sciences, (chemistry division) Vellore institute of technology

6. References

1. Xian W.T, Ain N.B.R, Suk F.C, Sing M.N, Carbon dots production via pyrolysis of sago waste as potential probe for metal ions sensing. Journal of Analytical and Applied Pyrolysis, *2014, 105, 157-165*.
2. Adhimoorthy P, and Toyoko I, One-pot synthesis of fluorescent carbon dots from orange waste peels.Industrial & Engineering Chemistry Research,*2013,52,15673-15678.*
3. Pei Y.L, Chiung W.H, Mei L.K, Ling-Ya C, Huei-Jhen H, Hui-Ting C, Wu D, Kuo C, Hsieh S, Shuchen H, Eco-friendly synthesis of shrimp egg-derived carbon dots for fluorescent bioimaging. Journal of Biotechnology, *2014,189, 114-119*.
4. Eliana F.C. S, Joaquim C.G, Silva E, João M.M.L, Carbon dots from tryptophan doped glucose for peroxynitrite sensing, Analytica Chimica Acta , *2014,852, 174-180.*
5. Zhou J, Zonghai S, Han H, Zou M, Li C, Facile synthesis of fluorescent carbon dots using watermelon peel as a carbon source, Materials Letters 2012,66,222-224.

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