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KARANJ FRUIT SHELL AS PRECURSOR FOR PREPARATION OF ACTIVATED CHARCOAL

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Abstract: **Karanj trees are grown and planted for extraction of oil from seeds. The shells of the karanj fruits are discarded as waste material. These fruit shells which otherwise had no economic value was used as precursors for preparation of activated charcoal. Acetic acid was used as activating agent. The parameters for activation of precursors such as: concentration of acetic acid, activation time and impregnation ratio was studied. Carbonization of activated material was performed from temperature ranging from 300^{0}C- 450^{0}C.**

Keywords: **Karanj Fruit shell, Activated charcoal, Activating agent, Carbonization, Impregnation ratio.**

1. INTRODUCTION

Different materials have been used for the preparation of Activated charcoal looking at its great demand in modern times. Activated charcoal has a high commercial value as it finds its applications in water purification, removal of colour and dyes from effluents, drugs and medicines [1] Nano materials and body care products. Production of AC requires large amount of raw materials for its production. Purchase of expensive raw materials as wood and coal makes the AC's very expensive. Therefore, to reduce the cost of producing AC's several waste and agro-wastes materials have been suggested by various authors [2 – 23] in the past. Karanj fruit (*pungamia pinnata*) shells are inexpensive as they are wastes and discarded materials. Use of such wastes as precursors for preparing AC will open new avenues for the farmers who were promoted to plant these trees to meet the oil demand for making bio diesel. Seeds of these fruits are the source of oil but shells have no role therefore it forms tones of wastes.

2. MATERIAL AND METHODS

Raw material

Karanj fruit shells were collected washed with water to remove dust particles. The shells were air dried in sunlight for several days. The dried shells were then crushed to a desired particle size using domestic mixer. The crushed and grinded shells were washed with distilled water to remove the fine dust. After drying in hot air oven at low temperatures was stored in airtight plastic bottles.

Activating agent

The activation of the air dried precursor was carried out by chemical activation method using acetic acid. The grinded material was immersed in acetic acid solution and the impregnation ratio was in the range of 3.5-12.25. The impregnation ratio (IR) was determined as the ratio of the weight of activating agent to the weight of the raw material.

Activation time

A 30% acetic acid was selected to study the effect of activation time. The dried material (3g) was soaked in 50ml of acetic acid solution for 6 -24 hours at room temperature. After the lapse of activation hours the sample was decanted and dried in a hot air oven at 70^{0}C for about two hours.

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Carbonization temperature

The activated sample was carbonized in muffle furnace at a temperature ranging from 300^{0}C to 450^{0}C in an inert atmosphere. A 15 minute's holding time at maximum final temperature was employed for carbonization of the sample.

Washing

Activated charcoal was washed with distilled water to get rid of the excess of acetic acid. The washed charcoal was dried in hot air oven at 150^{0}C. The dried product was weighed and the percentage yield was calculated.

Percentage Yield

The percentage yield of the activated charcoal was calculated using the formula:

$$\text{Yield (\%)} = \frac{W_1}{W_2} \text{ X } 100$$

Where, W_1 is the dry weight (g) of final activated charcoal, W_2 is the dry weight (g) of precursor.

3. RESULTS AND DISCUSSION

Effect of carbonization temperature on Percentage yield of Activated charcoal

The yield of AC decreased with rise in carbonization temperature as shown in the figure (Fig 1). Activation of precursor at different concentrations of acetic acid (20 – 70%) was also studied. The concentrations of activating agent and the yield are also shown in figure (Fig 1). The yield was maximum with 50% concentration of AA and minimum with 30% concentration respectively at 450^{o}C. The decrease in the yield is due to the removal of volatile matter along with the dehydration of the activated material which results in increased pore size and pore distribution in the material which enhances adsorption capacity of the AC.

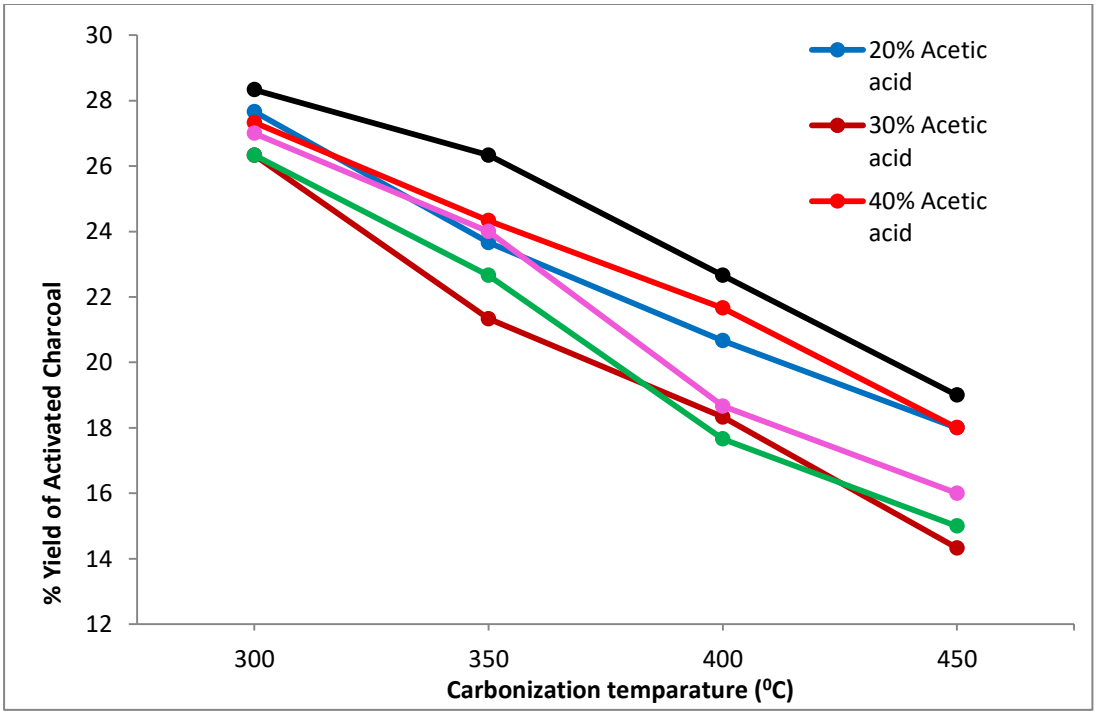

Fig 1: Effect of carbonization temperature on percentage yield of AC

Effect of impregnation ratio on percentage yield of activated carbon

The impregnation ratio (IR) had a great impact on the yield of the AC. Therefore IR on the yield at different temperatures (300^{0}C – 450^{0}C) was studied in the range of 3.5 - 12.25. The highest yield was obtained at IR 8.25 and was minimum at 5.25 as shown in the figure (Fig 2).

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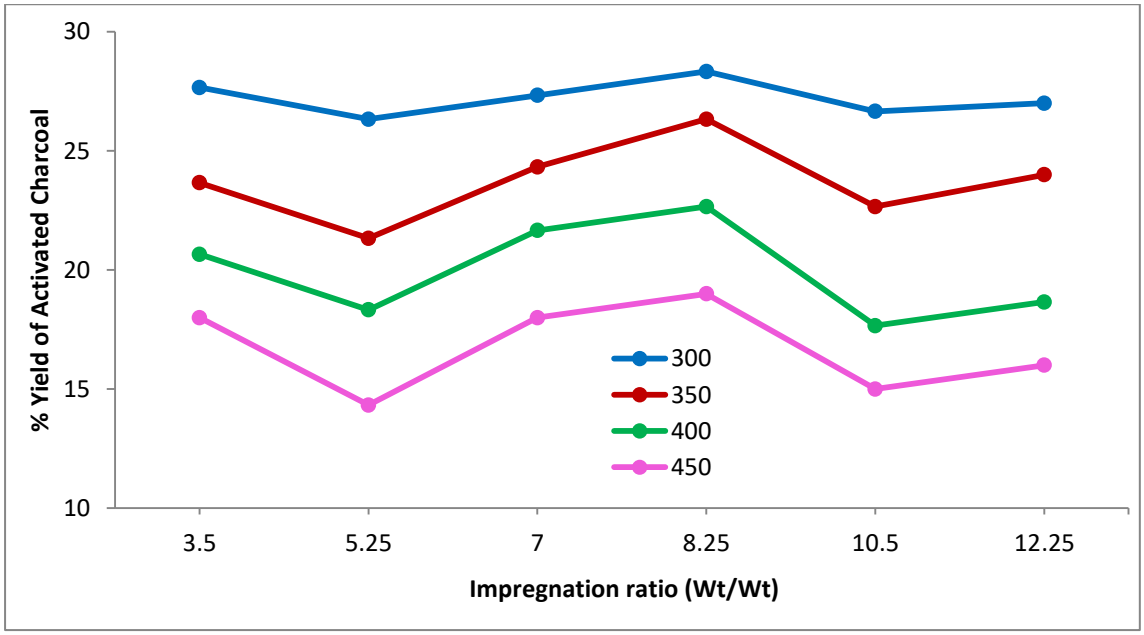

Fig 2: Effect of Impregnation ratio on percentage yield of AC

Effect of activation time on percentage yield of activated charcoal

Activation time or soaking period of the precursor was studied. The concentration selected for studying activation time was 30% concentration of AA. The optimum activation time of 12 hours was found to be ideal for getting desired activation. Further increase in activation period had no significant effect on the yield of the AC (Fig 3).

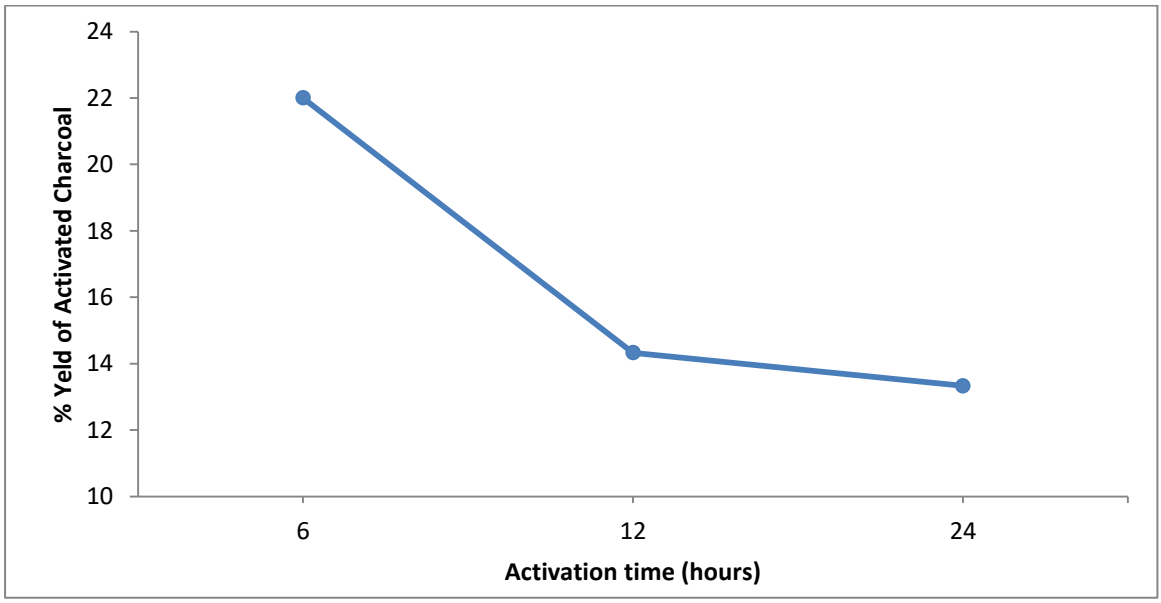

Fig 3: Effect of Activation time on Percentage yield of AC

4. CONCLUSION

Karanj fruit shells for preparation of AC can be used successfully as precursors. Use of Acetic acid as activating agent for its activation gives it a non-toxic nature. The decrease in yield makes it highly porous and adsorption efficient thus making it ideal for water purification and medical industry.

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REFERENCES

[1] Zaini, M. A. A. & Mohamad, N. A. "Activated charcoal for oral medicinal purposes: Is it really activated?" Journal of Applied Pharmaceutical Science, Vol. 5, no. 10, pp. 157-159, 2015.

[2] A.O.Lawal, J.A Lori and D Tom Tuker, "Removal of phenol from water by carbon adsorpbents prepared by pyrolysis of Sorghum and Millet Straws in Ortho Phosphoric Acid", Research Journal of Environmental and earth Sciences, vol. 3, no. 4, pp. 429-432, 2011.

[3] Abdul Halim Abdullah, Anuar Kassim, Zulkarnain Zainal, Mohd Zobir Hussien, Dzulkefly Kuang, Faujan Ahmad and Ong Sim Wool, "Preparation and Characterization of Activated carbon from Gelam Wood Bark (Melaleuca cajuputi)", Malaysiam Journal of Analytical Sciences, vol. 7, no. 1, pp. 65 – 68, 2001.

[4] D. Prahas, Y. Kartika, N. Indraswati and S. Ismadji, "Activated carbon from jackfruit peel waste by H_3PO_4 chemical activation: Pore structure and surface chemistry characterization", Chem. Eng. J., vol. 140, pp. 32–42, 2008.

[5] E. Demirbas, M. Kobya, and M.T. Sulak, "Adsorption kinetics of a basic dye from aqueous solutions onto apricot stone activated carbon, Bioresource Technology", vol. 99, no. 13, pp. 5368–5373, September, 2008.

[6] I.A. Rahman, B. Saad, B. Shaidan, and E.S. Sya Rizal, "Adsorption characteristic of malachite green on activated carbon derived from rice husks produced by chemical-thermal process", Bioresour. Technol, vol. 96, pp.1578–1583, 2005.

[7] I.A.W Tan, A.L.Ahmad, and B.H.Hameed, "Preparation of activated carbon from coconut husk: Optimization study on removal of 2,4,6 – trichlorophenol using response surface methodology", Journal of Hazardous Materials, vol. 153, pp. 709-717, 2008.

[8] Joshi Sahira, Adhikari Mandira, Pokharel Bhadra Prasad and Pradhananga Raja Ram, "Effects of Activating Agents on the Activated Carbons Prepared from, Lapsi Seed Stone", Research Journal of Chemical Sciences, vol. 3, no. 5, pp. 19-24, 2013.

[9] Juan F. Gonzalez, Silvia Roman, Carmen M. Gonzalez Garcia, J.M.Valente Nabais and A.Luis Ortiz, "Porosity Development in Activated Carbons Prepared from Walnut Shells by Carbon Dioxide or Steam Activation", Ind.Engg.Che.,Res, vol. 48, pp. 7474-7481, 2009.

[10] Kairvelu, K. Thamaraiselvi, K. and Namazivayam, C, "Removal of heavy metals from industrial wastewaters by adsorption onto activated carbon prepared from an agricultural solid waste", Bioresour. Technol., vol. 76, no. 1, pp. 63-65, 2001.

[11] M.C. Baquero, L. Giraldo, J.C. Moreno, F. Suárez-García, A. Martínez-Alonso, and J.M.D. Tascón, "Activated carbons by pyrolysis of coffee bean husks in presence of phosphoric acid", J. Anal. Appl. Pyrolysis, vol. 70, pp. 779–784, 2003.

[12] M. Chandrakala and Anima Upadhyay, "PREPARATION OF NONTOXIC ACTIVATED CHARCOAL FROM GULMOHAR (Delonix regia) SHELL", International Journal of Science, Environment and Technology, vol. 7, no. 2, pp. 689-695, 2018.

[13] M. Jagtoyen, and F. Derbyshire, "Activated carbons from yellow poplar and white oak by H_3PO_4 activation", Carbon, vol. 36, pp. 1085–1097, 1998.

[14] M.K.B. Gratuito, T. Panyathanmaporn, R.-A. Chumnanklang, N. Sirinuntawittaya and A. Dutta, "Production of activated carbon from coconut shell: Optimization using response surface methodology", Bioresource Technology, vol. 99, no. 11, pp. 4887–4895, 2008.

[15] Maryam Kazemipour, Mehdi Ansari, Shabnam Tajrobehkar, Majdeh Majdzadeh and Hamed Reihani Kermani, "Removal of lead, cadmium, zinc, and copper from industrial wastewater by carbon developed from walnut, hazelnut, almond, pistachio shell, and apricot stone", Journal of Hazardous Materials, vol. 150, no. 2, pp. 322–327, 2008.

[16] Nawar, S.S, and Doma, H.S, "Removal of dyes from effluents using low-cost agricultural by-products", Sci. Total Environ., vol. 79, no. 3, pp. 271-279, 1989.

[17] M. Olivares-Marin, C. Fernandez-Gonzalez, A. Macias-Garcia, and V. Gomez-Serrano. "Preparation of activated carbon from cherry stones by chemical activation with $ZnCl_2$", Sur. Sci., vol. 252, pp. 5967–5971, 2006.

[18] R. Prabakaran and S.Arivoil, "Biosorption of ferrous ion from Aqueous Solutions by using Activated carbon prepared from Thespesia Populnea Bark", Archives of Applied Science Research, vol. 3, no. 6, pp. 218-232, 2011.

[19] Ru-Ling Tseng, "Physical and Chemical properties and adsorption type of activated carbon prepared plum Kernels by NaOH activation", Journal of Hazordous Materials, vol. 147, no. 3, pp. 1020-1027, 2007.

[20] S.A. Dastgheib and D.A. Rockstraw, "Pecan shell activated carbon: synthesis, characterization, and application for the removal of copper from aqueous solution", Carbon, vol. 39, pp.1849–1855, 2001.

[21] S. Tangjuank, N. Insuk, V. Udeye and J. Tontrakoon, "Chromium (III) sorption from aqueous solutions using activated carbon prepared from Cashew nut shells", International Journal of Physical Sciences, vol. 4, no. 8, pp. 412-417, 2009.

[22] Valix M, Cheung WH and McKay G, "Preparation of activated carbon using low temperature carbonization and physical activation of high ash raw bagasse for acid dye adsorption", PubMed, vol. 56, no. 5, pp. 493-501, 2004.

[23] Wei Li, Li-bo Zhang, Jin hui Peng, Ning Li and Xue yun Zhu, "Preparation of high surface area activated carbons from Tabacco stems with K_2CO_3 activation using microwave radiation", Industrial Crops and Products, vol. 27, no. 3, pp. 341-347, 2008.