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Publications

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ONLINE ISSN: 2992-5819
PRINT ISSN: 2992-6149

NEWPORT INTERNATIONAL JOURNAL OF SCIENTIFIC AND EXPERIMENTAL SCIENCES (NIJSES)
Volume 4 Issue 3

https://doi.org/10.59298/NIJSES/2023/33.2.1161

Phytochemical screening of coconut husk and potentials of its activated charcoal as a stomach acid adsorbent

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ABSTRACT

The objective of the study was to determine the active principles present and investigate if coconut husk charcoal used in traditional ulcer management adsorbs stomach acid (0.16 M). Simple chemical tests were undertaken to test for the phytochemicals. The coconut fiber charcoal was activated with 1M and 2M KOH and H_2SO_4 at 500 °C respectively in muffle furnace. Adsorption mechanism of stomach acid was studied by the adsorption of the acid onto an activated coconut husk charcoals. Adsorption which depends on contact time, amount of adsorbent and temperature is the transfer of stomach acid to the surface was determined by titrimetric method using 0.16 M NaOH and methyl red indicator. Five phytochemicals (alkaloids, carbohydrates, tannins, saponin and glycoside) were recorded present incoconut husk extracts. The result of adsorption mechanism revealed that KOH activated coconut husk charcoal is a better adsorbent than H_2SO_4 activated coconut husk charcoal. The optimum contact time (minutes) and amount (g) were found to be 15 minutes and 1g respectively. Temperature was found not to have any effect on the adsorption of stomach acid. The result of this study shows that KOH activated coconut husk charcoal can be effectively used in ulcer management.

Keywords: Phytochemicals, coconut husk, activated charcoal, stomach acid, adsorption.

INTRODUCTION

Nigeria is among the developing countries where about 80% of the population [1]; [2]; [3] depend on medicinal plants for their primary health care. The prevention and cure of several ailments different herbs for different diseases are properties of families, community and as well as various cultures [4]; [5] and enough effort has not been made to document the phytochemicals, pharmaceutical and pharmacological activities of such plants used to treat various ailments. Extracts from the same plant materials obtained with different solvents of different polarity (low polarity solvent (such as n-hexane, ligroin and chloroform), intermediate polarity (such as ethyl acetate) and strong polar (such as methanol, ethanol, acetone and dichloromethane) will contain a mixture of biological active principles with varying structure and polarity [6] with have distinct biological activities [7]. In medicine, the multiple pores of activated charcoal are utilized to trap many toxic chemicals such as drugs, phytotoxins and poisonous chemicals, preventing their absorption from the gastrointestinal tract [8] and the capacity to adsorb depends on several factors (including the pH, solubility, particle size, ionization of the substance and stomach contents) [9]; [10]; [11] as a secondary decontaminate that prevents a potential circulation and perforation ofboth the liver and the intestine.[12]; [13]; [14] from binding to the toxic substance. Activated charcoal is now

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a supplement of choice in hopes of detoxifying their bodies of gas (ulcer), and treating a variety of ailments, including diarrhea, kidney problems, hangovers, and yellowed teeth [15]; [16]; [17]; [18]. The parietal cells (also known as oxyntic cells) that is responsible for producing the HCl in your stomach, transport proteins ferry chloride and potassium ions outward across the membrane. A proton pump exchanges hydrogen ions for potassium ions, so the net effect is the accumulation of HCl with a little KCl and the solution they secrete has a pH of 0.8 and concentration of 160 millimoles per liter, (0.16 moles per liter) [19]; [20]; [21] [22]. The increasing number of ulcer patients and the non-effective nature of the drugs in curing and the adverse effect of excess consumption of antacid medicine is alarming. The need for natural alternative drug that will be affordable, cheap, environmentally friendly and easy to prepare is desired. This study aimed to access the extracts of coconut husk samples for some of the phytochemicals present and the suitability of 1 M and 2 M KOH and H_2SO_4 activated coconut husk charcoal in adsorption of stomach (0.16 M HCl) acid to support its use in traditional medicine for ulcer management.

Materials and methods

Sample collection and preparation

The coconut husk was collected from Oghe in Ezeagu L.G.A, Enugu State on June 10th 2022. The huskwas separated from the greenish cover and put in a plastic can pending analysis.

Successive extraction of active principles for phytochemical analysis

The secondary metabolites in 70 g of the coconut husk samples were exhaustively extracted with 500 mL n-hexane in a 500mL capacity Soxhlet extractor using heating mantle. The extract was concentrated to half the volume and labeled n-hexane extract of coconut husk. The same procedure was repeated with 500 mL of ethyl acetate and methanol and labeled extracts of coconut husk respectively.

Screening for phytochemicals in coconut husk extracts

The extracts were subjected to a phytochemical screening using the following tests: Rosenthaler test for saponins employing frothing and emulsion formation method [23]; [24]; test for saponin glycoside using Fehling's solutions [23] test for steroids and triterpenoids (LibermannBurchaed method) [23]; [24]; Fehling's solution test for glycosides [23]; digital glycosides test [25]; Born Traggers test for anthracenes [23]; Ferric chloride solution, gelatin solution and lead acetate solution test for tannins [26]; [27]; [28]. Ammonium hydroxide test for hydrolysable tannins [23]; Testfor Pseudo tannins employing dark purple colourationa match stick [23],Magnesium ribbon test (Shinoda Test), alkaline test (NaOH and Acid Test) andLead Acetate test for flavonoids [26]; [29] and acetic anhydride activated with concentrated surphuric acid test for resins [23].Tests for alkaloids using Wagner's [30], Dragendorff's [23], [26], Mayer's [26] and Kraint's reagents [31] respectively. Ninhydrin tests for amino acids [32]; [33]; [34] and Biuret test for proteins [23]; [35]. Millon's, Fehling's and Benedict's reagentstests for carbohydrates [35]. The absolute alcohol test for gum and Mucilages [34]; [36].

Sample preparation and activation of coconut husk charcoal

The husks were then charred in open fire and the fire quenched with distilled water. The char coal was placed in a dry beaker for activation. The char powder (100 g) were mixed with 1 M and 2 M potassium hydroxide and sulphuric acid in 500 mL beaker respectively. The mixture was heated at 500°C for 1 hours in a muffle furnace and allowed to cool down to room temperature and sieved.

Adsorption of stomach acid (0.16 M HCl) at various contact time

The adsorption process were carried out with 30 mL of stomach acid (0.16 M HCl) and 1 g of 1 M and 2 M potassium hydroxide and sulphuric acid activated charcoals separately in five beakers at room temperature and stirred vigorously with a stirring rod for five minutes and filtered at a contact time of 15, 30, 45, 60, and 75 minutes and labelled for the titrimetric studies.

Adsorption of stomach acid (0.16 M HCl) with various quantities of 1 M and 2 M potassium hydroxide and sulphuric acid activated charcoals

Thirty milliliters of the stomach acid (0.16 M HCl) were added to 1, 3, 5, 7 and 9 g of 1 M and 2 M potassium hydroxide and sulphuric acid activated charcoals respectively and stirred vigorously for five minutes. It was left for 1 hour to enable adsorption of the stomach acid and filtered and labelled for titrimetric studies.

Adsorption of stomach acid (0.16 M HCl) with 1 M H_2SO_4 acid and 1 M KOH activated charcoals respectively at various temperature

Thirty milliliters of the stomach acid (0.16 M HCl) were mixture with 1 g of 1 M and 2 M potassium hydroxide and sulphuric acid activated charcoals respectively and placed in 250 mL beaker. The beakers were immersed in a thermo-stated heating water bath at temperatures, 50°C, 60°C, 70°C, 80°C and 90°C [37]. The mixture was heated with constant stirring for an hour at the set temperature and filtered and labelled for the titrimetric analysis.
The titrimetric analysis was recorded and the extent of adsorption depends on the calculated concentrations.

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RESULTS AND DISCUSSION

Screening for phytochemicals (Table 1) in the n-hexane (non-polar solvent), ethyl acetate (slightly polar solvent) and methanol (very polar solvent) extracts ofcoconut fiberrevealed the presence of alkaloids, carbohydrates, tannins, saponin and glycoside. Coconut husk is not rich in phytochemicals. Meanwhile n-hexane extract were found to be richer in phytochemicals with tannins, alkaloids and carbohydrates present, while ethyl acetate contain saponin, saponin glycoside, hydrolysable tannins and carbohydrate. Methanol with only glycoside, and carbohydrate.

Table 1: Results of phytochemical screening of coconut fiber extracts

Parameters	**Coconut fiber extracts**		
	n-Hexane	Ethyl acetate	Methanol
Saponin	-	+	-
Saponin Glycoside	-	+	-
Tannins	+	-	-
Hydrolysable Tannins	+	+	-
Pseudo Tannin	-	-	-
Test of Tannin (Using Gelatin)	-	-	-
Digital Glycoside	-	-	-
Glycoside General	-	-	+
Anthracene (Born Tragger Test)	-	-	-
Resins	-	-	-
Steroid and Triterpenoids (LibemannBuchard) Test	-	-	-
Volatile Oil Test	-	-	-
Alkaloid	+	-	-
a. Draggendoff Test			
b. Wagner's Test	+	-	-
c. Mayer's Test	+	-	-
d. Kraint's Test	+	-	-
Flavonoid Test	-	-	-
(a) Magnesium ribbon test			
(b). Alkaline test	-	-	-
(c). Lead Acetate test	-	-	-
Carbohydrate Test	-	+	+
Amino acid (Protein)	-	-	-

Adsorption isotherms of stomach acid (0.16 M HCl) with 1 M and 2 M KOH and H_2SO_4 respectively

As titrimetric analysis was taken in all experiments involving the stomach acid adsorption processes, the relative concentration of stomach acid adsorbed, x and the residual relative quantity at equilibrium, $xe$are obtained from Equations below [38].

$$X = \frac{A0 - A}{A0} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$\frac{A}{A0} = 1 - X = Xe \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

where Ao is the concentration of stomach acid (0.16 M) and A is concentration after adsorption.
Using Equations (1) and (2) and can be rearranged to Equations (3) and (4) (Lima et al., 2022).

$$\frac{Xe}{X/m} = 1/a + (b/a)\, Xe \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

$$\frac{X}{m} = KXe \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

Application of Langmuir and Freundlich equations to adsorption isotherms for absorption of stomach acid with 1 M and 2 M KOH and H_2SO_4activated coconut husk charcoal, showed that concentration of stomach acid decreased as the contact time and amount 1 M and 2 M KOH and H_2SO_4activated coconut husk charcoal increases was

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observed [39].No significant decrease was observed with increase in temperature between 50, 60, 70, 80 and 90°C. Successful application of Langmuir and Freundlich isotherms was based on the decrease in concentration of stomach acid as compared to initial concentration of stomach acid [39]; [40];[41]; [42]; [39].

Table 2: Results of adsorption of stomach acid at various contact time with 1 M and 2 M KOH and H_2SO_4 activated coconut husks charcoal.

Par.	Ads. 1 (M)	Ads. 2 (M)	Ads. 3 (M)	Ads. 4 (M)	KXe 1	KXe2	KXe3	KXe4
0	0.160	0.160	0.160	0.160	–	–	–	–
15	0.029	0.030	0.142	0.140	0.819	0.113	0.812	0.125
30	0.029	0.030	0.139	0.139	0.819	0.131	0.812	0.131
45	0.029	0.030	0.147	0.138	0.819	0.081	0.812	0.138
60	0.030	0.030	0.150	0.140	0.813	0.063	0.812	0.125
75	0.029	0.029	0.149	0.141	0.813	0.069	0.813	0.119

Key
Ads. 1= (adsorbed stomach acid with 1M KOHactivated charcoal), Ads. 2= (adsorbed stomach acid with 2 MHOH activated charcoal), Ads. 3= (adsorbed stomach acid with 1 M H_2SO_4activated charcoal), Ads. 4 = (adsorbed stomach acid with 2 M H_2SO_4 activated charcoal), Residual concentration = KXe; and 0 = Control (concentration of stomach acid).

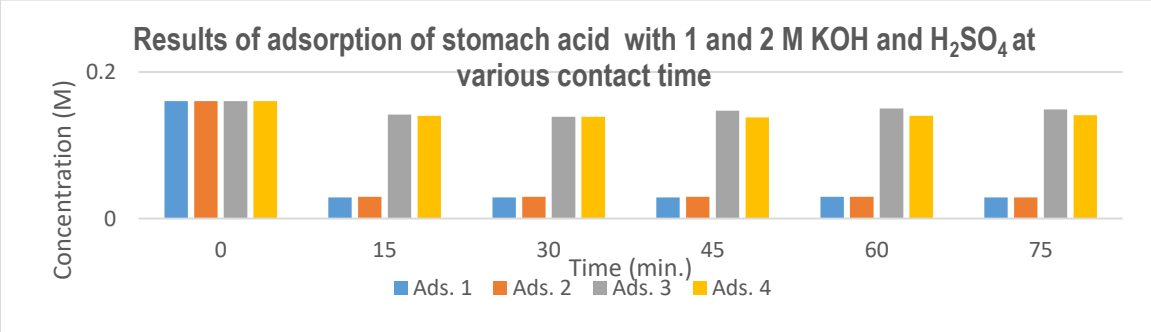

Figure 1: Results of adsorption of stomach acid with 1 and 2 M KOH and H_2SO_4at various contact time

Fig. 1 shows the effect of various contact time (0, 15, 30, 45, 60 and 75 minutes) on the extent of adsorption of stomach acid. There is a significant decrease in the concentration of stomach acid (0.16 M HCl) with increase in contact time that is optimum at 15 minutes after which no significant decreased is observed. Moreover, there is no meaningful different in the extent of adsorption of stomach acid between 1M and 2M KOH activation of coconut husks charcoal, this is supported by the findings that 2M KOHactivated coconut husks charcoal have greater surface area but with lowest bleaching efficiency. The poor performance of 2M KOH activatedcoconut husks charcoal is attributed to the collapse of the crystalline structure of coconut husks charcoal [43-54].This indicates that there is no need for activation with higher concentration KOH. The absorption result by using KOH activated coconut husks charcoal, it can be seen that the optimum contact time occurred at 15 minutes of 1 M and 2 M KOH acid activated coconut husks charcoal [55-65]. However, activation with 1M and 2 M H_2SO_4 show no significant adsorption of stomach acid. This revealed that sulphuric acid is not a good activation reagent for adsorption of stomach acid using coconut husks charcoal. This indicates that there is no need for activation with H_2SO_4 acid for adsorption of stomach acid. For the adsorption using various amounts of the activated coconut husks charcoal (1, 3, 5, 7 and 9 g), the result revealed that 3 g of 1 M KOH activated coconut husks charcoal is the optimum adsorption quantity.

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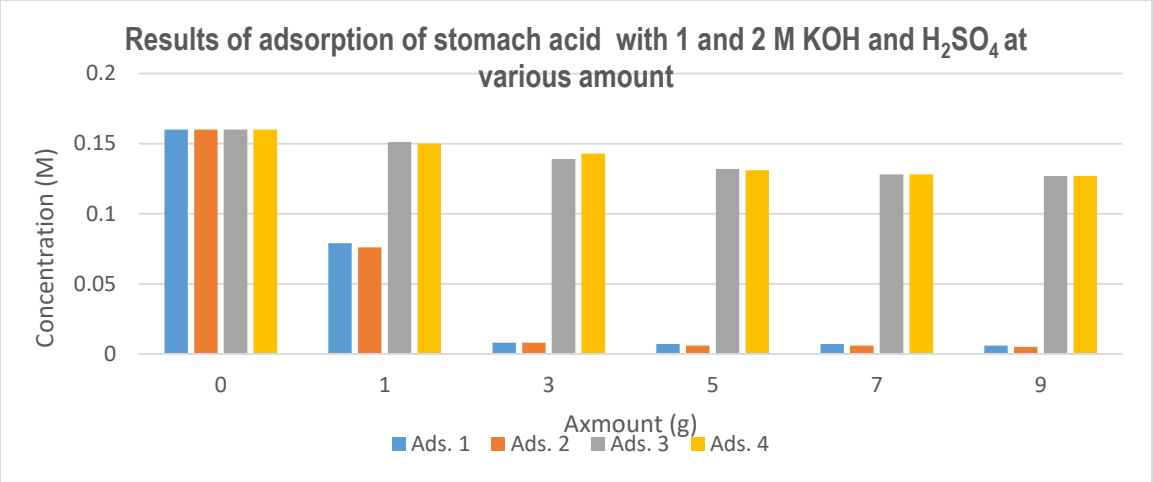

Figure 2: Results of adsorption of stomach acid with 1 and 2 M KOH and H_2SO_4 at various amounts.

The figure belowshows what takes place in the entire adsorption of stomach acid with 1 and 2 M KOH and H_2SO_4activated coconut husks charcoal at various temperatures. The concentration of stomach acid shows a significant decrease with 1 and 2 M KOH but not with increase in temperature.

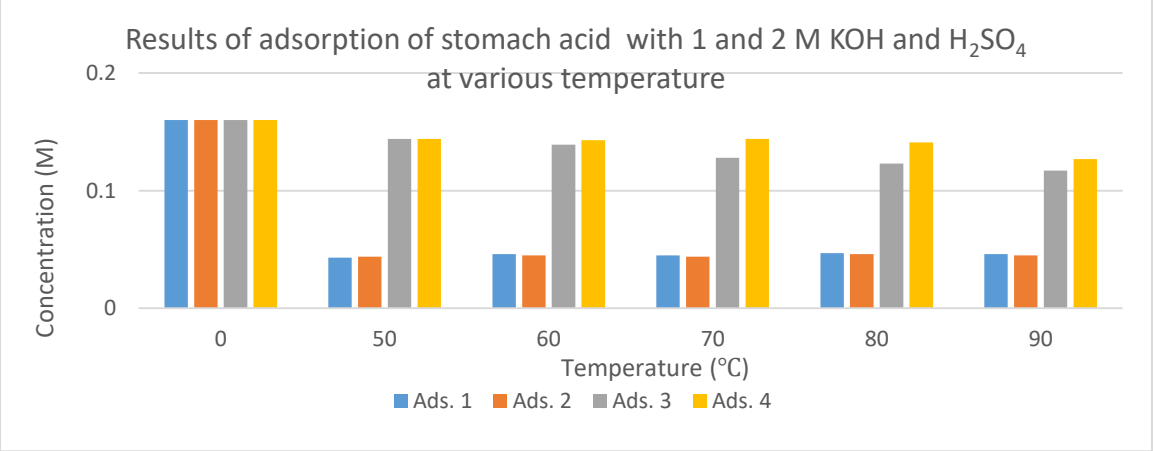

Figure 3: Results of adsorption of stomach acid with 1 and 2 M KOH and H_2SO_4 at various temperature.

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Table 3: Concentration of stomach acid adsorbed per gram of 1M and 2M KOH and H_2SO_4 activated coconut husks charcoal at various contact time (min.), quantities (g) and temperature ((℃)).

Parameter	Ads. /g of 1M KOH	Ads. /g of 2M KOH	Ads. /g of 1M H_2SO_4	Ads. /g of 2M H_2SO_4
Contact time (min.)				
0	0.000	0.000	0.000	0.000
15	0.819	0.813	0.125	0.125
30	0.819	0.813	0.131	0.131
45	0.819	0.813	0.081	0.138
60	0.813	0.813	0.063	0.125
75	0.819	0.819	0.069	0.119
Quantity (g)				
0	0.000	0.000	0.000	0.000
1	0.506	0.525	0.063	0.063
3	0.317	0.317	0.044	0.035
5	0.191	0.107	0.035	0.036
7	0.137	0.107	0.029	0.029
9	0.107	0.108	0.023	0.023
Temperature (℃)				
0	0.000	0.000	0.000	0.000
50	0.731	0.725	0.100	0.100
60	0.713	0.719	0.131	0.106
70	0.719	0.725	0.200	0.100
80	0.706	0.713	0.231	0.119
90	0.713	0.719	0.269	0.131

While adsorption of stomach acid with 1 and 2 M H_2SO_4 activated coconut husks charcoal shows a slight decrease in concentration with increase in temperature.

The concentration of solute (stomach acids (0.16 M HCl)) adsorbed per gram of adsorbent were calculated according to the following equation:

$$qt = \frac{A0 - A}{A0m}$$

where
A_o = concentration of the stomach acid
A = concentration of adsorbed stomach acid
m = mass of adsorbent used.

The results of quantity of stomach acid adsorbed by 1 and 2M KOH and H_2SO_4 activated coconut husks charcoal at various contact time (min.) (Table 4.7 and Figure 4.7) revealed that KOH is far more better activation reagent for coconut husks charcoal than H_2SO_4. From the figure it can be seen that the quantity of stomach acid adsorbed by 1 and 2M KOH is nearly the same, this indicates that there is no need for activation with higher concentration KOH. Moreover, the quantity of stomach acid adsorbed per gram of1 and 2M KOH is the same for all the contact times. This probably indicates that 15 minutes is the optimum contact time. From Figure 4.8 it was observed that the quantity of stomach acid adsorbed decreases with increase in quantity of 1M and 2M KOH activated coconut husks charcoal. This probably suggests that the optimum quantity might be lower than 1 g. Figure 3 shows that temperature has no effect on the adsorption stomach acid using 1M and 2M KOH and H_2SO_4 activated coconut husks charcoal at various Temperature (℃).

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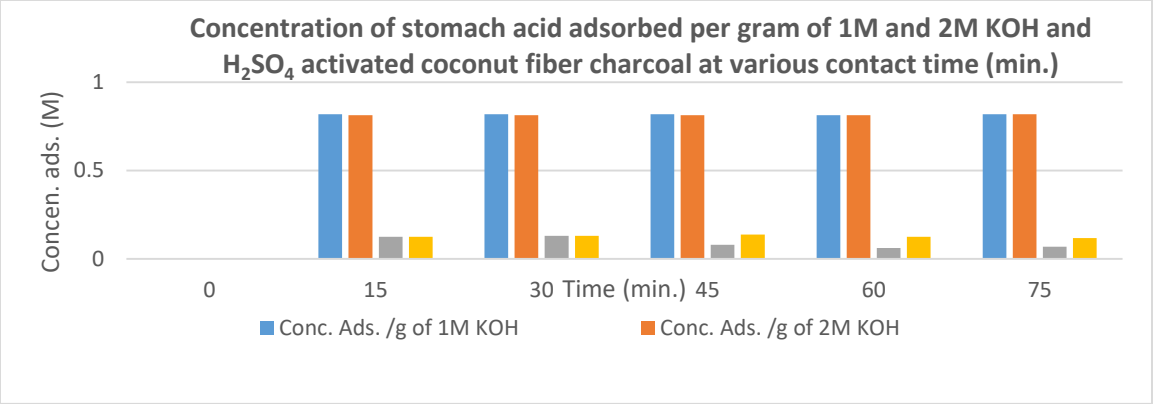

Figure 4.: Concentration of stomach acid adsorbed per gram of 1M and 2M KOH and H_2SO_4 activated coconut husks charcoal at various contact time (min.)

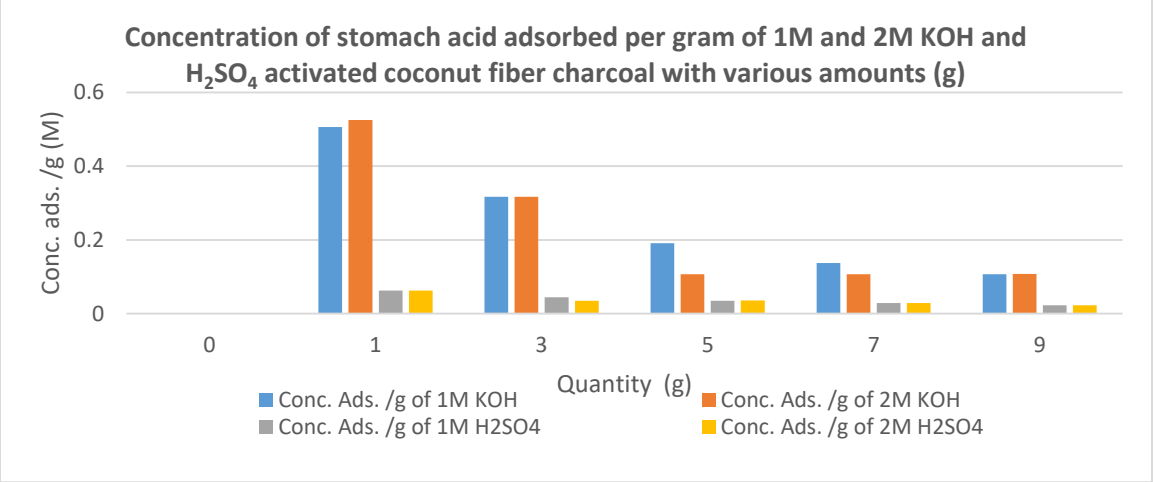

Figure 5: Concentration of stomach acid adsorbed per gram of 1M and 2M KOH and H_2SO_4 activated coconut husks charcoal at various contact time (min.)

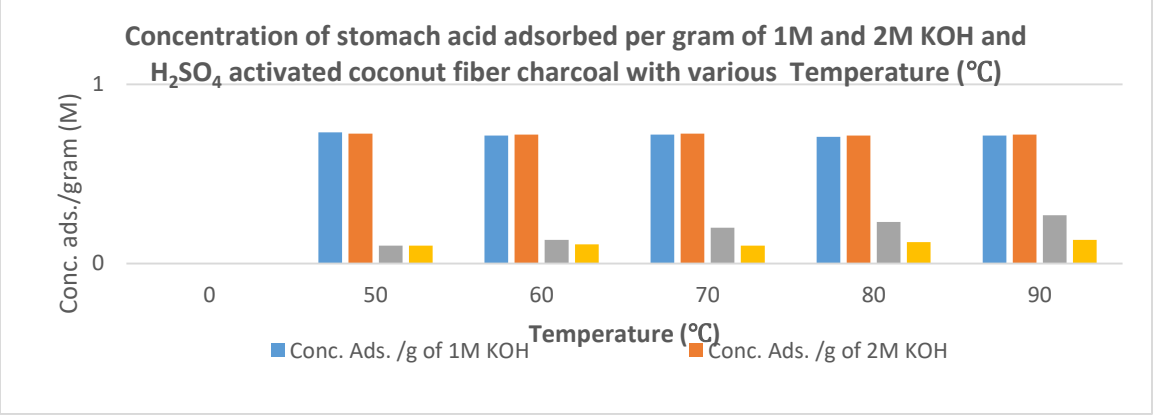

Figure 6: **Concentration of stomach acid adsorbed per gram of 1M and 2M KOH and H_2SO_4 activated coconut husks charcoal with various temperature (℃).**

CONCLUSION

Coconut husk is not rich in phytochemicals. KOH activated coconut husks charcoal is better than H_2SO_4 activated coconut husks charcoalforadsorption of stomach acid and 1M KOH is the optimum activation concentration. The optimum contact time from the study is 15 minutes for KOH activated coconut husks charcoalforadsorption of

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stomach acid. The optimum quantity for adsorption of stomach acid is 1 g per 25 ml of the stomach acid. Temperature has no effect in the adsorption of stomach acid.

REFERENCES

1. Mukherjee P. W. (2002). *Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals*. New Delhi, India: Business Horizons Publishers.
2. Bodeker C., Bodeker G., Ong C. K., Grundy C. K., Burford G., Shein K. (2005). *WHO Global Atlas of Traditional, Complementary and Alternative Medicine*. Geneva, Switzerland: World Health Organization.
3. Bandaranayake W. M. (2006). "Quality control, screening, toxicity, and regulation of herbal drugs," in *Modern Phytomedicine. Turning Medicinal Plants into Drugs* eds Ahmad I., Aqil F., Owais M. (Weinheim:Wiley-VCH GmbH & Co. KGaA;) 25–57.
4. Sharif, M.D.N. and Bariki, G.R. (2006). Status and utilization of medicinal plants in Rangamati of Bangladesh Res. J. Agric C. Bio Sc. 2(6): 268-273.
5. Kubmarawa, D., Ajoku, G. A., Enwerem, N. M. and Okorie, D. A. (2007). Preliminary phytochemical and antimicrobial screening of 50 medicinal plants from Nigeria. African Journal of Biotechnology 6(14): 1690-1696.
6. Paiva, P.M.G., Gomes, F.S., Napoleao, T. H., Sa, R. A., Carreia, M.T.S and Coelho, L.C.B.B. (2010). Antimicrobial activity of secondary metabolites and Lectins form plants. Current Research Technology and Education topics in Microbiology and Microbial Biotechnology A, Mendez-Vichas (ed) FORMATEX: 396-406.
7. Tepe, B., Daferera, D., Sokmen, A., Sokmen, M. and Polissiou, M. (2005). Antimicrobial and antioxidant activities of the essential oil and various extracts of Salvia Tomentosa miller (lamiaceae). *Food chemistry***90**: 333-340.
8. Zellner, T., Prasa, D., Färber, E., Hoffmann-Walbeck, P., Genser, D. and Eyer, F. (2019). The use of activated charcoal to treat intoxications. DtschArztebl Int; 116: 311–7.
9. Watson, W.A. (1987). Factors influencing the clinical efficacy of activated charcoal. *Drug Intell Clin Pharm.* ;21:160–166.
10. Andersen, A.H. (1947). Experimental studies on the pharmacology of activated charcoal; the effect of pH on the adsorption by charcoal from aqueous solutions. *Acta PharmacolToxicol (Copenh)* ;3:119–218.
11. Jürgens, G., Hoegberg, LC. and Graudal, N.A. (2009). The effect of activated charcoal on drug exposure in healthy volunteers: a meta-analysis. *Clin Pharmacol Ther.*;85: 501–505.
12. Pfab, R., Schmoll, S., Dostal, G., Stenzel, J., Hapfelmeier, A and Eyer, F. (2016). Single dose activated charcoal for gut decontamination: application by medical non-professionals—a prospective study on availability and practicability. *Toxicol Rep.* ;4: 49–54.
13. Eyer, F., Jung, N., Neuberger, H., et al. (2008). Seromucosal transport of intravenously administered carbamazepine is not enhanced by oral doses of activated charcoal in rats. *Basic Clin PharmacolToxicol.* ;102: 337–346.
14. Eyer, F., Jung, N., Neuberger, H., et al. (2007). Enteral exsorption of acetaminophen after intravenous injection in rats: influence of activated charcoal on this clearance path. *Basic Clin PharmacolToxicol.* ;101:163–171.
15. Jain, N.K., Patel, V.P. and Pitchumoni, C.S. (1986). Efficacy of activated charcoal in reducing intestinal gas: a double-blind clinical trial. Am J Gastroenterol.;81(7): 532-5.
16. Kuusisto, P., Vapaatalo, H., Manninen, V., Huttunen, J.K. and Neuvonen, P.J. (1986). Effect of activated charcoal on hypercholesterolaemia. Lancet.;2(8503): 366-7.
17. Bond, G.R. (2002). The role of activated charcoal and gastric emptying in gastrointestinal decontamination: a state-of-the-art review. Ann Emerg Med.;39(3): 273-86.
18. Dinsley, J. (2014). God's Natural Remedy – Activated charcoal. Health Reformer; 2-4(2-4): 1-45.
19. Hunt, A., Harrington, D. and Robinson, S. (2014). "Vitamin B12deficiency" . *BMJ.* 349: g5226.
20. Sakai, H. and Fujii, T. (2016). Functional complexes of the proton pump and chloride transporter in gastric acid secretion. Nihon Rinsho.;74(8):1401-1405.
21. Ray T. (2013). The parietal cell gastric H, K-ATPase also functions as the Na, K-ATPase and Ca-ATPase in altered states [version 2; peer review: 2 approved, 1 not approved]. *F1000Research* , 2:165 (https://doi.org/10.12688/f1000research.2-165.v2)

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22. Engevik, A.C., Kaji, I. and Goldenring, J.R. (2020).The Physiology of the Gastric Parietal Cell. Physiol Rev.; 100(2): 573–602.
23. Sofowora, A. (1993). Screening Plants for Bioactive Agents: *Medicinal Plants and Traditional Medicine in Africa*. 2nd Edn. Spectrum Books Ltd., Ibadan, Niger,ia, Pp. 134156.
24. Kokate, C.K. (1999). "Practical pharmacognosy" 4 th edition, Vallabh Prakashan Publication, New Delhi, India
25. Olaniyan, M.F. (2016).Health Promoting Bioactivities of Phytochemicals: *Research Findings*. Lap Lambert Academic Publishing, Germany.
26. Trease, G.E. and Evans, W.C. (1989). Pharmacognosy. 13th Edn. ELBS/Bailliere Tindall, London, UK, pp. 345346, 535-536, 772-773.
27. Priyanga, S., Hemmalakshmi, S. and Devaki, K. (2014). Comparative Phytochemical Investigation of Leaf, Stem, Flower And Seed Extracts Of MacrotylomaUniflorum L. Indo. *American Journal of Pharm Research*. 4(11): 5415-5420.
28. Mace, M.D. (1963). "Histichemical localization of phenols in healthy and diseased tomato roots", *Phytopathology*, 16: 915-925.
29. Biswas, S. and Pandita, N. (2015). Phytochemical analysis and chromatographic evaluation of alcoholicextract of Dilleniaindica LINN. leaves. International Journal of Pharmaceutical Sciences and Research 6(7): 2799-2812.
30. Wagner, H. (1993). Pharmaceutical Biologic. 5 (Eds). AUFI 15 BN 3-437-20 498-X. Gustav Fisher Vwelag, Stuttgart, Germany.
31. Ogbuanu, C.C.,Amujiogu, S.N.and Agboeze E. (2020). Secondary Metabolites Investigation and TLC Analysis of Leaves, Stem back and Root Extracts of *Uvariachamae*(Udagu). Journal of Natural Sciences Research. 10(10): 34-39
32. Yasuma, A. and Ichikawa. (1953). "NinhydrinSchiff and alloxan- Schiff staining. A new histochemical staining method for proteins", *J. Lab clin Med*, 41: 296-299, 1953.
33. Devi, B.N., Salma, S. and Lavanya, V. (2020). Phytochemical Evaluation and In vitro Antidiabetic Activity of Ethanolic Extract of Viscum articulatum. *Int. J. Pharm. Sci. Rev. Res.*, 60(1): 99-104.
34. Hemantkumar, A.T. (2017). Phytochemical Screening and Antibacterial, Antifungal activity of Pindaconcanensis (Dalzell) P.K. Mukh. & Constance (Apiaceae) an endemic plant from Nasik District (M.S.) India. *Annals of Plant Sciences*, 6(12): 1886-1892.
35. Sai KoteswarSarma D, Venkata Suresh Babu A. (2011). Pharmacognostic and phytochemical studies of *Thespesia populnea*Linn *J. Chem. Pharm. Res.* 3(4):237-244.
36. Whistler, R.L. and BeMiller, J.N. (1993). Industrial Gums; Polysaccharides and their Derivatives, Academic Press, London.
37. Lima, W.C., Oliveira, L.S. and Franca, A.S. (2022). Adsorption of Phenylalanine from Aqueous Solutions Using Activated Carbon from Sunflower Meal Functionalized with Sulfonic Groups. Foods;11(21): 3427.
38. Mukasa-Tebandeke, I.Z., Wasajja-Tebandeke, H., Schumann, A. andLugolobi, F. (2016). Bleaching Edible Oils Using Clay from Kangole, Moroto District, North Eastern Uganda. J Anal Bioanal Tech 7: 320. doi:10.4172/2155-9872.1000320
39. Khayyun, T.S. andMseer, A.H. (2019).Comparison of the experimental results with the Langmuir and Freundlich models for copper removal on limestone adsorbent. *Appl Water Sci* **9**, 170
40. Yadav, V.B., Gadi, R. andKalra, S. (2019).Adsorption of lead on clay-CNT nanocomposite in aqueous media by UV-Vis-spectrophotometer: kinetics and thermodynamic studies. *emergent mater.* **2**, 441–451.
41. Anah, L. and Astrini, N. (2018). Isotherm adsorption studies of Ni (II) ion removal from aqueous solutions by modified carboxymethyl cellulose hydrogel IOP Conf. Ser.: Earth Environ. Sci. 160 012017
42. Kalam, S., Abu-Khamsin**, S.A.,** Kamal, M.S. and Patil**, S. (2021).** Surfactant Adsorption Isotherms: A Review. *ACS Omega* 2021, 6, 48, 32342–32348.
43. Nde-Aga, B. J., Kamga, R. P. and Nguetnkam, J. P, (2007). Adsorption of Palm Oil Carotene and Free Fatty Acids onto Acid Activated Cameroonian Clays. Journal of Applied Sciences, 7: 2462-2467.

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44. Nguetnkam, J.P., Kamga, R., Villieras, F., Ekodeck, G.E., Rawafitianamaharavo, A. and Yvon, J. (2005). Assessment of the surface area of silica and clay in acid-leached clay materiel using concepts of adsorption on heterogeneous surfaces. J. Colloid Interface Sci., 289: 104-115.

45. Christidis, G.E., Scott, P.W. and Duhnam, A.C. (1997). Acid activation and bleaching capacity of bentonites from the islands of milos and chiosaegan. Applied Clay. Sci., 12: 329-347.

46. Kheok, S.C. and Lim, E.E. (1982). Mechanism of palm oil bleaching by montmorillonite clay activated at various concentrations. J. Am. Oil Chem. Soc., 59: 129-131.

47. Okechukwu, P. U., Okwesili, F. N., Parker, E. J., Abubakar, B., Emmanuel, C. O., & Christian, E. O. (2013). Phytochemical and acute toxicity studies of Moringa oleifera ethanol leaf extract. *International Journal of Life Science BiotechNology and Pharma Research*, *2*(2), 66-71.

48. Odo, C. E., Nwodo, O. F., Joshua, P. E., Ugwu, O. P., & Okonkwo, C. C. (2013). Acute toxicity investigation and anti-diarrhoeal effect of the chloroform–methanol extract of the seeds of Persea americana in albino rats. *journal of pharmacy research*, *6*(3), 331-335.

49. Adonu Cyril, C., Ugwu, O. P. C., Esimone Co, O., Bawa, A., Nwaka, A. C., & Okorie, C. U. (2013). Phytochemical analyses of the menthanol, hot water and n-hexane extracts of the aerial parts of cassytha filiformis (Linn) and leaves of cleistopholis patens. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, *4*, 1143-1149.

50. Orji, O. U., Ibiam, U. A., Aja, P. M., Ugwu, P., Uraku, A. J., Aloke, C., ... & Nwali, B. U. (2016). Evaluation of the phytochemical and nutritional profiles of Cnidoscolus aconitifolius leaf collected in Abakaliki South East Nigeria. *World Journal of Medical Sciences*, *13*(3), 213-217.

51. Offor, C. E., Ugwu, P. C., Okechukwu, P. M., & Igwenyi, I. O. (2015). Proximate and phytochemical analyses of Terminalia catappa leaves. *European Journal of Applied Sciences*, *7*(1), 09-11.

52. Nwali, B. U., Egesimba, G. I., Ugwu, P. C. O., & Ogbanshi, M. E. (2015). Assessment of the nutritional value of wild and farmed Clarias gariepinus. *International Journal of Current Microbiology and Applied Sciences*, *4*(1), 179-182.

53. Afiukwa, C. A., Igwenyi, I. O., Ogah, O., Offor, C. E., & Ugwu, O. O. (2011). Variations in seed phytic and oxalic acid contents among Nigerian cowpea accessions and their relationship with grain yield. *Continental Journal of Food Science and Technology*, *5*(2), 40-48.

54. Aja, P. M., Okechukwu, P. C. U., Kennedy, K., Ibere, J. B., & Ekpono, E. U. (2017). Phytochemical analysis of Senna occidentalis leaves. *IDOSR J Appl Sci*, *2*(1), 75-91.

55. Igwenyi, I. O., Isiguzo, O. E., Aja, P. M., Ugwu Okechukwu, P. C., Ezeani, N. N., & Uraku, A. J. (2015). Proximate composition, mineral content and phytochemical analysis of the African oil bean (Pentaclethra macrophylla) seed. *American-Eurasian J Agric Environ Sci*, *15*, 1873-1875.

56. Orji, O. U., Ibiam, U. A., Aja, P. M., Ugwu, P., Uraku, A. J., Aloke, C., ... & Nwali, B. U. (2016). Evaluation of the phytochemical and nutritional profiles of Cnidoscolus aconitifolius leaf collected in Abakaliki South East Nigeria. *World Journal of Medical Sciences*, *13*(3), 213-217.

57. Offor, C. E., Ugwu, P. C., Okechukwu, P. M., & Igwenyi, I. O. (2015). Proximate and phytochemical analyses of Terminalia catappa leaves. *European Journal of Applied Sciences*, *7*(1), 09-11.

58. Afiukwa, C. A., Ugwu, O. P., Ebenyi, L. N., Oketa, H. A., Idenyi, J. N., & Ossai, E. C. (2013). Phytochemical analysis of two wild edible mushrooms, Auricularia polytricha and Pleurotus ostreatus, common in Ohaukwu area of Ebonyi state, Nigeria. *Res J Pharm Biol Chem Sci*, *4*(2), 1065-70.

59. Chukwuemeka, I. M., Udeozo, I. P., Mathew, C., Oraekwute, E. E., Onyeze, R. C., & Ugwu, O. P. C. (2013). Phytochemical analysis of crude ethanolic leaf extract of Morinda lucida. *Int. J. Res. Rev. Pharm. Appl. Sci*, *3*(4), 470-475.

60. Udeozo, I. P., Nwaka, A. C., Ugwu, O. P., & Akogwu, M. (2014). Anti-inflammatory, phytochemical and acute toxicity study of the flower extract of Newbouldia laevis. *Int J Curr Microbiol App Sci*, *3*(3), 1029-35.

61. Afiukwa, C. A., Ugwu Okechukwu, P. C., Ebenyi, L. N., Ossai, E. C., & Nwaka, A. C. (2013). Phytochemical analysis of three wild edible mushrooms, coral mushroom, Agaricus bisporus and Lentinus sajor-caju, common in Ohaukwu Area of Ebonyi State, Nigeria. *International Journal of Pharmaceutics*, *3*(2), 410-414.

Open Access
ONLINE ISSN: 2992-5819
PRINT ISSN: 2992-6149

62. PC, U. O., & Amasiorah, V. I. (2020). The effects of the crude ethanol root extract and fractions of Sphenocentrum jollyanum on hematological indices and glycosylated haemoglobin of streptozotocin-induced diabetic albino rats. *INOSR Scientific Research*, *6*(1), 61-74.

63. Ikechukwu, A. A., Ibiam, U. A., Okechukwu, P. U., Inya-Agha, O. R., Obasi, U. O., & Chukwu, D. O. (2015). Phytochemistry and acute toxicity study of Bridelia ferruginea extracts. *World J. Med. Sci*, *12*(4), 397-402.

64. Igwenyi, I. O., Dickson, O., Igwenyi, I. P., Okechukwu, P. C., Edwin, N., & Alum, E. U. (2015). Properties of Vegetable Oils from Three Underutilized Indigenous Seeds. *Global Journal of Pharmacology*, *9*(4), 362-365.

65. Ibiam, U. A., Alum, E. U., Aja, P. M., Orji, O. U., Nwamaka, E. N., & Ugwu, O. P. C. (2018). Comparative Analysis Of Chemical Composition Of Buchholzia Coriacea Ethanol Leaf-Extract, Aqueous And Ethylacetate Fractions. *INDO AMERICAN JOURNAL OF PHARMACEUTICAL SCIENCES*, *5*(7), 6358-6369.

CITE AS: Ogbuanu C. C., Nwagu L. N., Ezeh C. N., Achara N. I. and Onwuatuegwu, J.T.C. (2023). Phytochemical screening of coconut husk and potentials of its activated charcoal as a stomach acid adsorbent. NEWPORT INTERNATIONAL JOURNAL OF SCIENTIFIC AND EXPERIMENTAL SCIENCES, 4(3): 11-21. https://doi.org/10.59298/NIJSES/2023/33.2.1161