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Comparing the Effectiveness of Activated Carbon Made from Natural Coal in Bleaching Goya Olive Oil and Palm Oil

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Abstract:- One of the many uses for activated carbons, which are incredibly adaptable adsorbents, is the bleaching of edible oils. Although wood, peat, lignite, and coal are the usual sources for activated carbon generation; agricultural wastes like nutshells are also taken into consideration as possible resources because of their renewable nature and abundance in Turkey. In this work, natural coal was used to make the activated carbon that was used to bleach the oil samples (Goya olive oil and palm oil). After the material has been dried, the experiment was conducted in a furnace that could be heated to 5000^{0}C. The sample (natural coal) underwent chemical activation by being weighed, combined with 100mls of 35% phosphoric acid, and heated in an oven between 60°C and 80°C for approximately 4 hours. Activated carbon made from natural coal was used to conduct adsorption on palm and soybean oils. Using a UV spectrophotometer with a wavelength of 460 nm, the absorbance and concentration of the two samples of neutralized oils were determined. Using the Langmuir isotherm equation, the equilibrium concentration, values for Ce/qc, b, and slopes for palm oil and soybean oil were determined. Ce/Qc = 1.Ce/Qo + 1/bQo, where Ce is the equilibrium concentration, Qc is the percent absorption, 1/Qo is the slope, Qo is the adsorption capacity, and b is the Langmuir constant. The results of % absorption obtained for goya olive oil are 86.10, 84.10, 82.90, 81.80, 77.70 and 77.50 while that results of %absorption obtained for palm oil are 31.20, 30.90, 30.80, 29.50, 20.20, and 09.50 respectively. Therefore; activated coal was found to be moresuccessful at bleaching palm oil than goya olive oil in experimental trials, which led to this conclusion.

***Keywords*:-** *Activated Carbon, Bleaching, Natural Coal, Goya Olive Oil, Palm Oil.*

I. INTRODUCTION

Vegetable oil is typically decolored utilizing an adsorption bleaching process with the right clay minerals and activated carbon. In-depth research has been done on the composition and properties of the clays utilized in the adsorption bleaching of these oils. Vegetable oils with a high percentage of free fatty acids (FFAs) are hydrolyzed to become other forms of fat **(Frega et al; 1999; Kishimoto, 2019)**. Vegetable oils may go rancid if there are even trace amounts of free fatty acids (FFAs), which will lower the quality of the oils **(Vaisali et al; 2015)**. Free fatty acids (FFAs) cause foul smells and hasten oxidation **(Chaiyasit et al; 2007)**. For a variety of uses, bleaching palm oil is advised since it removes organic components that can impact the flavor, taste, and quality of manufactured items while also reducing the oil's unmistakable color. The fact that the sample (coal) is locally accessible at a low cost and has been determined to be the safest material on earth is one of the benefits of activated carbon made from natural coal. One of the most significant edible oils in the world and a staple of the Mediterranean diet is olive oil. It is valued for its unique nutritious qualities that set it apart from other vegetable oils, as well as its aroma, taste, and color. Through its advantages, such as lowering lifestyle risk factors for heart disease, it can also enhance health **(Visioli & Galli, 2002)**. Because it is derived from fresh olive fruits using only physical processing and no additional chemical processing, it belongs to the highest quality category of vegetable oil and has been utilized for its sensory and nutritional characteristics **(International Olive Council, 2019)**. Additionally, olive oil is frequently used as cooking oil, which has caused the market for olive oil to grow quickly. It is extremely suitable to employ materials like nutshells, fruit stones, bamboo, apricot stones, and bones etc, as precursors for high-quality activated carbons that are beneficial in adsorbing both gases and solutes from aqueous solutions **(Toles, Marshall, & Johns, 1997; Iwoha & Agunanne, 1999; Hong, Proctor, & and Schultz, 2000)**. In order to increase its porosity, primary char can be partially gasified with steam, carbon dioxide, or a combination of the two. Alternatively, the precursor can be chemically activated with a chemical such as zinc chloride or phosphoric acid. As a result, several adsorbents can be produced from a single precursor by altering the production process or the circumstances of treatment **(Reinoso & Sabio, 1998)**. Chemical activation has a number of benefits since it combines carbonization and activation in one step. Additionally, it produces more carbon products and requires lower temperatures, thus in most circumstances, the added chemicals can be recovered in part. Activated carbon preparation in the presence of phosphoric acid has been documented by numerous researchers, though far less

frequently than treatment with zinc chloride. Using the Langmuir adsorption isotherm, this research evaluates the bleaching efficiency of activated carbon made from natural coal on goya olive oil and palm oil.

II. METHODOLOGY

➢ *Carbonization (Activation Process)*

The sample (natural coal) that was taken from the coal site at Emene in Enugu State was ground to pass through a 3mm sieve and was retained in a 1.5mm sieve. The raw material sample weighed 537.87g. 100ml of 35% phosphoric acid were added to 200g of natural coal after it had been weighed out. In order for the activation ingredient to function correctly, the mixture was well mixed using a glass rod and left for 24 hours. After 24 hours, the mixture was drained and dried for roughly 4 hours in a machine working between 60°C and 80°C. At a temperature of roughly 500^0C, the sample was carbonized in a muffle furnace (2hrs). After allowing the sample to cool, distilled water was used to wash it until the pH of the water was neutral or nearly neutral. The sample was dried at 105°C for 4 hours, and then it was crushed and sieved once more to achieve tiny particles for adsorption purposes. It was then stored in an airtight container for 24 hours.

➢ *Filtration Process*

Filter paper was used to filter the sample (natural coal) after it had been diluted with distilled water. To gauge the filtrate's level of acidity or alkalinity, litmus paper was used as a test. Once a pH level of 5 to 6 was reached, the filtration process was performed a further six times. As a result, the remaining activated carbon was gathered, dumped on a drying pan, and placed in an oven to dry at 105°C for four hours.

➢ *Absorption Process*

To examine the variations in their absorbance, the activated carbon from natural coal was put through a distinct absorption method. Against 10mls of the affluent in each case, six distinct grams of 0.5g, 1.0g, 1.5g, 2.0g, 2.5g, and 3.0g were absorbed.

➢ *Degumming*

Degumming was carried out using 500 mls of hot water heated to 100^0C, 500 ml of oil (palm oil or soya bean oil, respectively), and a separating funnel. The operation was repeated until clear water was visible behind the oil layer.

➢ *Neutralization*

Palm oil and soya oil, which had been 60 percent degummed, were neutralized separately at 800°C for about 10 minutes, after which 10 mls of 0.1 M NaOH and 6 g of NaCl were added to the oils. As soon as NaOH is added to the oil, it starts to catalyze, creating soap (triglyceride). To remove the soap, more hot water was added to the oils. This process was continued until the oils were free of soap.

➢ *Bleaching process*

Measured amounts of 0.5g, 1.0g, 1.5g, 2.0g, 2.5g, and 3.0g of activated carbon were added to 10mls of the neutralized oils and vigorously agitated before being added to the beaker and boiling for 30 minutes. After heating, cotton wool was used to filter the oil into a conical flask.

➢ *Readings using Ultra Violet (UV) spectrophotometer*

The absorbance and concentration of a sample are measured using a UV spectrophotometer. Before use, the UV spectrophotometer was turned on and left running for around 30 minutes while the oils (palm oil and soyabean oil) were added to a 5cm covet and a buffer solution was added to another covet. The two oil samples' absorbance and concentration were measured after 30 minutes. When the buffer solution (Acetone) and oil samples were added to the covet, the reading code was changed to 10%, and water-proof material was used to cover the covet to stop light from penetrating the oil samples. The water-proof substance was subsequently removed once the reading code was changed to 0%. The handle of the UV spectrophotometer was raised to read the absorbance, and the mode was activated to read the concentration.

➢ *Adsorption Isotherm and Langmuir Equation*

Adsorption is the concentration of a fluid component (gas or liquid phase) onto the surface of a solid while adsorption capacity is the accumulation of the solute molecules at the surface of a solid. The adsorption capacity of the oil samples used in this research was predicted using Langmuir isotherm thus; adsorption isotherm is a graph that represents the variation in the amount of adsorbate adsorbed on the surface of the adsorbent with the change in pressure at a constant temperature. Langmuir isotherm equation is given as $\mathbf{C_e/Q_c = 1.Ce/Q^o + 1/bQ^o}$, where Ce = equilibrium concentration, Q_c = percent absorption, $1/Q^o$ = slope, Q^o = adsorption capacity, and b = Langmuir constant.

➢ *Analysis*

2.9.1 Percentage Absorption of Goya olive oil and palm oil using activated coal

The % absorption for the two samples of oil (palm oil and soyabean oil) were calculated using the formula; qc = $C_o - C_e/ C_o$ X 100/1, where C_o and C_e are absorption before adsorption and absorption after adsorption thus; the % absorption for palm oil and soya bean oil adsorbed by activated coal were calculated and recorded in **table 1, table 2 and table 3 respectively.**

III. RESULTS AND DISCUSSION

The table 1 below shows the result of absorbance, %absorption and concentration of palm oil and soya bean oil adsorbed by activated carbon produced from natural coal (activated coal) using UV spectrophotometer thus; the lower the weight of concentration, the higher the absorbance while table 2 above showed the values obtained from concentration/%absorption for goya olive oil and palm oil and table 3 showed results of slope which speaks of the adsorption capacity, intercept and Langmuir constant

obtained for goya olive oil and palm oil. Thus; the activated carbon produced from natural coal has higher adsorption capacity on palm oil than on goya olive oil.

Table 1 Table of Values for Activated Carbon Obtained from Natural Coal

Weight Of Concentration Of Adsorbents (G)	Goya Olive Oil			Palm Oil		
	Absorbance	Conc. (Mg/l)	% Absorption	Absorbance	Conc. (Mg/l)	% Absorption
3.0	0.10	10.10	86.10	2.99	29.90	31.20
2.5	0.12	11.50	84.10	3.01	30.00	30.90
2.0	0.12	12.40	82.90	3.02	30.02	30.80
1.5	0.13	13.20	81.80	3.07	30.70	29.50
1.0	0.16	16.20	77.70	3.48	34.80	20.20
0.5	0.16	16.30	77.50	3.94	39.40	09.50

Table 2 Table of Values Obtained from Weight of Concentration/% Absorption (Ce/Qc).

Activated Coal	
Goya olive oil	**Palm oil**
0.035	0.096
0.030	0.081
0.024	0.065
0.018	0.051
0.013	0.050
0.001	0.053

Table 3 Table of Results Obtained from Slope, Intercept, and Langmuir Constant (B) for Goya Olive Oil and Palm Oil Adsorbed by Activated Coal.

Samples of oil	Slope $(1/Q^0)$	Intercept $(1/bQ^o)$	Langmuir constant (b)
Goya olive oil	0.01	0.006	0.6
Palm oil	0.02	0.03	1.5

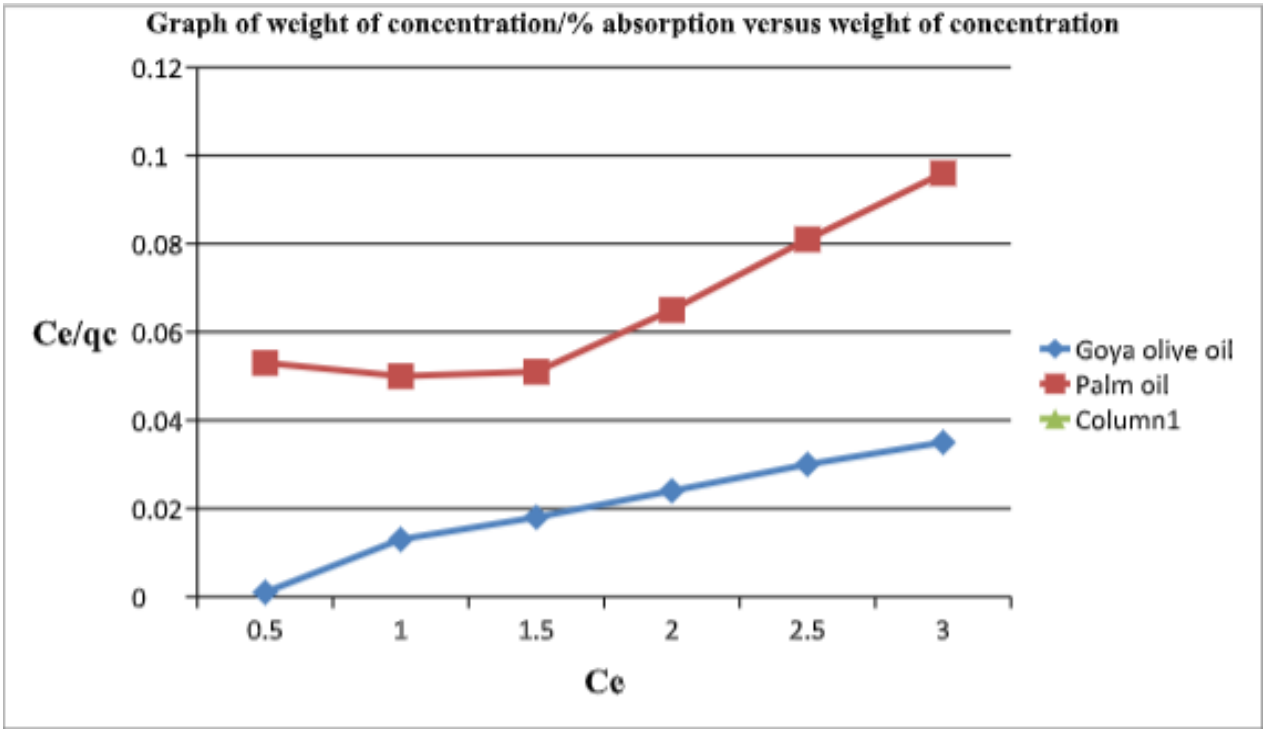

Fig 1 Graph of Weight of Concentration/% Absorption Versus Weight of Concentration for Goya Olive Oil and Palm Oil Adsorbed by Activated Coal using Langmuir Equation; $Ce/Qc = 1.Ce/Q^O + 1/Bq$.

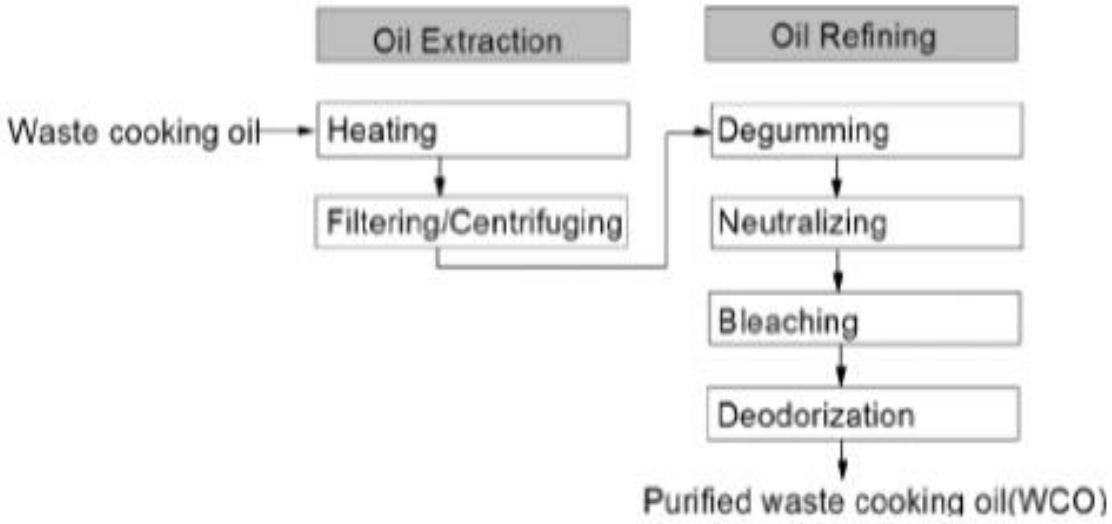

Fig 2 Diagrammatical Representation of Steps Involved in Refining Edible Oil

IV. CONCLUSIONS

The effectiveness of activated coal in bleaching goya olive oil and palm oil was validated by this study. Additionally, it was found from the results table and graph that palm oil has a higher capacity for adsorption than goya olive oil, which also suggests that palm oil has a higher purity percentage. As a result, according to the experiment that was conducted and the data provided, activated coal is more effective at bleaching palm oil than it is at bleaching goya olive oil.

- *Recommendation*

Further research work should be carried out on the adsorption capacity of goya olive oil and palm oil using activated carbon produced from other carbonaceous materials.

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