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Decolorization of Acacia Seyal Gum Arabic

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Abstract: This work aimed to decolourization of Acacia Seyal (Talha) Gum Arabic to improve its quality. The experimental set up consists of adsorption column made of Perspex. The adsorption media is activated charcoal of 350 μm pore size. The adsorption bed is 15 cm in depth and 3.5 cm in diameter. The experiment is conducted for wide range of Talha Gum concentrations (5.5 -55 g/L). The transmittance is measured for wide range of wave length (350 to 800 nm). The result showed that the colour has changed from pink to colourless-transparent. The transmittance (%) has improved by 5 to 22% depending on the initial transmittance. The colour removal is found to have significant influence on pH, and total dissolved solid (TDS) and less influence on viscosity. The pH increased by 1 unit indicating that the impurities are of basic origin. The TDS is reduced by 20 to 50% indicating the removal of other salts excluding Ca+2 and Mg+2 ions.

Keywords: *Acacia Seyal; Decolourization; Activated carbon.*

1. INTRODUCTION

Gum Arabic (E414) is the dried exudate produced from the trunk and branches of the Acacia senegal tree, known as hashab, and the acacia seyal tree, known as talha. It consists mainly of high molecular weight polysaccharides of the hydrocolloid group and their calcium, magnesium and potassium salts which on hydrolysis yield arabinose, galactose, rhanose and glucuronic acid (Williams and Phillips, 2000). Table 1 shows the average physicochemical properties of Gum Arabic of different origins. The data on minerals content is limited.

Table (1). Physicochemical properties of Gum Arabicl

Property	Sudan (Sabah Elkhir et al., (2008)	Tanzania (Mhinzi and Mrosso, 1995)	Kenya (Lelon et al., 2010)	Ethiopia (Yebeyena et al., 2009)
Moisture content %	10.8	13.8	13	15
Ash content %	3.4	4.2	2.0	3.56
Intrinsic viscosity mL/g	14.29	33.68	na	1.19
pH on 25% solution	3.9	na	na	4.4
Specific rotation	-29	-24.6	-26	-32.5
Nitrogen content%	na	4.4	0.26	0.35
Protein content %	1.7	2.9	na	2.31

Acacia Seyal is usually coloured, and the colours are usually referred to as impurities which in turn affect its quality. The colour stem generally from gum extraction method and tools, storage material and atmosphere, temperature and climatic conditions as sand storm, rain etc (Abdalla, 2005). The gum is generally collected by farmer in bags and extracted using axes of metals. During collection parts also fall into ground and become contaminated with sand and other materials. After collection is dried in solar where it open to rain and falls leaves, sand, wool and bird waste. Then it is transported to the market. Before auctioned it is subjected to some cleaning process including shaking, hand grading. The main purpose of this process is the removal of obvious impurities such sand, leave, tree bark, wools, etc.... (Ishaya, 2004).

To improve the colour of Gum Arabic the initial colour has to be removed with the aid of decolourizing agents. The most widely used of these decolourizing agents are Activated carbon and silica gels are generally used (ILPI, 2010). Activated charcoal is most widely used due to its economic advantages over others, its availability and its chemical inertness towards most of our materials of construction. Azeez (2005) has applied activated charcoal and decolorized Acacia Senegal of Nigerian Gum. He used 500 mm charcoal pore size. He found that charcoal is effective in colour removal.

2. MATERIALS AND METHODS

2.1 Materials

Commercially available mechanical powder of Talh Gum is obtained from the local market. Table 2 shows the specifications of Talha Gum used.

Table (2). Mineral content of tested sample in 100 g

Content	value	Unit
Sodium	14	mg
Potassium	310	mg
Total carbohydrates	86.6	g
Soluble dietary fiber	86.6	g
Protein	1.7	g
Calcium	1117	mg
Magnesium	292	mg
Iron	2	mg
pH		
Viscosity		

Distill water is prepared at Unit Operation Laboratory, Department of Chemical Engineering; University of Khartoum. The distillation units consist of an electrical regenerator and condenser. Table 3 shows the physical properties of distillated water used in this work.
The activated carbon used in the work is manufactured by the company CARA of Germany. It has a pore size of 350 μm.

Table (3). Properties of Distilled Water

Wavelength (nm)	350	520	600	800
Transmittance (%)	4.1	58.7	106.3	147.8
pH	Viscosity (mPa.s)		TDS (ppm)	
7.2	1.04		5.1	

2.2 Experimental Apparatus

Figure 1 show the apparatus used in this work. The adsorption column is made of Perspex which consists of four parts. The top section is free board with height of 40 cm. This part is followed by the supernatant section of 10 cm in depth.

Supernatant water is required to prove hydrostatic head to force the fluid to flow through the bed. The third part is filter bed (15 cm) filled with activated charcoal of 350 µm particle size. The last part is the under-drainage system. The different parts are held together with a flange and bolt (eights bolts).

A seal is sis used to eliminate the leakage. Filter cloth was also sandwiched between the supernatant and filter bed and between filter bed and under drainage system. There were made hinder impurities into bed and avoid the penetration charcoal bed to under-drainage system.

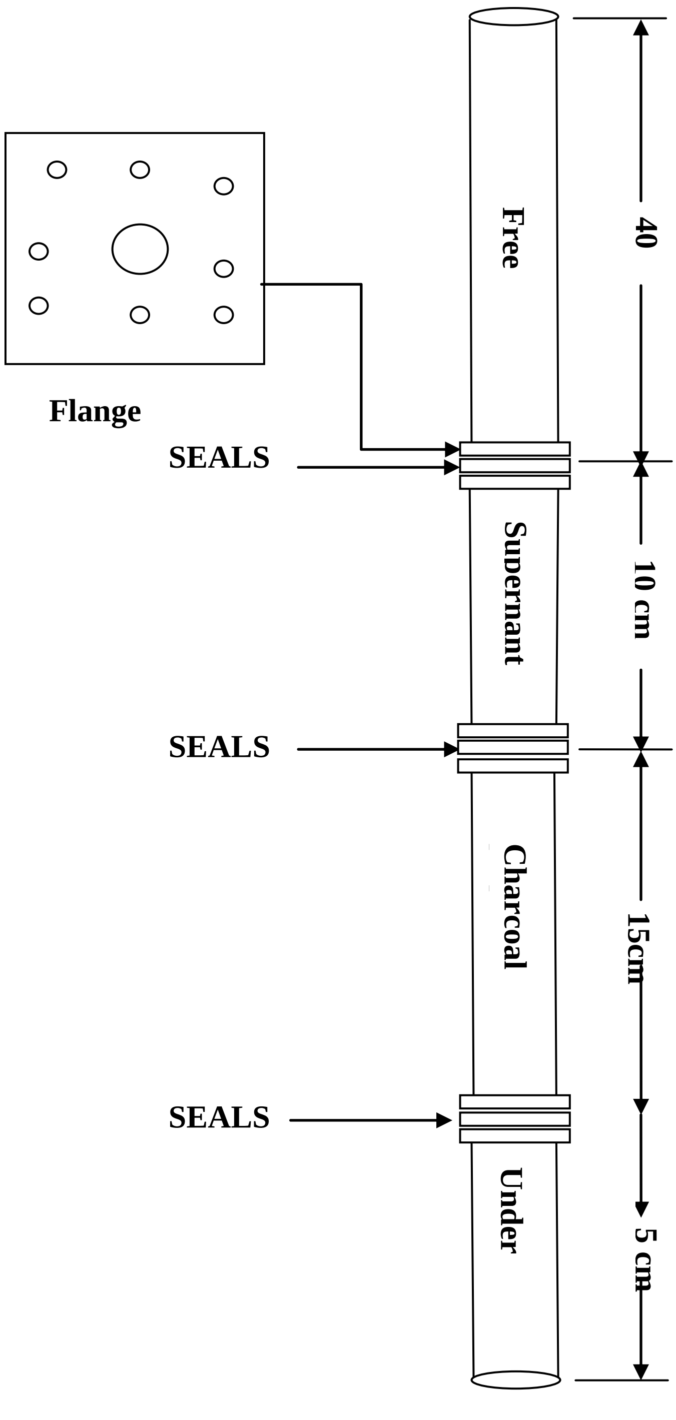

Figure (1). Adsorption Column

2.3 Experimental Design and Procedure

The adsorption column was charged with 15 cm of activated charcoal. The bed of adsorption column was washed with distilled water (at 50 °C) until all the fine dust of charcoal was removed. The washing was continued until there was no more colour in the distilled water.

Five samples of Talha Gum solution were prepared with different concentrations range from 5.5 g/L to 55g/l. Each sample is passed through the adsorption bed several times until there was no change in its colour is obtained. Before moving to the second sample the adsorption bed is washed with warm water (50 °C) to reactivate the charcoal bed. Samples from the raw and treated Talha Gum solutions were collected and tested for pH, Transmittance, viscosity and TDS. The measurement was repeated three times for each sample and the average was recorded.

3. Results and Discussions

3.1 Colour removal

Table 4 shows the Transmittance of raw and decolorized sample at different wave length for different acacia Seyal concentration. As expected the transmittance increases with concentration; more concentration more impurities which causes of colour. At constant concentration the transmittance increases with increase in wavelength. Similar trend is valid for the decolorized sample. The improvement in the acacia transmittance is defined as

$$E = \frac{\tau_D - \tau_R}{\tau_D} 100\% \qquad (1)$$

Where t_R and t_D are transmittance of the raw and decolorized gum.

It can be seen that the activated carbon has significantly improved the transmission of the Acacia Seyal solution. The improvement in the transmittance increases with the increase in the ttransmittance of the raw solution. Figure 1 and Figure 2 shows the coloured of the raw solution and decolorized solution of acacia Seyal. The difference between two states is obvious. The raw sample is pink while the decolorized is white transparent. The colours are in fact quite consistent with the transmittance presented in Table 3.

Table (4). Transmittance of raw and decolorized Acacia Seyal (R=Raw, E=enhancement)

l (nm)	Distilled water		Concentration (g/l)									
			5.5		11		16		22		55	
	R	E	R	E	R	E	R	E	R	E	R	E
350	4.1	0	4.1	8.9	3.9	11.4	3.7	5.1	3.4	8.1	3.2	11.1
430	7.5	0	7.1	4.1	6.1	15.3	5.8	14.7	5.5	12.7	5.2	13.3
470	25.3	0	22.8	7.3	20.0	17.4	17.4	21.6	17.0	19.4	16.7	16.1
490	39.9	0	36.5	6.4	32.2	15.3	28.7	20.3	27.5	22.5	27.0	22.0
520	58.7	0	55.7	7.3	44.4	24.7	42.0	22.1	41.0	21.2	39.7	22.0
540	74.0	0	71.1	6.6	65.1	13.1	60.0	12.3	58.1	12.9	56.8	13.1
580	97.3	0	94.6	6.7	89.2	10.8	82.4	9.9	80.3	11.8	78.4	13.1
600	106.3	0	104.8	6.9	99.7	9.7	93.0	10.1	91.7	8.7	89.1	10.3
650	127.1	0	126.7	8.1	122.5	8.0	98.0	22.0	96.6	21.3	94.9	21.4
710	146.2	0	147.8	7.6	143.8	6.8	138.0	6.5	136.4	5.9	134.8	5.1
800	147.8	0	151.6	6.8	150.0	6.2	140.0	6.7	138.2	6.6	137.0	6.2

Figure (2). Color of raw (left) and treated (right) acacia Seyal Solutions.

3.2 Influence of color removal on physicochemical properties of acacia Seyal.

Table 5 shows the pH, viscosity and TDS of raw and decolorized samples.

Table (5). pH, Viscosity and TDS of acacia Seyal solutions

Sample (g/l)	pH		Viscosity(mPa.s)		TDS (ppm)	
	Raw	Decolorized	Raw	Decolorized	Raw	Decolorized
Tap water	7.79	7.79	0.84	0.84	119.1	119.1
Distilled water	7.20	7.20	1.04	1.04	5.10	5.1
Bottle water	8.10	8.10	0.65	0.65	144.8	144.8
Sample (g/L)	Acacia Seyal Sample					
5.5	5.31	6.65	1.31	1.18	58.7	29.1
11	5.27	6.45	1.65	1.41	113.2	35.8
15.71	5.22	6.34	4.18	3.68	123.2	66.3
22	5.18	6.20	4.54	3.92	129.2	85.1
55	5.11	6.13	4.75	4.44	159.2	94.5

It can be seen the colour removal has significant effect on the physical properties of the acacia Seyal solutions. For example at 5.5 g/L concentration the pH values increased from 5.31 to 6.65. This means that the impurities that cause the colour are of acidic nature.

The total dissolved solved (TDS) are taken as indicative to the calcium and magnesium and other ions concentration. It can be seen that the TDS drop significantly upon decolonization. It is known that charcoal does not absorb the salt of calcium and magnesium. Hence this reduction may be attributed to other mineral and salt that are brought to the Gum by the extraction method (bark tree), earth storm, temperature and climatic.

Acacia Seyal is known to have high solubility in water (100% soluble Talha Gum solution with 50% concentration remains still Newtonian fluid. Clearly the removal of impurities has little change on the solution viscosity. This may be attributed to the nature of the impurities that cause the colour.

4. Conclusion

This work has provided information of the depolarization of Sudanese Acacia Seyal. It concluded that only 15 cm activated charcoal bed is enough to decolorize Talha gum solution. The work also the concluded that the decolorization has significant influence on the gum acidity and mineral content measured as TDS.

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