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# Characterization and Analytical Data of Preparative Fractions of Talha gum (Acacia Seyal), Hashab Gum (Acacia Senegal) and Kakamut Gum (Acacia Polyacantha).

**Elgaili A. Omer[1]*, Sana Adam Ahmed Shily[2], Yousif jumma abdurahman adam[3], Hajir Altoom Hassan[4,]**
[1a]Department of Chemistry, Faculty of Science, Al-Baha University, 65779 Saudi Arabia, eabdelrahman@bu.edu.sa. ORCID iD: 0009-0006-7050-6826.
[1b]Deanship of Graduated Studies & Scientific Research, Kassala University, P.O.Box266, Kassala, Sudan. Email: elgaili1965@gmail.com
[2]Deanship of Graduated Studies & Scientific Research, Kassala University, P.O.Box266, Kassala, Sudan, sanashily@gmail.com
[3]Department of Chemistry, Faculty of Science, Al-Baha University, 65779 Saudi Arabia, yadam@bu.edu.sa. ORCID iD : 0009-0001-2276-4904
[4]Department of Chemistry, Faculty of Science, Al-Baha University, 65779 Saudi Arabia, haltoom@bu.edu.sa. ORCID iD: 0009-0003-0022-053X.
*Corresponding Author: Elgaili Abdelrahman Omer
*Department of Chemistry, Faculty of Science, Al-Baha University, 65779 Saudi Arabia, elgaili1965@gmail.com

***Abstract***
*Acacia's gum samples (A.Seyal, A.Senegal and A.Polyacantha) were collected as natural exudates. Seven water fractions were obtained.* ***Aim:*** *this study aim to identify some physicochemical properties of seven successive fractions obtained from A. Seyal, A.Senegal and A.Polyacantha gum by fractional precipitation using water as a solvent.*
***Materials and Methods:*** *Analysis of the fractions were carried of the following parameters; moisture, ash, viscosity, optical rotation, nitrogen, protein, refractive index, pH, equivalent weight, uronic acid, reducing sugar.*
***Results:*** *Refractive index of A.Seyal and A.Polyacantha fractions were found to have same mean value (1.3322). Statistical analysis showed significant differences($p \leq 0.05$)were obtained for several parameters of A.Seyal, A.Senegal and A.Polyacantha fractions; moisture(5.8%), (9.0%), (9.7%),ash(3.1%),(3.3%),(3.8%)and nitrogen(0..47%),(0.51%),(0.54%), then protein(3.1%),(3.4%),(3.6%) respectively. Insignificant differences ($p \leq 0.05$) of parameters were found for Acacia's fractions were; viscosity (1.296), (1.292),(1.277), specific optical rotation (+23.4), (-29.1),(-19.0) respectively, specific optical rotation of A.seyal was dextrorotatory optically active(+23.4). Insignificant differences ($p \leq 0.05$) of such parameters of A.Seyal, A.Senegal and A.Polyacantha fractions as; pH (5.1), (5.3). (5.6), equivalent weight (1329.01),(11066.16),(1206.09), uronic acid (14.7%), (17.1%), (16.1%) and reducing sugar (0.14%), (0.08%),(0.13%) respectively. UV absorption showed fractions of A.Senegal (1.49) and A.Polyacantha (1.49) shared same value. The results of cationic composition showed values of this gum fraction. The results of parameters studied showed a wide variation. Accordingly, these data confirms the heterogeneity of acacia's gum fractions.*
***KEY WORDS:*** *Preparative fractions, Optical rotation, Solvent, Acacia Senegal.*

## INTRODUCTION

There are more than 1100 species of *Acacia* botanically known distributed the tropical and subtropical areas most commercial gum Arabic is derived from *Acacia Senegal*(Eldigair,218). Sudan is considered one of the largest producers and exporters of Gum Arabic because the greater portion of the Gum Arabic belt is located in Sudanese territory. Sudan alone produce about 80% of Gum Arabic in the world (Yassin,2015).The order of economic importance for Sudanese gums is *A. Senegal*, *Acacia Seyal* and *Acacia Polyacantha* (Elgaili et al.,2015). It is hardly distinguished from each other unless it can be recognized by acknowledged gum expert or by their physic-chemical characterized. Chemically gum Arabic consist mainly of high-molecular weight polysaccharide made up of L-rhamanose ,L- arabinose and D-galactose , glucuronic and 4-O- methoxyl glucuronic acid ,and the salts of calcium ,potassium , magnesium , and sodium of the two acids(Annoor et al.,2019).The *Acacia Senegal* and *Acacia Polyacantha* gums exudates from this group of *acacia* species show laevorotatory (-ve) specific rotation in contrast to the *A. Seyal* which has dextrotatary (+ve) specific rotation(Hamouda,2017).The increasing demands of these different type of gums in various technological application demanding through characterization of the gum exudates in commerce ,

so that it is necessary to assure the purity and consistency of the gum used in the industrial and technological processes however, it necessary to maintain its properties for technological industrial application. Plant gums are organic substances obtained as an exudation from trunks or branches of trees spontaneously or after mechanical injury of the plant by invasion of bacteria (Ibrahim et al.,2017).Gum often describe material which affect the sense of touch, taste and sight, it has been measured a property of gummosis which is difficult as define but it cause the observer to call it gum(Elgaili et al.,2014).Gum is a polysaccharide which dispersed in water giving viscous solution , gel or colloidal dispersion , molecular weight , polymers that dissolve or disperse in water to give thickening or gelling effect and exhibit related secondary functional properties, such as emulsification stability, and encapsulation(Dickinson,2015).The process of gum formation is not quite well understood whether the exudates: are the result of normal metabolic activity of the tree; a defense mechanism by the tree to seal wounds created tapping; result from microbial or fungal or bacterial infection of the disease yet to be determined(Barak et al.,2020). According to (Chikami et al.,1993), the principle factors governing gum production are summarized in physical, biotic institutional and Socio – economic factors as well as genetic and physiological factors. Climate, particular rainfall is the most important of the physical factors, which include the topographic and edaphic or soil factors. The biotic factors include pests such as locusts and termites, and browsing animals. The institutional factors include the deliberate effect to restock the gum belt area, poor infrastructure and services, such as research and extension they have a pronounced influence gum production. The Socio-economic factors, on the other hand include a wide spectrum of factors, such as income, gum prices, labor supply, and social transformation. All are interacting to play their role in affecting gum production(Adam et al.,2009).The inherent potential of gum production is governed by two sets of variables; ecological variable that determine the regeneration and extent of gum belt and environmental and socio-economic variables, which govern the exploitation of Hashab stands a good seed year is always a poor gum year, that biggest volume of exudation beginning during the hottest part of the day(Omer ,2004). *Acacia Seyal* botanically accept as *Acacia Seyal* Del. Belong to the family Leguminosae and subfamily mimosoideae. *Acacia Seyal* is known by a number of the vernacular names, for instance in the Sudan *Seyal* var *Seyal* is called Talha or talh ahmer, whereas var Fistula, talha abiad or Soffair (Arabic). Generally, it grows in tropical and subtropical hot and semi-arid zones (Osman et al., 1993). *Acacia Seyal* is the positive optical rotation and low viscosity the ratio of arabinose: galactose >1 and the low content of rhamnose (Esia et al.,2022). *Acacia Seyal* used in addition to gum talha production (around 10% of the Sudan gum expert) as fodder for sheep and goats for cattle or and camels(Mohamed et al.,2022). *A.Seyal* also find some medicinal uses as its bark is used for leprosy, dysentery, and headaches, branches used for brushwood hedge(Tauqeer et al., 2002). *Acacia Polyacantha* botanically accept as *A.Polyacantha* and belong to the family legumimosae and subfamily mimosoceae is called in Arabic name Kakamut, umsinina. In the Sudan the *A.Polyacantha* have several regional varieties, which usually occur a long river and valleys where the water table is fairly high and soils are good the woods is used mainly in fuel and charcoal of good quality , fence posts farm implement railway ; sleeper beams and rafters(Elgaili et al .,2014).The gum is edible and used as adhesive in the treatment of textile fibers .The roots is said to act as a general health tonic as and a general health tonic as an antidote for snake bite , and cure for venereal diseases, a preparation from the bark is used for general stomach disorders(Omer,2004).The *A.Senegal* is wide distribution in the Sudan gum belt, it has been an article of commerce for over 5000 years and used for the mainly type of manufacture. *Acacia Senegal* is readily dissolve in water and it has low viscosity at high concentration. *A. Senegal* component the inorganic matter such as Ca, K, Mg salts of Arabic acid, it is highly branched, closely packed molecules with a main chain of β-galactopyranose units terminating in glucuronic acid(Edward et al .,2020).Gum Arabic is defined as the dried exudation of *A.Senegal*, or closely related species of *Acacia* family leguminous. Gum defines as a highly branched uronic acid type hetropolysaccharide produced as exudates from trees of the genous *Acacia* maintained under unhealthy conditions (Defaye et al.,1986). Gum for their high viscosity in solution and inability crystallize ,are particular suited to serve in foodstuff such as : thickeners for beverages stabilizer for oil and water emulsion and as wider application where function is to prevent agglomeration and setting of minute particles .They are also used to incorporate flavors in confectionery such as pastilles and gum drops and the preparation of lozenges(Verbeken et al .,2020).The role of gum Arabic in confectionary products is usually either to prevent crystallization of sugar or to act an emulsifier, gum are used as a suspending and emulsifying or binding agent in pharmaceutical industries, it has been used in tablet manufacturing where is functions as a binding agent or a cooling prior to sugar coating, sometime in combination with other gums(Rosland et al .,2020).The *Acacias* gum used to act as general health tonic as antidote for snakebite and cure for venereal diseases, a preparation from the bark is used for general stomach disorders. They hydrophilic

colloids and modified cellulose find application in paint industry because of their stabilizing effect on paint emulsions. Waxes and numerous others products (Tauqeer et al., 2022).The gum also finds application in coating composition developed non-glare coating based on a water-soluble dye dissolved in gum Arabic. The historical photography process of gum bichromate photography uses gum Arabic mixed with ammonium or potassium dichromate and pigment to create colored photographic emulsion that is sensitive to ultraviolet light in final print, the gum Arabic permanently binds the pigment onto the paper (Kauther et al 2018). Gum prevents militancy at high shear regular distribution of pulp fiber increase mullein–bursting strength, crush and improves surface properties, finish ink acceptance and smoothness , It is used as a component in drilling fluids removing calcareous deposits, acidizing wells and secondary recovery. Other industry uses due to adhesive properties gum has been used in manufacturing of adhesive for postage and in formulation inks (Mohamed et al., 2022). Gum is used as a thickening agent for pigment in printing fabrics. It prevent of dyestuff in pad dying operations, and produces very fine line prints with good definition and excellent wash out(Ahmed et al ., 2023).Gum may serve as source of monosaccharide, as e.g. Mesquite gum (family propis) serve as a source of L-arabinose (51%) because of it's easer hydrolysis, and availability of the gum in large quantities, the mesquite gum can be dialyzed out neutralized hydrolyzed and crystallized by addition of ethanol or alternatively, isolated by crystallization from methanol after removal of acidic oligosaccharides on ion exchange resin or precipitated barium salts (Elnour,2007).Fractionation is one of the most important of analysis, the preparative technique for fractionating polydispersed polymer is the simplest, and it involves the addition of precipitants to unaqueous isolation of fractions having different solubility's. Coprecipitations may occur(Omer et al., 2015).The gum solution has been fractionated previously using ethanol, saturated sodium sulphates solutions , ion exchange chromatography in DEAE-cellulose, phenyl sepharose Cl-4B 9, anti- arabinogalactan protein (AGP) antibodies (Osman et al ., 1993).Gum arabic is used to stabilize flavor and oil emulsions in dried food mixes and industry of soft drinks. Where the gum is required to stabilize a concentrated oil emulsion (about 20%) for long periods also to contain to stabilize following dilution prior to bottling (Islam et al.,1997). Gum Arabic produces highly stable emulsions making it very useful in the preparation of oil in water food flavor emulsion particularly for citrus oils(Randal etal.,1988).Preparative fractionation of polydispersed polymer using water is simple, water is nontoxic and it can give best fractions precipitants.

## 2. AIM OF STUDY:

The aim of this study deals with some physicochemical properties of seven successive fractions obtained from *Acacia 's gum fractions of A.Seyal, A.Senegal and A.Polyacantha* gum by fractional precipitation using water as a solvent.

## 3- MATERIALS AND METHODS: -

### 3.1. Materials

Authentic samples of gum were collected as natural exudates in nodules forms of *A.Senegal A.Polyacantha and A.Seyal* trees. Gum samples were identified by experts of Gum Arabic Company Ltd, Khartoum, Sudan. Gum nodules were dried at room temperature (30 $C^0$) then cleaned by hand to insure freedom from sand, dust and bark impurities, then ground using a mortar and pestle, and then sieved through the sieve No.16, labeled and kept in plastic container for analysis**.**

### 3.2. Methods

The following analytical methods were adopted in this study:

**A- Fractionation**

Water solvent fractionation of the gum samples was carried out according to the method described by (Abderahim, 2006) with modification. According to that, 30 % gum solution was prepared in distilled water and the solution heated on the water bath at 50 – 60 $C^0$ until foaming stops. The foam was collected on a petri-dish and exposed at air be dried in a desiccator at room temperature (fraction 1) .On standing over 24 hours same process has been carried out for the remaining solution heated in the same way different fractions (F2 to F7) were separated successively.

**B- Moisture content**

The moisture content of the fractions was determined according to AOAC (1995) method. Crucible was dried in Heraeous oven at 105$C^0$ for 30 minutes, cooled in desiccators and then weighed (M1). About two grams of sample were placed in the crucible and weighed accurately( M2 ) .Content was heated in the oven ( OVER TIMP LIMIT No, 02 ) for 5 hours at 105 $C^0$ and cooled in desiccators and against reweighed (M3 ) loss calculated as follows:

$$M\% = \frac{(M2-M3)\times 100}{M2-M1}$$

Where:
M1: weight of the empty crucible
M2: weight of the crucible +sample.
M3: weight of crucible +sample after drying.

**C- Ash content**

Total ash of the fractions was determined according to Joint Expert Committee on Food Additives/FAO (1995). Used scot science UK crucible were heated in an oven for 30 minute, cooled in desiccators and then weighed (W1). About two grams of sample were placed in the crucible and accurately weighed (W2) .Then ignited at 550 $C^0$ in Heraeous electronic muffle furnace for 2 hours , cooled in desiccators and weighed (W3 ) .Total Ash % was calculated as follows:

$$\frac{(W3 - W1) \times 100}{W2 - W1}$$

Where:
W1: weight of empty crucible.
W2: Weight of crucible +sample.
W3: weight of crucible +sample after drying.

**D- Relative viscosity**

Viscosity of the fractions was obtained using a capillary viscometer (shot Gerate type 50120/11) .1% gum fraction solution in NaCl (1.0 M) was prepared for each fraction. The fraction of gum solution was filtered (Whatmann qualitative 12.5 No 90) and the solution were transferred into capillary tube at room temperature( $30C^0$) and left to attain thermal equilibrium for half and hours before taken any measurements the flow time for each concentration .Finally measured the flow time for pure solvent NaCl (1.0 M ) .

Relative viscosity= $\frac{eflux\ time\ of\ solution}{\text{eflux time of solvent}}$

**E-Specific optical rotation**

The Specific rotation of the fractions was determined according to Joint Expert Committee on Food Additives/ FAO (1990). 1.0 % gum fraction solution at room temperature( $30C^0$) using an Optical rotation activity polarimeter type (Bellingham +Stanley(Ltd), HCl , lamp unit Na ) fitted with sodium lamp with cell path length of 20 cm .The solution was passed through (Whatmann / qualitative 12.5cm No 90 ) filter paper before carrying out measurements at room temperature . Triplicate readings were taken and averaged. The specific rotation of gum fractions solution was calculated according to the relationship:

Specific rotation = $\frac{\alpha \times 100}{C \times L}$

Where:
α = Observed optical rotation
L = Length of the tube polarimeter in decimeter.
C = Concentration of the gum fractions solution

**F- Nitrogen and protein content**

Nitrogen content of the fractions was determined using Semi-micro Khjeldahl method described by Joint Expert Committee on Food Additives/ FAO (1995). Accurately weighed 0.2 gram of gum fractions sample was taken in triplicates in Khjeldahl digestion flasks and Khjeldahl tablet (Copper sulphate-Potassium sulphate catalyst) was added to each tube. 3.5mls of concentrated nitrogen free sulphate acid were added .The flask and contents were then heated over an electric heater until the solution attained a clear blue color and the walls of the flask were free from carbonized materials ($85C^0$) .The content s of the flask were then transferred to steam distillation unit, and 15ml of 40% sodium hydroxide solution were added, and distillation were carried out with steam. The distillation was then collected in 10mls of 2% boric acid solution to which three drops of methyl red indicators were added , and titrated against 0.01 N HCl. The same procedure was carried out for blank (distilled water)

N% = $\frac{(M1-M2)\times N\times 14.0\times 10}{S\times 1000}$

Where:
M1: mls of HCl that neutralized the sample distillate.
M2: mls of that neutralized the blank distillate.
N: Normality of HCl titrate (0.01).

S: sample weight (0.2).

The protein content was determined by multiplying nitrogen percent by the factor 6.6(Anderson et al., 1986).

**G- Refractive index**

Refractive index of 1% gum fractions solution was determined at room temperature (30 $C^0$) using (Bellingham +Stanly Ltd, Abbe 60 DR Refractometer).

**H- pH measurement**

The pH value of gum fractions was determined for 1% aqueous solution at room temperature, using (Pin pH meter 03 "1").

**I- Equivalent weight**

Apparent equivalent weight of the gum fractions was determined according to the method reported in the encyclopedia of chemical technology vol.11 with some modification (Omer et al.,2007). The aqueous gum fractions solution 3% was treated with acid washed Amberlite Resin 120 ($H^+$) [ 2 gm per 10mls of gum fractions solution] for an hour and then titrated against 0.02N of NaOH solution using phenolphthalein as indicator and the equivalent weight was determined as follows :

$$\text{Equivalent weight} = \frac{\text{Weight of the sample} \times 1000}{\text{Volume of titer} \times \text{molarity of alkali}}$$

**J- Uronic acid**

Uronic acid percentage was determined according to the relationship (Elamin, 2001):

$$\text{Uronic acid} = \frac{molar\ mass\ of\ acid\ unhydride \times 100}{equivalent\ weight}$$

**K-Reducing sugars**

Reducing sugars of gum fractions were determined according the method reported by (Samia et al.,2009) using the alkaline ferric cyanide method. The procedure use a single reagent composed of 0.34 gm of potassium ferric cyanide, 5 gm of potassium cyanide and 20 gm of solution carbonate dissolved in one litter of water. 0.1 ml of 1%gum fractions solution was added to 4.0 mls of the reagent then heated in a boiled water bath for 10 minute and cooled. The absorbance was measured at 420 nm using (Photoelectric Colorimeter-Ap-101) standard curve of different arabinose concentrations was blotted against absorbance in order to calculated the reducing sugar content as arabinose.

**L- UV absorption**

Maximum absorption spectra of 1% gum fraction solution of each acacia gum fractions were determined using Perkin-Elmer Lambda 2UV/VIS spectrometer(Samia et al .,2009).

**M- Analysis for inorganic matter**

Accurately weighed 2gms of dry fraction sample were ignited in muffle furnace at 550c for 4 hours 5ml of 5N of HCl were added to each crucible then allowed to warm for 10 minutes to dissolve the minerals. The mixture was filtered and distilled water was added to complete the volume to 100 ml. Cationic composition magnesium( Mg), manganese ( Mn) ,copper ( Cu ) , zinc ( Zn) , iron ( Fe) , lead ( Pb) , potassium (K),sodium (Na) were determined using (Perkin –Elmer-2380 Atomic Absorption Spectrophotometer ), following the method described by the manufacturer.

**N- Statistical analysis**

Each sample was analyzed chemically in triplicate averaged data was assessed by analysis of variance (ANOVA).The mean separation was carried out by regression tests with probability of 0.05 level.

## 4- RESULTS AND DISCUSSION

The present study, Fractionation of authentic acacia's gum samples such as A.Seyal, A.Senegal and A. *Polyacantha* was carried out by precipitation using water as solvent for each one. Seven different fractions were obtained (FI to F7).Some physicochemical properties of the fractions were determined in a comparison with all the fractions. Table (1) demonstrates the analytical data for seven *acacia's* gum fractions such as *A.Seyal*, A.Senegal and *A. Polyacantha*. It illustrated that the value of moisture content of *A.Seyal* fractions were found to be in the range (5.4 -6.2%) and the mean value (5.8%).The moisture content of *A.Senegal* fractions was found to be in the range (8.1- 9.8%) and the mean value was (9.0%). For *A.Polyacantha*, the range of moisture content was found to be in the range (9.6-9.9%), the mean value (9.7%). Analysis of variance shows significant difference ($p \leq 0.05$) among all the fractions. It was observed that the mean value of moisture content of *A. Polyacantha* fractions (9.7%) was greater than *that of A.Senegal* (9.0%), *A.Seyal* fractions (5.8%) respectively. It explained that the mean value of moisture content for the seven

*acacia's* gum fractions is 8.2%.Table (1) shows the range of ash content of *A.Seyal* fractions in the range (2.9-3.4%) and the mean value was (3.1%), *A.Senegal* the range of ash content was found to be in the range (2.9-3.7%) and the mean value (3.3%). The ash content of *A.Polyacantha* fractions was found in the range (3.4-4.1%) and the mean value (3.8%). Analysis of variance shows significant difference ($p \leq 0.05$) for all fractions. It was observed that the mean value of ash content of *A.Polyacantha* (3.8%) was higher than the value compared to *A.Senegal* (3.3%) and *A.Seyal* (3.1%). *A.Seyal* and *A.Senegal* fractions have approximately same ash content (3.1%), (3.3%) respectively .It illustrated that the mean value of ash content for the seven *acacia's* gum fractions is 3.4%.

Aqueous solution of all *acacia's* gum fractions showed low viscosity. Table (1) represents the relative viscosity of the *acacia's* gum fractions. It was found that the viscosity of the *A.Seyal* fractions was in the range (1.273–1.314) and the mean value was (1.296), *A.Senegal* ranged (1.269 -1.310) with the mean value (1.292) and A.Polyacantha was ranged (1.261-1.290) and their mean value was (1.277). Analysis of variance shows that there is insignificant difference ($p \leq 0.05$) for all fractions. It was observed that the mean value of viscosity for *A.Seyal* fractions was the greatest (1.296) compared to *A.Senegal* (1.292) and *A.Polyacantha* (1.277) respectively. It illustrated that the mean value for relative viscosity of the seven *acacia's* gum fractions is 1.288.Aqueous solutions were found to be optically active (levorotatory) for *A.Senegal* and *A.Polyacantha* fractions and (dextrorotatory) for *A.Seyal* fractions .Table (1) shows that the specific optical rotation of the acacia's fractions, it was found that the range of specific rotation of *A.Seyal* was (+20.4 to +27.0) and the mean value was (+23.4). As for *A.Senegal* and *A.Polyacantha* fractions the specific rotation were found to be in the range (- 22.0 to -34.0), (-14.0 to -22.0) with mean values (-29.1 to -19.0) respectively. Analysis of variance shows that there was insignificant difference ($p \leq 0.05$) for all fractions .It was found that the specific optical rotation of *A.Seyal* was optically active (dextrorotatory) while for *A.Senegal* and *A.Polyacantha* were found to optically active (levorotatory).

**Table 1. The analytical data of *A.Seyal, A.Senegal and A. Polyacantha* gum fractions.**

| Fraction No. | Moisture% | | | Ash% | | | Viscosity% | | | Specific rotation[α] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *A.Seyal* | *A.Senegal* | *A.Polyacantha* | *A.Seyal* | *A.Senegal* | *A.Polyacantha a* | *A.Seyal* | *A.Senegal* | *A.Polyacantha* | *A.Seyal* | *A.Senegal* | *A.Polyacantha* |
| F1 | 6.1 | 8.1 | 9.8 | 3.4 | 3.7 | 3.9 | 1.273 | 1.286 | 1.278 | +22.8 | -26.0 | -22.0 |
| F2 | 6.2 | 9.0 | 9.9 | 3.1 | 2.9 | 4.0 | 1.282 | 1.269 | 1.261 | +23.8 | -22.0 | -18.5 |
| F3 | 5.8 | 9.2 | 9.8 | 3.1 | 3.6 | 4.1 | 1.302 | 1.298 | 1.278 | +22.5 | -27.0 | -21.5 |
| F4 | 5.8 | 8.9 | 9.7 | 3.2 | 3.4 | 3.9 | 1.286 | 1.310 | 1.278 | +22.5 | -32.0 | -19.3 |
| F5 | 5.4 | 8.9 | 9.7 | 3.2 | 3.1 | 3.7 | 1.306 | 1.306 | 1.290 | +20.4 | -30.0 | -20.7 |
| F6 | 6.2 | 8.9 | 9.6 | 3.1 | 3.0 | 3.4 | 1.306 | 1.282 | 1.278 | +27.0 | -32.5 | -17.3 |
| F7 | 5.4 | 9.8 | 9.7 | 2.9 | 3.1 | 3.9 | 1.314 | 1.290 | 1.278 | +25.0 | -34.0 | -14.0 |
| Mean | 5.8 | 9.0 | 9.7 | 3.1 | 3.3 | 3.8 | 1.296 | 1.292 | 1.277 | +23.4 | -29.1 | -19.0 |
| Mean of all fractions | 8.2 | | | 3.4 | | | 1.288 | | | 23.8 | | |

Each value in the table is a mean of three replicates.

Table (2) explains the mean value of nitrogen and protein content of acacia's fractions. It was found that the mean value of the nitrogen and protein content of *A.Seyal* fractions (0.47%),(3.1%),*A.Senegal* fractions (0.51%), (3.4%) and *A.Polyacantha* fractions was found to be (0.54%), (3.6%) respectively. Analysis of variance shows that there was a significant difference ($p \leq 0.05$) for all fractions .It was observed that the mean value of the nitrogen and protein contents for *A.Seyal* fractions was the lowest (0.47%), (3.1%). It observed that the mean value of the nitrogen and protein content of *A. Senegal* (0.51%), (3.4%) was closer to *A.Polyacantha* fractions (0.54%), (3.6%), respectively. It illustrated that the mean value of nitrogen and protein content for the seven *acacia's* gum fractions is 0.51% and 3.4% respectively. This mean values it is disagree with results reported by (Annoor et al .,2019) and (Elgaili et al ., 2015), (0.37%, 2.44%), (0.37%, 0.21%) respectively. Table 2 illustrates the value of refractive index of *A.Seyal* fractions was ranged (1.3314-1.3334) and the mean value (1.3322). The refractive index of *A.Senegal* fractions was

found to be in the range (1.3310-1.3320), the mean value (1.3313), and A.*Polyacantha* fraction in the range (1.3315-1.3328) and the mean value is (1.3322). It illustrated that the mean value for refractive index for the seven *acacia's* gum fractions is (1.3320) .It is in a close agreement with the result (1.3337) reported by (Elgaili et al ., 2015).The pH of aqueous solution of all fractions indicated the acidity of the gum which may be due to the presence of acidic sugars (Glucuronic acid).Table (2)shows that the pH of A.*Seyal* fractions was found to be in the range (5.0 - 5.2) and the mean value (5.1). As for A.*Senegal*, the pH was ranged (5.3-5.5) and the mean value (5.3). It has been shown that the pH of A.*Polyacantha* fractions was ranged (5.1-5.9) and the mean was (5.6).Analysis of variance showed significant difference ($p \leq 0.05$) for all acacia's gum fractions. It was found that the mean value of pH for A. *Polyacantha* fractions (5.5) is higher value than that of A.*Senegal* fractions (5.3) and A.*Seyal* fractions (5.1). It illustrated that the mean value for pH of the seven *acacia's* gum fractions is 5.3. It is greater than the result (5.0) reported by (Elgaili et al. , 2015).

Table 2. The analytical data of *A.Seyal, A.Senegal and A. Polyacantha* gum fractions.

| Fraction No. | N% | | | P% | | | Refractive index | | | p H | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *A. Seyal* | *A.Senegal* | *A.Polyacantha* | *A.Seyal* | *A.Senegal* | *A.Polyacantha a* | *A.Seyal* | *A.Senegal* | *A.Polyacantha* | *A.Seyal* | *A.Senegal* | *A.Polyacantha* |
| F1 | 0.49 | 0.58 | 0.58 | 3.2 | 3.8 | 3.8 | 1.3322 | 1.3310 | 1.3321 | 5.2 | 5.3 | 5.9 |
| F2 | 0.53 | 0.58 | 0.49 | 3.5 | 3.8 | 3.2 | 1.3320 | 1.3314 | 1.3326 | 5.1 | 5.3 | 5.7 |
| F3 | 0.45 | 0.51 | 0.50 | 3.0 | 3.4 | 3.3 | 1.3322 | 1.3320 | 1.3318 | 5.1 | 5.3 | 5.6 |
| F4 | 0.45 | 0.48 | 0.56 | 3.0 | 3.2 | 3.7 | 1.3314 | 1.3312 | 1.3315 | 5.1 | 5.4 | 5.1 |
| F5 | 0.46 | 0.56 | 0.58 | 3.0 | 4.0 | 3.8 | 1.3334 | 1.3312 | 1.3322 | 5.1 | 5.3 | 5.1 |
| F6 | 0.46 | 0.38 | 0.55 | 3.0 | 2.5 | 3.6 | 1.3326 | 1.3312 | 1.3328 | 5.0 | 5.3 | 5.7 |
| F7 | 0.45 | 0.49 | 0.55 | 3.0 | 3.2 | 3.6 | 1.3315 | 1.3312 | 1.3324 | 5.1 | 5.5 | 5.8 |
| Mean | 0.47 | 0.51 | 0.54 | 3.1 | 3.4 | 3.6 | 1.3322 | 1.3313 | 1.3322 | 5.1 | 5.3 | 5.6 |
| Mean of all fractions | 0.51 | | | 3.4 | | | 1.3320 | | | 5.3 | | |

Each value in the table is a mean of three replicates.

Table(3)shows that the equivalent weight of A.*Seyal* fractions was ranged in(1224.49-1428.57) and the mean value was (1329.01).The equivalent weight of A.*Senegal* fractions was ranged (1132.08 to 1304.48) and the mean value was (1166.16) , A.*Polyacantha* fractions was found to be in the range (1111.11-1276.60) and the mean value was (1206.09). Analysis of variance showed insignificant difference ($p \leq 0.05$) for all *acacia's* gum fractions. It was found that the mean value of equivalent weight of A.*Seyal* fractions has higher value (1329.01) than that of A.*Polyacantha* fractions (1206.09) and A.*Senegal* fractions (1169.27), respectively. It illustrated that the mean value for equivalent weight of the seven *acacia's* gum fractions is (1234.75).It is less than the result (1583.20) reported by (Elgaili et al .,2015). Concerning the presence of uronic acids in all gum fractions indicated that all sample fractions have acidic sugar (Glucuronic acids). Table 3 illustrated that the uronic acid content of A.*Seyal* fractions was found to be in the range (13.6-15.8%) and the mean value was (14.7%).The uronic acid content of A.*Senegal* gum fractions was ranged (16.5-18.8%) and the mean value was (17.1%). As for A.*Polyacantha*, the uronic acid content was found to be in the range (15.2-17.5 %) and the mean value was (16.1%). Analysis of variance showed insignificant difference ($p \leq 0.05$) for all fractions of *acacia's* gum. It was found that the mean value of uronic acid content of A.*Senegal* fractions (17.1%) has highest value compared to A.*Polyacantha* (16.1%) and A.Seyal (14.7%). It illustrated that the mean value for uronic acid of the seven *acacia's* gum fractions is (16.0).It is greater than the result (12.26) reported by (Elgaili et al ., 2015). Table (3) shows the reducing sugar of the A.*Seyal*, A.*Senegal* and A.*Polyacantha* fractions .It was found that the range of reducing sugar content of A.Seyal was in the range (0.12 - 0.14%) and the mean value was (0.14%) .The reducing sugar content of the A.*Senegal* was ranged (0.07-0.09%) and the mean value was (0.08%), and for A.*Polyacantha* fractions the reducing sugar was found in the range (0.12-0.14%) and the mean was (0.13%). Analysis

of variance shows insignificant difference ($p \leq 0.05$) of all fractions. It was observed that the mean of reducing sugar of the *A.Seyal* fractions (0.14%) which was highest compared to *A.Polyacantha* (0.13%) and *A.Senegal* (0.08%).The presence of reducing sugar gives evidence to the reducing power (free reducing group) of this type of gum. It was observed that the mean values of *A.Seyal* fractions (0.14%) and *A.Polyacantha* fractions (0.13%) they have approximately same values of reducing sugar. It was observed that the mean value of reducing sugar content of *A.Senegal* fractions (0.08%) was lowest among the entire fractions.

Table 3. The analytical data of *A.Seyal, A.Senegal and A. Polyacantha* gum fractions

| Fraction No. | Equivalent weight | | | Uronic Acid% | | | Reducing sugar% | | |
|---|---|---|---|---|---|---|---|---|---|
| | *A.Seyal* | *A.Senegal* | *A.Polyacantha* | *A.Seyal* | *A.Senegal* | *A.Polyacantha* | *A.Seyal* | *A.Senegal* | *A.Polyacantha* |
| F1 | 1333.33 | 1304.48 | 1276.60 | 14.6 | 18.8 | 15.2 | 0.13 | 0.07 | 0.12 |
| F2 | 1340.35 | 1153.85 | 1111.11 | 14.9 | 16.8 | 17.5 | 0.14 | 0.08 | 0.13 |
| F3 | 1276.60 | 1132.08 | 1153.85 | 15.2 | 17.1 | 16.8 | 0.14 | 0.08 | 0.13 |
| F4 | 1428.57 | 1132.08 | 1224.49 | 13.6 | 17.1 | 15.8 | 0.12 | 0.08 | 0.13 |
| F5 | 1395.35 | 1132.08 | 1200.00 | 14.0 | 16.8 | 16.2 | 0.14 | 0.08 | 0.13 |
| F6 | 1224.49 | 1176.47 | 1276.60 | 15.8 | 16.8 | 15.2 | 0.14 | 0.09 | 0.13 |
| F7 | 1304.35 | 1132.08 | 1200.00 | 14.9 | 16.5 | 16.2 | 0.14 | 0.09 | 0.14 |
| Mean | 1329.01 | 1166.16 | 1206.09 | 14.7 | 17.1 | 16.1 | 0.14 | 0.08 | 0.13 |
| Mean of all fractions | 1234.75 | | | 16.0 | | | 0.12 | | |

Each value in the table is a mean of three replicates.

Cationic composition of *acacia's* gum fractions was determined using atomic absorption spectrophotometer, represented in table (4). The results show that iron (Fe) value of A.Senegal fractions was highest (8.0ppm) compared to *A.Polyacantha* and A.Seyal fractions (5.5147ppm), (4.8199ppm) respectively. Sodium (Na) value of *A. Senegal* fractions (35.3741 ppm) was highest than that of *A.Polyacantha* fractions (22.7647ppm) and *A. Seyal* fractions (20.5184ppm) respectively. It observed that *A.Senegal* fractions have higher value of magnesium (Mg) (22.5344 ppm) compared to *A.Polyacantha* fractions (19.99726 ppm) and *A.Seyal* fractions (20.3467 ppm) respectively. Manganese (Mn) value of *A.Senegal* was highest (4.932 ppm) while that of *A.Seyal* and *A.Polyacantha* have approximately the same value (1.5520ppm), (1.5778) respectively. Lead (Pb) was the highest value of *A.Senegal* (0.58 ppm) in comparison with *A.Polyacantha* (0.5061ppm) and *A.Seyal* (0.2222 ppm). The content of potassium (K) was found (34.00 ppm) of *A.Senegal* and (30.7539ppm) for *A.Seyal*, *A.Polyacantha* was (28.2541 ppm). Zinc (Zn) value in *A.Seyal* was (0.089 ppm), *A.Polyacantha* (0.5268 ppm) and (0.2680 ppm) for *A.Senegal*. The copper (Cu) content was highest in *A.Senegal* (0.0712 ppm) than *A.Polyacantha* (0.0503 ppm) and A.Seyal (0.0027 ppm). It observed that sodium (Na) has highest value in the seven different *acacia's* gum fractions. It is also revealed that the *acacia's* gum fractions may be a source of iron (Fe) and this indicates the nutritive values of these gums.

| Fraction | Mn | Zn | Cu | Fe | Na | K | Pb | Mg |
|---|---|---|---|---|---|---|---|---|
| *A.Seyal* | 1.5520 ppm | 0.0892 ppm | 0.0027 ppm | 5.5147 ppm | 20.5184 ppm | 30.7539 ppm | 0.2222 ppm | 20.3467 ppm |
| *A.Senegal* | 4.9320 ppm | 0.2680 ppm | 0.0712 ppm | 8.0010 ppm | 35.3741 ppm | 34.000 ppm | 0.5785 ppm | 22.5344 ppm |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *A.Polyacantha* | 1.5778 ppm | 0.5268 ppm | 0.0503 ppm | 4.8199 ppm | 22.7647 ppm | 28.2541 ppm | 0.5061 ppm | 19.9726 ppm |
| Mean | 2.6873 ppm | 0.2947 ppm | 0.0414 ppm | 6.1119 ppm | 26.2191 ppm | 31.0027 ppm | 0.4356 ppm | 20.9512 ppm |

Table( 4): The minerals content of *A.Seyal, A.Senegal and A. Polyacantha* gum fractions.
Each value in the table is a mean of three replicates.

UV absorptions spectra of gum fractions (Fig 1, 2, 3). It was found that the *A.Seyal* fraction was showed maximum absorptions points (1.60) where as *A.Senegal* (1.49) and *A.Polyacantha* (1.49) fractions have the same absorptions points. This may prove to be as a diagnostic feature and therefore an apparent analytical parameter of *the acacia's* gum fractions.

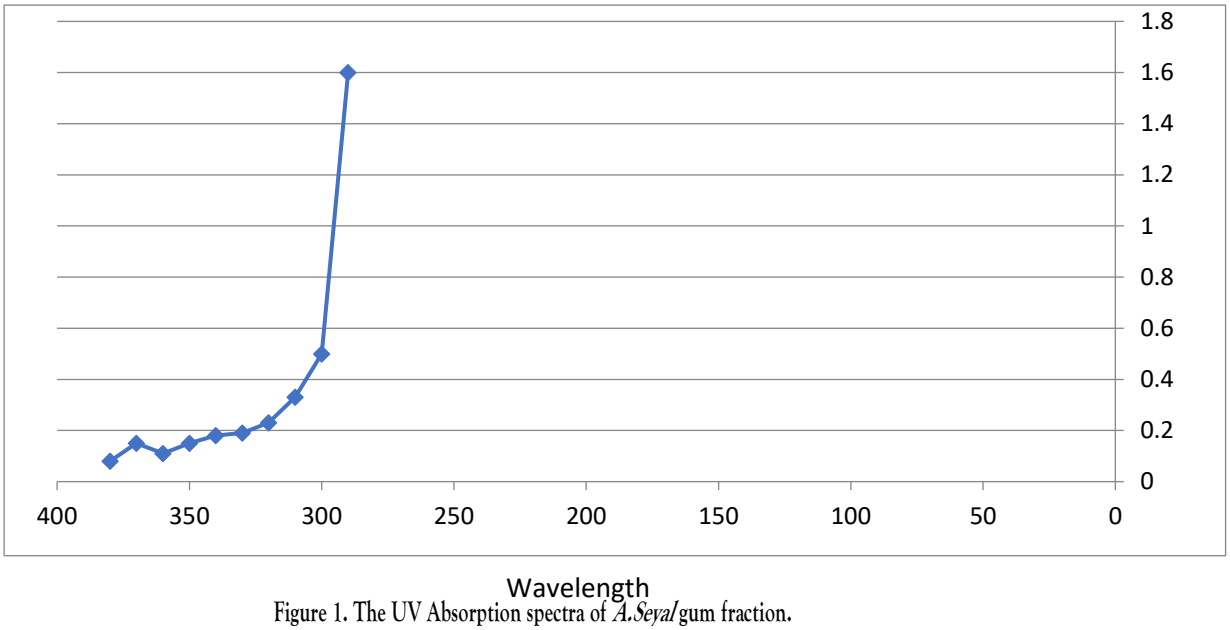


Figure 1. The UV Absorption spectra of *A.Seyal* gum fraction.

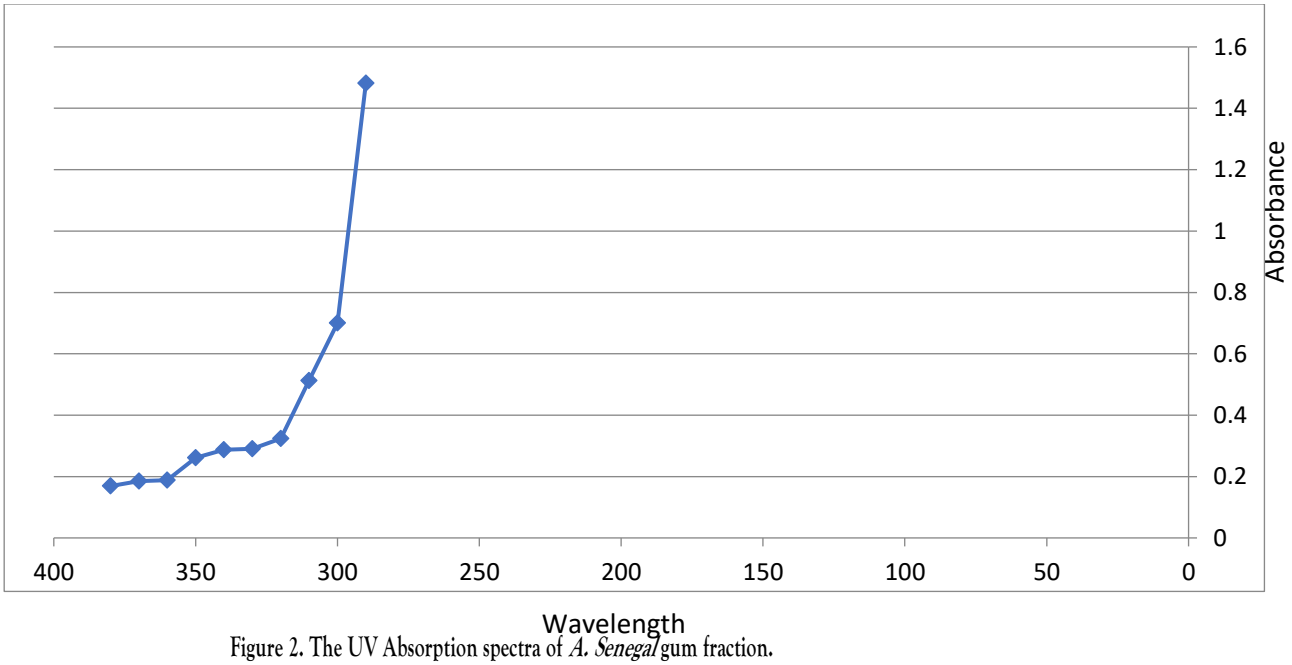


Figure 2. The UV Absorption spectra of *A. Senegal* gum fraction.

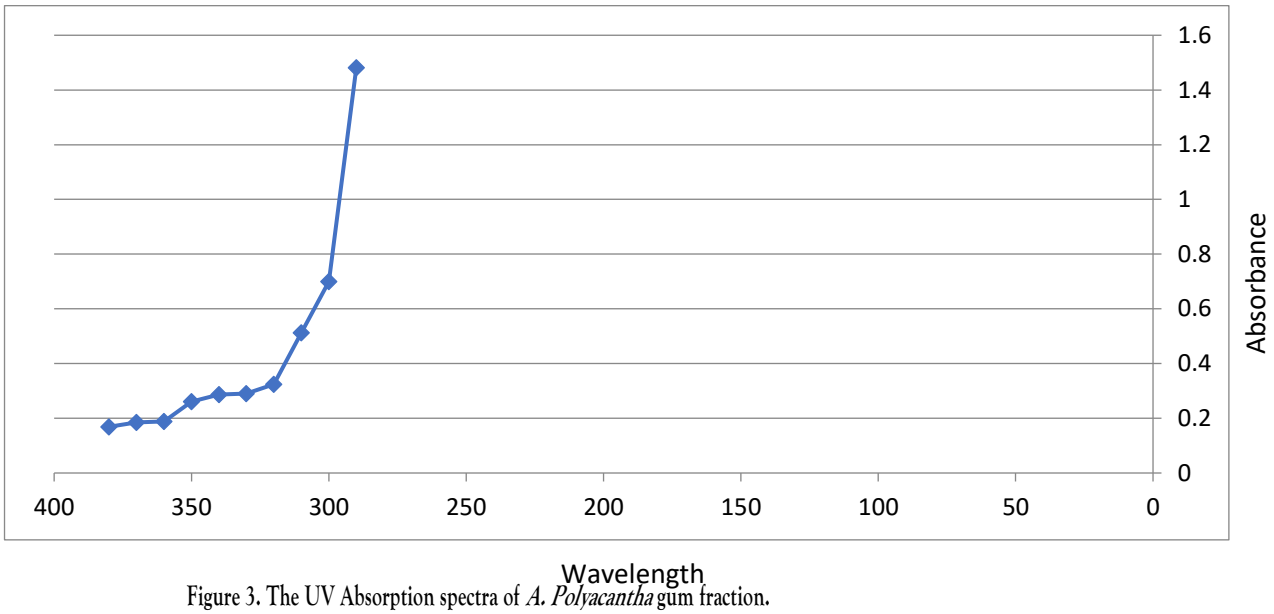


Figure 3. The UV Absorption spectra of *A. Polyacantha* gum fraction.

Thus, it has been indicated that the gum arabic is a hetropolymolecular polymer consisting of molecules that differ in their sugar composition and in their mode of linkage as well as in molecular mass. For all data presented here from physicochemical analysis explained that the fractionated gums differed in several parameters.

## 5-CONCLUSION

We have been succeeded to obtain different analytical data and physicochemical properties of some *Acacia's* gum (*A.Seyal, A.Senegal and A.Polyacantha*) fractions obtained by fractional precipitations using water as a solvent. This fractionation of gum confirmed the hetropolymolecular nature of the material, such results it agrees with (Anderson et al.,1968) and (Osman et al .,1993).Such data obtained from the physicochemical analysis indicated that the fractionated gum were insignificantly difference ($P \leq 0.05$) in several aspects of the gum fractions, but they differ significantly ($P \leq 0.05$) in their moisture, ash, and in protein content.

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