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The Emulsifying Stability of Gum Arabic using the Local Sesame Oil Obtained from AL-BAHA Area

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***Abstract*— Emulsifying stability of gum arabic(*Acacia Senegal*) has been studied using local sesame oil obtained from EL-BAHA area Kingdom of Saudi Arabia . The effects of different factors have been studied(concentration ,temperature, stirring time and blending).**

It has been observed that gum Arabic showed good results the of emulsifying stability(1.00347). It could be concluded that increasing of concentration(1% to 4%) increases the emulsifying stability of all the gum samples(1.00222 to 1.0393).

The rising in temperature (30 Cº- 60Cº) (1.01727862-0.99570815) will decline the emulsifying stability of the gum.

Increasing the time of stirring (1 – 4m), it will increase the emulsifying stability (1.00347 to 1.05682).

Blend of *A Senegal and. A. Polyacantha* gums that contain 50% l

***A Senegal and* 50% *A. Polyacantha* was found to possess approximately better emulsifying properties (0.99241) compared to parent *Senegal* gum (1.00347).**

The data obtained it can be used for characterization of this gum. These values of emulsifying stability, can serve as a benchmark for other workers to study another functional properties such as emulsifying activity, foaming capacity and encapsulating power.

Keywords—Functionalproperties; emulsifyingstability;Acacia Senegal ; belend.

I. INTRODUCTION

Plant gums are organic substances obtained as exudation from trunks, or, branches of trees, spontaneously or after mechanical injury, of the plant by incision of the bark, or by the removed of branch, or after invasion by bacteria or fungi[1]. The term gum often describes materials which affect the sense of touch, taste and sight ,in measure summed up as property of "gummosis" which is difficult to define but visual and manual examination of the material may cause the absorber to call it gum[2].

Gum refers to any polysaccharide that is dispersible in water to give viscous solution, gels or colloidal dispersions[3]. Generally gums are long chain high molecular weight polymers that dissolve or disperse in water to give thickening or gelling effect and exhibit related secondary functional properties, such as emulsification, stabilization, and encapsulation[4].Gums, or hydrocolloids, are mainly long – chain, straight to branched polysaccharides that contain hydroxy groups that can bond to water molecules. These chains consist of $2X10^3$ to 10^4 monosaccharides units. The sugar monomers can contain linked side units, or substituent groups, such as sulphates, methyl ethers, esters and acetals[5] .Gums composed mainly of C, H, O and N elements, and the acidic gums (e.g. gum arabic) contain mainly Ca, Mg, Na, and Fe, as cations[6].

Emulsions are chemical mixtures of liquids that are immiscible under ordinary conditions, and which may be separated into two layers on, standing, heating, and freezing, by agitation or the addition of other chemical[7]. The emulsifying agents act as surface-active agents, which when added to an emulsion it would increase its stability by interfacial action. Each emulsifying agent depends on its action on different principle to achieve stable produced.

Gum Arabic is used to stabilize flavor oil emulsions in the dried food mixes (such as soup, cakes, … etc) and in the soft drinks industry, where the gum is required to stabilize a concentrated oil emulsion (about20%) for long periods and also to continue to stabilize following dilution prior to bottling**[8]** .Emulsifying agent is usually along – chain organic compound that has protruding chains that are soluble in oil (lysophilic) as well as side chains or groups that are soluble in water (hydrophilic). Thus one portion of each molecule dissolve in the water phase while another portion dissolves in the oil phase and the main chain forms a link or bridge to keep both phases in position and there by emulsified. Gum arabic produces highly stable emulsions making it very useful in the preparation of oil in water food flavor emulsions particularly for citrus oils[9]. Some believe that gums are not true emulsifiers.

Randall, et.al[10] studied the effect of heat on the emulsification action, stability of the gum followed by changes in the gel permeation chromatography (GPC) profile of the gum. He concluded that heating at 100C for 3 hrs, results in a decrease in the intensity of the high molecular mass peak with a corresponding increase in the intensity of the lower molecular mass peaks. Continued heating leads to further loss of the high molecular mass fraction and loss in the emulsifying stability of the gum.

Dickinson[11]studied the surface and emulsifying properties of six *Acacia* gum samples. They concluded that there is no simple relationship between nitrogen content and emulsifying properties of the gum samples, from different *Acacia* species, depended not only on their total protein content, but also on the distribution of the protein/peptide between the low and high molecular weight fractions, and on the molecular accessibility of the protein/peptide for adsorption. In common with most emulsifiers, the arabinogalactan protein (AGP) complex has a hydrophobic region (protein) and hydrophilic region (carbohydrate). During the formation of oil in water emulsions the protein portion (arabinogalactan) protrudes into the water phase[12]. The bulk of gum arabic in the form of free AG can improve stability by increasing viscosity of the water[13].

Plant gums are organic substances obtained as exudation from trunks, or, ``branches of trees, spontaneously or after mechanical injury, of the plant by incision of the bark, or by the removed of branch, or after invasion by bacteria or fungi[13].

The main area of the Gum Arabic occurrences is the central parts of the Sudan, where a continuous belt extended from east to west .In the western sand plains of Kordofan and Darfur the *Acacia Senegal var Senegal* species is uniform and is found in pure stands, giving the Sudan the advantages of being the biggest producer and exporter of best qualities [15].*Acacia Senegal* trees are now planted each year in selected areas of the Sudan to stabilize soil erosion, nitrogen fixation, therefore gum Arabic production is important ecologically and economically[16].

The solubility and viscosity of the gum are the most fundamental properties, which make it unique amongst polysaccharides, the majority of gums dissolve in water at different concentrations, and such properties of gums are exploited in many applications. Gum Arabic is extensively used in the confectionary industry because it has ability to prevent crystallization of sugar and also because of its thickening effect. It is used to as a glaze in candy products and as a component of chewing gum, cough drops and candy lozenges[17].Gum Arabic is used in frozen products , such as ice creams, ices and sherbets as stabilizer[18,19]. Gums by their high viscosity in solutions and inability to crystallize, are particularly suited to serve in food stuff as: thickeners for beverages, stabilizers for oil and water emulsions and as wider application where function is to prevent agglomeration and setting out of minute particles. Gum Arabic has found use as stabilizer of frozen dairy products such as ice cream and sherbet[20]. Due to the high water holding properties of the gum; the gum imparts a smooth texture to the frozen product by inhibiting the formation of ice crystals[21]. The gum used as flavor fixative, the gum forms a thin and impenetrable film around the flavor particle protecting it from oxidation, evaporation and absorption moisture. 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 [22].The Objectives of this study is to find out the emulsifying stability of gum arabic, the effect of concentration ,temperature stirring time and the effect of blending on emulsifying stability .

II. MATERIALS AND EXPERIMENTAL TECHNIQUES

Authentic samples of *A.Senegal* gum were collected as natural exudates nodules from *A. Senegal* trees by the author with the help of forestry officers of ministry of Agriculture and forestry, and with the help of Gum Arabic company staff from Sudan in the season 2012/2013.Gum nodules were dried at room temperature, then cleaned by hand to ensure they were relatively free from sand, dust and bark impurities, then ground, sieved through sieve No. 16 and kept in a labeled container for analysis.

Emulsifying stability was determined according to method reported by [23]. Gum solution (20%) was mixed with oil in a ratio of 80: 20 W/W, respectively, using a blender for 1 minute at 18,000 rpm. The mixture was diluted in a ratio of 1:1000 and it was read at λmax 520nm using Spectrophotometer (serial. NO,303648, Apel .Co .LTD. PD-303. Japan) . Then the second reading was taken after 1hour. The emulsifying index is percentage or ratio of the emulsion capacity to zero time of emulsion capacity. Emulsifying stability was calculated as follows:

Emulsifying stability(E.S) = reading after 1 hour/first reading

III. RESULTS AND DISCUSSION

The stability of *Acacia Senegal* gum emulsion was determined .The mean values of the emulsifying stability of the gum is(1.00347) . Different factors affecting the emulsifying stability of the gum solutions have been observed , such as concentration , temperature ,time of stirring (minutes) and blending .

A. The effect of concentration on emulsifying stability

Table 1 **(Fig.1**) shows the effect of concentration on the quality of emulsion produced using *A.Senegal* gum. The emulsifying stability of the gum falls in the range (1.00222 – 1.0393). It's observed that emulsifying stability increases with increasing of concentration. The higher range of emulsifying stability of *A. Senegal* may be attributed to the strong correlation between the proportion of protein in the gum and its emulsifying stability[24,25].

Table 1. The effect of concentration on the emulsifying stability of *Acacia Senegal* gum.

Concentration (%)	First Reading	Reading after 1hr	Emulsifying Stability
1.0	1.354	1.357	1.00222
2.0	1.474	1.478	1.00271
3.0	0.864	0.867	1.00347
4.0	1.094	1.137	1.0393

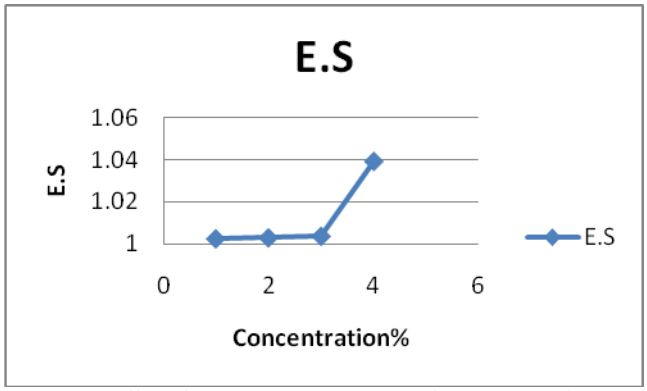

Fig .1. The effect of concentration on the emulsifying stability of Acacia Senegal gum

B. The effect of temperature on emulsifying stability

Table**2** (**Fig.2)** illustrates that the mean values of the emulsifying stability for *A.Senegal* at30C, 40C,50C and 60C 8 respectively. It is observed that the temperature has an adverse effect on the emulsifying stability, and this because the emulsifying stability depends on the protein in the gum, which may be affected by temperature, which may leads to denaturation of the component of protein.

Table .2 .The effect of temperature on the emulsifying stability of *Acacia Senegal* gum

Temperature c˚	First Reading	Reading after 1hr	E.S
30 c	0.463	0.471	1.01727862
40 c	0.462	0.466	1.01515152
50 c	0.460	0.466	1.01304348
60 c	0.466	0.464	0.99570815

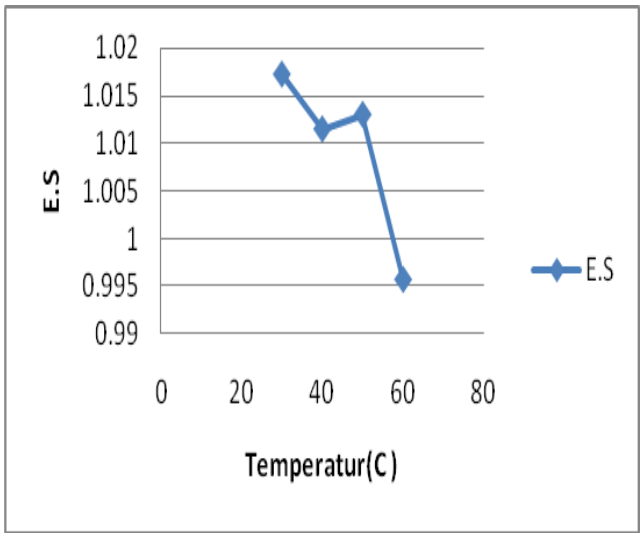

Fig. 2. The effect of temperature on the emulsifying stability of *Acacia Senegal* gum .

C. The effect of stirring time on emulsifying stability (minutes)

Table **3 (Fig. 3)** illustrates the variation of emulsifying stability for *A.Senegal.* It is evident that the emulsifying stability increases with increasing time of stirring. This may be due to the formation of homogenous emulsion, which shows the complete adsorption for protein at the surface of the oil.

Table 3. The effect of stirring time on emulsifying stability (minutes).

Stirring Time(min)	First Reading	Reading after 1hr	E. S
1M	0.864	0.867	1.00347
2M	0.684	0.687	1.00439
3M	0.684	0.691	1.01023
4M	1.144	1.209	1.05682

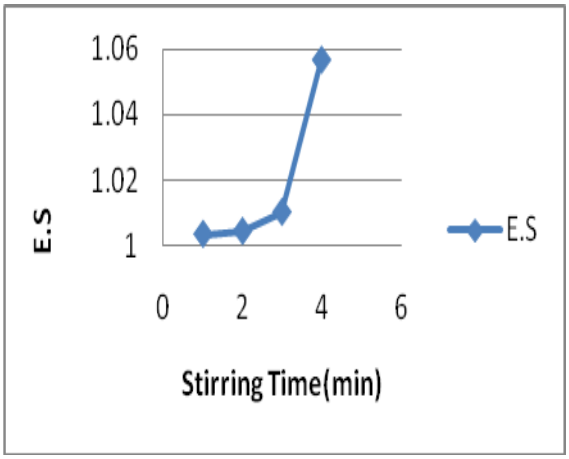

Fig.3. The effect of stirring time on emulsifying stability (minutes)

D. The effect of blending on the emulsifying stability

It is observed from table 4 (Fig.**4**) that the emulsifying stability increases for a blend of (50%H +50%P) and decreases for a blend of (20%H +80%P). The former found to possess less emulsifying properties compared to the parent *Senegal* gum(1.00347). It has been illustrated that the high molecular weight protein rich fraction of the gum is preferentially adsorbed to the oil phase during emulsification process. This may be also considered as additional evidence to the suggestion that both the high molecular mass and the protein content in the gum are influential in the emulsification of oil in water emulsions[11].

Table.4 The effect of blending on the emulsifying stability of Acacia Senegal gum in mixed with Acacia Polyacantha gum.

Blending %	First Reading	after 1hr Reading	E. S
80 Pol + 20 Sen	0.369	0.354	0.95935
60 Pol + 40 Sen	0.752	0.743	0.98803
50 Pol + 50 Sen	0.922	0.915	0.99241
40 Pol + 60 Sey	0.795	0.783	0.98491
20 Pol + 80 Sey	0.962	0.954	0.99168

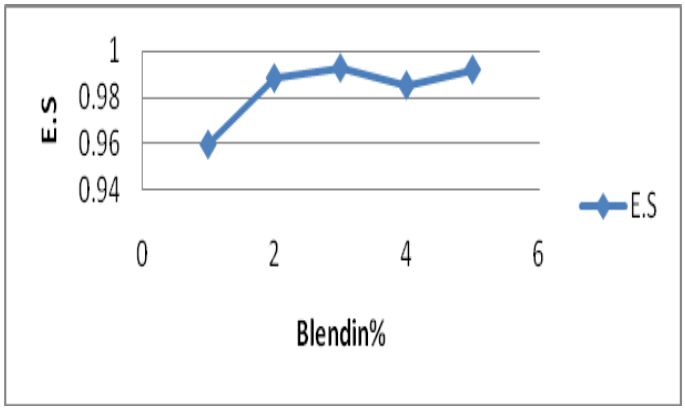

Fig. 4. The effect of blending on the emulsifying stability of Acacia Senegal gum in mixed with Acacia Polyacantha gum.

CONCLUSION

It has been observed that the results of emulsifying stability of *Acacia Senegal* showed good results . It could be concluded that increasing of concentration (1% to 4%) increases the emulsifying stability of all the gum. Blend of *A Senegal and. A. Polyacantha* gums that contain 50% *A Senegal and* 50% *A. Polyacantha* was found to possess approximately better emulsifying properties (0.99241) compared to parent *Senegal* gum (1.00347).Increasing the time of stirring (1 – 4m), it will increase the emulsifying stability (1.00347 to 1.05682). The rising in temperature (30 Cº- 60Cº) (1.01727862- 0.99570815) will decline the emulsifying stability of the gum. The data obtained it can be used for characterization of this gum. These values of emulsifying stability, can serve as a benchmark for other workers to study another functional properties such as emulsifying activity, foaming capacity and encapsulating power.

Recommendations

(1)Data obtained from the study can be used for setting specification of this gum.

(2)Intensive research is needed to study another functional properties i.e emulsifying activity, foaming capacity and encapsulating power.

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