Analytical Study of Acacia senegal and Acacia seyal gum

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SUMMARY

Powdered gum Arabic from *Acacia senegal* (L) Wild and gum talha from *Acacia seyal* Del were subjected to various analytical studies including total ash %, loss on drying %, Sulphated ash %, acid insoluble ash %, water insoluble residues % together with heavy metal determination such as Arsenic, lead, Copper and Zinc. The presence or absence of starch, dextrin, sucrose, fructose, tannins, agar tragath and others were also considered with an aim of evaluating the quality of locally produced commercial water soluble gums. The data obtained were promising and in most cases comparable to the internationally accepted ones.

1.0 INTRODUCTION

Acacia plants are characteristic of the African Arid and Semi-Arid lands. The plants are noted for their slow growth but have vital numerous uses. The single most important valuable product from the plant is Acacia gum. This is a term which embraces exudations from varieties or species of Acacia plants. The gum is mostly collected from important gum producing acacia's particularly Acacia senegal (L) Wild and A.seyal Del (Ayling, 1985). The product appears on the market as irregular tears of various sizes or as a transparent amorphous powder with colour varying from white to yellow-brown and even darker. Colour influences the price greatly with the highest price being commanded by practically colourless material (Ibid, 1985).

Gum arabic is widely used in high grade food applications such as confectionery and baking preparations because of its stabilizing and emulsifying properties. It is also used in soft drinks as a suspension, stabilizing or colouring agent. Other uses include preparations of flavouring products such as micro-encapsulated citrus flavours, pharmaceuticals especially as tablet coatings or binders, and a range of mainly non-food uses such as lithography, adhesives, textiles, paper making. Gum talha

(Acacia seyal gum) find applications mainly in non-food uses.

The chemical characterisation of the test article used in toxicological studies of gum arabic from A. senegal (L) Willd is a fair and an average representative to the established international standards of identity and purity criteria (Anderson et al, 1983). Gum arabic is used in food additives and confectionery ingredients if its solution is optically laevorotatory. This is an established criteria and identity of exudation from A. senegal (L) Willd and other related species (FAO, 1982). This disqualifies the use of other commercially vital acacia gum, gum tahla (A. seyal Del) which shows positive optical rotation ($+55^{\circ}$) Anderson et al, 1963). Anderson (1978) pointed out that the two species are in different sub-divisions of the genus Acacia. A study on the safety of gum arabic as food additive has been reviewed (Anderson, 1986).

Natural gum contains yeast, fungi, mould and other microorganisms, some are of considerable tolerance to heat treatment. It is therefore recommended that thermal or sterilization treatment is necessary to ensure the products meet established microbiological standards for pharmaceutical applications (Ibid 1986). Data for the liability of peripheral monossacharides in gum arabic and gum tahla and other Acacia exudates originating from Antohydrolysis and mild acid hydrolysis has been

computed (Anderson et al, 1970). A year earlier Anderson et al (1969) found Acacia gum to contain nitrogen with values ranging from 0.1% (low) to 7-9% (high). The presence of nitrogen symbolises the existence of amino acids, peptides or proteins. Anderson and Stoddart (1966) reported that precipitates from antohydrolysis of the gum were found to be proteineous. Exudates from A. polycantha and A. seyal (Anderson 1986, Anderson and McDougall, 1987) subjected to Smith degradation process yielded amino acid in peripheral chain terminating positions in the gum macromolecule with Amino acids located more extensively at the branched macromolecular framework. Isolation of a highly molecular weight fraction of high nitrogen and low molecular weight fraction with no nitrogen present signifies subunits interpersed with peptide linking units in gum arabic. Heating and treatment with proteases reduces the emulsification efficiency (Anderson 1986).

This paper presents the analytical studies on available commercial gums i.e. A. senegal and A. seyal.

2.0 Materials and Methods.

2.1. Materials

Gum samples from the two Acacia species were mainly collected from Isiolo District and were divided into three categories namely; A, B and C. Sample A represents gum from A.

senegal collected directly from the plant while samples B and C represent gums from A. senegal and A. seyal respectively that were bought from businessmen in Isiolo town.

2.1.1 Grading and handling

The samples were sorted out into three grades namely, 1, 2 and 3 depending on colour and the various grades separately packed into polythene bags with maximum access to light and the containers precluded from contamination of the contents with impurities. The samples were thereafter ground to fine powder using a mill and stored in vial bottles for future analysis.

2.2.0 Methods

Identification and purity determination tests of the gums were done using known procedures extracted from the following literature ;

(i) British Pharmacopoeia Volume IV 1986.

(ii) European Pharmacopoeia, Exp. Volumes Food and Agricultural Organization

and World Health Organisation 1980.

(iii) United States Pharmacopoeia 11th decimal.

(iv) Food Chemical codex Volume XI 1982.

(v) Indian Standard specifications for gum arabic food grade 1973.

(vi) Industrial gums 1936.

(vii) Water insoluble gums 1958.

Heavy metal determination were carried out using a Varian Techtron Atomic Absorption spectrophotometer. The standard solutions were prepared for the elements in question and their individual aspirations and absorbances in table 1 were used to plot straight line curves from which the concentrations of the elements were found and calculated as appear in table 2.

3.0 Results and Discussions.

3.1.0 Description and Physical Properties

3.1.1.0 Physical Properties

3.1.1.1 Unground Acacia

Form - Appears as lumps.

Colour - grade 1 - White and translucent.

grade 2 - Light yellowish.

grade 3 - Yellowish-brown or dark brown.

3.1.1.2. Powdered Acacia

Form - Powder.

Colour - grade 1 - White.

grade 2 - Whitish to light yellow.

grade 3 - Yellowish.

Solubility. Grades 1 and 2 are soluble in twice its own weight of water at room temperature. The resulting solution was flowing readily and acid to litmus paper. Grade 3 was also soluble in water with residues settling at the bottom of the container, slight warming increased the solubility for all the grades. However, all the grades were found to be insoluble in organic

solvents such as ethanol, methanol, ethylacetate, chloroform, petroleum ether and n-hexane.

Gum samples were found to vary in colour ranging from white to dark brown with the bought ones darker in colour than the collected lots in most cases. The samples were soluble in twice their weights of water and acid to litmus paper which is a fundamental physical characteristic of Acacia gums. The ability of the gum senegal to show laevorotatory (-15^{o} to -18.5^{o}) while tahla gum to show dextrarotatory (49.5^{o}) in a polanscope polarimeter further identified the gums. The latter property of gum senegal makes it suitable as food additive. Relative densities of the gums were found to vary between 1.30 and 1.50 with higher values recorded for samples dried at $100^{o}C$ and above. Moisture content for the gum senegal was found to be within the required limit (13-15%) (Mantell, 1958) while for gum tahla were higher (15%). This makes the gum tahla difficult to crush, is soft and more viscous.

Contents of total ash, sulphated ash, acid insoluble matter, water insoluble residues and nitrogen were determined in the gum samples and their values given in table 2. Values recorded were in most cases found to be within the range accepted by international standards in various literatures. Total ash for samples B and C, grade III's were higher than the required values and this is attributed to contaminants and sample handling techniques. The same reason can be extended to the recorded high values for sulphated ash % for C and water insoluble residues for grade III's samples.

The absence of dextrin, starch, sucrose, fructose, tannins, agar, traganth, cerasin and bassorin which if present lower gum quality shed light that the locally produced gums could be a substitute to the imported ones.

Table 1 Absorbance of stands solutions

Element	Standard	Absorbance
Cu	0.5	0.009
	2.0	0.038
	4.0	0.077
Zn	0.5	0.010
	1.0	0.020
	2.0	0.040
	4.0	0.031
Pb	0.5	0.006
	1.0	0.016
	2.0	0.034

Table 2 PURITY CRITERIA

	Actual experimental results						BP 1980, Exp Vols FAC/WHO USP XIX I & II 1978 1975 (Suppl.) 1969, 1977	F.C.C. 3rd E.C.C. Edition
	Acacia senegal			Acacia seyal				
	Grades			Grades				
	I	II	III	I	II	III		
ss on drying % aximum	A 14.32	14.33	14.19	C 15.16	15.49	15.12	15.0	15.0
	B 14.13	14.46	14.73					
otal ash % aximum	A 4.134	3.826	3.81					
	B 4.106	4.23	5.859	C 3,8495	3,855	4.6975	4.0	4.0
ulphated ash % aximum	A 4.155	4.079	5.199	C 5.202	5.166	5.061	5.0	5.0
	B 5.73	4.7232	4.447					
cid insoluble sh % maximum	A 0.20	0.41	0.85	C 0.863	0.812	1.310	0.5-1.0	1.0
	B 0.512	0.481	0.63					
ater insoluble esidues	A 0.021	0.04	0.07	C 0.045	0.053	0.065	0.05	0.05
	B 0.046	0.052	0.095					
pecific rotation n water	A -15.1	-16.0	-15.4	+49	+49.5	+48.6	0.5-1.0	1.0
	B -15.3	-17.0	-18.50					
pecific gravity	A 1.33	1.43	1.47	C 1.40	1.46	1.39	1.30-1.50	1.30-1.50
	B 1.38	1.42						
extrin and tarch	Not detected			Not detected			Not detectable by colour	Test with iodine
ucrose and ructose	Not detected			Not detected			Not detectable	
anins	A Not detected			C Not detected			Not detectable by Ferric chloride test	Not detectable by Ferric chloric e test.
	B Not detected							
	D Not detected							
gar and raganth	A Absent			C Not detected			Not detectable	Not detectable
	B Absent							
	D Absent							

	Actual experimental results						BP 1980, Exp Vols FAO/WHO USP XIX I & II 1978 1975 (Suppl.) 1969, 1977	F.C.C. 3rd E.C.C. Edition
	Acacia senegal			Acacia seyal				
	Grades			Grades				
	I	II	III	I	II	III		
itrogen %	A 3.5	3.8	4.0	C 5.0	4.8	3.96	0.1-5.0	0.1-5.0
	B 2.9	3.1	3.4					
rsenic % maximum	A 0.35	0.41	0.36	C 0.45	0.60	0.53	0.5 ppm	0.5 ppm
	B 0.49	0.57	0.63					
ead % maximum	A 6.20	4.877	4.595	C 8.798	7.60	9.339	1.7 ppm	1.7 ppm
	B							
opper % maximum	A 3.40	2.599	1.399	C 4.599	4.60	5.957	10 ppm	10 ppm
	B 3.622	3.398	4.598					
inc % maximum	A 4.00	5.243	0.999					
	B 2.786	2.998	1.00	C 2.999	2.00	1.986	10 ppm	10 ppm

Note

A - Acacia senegal collected from Central Isiolo Division

B - Acacia senegal bought in Isiolo town

C - Acacia seyal bought in Isiolo town

BP - British Pharmacopoeia

EP - European Pharmacopoeia

USP - United States Pharmacopoeia

F.C.C. - Food Chemical Codex

F.A.O./WHO - Specifications prepared by joint Food and Agricultural and World Health Organisations on Food.

Naturally occuring gums contain heavy metals which are generally in trace quantities. Therefore for gum to be used in foods and pharmaceuticals a given level of these elements is required. Atomic Absorption Spectrophotometer analysis of elements, Copper, Zinc, Arsenic and lead were carried out and values recorded for Zinc, Copper and Arsenic were found to be within the range required. However, values for lead were found to be slightly higher. Since there are no industrial activities around where the gums were collected that could precipitate lead to the environment neither is the area soil noted for the high level of lead content, the probable reason for this high lead content could be due to contamination due to platinum dish used during analysis.

Conclusions and recommendations

From the study one can conclude that locally produced gums i.e. gum arabic is of good quality to compete the imported ones. Gum collection was centred in Isiolo district and this might not give a true picture of quality for other areas were not