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CHARACTERIZATION AND UTILIZATION OF GUM FROM*ACACIA CATECHU(SHA)*

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Abstract

Gum arabic or gum acacia is the oldest and best known of natural gums obtained from different acacia species. This research was focused on characterization and utilization of purified gum from *Acacia catechu* (Sha), found in Sagaing Region of Upper Myanmar. Raw gum was manually collected in Summer, and purified by dissolving, filtration, and decolourization using hydrogen peroxide and drying the gum solution in vacuum dryer at 70ºC and 650 mm Hg. Solubility test, chemical tests and hydrolysis products test by thin layer chromatography were conducted to identify the purified gum. For the assessment of the quality of purified gum, purity tests (loss on drying, ash content, starch and dextrin, tannin bearing gum, heavy metals, microorganisms, etc.), physicochemical properties and emulsion stability of purified gum were investigated. Purified gum was used in clarification of three different wines comparatively regarding the characteristics of wines. As a result, the effective clarifying efficiency varied from one wine to another. Purified gum was utilized in making tamarind toffee and it is found that small amount (5%) of gum was efficient for the emulsification of the fat present in toffees. Moreover, purified gum powder was used as drying carrier in the preparation of dehydrated tamarind powder and the results indicate that the purified gum greatly affected the drying time (reduced from 23 hr to 3.5 hr) and solubility of this product.

Key words: Gum arabic, Clarification, Emulsification, Drying carrier

Introduction

Gum arabic or gum acacia is a tree gum exudate with high quality obtained from acacia species such as *Acacia Senegal* and *Acacia seyal* grown in Sudan which is the main gum arabic producing country. In Myanmar, gum Arabic can be obtained from *Acacia nilotica* (Subyu), *Acacia leucophloea* (Tanaung) and *Acacia catechu* (Sha) distributed in Mandalay, Sagaing and Magwe Regions of Upper Myanmar. The gum oozes from the stems and branches of trees (usually five years of age or more) when subjected to stress conditions such as drought, poor soil or wounding. Gum is soft and tacky as it

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exudes from trees and so the outer layer become contaminated with foreign substances such as sand, dirt, insects, pieces of bark and leaves etc. To remove the insoluble impurities, gum nodules are dissolved in a solvent, screening, filtering and recovering the gum from solution. Gum arabic readily dissolved in cold and hot water in concentration up to 50%. Because of the compact, branched structure, gum arabic solutions are characterized by low viscosity, allowing the use of high gum concentration in various application (Verbenken, 2003). Gums arabic is mainly used in the confectionery industry, where it is incorporated in a wide range of products. It has a long tradition of use in wine gums, where it produces a clarity that is higher than can beobtained with other hydrocolloids. Thus, it can be used for clarification of wine (Phillips and Williams et al., 2000).

Gum arabic is used in toffees and caramels as an emulsifier, to maintain a uniform distribution of the fat across the products. Emulsification, acid stability, low viscosity at high concentration, adhesive and binding properties and good mouth feel characteristics have been applied in five main food areas; confections, beverages and emulsions, flower encapsulation, baked goods and brewing (Chapman and Hall, 1997).

Thus, the objectives of this study is to produce a variety of value added products from natural sources, to give the knowledge for the application of plant materials to rural people in tropical regions and to upgrade the quality of local natural exudates to substitute the imported food additives.

Materials and Methods

Materials

Gum arabic from Sha (*Acacia catechu*) grown in Salingyi Township, Sagaing Region, was collected from February to May yearly and hydrogen peroxide (commercial grade) was purchased from Academy Chemical Store, Pabedan Township, Yangon Region.

Methods

Processing of Gum

In order to facilitate the purification, raw gum nodules collected from Sha trees were crushed and ground by using grinding machine. The resulting gum particles were sieved in a sieve shaker (up to -60mesh size). And then, the gum particles were dissolved individually in distilled water to obtain the gum solution of 10%, 20% and 30% (w/v) concentrations. The insoluble impurities were removed by filtering the gum solution with nylon filter (200nm and 400nm).After that, the filtrate was decolourized by using different concentration (10% w/v, 20% w/v, 30% w/v) of hydrogen peroxide solution. Finally, the decolourized gum solution was dried at about 70ºC for about 6 hr in vacuum drying oven.

Identification and Analysis of Purified Gum from Sha

The identification of the purified gum powder were carried out by solubility test by using water and 95% ethanol, chemical tests (*Fehling's* test, *Benedict's* test, *Barfoed's* test) and thin layer chromatography. The physico-chemical characteristics of purified gum powder such as moisture content, ash content, heavy metals, protein content, crude fiber, density, relative viscosity, emulsion stability etc., were also determined.

Applications

Purified gum was applied in the clarification of wines (Strawberry, Damson and Grape obtained from Pyin Oo Lwin District, Mandalay Region); as an emulsifier, the purified gum was also used in making tamarind toffees and as a drying carrier, in the preparation of dehydrated tamarind powder.

Results and Discussion

Raw gum arabic containing insoluble impurities can be removed by conventional filtration methods. Soluble colour impurities could be removed by using different amount and different concentrations (10%, 20%, 30% w/v) of hydrogen peroxide (H_2O_2). The extent of decolourization was assessed by Spectrometric measurement using UV-Vis Spectrophotometer. The results of Table (1) indicate that decolourization time was affected by concentration and amount of H_2O_2. For decolourization, the higher the concentration and the larger the amount of H_2O_2, the shorter the decolourization time. The lower absorbance values of the decolourized gum solutions indicate the extent of decolorization.

The purified gum was identified by solubility test using different solvents (cold and hot water, 95% ethanol), test on hydrolysis products by chemical tests and TLC analysis. From the results in Table (2), it is clearthat, gum arabic is soluble in both cold and hot water but insoluble in ethanol. The results of Tables (3) and (4) point out that the purified gum composed of reducing sugars containing four monosaccharides such as galactose, rhamnose, arabinose and glucuronic acid, etc., which is in agreement with literature (Phillips and Williams, et al., 2000).

The results in Table (5) show that the percent of loss on drying (moisture content) of purified gum is lower than that of France gum and that of standard value (15%max). Total ash content of purified gum was slightly higher than that of standard value reported by IS-3988 (1967). The total ash content is used to determine the critical levels of foreign matter, insoluble matter in acid (Mocak et al., 1998). Sha gum does not contain acid insoluble ash and heavy metals (lead and arsenic). According to the results of Table (6), purified gum has no crude fibre.

From the results, showing the effect of concentration of purified gum solution on relative densities and relative viscosity, in Tables (7) and (8), it is obvious that increase in the relative densities and viscosity of gum solution were proportional to their increasing concentrations. This is because the highly branched structure of the gum arabic molecules leads to compact relatively small hydrodynamic volume and consequently gum arabic will only become a viscous solution at high concentrations cited by Williams et al.,

1990. The results of the influence of pH of gum solution on its relative viscosity show that the relative viscosities increase with increase in pH up to pH 5 and decrease again beyond the pH values of 5(Table 9). This results agree with Anderson et al., 1990 cited that in very acidic solutions, acid groups neutralize so inducing a more compact conformation of the polymer which leads to a decreased viscosity; while a higher pH (less compact molecule) results in maximum viscosity whereas in very basic solution, the ionic strength increment reduces the electrostatic repulsion between gumarabic molecules producing a more compact conformation of the biopolymer and thus reducing the viscosity of the solution.

From the results as presented in Table (10), it is clear that the swelling capacities of purified Sha gum, 1.5 indicates the hydrophilic nature of the gum, the results of bulk and tapped densities show the volume reduction under applied tapped pressure and the value(1.004) of Hausner's ratio of the Sha gum points out the good flow property of gum. The results of the emulsion stabilities of Sha gum with regard to different types of edible oil (sunflower, groundnut, sesame, corn and soya oils) in Table (11) points out that soya oil gave the highest emulsion stability. Table (12) illustrates that the emulsion stability increases significantly with increase in stirring time from 1 to 5 minutes. The results in Table (13)revealed that emulsion stability increases with increasing the concentration of the gum solution. Emulsion stability at a temperature regime of 50, 100, 150, 200 and 250ºC slightly increases with increase in heating temperature as shown in Table (14).

Purified gum from Sha prepared under most suitable conditions was used in the clarification of three types of wine such as Damson, Grape and Strawberry Wine. It is clear that the optimum amounts of gum are 2g, 0.5g and 1g for Grape, Damson and Strawberry wine respectively as shown in Tables (15), (16) and (17). This finding is in agreement with Ribereuet al., (2006) that the effective amount of gum arabic varied from one wine to another. The results representing the use of purified Sha gum as an emulsifier in making tamarind toffee, in Table (18)point out that the amounts of gum from Shaaffect the texture, flavour and mouth feel of tamarind toffees and the most suitable amount of gum was 2 g or 5% (w/w) of tamarind based on the organoleptic properties. As shown in Table (19), moisture content of toffee made with Sha gum is less than that of toffee made with France gum but greater than the toffee from the Market which in turn, total dry matter of toffee made of Sha gum is greater than that of toffee made with France gum and less than that of toffee from Market. The results in Table (20) indicate that the microorganism load fell within the specifications. The effect of amount of drying aid (purified Sha gum) and drying temperatures on drying times and yield percent are shown in Table (21). It is obvious that drying times greatly decreased in the presence of gum arabic and solubility time also significantly decreased and the solubility time of samples was 60 seconds for 40(%w/w) purified Sha gum. It means that the tamarind powder could be dissolved in water at room temperature without difficulty. The drying carriers, gum arabic, is easily dissolved in water (Cano-Chauca*et al.*, 2005) thus, it enhances the dissolution ability of the tamarind powders. Also, the drying temperature had a positive effect on the solubility because the higher drying temperature resulted in more porosity of the powders. The higher porosity led to the more specific surface area of powder, resulting in larger contact surface area between powder and water. If the lower proportion of drying carrier is applied, the layer of drying carrier on the tamarind powder surface will be subsequently thinner.

The effect of drying temperature on physical properties of dehydrated tamarind powder was determined and the results are shown in Table (22). Bulk densities of tamarind powder decreased with increasing drying temperature. The bulk density is an important characteristic for the packaging design and the calculation of transportation volume. The drying temperature and the formula of feed are deemed as the causes of this occurrence. The higher drying temperature resulted in the lower bulk density (Chegini and Ghobadian, 2005).The higher drying temperature led to a higher rate of moisture evaporation from the feed resulting in a higher porosity and lower bulk density of the dried powder. Furthermore, at the same drying temperature, the higher proportion of drying aids would lower the bulk density. Drying temperature and drying aids also similarly affected on tapped density as shown in Table (22).

Table 1: Effect of Concentration of Hydrogen Peroxideon Decolourization of Gum Arabic from Sha

Amount of gum arabic = 50 mL (10%, w/v) = 5 g
Drying temperature and time = 70°C, 6 hr

Sr. No.	Concentration of H_2O_2 (%w/v)	Volume of H_2O_2 (mL)	Decolourization Time (hr), 70°C	**Absorbance		Weight of product (g)	Purified Gum Yield (%w/w)
				Before decolourization	After decolourization		
1	10	3	3.5	0.635	0.379	2.96	59.2
		5	3.0	0.635	0.363	3.23	64.6
		7	2.73	0.635	0.327	3.38	67.6
		*9	2.2	0.635	0.220	4.0	80.0
		11	2.2	0.635	0.205	3.93	78.6
2	20	3	2.00	0.635	0.190	4.03	80.6
		5	1.73	0.635	0.180	4.06	81.2
		7	1.65	0.635	0.159	4.02	80.4
		*9	1.12	0.635	0.155	4.17	83.4
		11	1.10	0.635	0.151	4.13	82.6
3	30	3	1.28	0.635	0.139	3.9	78.0
		5	0.92	0.635	0.122	4.0	80.0
		7	0.78	0.635	0.114	3.64	74.8
		*9	0.68	0.635	0.098	4.04	80.8
		11	0.66	0.635	0.084	4.0	80.0

*Most suitable condition
** Absorbanceindicatingtheextent of decolourization of gum

(a) (b) (c)

Figure 1: Sha(a)Gum Modules(b) Gum Particles(c) Purified Gum Powder

Table 2: Solubility Test for Purified Gum Arabic from Sha

Drying temperature = 70ºC
Drying time = 6 hr

Sr. No.	Solvent	Ratio of Gum to Solvent (w/v)	Observation	
			Sha Gum	**France Gum**
1	Ethanol (95%)	1:2	Insoluble	Insoluble
2	Cold water (20°C)	1:2	Soluble	Soluble
3	Hot water (65 °C)	1:2	Soluble	Soluble

Table 3: Chemical Tests for Monosaccharide (Reducing Sugar) in Purified Gum Arabic from Sha

Drying temperature = 70ºC
Drying time = 6 hr

Sr. No.	Experiments	Observation		Remark
		Sha Gum	**France Gum**	
1	Benedict's Test	Reddish precipitate	Reddish precipitate	Reducing sugar present
2	Fehling's Solution Test	Reddish precipitate	Reddish precipitate	Reducing sugar present
3	Barfoed's Test	Red precipitate	Red precipitate	Reducing sugar present

Table 4: R_f Value of Four Monosaccharides by Three Solvent System in TLC Analysis of Purified Gum Arabic from Sha

Drying temperature=70ºC
Drying time = 6 hr

Sr.No.	Solvent System	Galactose		Rhamnose		Arabinose		Glucuronic/a	
		Literature Value*	Gum from Sha	Literature Value*	Gum from Sha	Literature Value*	Gum from Sha	Literature Value*	Gum from Sha
1	BEW	0.16	0.16	0.22	0.22	0.38	0.4	0.21 0.33	0.34
2	BAW	0.16	0.16	0.22	0.22	0.33	0.33	0.37	0.43
3	PhOH	0.38	0.36	0.52	0.49	0.6	0.62	0.13	0.11

BEW ⇨ n. Butanol : Ethanol : Water (4: 1 : 2.2 v/v)
Ph OH ⇨ Phenol Saturated with water
BAW ⇨ n-Butanol: Acetic :Water (9:6:1 v/v)*(Aparna, 2000)

Table 5: Physicochemical Properties of Purified Gum Arabic from Sha

Drying temperature = 70ºC
Drying time = 6 hr

Sr.No	Characteristics	*Literature	Sha Gum	France Gum
1	Loss on drying (%)	15% max	8.47	13.09
2	Total ash (%)	4% max	4.23	2.91
3	Acid insoluble ash (%)	0.5%max	0.0	0.0
4	Lead (mg/kg)	10	Nil	Nil
5	Arsenic (mg/kg)	3	Nil	Nil

Table 6: Nutritional Values of Purified Gum Arabic from Sha

S r. No.	Composition	Sha Gum	France Gum	Methods
1	Protein (%w/v)	5	5.81	AOAC-2000-920
2	Sugar (%w/v)	9.8	9.0	Refractometer (Master-
3	Crude fibre (%w/v)	0	0	AOAC-2000-978
4	Soluble fibre (%w/v)	83.34	78.19	Sabah El-Kheir et al.,

Table 7: Effect of Concentration of Sha Gum Solution on Relative Density

Sr. No.	Concentration of Gum Solution(%w/v)	Relative Density	
		Purified Sha Gum	France Gum
1	1	1.074	0.9980
2	10	1.086	1.0280
3	20	1.136	1.0588
4	30	1.150	1.0832
5	40	1.272	1.1056

Table 8: Effect of Concentration of Sha Gum Solution on Relative Viscosity

Sr. No.	Concentration of Gum Solution(%,w/v)	Relative Viscosity	
		Purified Sha Gum	France Gum
1	5	1.45	1.272
2	10	1.6	7.348
3	20	1.7	19.65
4	30	5.57	56.76
5	40	74.6	105.7

Table 9: Effect of pH of Sha Gum Solution on Relative Viscosity
Concentration of gum solution = 10% (w/v)

Sr. No.	pH of Gum Solution	Relative Viscosity	
		Sha Gum Solution	France Gum Solution
1	3	1.44	1.84
2	5	1.45	2.07
3	7	1.14	4.74
4	9	1.11	4.71
5	11	1.10	3.66
6	13	1.10	2.96

Table 10: Physical Properties of Purified Gum Arabic Powder(Sha)

Sr. No.	Properties	Purified Sha Gum	Gum powder (France)
1	Bulk density (g/L)	0.556	0.558
2	Tapped density (g/L)	0.558	0.645
3	Swelling capacity	1.5	1.600
4	Hausner ratio	1.004	1.156
5	Hydration capacity	1.51	1.430

Table 11: Effect of Types of Edible Oil on Emulsion Stability of Gum Solution (Sha)

Stirring time =1 min

Ratio of oil to gum solution (20%w/v) =1:2

Stirring temperature = Room temperature (28-30º C)

Sr. No.	Types of Edible Oils	Emulsion Stability
1	Sunflower oil	0.864
2	Peanut oil	0.912
3	Sesame oil	0.886
4	Corn oil	0.867
5	Soya oil*	1.015

*Most suitable type of oil

Table 12: Effect of Stirring Time on Emulsion Stability of Gum Solution (Sha)

Ratio of soya oil to gum solution (20%w/v) =1:2

Stirring temperature = Room temperature (28-30ºC)

Sr. No.	Stirring Time(min)	Emulsion Stability
1	1	1.015
2	2	1.118
3	3	1.274
4	4	1.391
5	5	1.440

Table 13: Effect of Concentration of Gum Solution (Sha)on Emulsion Stability

Stirring time =1 min

Ratio of soya oil to gum solution (20%w/v) =1:2

Stirring temperature = Room temperature (28-30º C)

Sr. No.	Concentration of Gum Solution(v/v)	Emulsion Stability
1	1/1000	1.015
2	2/1000	1.016
3	3/1000	1.020
4	4/1000	1.024
5	5/1000	1.027

Table 14: Effect of Different Heating Temperatures on Emulsion Stability of Gum Solution (Sha)

Stirring time =1 min

Ratio of soya oil to gum solution (20%w/v) =1:2

Stirring temperature = Room temperature (28-30ºC)

Sr. No.	Temperature (ºC)	Emulsion Stability
1	50	0.930
2	100	0.934
3	150	0.942
4	200	0.944
5	250	0.947

Table 15: Effect of Amount of Gum(Sha)on Clarification of Grape Wine

Amount of Wine = 50mL
Turbidity of Untreated Wine (after 1month) = 221.2 NTU
Turbidity ofUntreated Wine (after 3months) = 318.8NTU
Turbidity of Untreated Wine (after 5months) = 448.8NTU

Sr. No.	Amount of Gum (g)	Turbidity of Wine after Treatment (NTU)			Transmittance	Absorbance
		After 1 month	After 3 months	After 5 months	After 5 months	After 5 months
1	0.1	149.8	174.4	256.6	68.6	0.167
2	0.5	157.2	198.8	240.1	70.2	0.192
3	1.0	197.6	190.2	219.0	72.8	0.157
4	1.5	170.6	164.2	183.6	75.2	0.146
5	2.0*	*140.1	236.4	144.4	84.2	0.104

*Most suitable condition

Table 16: Effect of Amount of Gum (Sha)on Clarification of Damson Wine

Amount of Wine = 50mL
Turbidity of Untreated Wine (after 1month) = 145.1 NTU
Turbidity of Untreated Wine (after 3months) = 445.1NTU
Turbidity of Untreated Wine (after 5months) = 681.0NTU

Sr. No.	Amount of Gum (g)	Turbidity of Wine after Treatment (NTU)			Transmittance	Absorbance
		After 1 month	After 3 months	After 5 months	After 5 months	After 5 months
1	0.1	70.0	97.4	113.5	75.4	0.126
2	0.5*	***52.3**	84.4	66.3	101.8	0.005
3	1.0	70.6	102.1	133.3	83.4	0.078
4	1.5	53.2	102.2	104.0	62.7	0.199
5	2.0	186.3	457.3	407.0	28.5	0.546

*Most suitable condition

Table 17: Effect of Amount of Gum(Sha)on Clarification of Strawberry Wine

Amount of Wine = 50mL

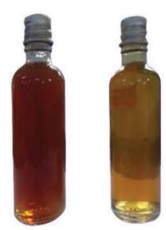
Turbidity ofUntreated Wine (after 1month) = 40.40 NTU

Turbidity of Untreated Wine (after 3months) = 260.0NTU

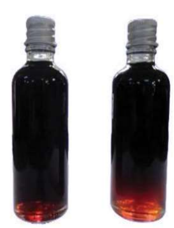
Turbidity of Untreated Wine (after 5months) = 470.0NTU

Sr. No.	**Amount of Gum (g)**	**Turbidity of Wine after Treatment (NTU)**			**Transmittance**	**Absorbance**
		After 1 month	**After 3 months**	**After 5 months**	**After 5 months**	**After 5 months**
1	0.1	29.0	11.6	27	93.7	0.028
2	0.5	28.4	21.5	21.1	98.5	0.069
3	1.0*	35.3	***2.1**	16.4	115.0	0.063
4	1.5	40.2	12.7	17.6	111.8	0.067
5	2.0	77.9	41.7	46.3	86.6	0.115

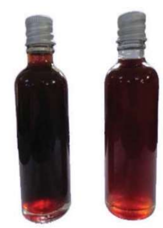
*Most suitable condition



Grape Wine (before and after clarification)



Strawberry Wine (before and after clarification)



Damson Wine (before and after clarification)

Tamarind Toffees

Table 18: Effect of Amount of Gum from Sha on Characteristics of Tamarind Toffee
Tamarind = 40g, Sugar = 105g, Glucose = 12g, Milk Powder = 8g, Margarine = 3g, Essence = 0.5ml, Salt = 3.5g,
Cooking Time = 50min, Cooking Temperature = 80°C

Sr. No.	Amount of Gum (g)	Acidity (%)	pH	Moisture (%)	Total Dry Matter (%)	Yield (%)	Shelf-life (Months)	Organoleptic Properties
1	1.0	4.9	2.7	8.6	91.4	81	5	Soft texture, pleasant taste, slightly creamy mouthfeel
2	1.5	4.5	2.8	7.9	92.1	84	5	Soft texture, pleasant taste, creamy mouthfeel
3	2.0*	4.5	2.8	7.8	92.2	81	5	Soft texture, pleasant taste, creamy mouthfeel
4	2.5	4.7	2.8	7.3	92.7	81	5	Soft texture, pleasant taste, creamy mouthfeel
5	3.0	4.6	2.8	8.6	91.4	85	5	Soft texture, pleasant taste, creamy mouthfeel

*Most suitable condition

Table 19: Physicochemical Properties of Tamarind Toffees

Sr. No.	Characteristics	Toffee made with Sha Gum	Toffee made with France Gum	Toffee from Market (Duwon)
1	Moisture (%)	7.9	8.2	5.7
2	Total dry matter	92.1	91.8	94.3
3	Acidity (%)	4.5	6.3	6.0
4	pH	2.8	2.7	2.7
5	Shelf-life (months)	5	5	5

Table 20: Microbial Loads of Tamarind Toffees

Sr. No.	Characteristics	Toffee made with Sha Gum	Toffee made with France Gum	Toffee from Market (Duwon)	International Specification
1	TPC (cfu/gm)	2.2×10^3	6.1×10^3	7×10^3	10^6
2	Yeast and mold	1×10^2	3×10^2	5×10^3	10^6

Table 21: Effect of Amount of Drying Aid (Sha, Gum Arabic) on Drying Time and Yield % of Dehydrated Tamarind Powder at Different Drying Temperatures

Amount of tamarind flesh =100 g

Sr. No.	Gum arabic Concentration (% w/w)	Drying Temperature (°C)	Drying Time (hr)	Moisture % (w/w)	Yield % (w/w)	Soluble Time (s)at (70^{o} C) in
1	0	50	22.5	18.33	5.47	1200
		60	22.5	17.85	5.36	1200
		70	23	17.24	5.42	1200
		80	23	16.73	5.40	1200
		90	23	15.88	5.31	1200
2	10	50	10	14.63	9.31	205
		60	10	14.31	9.25	200
		70	9	14.25	10.34	180
		80	8	10.24	10.54	160
		90	8	10.11	10.23	150
3	20	50	9.5	13.61	30.22	120
		60	9	13.46	30.13	120
		70	8.5	13.22	33.30	110
		80	6.5	9.46	36.08	95
		90	5	8.47	32.54	90
4	30*	50	8.5	12.32	40.34	100
		60	8	12.15	40.35	100
		70	7	11.04	42.67	95
		80	5	6.65	42.80	80
		90*	3.5	7.08	49.93	70
5	40	50	7	9.73	41.25	90
		60	6.5	9.12	41.44	90
		70	6	8.76	41.25	75
		80	5	6.41	42.80	60
		90	3.5	6.22	42.93	60

*most suitable condition

Table 22: Effect of Drying Temperature and Time and Drying Aid (Sha Gum Arabic) on the Physical Properties of Dehydrated Tamarind Powder

Amount of tamarind flesh=100 g

Sr. No.	Gum arabic Concentration (% w/w)	Drying Temperature (°C)	Drying Time (hr)	Bulk density (g/mL)	Tapped density (g/mL)	Water solubility Index (WSI)	Water absorption Index (WAI)
1	0	50	22.5	1.32	1.50	10.35	2.85
		60	22.5	1.30	1.47	10.56	2.81
		70	23	1.26	1.42	10.74	2.50
		80	23	1.14	1.33	10.81	2.47
		90	23	1.17	1.24	10.88	2.45
2	10	50	10	0.95	1.22	21.12	2.27
		60	10	0.94	1.13	21.36	2.21
		70	9	0.93	1.10	22.62	2.18
		80	8	0.86	0.91	22.90	2.15
		90	8	0.85	0.90	23.54	2.10
3	20	50	9.5	0.93	1.10	42.15	2.03
		60	9	0.91	1.01	42.47	2.01
		70	8.5	0.84	0.95	42.11	1.96
		80	6.5	0.78	0.82	43.05	1.85
		90	5	0.76	0.80	10.35	2.85
4	30*	50	8.5	0.82	0.90	64.13	1.68
		60	8	0.77	0.81	66.24	1.58
		70	7	0.65	0.72	71.16	1.36
		80	5	0.62	0.70	71.44	1.31
			3.5	0.55	0.64	72.96	1.28
5	40	50	7	0.78	0.85	63.24	1.69
		60	6.5	0.70	0.72	63.20	1.67
		70	6	0.67	0.71	63.18	1.64
		80	5	0.61	0.69	64.02	1.50
		90	3.5	0.53	0.65	65.89	1.46

*most suitable condition

Conclusion

Raw gum arabic from Sha can be purified by filtration and decolourization using hydrogen peroxide solution. It can be concluded that 20% w/v of hydrogen peroxide solution is the most suitable for decolourization with respect to decolouring time (40 min) and safety. Because, high concentration of hydrogen peroxide is irritating to skin, eyes and mucous membranes. Moreover, the explosion hazard is usually present with high strength. For these reason, 20% H_2O_2 was considered to be appropriate decolourizing agent.

The purity of gum from Sha can be assessed by moisture content, ash content, and heavy metals, (lead and arsenic). Bulk density and tapped density of purified gum determined can provides further use of gum other than as an emulsifier. The viscosity of gum arabic solution depends on its pH. It can be observed that gum solution has highest viscosity within acid pH and thus, it may conclude that the gums are more suitable for many acidic foods. The function of gum in tamarind toffees is to emulsify the fats and prevent the releasing of fats into outer layer of toffees. Moreover, gums contribute the flavour and mouth feel of tamarind toffee. Gum from Sha is the most suitable drying carrier for the preparation of dehydrated tamarind powder which cannot be dehydrated tamarind alone.

The comparative production cost of purified gum arabic from Sha (local source) and that of gum from France were 5077.9 K/kg and 29000 K/ kg, respectively. Thus, this research would be implemented in some way for substituting the imported additives used in food, pharmaceutical and cosmetic industries to produce cheaper value-added products.

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