INTERNATIONAL JOURNAL OF FAMILY STUDIES, FOOD SCIENCE AND NUTRITION HEALTH

PRINT-ISSN: 2735-5373

VOLUME 3, ISSUE 2, 2022, 193 – 211.

ONLINE-ISSN: 2735-5381

Utilization of Hollyhock (Althaea officinalis L.) roots in manufacture of juices and jams

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Abstract:

The aim of this study is investigating the effect of hollyhock Althea officinalis L. gum on the phenomenon of surface separation of juices and the homogeneity of jam without adding any industrial additives, as well as the effect of gum on the shelf life of the products. And to achieve this purpose. Althaea officinalis L. gum was added to strawberry juice at levels of 10%, 20%, and 30%, The juices were stored in the at 4°C.For 15 days and it was also added to make apricot jam And store it in the refrigerator at a temperature of 4 ° C for 6 months. And the tests were physicochemical and conducted on the gum, and you may perform notice that it contains a high percentage of carbohydrates (83.94%), starch (27.16%), pectin (10.22%), and a high percentage of vitamin C. (26.80%). It also notes that it is free of fat. The analyzes also showed that it contains a high percentage of Fe(790.36ppm), Na (391.35 ppm), K (372.61 ppm) and Mg (344.20 ppm). also, significant high total phenolic (80.31%) and antioxidant content (67.09%). The least in total flavonoids (22.37%). well recorded pH., titratable acidity, TSS and viscosity (7), (3.23%), (42.33°Brix) and (34.33cp), respectively. The best percentage compared to the control zero time and after the period of storing the juice at 4°C, was percentage of 20% compared to the control, as for the jam, no significant difference in the physico-chemical analyzes between zero time and the end of the experimental period, but a high in TSS (67°Brix) at zero time an increase (72°Brix) was observed at the end of the experimental period.

For the sensory evaluation of jam, there were no significant differences during the storage period, and the storage period did not affect the spreading property.

Keywords: Hollyhock- Minerals- Vitamins- Jam- Juices- Sensory evaluation- Storage.

1. Introduction:

Hollyhock Althaea officinalis L. is an herbaceous perennial belongs to the family Malvaceae, it is an ornamental plant grown in gardens grows plant stalk to about 1 metre tall can grow taller in ideal growing conditions, and a similar width. The stems and leaves are a soft sage green and covered with very fine velvety down. The leaves are alternate along the stem, are. Flowers burst forth in summer through to autumn, they usually a soft pink. The roots are thick, tapering and long, creamy on the outside and white inside, with high mucilage content roots mucilage, up to 20% incl, L-rhamsose, D-galactose, D-glucuronic acid & galacuonnic acid, also, polysaccharides, pectin, volatile oils, sugars, tannins, starch, amino acids, incl. asparagine, phenolic acids, quercetin and kaempferol, very high in Vitamin C and a wide range of minerals **(Detersa et al.,2010).** The leaves have similar constituents, though less mucilage, additionally, has flavonoids, polyphenolic acids & coumarins It does not contain toxic substances **(Husain et al., 2021).** Althaea officinalis (AO), It was imported into Europe from southwestern China during, or possibly before, the 15th century. In herbal medicine, hollyhock is believed to be an emollient and laxative. It is used to control inflammation, to stop bedwetting, and as a mouthwash in cases of bleeding gums. Studies show that most of these compounds, due to the activation of the host immune system, have more antitumor and antimicrobial properties than toxic effects **(Moazzezi et al., 2022**). Hollyhock (AO) is a plant Its origin is in various areas of Asia and Europe and is a native plant of Middle East areas **(Fahamiya et al., 2016)**.it follows pleasant and important glazed medicinal plants containing glazing mucilaginous cells in its stem, petiole, petals, and seeds that have anti-microbial and anti-inflammatory properties. **(Amiri et al.,2021)** (AO) .is a valuable herb for use as medicine internally and topically. The mucilage content, highest in the roots, is able 'to coat and protect' the bodies mucous membrane, thereby soothing and protecting it–from scratchy sore throats bronchitis and easing dry coughs, to the gastric mucosa, to ease digestive dysfunctions; stomach ulceration, irritable bowel, Crohn's disease and colitis, also, urinary system irritations and infections **(Yourdkhani and Jafarpour, 2021)**.The mucilage is not digested in the upper part of the gut but when reaches the colon is 'digested' by gut bacteria. It is a 'wound healer' whether internally or externally. Topically apply to wounds, irritations, inflammation, eczema, rashes and bruises. **(Tahan et al., 2018)**. Althaea officinalis (AO) is a stately ornamental plant. It was used in the past in folk medicine and recently it was used in the pharmaceutical industry. France is the first to use its gum content in making a type of candy known as marshmallow candy, so that's why hollyhock is known as a marshmallow. **(Farimani et al., 2020).** Due to the unhealthy effects of chemical and synthetic preservatives, consumers want to use natural preservatives derived from plant, animal, and microbial sources, in addition, to protecting themselves from the harmful impacts of chemical preservatives by increasing the shelf life of food. A variety of plants has been identified that contain many types of immunomodulatory polysaccharide. This study was to make natural juices and jam that are preserved with natural materials carried out the phenomenon of separation to occur in juices.

2. MATERIALS AND METHODS

2.1. Materials

2.1.1. Plant materials

The roots of cultivated were obtained of hollyhock (Althaea officinalis L.) from the farm the Faculty of Pharmacy, Cairo University Giza, Governorate.

2.1.2. Fruit materials

Strawberry (Fragaria xananassa) and apricot (Prunus armeniaca) fruits were purchased from collectors near Food Technology Research Institute Giza, Government, fifty fruits from each species were used for analysis was selected according to uniformity of shape and color. Fruits were thoroughly washed with tap water to remove surface dirt.

2.2. Methods

2.2.1. Preparation of raw materials

2.2.1.1. Classical method of isolation

The roots were washed with running water and cut into small pieces, and it was taken (100 g) was soaked in 800 ml of purified water for 24 h. then, filtered and squeezed through a muslin cloth to get the mucilage. **(Husain et al., 2021)**

2.2.1.2. Preparation of fresh strawberry juice

The juices. was extracted mechanically by beating the fruit in a blender (Type: Moulinex MFP626 – 220V – 50-60Hz – 1000W – 250 ml France) and then filtering to obtain a clear juice **(Ali et al., 2017)**

2.2.1.3. The formula of strawberry juice

Four types of natural juice were made without adding preservatives or additives preserve the color. The first type was control fruit juice and sugar only without adding gum. The second type was added gum to the juice by 10%. The third was add gum to the juice by 20%. The fourth type was to add gum to the juice by 30%. The juice was kept in the refrigerator at a temperature of 4 °C for 15 days.

2.2.1.4. Preparation of apricot jam

The jam was produced with slight modification according to **(Awulachew, 2021).** The fruit purees were taken for each sample formulation, poured into a big, clean stainless pot and boiled at a temperature of 120℃ using a thermometer for 25 mins. Once the fruit started boiling, Gum has been added to the mixture and stirred continuously. This was done for 30 minutes until a homogeneous mixture was observed was then 3% citric acid was added. After this, the jam produced was allowed to cool to 40℃ before been poured into already sanitized jars and sealed instantly. The jars were filled to about 60 % leaving a headspace of about a quarter inch to avoid contamination. The jam in a sanitized jar was then stored in a refrigerator 4°C for 6 months prior to carrying out analyses. **(Adegbanke et al., 2022)**

2.2.2. Methods of analysis

Chemical composition including crude protein, ash, fat and crude fiber were determined according to the methods of **(Fahamiya et al., 2016).** All the above-mentioned determinations was expressed as g/100g sample and performed in triplicate. Total carbohydrates were estimated by difference. % carbohydrates = 100-(% crude protein+ % crude fat+ % ash + % crude fibers). Moisture, and titratable acidity were determined according to **A.O.A.C.** (**2012).** pH was determined with a

(Jenway3510 pH meter) and TSS determined with a Hand Refractometer (ATAGO Type 500 cat No. 2340).

2.2.2.1. Extraction of pectin and starch

Pectin has been extracted from Althaea officinalis (OA) gum and the starch content based on the method proposed by **(Ranganna, 1996).**

2.2.2.2. Determination of Vitamin C

The Association of Official Analytical Chemists **A.O.A.C (1984)** determined limited range of possible procedures, based essentially on the chemical reactions of ascorbic acid.

2.2.2.3. Viscosity analyses

Viscosity measurement was carried out using advanced equipment, RhecoalcT2.1.52, made by Brookfield AMETEK. at 10 rpm at room temperature using RPM10, spindle RV7. **(Shahnawaz and Shiekh 2011)**

2.2.2.4. Determination of Total Antioxidant Activity

Total antioxidant content (TA) was estimated by using 2,2-diphenyl-1-picrylhydrazil (DPPH) assay to measure the free radical scavenging capacity **(Benbassat et al., 2011)**

2.2.2.4.1. Determination of Total Phenolic compounds

Total Phenolic content (TP) was determined using Folin-Ciocalteu reagent as described previously by **(Tobyn and Whitelegg 2011)**. The TP of was expressed as (milligrams of gallic acid equivalent GAE per 100 g) sample.

2.2.2.4.2. Determination of Total Flavonoid compounds

Total flavonoid content (TF)was measured using $Alcl_3$, a colorimetric method **A.O.A.C**
(**2006)** The absorbance was measured at 510 nm using the spectrophotometer. The TF of
extracts were expressed as (milligrams of) sample.

2.2.2.5. Determination of mineral

Mineral content iron (Fe), zinc (Zn), calcium (Ca), potassium (K), sodium (Na) and phosphorus (Mg) were determined using by Agilent Technologies (model 4210 MPAES), atomic absorption spectrophotometer according to the method of **A.O.A.C. (2011)**

2.2.2.6. Sensory evaluation

Sensory evaluation of juice and jam were color, taste, oder, appearance, Separation, Texture, and overall acceptability, and the evaluation was carried out by 10 judges of Food Tech Rec. Using a 10-point pleasure scale. samples receiving an overall quality score of 7 or above were considered palatable. according to the method of **(Pereira et al., 2015)**

2.2.2.7. Statistical analysis

One way analysis of variance (ANOVA), with multiple range significant difference (LSD) test Standard error was determined (SE) ($p < 0.05$) were carried out using SPSS according to **(Sarmento and Costa 2019)**

3. RESULTS AND DISCUSSIONS

3.1. Chemical analysis of Hollyhock gum

According to the results shown in **Table1**. it could be notice that a high percentage of carbohydrates in the gum of the hollyhock root (83.94%) as well as starch (27.16%) and pectin (10.22%) vitamin C (26.80mg/100g), while the gum contained an acceptable percentage of crude protein (7.49%) and ash (5.28%), in addition to the low percentage of crude fiber (3.28%). On the other hand, the gum did not contain fat, conclude from the table that gum is a good source of vitamin C, as well as pectin and starch these results are in symmetry with **(Karimi et al., 2022)**

Table (1): Chemical composition of Hollyhock gum

Parameters	Hollyhock
Fat %	0.0±0.0[h]
Ash %	5.28±1.45[f]
Crude protein %	7.49±0.70[e]
Crude fiber %	3.28±0.85[g]
Total Carbohydrates %	83.94±2.58[a]
Starch%	27.16±2.02[b]
Pectin%	10.22±0.99[d]
Vit. C (mg/100g)	26.80±0.1[c]

a. Mean ± SD; with different superscripts in a row differ significantly ($p < 0.05$).
b. Carbohydrates was calculated by difference {100- (Protein+ Fats +Ash and Crude fiber)}
c. Vit. C: vitamin C

3.2. Content of mineral elements

The mineral contents of gum of the hollyhock root are recorded at **Table 2.** notes an increase in the proportions of mineral elements, where the Fe element recorded the highest percentage ((790.36 ppm) followed by Na **(**344.20 ppm), K (372 ppm) and Mg **(**344 ppm)**,** While the content of both decreased Zn **(**273 ppm) and Ca (262 ppm). From the study of the mineral elements of the gum, it is clear that it contains a good percentage of the mineral elements. Therefore, when used in the food industry, it gives a high nutritional value to the products, the results are in harmony with **(Al-Snafi, 2013)**

Table (2): Mineral contents of Hollyhock

Mineral elements	(ppm)
Ca	262.32±0.04^{f}
K	372.61±2.7^{c}
Mg	344.20±1.9^{d}
Na	391.35±2.1^{b}
Zn	273.97±1.60^{e}
Fe	790.36±1.5^{a}

a. Mean ± SD; with different superscripts in a row differ significantly ($p < 0.05$).
b. Values ±SE; in the same column with different letters are significantly different at $P < 0.05$.

3.3. Antioxidant, total phenolic and total flavonoids contents

Gum of the hollyhock root a good source of antioxidants necessary for humans, as shown in a **Table 3.** significant high TP (80.31mg GAE /100g) and TA (67.09%), while TF (22.37mg CAT /100g) recorded lowest percentage, from that table it is clear that gum contains an acceptable percentage of antioxidant contents, these results are in agreement with those recorded by **(Benbassat et al., 2014)**

Table (3): Total antioxidant contents (TA), total phenolic, (TP) and total flavonoids (TF)

Parameters	Hollyhock
TA (%)	67.09±0.3^{b}
TP (mg GAE /100g)	80.31±0.92^{a}
TF (mg CAT /100g)	22.37±1.01^{c}

a. Mean ± SD; with different superscripts in a row differ significantly ($p < 0.05$).
b. Values ±SE; in the same column with different letters are significantly different at $P < 0.05$.

PRINT-ISSN: 2735-5373 VOLUME 3, ISSUE 2, 2022, 193 – 211. ONLINE-ISSN: 2735-5381

3.4. Determination of moisture, pH, titratable acidity and total soluble solids contents of Gum of the hollyhock root

It is evident from **Table 4.** that the moisture content in gum of the hollyhock root (3.71%), pH (7) refrigerator 4°C and TA (3.23%). While registered TSS (42°Brix) and viscosity (34.33 cP). These results are consistent with **(Husain et al., 2021)**

Table (4): moisture, pH, TAc (titratable acidity) and TSS (total soluble solids) contents of gum.

Raw materials	Parameters				
	Moisture (%)	pH	TAc (%citric acid)	TSS (°Brix)	Viscosity (cP)
Hollyhock gum	3.71±1.53	7.00±0.10	3.23±0.15	42.33±1.06	34.33±1.02

Mean ± SD; with different superscripts in a row differ significantly ($p < 0.05$).

3.5. Strawberry juice physicochemical properties at zero time

pH, titratable acidity and TSS, of samples are reported in **Table 5.** the highest pH was in the 30% sample was (4.56) and the lowest in the control sample (4.50), while the acidity was higher in the control (0.45cP) and lower in the 30% sample which was (0.39 cP), pH and acidity are important parameters in food processing to obtain products with consistent and well-defined properties. Also, the TSS percentage was higher in 30%, (57.23°Brix) as well as the viscosity (489.00cP), TSS and viscosity were lower, in the control where it was recorded (52.27°Brix) and (400.03cP), respectively. These results are agreement with **(Yildiz et al., 2020)**

Table (5): pH, TAc (titratable acidity), TSS (total soluble solids) and viscosity contents of strawberry juice samples at zero time

strawberry juice	Parameters			
	pH	TAc (%citric acid)	TSS(°Brix)	Viscosity (cP)
Control	4.50±0.90^{e}	0.45±0.10^{a}	52.27±1.06^{d}	400.03±0.06^{d}
10%	4.51±0.36^{c}	0.42±0.01^{b}	54.23±1.11^{c}	451.00±1.00^{c}
20%	4.54±0.02^{b}	0.40±0.02^{c}	56.57±0.80^{b}	471.66±1.53^{b}
30%	4.56±0.02^{a}	0.39±0.001^{d}	57.23±0.96^{a}	489.00±1.00^{a}

a. Mean ± SD; with different superscripts in a row differ significantly ($p < 0.05$).
b. Values ±SE; in the same column with different letters are significantly different at $P < 0.05$.

3.6. Sensory evaluation of strawberry juice at zero time

The sensory evaluation results were recorded in **Table 6.** of strawberry juice samples at zero time the best percentage of gum addition was 20% compared to the control, while 30% was better in terms of non-separation of the juice due to the increase in the amount of gum compared to the control. Although 20% is the best, there are no significant differences between the percentage of addition, especially 30%. These results were recorded with **(Verma and Bisen, 2020)**

Table (6): Sensory evaluation of strawberry juice samples at zero time

Characteristics	Control	10%	20%	30%
Color	8.00±0.00[d]	8.25±0.50[c]	8.75±0.50[a]	8.70±0.81[b]
Oder	7.75±0.50[d]	8.50±0.57[c]	8.78±0.53[a]	8.75±0.50[b]
Texture	6.80±0.95[d]	8.51±0.60[c]	8.80±0.58a	8.55±0.45[b]
Taste	7.00±0.8[d]	9.00±0.81[a]	9.15±0.60[a]	9.11±0.57[a]
Separation	6.50±0.58[d]	8.62±0.58[c]	8.77±0.51[b]	9.00±0.00[a]
Appearance	7.25±0.96[d]	8.66±0.35[c]	8.88±0.58[a]	8.87±0.49[b]
Overall acceptable	7.24±0.98[d]	8.55±0.43[c]	8.76±0.60[a]	8.70±0.57[b]

a. Mean ± SD; with different superscripts in a column differ significantly ($p < 0.05$).
b. Values ±SE; in the same line with different letters are significantly different at $P < 0.05$.

3.7. Strawberry juice physicochemical properties at the end of storage period 15 days at 4°C

May notice in the **Table 7.** the end of the storage period for strawberry juice samples the increase in pH occurred in the proportion of the addition gum 30% (4.53) compared to the zero time, While the acidity decreased by increasing percentage of addition 30% as recorded (0.40 %) compared to zero time, as well as a percentage of addition 30% decrease in the TSS and viscosity, which were recorded (55.24°Brix) and (486.00 cP), respectively. It is clear from the table at the end of the strawberry juice storage period that a change occurred in the pH, which led to an increase in acidity, decrease, in total soluble solids (TSS) and viscosity and by comparison compared to the table at the zero time, there are significant differences between the two tables, but they are not large enough to lead to a deterioration in physicochemical properties and spoilage of the juice. **(Wisal et al., 2022)**

Table (7): pH, TAc (titratable acidity), TSS (total soluble solids) and viscosity contents of strawberry juice samples at the end of the storage period (15 day)

strawberry juice	Parameters			
	pH	TAc (%citric acid)	TSS(°Brix)	Viscosity(cP)
Control	4.20±0.18^{e}	0.47±0.10^{a}	49.20±0.90^{d}	392.66±2.52^{d}
10%	4.45±0.15^{c}	0.43±0.15^{b}	53.20±0.91^{c}	449.00±1.01^{c}
20%	4.50±0.01^{b}	0.41±0.11^{c}	54.43±0.80^{b}	470.66±1.20^{b}
30%	4.53±0.10^{a}	0.40±0.01^{d}	55.24±0.98^{a}	486.00±1.00^{a}

a. Mean ± SD; with different superscripts in a row differ significantly ($p < 0.05$).
b. Values ±SE; in the same column with different letters are significantly different at $P < 0.05$.

3.8. Sensory evaluation of strawberry juice the end of the storage period period at 4°C for 15 days

Table 8. showed that the sensory evaluation of strawberry juice samples with different addition percentages at the end of the storage period may notice that the rate of adding gum 20% is still the best percentage, despite the occurrence of a decrease in the percentage of sensory evaluation compared to the zero time and also the percentage of 30% is still the best in terms of not separating the juice, although there are differences between The beginning of the storage period and the end of the storage period but it is not a big difference Making the juice sensory unacceptable **(Wisal, et al.2013)**

Table (8): Sensory evaluation of strawberry juice samples at the end of the storage period

Characteristics	Control	10%	20%	30%
Color	7.45±0.05^{d}	8.20±0.50^{c}	8.71±0.15^{a}	8.66±0.20^{b}
Oder	7.6±0.20^{d}	8.38±0.15^{c}	8.73±0.25^{a}	8.67 ±0.29^{b}
Texture	6.59±0.80^{d}	8.41±0.36^{c}	8.75±0.15^{a}	8.65±0.30^{b}
Taste	6.41±0.81^{d}	8.74±0.36^{a}	8.55±0.45^{a}	8.44±0.20^{a}
Separation	6.25±0.05^{d}	8.60±0.01^{c}	8.69±0.05 ^{b}	8.74±0.00^{a}
Appearance	7.01±0.29^{d}	8.58±0.20^{c}	8.75±0.15^{a}	8.79±0.28^{b}
Overall acceptable	6.75±0.21^{d}	8.49±0.01^{c}	8.58±0.26^{a}	8.55±0.17^{b}

a. Mean ± SD; with different superscripts in a row differ significantly ($p < 0.05$).
b. Values ±SE; in the same column with different letters are significantly different at $P < 0.05$.

3.9. Physicochemical properties of apricot jam during the storage period

From **Table 9.** it could be noticed a difference in the pH degree at zero time were registered (3.50) and recorded (3.32) at the end of the storage period, while the percentage of acidity increased at the end of the storage period where registered (1.17%) compared to that at zero time (1.01%), while the percentage of TSS recorded a higher percentage (71°Brix) at the end of the storage period compared to zero time (66°Brix). As a result of this table, it is clear that hollyhock gum it has been given to physio-chemical stability to apricot jam during storage. Similar findings were also obtained by **(Wani et al., 2017)**

Table (9): pH, TAc (titratable acidity) and TSS (total soluble solids) apricot jam during the storage period (180 days)

Apricot jam	pH		TAc (%citric acid)		TSS (°Brix)	
	Zero time	**180 days**	**Zero time**	**180 days**	**Zero time**	**180 days**
	3.50±0.01[a]	3.32±0.07[b]	1.01±0.1[a]	1.18±0.10[b]	67.00±1.00[b]	72.00±1.00[a]

a. Mean ± SD; with different superscripts in a row differ significantly (p < 0.05).
b. Values ±SE; in the same row with different letters are significantly different at P < 0.05.

3.10. Sensory evaluation of apricot jam during the storage period

Results of the sensorial evaluation of apricot jam through the **Table 10.** It could be noticed that there are significant differences in the color of the jam (score 7.74) at zero time, where the percentages were recorded (score 8.90), while was recorded at the end of the storage period notice significant differences between the beginning of the storage period and the end of the storage period, but not differences that make the product unacceptable. The color difference is due to not adding any additives to the product, as it is considered a natural product without additives. are similar to the results obtained **(Massoud et al., 2018)**

Table (10): Sensory evaluation of apricot jam during the storage period

Characteristics	Zero time	180 days
Color	8.90±0.15[a]	7.74±0.36[b]
Oder	9.15±0.13[a]	8.70±0.20[b]
Texture	9.14±0.10[a]	8.55±0.14[b]
Taste	9.11±0.01[a]	8.43±0.03[b]
Spreading	900 ±0.50[a]	8.44±0.04[b]
Appearance	9.01±0.36[a]	8.36±0.37[b]
Overall acceptable	9.75±0.64[a]	8.29±0.24[c]

a. Mean ± SD; with different superscripts in a row differ significantly ($p < 0.05$).
b. Values ±SE; in the same column with different letters are significantly different at $P < 0.05$.

4.CONCLUSIONS

Juices and jams are commonly used of foods that are popular with adults and children It is produced in different countries with different sensory quality and nutrition different types of fruits. Today, due to the unhealthy effects of chemical and synthetic preservatives, consumers wish to use natural preservatives derived from plants, animal, and microbial sources, in addition, to protecting themselves from the harmful impacts of chemical preservatives by increasing the shelf life of food. The phytochemical analysis of the Althaea officinalis gum revealed it being a good source of total phenolic and flavonoids. These compounds which are found naturally in fruits/vegetables protect body against free radical, besides improving immune system and also have healthy benefits. Also, to its high content of mineral elements. From this study, hence we must resort to natural sources which are very suitable to be taken as a good natural food or natural-food additive with many categories of healthy foodstuffs. and general consumer's acceptance the products obtained address all categories of consumers. The research has an important value in utilization of natural additives instead of artificial harmful to human health.

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PRINT-ISSN: 2735-5373
VOLUME 3, ISSUE 2, 2022, 193 – 211.
ONLINE-ISSN: 2735-5381

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