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FUNCTION PROPERTIES OF JEW'S MALLOW MUCILAGE AND SODIUM ALGINATE AND THEIR EFFECT ON DOUGH AND BREAD QUALITY

BY

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ABSTRACT

Function properties (thickening, solubility, water hydration retention and oil absorption) were determined for jew's mallow mucilage and sodium alginate. Jew's mallow mucilage was superion than sodium alginate in all studied properties at different concentrations. The addition of mucilage 0.6 % (M), sodium alginate 0.2% (A) and mixture (0.1%M+0.1%A) had positive effect in bread height and volume with added improved agent especially mixtures compared with control sample. Generally, there were significantly improvement in sensory attributes especially in general appearance, taste and odor as a result of these treatments. Farinograph data indicated that the addition M, A and M+A to wheat flour increased water absorption. It was 61.5, 61.3 and 59.3 % for the aforementioned samples compared with control sample (57.7%). Degree of weaking (BU) significantly decreased by additions compared with control sample (60, 80, 90 and 100 BU, respectively). Extensograph results indicated that the control sample gave the lowest value of resistance to extension (725 BU) followed by Jew, s mallow mucilage sample (870 BU) then sodium alginate sample (940 BU) and finally mixture sample (980 BU). The reductions % in specific volume were 27.74, 21.57, 23.08 and 13.14 % for C, M, A and M + A treatments, respectively at 3 days of storage at room temperature. The same trend was appeared in cooled samples at 7 days, the reductions % were 47.64, 37.05, 43.27 and 38.49 % for the same treatments. Bread samples prepared with 0.6 % jew's mallow mucilage, 0.2 % sodium alginate and mixture received significantly higher sensory attributes scores especially in crumb distribution, crumb texture and taste during storage (25-27 °C & 4-5 °C) .

The best freshness of pan bread were appeared in M treatment at room temperature whereas it reached 82.75 % during 3 days of storage, but at cold temperature, M + A treatment was the more freshness after 7 days at this conditions (77.13 %) when compared with control sample.

Key word: Jew's mallow Mucilage, Sodium alginate, Functional properties, Bread Physical properties, Rheological properties, Sensory attributes, Staling, Specific volume.

INTRODUCTION

Mucilage is one of water soluble dietary fibers, it is viscous in nature, and exists in many plants in high proportions, therefore they are named mucilaginous plants. Vegetables which grow abundantly in Egypt and rich in mucilages are of great biological value in Egyptian human feeding. Jew's mallow (*Corchorus olitorius* L.) is a popular cooking vegetable crop in Egypt and some Arab countries. Its leave was high content of high viscosity mucilage (Pagni, 1994).

Plant mucilage is mixture of poly saccharides that only partially dissolve in water to form viscous colloidal systems. Owing to their extremely high molecular weight, they are not absorbed into the blood stream. It is non toxic (Sue and Andrew, 1999). The dry powder of jew's mallow significant decreases in serum and liver cholesterol concentrations as reported by Innami *et al.*, (1995). In the same field Morton, (1990) reported that, the mucilages have in common a beneficial effect on burns, wounds, ulcers, external and internal inflammation and irritations, diarrhea and dysentery.

Food gums are obtained from a variety of sources. Most gums come from plant materials such as seaweed, seeds, and tree exudates, others are products of microbial biosynthesis, and still others are produced by chemical modification of natural polysaccharides (Dziezak, 1991). Alginate, polysaccharides extracted from certain species of the brown seaweed class phaeophyceae, include many types of products composed of D – manuronic acid and L – guluronic acid in varying properties. Alginates are available as salts of sodium, potassium, ammonium, and calcium. Clear candy gels are an example of an application of sodium alginate which, when used at 0.1 – 0.7 %, produces a tender to chewy texture (Dziezak, 1989). Most often alginates are used for thickening, emulsion stabilization, gelation, syneresis inhibition, and mouthfeel. On other side, thermal gelation properties of the alginate increase viscosity, strengthen the boundaries of the expanding cells in the dough, and reduce gas loss, there by protecting the dough from lose of volume, alginate also prevents loss of moisture during baking so that the finished product has a softer texture and longer shelf life.(Bell, 1990 and Kaur *et al.*, 2000).

Bread staling is a generic term used to describe loss of freshness perceived by consumers. It includes crumb firming, development of crumb dryness, loss of flavor, and similar changes (Kulp *et al.*, 1991).So, the hydrocolloids (guar gum, alginate and gelatine) use as an anti staling agent in cakes and breads. Breads made with gums have greater resiliency, shorter texture, longer shelf life, and improved handling properties.

Several studies have been carried out to use mucilage as an improvement agent in foods. Balyan *et al.*, (2001) studies were conducted to optimize process parameters for extraction of mucilage from fenugreek (Trigonella foenum – graecum) for use as a stabilizer in ice cream. Also, Taro meal is unique in terms of its extremely small particle size (1 – 5 micron) and high mucilage or gum content, making it a possible replacement for corn or wheat starch in weaning

foods (Onwulata and Konstance, 2002). Others, Myllymaki (2002), Lee *et al.*, (1998), Doerfer *et al.*, (1997), Hong and Nip (1990) extracted mucilage from mucilaginous plants and determined functional properties and used juice concentration, fruit puree and sorbets as a stabilizer, emulsion and thickening agent.

Thus, the present investigation was designed to evaluate the functional properties of jew's mallow mucilage and sodium alginate as well as their effect as dough and bread improvers .

MATERIALS AND METHODS

Materials

A - Alginate (A) was obtained from Sigma chemical Co. (St. Louis, Mo, USA) is used in this study.

B - Mucilage (M) used was extracted from jew's mallow and its major components were (moisture 5.71%, protein 11.62%, ash 11.28%, and carbohydrates 56.84%). Fresh of jew's mallow leaves its major component were 90.78%, 10.94%, 31.73%, 6.11%, and 29.87% for moisture, ash, protein, fat and carbohydrates, respectively.

C -Bread ingredients: sucrose and salt (commercial grade), oil (corn oil), activated compressed yeast, was obtained from company of Alex. and wheat flour (72 % extraction) contained 12.5 % moisture, 11.48 % protein, 1.15 % fat, 0.57 % ash and 74.30 % total carbohydrates) was obtained from 6 October Company for milling and marketing.

Methods

A - Extraction and preparation of jew's mallow mucilage:

Leaves of jew's mallow were cleaned and washed then drying in oven. Dry leaves were milling in blender. Mucilage was extracted as described by Laidlow and Percial, 1950).

B- Functional properties:

1- Thickening:

Thickening ability of aqueous solution of jew's mallow mucilage and alginate due to their ability to record high values of viscosity was studied. Apparent viscosity measurements of aqueous solutions of 2 % concentration of the tested samples were determined by using the Brookfield digital viscometer according to Prakongpan *et al.*, (2002).

2- Water and oil retention capacity:

The water and oil retention capacity of the different jew's mallow mucilage and alginate samples were determined following to the method described by Ang (1991).

3- Solubility:

The ability of jew's mallow mucilage and alginate to soluble in cold water (2°C – 4 °C) and hot water (90 °C) was tested according to Sharma (1981).

C- Rheological properties (Dough properties):

Rheological properties of the wheat flour with and without mucilage and alginate were carried out with a Farinograph and Extensogrsph for the Egyptian Baking Technology Center (EBTC) according to the method described in A. A. C. C. (1996).

D- Bread making method:

Bread making was performed according to Seguchi *et al.*, (1997). Flour 100 %, compressed yeast 2.9 %, sugar 5.0 %, salt 1.0 %, corn oil 2 % and water according to the baking absorption estimated from the pharinograph absorption at 500 B.U. were mixed. Mucilage and alginate were used as added for 0.0, 0.2, 0.6 % of wheat flour, in addition to mixture of them.

E- Chemical, physical and sensory qualities:

1- Chemical quality :

Moisture, ash, protein and fat contents of different samples were determined according to the methods described in A. O. A. C. (1990).

2-Physical quality:

The weight and volume of pan bread were measured after one hour of baking and during storage (Randez – Gil *et al.*, 1995). The ratio of volume to weight was also calculated to obtain the specific volume.

3-Sensory quality :

The organoleptic evaluation for pan bread was estimated with a possible overall of 100 according to Faridi and Rubenthaler (1984).

F- Staling of bread:

The baked bread was cooled at room temperature and stored at 25-27 ^{0} c & 4-5 ^{0} c in polyethylene bags to prevent moisture loss. Staling was periodically measured throughout the days of storage . Bread was cut into small pieces, dried at 130 ^{0} c for 4 h, and then ground The bread staling was measured by alkaline water retention capacity (AWRC) according to Mahmoud and Abou – Arab (1989).

The freshness values during storage were calculated as follows :

$$\frac{\text{\% water retention of stored sample}}{\text{\% water retention of fresh sample}} \times 100 .$$

G- Statistical analysis:

The statistical Analysis System (SAS, 1996) was used to carry out mean values, standard errors in addition to an over all analysis of variance (ANOVA) and least significant differences (LSD) at 0.01.

RESULTS AND DISCUSSION

1-Functional properties:

1.1- Solubility, water and oil retention capacity and viscosity:

Water and oil retention capacity, solubility and viscosity of jew s mallow mucilage and alginate were determined and their results are shown in Table (1). Overall, it was found that, jew s mallow mucilage could retain more water and oil than sodium alginate. The characteristics of fibers in imbiling and swelling in water are important not only in food application but also in human gastrointestinal function. All fibers are hydrophilic, so they could retain a larger amount of water than oil. These findings are confirmed with that of Prakongpan *et al.*, 2002.

The ability of thickening aqueous solutions (refer to viscosity) and solubility are most important application of polysaccharides and fibers in food. Therefore, the apparent viscosity at speed 100 and solubility of jew s mallow mucilage were measured and results are presented in Table (1).

Table (1): Functionally properties of sodium alginate and Jew's mallow mucilage

Samples	Solubility Hot Cold	Oil retention g oil / g sample	Water retention g water / g sample	Viscosity at speed 100 (cps)
Sodium alginate	- +	0.88	4.95	11.00
Jew's mallow mucilage	+ +	7.00	27.30	27.40

- : Non soluble
+ : Soluble

2- Sensory evaluation and specific volume of bread :

It is notable that this positive effect in bread height and volume with added improved agent especially mixtures (0.1% M + 0.1% A) compared with control sample .

Sensory properties data of bread prepared using 0.0, 0.2 and 0.6 % of jew's mallow mucilage and alginate and mixture are given in Table (2). Generally, there were significantly improvement in attributes especially in general appearance, taste and odor as a result of these treatments. Meanwhile, samples containing jew's mallow mucilage had lower values in crumb color than control, alginate and mixture samples.

From the previous data it could be concluded that, jew's mallow mucilage, alginate and their mixture which percentage of 0.6, 0.2 and 0.2 %, respectively could be improved keeping quality of bread manufacture and also, as an antistaling agents in the same product.

Table (2): Effect of concentration (%) of jew's mallow mucilage and sodium alginate on sensory and physical attributes of bread

Treatments	C	M		A		M + A	
Parameters	0.0 %	0.2 %	0.6 %	0.2 %	0.6 %	0.2 %	0.6 %
General appearance (20)	16.0 ^{b}	16.5 ^{b}	18.1 ^{a}	17.9 ^{a}	18.9 ^{a}	18.6 ^{a}	18.3 ^{a}
Crust color (10)	8.8 ^{ab}	8.5 ^{b}	8.9 ^{ab}	9.0 ^{ab}	9.3 ^{a}	9.2 ^{a}	8.7 $^{a b}$
Crumb color (5)	4.6 ^{ab}	4.0 ^{cd}	3.2 ^{d}	4.8 ^{a}	4.8 ^{a}	4.6 $^{a b}$	4.2 ^{bc}
Crumb distribution (15)	12.3 ^{b}	12.2 ^{b}	13.9 ^{a}	13.9 ^{a}	14.2 ^{a}	13.8 ^{a}	12.6 ^{b}
Crumb texture (10)	6.9 ^{b}	7.2 ^{b}	8.5 ^{a}	8.4 ^{ab}	9.0 ^{a}	8.7 ^{a}	8.9 $^{a b}$
Pocket formation (20)	16.2 ^{c}	16.2 ^{c}	18.3 ^{ab}	18.2 ^{ab}	18.8 ^{a}	17.7 $^{a b}$	17.2 ^{bc}
Taste (10)	7.4 ^{c}	8.0 ^{b}	8.6 ^{ab}	8.5 ^{ab}	8.7 ^{a}	8.8 ^{a}	8.3 $^{a b}$
Odor (10)	7.4 ^{c}	8.3 ^{b}	8.9 ^{ab}	8.9 ^{ab}	9.1 ^{a}	9.2 ^{a}	8.4 ^{bc}
Overall acceptability (100)	79.6 ^{d}	80.9 ^{d}	88.3 ^{bc}	89.4 ^{abc}	92.8 ^{a}	90.6 $^{a b}$	85.8 ^{c}
Specific volume (cm^3/g)	3.29 ^{d}	3.41 ^{cd}	4.12 ^{b}	3.59 ^{c}	4.10 ^{b}	4.04 ^{b}	4.36 ^{a}

a, b,.....Means with the same superscript letter within the same parameter are not significantly different ($p > 0.01$).

C: Control samples M: Jew's mallow mucilage (0.6%) samples A: Sodium alginate (0.2%) samples

M + A: Mixture of Jew's mellow mucilage (0.1%) + Sodium alginate (0.1%) samples

In the same time, data indicated that specific volume of bread was varied depending on concentration of jew' s mallow mucilage and alginate. Bread sample contained 0.6 % mixture (0.3 % mucilage + 0.3 % alginate) was significantly the highest of specific volume (4.36 cm^3/g). Generally, all samples had specific volume values higher than control sample (3.29 cm^3/g).

These results are agreements with Anonymous (1989) and Kulp *et al.*, (1991) who stated that volume and specific volume are indications of bread lightness which means that the higher the values of volume and specific volume the lighter the bread is.

Therefore doughs containing 0.6, 0.2 and 0.2 % of M, A and M+A were subjected for further studies.

3- Rheological properties of dough containing different concentrations of jew' s mallow mucilage and sodium alginate and mixture of them:

For study the effect of adding of 0.6 % jew' s mallow mucilage and 0.2 % of sodium alginate and mixture of 0.1 % mucilage + 0.1 % alginate to wheat flour on rheological properties of dough, the results are given in Table (3). From these data, it could be noticed that, water absorption precent was increased with the addition of mucilage and alginate depend on the concentration of them than that of control. This behaviour is due to the high water retention capacity for mucilage and alginate. The wheat flour sample was the similar in dough development time as compared with the other treatments. Dough stability is an important index for the flour strength. The results revealed that the dough

containing 0.6 % M, 0.2 % A and (0.1 % M + 0.1 % A) were higher in dough stability as compared with the wheat flour dough. This is may be due to the presence of organic phosphates and phosphorus which have negative electric charges, thus stimulating hydrogen bond formation and increasing dough stability (Farag *et al.*, 1999).

The mixture sample (0.1 % M + 0.1 % A) had the highest tolerance index as compared with the other samples. Degree of weakening by the addition of jew s mallow mucilage, alginate and mixture to wheat flour which caused an decreasing in this parameter of dough as compared with the control sample

Also, the data presented in the same Table (3), show the properties of wheat flour dough and the dough containing different concentrations of mucilage and alginate examined by extensograph. The results gave an identical image for the effect of formation and deformation of chemical and non chemical bonds in the mechanism of dough formation. The results show that mixing of wheat flour with addition caused an increase in resistance to extension of the dough. On the other hand, all the treatments had low extensibility compared with the control one.

The proportional number is the ratio of resistance to extension / extensibility. Data in Table (3) indicated that, the control sample gave the lowest value of proportional number followed by M sample then A sample and finally M + A sample. Considering to extensibility energy, it is clear that, the area under the extinsogram increased especially in M + A sample indicating the increase of resistance to extension.

Table (3): Effect of adding jew's mallow mucilage and alginate to wheat flour on the rheological properties of dough

Indices	Wheat flour dough	Jew's mallow mucilage (0.6%)	Sodium Alginate (0.2%)	0.1 % mucilage + 0.1 % alginate
Farinograph results				
Water absorb (%)	57.70	61.5	61.30	59.3
Dough development (min)	2.0	2.0	2.0	2.0
Dough stability (min)	1.5	2.0	2.0	2.0
Mixing tolerance index (B.U.)	80.0	70.0	70.0	90.0
Degree of weakening (B.U.)	100.0	60.0	80.0	90.0
Extensograph results				
Extensibility (E) (mm)	160.0	115.0	120.0	115.0
Resistance to extension (R)	725.0	870.0	940.0	980.0
Proportional number (R/E)	4.53	7.56	7.83	8.52
Area under the curve (cm^2)	137.0	134.0	134.0	140.0

4- Chemical analysis of pan bread prepared from selected concentration of jew's mallow mucilage and alginate and mixture of them:

The chemical composition of pan bread added 0.6 % jew' s mallow mucilage, 0.2 % alginate and 0.2 % mixture (0.1 % M + 0.1 % A) to wheat flour are presented in Table (4). The protein, fat and ash contents were increased with added 0.6 % jew' s mallow mucilage, while, the total carbohydrate was decreased by added. These results are in agreement with those of Latif (1997); Khalon and Chow (2000).

Table (4): Chemical compositions * of bread produced by added Jew's mallow mucilage, sodium alginate and mixture to wheat flour (dry weight basis)

Treatments	Moisture content %	Protein %	Fat %	Ash %	Total carbohy-drate** (%)
C	37.10±0.38	12.04±0.36	1.93±0.35	1.24±0.17	84.79
M	36.33±0.44	12.31±0.71	2.01±0.22	1.36±0.25	84.32
A	36.91±0.53	11.89±0.64	1.83±0.18	1.19±0.15	85.09
M+A	37.47±0.88	12.01±0.34	1.98±0.35	1.34±0.19	84.67

*: Means of three replicates ± standard error

**: Total carbohydrate was calculated by difference .

5-Specific volume in bread as effected of storage at room and cooling temperature:

As shown in the same Tables (5 and 6), the addition of 0.6% jew's mallow mucilage (M), 0.2% alginate (A) and mixture of (0.1% M + 0.1% A) caused a noticeable increase in specific volume in bread. These results are coincided with that of Prakongpan *et al.*, 2002. Who attributed this increase to the help of particles of fiber in the distribution of air cells during the preparation steps. Also, fibers have high water retention capacity; the pan bread had greater ability to hold air cells inside. Moreover, the shelf life of finished products is prolonged because moisture is retained in the products due to the hydrophilic property of fiber. Specific volume of bread was affected by storage conditions (room or cooling temp.). The loss of that attribute was referred to the evaporation of water from the surface of baked products during storage (Ziderman and Friedman, 1985).

From the same Tables (5 and 6), it could be noticed that, the mixture of M + A treatment provided the highest specific volume during storage compared with the other treatments. For example, the lost of this criteria was 27.75, 21.57, 23.08 and 13.14 % for C, M, A, and M + A treatments, respectively after 3 days of room storage. About cooling storage it reached 47.64, 37.05, 43.27 and 38.49 % for the same samples after 7 days of that storage.

Table (5): Effect of storage periods (days) at room temperature on specific volume (cm 3/ g) of mucilage and alginate and mixture of them. bread produced by added jew's mallow

Storage time (days)	Treatments			
	C	M	A	M + A
0	3.82^{Ba}	3.94^{Ba}	4.16^{Aa}	4.26^{Aa}
1	3.26^{Cb}	3.55^{Bb}	3.57^{Bb}	3.79^{Ab}
2	3.10^{Bb}	3.41^{Ab}	3.50^{Ab}	3.60^{Ac}
3	2.76^{Cc}	3.09^{Bc}	3.20^{Bc}	3.70^{Ad}

Table (6): Effect of storage periods (days) at cooling temperature on specific volume (cm 3/ g) of bread produced by added jew' s mallow mucilage and alginate and mixture of them:

Storage time (days)	Treatments			
	C	M	A	M + A
0	3.82^{Ab}	3.94^{Ab}	4.16^{Aa}	4.26^{Aa}
1	3.33^{Bc}	3.75^{Bb}	3.86^{Bb}	4.04^{Ab}
2	3.19^{Cc}	3.48^{Cb}	3.62^{Ac}	3.69^{Ac}
3	3.00^{Dc}	3.20^{Db}	3.26^{Bd}	3.53^{Ad}
4	2.79^{Ec}	2.96^{Eb}	3.02^{Be}	3.29^{Ae}
5	2.48^{Fd}	2.75^{Fe}	2.91^{Be}	3.00^{Af}
6	2.37^{Ge}	2.57^{Gb}	2.45^{Cf}	2.74^{Ag}
7	2.00^{Fe}	2.48^{Gb}	2.36^{Cf}	2.62^{Ag}

a, b,....Any two means have the same small letter within the same storage time have no significant difference ($p > 0.01$)

A, B,....Any two means have the same capital letter within the same treatment have no significant difference ($p > 0.01$).

6- Effect of storage (at room & cooling temp.) on stability of bread:

6-1 Sensory attributes:

Sensory evaluation data of pan bread made by added 0.6% jew's mallow mucilage, 0.2 % alginate and mixture of (0.1% M + 0.1% A) to wheat flour are recorded in Tables (7 and 8). Generally, bread with 0.2% alginate and mixture of (0.1% M + 0.1% A) were better quality and showed significantly superior sensory properties scores than control and those contained 0.6% jew's mallow mucilage at zero time as shown in fig. (1). Bread samples stored at room and cooling temp. for 1-3 days (Table 7) and 1-7 days (Table 8), respectively significantly reduced all their sensory properties but the maximum reduction was shown by samples stored at room temp. than those stored at cooling temp. Changes in attributes were much faster in control sample than added 0.6% jew's mallow mucilage (M), 0.2% alginate (A) and mixture of (0.1% M + 0.1% A) samples.

After storage for 3 days on room temp. bread samples became unacceptable, while, bread samples stored at cooling temp. gave higher values till 4 days and were be desirable till the end of storage period.

Table (7): Effect of storage periods (days) at room temperature (25°C – 27°C) on sensory properties of bread produced by added jew,s mallow mucilage and alginate

Storage time (days)	Treatments			
	C	M (0.6 %)	A (0.2 %)	(M 0.1% + 0.1% A)
General appearance (20)				
Zero	16.2^{Ba}	17.0^{Ba}	18.7^{Aa}	18.5^{Aa}
1	15.5^{Ba}	15.5^{Bb}	17.4^{Ab}	17.8^{Aa}
2	12.6^{Cb}	12.8^{BCc}	14.2^{ABc}	14.8^{Ab}
3	10.0^{Ba}	11.3^{Bd}	12.1^{ABd}	13.1^{Ac}
Crust color (10)				
Zero	7.6^{Ba}	7.7^{Ba}	9.0^{Aa}	9.0^{Aa}
1	6.8^{Ba}	6.6^{Bb}	7.8^{Ab}	7.8^{Ab}
2	4.0^{Bb}	4.0^{Bc}	5.4^{Ac}	5.8^{Ac}
3	2.8^{Cc}	3.0^{BCd}	3.6^{Abd}	4.2^{Ad}
Crumb color (5)				
Zero	3.6^{Ca}	3.4^{Ba}	4.2^{Aa}	4.2^{Aa}
1	3.7^{Aa}	2.9^{Bab}	3.5^{Abb}	3.6^{ABb}
2	2.8^{BCd}	2.4^{Cb}	3.0^{Bc}	3.8^{Aab}
3	1.9^{Cc}	2.4^{Bb}	2.8^{Bd}	3.5^{Ab}
Crumb distribution (15)				
Zero	12.9^{Ba}	13.2^{Ba}	14.0^{Aa}	14.4^{Aa}
1	12.8^{Aba}	12.3^{Ba}	13.2^{Ab}	13.4^{Ab}
2	11.2^{Bb}	10.7^{Bb}	12.2^{Ac}	12.6^{Ac}
3	8.9^{Bc}	9.3^{Bc}	10.7^{Ad}	11.6^{Ad}
Crumb texture (10)				
Zero	7.2^{Ca}	7.8^{Ba}	8.2^{Ba}	8.9^{Aa}
1	7.0^{Ba}	6.9^{Bb}	7.9^{Aa}	8.2^{Aa}
2	5.0^{Ab}	5.6^{Ac}	6.0^{Ab}	6.2^{Ab}
3	4.0^{Cc}	4.8^{BCc}	5.6^{ABb}	5.9^{Ab}
Pocket formation (20)				
Zero	17.2^{Ca}	17.9^{Ba}	18.4^{Aba}	18.9^{Aa}
1	16.9^{Ba}	16.9^{Ba}	17.3^{Ba}	18.0^{Ad}
2	12.6^{Bb}	13.6^{ABb}	14.0^{Abb}	14.8^{Ab}
3	9.9^{Bc}	11.6^{Ac}	12.2^{Ac}	12.9^{Ac}
Taste (10)				
Zero	7.5^{Ba}	7.8^{Ba}	8.9^{Aa}	9.3^{Aa}
1	7.9^{Ba}	6.7^{Cb}	8.1^{Abb}	8.5^{Ab}
2	5.0^{Bb}	4.7^{Bc}	5.8^{Ac}	6.1^{Ac}
3	4.1^{Bc}	4.4^{Bc}	4.8^{Abd}	5.2^{Ad}
Odor (10)				
Zero	7.4^{Ca}	7.9^{Ba}	8.9^{Aa}	9.1^{Aa}
1	7.7^{Aba}	7.4^{Ba}	8.1^{Aba}	8.4^{Ad}
2	5.2^{BCb}	4.9^{Cb}	6.2^{Abb}	6.6^{Ab}
3	4.1^{Bc}	4.2^{Bb}	5.1^{Ac}	5.4^{AC}
Overall acceptability (100)				
Zero	79.6^{Ca}	82.7^{Ba}	90.3^{Aa}	92.3^{Aa}
1	78.9^{Ba}	75.2^{Cb}	83.7^{Ab}	85.7^{Ab}
2	58.2^{Bb}	58.7^{Bc}	66.8^{Ac}	70.7^{Ac}
3	45.9^{Dc}	51.0^{Cd}	56.6^{Bd}	61.8^{Ad}

a, b,....Any two means have the same small letter within the same storage time have no significant difference ($p > 0.01$)

A, B,....Any two means have the same capital letter within the same treatment have no significant difference ($p > 0.01$)

Table (8): Effect of storage periods (days) at cooling temperature (4°C – 5°C) on sensory properties of bread produced by added jew, s mallow mucilage and alginate

Storage time (days)	Treatments			
	C	M	A	(M 0.1% + 0.1% A)
General appearance (20)				
Zero	16.2^{Bab}	17.0^{Ba}	18.7^{Aa}	18.5^{Aab}
1	16.6^{Ca}	16.9^{Ca}	18.2^{Ba}	19.0^{Aa}
2	15.3^{Bb}	14.7^{Bb}	16.7^{Ab}	17.5^{Abc}
3	13.0^{Cc}	13.4^{Cc}	15.6^{Bc}	16.7^{Ac}
4	10.0^{Cd}	11.5^{Bd}	13.1^{Ad}	14.2^{Ad}
5	6.8^{De}	8.7^{Ce}	9.9^{Be}	11.5^{Ae}
6	4.5^{Cf}	5.6^{BCf}	6.7^{Bf}	8.2^{Af}
7	3.3^{Bg}	4.2^{Bg}	5.5^{Ag}	6.6^{Ag}
Crust color (10)				
Zero	7.6^{Bab}	7.7^{Ba}	9.0^{Aa}	9.0^{Aa}
1	8.1^{Ba}	7.5^{Ca}	8.7^{Aa}	8.8^{Aa}
2	6.8^{Bb}	6.1^{Bb}	8.1^{Ab}	8.1^{Ab}
3	5.3^{Cc}	5.7^{Cb}	7.0^{Bc}	7.7^{Ab}
4	5.0^{Cc}	4.8^{Cc}	6.0^{Bd}	6.4^{Ac}
5	3.4^{Bd}	3.4^{Bd}	4.8^{Ae}	4.8^{Ad}
6	2.9^{Cd}	3.6^{Bd}	4.4^{Ae}	4.6^{Ad}
7	1.9^{Ce}	2.8^{Be}	$٣,٤^{ABf}$	4.0^{Ae}
Crumb color (5)				
Zero	3.6^{Ba}	3.4^{Ba}	4.2^{Aa}	4.2^{Aa}
1	3.7^{ABa}	3.4^{Ba}	4.0^{Aab}	4.1^{Aab}
2	3.7^{ABa}	3.2^{Ba}	3.9^{Aab}	4.0^{Aabc}
3	3.2^{Bab}	3.0^{Bab}	3.7^{Abc}	4.0^{Aabc}
4	2.8^{Bb}	2.2^{Ccd}	3.2^{ABde}	3.6^{Acd}
5	2.8^{Bb}	2.3^{Cc}	3.0^{Be}	3.4^{Ade}
6	3.2^{Aab}	2.6^{Bbc}	3.5^{Acd}	3.7^{Abcd}
7	2.2^{BCc}	1.8^{Cd}	2.6^{ABf}	3.1^{Ae}
Crumb distribution (15)				
Zero	12.9^{Ba}	13.2^{Ba}	14.0^{Aa}	14.4^{Aa}
1	13.5^{Aa}	13.5^{Aa}	13.8^{Aa}	14.0^{Aab}
2	11.9^{BCb}	10.6^{Cb}	12.4^{ABb}	13.5^{Ab}
3	11.0^{Bc}	10.8^{Bb}	11.5^{Bc}	12.7^{Ac}
4	10.0^{Cd}	10.6^{BCb}	11.3^{Bc}	12.4^{Ac}
5	7.5^{Ce}	8.2^{Cc}	9.3^{Bd}	10.4^{Ad}
6	5.0^{Bf}	5.7^{Bd}	7.0^{Ae}	8.0^{Ae}
7	3.0^{Cg}	4.4^{Be}	5.3^{ABf}	6.2^{Af}
Crumb texture (10)				
Zero	7.2^{Cab}	7.8^{Ba}	8.2^{Bab}	8.9^{Aa}
1	7.8^{Ba}	7.9^{Ba}	8.7^{Aa}	8.6^{Aab}
2	6.7^{Cb}	7.5^{Ba}	7.8^{ABb}	8.2^{Ab}
3	5.7^{Cc}	6.2^{BCb}	6.9^{ABc}	7.5^{Ac}
4	3.8^{Cd}	4.8^{Bc}	5.6^{ABd}	6.0^{Ad}
5	3.0^{Ce}	3.6^{Bd}	4.6^{Ae}	4.8^{Ae}
6	2.5^{Cef}	3.2^{Bde}	4.2^{Ae}	4.6^{Ae}
7	2.0^{Df}	2.6^{Ce}	3.2^{Bf}	3.9^{Af}

Continued Table (8):

Storage time (days)	Treatments			
	C	M	A	(M 0.1% + 0.1% A)
Pocket formation (20)				
Zero	17.2^{Ca}	17.9^{Ba}	18.4^{ABab}	18.9^{Aa}
1	17.7^{Ba}	18.2^{ABa}	18.7^{Aa}	18.7^{Aa}
2	15.2^{Bb}	15.2^{Bb}	17.5^{Ab}	16.8^{Ab}
3	13.9^{Bc}	14.4^{Bb}	16.0^{Ac}	16.7^{Ab}
4	11.1^{Cd}	12.5^{Bc}	13.7^{ABd}	14.5^{Ac}
5	7.0^{De}	8.4^{Cd}	9.9^{Be}	11.1^{Ad}
6	4.8^{Cf}	5.9^{BCe}	7.2^{ABf}	8.4^{Ae}
7	3.4^{Dg}	4.7^{Cf}	5.8^{Bg}	7.0^{Af}
Taste (10)				
Zero	7.5^{Bb}	7.8^{Ba}	8.9^{Aa}	9.3^{Aa}
1	8.5^{BCa}	7.9^{Ca}	9.1^{ABa}	9.2^{Aa}
2	6.3^{Bc}	6.9^{Bb}	8.6^{Aa}	8.3^{Ab}
3	5.2^{Cd}	6.1^{Bc}	7.5^{Ab}	8.0^{Ab}
4	4.8^{Cd}	5.8^{Bc}	6.8^{Ac}	6.8^{Ac}
5	3.6^{Be}	3.8^{Bd}	5.3^{Ab}	5.7^{Ad}
6	2.2^{Df}	3.6^{Cd}	4.6^{Be}	5.6^{Ad}
7	1.4^{Dg}	2.6^{Ce}	3.6^{Bf}	4.7^{Ae}
Odor (10)				
Zero	7.4^{Cb}	7.9^{Ba}	8.9^{Aab}	9.1^{Aa}
1	8.5^{BCa}	8.4^{Ca}	9.1^{ABa}	9.3^{Aa}
2	6.3^{Cc}	7.1^{Bb}	8.4^{Ab}	8.6^{Ab}
3	5.4^{Cd}	6.3^{Bc}	7.5^{Ac}	8.2^{Ab}
4	4.6^{Ce}	5.8^{Bc}	6.8^{Ad}	7.2^{Ac}
5	3.8^{Cf}	4.3^{Bd}	5.2^{Ae}	5.6^{Ad}
6	2.4^{Dg}	3.6^{Ce}	4.5^{Bf}	5.6^{Ad}
7	1.5^{Dh}	2.6^{Cf}	3.8^{Bg}	4.6^{Ae}
Overall acceptability (100)				
Zero	79.6^{Cb}	82.7^{Ba}	90.3^{Aa}	92.3^{Aa}
1	84.4^{Ba}	83.7^{Ba}	90.3^{Aa}	91.7^{Aa}
2	72.1^{Bc}	71.2^{Bb}	83.4^{Ab}	85.0^{Ab}
3	62.5^{Dd}	66.0^{Cc}	75.7^{Bc}	81.5^{Ac}
4	52.1^{De}	58.0^{Cd}	66.2^{Bd}	70.6^{Ad}
5	37.9^{Df}	42.2^{Ce}	51.6^{Be}	57.3^{Ae}
6	27.5^{Dg}	33.8^{Cf}	41.0^{Bf}	48.9^{Af}
7	18.7^{Dh}	25.7^{Cg}	32.3^{Bg}	40.1^{Ag}

a, b,....Any two means have the same small letter within the same storage time have no significant difference ($p > 0.01$)

A, B,....Any two means have the same capital letter within the same treatment have no significant difference ($p > 0.01$)

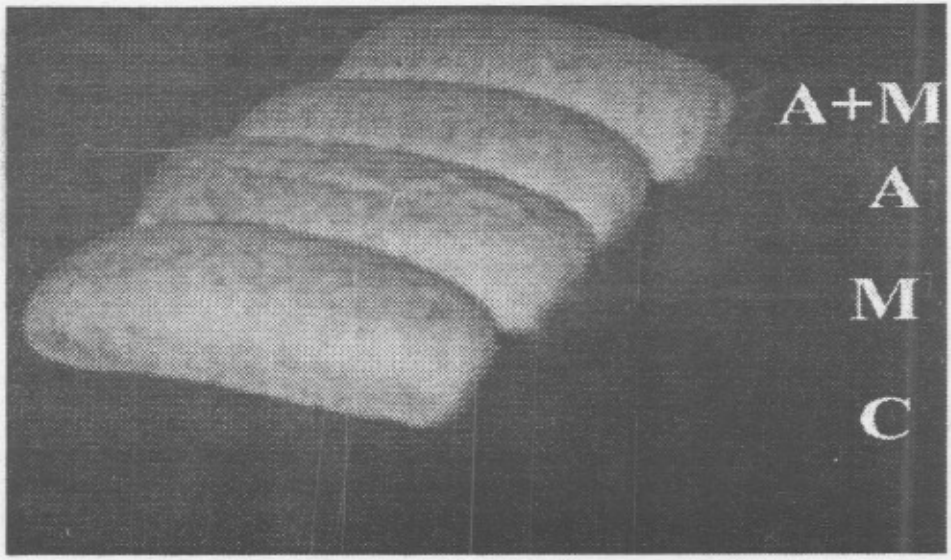

Fig (1): Photographs of bread.(C)Original bread control, (M) bread containing 0.6% jew's mallow mucilage, (A) 0.2% sodium alginate and (A + M) mixtures (0.1% A+ 0.1% M)

6-2. Freshness:

The results are given in Figs (2, 3), revealed a noticeable decrease in freshness of bread after 1-3 days of storage at room temp. (25°C - 27°C), 1-7 days of storage at cooling temp. (4°C - 5 °C) as shown in Fig 2 & 3. Control of bread stored at room temperature (25°C - 27°C) for (1-3) days and cooling temperature (4 °C - 5 °C) for (1-7) days had higher reduction of freshness compared to the other treatments (addition of 0.6 % jew's mallow mucilage or 0.2 % alginate or mixture of them; 0.1 % M + 0.1 % A.

The lower reduction in freshness values were achieved in bread with 0.6% M samples and then M + A samples, since the staling reached 362.66, 423.38, 403.33 and 414.18 for C, M, A and M + A samples after 3 days of storage at room temp., respectively. Meanwhile, it reached for the same treatments after 7 days of storage at cooling temp. 310.66, 378.88, 374.90 and 394.41, respectively.

From the above results we could known that, the addition of either Jew's mallow mucilage (0.6%) or mixture of Jew's mallow mucilage (0.1%) and alginate (0.1%) caused a considerable improvement in bread freshness compared to control.

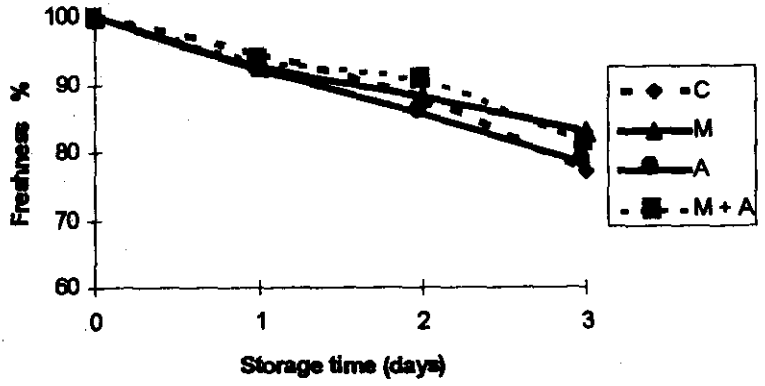

Fig (2): Effect of adding jew's mallow mucilage and sodium alginate to wheat flour on freshness of bread during different storage periods at room temperature(4°C - 5°C)

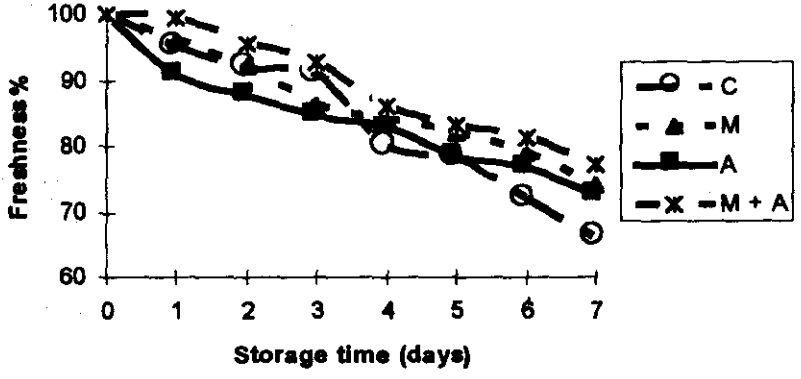

Fig (3): Effect of adding jew's mallow mucilage and sodium alginate to wheat flour on freshness of bread during different storage periods at cooling temperature (4°C - 5°C).

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15

الخصائص الوظيفية لميوسيلاج الملوخية والجينات الصوديوم وتأثيرها على جودة العجين والخبز

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تم تقييم الخصائص الوظيفيه والمتمثله في (التغليظ والذوبان والقدره علي الإحتفاظ بالماء والزيت) لكلا من ميوسيلاج الملوخيه والجينات الصوديوم حيث أوضحت عينات الميوسيلاج أرقام أعلي للخصائص السابقه للتركيزات المختلفه .كما أظهرت النتائج المتحصل عليها أن إضافه ميوسيلاج الملوخيه بتركيز ٠,٦ % وكذلك إضافه الجينات الصوديوم بتركيز ٠,٢ % وخليط منهما بتركيز (٠,١ % ميوسيلاج + ٠,١ % الجينات الصوديوم) لها تاثير ايجابى على ارتفاع وحجم الخبز الناتج بأضافة المواد المحسنة وبخاصة الخليط منها (١و%ميوسيلاج + ١و%الجينات الصوديوم).وبصفة عامة هناك تحسن معنوى فى الخصائص الحسية خاصة فى المظهر العام والمذاق والرائحة كنتيجة لهذه الأضافات . دلت نتائج الفارينوجراف أن أضافة الميوسيلاج والجينات الصوديوم والخليط منهما إلي دقيق القمح يؤدى الى زيادة نسبة امتصاص الماء (٦١,٥ و٦١,٣ و٥٩,٣ %) للعينات السابقة الذكر بالمقارنة بالعينة الكنترول (٥٧,٧ %)، بينما درجة الضعف قلت معنويا بالاضافات بالمقارنة بالعينة الكنترول (٦٠ و٨٠ و٩٠ و١٠٠ وحدة برابندر على التوالى). دلت نتائج الاكستنسوجراف ان العينة الكنترول اعطت اقل رقم للمقاومة للشد ٧٢٥ وحدة برابندر يليها عينة ميوسيلاج الملوخية (٨٧٠ وحدة برابندر) ثم الجينات الصوديوم (٩٤٠ وحدة برابندر)واخيرا الخليط (٩٨٠ وحدة برابندر). ومن جهه أخري بلغت نسبه الإنخفاض

في الحجم النوعي للخبز ٢٧,٧٤ %، ٢١,٥٧ %، ٢٣,٠٨ %، ١٣,١٤ % للكنترول وميوسيلاج الملوخيه والألجينات والخليط علي التوالي وذلك عند تخزين الخبز لمده ٣ أيام علي درجه حراره الغرفه. وظهر نفس الإتجاه في العينات المخزنه علي درجه حراره التبريد ولمده ٧ أيام حيث بلغت نسبه الإنخفاض٤٧,٦٤%، ٣٧,٠٥%، ٤٣,٢٧ %، ٣٨,٤٩ %، لنفس المعاملات. كما اوضحت النتائج ان الخبز المحتوى على الميوسيلاج والالجينات والخليط بينهم اعطى معنوية اعلى للصفات الحسية وخصوصا توزيع اللبابة وتركيب اللبابة بالاضافةالى المذاق أثناء التخزين (٢٥- ٢٧°م ٤-٥ °م).

كما تميزت المعامله بالميوسيلاج عن غيرها من المعاملات، حيث أعطت هذه المعامله طزاجه للخبز أفضل وذلك عند تخزين الخبز علي درجه حراره الغرفه ولمده ٣ أيام حيث بلغت % للطزاجه ٨٢,٧٥ . بينما أظهرت المعامله الخليط أفضل طزاجه بعد ٧ أيام تحت ظروف التخزين المبرد (% للطزاجه ٧٧,١٣) وذلك مقارنه بعينه الكنترول.