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QUALITY CHARACTERISTICS OF DRIED SHEETS PREPARED FROM BLENDED APPLE: CANTALOUPE JUICES

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ABSTRACT

This investigation was aimed to produce and evaluate untraditional dried apple/cantaloupe sheets. Physico-chemical analysis indicated that the apple and cantaloupe fruits contained 12.3 % and 9.6 % of total soluble solids, 8.77% and 1.07% of pectin based on dry weight basis, respectively. While, the cantaloupe fruits contained 194.15 mg/100g ascorbic acid, and apple fruits contained 76.24 mg/100g as dry weight basis.

Owing to the physico-chemical and organoleptic analysis of apple/cantaloupe juice blends to estimate the optimal mixing ratio, results showed that,the blend ratio of 2:1 of apple/cantaloupe was suitable for preparing the blended sheet, which gave balance in physico-chemical properties and high scores of sensory attributes (color, taste flavor and overall acceptability. The addition of Arabic gum, carboxy methyl cellulose (CMC), and starch as binding agents to the sheet formula, led to the enhancement of the product. While,adding the CMC to the apple/cantaloupe sheets, came in the first order, followed by starch, while the arabic gum was in the last one. This enhancement was in the color, the retention of ascorbic acid and the reconstitution process at zero time as well as the end of the storage of treated sheets compared with the control sheets.

Statistical analysis for color, taste, flavor and overall acceptability attributes after storage at room temperature(25°C ± 5°C) for 6 months indicated that there were significant differences between the sheets containing binding agents and the control.

INTRODUCTION

The apple fruits contain higher contents of dietary fiber, vitamins, minerals, phenols and other nutritive components.

Volos, Birkher and Balady apple fruits are the main cultivars grown in Egypt, having poor colour and flavour, small size with higher acidity (Ibrahim, 1994).But New apple cultivars successfully grown in Egypt are Anna, Ein Sheimer and Dorsett golden. Anna apple fruits were characterized by larger size, slightly acidic to sweet taste and mild flavour (Reid and Olmo, 1972).

Cantaloupe has soft and juicy texture with a sweet, musky aroma that emanates through the melon when it is ripe. *Concentrated* beta-carotene content of cantaloupe is considered an excellent source of provitamin A, it is also qualified as a very good source of ascorbic acid, B6, B3, dietary fibers, folic acid and potassium. The combination of B complex vitamins along with the fibers found in cantaloupe make it an exceptionally good fruit for supporting energy production through good carbohydrates metabolism and blood sugar stability (Baybutt *et al.*, 2000; Cho *et al.*, 2004 and Lamikanra, 2005

Dried fruits and vegetables contains some concentrated nutritional valuable constituents and considered the favorite products when being out of season. In dried sheets, the moisture content plays an a vital role in their

quality attributes (Hamed,1980). Prain *et al.*, (1969).

Unlike most insoluble forms of fiber, the soluble fiber provided by most gums when consumed in large amounts have been shown to have other benefits, such as improved response to insulin from sugar and locust bean gum and reduced cholesterol effects of sugar gum and Arabic gum (Anonymous, 1985).

Sanderson, (1996) reported that the starch is widely used as hydrocolloid in the food industry. It is the energy reserve polysaccharides in plants and occurs naturally as water-insoluble granules. One of the major advantages of granular starches is that, being soluble in cold water, they can be easily dispersed and then rendered functional by heating, which causes the granules to swell, absorb water, and impart viscosity. Carboxy methyl cellulose (CMC) has multipurposes i..e,thickening agent, and in common with other substituted cellulosics, produces extremely clear solution a distinct advantage in a number of foods. It is the ability to hydrate and build viscosity quickly making it the product of choice in some dry mixes that are reconstituted by the addition of milk or water. Voi *et al.* (1995) reported that moisture content, total acidity, total sugars and reconstitution ratio were the most important parameters affecting the quality of the dried products. The annual Egyptian production of apple and cantaloupe fruits were 546183 and 563.016 tons respectively, (Anon, 2004 and FAO, 2004).

Due to the importance of nutritive value and the excessive production of apple fruits and cantaloupe as well as the low price during their harvesting season, therefore this investigation was carried out to study the optimal conditions for producing the mixed dried sheets from apple and cantaloupe fruits. As well as to study the effect of some binding agents and storage conditions on the quality characteristics of dried apple/cantaloupe sheets.

MATERIALS AND METHODS

Materials:

Apple fruits (*Mouls domestica*), Anna variety were obtained from special farm at kalubia Governorate, Egypt, and cantaloupe fruits (*Cucumis melo*) were obtained from Elsalhia distinct, El-Sharkia Governorate, Egypt. The fruits were at the ripe stage. Starch, was obtained from the National Company of Maize products, 10th of Ramadan City, Sharkia, Egypt. Carboxy methyl cellulose (CMC), Arabic gum and Sodium metabisulfite were obtained from ADWIC Company. Sucrose was purchased from local market.

Methods:

Extraction of apple juice

The fruits were carefully sorted, washed, cut into several pieces and minced with a kitchen machine, then adding 200 ppm of sodium metabisulfite. The obtained mash was strained through two layers of cheese cloth under pressure to obtain the desired apple juice. The juice was pasteurized at 90°C for 10 min, cooled and used as a resource for blended juice.

Extraction of cantaloupe juice:

The fruits were sorted, washed, peeled with knives and cut into pieces, minced with kitchen machine, adding 200ppm of sodium metabisulfite the extract passed through cheese cloth to obtain the desired cantaloupe juice, then pasteurized at 90°C for 10 min., cooled and used as a cantaloupe juice of blending

Preparation of blended formula:

Apple and cantaloupe juices were blended at various ratios of 1:1, 2:1, and 1:2 (apple: cantaloupe) respectively. Chemical and sensory evaluation were conducted on the blends to select the suitable mixing ratio. Then added 1g/L of each of arabic gum, starch and CMC as thickening agents, and the sucrose was also added to reach the total soluble solids for blends to 18 °Brix.

Drying process:

The chosen prepared blended juices were poured into trays, which covered with paraffin oil and drying process was accomplished in an oven at 55°C for 18 hours, till the moisture content of dried sheets reached to 16-18% to obtain apple/cantaloupe sheets. The sheets were tightly packaged between two layers of cellophane. Then stored at room temperature (25±5°C) for 6 months and subjected for further analysis.

Analytical methods:

Moisture content, total soluble solids, total titratable acidity, pH value, total sugars, reducing and non reducing sugars, and ascorbic acid contents were determined according to methods in the A.O.A.C (1995). Browning index was measured according the method described by Meydev *et al.* (1977).

Alcohol insoluble solids (AIS%) was determined as described by Ting, (1976). Pectin was determined according the method of Blumenkrantz and Absoe-Hansen (1973).

The solubility rate was carried out by homogenization, centrifugation and determination of insoluble residue by disolving of 1g of the dried apple and cantaloupe sheet in 10 ml distilled water at 25°C according to the method of IAL (1977).

Sensory evaluation was done by ten trained panelists of staff members in the Food Technology Institute, Agric. Research Center, Giza, Egypt, according to the method descrybed by Larmond (1970) using 1-10 point hedonic scale. The panelists were requested for score of color, taste and aroma.

Statistical analysis

Sensory data were statistically analyzed using SPSS program, one-way ANOVA, Version, 10 (SPSS, 1990).

RESULTS AND DISCUSSION

Physico-chemical properties of fresh apple and cantaloupe fruits:

Table (1) shows the physico-chemical properties of fresh apple and cantaloupe fruits. It could be noticed that, total soluble solids of apple and cantaloupe fruits were 12.3 and 9.6 %, respectively. While the apple fruits contained 50.23%, and 7.8% of alcohol insoluble solids (AIS%) based on dry weight basis. The pectin of apple and cantaloupe were 8.77%, and 1.07%. On the other side, cantaloupe fruits had higher amount of ascorbic acid (194.15 mg/100 gm) compared to the apple fruits (76.24 mg/100g). Browning index of cantaloupe was lower than that found in apple fruits. Total, reducing and non-reducing sugars of apple were 74.58, 48.92 and 25.66% respectively. The corresponding values for cantaloupe were 72.36, 43.81 and 28.55 % respectively.

These results are in accordance with those found by Ahmed (1998) and Mekky (1999).

Physico- chemical composition and sensory evaluation of blended apple/cantaloupe juice

Physico-chemical and sensory evaluation of juice blends are very important to estimate the optimal mixing ratio of both juices, which affects the quality of blends.

Table (2) shows the effect of blending process on physico-chemical properties at various ratios in blended juices. Data revealed that, there were a good correlation between the constituents of browning index, total acidity, ascorbic acid, total, reducing and non-reducing sugars and pectin contents, whereas, the blended juices at (2:1) apple: cantaloupe was the best formula.

Table (3) shows that the ratio of 1:1 from apple and cantaloupe gave the moderate taste, color, flavor and overall acceptability, which statistically recorded 7.8, 7.2 and 7.1 degrees, respectively.

Table (1): Physico-chemical composition of fresh apple and cantaloupe fruits.

Constituents	Cultivar	
	Apple fruits	Cantaloupe fruits
Moisture content (%)	84.7	88.13
Total soluble solids %	12.3	9.6
Browning index (A420 nm)	0.442	0.358
pH value	3.83	5.77
*Total titratable acidity (%)	4.36	1.38
*Ascorbic acid (mg/100g)	76.24	194.15
*Total sugars (%)	74.58	72.36
*Reducing sugars (%)	48.92	43.81
*Non-reducing sugars (%)	25.66	28.55
*Alcohol insoluble solids(AIS%)	50.23	7.80
* Pectin (%)	8.77	1.07

* Calculated on dry weight basis

Table (2): Physico-chemical composition of various juice blends at various ratios.

Constituents	Blends of (Apple: Cantaloupe)			
	1:1	2:1		1:2
Total soluble solids %	10.8	11.20		10.30
Browning index A 420 nm	0.411	0.419		0.395
pH value	4.73	4.35		5.21
* Total titratable acidity (%)	2.91	3.42		2.35
* Ascorbic acid (mg/100g)	127.68	110.73		141.6
* Total sugars (%)	73.40	73.25		72.83
* Reducing sugars (%)	46.36	46.44		43. 13
* Non- reducing sugars (%)	27.04	26.81		29.70
* Alcohol insoluble solids (AIS%)	28.87	33.78		20.76
* Pectin (%)	4.86	5.88		3.50

* Calculated on dry weight basis

Table (3): Sensory evaluation of various blends of juice prepared by different levels of apple/ cantaloupe juices

Blends ratios of juice			Taste	Color	Flavor	Overall
Apple	:	Cantaloupe	Mean	Mean	Mean	acceptability
1	:	1	7.8^{b}	7.2^{b}	7.1^{b}	7.36
2	:	1	8.9^{a}	8.9^{a}	8.7^{a}	8.83
1	:	2	6.4^{c}	5.5^{c}	6.2^{c}	6.03

The ratio of (2:1) from apple: cantaloupe gave the higher scores in their sensory parameters. They were 8.9, 8.9,8.7 and 8.83 degrees respectively for taste, color, flavor and overall acceptability respectively.

Data also in Table (3) revealed that there were significant differences between the juice blend containing (2:1) and the other two blends in tested sensory attributes i.e. taste, color and flavor, respectively. The blended juice contained (1:2) apple: cantaloupe had the lowest scores of sensory parameters. From the sensory data, it could be observed that, the blend ratio affected the sensory properties and that could be confirmed by the physico-chemical analysis of juice blends. These results are in agreement with (Chang *et al.*, 1994), they mentioned that, in order to obtain the best product having consistent flavor, juice from

several cultivars would be needed in blends, to provide the best balance between acidity, sweetness, aroma and astringency.

Thus, the ratio of (2:1) from apple: cantaloupe juice was the best and appropriate ratio for preparing the blends based on the aforementioned analysis in this investigation

Physico-chemical composition of prepared dried sheets:

Table (4) shows some physico-chemical properties for dried sheets during storage for 6 months at ambient temperature (25C°±5C°).Results indicated that, the moisture content varied according to the type of binding agents for the prepared dried apple: cantaloupe sheets. Where, the moisture content at the initial time of preparing sheets were 16.50%,17%,18.40% and 17.40 % in the control for the appearance with Arabic gum, CMC and starch respectively. Mean-while, the moisture content increased gradually in all tested sheets with increasing storage time. On the other hand, the total titratable acidity, total sugars, reducing sugars and ascorbic acid were (3.17 %,72.22% 45.11% and 100.38 mg/ 100g), (3.22%, 73.07%,,45.23 % and 105.12 mg/100g), (3.15 %,72.25 %,45.15% and 110.72mg/100g) and (3.25%, 72.89%, 45.30% and 109.08 mg/100g) for the control and in those containing arabic gum, CMC and starch respectively. However, using various binding agents caused high retention of ascorbic acid in dried sheets, recorded 42.3%, 61.6%, 68.55% and 65.19 % retention of ascorbic acid after 6 months of storage at room temperature for control sheets, contained arabic gum CMC and starch respectively (Fig. 1). These results are in accordance with Kurata *et al.* (1973); Nguerira *et al.* (1978), Hamed *et al.* (1999) and Nagib *et al.* (2005). On the contrary, Maatuk *et al.* (1991) reported that the total titratable acidity of guava sheets was slightly increased during storage period.

The addition of binding agent gave a technological enhancement and in protecting the degradation of vitamin C Table (4) and Fig. (1). These results are in agreement with Abd El-Salam (1991) and Pakash *et al.* (1994), they mentioned that, The addition of binding agents to the dried products caused to maintain the ascorbic acid more stable. On the other hand, total sugars decreased gradually with slight difference by extending the shelf life up to 6 months, but reducing sugars and non reducing sugars were recorded little increasing up to 6 months of storage being affected by the type of binding agents used in dried sheets processing. These results are in accordance with those obtained by Nagib *et al.* (2005). The increment in reducing sugars and the decrement in the total and non reducing sugars may be resulted from the inversion and/or decomposition into reducing sugars or more simple compounds during storage of dried products (Canellas *et al.*, 1993). Browning index is the main physical parameter of the dried product. It is clear from Table (4), that the browning index was affected by the type of binding agents used in the preparation of apple : cantaloupe sheets. Where, the sheets containing CMC came in the first order recorded less browning index as O.D at 420 nm (0.650) followed by the sheets contained starch (0.655), which came in the second order, the sheets containing arabic gum (0.663), came in the third order and the control came in the last (0.726).On the other hand, the browning index developed gradually with increasing the storage period. The incremental percentage at the end of storage were 35.81, 22.17, 14.15 and 22.14% for the control sheets, sheets containing arabic gum, CMC and starch respectively. Therefore, the presence of binding agents reduced the development of browning during storage. These results are in accordance with Hamed *et al.* (1999).

Fig. (2) shows the solubility of dried sheets after reconstitution in distilled water at the initial time of storage being 61.93%, 63.0 and 66.62% of the sheets containing Arabic gum, starch and CMC respectively, compared to the control, which recorded 53.24%. Whereas, after 6 months of storage, the solubility increased in all samples especially in the sheets containing arabic gum, CMC and starch. They recorded 66%, 73.17% and 68.45%, respectively. In the dried passion fruits, the solubility ranged between 44.6% to 57.59% (Jorge *et al.*, 2003), and reached 81.56% of dried pineapple juice (Abadio *et*

al., 2004). From the data of the solubility it can be noticed that, the addition of binding agents enhanced solubility and increased the rate of reconstitution ratio in dried apple/ cantaloupe sheets.

Sensory evaluation of prepared apple : cantaloupe sheets

To perform the judgment of sensory analysis, the dried sheets were reconstituted to the original soluble solids (14%) preferred by the consumer. Sensory evaluation is used considerably in the food industry for development of the product, recipe modifications and for the evaluation of the products. It is also plays a key role in quality control and in the marketing of the products (Carpenter *et al.*, 2000).

Statistical analysis of the resultant data showed significant differences between the control sample and those containing the binding agents in their sensory parameters after 6 months of storage at room temperature (Table 5). Consumer demand for high quality, minimally processed products has increased remarkably in recent years. Preferences have shifted towards the fresh, healthy and rich flavored ready to eat foods with an enhanced shelf life. It is necessary to minimize the damage of sensory and nutritional quality (Shi and Maguer, 2000).

Table (4): Some physico-chemical properties of dried apple /cantaloupe sheet during and after storage for 6 months at room temperature.

Parameters / Storage (months)	Control			Arabic gum			CMC			Starch		
	0	3	6	0	3	6	0	3	6	0	3	6
Moisture content %	16.5	17.2	18.0	17.0	17.7	18.6	18.4	19.3	20.5	17.4	18.0	19.60
Total acidity %	3.17	3.0	2.68	3.22	3.11	2.93	3.15	3.05	2.95	3.25	3.17	2.90
Total sugars %	72.22	71.39	69.50	73.07	72.40	71.70	72.25	71.53	70.67	72.89	72.31	71.61
* Reducing sugars %	45.11	45.46	45.96	45.23	45.89	46.55	45.15	45.83	46.69	45.3	45.85	46.55
* Non-reducing sugars %	27.11	25.93	23.54	27.84	26.51	25.15	27.10	25.70	23.98	27.59	26.46	25.06
* Ascorbic acid mg/100g	100.38	85.0	42.47	105.12	92.17	64.81	110.72	101.20	75.90	109.08	95.77	71.11
Browning indexA420 nm	0.726	0.832	0.986	0.663	0.750	0.810	0.650	0.710	0.742	0.655	0.725	0.800

* CMC: Carboxy methyl cellulose

• Calculated on dry weight basis

Table (5):Sensory evaluation of rehydrated apple/ cantaloupe sheets after 6 month of storage at room temperature.

Parameters / Additive		Taste Mean	Color Mean	Flavor Mean	Overall acceptability
Control	0	7.85^{b}	8.21^{a}	8.71^{a}	8.25
	6	6.21^{d}	7.21^{c}	6.42^{f}	6.61
Starch	0	8.57^{a}	8.40^{a}	7.64^{c}	8.37
	6	7.00^{c}	7.35^{bc}	6.85^{de}	7.04
CMC*	0	8.50^{a}	7.71^{b}	8.21^{b}	8.14
	6	7.57^{b}	6.71^{d}	7.21^{d}	7.16
Arabic gum	0	8.28^{a}	7.21^{c}	8.14^{b}	7.71
	6	7.07^{c}	6.50^{d}	6.78^{cd}	6.81

* CMC: Carboxy methyl cellulose

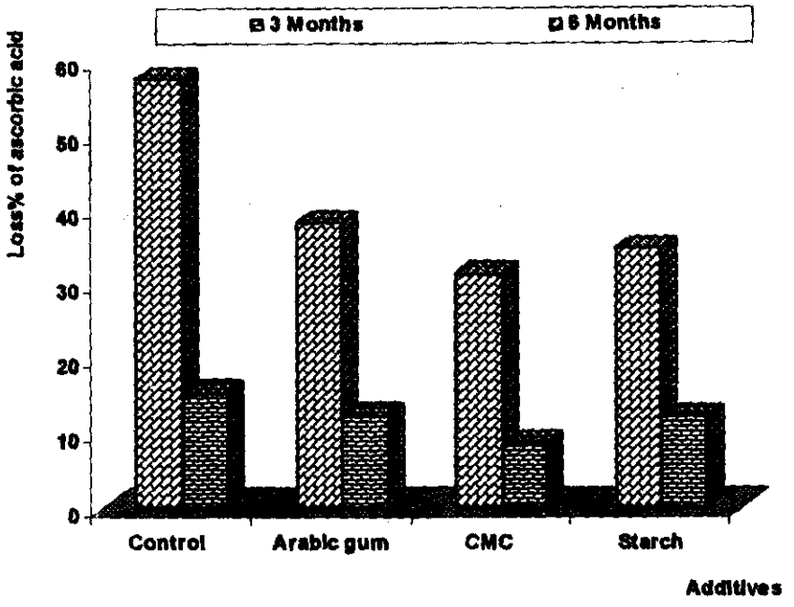

Fig.(1): Loss (%)of ascorbic acid in dried apple/cantaloupe sheets during and after storage for 6 months at room temperature.

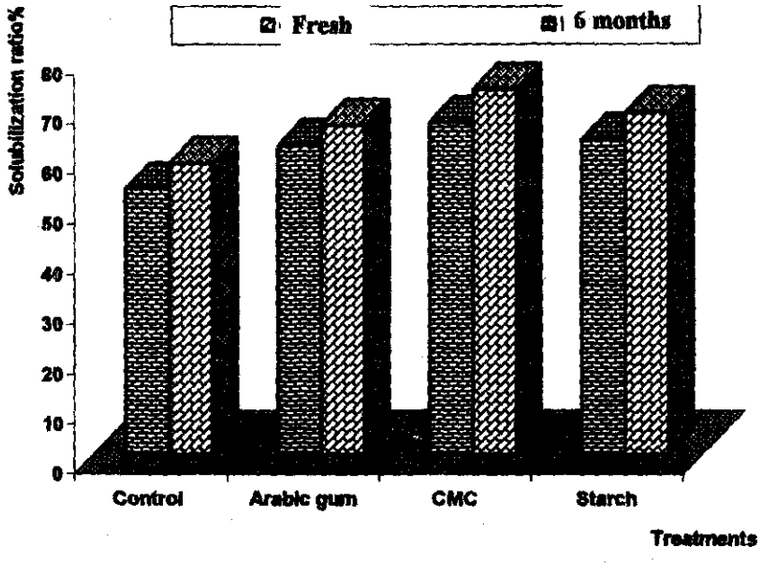

Fig. (2): Solubilization (%) of dried apple/cantaloupe sheets at zero time and after 6 months of storage at room temperature.

For instance the production of untraditional dried sheets from apple/cantaloupe fruits is possible and the addition of binding agents in this study enhanced the quality attributes of the final product, being successfully stored for 6 months at room temperature with maintaining the higher reconstitution quality.

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صفات الجودة للفائف المجففة المحضرة من مخلوط عصير التفاح والكنتالوب

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أجريت هذه الدراسة بغرض إنتاج وتقييم لفائف مجففة غير تقليدية من مخلوط عصائر التفاح والكنتالوب.

أظهرت نتائج تقييم الاختبارات الطبيعية والكيميائية أن ثمار التفاح احتوت على ١٢,٣% من المواد الصلبة الذائبة الكلية بينما احتوى الكنتالوب على ٩,٦ %. كما أظهرت النتائج أن ثمار التفاح قد احتوت على ٨,٧٧% بكتين في حين احتوى الكنتالوب على ١,٠٧% وذلك على أساس الوزن الجاف. ،ولقد احتوت ثمار الكنتالوب على نسبة مرتفعة من حمض الأسكوربيك وصلت إلى ١٩٤,١٥ ملجم/١٠٠جم مقارنة بثمار التفاح التي احتوت على ٧٦,٢٤ ملجم/١٠٠جم وذلك على أساس الوزن الجاف.

فيما يخص الاختبارات الطبيعية والكيميائيه والحسية لمخاليط عصير التفاح والكنتالوب وذلك لتحديد نسبة الخلط المثلي لكلا من عصير التفاح والكنتالوب، أوضحت النتائج أن نسبة الخلط ٢: ١ من عصير التفاح: الكنتالوب هي المناسبة لعمل اللفائف من حيث التوازن في الخواص الطبيعية والكيميائيه ،علاوة على انها حصلت على درجات مرتفعه لمقاييس التحكيم الحسي من حيث اللون والطعم والرائحة والتقبل العام.

هذا وقد أوضحت النتائج أن إضافة كل من الصمغ العربي، الكربوكسى مثيل سليلوز والنشا كمواد رابطه قد ساعدت على احتفاظ اللفائف بجودتها خلال وبعد نهاية فترة التخزين لمدة ٦ شهور على درجة حرارة الغرفة.

كما أوضحت النتائج أن إضافة الكربوكسى مثيل سليلوز عند تحضير اللفائف جعلها تأتي في المرتبة الاولى يليها تلك التي أضيف إليها النشا ثم الصمغ العربي مما أدى إلى تحسين خواص المنتج أثناء وبعد نهاية فترة التخزين لمدة ستة شهور على درجة حرارة الغرفة. حيث تمثل هذا التحسن في الحفاظ على اللون ،تقليل الفاقد من حمض الاسكوربيك والقابلية العالية للاسترجاع بعد التصنيع مباشرة وعقب انتهاء فترة التخزين، علاوة على الحفاظ على الخواص الحسية وذلك مقارنة بالكنترول. كما أوضحت نتائج التحليل الاحصائى للصفات الحسية من لون وطعم ورائحة وتقبل عام أن هناك فروقاً معنوية بين العينات المضاف إليها مواد رابطة والعينة المقارنة وذلك فيما يخص المقاييس الحسية بعد نهاية فترة التخزين.