CHANGES OCCURRING DURING DATE PICKLING PROCESS

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ABSTRACT

The possibility of production of an untraditional pickle from date (*Phownix dactylifera L.)* using date byproducts like Kimri (pre-maturated date) and Seas (unfertilized date) was the main goal of this study. In order to object this goal, both of date types were pickled in different brines (10% NaCl, 10% NaCl + 200 ppm sodium benzoate, 10% NaCl + 1% glucose + 1% starter and 10% NaCl + 0.5% citric acid), stored at room temperature for seven weeks and weekly analyzed for chemical parameters (NaCl%, TSS, pH and acidity %) and sensory evaluation. *Lactobacillus plantarum* was used as an inoculumn in date pickle. Also, total bacterial and lactic acid bacterial counts were performed. From obtained results, it was concluded that date could be considered as an excellent raw material for pickling process and using of brine mixture containing citric acid had the highest score in sensory evaluation. Finally, this search was only a trail or start and will be followed by group of studies.

INTRODUCTION

Date is an important commercial crop in Middle East and Arab countries. Egypt lies in the first largest date producer among Arab and world countries where, Egyptian date production in 2004 was 1.1 million tons which represented 16.2% of world production **(FAO, 2004)**.

Abdel-Fatah, (1995) demonstrated that date flesh part contained carbohydrate more than 50%, protein ranged between 1.5-2.9%, Fat ranged between 0.3-1.9%, fibers between 1.9-4.5% and minerals between 2.0-3.8%. While, **Ibrahim et al., (2008)** stated the following chemical composition of Hayany date: Fat 2.8%, protein 3.6%, carbohydrates 83.2%.

Date takes up to about 200 days from pollination to reach full maturation (tamr stage). During its formation and ripening the fruit passes through a number of distinct phases, each of them distinguished by one or more particular characteristics, both physiognomically and chemically. These models help to understand the development of the date through basically 4 stages named by their Arabic denominations; kimri, khalaal, rutab and tamr. Hababauk is the term used for the female flower and the period just after pollination when the young fruit is still creamy white before gradually turning green at the kimri stage. At the kimri stage there is a rapid increase in size, weight, and reducing sugars; it is the period of highest acid activity and moisture content (up to 85%). All factors level off at the end of this stage when the fruit starts to turn yellow (or red according to variety). At this point the date seed could already germinate and the fruit is botanically mature. At the khalaal stage weight gain is slow but sucrose content increases, moisture content goes down, and tannins will start to precipitate and lose their astringency. In some varieties this latter process evolves rapidly, which makes them already palatable at the khalaal stage, and one could speak of commercial maturity for this type of fruit at this stage. With (normally) the tips of the fruit starting to turn brown, the rutab stage sets in which is characterized by a decrease in weight due to moisture loss, a partial (the degree depending on the variety) inversion of sucrose into invert sugar and a browning of the skin and softening of the tissues. The moisture content goes down to about 35% and the dates at this stage are sold as fresh fruit. Only when the dates are left to ripen further on the palm will they turn into tamr, climatic conditions

permitting, characterized by a moisture content at which the date is self-preserving. The upper limit for the date to be self-preserving lies at around 24-25% **(FAO, 1993)**.

In date packing and processing operations a number of by-products are becoming available, for which a use should be found in order to improve the economics of the operation as a whole and to decrease disposal problems and costs. The main byproducts are cull dates and date pits from packing operations, and pits and presscakes from date processing**.** Practically all parts of the date palm, except perhaps the roots, are used for a purpose best suited to them. A main division of date palm parts is made as follows: a) the trunk, b) the leaves (whole leaves, midribs, leaflets and spines, and the sheath at the leaf base), c) the reproductive organs (spathes, fruit stalk, spikelets and pollen) and d) a number of palm extracts **(FAO, 1993)**.

The manufacture of pickle (fermented fruits and vegetables) has a long tradition in Egypt and there is a wide variety of typical preparations, many of them still being produced using traditional technologies.

Pickles means the product prepared entirely or predominantly from cucumbers (*Cucumis sativus L*). Clean, sound ingredients are used that may or may not have been previously subjected to fermentation and curing in a salt brine. The product is prepared and preserved through natural or controlled fermentation or by direct addition of vinegar to an equilibrated pH of 4.6 or below. The equilibrated pH value must be maintained for the storage life of the product. The product may be further preserved by pasteurization with heat, or refrigeration and may contain other vegetables, nutritive sweeteners, seasonings, flavorings, spices, and other ingredients permissible under the Federal Food, Drug, and Cosmetic Act. The product is packed in commercially suitable containers to assure preservation **(USDA, 1991)**.

Lactic acid bacteria (LAB) are importance in the food industry, mainly for lactic acid, flavor compound, and bacteriocin production **(Novak, et al., 1997)**. For the production of high-quality fermented vegetable products, starter cultures with desirable properties and high counts of bacteria are of particular importance. In the manufacture of fermented cucumbers, lactic acid bacteria starter cultures are known to make food products of a standard quality in a shorter time or of significantly increased acid content **(Desai and Sheth, 1997)**. In sauerkraut fermentation, starters have been reported to ferment cabbage effectively by decreasing the pH to lower levels by forming many bioactive compounds **(Tolonen et al., 2002)**. Recently, the use of functional starter cultures in the food fermentation industry is being explored. Functional starter cultures are starters that possess at least one inherent functional property, which can contribute to food safety and/or offer one or more organoleptic, technological, nutritional, or health advantages (Leroy & De Vuyst, 2004). LAB are the principal microorganisms responsible for the fermentation of vegetables, but the indigenous LAB flora varies as a function of the quality of the raw material, temperature, and harvesting conditions. Spontaneous fermentation thus leads to variations in the sensory properties of the products. It has been shown that the use of a starter culture helps to standardize fermentation by controlling the microbial flora. Although suppliers of lactic cultures have numerous starter cultures for the dairy and meat sectors, very few cultures designed for vegetable fermentations are available **(Eom, et al., 2007)**.

The manufacture of pickle (fermented fruits and vegetables) has a long tradition in Egypt and there is a wide variety of typical preparations, many of them still being produced using traditional technologies. So, The possibility of production of an untraditional pickle from date (***Phownix Dactylifera)*** using date byproducts like Kimri (pre-maturated date) and Seas (unfertilized date) was the main goal of this study.

MATERIALS AND METHODS

Materials: Kimri (pre-maturated date) and Seas (unfertilized date) were obtained from Faculty of Agriculture garden, Damiatta, Mansoura University.

Glass jars and salt were bought from local market, Damiatta city.

Methods:

Pickling Process: Both of date types were pickled in different brines (10% NaCl, 10% NaCl + 200 ppm sodium benzoate, 10% NaCl + 1% glucose + 1% starter and 10% NaCl + 0.5% citric acid), stored at room temperature for seven weeks and weekly analyzed for chemical parameters (NaCl%, TSS, pH and acidity %), total bacterial and lactic acid bacterial counts and sensory evaluation at the end of storage period.

Chemical analysis: Total soluble solid (TSS) was determined in brines using a refractometer, sodium chloride contents were determined according to the method described by ***A.O.A.C. (1990)*****,** pH value was measured according to the method of ***Lima Dos Santos et al., (1981)*** and acidity % (as lactic acid) was determined by alkaline titration.

Culture media and microbiological measurements: An axinic culture of Lactic acid bacteria (*Lactobacillus plantarum*) was used as an inoculumn (about 105 cfu/ml) for date pickle. The number of cells in the inoculumn was the same in all the treatments (about 106 cfu/ml). This inoculumn was suspended in the saline solution before the following treatments. After the inoculation period, (72 h at 37 °C) samples of date pickle were taken weekly under aseptic conditions. Total bacterial count and LAB counts were performed on MRS agar plates and nutrient agar medium, respectively. Counts were expressed as colony forming units (cfu) per milliliter of of saline solution. All microbiological analyses were made in triplicate and mean values were calculated.

Lactic Acid Bacterial Count (LAB) was conducted using de Man, Rogosa and Sharpe (MRS) agar medium (g/l): Peptone 10.0; beef extract 8.0; yeast extract 4.0; glucose 20.0; K2HPO4 2.0; Tween 80 1.0 ml; di-ammonium hydrogen citrate 2.0; sodium acetate 5.0; MgSO4.7H2O 0.2; MnSO4.4H2O 0.04; agar agar 20.0. and the pH was 6.4 (**Sesena et al., 2005**).

Total Bacterial Count (TBC) was conducted aerobically by using plate count agar method according to **Post (1988).** Nutrient agar medium was (g/l) : Peptone 5.0; beef extract 3.0 agar agar 20.0 and pH was 7.0.

Sensory assessment: An untrained panel of eight persons assessed the sensory properties. Five parameters were analyzed: taste, color, texture and defects. The scale used is based on the sensory scoring scheme described by **(USDA, 1991)**.

RESULTS AND DICSSIONS

Knowledge of the qualitative and quantitative chemical composition of date fruit is of prime importance to the user of dates, in particular the packer, processor or trader, because it affects the possibilities and limitations of the raw material for the intended end-use. The consumers' interest will mainly focus on the organoleptic and nutritional properties of the product. There is a good deal of information to be found in date literature, mostly on individual varieties, but a general picture emerges of what the date fruit consists of and what are the average quantitative values **(FAO, 1993).**

Moisture and sugar contents of various types of date were obtained from FAO,1993 and presented in table (1).

Regard to moisture content which considered the most important factor, that controls and regulates the deterioration of sensitive quality attributes in all fruits products. Data in table (1) show that the moisture content of fresh soft, semi-dry and dry

dates ranged from 15.5% to 37.3%. **Al-Shahib and Marshall, 2002** found that moisture contents were mostly between 11% and 36% in different dates.

Table (1): Moisture and sugar contents of soft, semi-dry and dry dates.

Types	% Moisture (fresh weight)	Total sugar % on dry weight basis	Reducing sugars % on dry weight basis	Sucrose % on dry weight basis
Soft				
Barhee	**37.3**	**84.8**	**84.8**	**0**
Khadrawy	**24.4**	**82.2**	**82.2**	**0**
Semi-dry				
Deglet Noor	**24.1**	**77.1**	**38.6**	**38.5**
Dayri	**22.2**	**75.7**	**70.4**	**5.3**
Zahdi	**13.6**	**78.2**	**70.7**	**7.5**
Dry				
Thoori	**15.5**	**73.0**	**40.9**	**32.1**
Kinta	**-**	**80.0**	**35.0**	**45.0**

(FAO, 1993).

While, total sugar content varied from 73.0% to 84.8% on dry weight basis in soft, semi-dry and dry dates. For reducing sugar content, it was the similar incase of soft dates but ranged from 35.0% to 70.7% in case if semi-dry and dry dates. The highest value of sucrose % was 45.5% in dry dates. So, different types of date could be considered suitable raw materials to produce high quality date pickles.

The changes in the acidity %, pH, NaCl% and TSS of Seas date pickles stored at room temperature for seven weeks were studied and the obtained results were illustrated in Fig. (1,2,3 and 4).

The demonstrated results indicated that acidity % gradually increased from zero until reach the highest values at the end of storage period for 10% NaCl, 10% NaCl + 200 ppm sodium benzoate and 10% NaCl + 1% glucose + 1% starter treatments. The highest values were 0.21, 0.33 and 0.28, respectively. While, in case of 10% NaCl + 0.5% citric acid, acidity sharply decreased at the first week from 0.5 to 0.31 then, it was still constant until the end of storage period. In contrast, pH value gradually decreased from higher than 7 until reach the lowest value (4.12) at the end of storage period for 10% NaCl + 200 ppm sodium benzoate treatment. From the same figure (2) it could observed a clear rise in pH value of 10% NaCl + 0.5% citric acid treatment from 2.05 at zero time until reach 4 at the end of storage period. These finding may be explained as the high total bacterial count at the end of storage period and so it consumed the acidity added at the beginning (**Tamang & Sarkar, 1996**).

On the other hand, NaCl % sharply decreased at the first week of storage period until reached an equilibrium point (4.73 – 5.19) then, it seems to be constant until the end of storage period (4.31 – 4.43). In similar way, TSS of all treatments had the same trend but in higher values (equilibrium point: 5.5 – 6.4, end point: 6.5 – 6.9). These observations could be due to penetration of NaCl into date tissue and loss of water and some soluble materials from date tissue.

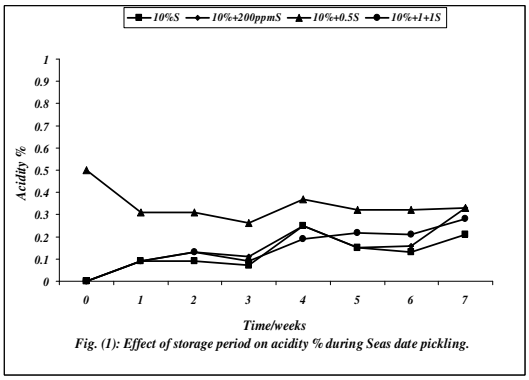

Fig. (1): Effect of storage period on acidity % during Seas date pickling.

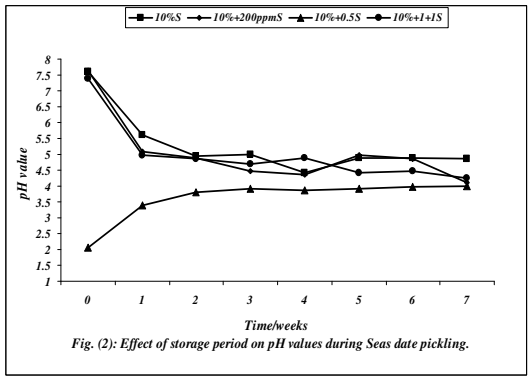

Fig. (2): Effect of storage period on pH values during Seas date pickling.

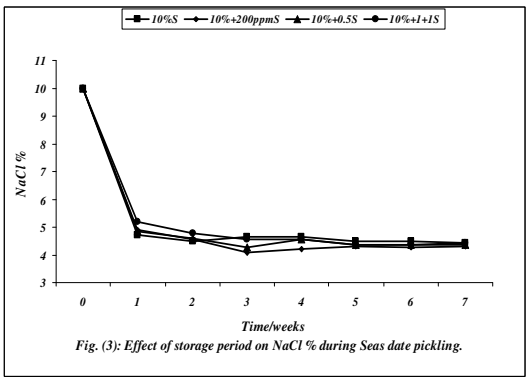

Fig. (3): Effect of storage period on NaCl % during Seas date pickling.

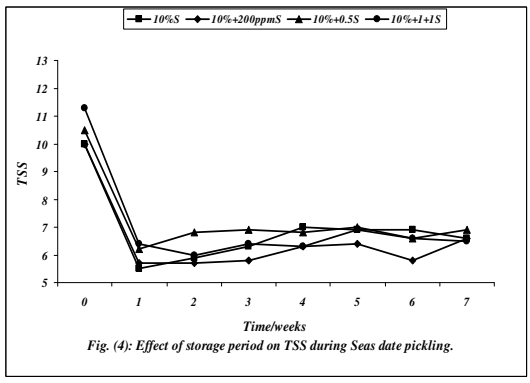

Fig. (4): Effect of storage period on TSS during Seas date pickling.

The changes in the acidity %, pH, NaCl% and TSS of Kimri date pickles stored at room temperature for seven weeks were studied and the obtained results were illustrated in Fig. (5,6,7 and 8).

The demonstrated results indicated that acidity % gradually increased from zero until reach the highest values at the end of storage period for 10% NaCl, 10% NaCl + 200 ppm sodium benzoate and 10% NaCl + 1% glucose + 1% starter treatments. The highest values were 0.09, 0.12 and 0.12, respectively. While, in case of 10% NaCl + 0.5% citric acid, acidity sharply decreased at the first week from 0.5 to 0.26 then, it was still nearly constant (0.31 – 0.37) until the end of storage period. In contrast, pH value gradually decreased from higher than 7 until reach the lowest value (4.45) at the end of storage period for 10% NaCl treatment. From the same figure (6) it could observed a clear rise in pH value of 10% NaCl + 0.5% citric acid treatment from 2.05 at zero time until reach 3.57 at the end of storage period.

On the other hand, NaCl % sharply decreased at the first week of storage period until reached an equilibrium point (4.73 – 5.19) then, it is seem to be constant until the end of storage period (4.54 – 5.39). In similar way, TSS of all treatments had the same trend but in higher values (equilibrium point: 6.8 – 7.1, end point: 5.9 – 7.0). these observations could be due to penetration of NaCl into date tissue and loss of water and some soluble materials from date tissue.

From all the previous results, it could be stated that, all results (acidity, pH, NaCl and TSS) were in the same trends but acidity % were higher in Seas date pickles than Kimri date pickles. This spotlight point refers to the high microbial and enzymatic activity in case of Seas date pickles. NaCl % were higher in Kimri date pickles than Seas date pickles and this is an index to moisture content and texture of both of pickles.

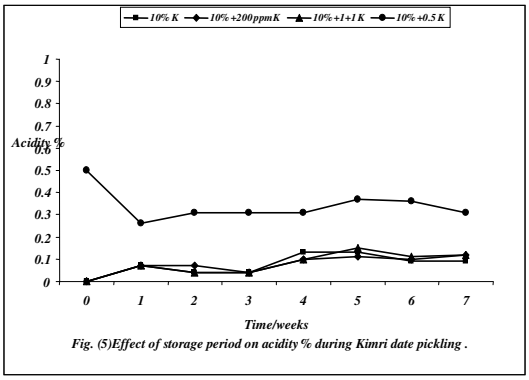

Fig. (5)Effect of storage period on acidity % during Kimri date pickling .

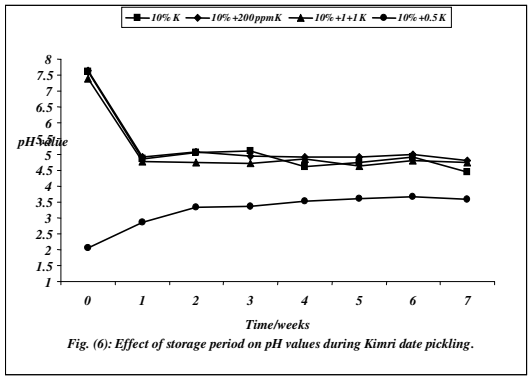

Fig. (6): Effect of storage period on pH values during Kimri date pickling.

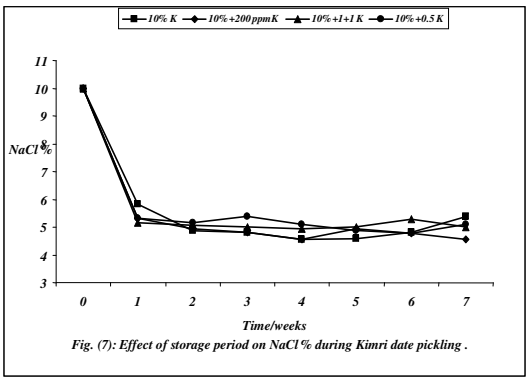

Fig. (7): Effect of storage period on NaCl % during Kimri date pickling .

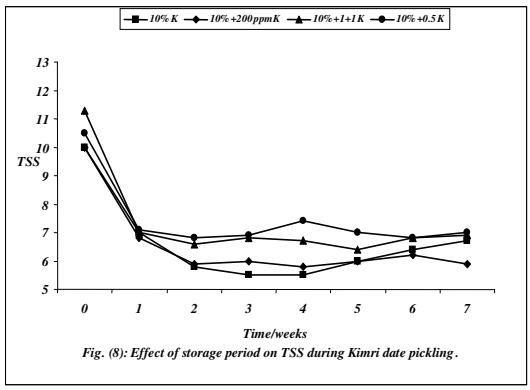

Fig. (8): Effect of storage period on TSS during Kimri date pickling .

Table (2 and 3) shows the changes in Total Bacterial Count (TBC) and Lactic Acid Bacterial Count (LAB) during fermentation process in Seas and Kimri date pickle. The total bacterial counts in the early stages of fermentation was low in control and in the first week , but these counts strongly increased by the weeks in all treatments. In the first week, TBC was in the lowest value (3.9) in Seas date (10% salt + 200 ppm Na Benz.) and the highest values was observed in all treatments after 5 weeks.

Table (2): Changes in Total Bacterial Count TBC (Log cfu/ml) during fermentation process in Seas and Kimri date pickle.

Treatments / Time/week		0	1	2	3	4	5
Seas date	10 % salt	2.44	4.68	6.48	8.7	9.3	9.39
	+ 200 ppm Na Benz.	2.06	3.9	7.38	9.74	8.0	9.3
	+ 0.5 % citric	2.06	4.84	6.3	7.69	8.69	10.0
	+ 1 % starter + 1 % glucose	2.04	4.54	7.69	8.69	8.78	9.3
Kimri date	10% salt	2.57	4.9	8.68	8.48	9.54	9.78
	+ 200 ppm Na Benz.	2.36	5.3	8.34	8.9	9.7	9.89
	+ 0.5% citric	2.43	5.0	7.3	8.08	9.3	9.77
	+ 1 % starter + 1 % glucose	1.98	5.18	8.6	9.04	9.6	9.86

On the other hand, the population of ***L. plantarum*** increased continuously from the start of fermentation until the end of fermentation. The count of lactic acid bacteria in the beginning of fermentation was ranged from 0.48 to 1.0 in the non-inoculated treatments, but in the inoculated treatments were 3.7 and 3.8 in Kimri and Seas,

respectively. The counts of LAB grew most rapidly in inoculated treatments, and slowly in other treatments in the first week. And then LAB increased gradually from the third week to the end of fermentation period. At the end of fermentation time (5 weeks), the lowest value was 7.48 in Seas date (10% salt + 0.5% citric) and the highest value was 10.04 in Kimri date (10% salt + 1% starter + 1% glucose).

Table (3): Changes in Lactic Acid Bacterial Count LBC (Log cfu/ml) during fermentation process in Seas and Kimri date pickle.

Treatments / Time/week		0	1	2	3	4	5
Seas date	10 % salt	0.48	1.6	4.62	6.0	7.52	9.18
	+ 200 ppm Na Benz.	0.7	3.0	5.5	7.7	7.84	7.82
	+ 0.5 % citric	0.85	2.0	4.4	6.78	7.69	7.48
	+ 1 % starter + 1 % glucose	3.7	5.1	7.3	7.9	8.78	8.3
Kimri date	10% salt	0.6	3.04	7.7	8.45	8.85	8.3
	+ 200 ppm Na Benz.	0.78	2.98	7.3	7.85	8.48	8.88
	+ 0.5% citric	1.0	2.75	7.28	7.48	8.74	8.54
	+ 1 % starter + 1 % glucose	3.8	5.2	6.7	8.6	9.26	10.04

Microbial analysis of date pickle demonstrated the presence of lactic acid bacteria in all treatments. This finding is in agreement with the report of **Tamang & Sarkar, 1996** about the occurrence of pediococci and lactobacilli in plants. These data also show that, inoculation had no effect on the growth of total bacteria and LAB with or without inoculation in the end of fermentation time , similar results obtained from **Zhao & Ding, 2007.**

Studies of **Richardson & Gray, 1981** have found that, Benzoic acid concentrations of up to 50,000 ppm (5%) are not effective in reducing the activity of some lactic acid bacteria. A possible explanation for the lack of antimicrobial activity is the typical pH of whey. Benzoic acid inhibits microorganisms, however, optimum antimicrobial activity for benzoic acid is between pH 2.5 to 4.0. The pH of date pickle almost always is above pH 4.0 therefore, benzoic acid is ineffective at controlling growth of bacteria. Also, several strains of lactic acid bacteria are able to produce benzoic acid during fermentation process.

The quality and nutritive value of dates are influenced by their chemical composition **(Vandercook et al., 1979)**. Seas and Kimri date pickles were sensory evaluated for taste, color, texture and defects and the results were illustrated in Fig. (9).

From the obtained results, it could be noticed that, in case of Seas date, treatments: 10% NaCl, 10% NaCl + 200 ppm sodium benzoate and 10% NaCl + 0.5% citric acid recorded the highest values: 75, 76 and 75.5, respectively. While, in case of Kimri date, 10% NaCl + 0.5% citric acid treatment was the best treatment in relation to sensory properties (68.5) followed by control treatment (67).

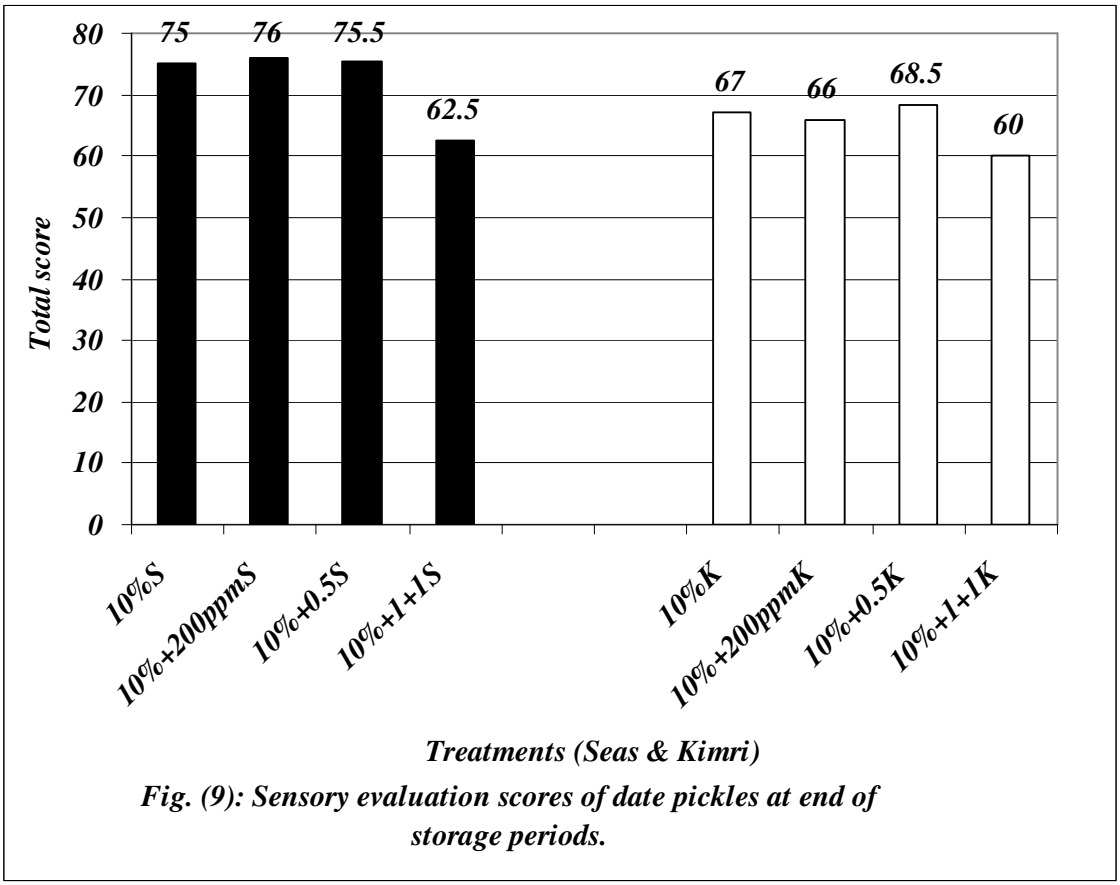

Fig. (9): Sensory evaluation scores of date pickles at end of storage periods.

From the previous figure, it could be stated that, Seas date pickles had higher score than Kimri date pickles in all treatments.

Finally, from chemical and sensory tests, it could be concluded that, Seas date could be considered as an excellent raw material for pickling process and using of brine mixture containing an organic acid had the highest score in sensory evaluation. Also, this search was only a trail or start in this area and will be followed by group of studies using a lot of component like Lemon, green pepper and spices.

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الملخص العربي

التغيرات التي تحدث أثناء عملية تخليل البلح

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إن الهدف الرئيسي من هذه الدراسة هو إمكانية إنتاج مخلل غير تقليدي من البلح (*Phownix dactylifera L.*) باستخدام فاقد الإنتاج مثل القمري (بلح قبل مرحلة النضج) و الصيص (بلح غير ملقح). و لتحقيق هذا الهدف تم تخليل نوعي البلح في محاليل مختلفة (١٠% ملح – ١٠% ملح + ٢٠٠ جزء في المليون بنزوات صوديوم – ١٠% ملح + ١% جلوكوز + ١% بادئ – ١٠% ملح + ٠,٥% حمض ستريك) و تم التخزين على درجة حرارة الغرفة لمدة سبعة أسابيع و تم التحليل الكيماوي أسبوعياً (% للملح – المواد الصلبة الكلية الذائبة – الأس الأيدروجيني – % للحموضة) و كذلك التقييم الحسي. كما تم استخدام عزلة من الـ *Lactobacillus plantarum* في مخلل البلح و تم تقدير العدد الكلي للبكتريا و عدد بكتريا حامض اللاكتيك. و من النتائج المتحصل عليها نستطيع أن نستنتج أن البلح يعتبر مادة خام ممتاز لعملية التخليل و أن استخدام الحامض في مخلوط التخليل أعطى اعلي درجات في التقييم الحسي. و في النهاية يعد هذا البحث مجرد محاولة أو بداية و سوف يتبع بمجموعة دراسات.