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EFFECT OF BLANCHING TREATMENTS ON PHYSICOCHEMICAL AND SENSORY CHARACTERISTICS OF CANNED ARTICHOKE

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ABSTRACT

Two blanching treatments were used for artichoke before canned. Artichoke was blanched with bracts for 15- 20 min according to their size hearts but artichoke without bracts for 5 min in acidified media by citric acid solution (0.3%) at the boiling temperature. The effect of blanching treatments on the physicochemical and organoleptic characteristics of the artichoke were studied. Blanching the artichoke heads with their bracts and the removal of bracts before canning improved the chemical constituents and organoleptic properties even after canning and storage for six months at room temperature. The canned artichoke had a good taste with excellent flavor and white yellowish color. Sucrose decreased but fructose increased due to hydrolysis of sucrose and inuline in acid media.

Firmness was improved by adding $CaCl_2$ at (0.1%) level to the brine. Artichoke hearts were analyzed for chemical constituents before and after being blanched, canned and storage for six months at room temperature. Also pH and total soluble solids of the brine were determined. In addition, cations were determined in fresh and canned artichoke to estimate the loss rate as a result of blanching and canning process which slightly decreased according to their solubilities. Color was determined by Minolta colorimeter for artichokes hearts before and after blanching and canning. Color differences were calculated and compared to fresh artichoke. The color was satisfactory especially when blanched artichoke hearts with their bracts.

INTRODUCTION

Artichoke is a unique plant of medical values is considered a healthy vegetable recommended to people of all age groups because it stimulates the liver function, sheathes coughs helps to purify the blood and dissolves stones, however it is tedious to be prepared since the peeling process is quite difficult. Beside fast browning may occur for artichoke results from the oxidation of phenollic compounds by polyphenoloxidases into quinone substances (Lattanzio *et al.*, 1994). Quinone substances may be a complex with amino compounds which can undergo condensation and polymerization to produce highly colored products. However the application of antioxidants (ascorbic acid, cysteine, sodium bisulphate, and flavonoid glycoside) retard darkening of the tissues (Bae and lee, 1990). Blanching with hot water steam or electromagnetic energy are widely used in eliminating the enzymatic activity responsible for flavor alteration and tissue softening (Rejano *et al.*, 1997).

Beside texture in general is very important in determining consumer acceptability. The texture of vegetables is affected by the biochemical constituents, water content and cell wall composition .Thus any external factor affecting these traits can modify texture and therefore can lead to changes in the final product quality (Van Buren, 1979; Seymour and Gross, 1996, Harker *et al.*, 1997). However, a decrease in firmness is desirable like asparagus and or artichoke, since a lower fibrosity is preferred. Accordingly, artichoke

firmness entirely depends on cultivation, maturity, storage and thermal process (as cooking, blanching and sterilization). That result in softing of vegetables (Huang and Bourne, 1983) . Much work has been done on Firmness pertaining asparagus (Rodrigo *et al.*, 1997) and Potato (Kaur *et al.*, 2002) but less work was carried out on artichoke especially for canned artichoke and the effect of different solution since some minerals can affect the texture (Petracek and Sams 1987, Poovaiah *et al.*, 1988) .

The aims of this investigation were:

1- To compare the methods of blanching process with or without bracts pertaining the physical and chemical properties of the artichoke.
2- To study the physical, chemical and sensory characteristics of the canned artichoke after being stored for six months.

MATERIALS AND METHODS

I .Materials:

Fresh artichoke (Cynara Scolymus Balady cv.) was brought from Qaha Experimental Farm Qalyoubia Governorate. The artichokes were harvested and selected according to the most desirable quality being compact, plump heavy in relation to size, somewhat globular and with large, fresh, fleshy, tightly clinging leaf scales. Freshness is indicated by the green color. Accordingly, the fresh artichokes were stored according to the above mentioned standard (Seelig and Charney, 1967).

II. Methods:

The artichoke peduncles were hand removed and the heads were blanched by two methods:

1-The hearts were sized, and blanched in boiling citric acid solution (0.3%) for 15- 20 min according to their size then the blanched artichoke hearts were cooled by water to 25°C. The bracts were hand removed and the hearts were submerged in 0.3% citric acid solution till canned.
2-The bracts were removed before blanching from artichoke hearts and submerged into 0.3% citric acid, afterwards for about two hrs period .Then the hearts were blanched in boiling 0.3% citric acid for 5 min.

The blanched hearts were packed in cans of one liter capacity (10 cm of base diameter and 12 cm of height). Each cane contained between 10-12 hearts. The cane had a net weight (900g) and drained weight (325g) on average. Two different solutions with different composition were used as aqueous solution of 0.3% citric acid + 0.2% ascorbic acid and 0.2% NaCl/100 ml water. The same solution plus 0.1 % calcium chloride was used (solution pH were ranged from (3.9) but not exceeding (4.2) in all cases. The solution was heated to 100°C before being added to the filled containers. The cans were directly sealed and sterilized at 100°C for 15-20 min and cooled by cool water to 30 to 35°C and stored at room temperature 20°C ±5°C until analysis which were carried out at of two months interval for six months.

Some cans were drawn at zero time and others subsequently every two months intervals. The cans were opened and the contents were drained and the hearts were tested for firmness, color and evaluated organolepticlly. Whereas the brine was tested for T.S.S. and pH value. There after the heads were homogenized and analyzed for moisture, sugars (sucrose, glucose and fructose), protein, fat, crude fiber, ash, pH and the minerals including Na, Ca, K, Mg, Mn, Fe and Zn were determined according to (AOAC, 1990). Where as the carbohydrate was determined by difference. The instrumental analysis of texture was accomplished on 10 quarters using (Mecmesin Forces and Torque) Advanced Force Gauge FG 250N. Color determination were carried out using (Minolta color meter chroma meter CR400). Color measurements were carried out in 2 different position of the artichoke hearts the first was the inner portion while the second was the outer surface ten replicates were measured for every treatment.

Minolta which defines the color in 3 dimensional space *L to indicate lightness and a*, b* are the chromaticity coordinates.

$$\Delta E^{\frac{1}{2}} = \sqrt{(\Delta l)^2 + (\Delta a)^2 + (\Delta b)^2}$$

Other parameters of canned artichoke were solution Ph which was determined by (PH meter)and total soluble solid by (refractometer).

Sugar determination: for sugar extraction, the quarters were homogenized with a blender and extracted using distilled water at 80°C for 30 min. The homogenate was filtered through cheese cloth and centrifuged (20000g, 30min) the supernatant was used for sugar determination. Sucrose, glucose and fructose were analyzed using HPLC method according to (Black and Bagley, 1978). The column temperature was maintained at 85°C. An isocratic separation was carried out with deionized water as a mobile phase at flow rate 0.8 ml/min, the sugars standard from Sigma CO. were solved in a mobile phase and injected into HPLC. Retention time and peak area were used for the calculation of sugars concentration by the data analysis of hewllet packared software .

Sensory evaluation: Color, firmness flavor and overall acceptability of canned artichoke hearts were organolepticlly determined by ten panelists as described by (Reitmeier and Nonneckes, 1991) Statistical Analysis of variance was carried out using the method of (Snedecor and Cochran, 1973).

RESULTS AND DISCUSSION

The blanching process caused an increments in moisture content which resulted in decreasing all the solid components .The latter could be arranged in descending order 4.33, 4.04, 2.69, 0.90, 0.83 and 0.09 for carbohydrate, fiber, protein, sugar, ash and lipid, respectively for the blanched artichoke without bracts. However, in case of blanching artichoke with bracts the decreasing percent of the solids were lower than the previous mentioned values since the corresponding values were 5.15, 4.28, 2.93, 1.06; 1.06 and 0.12 as shown (Table 1) which could be ascribed to the increase in moisture content and the solubility of the different component. These results agree with those obtained by (Lopez *et al.*, 1997). Accordingly it could be recommended to blanch artichoke hearts without removing their bracts.

Table (1): Chemical composition of fresh and blanched artichoke.

Constituents Treatments	Mositure content %	Total sugar%	*Carbo-hydrate %	Protein %	Lipids %	Ash %	Fiber%
Fresh Artichokes	83.6	1.20	6.47	3.29	0.14	1.19	4.11
Blanched artichoke with out bracts.	87.12	0.90	4.33	2.69	0.09	0.83	4.04
Blanched artichokes with bracts.	85.4	1.06	5.15	2.93	0.12	1.06	4.28

*by difference.

Sugar constituents are important components since they may improve the flavor and affect the consumer preference. Data in (Table 2) represent the different sugar values for blanched artichoke hearts without bracts it could be observed that both sucrose and glucose decreased after blanching and or sterilizing. However, the degree of decrements were slight during the storage period of canned artichoke. While, fructose increased during the storage period since it reached 4.292 % on dry weight basis after six months of storage. Meanwhile blanching the artichoke hearts with bracts (Table 3) could preserve the

sugar from being lost through the blanching process. Both sucrose and glucose decreased while fructose had a reverse trend. Fructose increased to 4.383 % on dry weight basis after storage for six months. These results are in agreement with result obtained by (Almela *et al.*, 2004) who stated that both glucose and sucrose content decreased between 30 and 40% while, fructose increased. Also (Lopez Molina *et al.*, 2005) stated that artichoke inuline was fructose and its degradation by inulinase. Inuline hydrolyzed to fructose during blanching or canning in acid media causing an increment in fructose .

Table (2): Sugar content of canned artichokes after blanched without bracts, sterilized and stored for six months (on dry weight basis).

Sugars constituent	Fresh heads	After blanching without bracts	After sterilization	Storage periods (months)		
				2	4	6
Sucrose%	6.738	3.303	2.477	2.477	2.477	2.394
Glucose%	3.567	2.559	3.385	3.303	2.725	3.550
Fructose%	0.264	1.568	1.899	2.229	3.055	4.293
Total Sugars%	10.569	7.430	7.761	8.009	8.257	10.237

Table (3): Sugar content of canned artichoke after blanched with bracts, sterilized and stored for six months(on dry weight basis).

Sugars constituents	Fresh bracts	After blanching with bracts	After steriliza-tion	Storage periods (months)		
				2	4	6
Sucrose%	5.589	4.726	3.767	3.767	3.493	3.427
Glucose%	2.958	1.232	1..849	2.534	2.671	3.287
Fructose%	0.219	1.301	3.356	3.356	3.698	4.383
Total Sugars%	8.766	7.259	8.972	9.567	9.862	11.097

Data in (Table 4) show the color values of blanching, canning and storage periods of artichoke hearts. Color was define in three dimensional space L indicates lightness and a and b are the chromaticities coordinates green, red, blue and yellow respectively. Color behavior as affected by different processing technique are in agreement with results obtained by (Guillen-Rios *et al.*, 2006). However browning reactions were inhibited by the intense of acidic media either in blanching or in canning of artichoke hearts.

Table (4): Effect of blanching canning and storage period on color of artichoke hearts.

Color / Treatments	L	a	b	E
Blanching without Bracts	70.24	- 1.83	32.14	13.74
Blanching with Bracts	79.45	- 1.81	28.84	10.79
Canned Artichoke without Bracts	64.7	-4.3	34.17	20.40
Canned Artichoke with Bracts	69.24	-2.91	33.64	15.52
Storage for 6 months without Bracts	57.63	-5.84	35.90	26.71
Storage for 6 months with Bracts	60.55	- 5.19	35.12	23.69
Fresh was taken for comparison:	80.88	-1.71	23.44	--

The difference values from the fresh in color did not exceed 10.79 for blanched artichoke with bracts. Also the artichoke with the same treatments the increase in color was about 15.52 for canned artichoke with bracts after being stored for six months at room

temperature while the color differences of blanched artichoke hearts without bracts increased about 13.74 when compared to the fresh artichoke even after canned the increment in color did not exceed 20.40. During storage the treatment with bracts increased in color compared to fresh within 23.69. However treatment with out bracts increased in color after processing within 26.71 compared to fresh artichoke. Consequently, the best method for preserving color was that of blanching the hearts of artichoke with bracts .

Table (5): Effect of blanching and mixture solution on firmness pH and T.S.S. of the canned artichokes hearts.

Sample	Blanching with out bracts							Blanching with bracts					
	1				2			1			2		
	Storage period (months)												
	0	2	4	6	2	4	6	2	4	6	2	4	6
Firmness	139	12	10	9	13	12	10	14	12	10	16	14	12
Soluble solids	4	4.1	3.9	4.1	4.2	4.2	4.2	4.1	4.2	4.2	4.1	4.2	4.2
pH	6.3	3.9	4.1	4.2	4.2	4.1	4.1	3.9	3.9	3.8	3.8	3.9	3.9

Fresh value for firmness, T.S.S., pH, 138.40, 603, respectively.
1: 0.3% Citric acid + 0.2%Ascorbic acid + 0.2% NaCl.
2: 0.3%Citric acid + 0.2% Ascorbic acid + 0.2%NaCl + 0.1%$CaCl_2$.

Data in (Table 5) show that the effect of brine was clear since the addition of $CaCl_2$ in combination with citric acid and ascorbic acid was able to increase the firmness measurement to 12 for artichoke hearts blanched with bracts after processing and stored for six months at room temperature. Best method to keep the firmness of the artichoke heart was to blanch them with bracts and to incorporate $CaCl_2$ in the brine of canned artichoke. The pH values of the brine were in a range of 3.8 to 4.2 which was considered safe for the open sterilization process which could be done under atmospheric pressure .These minerals affect the firmness of artichoke.

The firmness in case of artichoke is of prime importance. The most turgid or hard preserved artichoke were those blanched with their bracts compared to the others which were blanched after removing their bracts. Data in (Table 5) indicated that firmness values for blanched artichoke hearts with their bracts were higher compared with those obtained for blanched artichoke hearts without bracts. However firmness values decreased obviously during the storage period of canned artichoke. These results are in agreement with those of (Huang and Bourn, 1983) who stated that firmness of artichoke depends on maturity, storage and thermal process (blanching and sterilization).

Calcium chloride was able to preserve the turgidity of artichoke However, it slightly increased the pH values which remained under the recommended level for open sterilization since maximal value did not surpass the value of 4.2. However, influence of different brines could affect the feasibility of different minerals which in turn affect the texture (Poovaiah *et al.*, 1988) (Petracek and Sams, 1987). Total soluble solids ranged from 3.9 to 4.2.

Data in (Table 6) indict the decreasing of minerals due to blanching and storage for six months at room temperature. However in all cases the decrements were high in case of blanching without bracts than when being blanched with bracts. Other factors could be effective in the loss of such cations using citric acid as a blanching media with higher concentration or using different brines in the canning process and the longer period of storage. All these factors should be considered when discussing the loss of cations due to canning process. Also, cations could be lost according to their solubilities

Table (6): Effect of blanching methods on minerals content of artichoke hearts solution.

Treatments \ Elements	Minerals (mg)						
	K	Na	Ca	Mn	Mg	Fe	Zn
Fresh Artichoke	430	43	40.7	60	27	1.00	0. 050
Blanched with out bracts and Canned in brine*	235	102	54.7	52	22	0.66	0.032
Blanched with Bracts and Canned in brine*	340	170	52.3	56	25	0.75	0.045

*Brine:0.3% citric acid +0.2%ascorbic acid+%0.2%NaCl +0.1% $CaCl_2$.

Organoleptic properties are of utmost importance since they affect directly the consumer preference. Data in (Table 7) represent the different scores given by the panelists for the different sensory aspects including color, flavor, firmness and overall acceptabilities. These results reveal that differences in color due to method of blanching that significant color scores were higher in case of samples blanched with bracts than that blanched without bracts. However differences between flavor scores were not significant when compared with the method of blanching. As for firmness the scores given to the treatment of $CaCl_2$ were significantly higher than the other treatments. The overall acceptability scores indicate that artichoke blanched with bracts had higher scores which were insignificant than that blanched without bracts .

In conclusion blanched artichokes hearts with bracts was superior than that blanched without bracts pertaining color, firmness and overall acceptability as for flavor difference was not significant between scores given to artichoke either blanched with or without bracts.

Table (7): Effect of blanching methods, mixture salutation and storage period on organoliptic properties.

Organo-leptic	Blanching without bracts						Blanching with bracts						L.S.D 0.05
	1			2			1			2			
	Storage period (months)												
	2	4	6	2	4	6	2	4	6	2	4	6	
Color	DEF 7.6	CDEF 7.8	EF 7.4	CDE 7.9	F 7.2	F 7.2	C 8.3	CD 8.2	A 9.9	B 9.2	B 9.0	CD 8.2	0.6086
Flavor	A 8.2	BCD 7.6	DE 7.2	ABC 7.8	ABC 7.8	CDE 7.4	AB 8.0	A 8.1	AB 8.0	CDE 7.4	DE 7.2	E 7.0	------
Firmness	CDE 5.9	E 5.6	F 4.9	C 6.2	CD 6.0	CD 6.0	A 7.6	B 6.7	C 6.2	A 7.6	B 6.9	B 6.7	0.3070
Over all accepta-bility	EF 6.6	FG 6.4	G 6.2	DE 6.9	E 6.8	EF 6.6	B 8.2	C 7.3	CD 7.2	A 8.9	B 8.2	B 8.0	0.3199

1: 0.3% Citric acid + 0.2% Ascorbic acid + 0.2% NaCl.
2: 0.3% Citric acid + 0.2% Ascorbic acid + 0.2% NaCl + 0.1%$CaCl_2$.

Color $\bar{x} = 8.158 \pm 0.2136$ **Flavor** $\bar{x} = 7.85 \pm 0.6335$
Firmness $\bar{x} = 6.192 \pm 0.1079$ **Over all acceptability** $\bar{x} = 7.158 \pm 0.1120$

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تأثير معاملات السلق علي الصفات الطبيعية والكيماوية والحسية للخرشوف المعلب

جميلة يوسف عطية

معهد بحوث تكنولوجيا الأغذية- مركز البحوث الزراعية ــ الجيزة – مصر

تم دراسة طريقتين لعملية سلق الخرشوف قبل تعليبه حيث تم السلق بالقنابات الخضراء لمدة (١٥- ٢٠) دقيقة حسب حجم الخرشوف والسلق بإزالة القنابات الخضراء لمدة (٥) دقائق فى ماء به حامض ستريك (٠,٣%) على درجة حرارة الغليان وتم دراسة تأثير عمليات السلق السابق ذكرها على الصفات الطبيعية والكيماوية والحسية للخرشوف وقد وجد أن سلق الخرشوف بالقنابات وإزالتها قبل التعليب أدت إلى تحسين المكونات الكيماوية والصفات الحسية حتى بعد التعليب والتخزين لمدة ستة أشهر على درجة حرارة الغرفة حيث تم الحصول على خرشوف معلب ذو طعم جيد ولون أبيض مصفر مع إنخفاض مستوى السكروز وزيادة معدل الفركتوز نتيجة للتحليل المائى للأنيولين والسكروز فى الوسط الحامضي.

وقد تحسنت الصلابة للخرشوف المعلب نتيجة إضافة كلوريد كالسيوم بنسبة (٠,١%) إلي محاليل التعبئة وقد تم تحليل المكونات الكيماوية للخرشوف قبل وبعد عمليات السلق والتعليب والتخزين لمدة ستة أشهر كما تم تقدير الـ pH والمواد الصلبة الذائبة الكلية في محاليل التعبئة بالإضافة إلي بعض العناصر المعدنية فى الخرشوف الطازج والمعلب لمعرفة مقدار الفقد الناتج عن السلق الذي كان بسيطاً حسب مقدار ذوبان المعادن المختلفة كما تم تقدير اللون بواسطة جهاز Minolta للمعاملات المختلفة قبل وبعد السلق والتعليب وحسبت معدلات الاختلاف في اللون بالمقارنة بلون الخرشوف الطازج وكان اللون جيد خصوصا بالنسبة للخرشوف الذي تم سلقه بالقنابات.