Effect of Calcium Lactate on the Quality parameters of Galia' Melons Compote

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Abstract: Galia' melon (*Cucumis melon var. cantalupensis Naud*.) is one of the most common melon cultivars produced for fresh consumption. The main problem with 'Galia' is its short shelf-life during marketing. The objective of this study was to identify extend of opportunity for develop melon compote from melon fruit and to evaluate its nutritional and physical properties. Fresh melon fruits were cut into cubes and filled with 40% sugar syrup into glass jars. Calcium lactate added by 0, 400, 600 and 800 ppm as firming agent at either room temperature or 60°C.The obtained results declared that the combination of Ca lactate with 60°C was more effective for maintaining the quality indices. Ca content and firmness of melon compote were increased as increasing the level of Ca lactate. The statistical analysis for sensory evaluation of melon compote showed that 600ppm Ca lactate 60°C compote obtained the highest degree of acceptability.
[Abd El-Hady, M.M.M; Assous, M.T.M. and Ginat El-Sherif. **Effect of Calcium Lactate on the Quality parameters of Galia' Melons Compote**. Journal of American Science 2013; 9(5): 145-151]. (ISSN: 1545-1003). http://www.americanscience.org.20

Key Words: Galia' melon compote – *Cucumis melon var. cantalupensis Naud***.** - Firmness- Calcium lactate

1. Introduction

Melon considered being a good source of naturally occurring vitamins, minerals, and pigments, which provide high antioxidant and anti-inflammatory properties (Vouldoukis *et al.*, 2004).

Galia' melon (*Cucumis melon var. cantalupensis Naud*.) is one of the most common melon cultivars produced for fresh consumption because of its highly appreciated sensory attributes, unique aroma and attractive color in addition to tasty flavor and health benefits. It has become a popular fruit throughout the Mediterranean and Europe (Aguayo *et al.*, 2004 and Beaulieu *et al.*, 2004).

The main problem with 'Galia' is that it has a limited shelf-life. To achieve peak flavor and sweetness, 'Galia' muskmelon should be picked at the full-ripe stage, therefore shelf-life can be limited (Shaw *et al.*, 2001).

According to the FAO, the world production of cantaloupes and other melons in 2005 was about 28 million tons. In 2010, the total production of melons in Egypt reached to 157996 tons obtained from 16464 Fedans (Anon, 2010).

Most melon is marketed fresh during the production season. Fruit is mainly eaten raw; marginal uses are cubes canned in syrup, in "fruits comfits"', candies, ice-creams, biscuits and also in cosmetics.

Fresh-cut processing of melons induces changes in a number of quality attributes: color, sweetness, firmness (Portela & Cantwell, 1998), ethylene and respiration rate (Aguayo *et al.*, 2007), microbial load (Ayhan *et al.*, 1998 and Aguayo *et al.*, 2003), and aroma volatiles (Beaulieu, 2006a, b).

Nevertheless, fresh-cut melon is very susceptible to softening during storage, even under chilling; this process is related to the enzymatic degradation of the middle lamella of the cell wall and loss of cell adhesion. Enzymes such as pectin methylesterase (PME) and polygalacturonase (PG) play an important role in 'Galia' melon softening (Chisari *et al.*, 2009).

Firmness and resistance to softening can be increased by the addition of Ca, due to stabilization of membrane systems and formation of Ca pectates increasing the rigidity of the middle lamella and cell walls and retarding polygalacturonase (PG) activity (Poovaiah, 1986). The level of Ca penetrated in fresh-cut fruit depends on Ca concentration, time and temperature of dip and the sizes of pieces (Poovaiah, 1986 Siddiqui and Bangerth, 1995). Calcium chloride is commonly used industrially as a firming agent for canned tomatoes and cucumber pickles. Other products in which texture is improved or maintained by calcium chloride dips include whole apples (Sams *et al.*, 1993), whole hot peppers (Mohammed *et al.*, 1991).

Although beneficial for product texture, the use of calcium chloride may impart bitterness or flavor differences (Monsalve-Gonzalez *et al.*, 1993). Following, the dip treatment was a residual amount of calcium chloride remains on the surface of the product, thus increasing likeliness of bitterness detection by the consumer. Calcium lactate represents an alternative calcium source. Calcium lactate (0.5 – 2%) has been used as a firming agent for processed

strawberries (Main *et al.,* 1986) and grapefruit without reported flavor differences (Baker, 1993).

Heat treatments have also resulted in tissue firming in products such as cherries (Van-Buren, 1974), tomatoes (Floros *et al.,* 1992), potato strips (Aguilar *et al.,* 1997), and melons (Aguayo *et al.,* 2008). Firming effects obtained from heat treatments alone or combined with calcium salts treatments may be attributed to the action of heat-activated pectin methyl esterase (PME) and :or to increased calcium diffusion into the tissue (Garcı´a *et al.,* 1996). Heat can be applied with the calcium treatment by increasing the temperature of the calcium solution in contact with the fruit or vegetable, or at a different stage (Luna-Guzma´n *et al.,* 1999)

Hence, the aim of this study was to develop a Galia' melons fruit compote using calcium lactate as firming agent to improve the quality parameters of Galia' melons compote.

2. Material and Methods

Material:-

- Full ripe Galia' melon (*Cucumis melon var. cantalupensis Naud*.) fruits were obtained from local market
- Chemicals used in this study were of analytical grade and purchased from El-Gomhoria Co.

Methods:-

Preparation of melon compote

Whole melons were stored overnight at 10◦C, washing the fruit with tap water, draining, and blotting dry with paper towels. Melons were hand-peeled with a sharp knife and the blossom and stem-ends were discarded then hand-cut into eight slices parallel to the longitudinal axis. Seeds, placenta and peel were also discarded and each slice was hand-cut into cubic pieces (about 3 cm thickness).

A total of 280 g of melon pieces were filled into a sterilized glass jar (400 g) then covered with either hot (at 60◦C) or cold (at room temperature~25°C) 40% sugar syrup containing 0.1% citric acid and 0.05% Potassium sorbate. Calcium lactate was added at level of 0, 400, 600 and 800ppm and mixed well for 2 minutes. To maintain the relevant temperature, a water bath with continuous cold or hot water recirculation plus stirring was used then the jars heated into the water bath to 95◦C for 5 minutes and tightly closed then cooled with tap water. The melon compotes were stored at room temperature for 6 months.

Analytical methods:-

- Moisture content, total soluble solids, total titratable acidity, pH values and ash were determined according to AOAC (2005).
- Ascorbic acid and carotenoids were determined as described in AOAC (2005).
- Calcium contents were determined according to method of AOAC (2005) using atomic absorption spectrophotometer (SPY9).
- Browning index was determined according to the method of Meydev *et al.* (1977), as its light absorbance at 420 nm
- Firmness (N) measurements were performed with a universal testing machine (Comietech, Type B, Taiwan) equipped with a 2000N load cell and operated at a crosshead speed of 20mm/ min. The force needed to compress the disk to 15 mm with a flat- plate probe (25mm diameter) was registered. All measurements were performed at 20◦C as reported by Susana and Almeida (2008).

Organoleptic properties:-

- Sensory properties were evaluated using the method described by Larmond (1970) using 1-9 point hedonic scale ranging from like extremely to dislike extremely. The panelists were requested to score the samples for color, appearance, taste, flavor and overall acceptability.
- The organoleptic data were statistically analyzed using the ANOVA procedure of the SPSS statistical package for IBM computer (SPSS, 1990).

3. Results and Discussion

Chemical properties of Galia melon pulp:

Results in Table (1) represent some physicochemical properties of Galia melon pulp. The percentage of pulp after removing peel, seeds and placenta was 72.4%. It could be observed that although melon pulp contained high level of total soluble solids 9.6, total titratable acidity being very low 0.11%. Brix /acid ratio was very high (64:1) giving it a sweetly taste. PH value reached to 5.6 as a result of lowering of acidity which makes it a very attractive media for microorganism's activity causing rapid spoilage. Melon is consider to be a good source for ascorbic acid and carotene (provitamin A) 23.83 and 0.86mg/100gm respectively. The initial content of firmness and calcium for fresh melon pieces was 49.6 N and 13.5 mg/100gm respectively. However these results in general accordance with that obtained by Aguayo *et al.* (2004) and Silveira *et al.* (2011).

Effect of adding Ca lactate on the quality parameters of melon compote:

To reduce the changes in quality indices after processing melon compote, Calcium lactate was added to maintaining the texture of melon pieces at either 60◦C or room temperature.

The influence of Ca treatments at room temperature on melon compote properties during 6 months of storage was presented in Table (2). The obtained results show a gradual increment in TSS content as increasing storage period due to osmosis

and diffusion characteristics of syrup. The untreated melon compote (control) had TSS higher than other treatments furthermore; such increment decreased as increasing the level of Ca addition. The pH values were also raised in all treatments during the storage period as a result of lowering of total acidity.

The results for the color index showed that all treatments had similar color values. The color index values increased especially at the end of storage period may be due to Millard reaction which causing an increment in brown color intensity.

The obtained data showed a gradual decrease in ascorbic acid for all treatments during storage period moreover, the retention of ascorbic acid was increased as increasing the level of Ca.

Concerning, the drained weight was (the remaining of melon pieces after excluding the syrup), the initial filling weight adjusted to represent 70% of total capacity of jars. The drained weight decreased in all treatments during storage as a result of removing water from plant cells due to the difference in osmotic pressure between the fruit and the syrup where the complex cellular structure of the fruit acts as a semi -permeable membrane as reported by Corzo & Go´mez (2004).

The results observed that, the addition of Ca lactate reduced the loss in drained weight by 15% at least and this reduction depend up on the level of Ca addition. However, calcium ions may impact tissue firmness by contributing to increased membrane integrity and the consequent maintenance or increase of cell turgor pressure (Mignani *et al*. ,1995).

The same trend was also observed in case of adding Ca lactate at 60◦C as shown in data tabulated in Table (3). TSS and total acidity content of melon compote treated at 60◦C by 0, 400, 600 and 800 ppm of Ca lactate was lower than that of treated at room temperature. The results show that TSS and total acidity decreased by 0.65, 25.6; 3.8, 7.7; 0.85, 18.3 and 3.5, 15.5% respectively than of compote treated at room temperature by same concentrations after 6 months of storage respectively. On the other hand, a slight change was induced in pH and browning index values. The retention of ascorbic acid was more effective where increased by 16.3, 16.7, 23.4 and 22.3% respectively. The drained weights increased by about 1-1.5% compared to compote treated at room temperature such results may indicate that the firming effect is accompanied by improved water holding capacity due to a more cross linked pectin network; thus, less juice is released when biting through calcium treated melon pieces. Additionally, higher water holding capacity could be related to increased firmness due to higher turgor pressure which is supported by a significant correlation between moisture content and hardness attributes (Luna-Guzma´n and Barrett, 2000).

Calcium content

Initially, tissue bound Ca level increased in melon pieces treated with Ca lactate. Slight differences among treatments were found between either thermally treated or untreated melon compote without any addition of Ca lactate (Fig.1).

The level of Ca content increased as increasing the concentration of added Ca lactate. Furthermore, the 60°C treatments had higher Ca levels by about 10 – 15% than room temperature treatments.

The fact that the 60°C treatment had a significantly higher calcium concentration suggests possible enhanced diffusion at higher temperatures **(**Luna-Guzma´n *et al.,* 1999). However, Aguayo *et al.* (2008) reported an increase in Ca levels, mainly of bound Ca, in 'Amarillo' melon pieces treated with CaCl2, propionate, lactate and carbonate for 1 min combined with heat treatment (60◦C).

Firmness

Generally, the firmness of all melon compote treatments were gradually reduced during the storage period but the addition of calcium lactate reduced the loss in firmness of the melon compote as shown in Tables 2, 3 and Fig.2. The highest the calcium concentration applied, the greatest the improvement in firmness. Similar effects were obtained in both the room temperature and 60°C treatments, but the 60°C calcium treated samples were firmer than samples from any other treatments. Firmness was improved by 166.6, 191.1; 245.5, 279.7 and 280.5, 308.9% in case of adding 400, 600 and 800 ppm of Ca lactate at room temperature and 60°C respectively. Furthermore, heat treatment alone without any addition of Ca affected sample firmness by 33.3% compared with unheated sample throughout storage. The results revealed that firming effects obtained from 60°C treatments alone or combined with calcium. A firming effect by a combination of calcium chloride dip and heat treatment has also been shown in fresh-cut melons by Luna-Guzma´n *et al.* (1999). The beneficial effects reached with high temperatures have generally been explained in terms of pectin methylesterase (PME) activation allowing Ca incorporation. Another related effect of higher temperature is the increase of Ca diffusion, especially throughout apoplast pores, which also increases the solubility of Ca salts in vegetable tissue (Harker *et al.,* 1989).

Organoleptic properties:

Table (4) represents the effect of using Ca lactate on the sensory properties of Galia melon compote after 6 months of storage. Data show no significant deference in color between all treatments while, significant differences were found in the taste, flavor and texture between Ca treatments and either room temperature or 60°C treatments without any Ca addition.

Generally, it could be observed that sensory acceptance increased as increasing the proportion of Ca in all treatments due to the relative increase in taste, flavor and texture scores.The texture was obviously enhanced in all Ca treatments by increasing the level of addition.

The results reveal that compote produced from compote treated by 600ppm of Ca lactate at 60°C had the highest sensory acceptance 84.5% followed by compotes treated by either 600ppm Ca lactate at room temperature or by 800 ppm Ca lactate at 60°C.

4. Conclusion

Melon compote considers being a good alternative product to extend the marketing period for melon. The study has shown that melon compote can be effectively produced by using Ca lactate (600 ppm) combined with heat treatment at 60°C as firming agent for improve the quality indices in Galia' melon compote up to 6 months of storage without providing undesirable bitterness.

Table (1): Some physicochemical properties of fresh melon

Components	Value
Pulp yield (%)	72.4
Moisture content (%)	88.6
Total soluble solids (Brix)	9.6º
Total titratable acidity (%)	0.11
pH value	5.6
Ascorbic acid (mg/100gm)	23.83
Carotenoids (mg/100gm)	0.86
Brix /acid ratio	64:1
Firmness (N)	49.6
Ash content %	0.64
Calcium (mg/100gm)	13.5

Table (2): Effect of adding Calcium lactate at room temperature (~25°C**) on some properties of melon compote during 6 months of storage.**

Parameter	Control			Ca lactate (400 ppm)			Ca lactate (600 ppm)			Ca lactate (800 ppm)		
	Storage period (month)			Storage period (month)			Storage period (month)			Storage period (month)		
	2	4	6	2	4	6	2	4	6	2	4	6
TSS	13.8	14.9	15.4	10.6	11.7	13.2	10.5	11.3	11.7	10.2	10.8	11.4
pH	4.6	5.1	5.2	4.7	5.0	5.3	4.8	5.1	5.3	4.8	5.2	5.3
Acidity (%)	0.187	0.148	0.117	0.145	0.123	0.104	0.125	0.107	0.109	0.124	0.106	0.097
Browning index	0.126	0.168	0.237	0.124	0.155	0.229	0.109	0.125	0.187	0.125	0.136	0.174
Ascorbic acid (mg/100gm)	11.88	8.13	5.47	14.65	11.62	8.96	16.53	11.75	10.05	17.35	12.14	10.43
Firmness (N)	24.6	18.7	12.3	37.6	36.5	32.8	48.5	45.3	42.5	48.5	47.7	46.8
Drained weight (%)	65.3	56.7	45.8	66.3	62.4	61.0	67.2	65.1	64.3	67.8	65.8	65.2

Table (3): Effect of adding Ca lactate at 60◦C on some properties of melon compote during 6 months of storage.

Parameter	Control			Ca lactate (400 ppm)			Ca lactate (600 ppm)			Ca lactate (800 ppm)		
	Storage period (month)			Storage period (month)			Storage period (month)			Storage period (month)		
	2	4	6	2	4	6	2	4	6	2	4	6
TSS	13.6	14.6	15.3	10.4	11.5	12.7	10.7	11.2	11.6	10.3	10.6	11.0
pH	5.0	5.1	5.3	5.1	5.4	5.4	4.8	5.2	5.5	5.2	5.4	5.5
Acidity (%)	0.125	0.108	0.087	0.143	0.105	0.096	0.135	0.114	0.089	0.118	0.096	0.082
Browning index	0.126	0.168	0.237	0.124	0.155	0.229	0.109	0.252	0.218	0.125	0.186	0.198
Ascorbic acid (mg/100gm)	12.57	8.24	6.37	15.35	12.22	10.46	17.78	13.65	12.44	17.93	13.43	12.76
Firmness (N)	26.2	19.3	16.4	38.5	37.4	35.8	47.5	47.6	46.7	48.8	48.4	48.3
Drained weight (%)	66.4	59.2	47.3	67.8	64.8	62.1	68.1	66.5	65.8	68.4	67.8	66.2

Table (4): Effect of the level of Calcium lactate and temperature on the organoleptic properties of melon compote after 6 months of storage.

Parameter	~25°C				60°C			
	0 ppm	400 ppm	600 ppm	800 ppm	0 ppm	400 ppm	600 ppm	800 ppm
Taste (10)	6.5 ^{c}	7. 4 ^{b}	8.6 ^{a}	7.9 ^{b}	7.2 ^{bc}	8.2 ^{ab}	8.8 ^{a}	8.1 ^{ab}
Flavor (10)	7.3 ^{b}	7.6 ^{b}	8.2 ^{ab}	7.8 ^{b}	7.4 ^{b}	7.7 ^{b}	8.4 ^{a}	7.8 ^{b}
Color (10)	8.0 ^{ab}	8.2 ^{ab}	8.3 ^{a}	8.4 ^{a}	8.2 ^{ab}	8.4 ^{a}	8.4 ^{a}	8.3 ^{a}
Texture (10)	4.5 ^{d}	6.4 ^{c}	7.5 ^{b}	7.8 ^{b}	6.2 ^{c}	7.3 ^{b}	8.2^{a}	8.4 ^{a}
Overall acceptability (%)	65.8	74	81.5	79.8	72.5	79.0	84.5	81.5

Different letter in each column mean significant difference ($P < 0.05$).

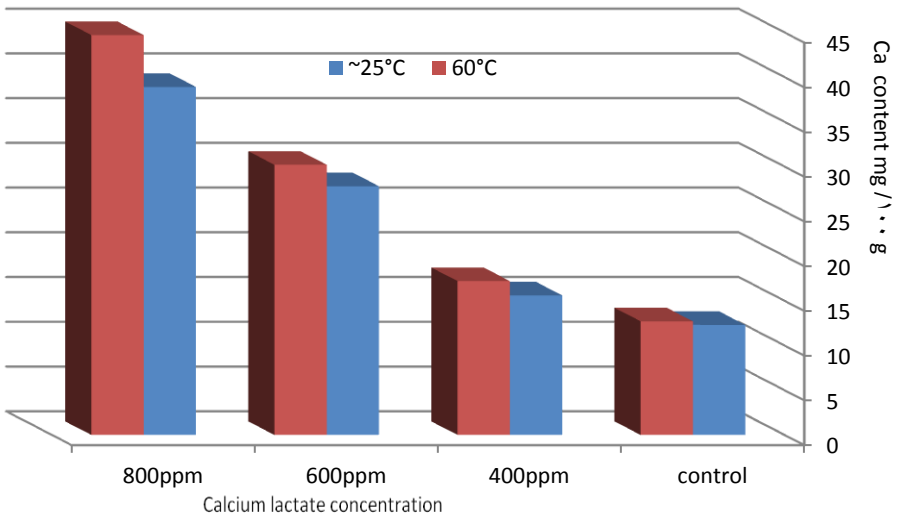

Fig (1): Effect of the temperature and Ca Lactate concentration on the Calcium content of melon compote after 6 months of storage.

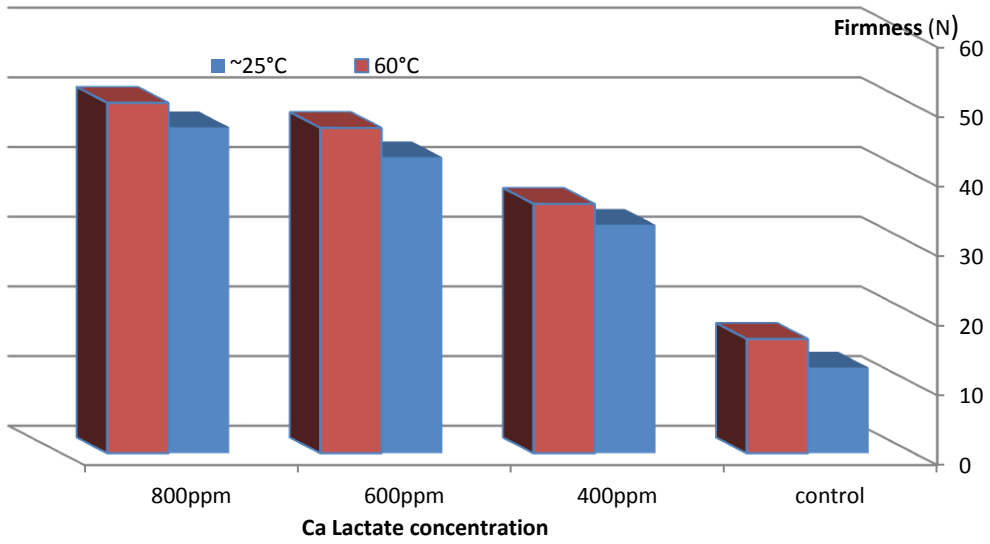

Fig (2): Effect of the temperature and Ca Lactate concentration on firmness of melon compote after 6 months of storage.

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