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Physicochemical characteristics and phytochemical content of jam made from melon (*Cucumis melo*)

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Abstract

Melon (*Cucumis melo*) is a fruit with high market value in Algeria with little details about its quality characteristics. Physico-chemical and microbiological parameters, sensorial profile, antioxidants content and antioxidant activity were evaluated in jam made from Algerian melon fruit (*Cucumis melo*). For that purpose, special attention was paid to total soluble solids (TSS), titratable acidity (TA), viscocity, total sugars (TS) and others, bioactive compounds and anti-radical activity. Results show that jam made from melon had a comparatives physicochemical characteristic to other fruit jams and was highly hygienic with absence of microbiological contamination. wherease, the jam presents a low content of bioactive compounds, but it still remain an important source of antioxidants compounds with antioxidant potential in the diet.

Introduction

The culture of the melon is too old to certify its origin, it was cultivated since ancient Egypt, before being adopted by the Greek and Roman antiquity. The melon, whose scientific name is *Cucumis melo*, is a climbing plant of the family Cucubitaceae. The word melon indicates both the fruit and the plant that is largely cultivated as its fruits are edible, sweet and flavoured.

Cucumis melo L. is among the most consumed fruit in the summer because of its high water content (90%). In addition to its high potassium content, folic acid, niacin and carbohydrates, melon contains nutritional bioactive compounds such as vitamins, elements minerals, fiber and secondary metabolites or non-nutritive bioactive compounds (Kader *et al*., 2004) such as flavonoids, phenolic compounds and carotenoids (Henane *et al*., 2014) in particular carotenes (α-carotene, β-carotene, β-cryptoxanthin, lutein, zeaxanthin). These bioactive compounds possess antioxidant properties to fight against diseases such as chronic diseases like cancer and cardiovascular disease (Giovanucci, 2002). This protective effect is mainly due to the antioxidant activity of these compounds that neutralize free radicals.

World melon production is around 28.3 million tons. The first world producer is China with over 15 million tons (53% of world production). In Africa the first melon producer is Egypt. Melon (*Cucumis melo*n), fruit with short storage life due in part to its respiration rate and a rapid ripening process, is an important source of phytochemicals in the Algerian diet, which can be consumed raw and cooked. Thus, in order to reduce post-harvest losses, numerous techniques and process for fruit conservation into jam, jelly, marmalade, as well as nectar have been developed. Cooking jams, jellies and marmalades using fruits, sugar, pectin and edible acids is one of the oldest food preserving processes known to mankind and presents a way of making food stable by increasing the content in soluble solids.

Historically, jams originated as an early effort to preserve fruit for consumption during the off-season. It is an intermediate moisture food prepared by boiling fruit pulp with sugar, pectin, acid and other ingredients (preservatives, colouring and flavouring substances) until obtaining a reasonably thick consistency. Generally, fruit jam storage at high temperature leads to a significant decrease of nutritive values and sensorial properties (Wicklund *et al*., 2005). The use of melon is limited in growing areas of country and therefore calls for research into its composition and other means of utilization and value addition due to its high perishable nature.

Common fruit jams in the market are strawberry, pineapple, apricot, orange and many other fruit. However, there is no melon jam found in the market as of now. Until recently, research about jam only

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focused on the commercial fruit spread, especially on apricot and berry fruit. Besides, not much research has been done for melon jam. Thus, the objective of this study is to offer a new product to the consumers that is a melon jam, to determine its physicochemical, microbiological and organoleptic qualities, antioxidant content and the antioxidant activity.

Materials and Methods

The *Cucumis melo* (melon) used for the study was purchased from fruit vendors at Boutheldja city, El-Tarf, North- East of Algeria an area known to support the growth of melon.

Preparation of jam

Jam is prepared by boiling the fruit pulp with sufficient quantity of sugar to a reasonably thick consistency, firm enough to hold fruit issues in position. Two different recipes were prepared (Figure 1) with two different quantities of sugar (250 and 500g).

Organoleptical attributes

Organoleptical attributes of the two different formulas was carried out. Twenty untrained panelists of the teachers and students from the agronomy Department, El-Tarf University, in the age range of 24 to 60 years were asked to evaluate the prepared jams towards aspect, color, texture, taste, smell and sugar. Each tested parameter is evaluated by scoring. Results were subjected to analysis of variance and average of the mean values of the aforementioned attributes and their standard error were calculated according.

The sensory evaluation results of the jams prepared from the two recipes showed significant difference ($0 < 0.05$) in the score of characteristics among the two with exception of color, taste and smell (Figure 2). This test is performed for the purpose of choosing the most favorite recipe by consumers. The statistical study showed that the jam of pot bearing the number 2 is most preferred by tasters. In what follows, the different tests were carried out on the jam of the pot 2, in other words on the jam prepared with 500 g of sugar for 1 kg of the melon.

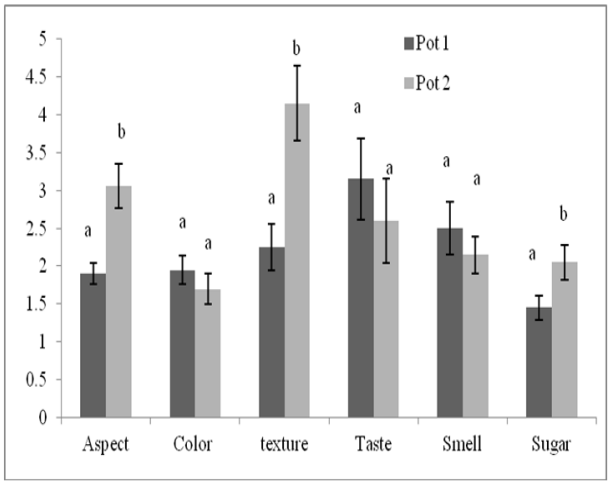

Figure 2. Sensory quality attributes of melon jam

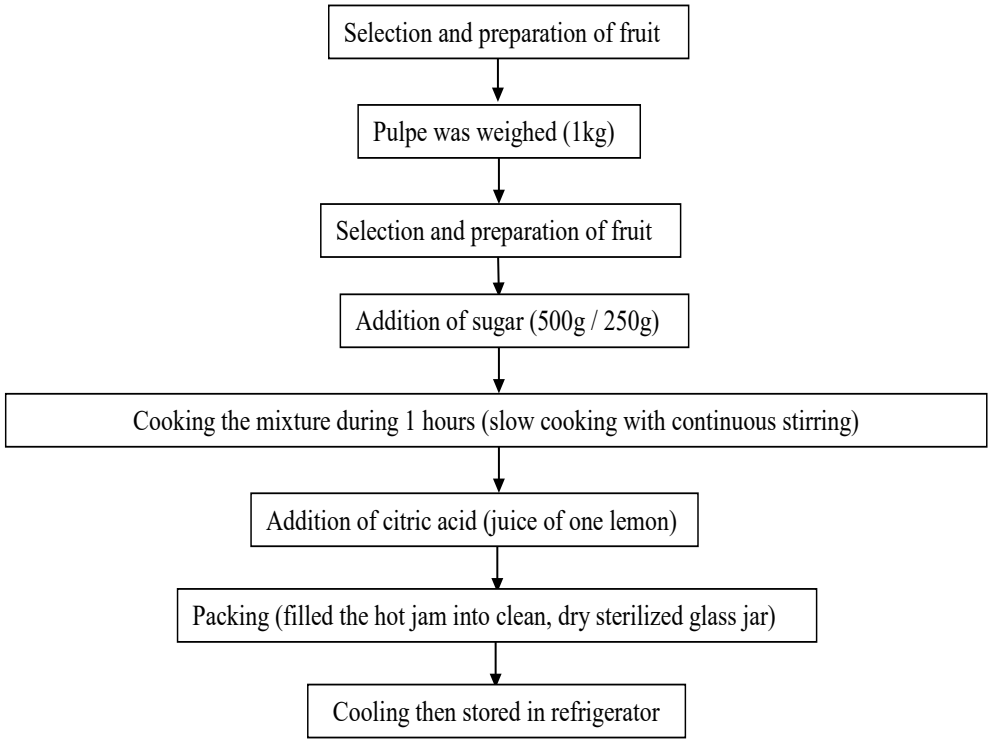

Figure 1. Preparation of melon jam

Table 1. Organoleptic quality of jams prepared according to the powers of the tasting panel

N°	pot 1	pot 2	pot 1	pot 2	pot 1	pot 2	pot 1	pot 2	pot 1	pot 2	pot 1	pot 2
1	2	3	2	1	2	6	1	1	2	1	1	3
2	2	1	3	2	2	4	5	1	1	3	2	1
3	2	3	2	1	2	6	1	1	2	1	1	3
4	2	5	1	1	1	6	1	1	5	5	2	1
5	2	4	1	2	2	3	2	1	2	3	2	1
6	3	4	1	4	2	6	7	7	5	1	1	3
7	1	1	3	1	2	1	1	1	2	3	1	1
8	3	4	3	1	2	6	5	1	2	2	2	3
9	1	4	2	2	1	3	1	2	1	1	3	1
10	2	4	1	2	2	6	1	2	1	3	1	3
11	2	1	2	1	2	1	6	1	5	1	1	1
12	1	2	1	2	1	6	7	8	5	1	1	W.E
13	2	1	2	1	6	7	3	7	1	3	1	3
14	1	3	1	2	2	6	3	2	1	2	1	1
15	3	4	1	1	1	3	1	1	4	3	3	3
16	2	3	2	4	2	6	7	1	2	3	1	3
17	1	W.E	3	2	2	1	1	3	3	2	1	3
18	2	3	3	1	2	1	1	3	1	1	1	1
19	2	3	3	2	3	4	6	1	4	2	2	1
20	2	5	2	1	6	1	3	7	1	2	1	3

WE: without evaluation

Determination of physico-chemical parameters

The melon jam was studied to determine the following parameters: pH (AFNOR, 1982), titratable acidity (Verma and Joshi 2000), water content (Doymaz *et al*., 2004), total soluble solids (TSS), total sugar, reducing sugar, non reducing sugar, total ash (AFNOR, 1982), density with a densimeter (hach-lang), viscosity with a viscosimeter and the non enzymatic browning index (NEB) (Arkoub-Djermoune *et al*., 2015)

Preparation of the extracts

The extract was prepared as prescribed in the study of Benmeziane *et al*. (2014) with slight modifications. The melon jam sample (10g) was extracted with 50 ml of 80% methanol. The extraction was performed at room temperature, using magnetic blender during 40 min. After agitation, the solution was centrifuged at 3 000 rpm/15 min, the supernatant was filtered (Whatman paper) and stored in a fridge (4°C) until further analysis.

Quantification of antioxidants

Total phenolic content in the melon extract was determined using Folin-Ciocalteu reagent according to the method described by Nickavar *et al*. (2008) with some modifications. Briefly, 200 µl of freshly prepared extracts was mixed with 1 ml of Folin-Ciocalteu reagent (diluted 1 /1 0) and incubated at room temperature. After 10 min, 0.8 ml of sodium carbonate solution (7.5%) was added. The final solution was mixed thoroughly and allowed to remain in the dark for 2 hours at room temperature. The absorbance was measured at 765 nm with a spectrophotometer (Hach DR 3900-lang). Gallic acid was used as standard phenolic compound (0.01 - 0.1 mg/ml) and the results were expressed as mg of gallic acid equivalent (GAE)/g FW. The assay was performed in two replicates for each extract.

The total flavonoïds content was measured by a colorimetric assay developed by Kim *et al*. (2003), with modifications. Briefly, 250 µl of extract or standard solution of catechin at different concentration (20 - 260 µg/ml) and 1 ml of distilled water were mixed in a 10 ml test tube. The following were successively added : at zero time, 75 µl of 5% NaNO2 ; at 5 min, 75 µl of 10% AlCl3 ; and at 6 minutes, 500 µl of 1N NaOH. The solution was then immediately diluted by adding 2.5 ml of distilled water and mixed thoroughly. The absorbance of the mixture, pink in color, was directly measured in a spectrophotometer at 510 nm against a blank sample and the results were expressed as catechin equivalents (mg CE/g FW). Samples were analyzed in two replicates for each extract.

The amount of total carotenoïds and lycopene was determined using the method of Sass-Kiss *et al*. (2005). Briefly, 20 ml of solvent mixture (hexane-

acetone-ethanol, 2:1:1; v: v: v) were added to 5 g of the homogenized samples. After 30 min of agitation, the supernatant was collected and the residue was added with 10 ml of hexane for a second extraction. The amount of carotenoïds was determined after measuring the absorbance of the supernatant at 420 nm. The results were expressed as mg of β-carotene equivalent per 100 g of fresh weight (mg β-CE/100 g FW). Concerning the amount of lycopene, it was determined after measuring the absorbance of the supernatant at 472 nm. The results are expressed as mg lycopene equivalent per 100 g of dry weight (mg LE/100 g DW) from the standard curve prepared with lycopene. The amount of ascorbic acid in the sample was determined according to the oxidation-reduction method described by Njoku *et al*. (2011). It is a direct titration of 10 ml of diluted melon jam with iodine (I_2). Results are expressed as mg of vitamin C/100 g of jam.

Antioxidant activity

DPPH radical scavenging effect was determined according to the Milardović *et al*. (2006). The radical scavenging activity was expressed as % of inhibition according to the formula

$$\text{Inhibition (\%)} = \frac{\text{A Control - A Sample}}{\text{A Control}} \times 100$$

where $A_{control}$ and A_{sample} are the absorbances of the control and sample, respectively.

Statistical analysis

All data are reported as mean ± standard deviation of mean of three replicates.

Determination of microbial load

Contamination of food by moulds and bacteria is common. Hence their presence in the finished products is considered unfit for consumption. The microbiological analyzes are intended to ensure that the prepared jam has a higher hygienic and commercial quality. Table 2 summarizes all of germs sought and counted according to the standard (NF 4833, 1991).

Table 2. Microbiological analyses

Germs sought	Culture media used	Incubation T°C	Incubation time
Total coliforms	BCPL	37	24h
Fecal coliform	Schubert	44	24h
Staphylococcus aureus	Chapman	37	24/48h
Salmonelles	BLMT + SFB + Hektoen	37	72h
Clostridium	VF	37	24/48h
Yeasts and molds	Sabouraud	20	3 to 5 days

Results and Discussion

Physicochemical parameters

The proximate physicochemical composition of melon jam has been given in Table 3. No data were available on the physicochemical parameters of melon jam, although all fruits can be processed into jam, which makes comparison very difficult. So, all of comparisons were made with results obtained on jam made from other fruits.

Table 3. Some physicochemical and antioxidants content of melon jam

Physicochemical parameter	Result
pH	4.01 ±0.01
TA (in citric acid)	2.97±0.31
Brix (%)	73.10 ± 0.00
Moisture (%)	24.20 ± 0.01
Viscosity (Pa.s)	0.78 ± 0.05
Density	2.33 ± 0.21
Dry matter (%)	75.80 ± 0.01
Organic matter (%)	99.80±0.00
Total ash (%)	0.20 ±0.00
Total sugar (g/100g)	56.18 ± 0.66
Reducing sugar (g/100g)	26,89 ± 0.21
Non reducing sugar (g/100g)	29.29 ± 0.87
NBE index	0.61 ± 0.09
Pectin	Presence
Antioxidants content	**Result**
Vitamin C (mg/100g)	5.4 ± 0.06
Polyphenols (Gallic Acid Equivalent/100g)	14.04 ± 0.06
Flavonoïds (mg Catechin Equivalent/100g)	8.62 ± 0.96
Carotenoïds (mg β-Carotene Equivalent /100g)	1.44 ± 0.06
Lycopene (mg Lycopene Equivalent /100g)	0.93 ± 0.24
% DPPH	4.95 ± 0.8

The TA is one of a number of physicochemical parameters which affect product quality; to a large extent, acidity protects against the development of microorganisms. The TA of melon jam reported in this study was 2.97%. The pH of melon jam was 4.01, this value of pH facilitate the inversion of 30–50% of the added sucrose during cooking and limit the crystallization of sugars. The pH must not be too low (>3.5) since it could induce deterioration of sensory quality: glucose crystallization; granular texture; excessive acidic flavour; and exudation phenomenon (Besbes *et al*., 2009); The TSS is primarily represented by sugars, with acids and minerals contributing. According to the Codex Alimentarius standard (CODEX STAN, 2009), normal fruit conserves or preserves must contain 60% soluble solids, the TSS of melon jam was 73%. An increase in TSS implies decrease in moisture content of the

sample thus increase in the nutritional composition of the jam samples. The pH and TA were higher than those found by Touati *et al*. (2014) for apricot jam, unlike TSS. These authors reported 3.54, 0.82% and 64.42% for pH, TA and TSS, respectively; and higher than those recorded by Jaiswal *et al*. (2015) on apple, pineapple, peach and a mixed fruit jams.

Ash content represents the quantity of minerals like calcium, phosphorus and iron present in the sample. Value of ash indicates the stability of products. Ash content was 0.20%. The total ash in the present study is slightly lower than that reported by Ejiofor and Odwuno (2013) for jackfruit jam with 0.27%; and higher than those reported by Mohd Naeem *et al*. (2015) on grape and blueberry jam with a content of 0.18 and 0.12% respectively. Acceding to Nwosu *et al*. (2014), the variation in ash content is due to variation in inorganic compounds especially calcium ion present in pectin present in the different fruits. Mineral components show great changes during cooking operations, because of their solubility in water. Cooking might improve mineral bioavailability by increasing solubility due to cell wall disruption, protein denaturation and release of organic acids, which is found in the work of Arkoub-Djermoune *et al*. (2015). Generally, low ash content indicates that the melon jam analyzed is not a rich source of minerals.

Water is a source of degradation of antioxidants thus the preservation of the chemical composition in cell is performed by removing water from the fruit cooking. After harvesting in the presence of water, an enzymatic activity may quickly cause irreversible changes in antioxidants, such as oxidation which leads to their decomposition or polymerization. The moisture test permits to know the water content of the melon jam. Moisture has a great impact on the shelf life of products, usually high sugar content makes the moisture unavailable for the growth of microorganisms. The moisture content was 24.20%, which is close to those observed by Nwosu *et al*. (2014) between 27 and 34% and to that recorded by Ejiofor and Owuno (2013) with 24.60% of moisture on jackfruit jam. It is important to note that moisture content is directly related to the conservation of the product in storage, and jams with lower moisture content have a longer shelf life.

The sugar present in jam comprises natural and added sugar and is an important preservative. The proportion of sugar to fruit varies according to the type of fruit and its ripeness. Total sugar content of melon jam (56.18%) was close to that of appel jam (66.84%), jamun jam (69.12%) and peach jam (69.14%) reported by Jaiswal *et al*. (2015); and consistent with results reported by Oliveira Mamede *et al*. (2013) on umbo caja jam made from green and ripe pulpe (56.9 and 52.5%, respectively). These differences in sugar content can be attributed to the differences in methodology followed, quantity of sugar added and variety of fruit used. Low sugar jams can be called as better jam from health point of view.

During jam making, sucrose is added. During boiling, the sucrose partly gets converted into invert sugar which prevents crystallization. Reducing sugar content recorded in this study was 26.89%. Ahmmed *et al*. (2015) found reducing sugar content of mango jams ranged from 28.00% to 60.30% and results of Nour *et al*. (2011) varied between 24.54 - 34.11%. The range is close to the present investigation, but reducing sugar content found in jams made from Tunisian dates varied from 35.42 to 86.65% (Besbes *et al*., 2009) which is higher than the result recorded in this research. Whereas, our result is higher than that reported by Correa *et al*. (2011) whose recorded 8.10% on guava jam and those reported by Sindumathi and Amutha (2014) on coconut jam (15.79%). These differences can be explained by differences in fruit used, preparation and ingredient, specially sugar and its quantity, but also the cooking parameters mainly, time and temperature. The inversion process is desirable when elaborating jams as the reducing sugars give a more shiny aspect to the jam, minimize the crystallization of the sucrose, stop exudation and reduce the sweetness of the jams. Thus, jams with higher reducing sugar contents tend to present less crystallization during storage, which is favorable to the stability of the products (Viana *et al*., 2014).

Data regarding non-reducing sugar indicate a content of 29.29%, which was higer than reducing sugar (26.89%), these results can be explained by the hydrolysis or inversion of reducing sugars to non-reducing sugar and by a partial hydrolysis of sucrose (initial and added) during cooking. This inversion may be due to the presence of acids such as citric acid, malic acid which along with high temperature speed up the inversion process (Besbes *et al*., 2009). Similar findings were reported by Nour *et al*. (2011) on Sudanese mango jam and Shahnawaz *et al*. (2009) on some jams prepared from jamun fruit.

The result of viscosity measurement is shown in table 3. Viscosity of melon jam was found to be 0.78 Pa.s (780cp), which makes it solidified in nature and extremely liked by the tasters. Viscosity measurement of product is dependent upon the applied force and shear rate. Number of factors like pH, sugar and pectin are responsible for the formation of tough gel which affects the rheological properties of jam (Jaiswal *et al*., 2015). Our result is very far from that

obtained by Jaiswel *et al*. (2015), whom found 500.3 poise.

As it can be noted in Table 3, the NEB of melon jam was 0.61. The initial browning of melon jam is probably due to enzymatic reactions and essentially to non-enzymatic browning (Maillard Reaction) that occurred during cooking and pasteurization. Indeed, the enzymatic browning is disfavored by lowering the pH and thermal treatment. However, the NEB is favored by heating and it can still occur at pH 4.0 (Besbes et la., 2009). A similar result have been found by Arkoub-Djermoune *et al*. (2015), these researchers reported that the index of NEB of eggplant increases after cooking with a range of 48.89%, 66.18% and 76.76% in grilled, fried and baked sample, respectively.

Ascorbic acid

The naturally occurring antioxidants were significantly decreased during heating. The data on ascorbic acid or vitamin C of melon jam is shown in Table 3. It is known that freshly harvested melon fruits contain ascorbic acid 36.7mg/100 as reported by the USDA. In our study, the vitamin C content in melon jam was 5.40mg/100g which show a significant decrease agreeing with results found by Ejiofor and Owuno (2013). Our result is in the range of those found by Mohd Naeem *et al*. (2015) on some fruit jams.

The reduction of the vitamin C content in melon jam is the result of thermal treatment which is known to accelerate oxidation of ascorbic acid to dehydroascorbic acid, followed by the hydrolysis to 2,3-diketogulonic acid and eventually polymerization to other nutritionally inactive components (Chuah *et al*., 2008). These finding are also in line with those of Lee and Kader (2000) who had reported that when the storage temperature or duration was increased, a gradual decrease in ascorbic acid content is observed.

Polyphenols

As it can be noted in Table 3, the total polyphenol content was lower (14.04 mg/100g) compared with other results on jam polyphenols. This low content may be explained by the low polyphenols in the fresh fruit as stated previously by Mélo *et al*. (2006); and Henane *et al*. (2015), and due also to the processing and storage. This result was in agreement with those obtained by Oancea and Călin (2016); Poiana *et al*. (2012) and Levaj *et al*. (2012).

Flavonoïds

The flavonoïds concentration in the studied sample is shown in Table 3. The flavonoïds content was 8.62 mg/100g. It can be noted that flavonoïds content of melon jam followed the trend observed with polyphenols content. Total flavonoïds was lower in the jam sample prepared compared to those of Levaj *et al*. (2012), this low value can be due to the thermal degradation as stated by Arkoub-Djermoune *et al*. (2015) during preparation.

Total carotenoïds

The Carotenoïd contents (Table 3) of melon jam was 1.44mg βCE/100g. melon fruit is known to be a rich source of β-carotene (Lester, 1997), however the value obtained in this study seems to be low, according to Khoo *et al*. (2011), the degradation of carotenoïds in fruits and vegetables is a major issue due to carotenoïd loss. Nevertheless, Giufrida *et al*. (2013) state that the carotenoïd content was not particularly affected during the peach processing for the production of the juice and the jam and concluded that peaches and their products (juice and jam) can usefully be included in the range of fruits chosen by consumers to improve their daily consumption of healthy phytochemicals. Nicoli *et al*. (1999) come to the same conclusion. The low carotenoïd content may be due either to the method of extraction and analysis (performed assay is quantitative), the nature of the standards used in the sample as well as geographic origin, maturity and storage conditions. No results were reported on the carotenoid content of the jam melon, but this result is 1.90 more lower than that found by Selvamithukumaran and Khanum (2014) which is 2.74mgEC/100g in his study of seabuckthorn jam, but it is higher than results recorded by Giuffrida *et al*. (2013) on the jam fishing which was 0.142mg/100g and those recorded by Abozeid and Nadir (2012) on loquat fruit jam from Egypt which was 0.893 mg/100g.

Lycopene

Lycopene is highly susceptible to oxidative degradation because of its highly conjugated polyenic structure (Arkoub-Djermoune *et al*., 2015). The melon jam presents a content of 0.93 mg LE/100g of lycopene (Table 3). As carotenoïds, the value obtained in this study seems to be low and was the lowest value compared with other antioxidants jam melon content. This value is lower also as compared to lycopene rate in tomato jam which had a content of 75.64 mg/100g according to Veljovic *et al*. (2012), whom stated that the absolute lycopene content was reduced more than 50 % during thermal processing of tomatoes into jam. However, many studies have shown that uptake of lycopene is greater from heated-processed tomato products than from unprocessed

tomato. The reason for this occurrence is probably enhanced bioavailability due to breaking down of sturdy cell walls, thus making lycopene more accessible (Veljovic *et al*., 2012), and according to Mayeaux *et al*. (2006), thermal isomerization of lycopene is known to improve its bioavailability from food matrices. There is no data about lycopene content of jam melon which makes comparisons difficult.

Antioxidant activity

The inhibition percentage of the radical DPPH• by the melon jam extract is presented in Table 3. The percentage of inhibition was 4.95%. This result leads us to say that melon jam has a weak antioxidant activity comparing to the seabuckthorn jam with a pourcentage of 69.39% (Selvamithukumaran and Khanum, 2014). However, melon jam exhibits a higher antioxidant activity than tomato jam which was 1.195% according to Veljovic *et al*. (2012). Whereas, Rababah *et al*. (2011), found in their work on cherry, apricot and fig jam a percentage of inhibition of DPPH radical of 10.06%, 9.95% and 8.96%, respectively, after five month of strage at 25°C and Jaiswal *et al*. (2015) found an inhibition of 13.66% on jam peach. This result can be explained, according to Ścibisz and Mitek (2009), by the loss of phenolic compounds, which showed in their work on jam blueberry losses between 13 and 19%. Referring to the literature, several studies have shown the antioxidant effect of polyphenols, their reduction (7-17%) systematically resulted in a decreased total antioxidant activity and anti-radical activity. Similarly, Poiana *et al*. (2011) recorded losses between 30 to 41% in the antioxidant activity during the manufacture of jam, they attributed these losses to the decrease of phenolic content, the loss was between 25 and 43%. Our results indicated that the highest correlation (0.79) was found in polyphenols content and the DPPH activity, while flavonoïds, carotenoïds and lycopene shown no significant correlations. Hence, these results were considered to show that the infuence on the DPPH activity was mostly due to the phenolic compounds. This observation matches that found by Bursać Kovačević *et al*. (2009).

Microbial evaluation of stored melon jam

With respect to microbial analysis of jam, no detectable, yeast and mold was observed after four months storage period, the same was observed for data regarding total viable count of melon jam. The temperature and the cooking time can be at the origin of the hygienic quality of the product, in addition to the sugar effect. Sugar in solution exerted an osmotic pressure, which helped in keeping away osmophilic loads in the jam. The sugar content added in jam prevented microbial spoilage. Results were are in agreement with previous investigations of Nour *et al*. (2001) who reported no yeast and mold growth and insignificant total viable cont in Sudanese mango jams during four months storage.

Conclusion

Melon (*cucumis melo*) represents one of the most important sources of bioactive compounds with antioxidant activity, with its high fiber content, nutrient compositions and sensory attributes can successfully be used for the preparation of jam to add value to the fruit, reduce post harvest losses due to its perishability as a result of its high moisture content rather than 90%. The product (melon jam), exhibits a high microbiological quality given the absence of contamination germs, which making it a safe product for human consumption and thereby lengthen its shelf life. Jam melon presented a low content of antioxidants compared to the fresh product as described in the literature. But, regardless of the degradation of total phenolics and some antioxidants, the present results suggest that jam made from melon fruit still remain good sources of bioactive compounds with antioxidant potential in the diet.

References

Abozeid, W.M. and Nadir, A.S. 2012. Physicochemical and Organoleptic Characteristics of Loquat Fruit and Its Processing. *Nature and Science* 10(6): 108-113.

AFNOR. 1982. French Standards Series Derivatives of Fruits and Vegetables, Fruits juice. *Ed. AFNOR*. pp 1–327. Retrieved from http://www.afnor.org/.

AFNOR. 1986. Collection of French standards. Milk and milk products. Test Methods . *Ed. AFNOR.* pp 107-251. Retrieved from http://www.afnor.org/.

Ahmmed, L., Islam, M.N. and Islam, M.S. 2015. A Quantitative Estimation of the Amount of Sugar in Fruits Jam Available in Bangladesh. *Science Journal of Analytical Chemistry* 3(5): 52-55.

Arkoub-Djermone, L., Boulekbache –Makhlouf, L., Zeghichi-Hamri, S., Bellili, S., Boukhalfa, F. and Madani. 2015. Influence of thermal processing on the physicochemical propreties and the antioxidant activity on of a solanaceae vegetable: eggplant. *Journal of Food Quality* 181 – 191. 10.1111/jfq.12192.

Benmeziane, F., Djamai, R., Cadot, Y. and Seridi, R. 2014. Optimization of extraction parameters of phenolic compounds from Algerian fresh table grapes, (*Vitis Vinifera*). *International Food Research Journal* 21(3): 1061-1065.

Besbes, S., Drira, L., Blecker, C., Deroanne, C. and Attia, H. 2009. dding value to hard date (*Phoenix dactylifera* L.): Compositional, functional and sensory characteristics of date jam. *Food Chemistry* 112: 406–411.

Bursać Kovačević, D., Levaj, B. and Dragović-Uzelac, V. 2009. Free Radical Scavenging Activity and Phenolic Content in Strawberry Fruit and Jam. *Agriculturae Conspectus Scientifcus* 74 (3): 155 – 159.

Chuah, A.M., Lee, Y.C., YamaguchI, T., Takamura, H., Yin, L.J. and Matoba, T. 2008. Effect of cooking on the antioxidant properties of coloured peppers. *Food Chemistry* 111: 20 – 28.

Correa, R. C. G., Sora, G. T. S., Haminiuk, C. I. W., Ambrosio-Ugri, M. C. B., Bergamasco, R. and Vieira, A. M. S. (2011). Physico-chemical and sensorial evaluation of guava jam made without added sugar. *Chemical Engineering Transactions* 24: 505-510.

Doymaz, I., Gorel, O. and Akgun, N. 2004. Drying characteristics of the solid by-product of olive oil extraction. *Biosystems Engineering* 88: 213–219.

Eke-Ejiofor, J. and Owuno, F. 2013. The physico-chemical and sensory properties of jackfruit (*artocarpus heterophilus*) jam. *International Journal of Nutrition and Food Sciences* 2(3): 149-152.

Giovannucci, E. 2002. Lycopene and protaste cancer risk. Methodological consideration in the epidemiology literature. *Pure and Applied Chemistry* 74: 1427-1434.

Giuffrida, D., Torre, G., Dugo, P. and Dugo. G. 2013. Determination of the carotenoid profile in peach fruits, juice and jam. *Fruits* 68 : 39 – 44.

Henane I., Tlili I.,Ilahy R., Rhim T., Mezghani N., Ben Ali A. and Jebari H. 2014. Evaluation of agronomic and physicochemical quality of two local varieties of melon (*Cucumis melo* L.): Maazoun (southern Tunisia) and Galaoui (Northern Tunisia) grown in Tunisia. Journal of Arid Regions, *Proceedings of the 4th Meeting International*, p. 267. Tunis. Tunisia.

Jaiswal, S.G., Patel, M. and Naik, S.N. 2015. Physico-chemical propreties of *Syzygium cuminii* (L.) Skells jam and comparative antioxidant study with other fruit jams. Indian *Journal of Natural Products And Resources* 6(1): 9 – 15.

Kader, A.A., Perkins-Veazie, P. and Lester G.E. 2004. Nutritional Quality of Fruits, Nuts, and Vegetables and their Importance in Human Health. Retrieved on May 10, 2016 from Website: http://www.ba.ars.usda.gov/hb66/025nutrition.pdf/.

Khoo, H.E., Nagendra Prasad, K., Kong, K.W., Jiang, Y. and Ismail, A. 2011. Carotenoids and Their Isomers: Color Pigments in Fruits and Vegetables. *Molecules* 16: 1710-1738.

Kim, D.O., Jeong S. W. and Lee, C.Y. 2003. Antioxidant capacity of phenolic phytochemicals from various cultivars of plum. *Food Chemistry* 81: 321-326.

Lee, S.K. and Kader, A.A. 2000. Preharvest and postharvest factors influencing vitamin C content of horticultural crops. *Postharvest Biology and Technology* 20: 207-220.

Lester, G. 1997. Melon (*cucumis melo*n L.) fruit nutritional quality and health functionality. *Hortechnology* 7(3): 222 – 227.

Levaj, B., Kovačević, D.B., Bituh, M. and Dragović-Uzelac, V. 2012. Influence of Jam Processing Upon the Contents of Phenolics and Antioxidant Capacity in Strawberry fruit (Fragaria ananassa × Duch.). Croatian Journal of Food Technology. *Biotechnology and Nutrition* 7: 18-22.

Maria Eugênia de Oliveira Mamede, M.E., de Carvalho, L.D., de Souza Viana, E., de Oliveira, L.A., Filho, W.S.S. and Ritzinger, R. 2013. Production of Dietetic Jam of Umbu-Caja (*Spondias* sp.): Physical, Physicochemical and Sensorial Evaluations. *Food and Nutrition Sciences* 4: 461-468.

Mayeaux, M., Xu, Z., King, J. and PrinyawiwatkuL, W. 2006. Effects of cooking conditions on the lycopene content in tomatoes. *Journal of Food Science* 71: 461–464.

Mélo, E.A., Lima, V.L.A.G., Maciel, M.I.S., Caetano, A.C.S. and Leal, F.L.L. 2006. Polyphenol, ascorbic acid and total carotenoid contents in common fruits and vegetables. *Brazilian Journal of Food Technology* 9(2): 89-94.

Milardović, S., Ivekovic, D. and Grabarić, B. S. 2006. A novel ampirometric method for antioxidant activity determination using DPPH free radical. *Bioelectrochemistry* 68: 175- 180.

Mohd Naeem, M.N., Mohd Fairulnizal, M.N., Norhayati, M.K., Zaiton, A., Norliza, A.H., Wan Syuriahti, W.Z., Mohd Azerulazree, J. Aswir, A.R. and Rusidah, S. 2015. The nutritional composition of fruit jams in the Malaysian market. *Journal of the Saudi Society of Agricultural Sciences* 1 - 8 http://dx.doi.org/10.1016/j.jssas.2015.03.002.

Nicoli M. C., Anese M. and Parpinel M. 1999. Influence of processing on the antioxidant properties of fruit and vegetables. *Trends in Food Science and Technology* 10: 94-100.

Njoku P.C., Ayuk A.A. and Okoye C.V. 2011. Temperature effects on vitamin C content in citrus fruits. Pakistan *Journal of Nutrition* 10: 1168-1169.

Nour, A.A.M., Khalid, K.S.M. and Osman, G.A.M. 2011. Suitability of some Sudanese mango varieties for jam making. *American Journal of Industrial Research* 2: 17-23.

Nwosu, J.N., Udeozor, L.O., Ogueke, C.C., Onuegbu, N., Omeire, G.C. and Egbueri, I.S. 2014. Extraction and Utilization of Pectin from Purple Star-Apple (*Chrysophyllum cainito*) and African Star-Apple (*Chrysophyllum delevoyi*) in Jam Production. *Austin Journal of Nutrition and Food Science* 1(1): 1003 - 1009.

Oancea, S. and Călin, F. 2016. Changes in Total Phenolics and Anthocyanins during Blackberry, Raspberry and Cherry Jam Processing and Storage. *Romanian Biotechnological Letters* 21 (1): 11232 – 11237.

Poiana, M.A., Alexa, E. and Mateescu, C. 2012. Tracking antioxidant properties and color changes in low-sugar bilberry jam as effect of processing, storage and pectin concentration. *Chemistry Central Journal* 6: 1 – 11.

Rababah, T.M., Al-Mahasneh, M.A., Kilani, I., Yang, W., Alhamad, M.N., Ereifej, K. and Al-u'datt, M. 2011. Effect of jam processing and storage on total phenolics, antioxidant activity, and anthocyanins of different fruits. *Journal of Science of Food and Agriculture* 91: 1096 – 1102

Sass-Kiss, A., Kiss, J., Milotay, P., Kerek, M.M. and Toth-Markus, M. 2005. Differences in anthocyanin and carotenoid content of fruits and vegetables. *Food Research International* 38: 1023-1029.

Ścibisz, I. and Mitek, M. 2009. Effect of Processing and Storage Conditions on Phenolic Compounds and Antioxidant Capacity of Highbush Blueberry Jams. *Polish Journal of Food and Nutrition Sciences* 59 (1): 45-52.

Selvamithukumaran, M. and Khanum, F. 2014. Processing seabucktorn fruit for antioxidant rich jam development and shelf stability assessment. *Indian Journal of Traditional Knowledge* 13 (2): 335 – 346.

Shahnawaz, M., Sheikh, S.A. and Nizamani, S.M. 2009. Determination of Nutritive Values of Jamun Fruit (*Eugenia jambolana*) Products. *Pakistan Journal of Nutrition* 8 (8): 1275-1280.

Sindumathi, G. and Amutha, S. 2014. Processing and quality evaluation of coconut based jam. *Journal of Environmental Science, Toxicology And Food Technology* 8(1): 10 – 14.

Touati, N., Tarazona-Díaz, M.P., Aguayo, A. and Louaileche, H. 2014. Effect of storage time and temperature on the physicochemical and sensory characteristics of commercial apricot jam. *Food Chemistry* 145: 23–27.

Veljovic, M., Davidovich, S., Pecic, S., Despotovic, S., Leskosebe-Cucalovic, I. and Vukosavejevic, P. 2012. Lycopene content and antioxidant capacity of tomato jam. 6th Central European Congress on Food, CEFood2012, p. 138 – 143. Novi Sad: Serbia.

Verma, L. and Joshi, V. 2000. Postharvest Technology of Fruits and Vegetables: Handling, Processing, Fermentation and Waste Management: General Concepts and Principles. New Delhi: Indusutrial Publishing Company.

Viana, E.S., Jesus, J.L., Reis, R.C., Marcos Vinícius Silva de Andrade, M.V.S. and Sacramento, C.K. 2014. Physicochemical and Sensory Characterization of Banana and Araçá-Boi Jam. *Food and Nutrition Sciences* 5: 733-741

Wicklund, T., Rosenfeld, H. J., Martinsen, B. K., Sundfor, M. W., Lea, P., Bruun, T., R, Blomhoff. and K, Haffner. 2005. Antioxidant capacity and colour of strawberry jam as influenced by cultivar and storage conditions. *Food Science and Technology* 38: 387–391.