Studies on the Hazard analysis and critical control point (HACCP) in the production of some jams

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Abstract

The quality of strawberries jam and the Hazard Analysis and Critical Control Point system (HACCP) were evaluated Jams. The results showed that the chemical composition for fresh strawberry fruit, was high in calories and moisture content, while protein, fat, ash and fiber, content recorded the lower values. Also, strawberry recorded the higher values of potassium, calcium and magnesium contents. The bacterial count of the strawberry jam were showed at the safe levels and the recorded the best results was with the sample made from Fructose. Also, anthocyanin's recorded the best strawberry jam during the storage for 6 weeks. Control from with sucrose showed the less redaction in anthocyanin's contents while, the higher values recorded with jam with sucrose and fructose.

Keywords: HACCP, strawberry, orange, sweeteners, anthocyanin's, carotenoids, antioxidant, free radicals, flavonoids.

1. Introduction:

Hazard analyzes and critical control points (HACCP) is a system that identifies, evaluates and controls hazards which are significant for food safety. It is a structured, systematic approach for the control of food safety throughout the commodity system, from the farm to the plate. It requires a good understanding of the relationship between cause and effect in order to be more pro-active and it is a key element in Total Quality Management (TQM) (**Arvanitoyannis and Mauropoulos, 2000)**.

ensure the safety of food prepared for astronauts in the NASA space program. Many U.S. and Canadian health departments have begun to incorporate HACCP in their inspections. Sodexho has developed a HACCP program that addresses the specific needs of our company. This program complies with the U.S. Food & Drug Administration (FDA) 2001 Food Code. HACCP is a comprehensive food safety and self- inspection system that goes beyond routine inspections of equipment and appearance and helps uncover and solve dangerous defects in food handling. HACCP looks at the flow of potentially hazardous foods -- the path that food travels throughout the food service operation. We must follow this path from recipe development through delivery of products, storage, preparation, holding or displaying, serving, cooling and storing leftovers for the following day, and reheating foods. Each step of the way poses the risk of contamination due to mishandling **(FDA 2001)**.

The HACCP system offers a structured approach to the control of hazards in food processing and, properly applied, identifies areas of concern and appropriate control measures before product failure is experienced. It represents a shift from retrospective quality control through end-product testing to a preventative quality assurance approach. End product testing against microbiological criteria is shifted to the role of verification in a HACCP program **(Jervis, 2002)**.

Sweeteners are food additives that are used to improve the taste of everyday foods. **(Scheufele and Tewksbury, 2007)**.Table sugar has been an essential component of human diet. Its excess can lead to unhealthy effect on the body, most notably diabetes mellitus. Therefore sugar substitutes were introduced as safer alternatives. These are now used by millions of people worldwide without knowing their harmful effects on the body **(Tandel, 2011).**

Strawberries are the edible fruits of the plants of the Fragaria genus. It is a very popular berry, mainly due to its attractive taste and appearance that varies quite a lot between different cultivars. Strawberries are used all over the world for the production of a range of products such as juices, jams, syrups, desserts and wines **(Sjöholm *et al.,* 2004).** Many epidemiologic studies have shown that a diet rich in fruits and vegetables is often associated with a lower incidence of several chronic pathologies, including obesity, infections, cardiovascular and neurologic diseases, and cancer **(Chu *et al.,* 2002; Etminan *et al*., 2004 and Vauzour *et al.,* 2010).**This review focuses

on the nutrient and phytochemical contents of the strawberry and on factors affecting the composition of this fruit. An overview on the bioavailability and metabolism of the most abundant strawberry phytochemicals after consumption is also presented, and the currently hypothesized health benefits related to strawberry consumption is reviewed, with particular attention given to recent evidence on the impact of berries on cardiovascular health and cancer prevention **(Basu *et al.*, 2010 and Wang *et al.*, 2011)**.

2. Materials and Methods:

The strawberry represents a relevant source of micronutrients, such as minerals, vitamin C, folate and phenolic substances, most of which are natural antioxidants and contribute to the high nutritional quality of the fruit. All these compounds are essential for health and, in particular.

PH measurement:

The pH value was measures using a pH meter of a glass electrode. The pH meter was allowed to stabilize for one minute and then the pH of the sample was directly reported according to the official method of the analysis **(A.O.A.C. 2005)**.

Total Acidity:

Titratable acidity was determined according to the official method **(A.O.A.C. 2005)**.

Total soluble solids (TSS):

The total soluble solids (TTS) were determined at room temperature using hand refract meter with degree °Brix scale 0 – 50 according to **(A.O.A.C. 2005)** standard methods.

Ascorbic acid (Vitamin C):

Vitamin C was determined by using 2, 6- dichlor-ophenol-indophenol dye according to the official method **(A.O.A.C. 2005)**.

Total and reducing sugars:

Total and reducing sugars were determined according to lane and Enontitrometric methods **(A.O.A.C. 2005)**.

Data in Table (1) show the chemical composition of fresh strawberry fruits. It is clear to notice that strawberry contain a high percentage of a moisture values is 85.76%, Add to containing from protein, fat, ash and fiber in by0.73, 0.42, 0.31, 1.80% respectively. Also strawberry contain carbohydrates 10.98%, Finally fresh strawberry given calories in High rate, it is 68.62 %.

Table (1): Chemical composition of fresh strawberry:

Elements	Strawberry (100g)(W/W)
Moisture	85.76
Protein	0.73
Fat	0.42
Ash	0.31
Fiber	1.80
Carbohydrates	10.98
Energy value	68.62

The strawberry is also rich in potassium and has been qualified as a good source of magnesium, iron, calcium, and phosphorus (**table 2).** Strawberry higher than in potassium, the value was 153 mg/100g, Phosphorus in strawberry fruit higher also being 24mg/100g, Iron, magnesium and zinc in strawberry fruit were being In a simple proportions 0.41, 13 and 0.14 mg/100g, respectively.

Table (2): Minerals content of strawberry fruit:

Elements	Strawberry (mg/100g)
Calcium	16
Iron	0,41
Magnesium	13
Phosphorus	24
Potassium	153
Zinc	0,14

Strawberry phytochemicals are mainly represented by the extensive class of phenolic compounds that have many non- essential functions in plants and huge biological potentialities in humans. Strawberry phenolics are best known for their antioxidant and anti-inflammatory action, and possess directly and indirectly antimicrobial, anti-allergy and anti-hypertensive properties, as well as the capacity to inhibit the activities of some physiological enzymes and receptor properties**.** The total phenolic contents in the examined extracts ranged from all treated strawberry jam between 339.25 ± 1.17 and 424.71 ±0.08, (mg GA/kg) at zero time of storage (**table 3)**. With progress of storage for 2 weeks all total phenols content (mg GA/kg) decreased, The highest content was recorded for strawberry jam with aspartame, it was 259.00±0,08 while the lower content wasrecorded 184.82 ±0.16 mg GA/kg. In the same table strawberry jam stored for 4 weeks, all total phenols content were decrease ,the lowest sample was control jam (sucrose) by 133.61±0.39 mg GA/kg while a sample with sucrose +fructose was a higher. With advancement of storage period up to 4 weeks .The total phenols content (mg GA/kg) in all treated jam were slightly decreased in cold storage (4°C). The values were, 108.31 ±0.06 and 206.36±0.23 mg GA/kg, respectively. At the end of storage period at 4°c all treated jam recorded the lowest values.The lowest reduction of phenols content recorded for sucrose being, 73.92 ±0.02 mg GA/kg, while the jam sample with sucrose + fructose recorded higher phenols content than jam samples with fructose and with aspartame. The mean values were 185.61±0.12, 97.60±0.08 and 102.72 ±0.12 mg GA/kg, respectively.

Determination of the total phenol content:

After the isolation of the phenolic compounds by the extraction method described in the previous section, the concentration of total phenols was estimated by the Folin-Ciocalteau method, with

absorbance monitoring at 765 nm, according to the method described by **(Ough and Amerine 1988)**. The spectrophotometric measurement was repeated two times with each extract and the average value was interpolated on the gallic acid calibration curve and expressed as g of gallic acid per kg of the sample.

Table (3): Total phenols content (mg GA/kg) of strawberry jams stored at room temperature and 4 C:

Samples	Samples After preparation Mean ± SD	After 2 weeks Mean ± SD	After 4 weeks Mean ± SD	After 6 weeks Mean ± SD
Storage at room temperature				
Control jam (sucrose)	339.25 ± 0.17	199.40 ± 0.34	133.61 ± 0.39	79.31 ± 0.04
Jam + fructose	396.13 ± 0.28	246.01 ± 0.04	150.00 ± 0.05	98.45 ± 0.06
Jam+Aspartame	424.71 ± 0.08	259.00 ± 0.08	159.42 ± 0.17	107.02 ± 0.05
Jam+ sucrose+ fructose	421.23 ± 0.17	184.82 ± 0.16	171.69 ± 0.16	168.34 ± 0.10
Storage at 4°C				
Control jam (sucrose)	339.55 ± 0.28	206.80 ± 0.38	108.31 ± 0.06	73.92 ± 0.02
Jam + fructose	396.72 ± 0.15	226.53 ± 0.08	112.00 ± 0.09	97.60 ± 0.08
Jam+ Aspartame	424.80 ± 0.31	256.43 ± 0.05	126.72 ± 0.37	102.72 ± 0.12
Jam+ sucrose+ fructose	489.02 ± 0.40	229.42 ± 0.02	206.36 ± 0.23	185.61 ± 0.12

* GA = Gallic acid

Anthocyanin degradation in frozen strawberry is very likely related to the presence of native enzymes, particularly polyphenoloxidase، which has been shown to be very active in both strawberry flesh **(Pifferi and Cultrera 1974)**. **(Kader *et al.*, 1998)** showed that in strawberry, polyphenol oxidase oxidized chlorogenic acid to a quinine, which would couple with anthocyanin's in a degradation reaction. Anthocyanin's in strawberries are the best known poly- phenolic compounds and quantitatively the most important **(Clifford 2000) (Table 4).** The results have shown that at zero time of storage period the total anthocyanin's content (mg/kg) of all treated strawberry jams were values between 140.44±4.21 and 248.81±4.23, mg/kg. With progress of storage for 2 weeks all total anthocyanin's content (mg/kg) decreased, the highest content was recorded for strawberry jam with sucrose + fructose; it was 236.71±3.28 mg/kg, while the lowest content was recorded 110.13±4.32 mg/kg. At the end of storage period of room temperature (6 weeks) the total anthocyanin's content (mg/kg) slightly decreased, the values recorded 61.12±4.12, 76.40±5.11, 89.99±5.62 and 170.01±2.01 mg/kg, for control jam, jam with fructose, jam with aspartame and jam with sucrose +fructose, respectively. On the other hand, jam storage at cold storage (4 C) the total anthocyanin's content

(mg/kg) at zero time recorded between 140.44±4.21 and 265.51±4.89, mg/kg. At the end of storage period at 4°C up to 6 weeks all treated jam were slightly decreased. The highest reduction of total anthocyanin's content (mg/kg) recorded for jam with sucrose +fructose it was being 215.14±1.13 mg/kg, while the jam sample with sucrose recorded lowest anthocyanin's content compared to sample with fructose, sample with aspartame and sample with sucrose +fructose. The mean values were 111.21±3.21 mg/kg compared to 123.63±3.89, 132.40±4.87 and 215.14±1.13 mg/kg, respectively.

Measurement of total anthocyanin's:

The extraction of anthocyanin's from strawberry jams was carried out with acidified methanol. The samples were held at 4 °C over night and centrifuged for 10 min at 4000 rpm. The extracts were used for the determination of monomeric anthocyanin's by pH-differential method. Total monomeric anthocyanin's were expressed as cyanidin-3-glucoside, according to the method described by **(Giusti and Wrolstad 2001)**. The measurements were done in triplicates.

Many studies have determined total anthocyanin content, reporting values from 150 to 600 mg/kg of fresh weight **(Lopes *et al.*, 2002 and Castro *et al.*, 2012)**.

Table (4): Total anthocyanin's content (mg /kg) of strawberry jams stored at room temperature and 4 °C**:**

Samples	Samples After preparation Mean ± SD	After 2 weeks Mean ± SD	After 4 weeks Mean ± SD	After 6 weeks Mean ± SD
Storage at room temperature				
Control jam (sucrose)	140.44 ± 4.21	110.13 ± 4.32	69.29 ± 3.45	61.12 ± 4.12
Jam + fructose	147.78 ± 3.28	119.98 ± 3.24	83.49 ± 3.21	76.40 ± 5.11
Jam+ Aspartame	175.34 ± 5.31	130.76 ± 4.12	100.19 ± 5.12	89.99 ± 5.62
Jam+ sucrose+ fructose	248.81 ± 4.23	236.71 ± 3.28	192.04 ± 3.45	170.01 ± 2.01
Storage at 4°C				
Control jam (sucrose)	140.44 ± 4.21	131.50 ± 3.89	118.35 ± 4.87	111.21 ± 3.21
Jam + fructose	147.78 ± 3.28	138.60 ± 4.21	128.12 ± 5.01	123.63 ± 3.89
Jam+ Aspartame	175.34 ± 5.31	155.93 ± 4.58	139.67 ± 4.21	132.40 ± 4.87
Jam+ sucrose+ fructose	265.51 ± 4.89	250.97 ± 4.98	237.12 ± 5.21	215.14 ± 1.13

Data presented in table (5) show the total bacterial counts of strawberry jams at room temperature and 4°C. It is clear to notice that at zero time of storage period the total bacterial counts (cfu/g) of all treated strawberry jam were recorded values between 3.1-3.3x10^1,cfu/g. At the end of storage period of room temperature (6 weeks) the total bacterial counts recorded the highest values. The counts were 2.5x10^2, 2.6x10^2, 2.9x10^2and2.7x$10^2$for control jam, jam with fructose, jam with aspartame and jam with sucrose + fructose, respectively. On the other hand, jam storage of cold storage (4°C) at zero time recorded the total bacterial counts ranged between 3.1-3.3x010^1. At the end of storage period at4°Cal treated jam recorded the highest. Total bacterial counts ranged between 5.1x10^1-5.3x10^1 cfu/g. Finally it could be concluded that the total bacterial counts of jam which storage of 4°C showed the lower total bacterial counts compared with jam storage at room temperature.

Table (5): Total bacterial counts (cfu/g) of strawberry jams stored at room temperature and 4°C:

Samples	Samples After preparation 0 weeks	After 2 weeks	After 4 weeks	After 6 weeks
Storage at room temperature				
Control jam (sucrose)	3.2x10^1	3.4x10^1	3.8x10^1	2.5x10^2
Jam + fructose	3.1x10^1	3.3x10^1	3.7x10^1	2.6x10^2
Jam+ Aspartame	3.3x10^1	3.6x10^1	4.0x10^1	2.9x10^2
Jam+sucrose+ fructose	3.2x10^1	3.5x10^1	3.8x10^1	2.7x10^2
Storage at 4°C				
Control jam (sucrose)	3.2x10^1	3.2x10^1	3.5x10^1	5.2x10^1
Jam + fructose	3.1x10^1	3.2x10^1	3.3x10^1	5.1x10^1
Jam+ Aspartame	3.3x10^1	3.4x10^1	3.5x10^1	5.3x10^1
Jam+ sucrose+ fructose	3.2x10^1	3.3x10^1	3.6x10^1	5.2x10^1

*CFU/G= Coloni form units

3. Results and Discussion

The soluble solids (TSS), titratable acidity (TA) and pH of strawberry are presented in the following **table (6)**. For jam production, those three components have technological importance since they influence the cooking time, and also the formation, structure, stability and continuity of the gel formed.

Previously, **(Ritzinger *et al.*, 2008)** evaluated the TA and TSS in these same accessions. The TA value of the strawberry jam found in the present work is in agreement with the previous work, but the values for TSS found in the two works are different. We found TSS mean

values ranged between fructose was the higher and aspartame was less being 68.40, 68-01 respectively. The results of the physical properties characteristics of the manufactured jams are presented in the same **Table**. These results showed that the characteristics of jams prepared with fructose was record high result in Reflective index. The pH values ranged from4.44 to 4.35 and titratable acidity values ranged from 1.71 to 1.68.

Table (6): Physical properties of strawberry jam with different sweeteners system:

Parameters %	Investigated jam			
	Control (Sucrose)	Fructose	Aspartame	Sucrose+Fructose
TSS	68.10	68.40	68.01	68.03
Reducing sugars	18.12	38.49	22.21	22.42
Non reducing sugars	6.13	9.18	6.98	5.84
Total sugars	24.25	47.67	29.19	28. 26
pH value	4.35	4.43	4.37	4.44
Titratable acidity (% as citric acid)	1.71	1. 68	1.69	1.70
Reflective index	1.3216	1.3247	1.3217	1.3216
Vitamin C (mg/100g)	25.11	25.15	25.80	25.75

4. Conclusions

The fruit of strawberry showed to be promising for jam production. The use of sweeteners in the manufacture of jam was shown to be satisfactory, resulting in a product with jam characteristics and with flavor and texture similar to conventional jam, with low caloric value, allowing its indication as much for diabetics as to the individuals that are on a diet with caloric restriction. The jam conventional and diet, manufactured with both accessions, sweetened with sucrose or fructose presented a good acceptance, considering all attributes evaluated and purchase intention.

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دراسات على تحليل مخاطر نقاط التحكم الحرجة (الهاسب) في إنتاج بعض المربات

Studies on the Hazard analysis and critical control point (HACCP) in the production of some jams

تحت إشراف

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المستخلص العربي

تقييم جودة مربى الفراولة ونظام تحليل المخاطر وتحديد نقاط التحكم الحرجة (الهاسب). وأظهرت النتائج أن التركيب الكيميائي لفاكهة الفراولة الطازجة كانت عالية في السعرات الحرارية ومحتوى الرطوبة، بينما سجلت البروتينات والدهون والرماد والألياف المحتوى الأقل. أيضاً سجلت الفراولة القيم الأعلى من محتويات البوتاسيوم والكالسيوم والماغنسيوم. أظهر العد البكتيري لمربي الفراولة المستويات الآمنة وسجلت أفضل النتائج مع العينة المصنعة من الفركتوز. أيضاً سجلت الأنثوسيانين أفضل مربى الفراولة خلال التخزين لمدة 6 أسابيع وأظهرت العينة مع السكروز أقل النتائج في محتويات الأنثوسيانين بينما سجلت القيم الأعلى مع المربى باستخدام السكروز والفركتوز