PRODUCTION AND EVALUATION OF NEW PRODUCTS PREPARED FROM HUSK TOMATO FRUITS "Harankish"

H.A. Abou-Gharbia* and E-S.M. Abou-Tour*

Received on: 3/4/2006 *Accepted on: 30/8/2006*

ABSTRACT

Husk tomato is a member of the Solanceae family usually used to prepare the green sauces of Mexican food. Husk-tomato fruits were subjected to technological processing in order to prepare a new products namely jam, jelly, juice, candied and sheets. A slight change in colour occurred for husk tomato fruits from yellowish or orangy colour to a yellow brownish colour during preparing of jam, jelly, juice, candied and sheets. Results showed significant differences (P<0.05) among products for all investigated parameters. Total soluble solids, increased five times after processing, whereas total sugars doubled its value for all products. On the other hand, there was a slight decrease in titratable acidity in case of jam and jelly and a significant increase in case of candied and sheets. Also, there was a significant decrease (p<0.05) in ascorbic acid content in most products. Moreover, β-carotene decreased significantly (p<0.05) in all products. Results also showed that there was a considerable decrease in tannins content whereas, crude fibers increased significantly (p<0.05) after processing for all products. Results given by the panelists showed a good acceptability for candied as well as for the sheets with good specifications. The results of drying curves indicated the difficulty to reach the safe level of moisture content for husk tomato sheets.

Key words: Technological processing, Chemical composition, Quality attributes, Husk tomato products.

INTRODUCTION

Husk tomato (*Physalis pruinosa* L.) is a member of the family *Solanceae*, which have different names such as husk tomato, strawberry-tomato, tomatiloll fruit, goldenberry or winter cherry and commonly known in Egypt as Harankish. It has long been a minor fruit of the Andes and has also been grown in North and East Africa, India, Australia and Great Britain (McCain, 1993) and nowhere became a major crop. It is one of the most unusual and pretty plants, which often appears in illustration fairy stories is the Chinese lantern *Physalis alkekengi* (Bianchini and Corbetta, 1977). It is native to the region extending from central Europe to the Urals (Bianchini and Corbetta, 1977). Like borage, the Chinese lantern is a garden escape grows on waste ground, although, it is often cultivated in gardens as an ornamental or for decoration. The juice of berry is slightly acid but agreeable to the taste and quite high in vitamin content (Bianchini and Corbetta, 1977).

Husk tomato grown in semi-tropical regions are usually eaten raw, and have mainly diuretic properties. The plant was formally highly prized by the Arab physicians as a medical plant for treating kidney disease and diseases of urinary passages. Today, it is used in homeopathy for the same purpose (Stary, 1983). Moreover, it is very important in draining the bile juice and activating the liver functions (Stary, 1983).

Husk tomato is cultured in Egypt in limited areas near the big cities, also it can be cultured in the south of Elwady as well as in the new repaired regions in Toshki. About 300 acres are cultivated with husk tomato in Egypt), producing 3000-4500 tons/year of the fruits (Agricultural Statistics Newsletters, 1996). It has a common name in Egypt called Harankish. It has been reported that Harankish is cultivated to eat the fresh fruits because of its high nutritional value.

The fruits are perishable, having high moisture content, which leads to a rapid spoilage if it does not processed. Also, it has a short marketing season start from October till February. Due to its very acceptable and popular sweet taste with acidic nature, its high nutritive value and its medical importance, its consumption in Egypt is starting to increase.

The plant is fairly adaptable to a wide variety of well drained soils, and very good crops are obtained on rather poor sandy ground (Rehm and Espig, 1991). A single plant may yield 300 fruits and carefully tended plants can provide 20-33 tons per hectare. In most places where they are grown, husk tomato are now considered fruits only for backyard gardens or for children to pluck and eat; however, they do carry prestige in some international markets (Rehm and Epsig, 1991). In addition to having a future as fresh fruits, the exotic fruit can be enjoyed in many ways as an interesting ingredient in salads, deserts, natural snacks and preserves.

No attention has been paid to utilize the husk tomato in food industries, to consume it after processing to extend its shelf-life from few days to several months, especially if we know that the fruits are perishable, having a short season. Very little data is available in the literature regarding the processing of husk-tomato to any products. Therefore, the present study was concerned on producing new products of husk-tomato and to evaluate the adaptability of this new products by consumers as well as the effect of different processing methods on husk tomato fruits.

* Food Science and Technology Department, Faculty of Agriculture, El-Shatby, Alexandria University

MATERIALS AND METHODS

Materials :

Husk tomato (*Physalis pruinosa*, L.) fruits used in the present study were obtained form Alexandria market, Alexandria, Egypt in December 2003 the fruits were nearly orangy or yellow in colour i.e. were ripe. The fruits are of a local variety (Balady) covered with husk, ca. 2cm in diameter. The fruits were sorted, dehusked and then washed with water. The dehusked and cleaned fruits were either used as a whole (in case of jam and candied) or crushed using a fruit pulper (in case of jelly and sheets).

Methods :

1- Physical methods

Colour of fresh husk tomato fruits as well as its products after processing were assessed using Lovibond Schofield tintometer type IA adopting as described by Mackinnery and Little (1962).

2- Technological methods

Figure (1) illustrates the flow sheets followed for preparing husk tomato sheets and candied and Fig. (2) showed the flow sheets used for preparing juice, jelly and jam.

3- Chemical analysis

Total Soluble Solids (T.S.S.) at 20°C by pocket refractometer, total titratable acidity as citric acid, ascorbic acid determined by 2, 6 dichlorophenol indophenol dye, crude fibers and pH with Cole Parmer digital pH meter, on the crushed, screened whole fresh fruits were determined according to the AOAC (1990) procedures unless otherwise stated. Total reducing sugars before and after acid hydrolysis according to Lane and Eynon method and phenolic substances colorimeterically as tannic acid by Folin – Denis reagent after extracting with 70% ethanol were determined as described by Naczk and Shahidi (1989).

Carbohydrate analysis: Soluble sugars were extracted successively with three portions of boiling 80% (v/v) aqueous ethanol. The supernatants were combined and the ethanol was evaporated under vacum. The soluble sugars content was analyzed by HPLC-PAD (Dionex, Sunnyvale, CA), using a PA_1 column (Dionex) in an isocratic run, with 18 mM NaOH during 25 min (Forney and Breen, 1986).

β-carotene was determined in the acetone extract (80%) according to the method of AOAC (1990). Concentration of β-carotene (μg/g sample) was calculated from the following equation :

$$\beta\text{-carotene} = A_{436nm} \times 0.128$$

Where, A ≈ Absorbency of solution.

Pectinase activity was determined according to the method of Hours *et al.* (1988). Values of enzyme activity were expressed as mg of methoxyl group liberated/ 1ml juice/ 30 min.

4- Evaluation of sensory (organoleptic) properties

The husk tomato products were introduced to 12 panelists (post graduate students) to evaluate the samples colour, taste, odour, texture, general appearance and total acceptability using a numerical scale as mentioned by Rangana (1977). The panelists were asked to check the best properties which described the samples and to score them for acceptability.

5- Statistical analysis

Data of taste panel testing were subjected to ANOVA and Duncan's multiple range analysis ($P<0.05$) as outlined by Steel and Torrie (1980).

RESULTS AND DISCUSSION

1- Physicochemical and chemical composition of husk-tomato products

Physicochemical characteristics. The general appearance of the different husk tomato products namely, jam, jelly, candied and sheets are shown in Fig. (3). As illustrated in Table (1), the value of red, yellow and blue of the fresh husk tomato juice, were 6.0, 20.0 and 4.9, respectively and also the yellow colour was the predominant whereas the red colour was the complementary one. As shown in Table (1), the lovibond reading varied from one product to another. There was a significant increase in the blue colour for all products as well as for the red colour except for the juice. The results of colour in case of jam and jelly varied from 7.2-7.4, 8.0-9.0 and from 4.6-4.9 for the red, yellow and blue colour, respectively. The values of red, yellow and blue for the sheets A, B and C were 8.4-9.3, 20-27.5 and 7.0-7.5, respectively, and the yellow colour was the predominant.

Chemical composition. Husk tomato flavour is conditioned in part by the balance between sugars and acids in ripe fruits (Green, 1971). As shown in Table (1), the pH value for husk tomato fruit was 3.78 and it remained at the same level (3.6-3.8) for all products. These results was nearly close to those mentioned by Cantwell *et al.* (1992) and Cordenunsi *et al.* (2002) for fresh husk tomato fruits. Sugars and organic acids are the main contributors to the soluble solids in husk tomato fruits, Table (1) shows a significant increase ($p<0.05$) in total soluble solids (T.S.S.) from 13.0 due to the addition of sugar for the products; jam (67.0%), jelly (68.0%), candied (76.0%) and sheets (72.4-73.7%). Total sugar (TS) follow the same trend, there was a significant increase ($P<0.05$) in total sugars for all products, except for the juice as shown in Table (1). Sucrose, fructose and glucose were the main soluble sugars detected in husk tomato fruits as well as in all other products. Sucrose content varied from 41.7% in jam to 56.3% in candied, there was a significant decrease in sucrose content in jam, jelly and sheets, this may be due to the addition of citric acid to those products. Whereas, there was an insignificant increase in sucrose content in case of candied and juice. There was a close relationship between glucose and fructose content, they varied from 19.6 and 21.4% in candied to 24.8 and

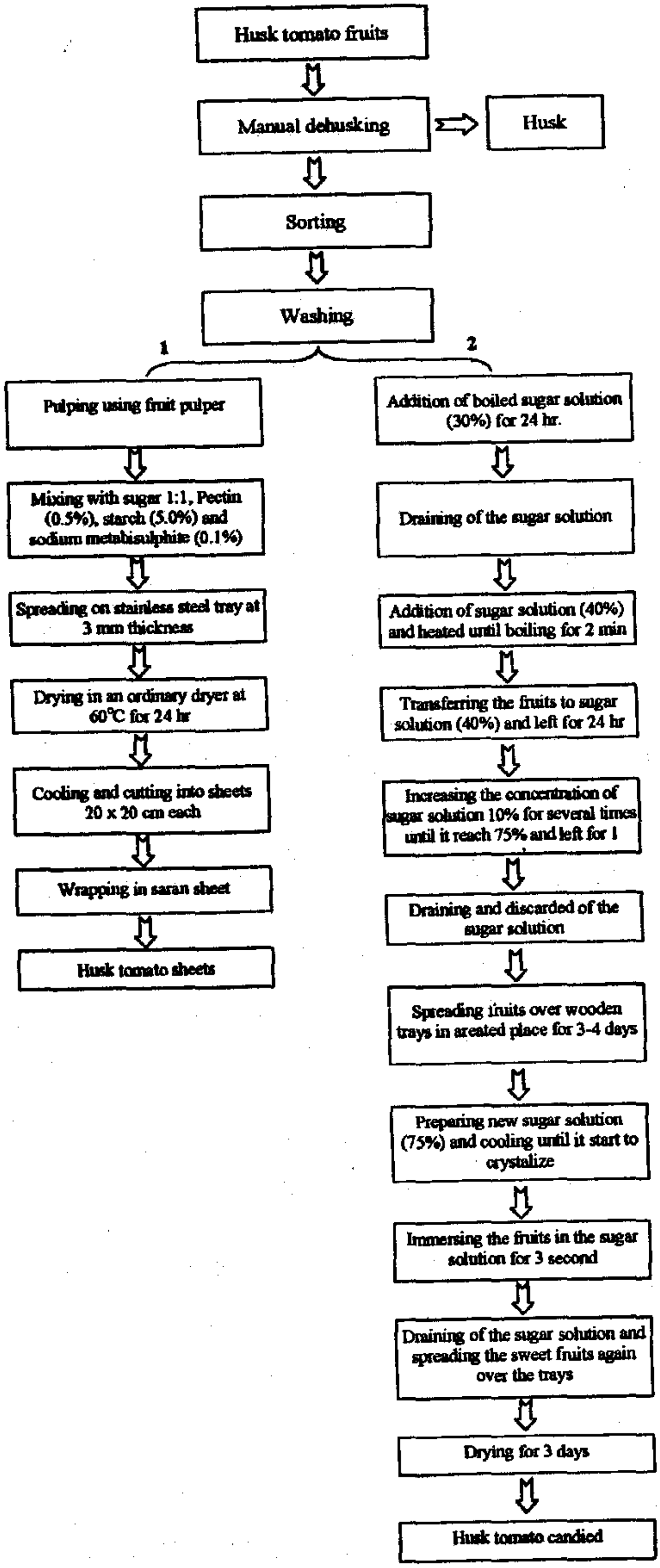

Fig (1) : Flow-sheet of preparing husk tomato products
1 : Sheets and 2 : Candied

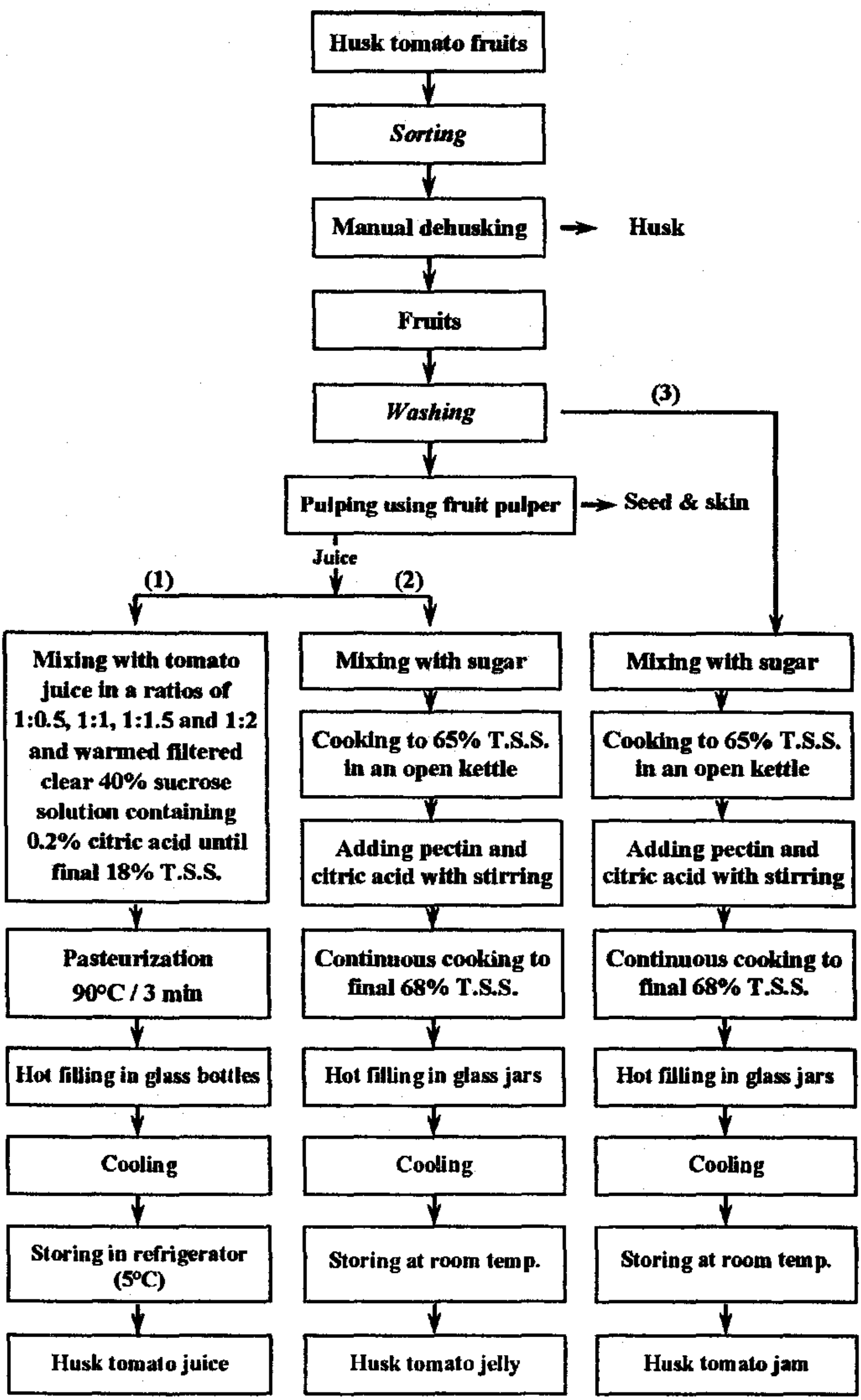

Fig (2): Flow sheet for preparing husk tomato products: 1- Juice, 2- Jelly and 3- Jam
H.A. Abou-Gharbia and E.M. Abou-Tour (2001)

Table (1) : Physicochemical and chemical properties of husk tomato products (jam, jelly, juice, candied and sheets)

Property	Husk tomato fruits	Husk tomato products*						
		Juice	Jam	Jelly	Candied	Sheets		
						A	B	C
Lovibond colour								
Red	4.15±0.02^{a}	6.0±0.03^{ab}	7.20±0.01^{bc}	7.40±0.03^{bc}	7.60±0.02^{bc}	8.40±0.02^{bc}	9.10±0.03^{c}	9.30±0.04^{c}
Yellow	7.45±0.03^{a}	20.00±0.03^{b}	9.00±0.02^{a}	8.00±0.02^{a}	9.00±0.03^{a}	27.50±0.04^{c}	27.00±0.05^{c}	20.00±0.05^{c}
Blue	0.38±0.01^{a}	4.90±0.03^{b}	4.90±0.01^{b}	4.60±0.02^{b}	4.60±0.02^{b}	7.50±0.04^{c}	7.00±0.05^{c}	7.00±0.05^{c}
pH value	3.78±0.10^{a}	3.80±0.13^{a}	3.62±0.15^{a}	3.60±0.14^{a}	3.80±0.15^{a}	3.75±0.18^{a}	3.70±0.10^{a}	3.68±0.10^{a}
Total S.S. (%)***	13.00±0.20^{a}	17.90±0.41^{a}	67.00±2.01^{b}	68.00±1.01^{b}	76.00±1.22^{b}	72.40±1.51^{b}	73.20±1.40^{b}	73.75±1.60^{b}
Total sugar (%)**	36.9±0.45^{a}	17.78±0.41^{b}	67.0±2.64^{c}	67.2±3.34^{c}	75.2±3.77^{c}	72.4±3.60^{c}	73.1±2.81^{c}	73.3±2.93^{c}
Sucrose (%) of total	52.0±0.25^{a}	54.4±0.34^{a}	41.7±0.21^{b}	43.8±0.28^{b}	56.3±0.36^{a}	44.9±0.20^{b}	45.2±0.21^{b}	45.7±0.27^{b}
Fructose (%) of total	22.9±0.12^{a}	21.8±0.10^{a}	30.6±0.12^{b}	28.7±0.11^{b}	21.4±0.10^{a}	27.6±0.13^{b}	27.3±0.16^{b}	26.9±0.14^{b}
Glucose (%) of total	21.4±0.14^{a}	20.2±0.12^{a}	24.8±0.12^{b}	23.9±0.10^{b}	19.6±0.16^{a}	24.5±0.16^{b}	24.1±0.14^{b}	23.8±0.10^{b}
Maltose (%) of total	3.7±0.03^{a}	3.6±0.02^{a}	2.9±0.04^{b}	3.6±0.03^{a}	2.7±0.03^{b}	3.0±0.04^{b}	3.4±0.03^{ab}	3.6±0.03^{a}
Titratable acidity (%)***	1.22±0.05^{a}	1.34±0.06^{a}	1.13±0.06^{a}	1.10±0.06^{a}	1.59±0.06^{a}	3.98±0.07^{b}	4.15±0.10^{b}	4.62±0.10^{b}
Ascorbic acid (mg/100g)***	39.50±0.35^{a}	16.47±0.20^{b}	16.10±1.90^{b}	15.20±1.70^{b}	28.40±1.20^{c}	14.20±1.30^{b}	14.10±1.70^{b}	14.52±1.20^{b}
β-carotene (μg/g)***	60.00±2.10^{a}	33.55±2.20^{d}	40.20±3.60^{c}	43.10±2.80^{c}	49.80±3.70^{b}	46.70±1.90^{bc}	44.37±2.86^{c}	46.30±2.25^{bc}
Tannins (mg/100g)**	35.29±1.40^{a}	23.50±1.30^{c}	30.90±1.70^{b}	29.60±2.10^{b}	31.60±2.60^{b}	30.20±2.40^{b}	31.76±1.75^{b}	31.95±2.23^{b}
Crude fibers (%)**	5.87±0.15^{a}	4.65±0.15^{c}	7.02±0.40^{b}	6.98±0.20^{b}	7.42±0.20^{b}	7.50±0.20^{b}	7.52±0.99^{b}	7.56±0.21^{b}
Pectinase activity (PEU)/g	0.152	---	---	---	---	---	---	---

* Results are mean values of three determinations ±S.D. ** On dry weight basis *** On fresh weight basis

A : Sheets from apricot juice (100%).

B : Sheets from husk tomato juice : apricot juice (1:1).

C : Sheets from husk tomato juice (100%).

30.6% in jam respectively. Glucose and fructose showed similar profiles after processing, they showed significant increase in jam, jelly and sheets. Although, there was an insignificant decrease in case of juice and candied.

Husk tomato is considered as a good source of ascorbic acid (39.5mg/100g) compared to other fruits (apricot, cherry, grape, pear and kiwifruit 15.0, 31.0 30.0, 25.0 and 59.5 mg/100g, respectively) (Kirk and Sawyer, 1991; Agar *et al.*, 1997 and Nishiyama *et al.*, 2004). The results in Table (1) also show a significant decrease ($P<0.05$) in ascorbic acid for most husk tomato products; sheets, jam, jelly and juice ranged from 58.9-65.1%, whereas the percentage of decrease for husk tomato candied was lower (27.27%), this mean that husk tomato candied was still a good source of vitamin C. The decrease of ascorbic acid may be due to the oxidation and heating effects during processing.

As shown in Table (1) titratable acidity (TA) was 1.22% in the fresh fruits, whereas it varied from 1.10% to 4.62% for the different products. This may be due to the method of preparation as well as the used ingredients. Joslyn (1970) and Agar *et al.* (1997) reported that apricaot, cherry, banana and strawberry had 1.06, 1.15, 1.16 and 1.02% of TA, respectively, which is lower than the TA in our study (1.22%). Moreover, Cordenunsi, *et al.* (2002) found that the acidity of a typical ripe strawberry is 1.01%, with minimum of 0.6, 0.57 and a maximum of 2.26%.

Tannins are mostly responsible for the bitter and astringent taste. Meanwhile, this astringency taste has been removed or evacuated completely after processing of these new products, jam, jelly, juice, candied and sheets due to the addition of sugar and the decrease in tannins content. There was a significant decrease ($P<0.05$) in tannins for all husk tomato products (9.5-33.4%).

β-carotene content followed the same trend of tannins to a more extend (17.1-44.1%). On the other hand, data in Table (1) show that there was a significant increase ($P<0.05$) in crude fiber (18.9-28.8%) for all products, whereas, there was a significant decrease ($P<0.05$) in case of juice (20.8%).

Enzymes activity. Pectinase activity was limited in husk tomato pulp, it was 0.15 pectin esterase unit (PEU) for fresh fruits and it inhibited completely by heating after process. On the other hand, Bauman (1981) and Hours *et al.* (1988) found that pectinase activity varied from 0.236 and 0.24 PEU for mandarin and grapefruit, respectively, which is approximatly twice the value of husk tomato fruits. The low value of pectinase activity is due to the high acidity of husk tomato fruits. This result was close to that of orange pulp (0.153 PEU) (Bauman, 1981 and Hours *et al.*, 1988), which also followed the same trend for acid foods.

2- Organoleptic characteristics of husk tomato products:

2.1- Husk tomato sheets

Fig. (3A) shows the appearance of husk tomato sheets compared with the sheet of apricot juice. The dried sheets prepared from husk tomato fruits only (100% husk tomato juice) had light brown colour, sweet with some acidic nature taste, soft, smooth and sticky texture difficult to handle. For this reasons it was purposed to add apricot juice in ratio of 1:1 to the husk tomato juice. Addition of apricot juice (50%) enhanced the quality of husk tomato sheets either in the dried state or after reconstitution Table (2), e.g. the colour (became lighter and more acceptable, the colour fractions were changed (Table 1).

Organoleptic properties of juice made from reconstituted sheets (mixture of husk tomato and apricot juice 1:1) was near to those of 100% apricot juice, whereas there was a significant decrease in all organoleptic characteristics for reconstituted sheets made of 100% husk tomato juice.

2.2- Husk tomato candied (sweet fruits)

As shown in Fig (3B), the colour of the candied had light brown colour, with a sweet taste-acidic nature, good pleasant odour with no interfering of any other strange odour, firm, unsticky texture and in a good golden appearance. Moreover, the colour of the final product was slightly more darker than the fresh fruits of husk tomato, due to the processing of the fruits. However, the candied had sweet taste, not fibrous, but the presence of the fine seeds inside the fruits made it chewy and firm without any strange taste. The presence of acidic taste in the fresh husk tomato was still present in this product and it was very like to the raisin taste. From this point of view, it may be used like raisin in cake or other baked products. Pfannhauser (1988) correlated the reduction of some components like esters and organic acids with increase in the formation of terpenic esters and linalool with a shift in the flavour impression from fresh green to the processed one. The same author and Yang *et al.* (1996) reported that differences in the chemical composition between the volatile of freshly prepared mature and over-ripe fruit and processed one are responsible for this shift.

3- Drying curves and drying parameter of husk tomato sheets.

The aim of this experiment was to study the behaviours, to monitor moisture content of husk tomato juice during drying of prepared sheets and to record the overall time needed to lower the moisture content of juice down to a 'safe level' behind which the sheets can be kept/stored without spoilage. At this 'safe level' of moisture content, the food material will be immune against chemical and microbiological spoilage factors.

At this 'safe level' the sheets will be in balance with the environment. Even after drying they will neither absorb nor desorbs water from or to the surrounding atmosphere, this is what is known as the equilibrium moisture content of the specific dried commodity. From the literature (Jason, 1958) it is known as dried food products. The moisture content lies at the level of 18–22% in husk tomato sheets we can't reach a level lower than this moisture content because of its high sugar content.

3.1- Moisture and the drying rate as a function of time

The normal drying curve Fig. (4A) represents the relationship between moisture content (g water/g dry

Table (2) : Sensory evaluation and acceptability of husk tomato candied and sheets

Husk tomato products	Colour* out of 10	Taste* out of 10	Texture* out of 10	Odour* out of 10	General* Appearance	Over-all* Acceptability out of 10
(1) Sheets :						
• Before reconstitution						
- Apricot juice 100% (control)	9.0±0.06^{a}	9.0±0.05^{a}	9.0±0.05^{a}	9.0±0.06^{a}	9.0±0.05^{a}	9.0±0.04^{a}
- Husk tomato juice + apricot juice (1:1)	8.0±0.04^{a}	8.0±0.04^{a}	8.0±0.05^{a}	9.0±0.05^{a}	8.0±0.05^{a}	7.0±0.05^{b}
- Husk tomato juice 100%	7.0±0.05^{b}	7.0±0.03^{a}	5.0±0.03^{b}	8.0±0.05^{a}	6.0±0.05^{b}	5.0±0.03^{c}
• After reconstitution						
- apricot juice 100% (control)	9.0±0.05^{a}	8.0±0.06^{a}	8.0±0.05^{a}	9.0±0.05^{a}	8.0±0.04^{a}	7.0±0.05^{a}
- Husk tomato juice + apricot juice (1:1)	8.0±0.02^{a}	7.0±0.04^{a}	7.0±0.04^{b}	9.0±0.05^{a}	7.0±0.03^{a}	7.0±0.03^{a}
- Husk tomato juice 100%	5.0±0.04^{b}	5.0±0.04^{b}	6.0±0.03^{c}	6.0±0.03^{b}	5.0±0.02^{b}	5.0±0.03^{b}
(2) Sweet fruits (candied)	8.0±0.03	9.0±0.04	9.0±0.05	8.0±0.04	8.0±0.05	8.0±0.04

* Results are mean values of 12 replicates ±S.D.

Values for each session in each column bearing the same superscripts are not significantly ($p>0.05$) differed from one to another.

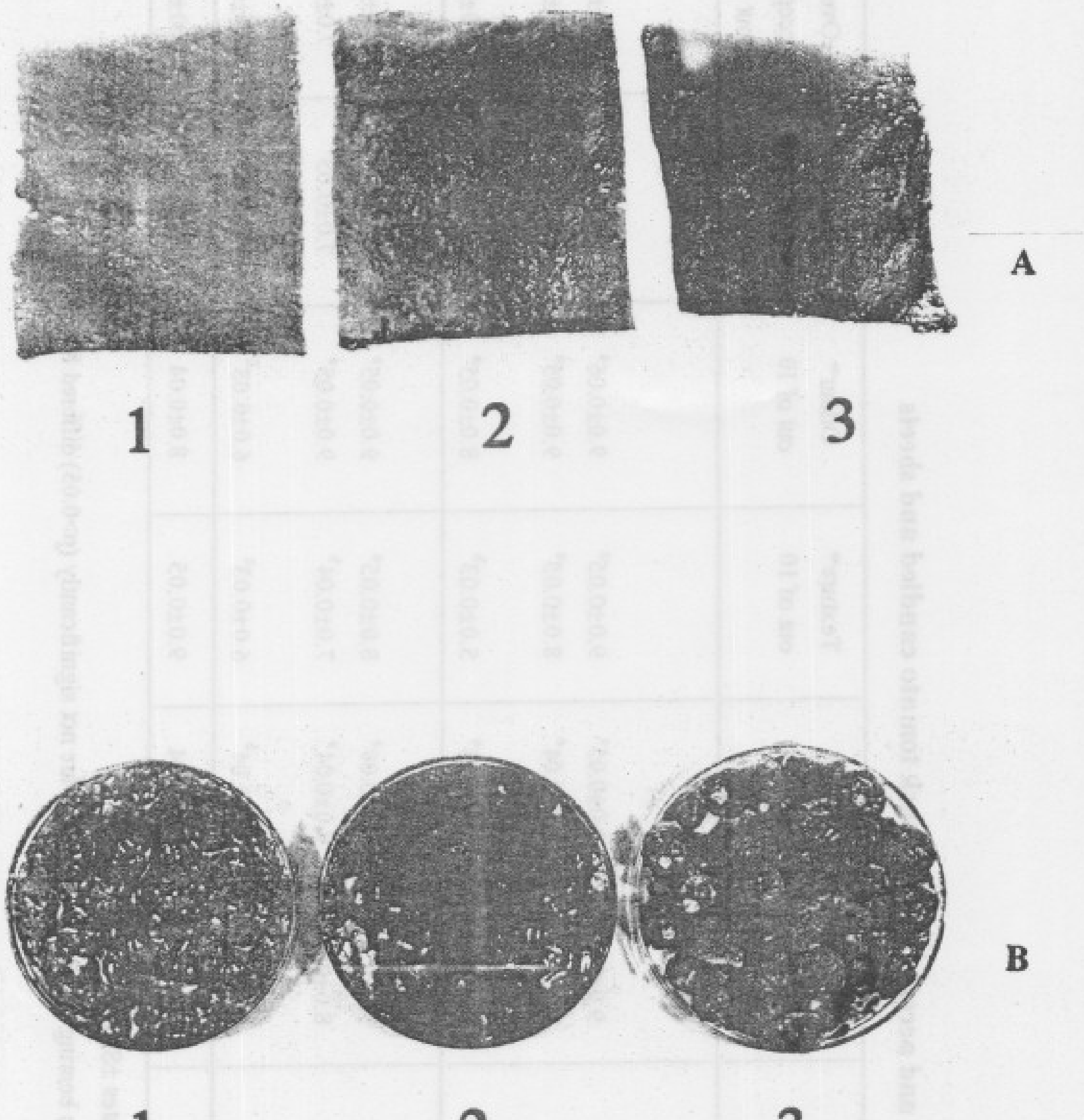

Fig (3) : General appearance of husk tomato products, (A_1) sheets from 100% apricot juice (A_2) sheets from 1:1 (husk tomato juice : apricot juice), (A_3) sheets from 100% husk tomato juice, (B_1) husk tomato jam, (B_2) husk tomato jelly, (B_3) husk tomato candied.

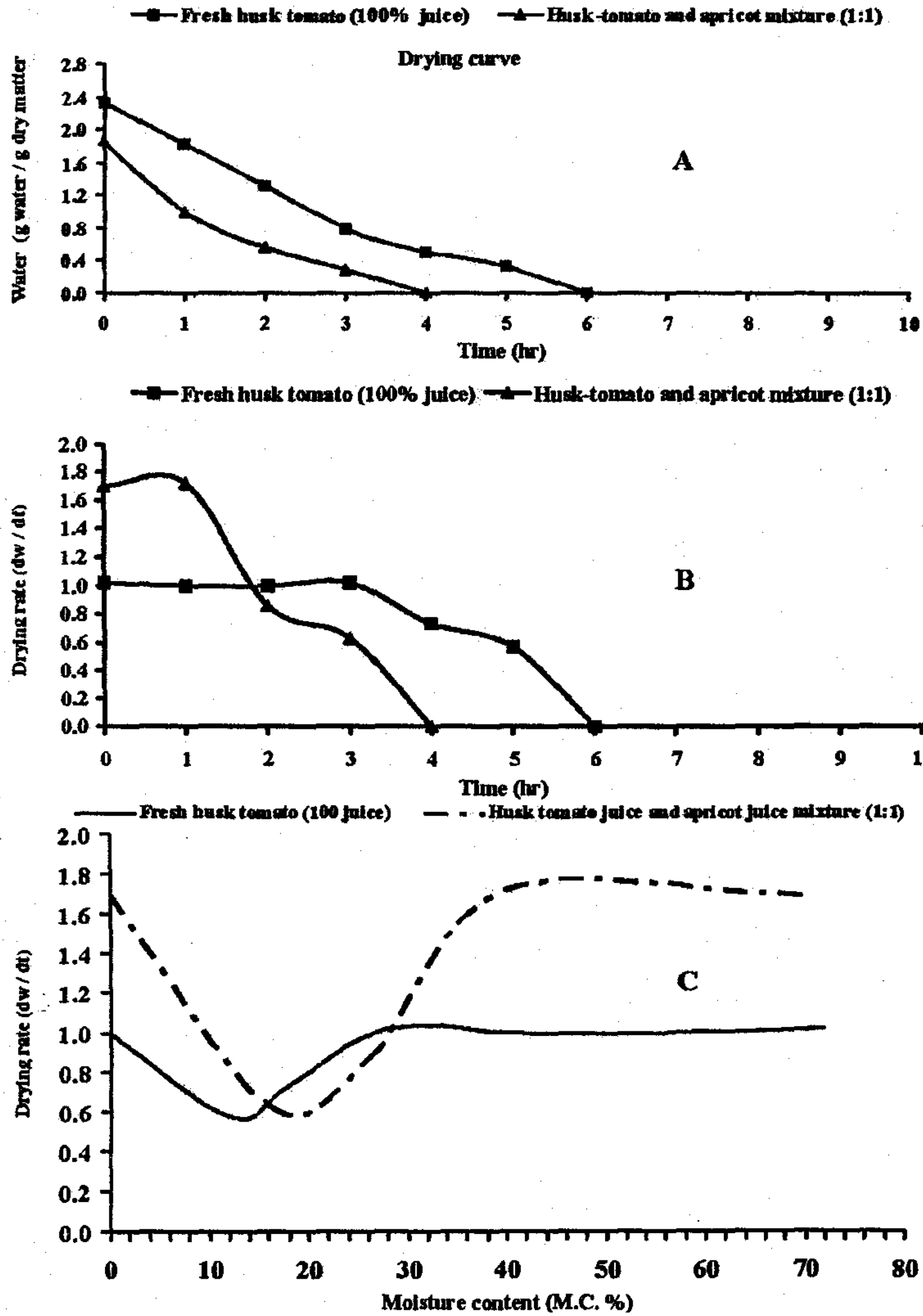

Fig (4): Change of water (A), drying rate (B) in correlation with time (hr) and the drying rate in correlation with M.C.% (C)

husk tomato) and time. The shape of the obtained curve agrees well with that is known as the normal drying curve of food materials. Comparing the two curves Fig. (4B) with each other for both treatments, it can easily be seen that all followed the same trend. From this curve it can be deduced that the process, of drying may be divided into a "constant rate period", "surface evaporation period" and "falling rate periods" diffutional evaporation period'. At the beginning of the drying process there was one period where the rate of drying (moisture loss or water mass transfer) was more or less constant and depends on relative humidity more than temperature.

The end of the constant rate period occurs when the internal rate supply (water, mass transfer within the food material) becomes inadequate to saturate the surface. The constant rate period comes after the falling rate period. According to Fennema (1985) it is assumed that during this period the water mass transfer from a level inside the food materials in which saturation conditions still perversely occurs by transport in the gaseous phase to the surface and from the surface to the atmosphere, the rate is assumed to fall during this period due to the increase of internal resistance. The end of the falling rate period is reached when the center of the food material has no longer enough moisture to maintain saturation. In this period the partial pressure of water throughout the food material was every where below the saturation level according to Fennema (1985).

3.2- The drying rate as a function of moisture content

Inspection of the geometry of the drying rate Fig. (4C) revealed that at high moisture content (beginning of the drying process) there is also a period (where the husk tomato juice has over 10% moisture content), which can be regarded as a constant rate of drying.

CONCLUSION

The results in this study indicated that husk tomato products were highly acceptable by the panelists and can be represented as a promising fruit crop. Moreover, it could become a commercial fruit of particular interest to restaurants, bakeries and supermarkets. Increasing the area of cultivation in Egypt of this crop must be considered, in the Delta lands as well as in the new reclaimed lands. Husk tomato fruits could be successfully used to prepare different products such as jelly, jam, sheets (after mixing with 50% apricot) as well as candied.

ACKNOWLEDGMENT

We wish to express our deepest gratitude to Dr. Ahmed Rafik El-Mahdy, Professor of Food Science University for his kind help during the work and also during writing the manuscript.

REFERENCES

Abou-Gharbia, H.A. and Abou-Tour, E. M. (2001). Properties and processing of husk tomato (Physalis pruinosa L.). Minufiya J. Agric. Res., 26: 761-781.

Agar, I.I.; Streif, J. and Bangerth, F. (1997). Effect of high CO2 and controlled atmosphere (CA) on the ascorbic and dehyroascorbic acid content of some fruits. Post harvest Biol. Technol. 11: 47-55.

Agricultural Statistics Newsletters (1996). Economical affairs sector, agricultural economics management center, Ministry of Agriculture and Land Reclamation. Cairo, Egypt, Vol. (4), Nov., 1996 (in Arabic).

A.O.A.C. (1990). Official methods of analysis. Association of official analytical chemists. 15th, Ed., Washington, DC., U.S.A.

Bianchini, F. and Corbetta, F. (1977). Health Plants of the World. Atlas of the Medicinal Plants. Francesco Le-piante, Della-Salute, Bisboia, Newsweek Books, New York.

Bauman, J.W. (1981). Applications of enzymes in fruit juice technology. Enzymes Food Process (Ind. Univ. Co-op. Symp. 1980), pp 129-147.

Cantwell, M.; Flores, M.J. and Trejo, G.A. (1992). Development changes and post-harvest physiology of tomatills fruits (Physalis ixocarpa, B.). Scientia Horticulturae, 50: 59-70.

Cordenunsi, B.A.; Nascimento, J.K.O.; Genovese, M.I. and Lajolo, F.M. (2002). Influence of cultivar on quality parameters and chemical composition of strawberry fruits grown in Brazil. J. Agric. Food Chem. 50, 2581-2586.

Fennema, O.R. (1985). Food Chemistry. Second Edition. Marcel Dekker, INC. New York and Basel.

Forney, C.F. and Breen, P.J. (1986). Sugar content and uptake in semi-tropical fruits. J. Am. Soc. Hortic. Sci., 111 (2): 241-247.

Green, A. (1971). A soft fruits. In "The Biochemistry of Fruits and Their Products"; Hulme, A.C., Ed., Academic Press : London, U.K., Vol. 2.

Hours, R.A.; Voget, C.E. and Ertola, R.J. (1988). Some factors affecting pectinase production from apple pomace in solid state cultures. Biological Wastes. 24: 147-157.

Jason, A.C. (1958). A study of evaporation and diffusion process in the drying of fish muscle. In fundamental aspects of the dehydration of foodstuffs. Macmillan Co. New York.

Joslyn, M.A. (1970). Methods in food analysis. Second Ed., Academic Press, Inc., New York.

Kirk, R.S. and Sawyer, R. (1991). Person's composition and analysis of foods. Ninth Edition, Longman, Singapore Publishers (Pte) Ltd.

Mackinnery, G. and Little, M. (1962). Colour of foods. Avi. Pub. Co., West Port, USA.

McCain, R. Goldenberry (1993). Passion fruit and white sapote : potential fruits for cool subtropical areas. In : New Crops. Janick, J. and Simon, J.E. (Eds); Wiley, New York, pp. 479-786.

Naczk, M. and F. Shahidi (1989). The effect of methanol ammonia-water treatment on the content of phenolic acids of canola. Food Chem., 31: 159-164.

Nishiyama, J.; Yamashita, Y.; Yamanaka, M.; Shimohashi, A.; Fukuda, T. and Oota, T. (2004). Varietal difference in Vitamin C content in the fruit of kiwi fruit and other actinidia species. J. Agric. Food Chem., 52: 5472-5475.

Pfannhauser, W. (1988). Sensorial and instrumental analytical investigation of kiwifruit aroma. Teistchrift für LebonsmiHle Üntersuchung Ünd Forschung, 187 (3) : 224-228.

Rangana, S. (1977). Mannual of analysis of fruit and vegetable products. Tata McGraw-Hill Pub. Co. Ltd., New Delhi.

Rehm, S. and Epsig, G. (1991). Fruit. In : The Cultivated Plants of the Tropics and Subtropics, Cultivation, Economic Value and Utilization. Sigmund, R. and Custav, E., (Ed.); Verlag Josef Margraf : Weikersheim, Germany, pp. 169-245.

Stary, F. (1983). Poisonous Plants. Hamlyn Colour Guides, Hamlyn, London, New York, Sydney. Toronto.

Steel, R.G. and Torrie, T.H. (1980). Principles and procedures of statisticals. A biometrical approach., McGraw Hill Book Comp. Inc., New York, USA.

Yang, M.; Pan, X. and Zhao, X. (1996). Chemical analysis on the constituents of essential oil in the berry of Physalis pubesces. Journal of Northeast Forestry, 24 (2) : 94-98.

الملخص العربي

إنتاج وتقييم منتجات جديدة مصنعة من ثمار الحرنكش

هانئ علي أبو غربية – السيد محمد إبراهيم أبو طور

قسم علوم وتكنولوجيا الأغذية – كلية الزراعة (الشاطبي) – جامعة الإسكندرية

تعتبر ثمار الحرنكش من أصل مكسيكي وتابعة للعائلة الباذنجانية، وتستخدم في إعداد الشوربة الخضراء في المأكولات المكسيكية. تم تعريض ثمار الحرنكش لبعض المعاملات التكنولوجية لإعداد منتجات جديدة؛ مربي، جيلي، عصير، حلوى ممكرة ولفائف. وحدث تغير بسيط في اللون لثمار الحرنكش من الأصفر أو البرتقالي إلي الأصفر البني عند إعداد المنتجات المختلفة. وأظهرت النتائج وجود اختلافات جوهرية (ف<٠,٠٥) للمنتجات المصنعة عند تقييمها وإجراء بعض الاختبارات عليها. كما حدث زيادة ملحوظة للمواد الصلبة الذائبة نتيجة العمليات التصنيعية وإضافة السكر كما تضاعفت قيمة السكريات الكلية لكافة المنتجات. وعلي الجانب الآخر فقد حدث انخفاضاً طفيفاً في الحموضة المنقطة في حالة المربي والجيلي بينما كان هناك ارتفاعاً جوهرياً (ف<٠,٠٥) لكافة المنتجات وكذلك بالنسبة لنتائج التانينات. وقد وجد أيضاً حدوث ارتفاع جوهري (ف<٠,٠٥) في مستوى الألياف الخام لكافة المنتجات. أظهرت الاختبارات العضوية الحسية تقبلا جيداً سواء للحلوى المسكرة أو اللفائف. واتضح من منحنيات التجفيف صعوبة الوصول إلي مستوي الأمان للمحتوي الرطوبي للفائف ثمار الحرنكش.