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ABSTRACT

This investigation was undertaken to study the effect of carrot puree percentage addition (25, 33, 40, 50, 60, 67, 75%of carrot) on the physical and chemical characteristics of the dehydrated apricot sheets and sensory attributes of the rehydrated sheets before storage at room temperature for 9 months and the effect of using commercial enzymes for the production of improved mango and carrot concentrates with special reference to good physical and chemical properties.

Results showed that addition of carrot puree reduced the total acidity and ascorbic acid content of the dried sheets, while carotene content increased by increasing the carrot puree percentage.

Results indicated that storage of dried sheets affected the chemical constituents of the dried sheets. It reduced moisture content, total sugars, total acidity, ascorbic acid, carotenoids and SO2 content. Results showed that sheets with high carrot puree percentage were higher than the other sheets in the sugar and carotenoids contents.

Results concerning the physical and chemical properties of carrot and mango puree and concentrates indicated that enzymatic treatments increased the values of total solids,total soluble solids and total titratable acidity compared to the untreated samples.While ascorbic acid ,pH and viscosity values of the purees and concentrates produced by enzymatic treatments were lower than that of the untreated ones.

Sugar fractions of mango and carrot purees and/or concentrates showed that sucrose was the predominant sugar followed by fructose.Galactose was not identified in mango puree and concentrates,while it was identified only in carrot products.

Accordingly, it could be recommended that commercial enzymes can be successfully used for the production of improved carrot and mango concentrates with special reference to good physical and sensorial properties.

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1. Introduction

Carrots ***(Daucus carota L.)*** is a good source of some nutritive substances i.e., β-carotene, sugars, minerals and fibers. Substantial quantities of carrots are processed into jams and pickles. β-carotene is considered a good precursor for the synthesis of vitamin A in the body **(El-Nemr *et al.*, 1995).** In Egypt the total annual cultivated area of carrots was 8955 feddans yielding an annual production of about 107022 tons in 2004 **(Statistical report, Ministry of Agriculture and Land Reclamation, Egypt, 2004).**

Apricot ***(Prunus armenica L.)*** is one of the most popular fruits cultivated in Egypt. Since its season is rather short, considerable quantities are freshly consumed while the rest are processed into natural or standardized juice, dried sheets or fruits, canned apricots, jams, and concentrated juice **(El-Nemr *et al.*, 1995).** The total area of apricot cultivated in Egypt was 20091 feddans yielding an annual production of about 103070 tons in 2004 **(Statistical report, Ministry of Agriculture and Land Reclamation, Egypt, 2004).**

Mango ***(Mangifera indica L.)*** is one of the most and oldest important tropical fruits, originated apparently in the Indo-Burma region. It is considered to be one of the best fruits in the world market due to its excellent flavor, attractive fragrances and beautiful color, delicious taste and health giving properties **(Abd El-Hady, 2002).** The total area of mango cultivated in Egypt was 109018 feddans yielding an annual production of about 287317 tons in 2004 **(Statistical report, Ministry of Agriculture and Land Reclamation,Egypt,2004).**

Drying of fruits and vegetables is important for the food industry. Reduction of water content prevents

microbial growth and slows enzymatic changes, thus making storage without refrigeration possible. It also reduces shipping weight **(Van Arsdel and Copley, 1964).**

In the evaluation of a dehydrated food products many factors important to the consumer must be considered, such as appearance, taste, texture and convenience of preparation of equal importance is the nutritional quality of the product. **(Della Monica and McDowell, 1965).** Apricot sheets are considered one of the most popular dehydrated fruit juice products, known as Qamar El-Din a dessert consumed all over the year specially during the fasting month of Ramadan.

The purée of tropical fruits are usually used in preparing nectars, breakfast drinks, jams and preserves, as well as other fruit products. A high quality concentrate would be a desirable form suitable to be transported from tropics to markets in the temperate zone. An important characteristic of a concentrate is its consistency or thickness, which is limiting in the performance of some evaporators, and can be a problem during pumping or filling of the product into containers **(Brekke and Myers, 1978).**

The primary objective of the juice processor is to obtain the highest possible yield with maximum productivity, while maintaining or improving the quality and stability of the final juice product. To achieve this goal, fruit processors rely on continuous technological support with respect to equipment, processes, and processing aids such as enzymes **(Faigh, 1995).** Enzymatic liquefaction produces products of high aromatic and nutritive quality. The quantities of residual pomace are greatly reduced **(Grassin, 1992).**

2. Aim of investigation

The aim of this investigation was to study the following topics:-

1- Production of improved dehydrated sheets of carrot and apricot blends characterized by long shelf-life and high qualities.

2- The utilization of synthetic apricot aroma in the production of the sheets instead of the natural apricot purée. The effect of storage period on the physical, chemical and sensory evaluation of dehydrated sheets.

3- Effect of using commercial enzymes for the production of improved mango and carrot concentrates with special reference to good physical, chemical and sensorial properties.

3. Review of literature

3.1. Chemical composition of fresh carrot, apricot and mango fruits:-

3.1.1 Chemical composition of fresh carrot:-

Virtually all humans dietary vitamin C, an important constituent of human diet, is obtained from fruits and vegetables, some of which are rich in pro-vitamin A (Beta-carotene) (e.g., mango, carrot, etc.).They are also important suppliers of calcium,phosphorus and iron **(Jayaraman and DasGupta, 1995).**

3.1.1.1 Moisture content

Awad (1988) reported that moisture content of fresh carrot was 88%. **El-Nemr *et al*. (1995)** demonstrated that fresh carrot, variety Chentenay Red Core contained 81.90% of moisture content. Also **Matuk *et al.* (1996)** reported that moisture content of fresh carrot, variety Chentenay was 86%, however **El-Sayed (2000)** reported that moisture content of fresh carrot variety Nantass was 89.18%. **Saad (1989)** and **Dyab (2003)** found that fresh carrot contained 91.31% and 91.82% of moisture content, respectively.

3.1.1.2. Total titratable acidity

Foda *et al.* (1985) showed that the total titratable acidity of carrot (Baladi variety) was 0.15g/100ml juice (as citric acid). **El-Gharably (1993)** reported that the acidity content of carrot as citric acid was 2.61% (on dry weight basis). While, **El-Nemr *et al.* (1995)** stated that carrot (Chentenay Red Core variety) contained 1.22%g/100g dry weight of total acidity (as citric acid)

3.1.1.3 Ascorbic acid content

Saad (1989) reported that the ascorbic acid content of carrot was 73.48 mg/100g dry matter. Moreover, **Dyab (2003)** stated that carrot contained 60.12 mg/100g dry matter of ascorbic acid. While, **El-Gharably (1993)** and **El-Nemr *et al*. (1995)** reported that carrot contained 314.33 and 27.40 mg/100g (on dry weight basis) of ascorbic acid content, respectively.

3.1.1.4 Total carotenoids content

Carotenoids are responsible for color and also in nutritional value as precursors of vitamin A in the body, carrot is a rich source of B-carotne **(El-Nemr *et al.* (1995). DellaMonica** and **McDowell (1965)** reported that β-carotene content of fresh carrot **(**Chentenay Red Core variety) varied from 62.2 to 100mg/100g (on dry weight basis). **Van Deelen (1986)** and **Park (1987)** found that the β-carotene content of fresh carrot was 89.6 and 98.88 mg/100g (on dry weight basis), respectively while, **Bao and Chang (1994)** reported that the β-carotene content of fresh carrot (Emperator cultivar) was 53.4 mg/100g dry matter.

3.1.1.5 Sugars content

Krarup and Mosnaim (1980) studied some parameters for evaluating quality attributes in ten carrot cultivars and found that sugar was the highest in three cultivars i.e., Saint valery (8.1%), De La Haya (6.3%) and Emperador (6%). **Foda *et al.* (1985)** showed that fresh carrots contained 5.5% total sugars (on fresh weight basis). Moreover, **Saad (1989)** reported that reducing and non-reducing sugars contents of fresh carrot were 34.86 and

18.29% (on dry weight basis), respectively.While, **El-Gharably (1993)** reported that reducing, non-reducing and total sugars of fresh carrot were 10.62, 26.50 and 37.12% (on dry weight basis), respectively. Moreover, **Bao and Chang (1994)** found that reducing sugars content of fresh carrot (Emperator cultivar) was 8.3% (on dry weight basis).

3.1.1.6 Ash and minerals

Bao and Chang (1994) found that fresh carrot (Emperator cultivar) contained 5.7%, 2.3% and 1% of ash, calcium and magnesium (on dry weight basis). Moreover, **Matuk *et al.* (1996)** reported that the ash content of carrot (Chentenay cultivar) was 3.93% and that the minerals content (mg/100g Dry matter(D.M)) were 250 for calcium and 6.43 for iron. While, **El-Nemr *et al.* (1995)** showed that the minerals content (mg/100g D.M.) of carrot (Chentenay Red Core variety) were 7.24 for calcium, 40.55 for sodium, 101.6 for potassium and 10.05 for magnesium .**El-Sayed (2000)** reported that ash content of carrot (Nantass variety) was 3.88% (on dry weight basis).

3.1.1.7 Crude fiber content

Matuk *et al.* (1996) found that crude fiber content of carrot (Chentenay cultivar) was 5.71% (on dry weight basis). **El-Sayed (2000)** reported that carrot (Nantass variety) contained 7.49% crude fiber (on dry weight basis). **Dyab (2003)** reported that crude fiber of carrot was 7.58% (on dry weight basis).

3.1.2. Chemical composition of fresh apricot fruits:

3.1.2.1. Moisture content

Elewa (1982) found that apricot pulp (Fark variety) contained 79.42% moisture content. Morever, **Sanad (1991)**showed that fresh apricot pulp contained 85.2% moisture content. **Ahmed (1995)** demonstrated that fresh apricot fruits contained 81.23% moisture content . **Ali (2000)** reported that the moisture content of fresh apricot pulp(Amar variety) was 85.52%.

3.1.2.2. Total titratable acidity

Hamed (1980) reported that total acidity of Hamawy apricot pulp was 9.93% as citric acid (on dry weight basis). **Ibrahim (1990)** found that the total acidity of apricot halves was 13.42% as citric acid (on dry weight basis). Moreover, **Sanad (1991)** showed that the total acidity (as citric acid) and pH value of apricot pulp were 14.85%(on dry weight basis) and 3.25, respectively. **Ahmed (1995)** reported that the total acidity and pH value of apricot were 9.42% (on dry weight basis) and 3.10, respectively. Also, **Dyab (2003)** found that apricot juice (Amar variety) contained 16.48% total acidity (as citric acid) and pH value was 3.4.

3.1.2.3. Ascorbic acid content

Salem and **Hegazi (1973)** stated in their studies on fresh apricot juice (Hamawy variety) that ascorbic acid content was 35.9mg/100g (on dry weight basis) . **Elewa (1982)** reported that apricot pulp(Fark variety) contained 58.69mg/100g ascorbic acid (on dry weight basis). **Ibrahim (1990)** showed that ascorbic acid content of fresh apricot halves was 44.59 mg/100g dry matter. While,

Hamed *et al.* (1999) reported that apricot pulp (Baladi variety) contained 96.71% mg ascorbic acid /100g D.M.. **Ali (2000)** stated that ascorbic acid content of apricot fruits (Amar variety) was 107 mg/100g (on dry weight basis)

3.1.2.4. Total carotenoids content

Salem and Hegazi (1973) reported that apricot juice(Hamawy variety) contained 23.4 mg carotenoids/100g D.M.. While, **Hamed (1980)** found that the carotenoids content (as β-carotene) of apricot (Hamawy variety) was 9.48 mg/100g (on dry weight basis) . **Sanad (1991)** stated that apricot (Baladi variety) contained 5.07 mg/100g of β-carotene (on dry weight basis). **Dyab (2003)** reported that the carotenoids content (as β-carotene) of apricot juice (Amar variety) was 25.76 mg/100g (on dry weight basis).

3.1.2.5. Sugars content

Hamed (1980) reported that reducing , non-reducing and total sugars contents of apricot pulp were 15.44, 36.67 and 52.11% (on dry weight basis), respectively. **Hamed *et al.* (1999)** reported that the reducing , non-reducing and total sugars of apricot fruits were 17.28, 39.88 and 57.16% (on dry weight basis), respectively. **Ali (2000)** found that apricot pulp contained 14.42, 35.38 and 49.80% (on dry weight basis) of reducing, non-reducing and total sugars, respectively.

3.1.2.6. Ash and minerals

Sanad (1991) stated that ash content of apricot pulp was 5.47% and minerals content (mg/100g D.M.) were 7.5 for calcium, 10.23 for sodium, 123.58 for potassium and

8.07 for magnesium. **Hamed *et al.* (1999)** and **Ali (2000)** reported that apricot pulp contained 3.61 and 4.5% ash (on dry weight basis) , respectively. **Dyab (2003)** found that fresh apricot juice contained 4.04% ash and 160.65, 11.98, 18.56 and 10.315 mg/100g for potassium, sodium, calcium and magnesium (on dry weight basis) , respectively .

3.1.2.7. Crude fiber content

Hamed (1989) reported that the crude fiber content of apricot (Hamawy variety) was 2.70% (on dry weight basis). Moreover, **Sanad (1991)** found that apricot fruits (Chentenay Red Core) contained 2.00% of crude fiber content (on dry weight basis). **Dyab (2003)** stated that crude fiber content of apricot juice was 4.23% (on dry weight basis). While, **Elewa (1982)** reported that crude fiber in Fayum´s apricot was 10.83% (on dry weight basis).

3.1.3. Chemical composition of fresh mango fruit

3.1.3.1. Moisture content

Khalil (1962) showed that the moisture content of mango pulp (Baladi variety) were 79.53%. **Askar (1966)** reported that the moisture content of mango pulp (Zebda, Pairy and Baladi varieties) during two harvest seasons ranged from 81.76% to 83.22%. **Zeid (1996)** and **Meky (1999)** found that mango pulp (Baladi varieties) contained 80.9 and 79.06% of moisture content, respectively.

3.1.3.2. Total titratable acidity

Khalifa (1983) reported that the total acidity of mango flesh (Baladi variety) was 3.93% as citric acid (on dry weight basis). **Ibrahim *et al*. (1985)** stated that mango pulp (Baladi variety) contained 0.608% of total acidity as citric acid (on fresh weight basis). **Abd El-Hady (2002)**

found that mango pureé (Baladi variety) contained 0.47% and 4.35 of total acidity and pH value (on fresh weight basis), respectively .Moreover, **Afifi (1995), Essa (1998)** and **Ali (1999)** reported that mango pureé contained 0.66, 0.77 and0.43% of total acidity as citric acid (on fresh weight basis), respectively. They added that pH value of mango pureé were 3.72, 3.68 and 3.92, respectively .

3.1.3.3. Ascorbic acid content

Ascorbic acid content of mango pulp (Baladi variety) was 377.14 mg/100g (on dry weight basis) **(Khalil, 1962). Askar (1966)** stated that ascorbic acid content of mango pulp during two harvest seasons ranged from 13.2 to 54.5 mg/100g (on fresh weight basis). **Zeid (1996)** and **Meky (1999)** reported that mango juice (Baladi variety) contained 66.63 and 74.98 mg/100g of ascorbic acid content (on dry weight basis), respectively. While, **Avena and Luh (1983)** and **El-Mokadem (1999)** found that ascorbic acid content of mango purée i.e., Kent and Alphonso were 221.36 and 359.78 mg/100g (on dry weight basis), respectively.

3.1.3.4. Total carotenoids content

Khalifa (1983) and **Meky (1999)** reported that mango flesh (Baladi variety) contained 84.64 and 24.98 mg/100g (on dry weight basis) of carotenoids content, respectively. Moreover, **Ibrahim *et al.* (1985)** and **Abd El-Hady (2002)** found that carotenoides content of mango pulp (Baladi variety) were 4.88 and 3.25 mg/100g (on fresh weight basis), respectively. **Afifi (1995)** and **Ali (1999)** showed that mango purée contained 13.73 mg/ml and 35.5 mg/100g (on dry weight basis) of carotenoids content, respectively.

3.1.3.5. Sugars content

Khalil (1962) reported that the reducing , non-reducing and total sugars content of mango flesh (Baladi variety) were 7.52%, 52.08% and 59.59% (on dry weight basis), respectively**. Zeid (1996)** showed that the reducing, non-reducing and total sugars of mango pulp (Baladi variety) were 2.57%,20.36% and 22.93% (on dry weight basis), respectively. **Ibrahim *et al.* (1985)** found that reducing, non-reducing and total sugars content of mango pulp (Baladi variety) were 5.1,5.1 and 10.2% (on fresh weight basis), respectively. **Chan and Kwok (1975)** determined sugars in mango purée (Hayden variety) and found that glucose, fructose and sucrose represented 0.65%, 2.50% and 9% (on fresh weight basis), respectively**. Avena and Luh (1983)** declared that glucose, fructose and sucrose represented 7.2%,23.8% and 69.0% in the total sugars (on fresh weight basis) in mango purée (Kent variety), respectively

3.1.3.6. Ash, minerals and crude fiber contents

Askar (1966) reported that the ash content and crude fiber content of mango pulp (Baladi variety) ranged from 0.37 to 0.58% and 0.09-0.52%(on fresh weight basis), respectively. **Ibrahim *et al.*(1985)** showed that the minerals content of mango pulp (Baladi variety) were 0.75% for potassium, 0.60% for calcium, 0.09%for magnesium and 0.12% for sodium (on fresh weight basis). **Khalil (1962)** reported that the ash and minerals contents i.e., calcium, sodium and potassium of mango pulp (Baladi variety) were 1.73% and 44.94, 670.15 and 474.55 mg/100g (on dry weight basis) respectively . Moreover, **Meky (1999)** showed that the ash content of mango pulp (Baladi variety)was 2.39% (on dry weight basis).

3.2. Effect of pre-drying treatments on quality of dried fruits

Processing treatments applied to fruits before being dried are usually necessary to ensure a reasonably short drying time and to limit heat-induced deteriorative changes to a minimum (**McBean *et al.* 1971).**

3.2.1. Effect of blanching treatment

Blanching is considered an important heat process used in the preparation of most vegetables and some fruits for dehydration. Its main purpose is to inactivate enzymes or destroy enzyme substrates such as peroxides. If not inactivated, enzymes may cause discoloration, softening and undesirable flavour development during subsequent processing and storage of the dried product. Blanching involves rapidly heating the food to a predetermined temperature, holding it at that temperature for a predetermined time and rapidly cooling it. In addition to the inactivation of enzymes, blanching assists in cleaning the food, causes a reduction in its bacterial load and influences the texture of the product. (**Brennan, 1994).**

Effect of steam blanching of carrots on its β-carotene content was studied by **(Della Monica and McDowell, 1965)** and they found that steam blanching caused an apparent increase in β-carotene content varying from 2% to 25% above the original values, indicating that losses of soluble solids are the most probable explanation for this increase.

Blanching either before or after sulfiting reduced the drying time of apricot by 10 to 20% **(Abd El-Haq and Labuza, 1987).**

Bao and Chang (1994) reported that pulp prepared from blanched carrot contained the total α- and β-carotenes, 110.3 mg/100g (dry wt basis), and retained 35% of total carotenes in fresh carrot. Meanwhile, pulp prepared from unblanched carrot contained the lowest total α- and β-carotenes (71.3 mg/100g) and retained 17% only of total carotenoids in fresh carrots. While reducing sugar content of pulp prepared from water-and acetic acid blanched carrots were higher than that prepared from the unblanched carrots (8.3% dry matter basis for the unblanched, 9.7% for the water blanched and 9.0% for the acetic acid blanched carrots). They also observed that ash, calcium and magnesium contents of carrot pulp was not affected by blanching treatments of carrot products.

3.2.2. Effect of sulfuring treatment

McBean *et al.* (1965) reported that in most countries, sulfur dioxide (SO_2) is permitted in limited quantities in dried tree fruits, in which it retards deteriorative changes in color and flavour. The allowable concentrations of SO_2 are generally sufficient to insure that the dried fruits remain acceptable in quality for 6-12 months, depending up on storage conditions.

Sulfur dioxide is the only additive widely used for its chemical or preservative effect during storage of dried fruit and vegetable juices. Its use is primarily based on the prevention of carbonyl group reactions with amino groups, by forming additional compounds with the carbonyls. A secondary effect is its action as an antioxidant **(Ponting *et al.* 1973)**

No significant differences were found by **Stone *et al.* (1986)** between the amount of ascorbic acid retained in case

of the unblanched okra (98.2 mg/100g) and that blanched in 0.1% So_2 solution (101.7 mg/100g).

Zhao and Chang (1995) studied the effect of sulfite-treatment of carrot samples before dehydration on the carotene content during storage, they found that in the begining of the storage 0.2% sulfite-treated samples were higher in carotene contents compared to those treated by 0.05% sulfite being 171.9 and 131.8 mg/100g of total carorenoids, and 114.2 and 84.1 mg/100g β-carotene, respectively .

3.3. Effect of drying process on quality of dehydrated fruits

A wide range of chemical changes can take place during food dehydration, and these contribute to the final quality of both the dried items and their reconstituted counterparts in term of food color, flavor, texture, viscosity, reconstitution rate, nutritional value and storage stability. The extent of these changes depends on the composition of the food and the severity of the drying method. **(Potter and Hotchkiss, 1995).**

3.3.1. Sugars

Awad (1988) found that total sugars content, reducing and non-reducing sugars decreased during dehydration of carrot either by sun-drying or oven dehydration. However, **Galal *et al.* (1989)** stated that a marked decrease in the reducing, non reducing and total sugars content can be observed for all plum cultivars dehydrated by different procedures. This decrease was pronounced in the unsulfured treatments compared to sulfured ones. The decrease in reducing sugars could be attributed to many factors, i.e., SO_2 may by attached to the

carbonyl groups or due to Millared reaction. While, **Hassan (1995)** reported that reducing and total sugars decreased slightly as a result of drying process of fig sheets. Moreover, **Matuk *et al.* (1997)** noticed that dehydration process of guava slices had a clear effect on sugar content. While an obvious decrease occured in the non-reducing sugars, a simultaneous increase was observed in the reducing ones. This may be due to the fact that under acidic conditions and drying temperature the non-reducing sugars are inverted into reducing ones. **Tawfik (2001)** reported that the total sugars of dehydrated persimmon cultivars decreased slightly compared to the fresh fruit.

3.3.2. Total titratable acidity

Hamed (1980) demonstrated that dehydration process caused a slight decrease in acids content of the dried apricots. The least decrease in total acidity was in the sulfured products as a result of the presence of sulfrous acid which would be composed during smoke sulfuring. Moreover, **Hassan (1995)** showed that total acidity in the fresh fig fruits and pureé decreased after drying. Also, **Tawfik (2001)** reported that a slight decrease occurred in total acidity after dehydration of persimmon sheets and slices.

3.3.3.Carotenoids (as β-carotene)

Park (1987) reported that the carotene contents of the fresh samples of the three vegetables (carrot, broccoli and spinach) were significantly decreased when they were freshly air dried. Besides, **Awad (1988)** mentioned that a significant loss of carotenoids content was observed in carrot samples dehydrated by three different methods.**Dell Monica and McDowell (1965)** reported that β-carotene content was determined in fresh carrots, and carrots

dehydrated by three dehydration methods, explosive puffing, air drying, and vacuum freeze-drying and they found that the retention of β-carotene was 64%, 52% and 76%, respectively. However, **Tawfik (2001)** mentioned that the total carotenoids decreased sharply in all persimmon samples after drying.

3.3.4. Ascorbic acid

Salem and Hegazi (1973) stated that most of the ascorbic acid present in the raw apricot (35.9 mg/100g) was lost during juice extraction and sun-drying (8.30 mg/100g). Moreover, **Bolin and Stafford (1974)** noticed that apricot halves which were dried without sulfuring lost 95% of their ascorbic acid during drying, compared to a 74% loss from the sulfured samples. However, **Ali (2000)** declared that ascorbic acid content in dehydrated apricot sheets highly decreased during processing compared to ascorbic acid content of fruit pureé.

3.4. Rehydration of dried products

Rehydration is a complex process aimed at the restoration of raw material properties when dried materials is in contact with water **(Lewicki, 1998).** Water that is removed from a food during dehydration can not be replaced in the same way when the food is rehydrated (that is, rehydration is not the reverse of drying). The rate and extent of rehydration may be used as an indicator of food quality, those foods that are dried under optimum conditions suffer less damage and rehydrate more rapidly and completely than poorly dried foods **(Fellows, 2000)**

Hamed (1980) reported that blanching increased the percentage of rehydration by about 8-10% as compared to unblanched apricot samples. Blanching may have

somewhat weakening effect on cell walls to allow higher absorption of water.

Quintero-Ramos *et al.* (1992) reported that a double blanch consisting of a long time-low temperature blanch followed by a short time-high temperature blanch before dehydration had little effect on rehydration ratios of dried carrots.

Haas *et al.* (1974) carried out an investigation on rehydration and respiration of dry and partially dried green beans, carrots and green bell peppers. They stated that the greater the degree of drying, the slower and less complete the degree of rehydration.

Kaymak-Ertekin (2002) stated that predrying treatments (blanching, sulfiting and sodium chloride dipping) were found to partly improve the rehydration characteristics of peppers. Rehydration rates were not significantly affected by rehydration temperature.

Awad (1988) investigated the utilization of solar energy in drying of carrots and pepperment, and she reported that the higher rehydration ratio was for treated (blanched and sulfured) solar dehydrated carrots (1:6.9). Treated sun-dried and oven-dehydrated samples have almost the same rehydration ratio (1:6.1 and 1:6.0, respectively). The rehydration ratios of untreated carrots were 1:5.5, 1:5.6 and 1:5.8 for solar-dehydrated, sun-dried and oven-dehydrated samples, respectively.

Ibrahim *et al.* (1990) studied the technological aspects for drying some local plum varieties and found that the reconstitution tests reveal that coefficient of rehydration was always higher in ventilated oven dried plums when compared to sun dried ones.

Eshtiaghi *et al.* (1994) stated that freezing of samples prior to drying generally resulted in more effective rehydration (water uptake : 2.1-4.8 ml/g) for green beans and carrots it was better than water blanched samples.

Hamed (1980) reported that the ability of dried apricot halves for rehydration increased highly by increasing the storage time, regardless of storage temperature, which appeared to have little or no effect on this property. Ability of rehydration increased after storage for 20 weeks by about 20% compared to the values before storage.

Hamed *et al.* (1999) noticed that dried sheets from plum and apricot fruits after storage at 4˚C for 24 weeks had reconstitution percentages higher about 10-15% compared to the dried sheets tested directly after dehydration.

3.5. Effect of storage conditions on quality of dehydrated fruits

3.5.1. Moisture content

Awad (1988) studied the effect of storage conditions on the chemical composition of carrots dried by different methods, she found that the moisture content increased continuously as the time of storage increased in all samples, which could be attributed to the absorbance of moisture from the atmosphere. Meanwhile, **Ibrahim *et al.* (1990)** and **Abd El-Moitte (1996)** found that moisture decreased during the storage period at room temperature for dried plums and figs. Such decrease was probably due to permeability of the package materials to moisture.**Tawfik (2001)** stated that the moisture content of persimmon sheets

and slices increased from 15.65% to 17.81% and from 15.12% to 16.88% during storage for 8 months at room temperature, respectively.

3.5.2. Sugars content

Foda *et al.* (1972) declared that the total sugars content of the dried apricot sheets showed noticeable decrease during storage. This might be due to Maillard reactions that took place between the reducing sugars and the total free amino acids. **Sanad (1991)** reveald that sugars content of apricot sheet sample for reducing, non-reducing and total sugars content slightly decreased from 21%, 29.20% and 50.20% at zero time storage to 20.93%, 28.75% and 49.68%,respectively after storage. However, **Cañellas *et al*. (1993)** reported that sugars are involved in Maillard reaction and consequently a decrease was observed during storage of raisins. **Rosselló *et al.* (1994)** reported that there was little change in sugar content of dried apricot samples with a high SO_2 under refrigeration. Also, **Hamed *et al.* (1999)** showed that during storage of dried plum and apricot sheets at 4°C the reducing sugars began to decrease.**Ali (2000)** reported that total sugars and non-reducing sugars of dried apricot and peach sheets decreased slightly during storage of 3,6 and 9 months at 4°C, while reducing sugars increased slightly during storage.

3.5.3. Total titratable acidity

Sanad (1991) showed that the total acidity values of apricot sheets (Qamar El-Deen) was 11.36% at zero time storage, after 12 weeks of storage it decreased to be 10.71%. **Cañellas *et al.* (1993)** reported that no significant differences were observed in total acidity values between stored raisins samples at different temperatures.However,

Matuk *et al.*(1997) found that the decrements in total acidity content in all guava powders continued during storage at room temperature up to 24 weeks. These losses in total acidity could be attributed to the non-enzymatic browning which usually occurs during dehydration process and by storage conditions.**Tawfik (2001)** noticed a slight and gradual decrease in total acidity in all samples throughout storage of dried persimmon products. The decrement ranged between 5.9-11.5 for dried sheets.

3.5.4. Total carotenoids

Foda *et al.* (1972) reported that there was a remarkable decrease in the total carotenoids content of the apricot sheet samples during storage. The loss of carotenoids in the non-sulfured apricot sheets (15.6 mg/100g at zero time – 3.9 mg/100g after 12 months) was higher than that in the sulfured samples (23.5 mg/100g at zero time - 9.0 mg/100g after 12 months). Moreover, **Zhao and Chang (1995)** reported that during the 12 months storage period, β-carotene loss in the control dehydrated carrots, 0.05% sulfite-treated samples and 0.2% sulfite-treated samples was 60, 56 and 59%, respectively. **Kim *et al.* (2004)** reported that β-carotene content of Korean red pepper was significantly decreased during storage for 6 months.

3.5.5. Ascorbic acid

El-Senousi (1999) reported that the reduction in the ascorbic acid after 12 months of storage was 77.6% for dehydrated apple slices Anna variety. **Abd El-Fadeel e*t al.* (1995)** showed that a gradual reduction in ascorbic acid content during storage from 14.40 mg/100g at zero time to 1.60 mg/100g after 12 months. Moreover, **Hamed *et al.* (1999)** mentioned that a pronounced decrements could be

observed in ascorbic acid content of dried sheets from plum and apricot pulp (from 105.25 mg/100g dry matter at zero time to 42.86 mg/100g dry matter after 24 weeks) during storage.

3.5.6. Sulfur dioxide

Nezam El-Din (1978) reported that residual sulfur dioxide (SO_2) in apricot sheets decreased gradually during storage at room temperature to 3% after 9 months. **Awad (1988)** found that sulfure dioxide cotent decreased by increasing storage time, especially in dried carrot samples stored at room temperature. This was due to the volatile characteristics of sulfur dioxide at room temperature. **Zhao and Chang (1995)** reported that the total residual sulfite content of 0.2% sulfite-treated dehydrated carrot decreased by 10, 21 and 50% after 4-, 8-, and 12- months storage, respectively **Matuk *et al.* (1997)** found that the residual amount of sulfur dioxide was gradually decreased during storage at room temperature where the highest loss reached nearly about 85% after six months of storage of guava powder formely sulfured by soaking in sodium metabisulfite solution. It could also be observed that the minimum loss of sulfur dioxide content was recorded in guava powder sulfured by SO_2 fumes either after dehydration or after storage at room temperature to 6 months. The aforementioned loss reached about 72% at the end of storage. **Masoud (1998)** showed that sulfure dioxide content decreased during storage in different packaging materials and different dehydrated banana products.

3.5.7. Color

Elewa (1982) stated that the absorbance at 420 nm of apricot sheets was 0.07 at zero time and increased gradually to reach 0.43 after six months of storage at room

temperature. **Galal *et al.* (1989)** reported that color intensity of dried plum sheets as shown by transmittance values reveled that sulfuring process exerted its action on suppressing the Millared reaction mainly responsible for browning and undesirable color changes. **Rosselló *et al.* (1994)** mentioned that an increase in browning was observed mainly in dried apricot samples at room temperature up to the sixth month while the samples at 4 and 11°C scarcely suffured any color loss. Moreover, **Hassan (1995)** reported that the color values (O.D) of the dried fig samples increased gradually by increasing the storage period. This increase in O.D during storage may be due to the changes in color affected by the browning reactions. Also, **El-Senousi (1999)** stated that the degree of browning of the dehydrated apple slices increased as the storage period increased. Besides, **Ali (2000)** reported that the optical denisity (O.D) of reconstituted juice prepared from apricot and peach dried sheets increased gradually during storage at 4°C.

3.6. Effect of pre-concentrating treatments on chemical constituents

3.6.1. Effect of enzymatic treatment

Modern trends in fruit and vegetable juice technology are towards the use of a greater variety of raw materials, a more complete utilization of these raw materials, speeding up of process and the presentation of a greater variety of bases and finished products. In many of the modern processes, the use of enzyme preparations as processing aids has become normal practice. Pectolytic enzymes, the most important group of enzymes in this respect, are used for a great variety of purpose. **(Rombouts and Pilnik, 1978).**

Urlaub (1992) stated that the enzymatic method can be used instead of sulfurization, which is still widely practiced with citrus juice, although it has the disadvantage of leaving a high residual SO_2 content in the end product.

Carrots are the most commonly processed vegetables, and are either used to manufacture carrot juice and concentrate, or carrot pureé . Pectinases with high pectinlyase activity, combined with cellulase, are suitable for juice or concentrate manufacture. In this case, the legislator allows the use of cellulase, which leads to much better results as far as yield and beta-carotene yield are concerned. **(Urlaub, 2002).**

Foda *et al.* (1985) stated that the increase in percent sugar of enzymatic treated samples (polygalacturonase enzyme) corresponded to 34.7, 30.6, 32.0 and 26.5% for orange, grapefruit, lemon and carrot, respectively as compared to the non enzymatic controls. Also, the total acidity increased in the range between 7.1 to 20% depending on type the juice extracted.

El-Zoghbi *et al.*(1992) reported that total soluble solids (T.S.S.) of enzyme-reated guava purée were higher than the untreated one. The increase may be due to the conversion of insoluble pectin by pectinolytic enzymes, and the action of arabinase and cellulase on araban and cellulose to produce the soluble sugars **:** arabinose and cellobiose. The pH values decreased in all enzyme treatments. The decrease of pH value may be due to the release of carboxyl groups and galacturonic acid from pectic substances. The enzyme treatments resulted in a decrease in visosity (25 and 31 values for Ultrazyme 100 special and Pecinex Ultra SPL treatments, respectively) as compared with the untreated purée (65 value).

Chang *et al.* (1994) reported that addition of 0.2 % of Clarex L (commercial pectinase) increased soluble solids of plum juice by 2.2 % to 20.8 %**.** The pH value of juice was not affected by processing conditions, while the acidity of pectinase-extracted juice was 24 % higher than the control. They added that enzyme-extracted plum juice was higher in total sugar content than the control samples owing to the release of soluble solids from the cell walls. Glucose and fructose contents of juice were higher than the average and the sucrose content was lower than the average in enzyme-extracted juice.

Siliha *et al.* (1994) demonstrated that the Rohament P (commercial pectolytic enzyme) reduced the original viscosity of banana purée by 40% , while Novoferm (pectolytic enzyme) and Pectinex Ultra SPL caused, respectively , 63 and 80% reduction in viscosity. The reducing sugars content of banana powder prepared from enzyme treated purée (11.50%) was found to be higher than the untreated one (6.75%). The control sample (0.019 mg/100g) had slightly higher vitamin C content than the enzyme treated ones (0.016 mg/100g). The same trend was found with total carotenoids and β-carotene for the control (1.138 g/100g- 0.068 mg/100g) and enzyme treated ones (1.113 g/100g– 0.053 mg/100g, respectively).

Siliha *et al.* (1995) studied the effect of enzymatic treatment on viscosity of carrot purée. They found that the untreated carrot puree was characterised by high viscosity (2000 Brabender units, BU), treatment with Pectinex Ultra SPL was more effective (1060 BU) than Rohament K (1355 BU) in reducing the viscosity of carrot purée within 2 hrs of enzyme action.

Enzymatic liquefaction of mango might prove the usefulness in reducing the pulp viscosity, which should

result in improved juice recovery and higher soluble solids. This is advantageous for concentrating the juice to a higher °Brix **(Sreenath *et al.* 1995).** The viscosity reduction in the tested mango juice of different varieties was high (50-70%) using pectinex and the enzyme mixture (a combination of equal quantity of pectinex and celluclast), but with celluclast alone it was poor. Viscosity results with the enzyme mixture were similar to those obtained with pectinex alone. The maximum viscosity reduction acheived with celluclast treatment was only 20 - 40% even with extended incubation.

Sakho *et al.* (1998) studied the effect of enzymatic maceration on volatile components of mango pulp and found that the main difference after pectolyase hydrolysis was the release of six terpene hydroxylated derivatives .

3.7. Effect of concentration process on quality of fruit juices

The most important events happen during evaporation are chemical reactions between the components (including water), which are usually present in great number and in widely varying concentrations, and thermal degradation. These reactions can affect products appearance, taste, nutritional value and so on, and depend on concentration´s time and temperature **(Leniger, 1977).**

In the process of making a purée and a concentrate from a pectinolytic enzyme treated papaya purée, small but statistically significant losses in vitamin C occurred. Changes in carotenoids were measurable. No obvious changes in color due to heat-induced browing was seen. Flavour quality was not changed by concentration of the purée, and little or no change took place in aroma. However, **Chan *et al.* (1975)** concluded that quality

retention is satisfactory in low temperature low pressure evaporation of papaya purée to produce a concentrate **.**

During the processing steps of concentrated mango juice, a decrease in acidity, color index, total sugars, carotenoids and ascorbic acid content was noticed in conventional methods **(Abd El-Fadeel, 1981).**

The extracted "Orit" variety tomato juice was affected by the concentration process. The total soluble solids increased rapidly from about 7.4% to 25% by concentration. While, some decrease were observed in total acidity after concentration even after the juice was acidified with 0.1% citric acid. Also, the loss of ascorbic acid was significant. On the other hand, the non- reducing sugars and total sugars were slightly decreased by concentration. But, the reducing sugars were slightly increased in the concentrated tomato paste. The viscosity was highly increased about 3-4 times after concentration **(Zeid, 1996).**

Wrolstad *et al.* (1993) noticed that citric acid is the major acid in red raspberry juice and there was a slight increase in the concentrated juice (43.5 ˚Brix) using conventional evaporative technology.

Meky (1999) studied the physical and chemical changes of mango and cantaloupe pulp treated by pectinolytic and cellulytic enzymes and there concentrates during concentration process and found that the acidity was increased with increasing concentration time. The reducing sugars was increased during concentration which may be due to evaporation of water causing an increase in all total solids of pulps. The viscosity and browning index were increased during increasing concentration. The total soluble solids increased in all concentrates, but it increased sharply in the pectinolytic enzyme treated Baladi mango pulp

concentrate it reached 64%, while it was 47.5% for the untreated pulp concentrate.

Abd El-Latif *et al.* (2000) stated that total titratble acidity (0.695% as citric acid), ascorbic acid (12.40mg/100ml), reducing sugars content (6.24%) and total sugars content (10.51%) of pomegranate juice increased as affected by concentration using rotary evaporator at 40˚C till 32% T.S.S.to reach 0.980%as citric acid, 25.50mg/100ml , 15.95%and18.08% ,respectively.

Evaporation darkness the color of foods, partly because of the increase in concentration of solids, but also because the reduction in water activity promots chemical changes, (for example Maillard browning). As these changes are time and temperature dependent, short residence times and low boiling temperatures produce concentrates which have a good retention of sensory and nutritional qualities **(Fellows, 2000)**. Aroma compounds that are more volatile than water are thus lost during evaporation. This reduces the sensory characteristics of most concentrates.

El-Mansy *et al.* (2000a) reported that total titratable acidity, ascorbic acid, color index (O.D at 420 nm), carotenoids, reducing sugars and total sugars contents of orange juice (total soluble solids 12˚Brix) were1.57% as citric acid, 12.70mg/100g, 0.135(O.D at 420nm),0.686mg/L,3.12%and6.02%, respectively. These parameters increased during concentration using rotary evaporation at 45-50C under vacuum to obtain orange juice concentrate (T.S.S. 25˚Brix) and reached 2.84% as citric acid, 18.58 mg/100g, 1.603(O.D at 420nm), 3.768 mg/L, 7.91% and 14.58%, respectively.

El-Mansy *et al.* (2000b) studied the chemical and rheological properties of juice and concentrates of some tomato varieties and found that the total acidity, ascorbic acid, reducing sugars and carotenoids were increased by 128.57%, 81.25%, 111.68% and 245.68%, respectively with increasing concentration time till T.S.S. reached 20%.

Ali *et al.* (2000) investigated the production of natural mandarin peel concentrates enzymatic treatments using nine commercial pectinase and cellulase enzymes and found an increament in ascorbic acid content, total sugars and carotenoids content in the concentrates after using a rotary evaporator under vacuum. Ascorbic acid content, total sugars and carotenoids contents of fresh mandarin peel were 0.232mg/100ml, 3.50% and 2.26mg/100g, respectively the content reached 4.19, 4.03mg/100ml, 39.10, 38.50% and 9.75, 17.70mg/100g for pectinase and cellulase enzymes treated samples, respectively. Moreover, **Rasmy *et al.* (2001)** studied the physico-chemical properties of the pectinase and cellulase enzymes treated peach and tomato juices and their concentrates, and they found that T.S.S., titratable acidity, reducing sugars and non-reducing sugars content increased during concentration process in all concentrates untreated and enzyme treated ones, the T.S.S. represented 15%, 55%, 50% for untreated, pectinase and cellulase enzyme treated peach juice, respectively, also titratable acidity represented1.84%, 3.56% and 2.35% for untreated, pectinase and cellulase enzyme treated peach juice, respectively, reducing sugars content represented 7.04%, 13.64% and 11.12% for untreated, pectinase and cellulase enzyme treated peach juice, respectively, and non-reducing sugars content represented 9.65%, 20.13% and 18.19% for untreated, pectinase and cellulase enzyme treated peach juice, respectively, generally the increament was higher in the pectinase treated samples then the cellulase treated ones

while the untreated juice concentrate had the lowest increase.

3.8. Sensory evaluation of dehydrated products

McBean *et al.* (1971) stated that the deteriorative changes in flavor, texture and color are initiated during drying and possibly during pre-drying for dehydrated foods.

Elewa (1982) reported that addition of 5% sucrose and 500 p.p.m SO2 to apricot juice (or rather purée) is quite advisable and improved the quality of the end product, especially when the color, taste, storage stability, nutritive value and general consumer's acceptability were considered.

Sanad(1991) observed that organoleptic properties of Qamar El-Din (prepared by the dehydration of a mixture of apricot and carrot) sheets decreased gradually during storage at room temperature for 12 weeks.

Hassan (1995) reported that dehydrated fig sheets sweetened either by sucrose or high fructose corn syrup combined with 0.2% sodium metabisulfite and dried by sun or oven had the highest scores of overall organoleptic quality, and the differences between these treatments were not significant.

Tawfik (2001) noticed that the dried persimmon sheets sweetened with 10% sucrose combined with o.4% sodium metabisulfite and 3g citric acid per kilogram of sucrose had the highest scores of overall organoleptic quality.

4. Materials and Methods

4.1. Materials

4.1.1. Full mature carrot (Chentenay cultivar), ripe apricot (Hamawy cultivar) were obtained from local market, and ripe mango fruit (Baladi cultivar) was obtained from Ismalia Governorate.

4.1.2. Carboxy methyl cellulose (C.M.C) as binding agent, citric acid and sodium metabisulfite were obtained from El-Nasr pharmaceutical chemicals Co., Egypt.

4.1.3. Starch gel as binding agent was purchased from Starch and Glucose Co., Bahteem, Kaluobia Governorate.

4.1.4. Sucrose was obtained from Sugar and Integrated Industries Co., Egypt.

4.1.5. Commercial pectolytic enzymes Pectinex Ultra SPL (a wide spectrum pectolytic enzymes) and cellulytic enzymes Cellubrix L provided by Novo Nordisk Ferment (Switzerland).

4.1.6. Apricot synthetic aroma obtained from Kato aromatic Co., Egypt.

4.2. Methods

4.2.1. Preparation of purées

4.2.1.1. Preparation of carrot purée

The whole carrot was washed, peeled, cut into slices and steam blanched at 93°C for 15 min., then cooled

rapidly to room temperature, and homogenized using a blender at full speed for 10 min.

4.2.1.2. Preparation of apricot purée

The apricot fruits were washed by tap water, cut into halves and seeds removed, then the apricot halves were steam blanched at 93°C for 15 min. , and cooled to room temperature. Apricot purée was obtained by blending the blanched apricot halves using a blender at full speed for 10min..

4.2.1.3. Preparation of mango purée

Mango fruit was thoroughly washed by tap water and then manually peeled. The edible portion was released from seed by knife and homogenized using a blender at full speed for 10 min.. The obtained purée was immediately pasteurized at 85°C for 5 min. then cooled rapidly to room temperature.

4.2.2. Prepation of sheets blends

4.2.2.1. Apricot sheets

Apricot sheets (Qamar El-Din) were prepared using apricot purée,10% sucrose, 2000 p.p.m. sodium metabisulfite and 1% of CMC and starch gel mixture (2:1).

4.2.2.2. Carrot sheets were prepared using carrot purée, 10% sucrose, 2000 p.p.m. sodium metabisulfite, 0.2% citric acid and 2% of CMC and starch gel mixture (2:1).

4.2.2.3. Mixed sheets were prepared using carrot purée mixed with apricot purée in different carrot ratios (25, 33,

40, 50, 60, 67, 75%), 10% sucrose, 2000 p.p.m. sodium metabisulfite and 1% of CMC and starch gel mixture (2:1).

4.2.2.4. Carrot sheets with apricot synthetic aroma (Cas)were prepared using carrot puree, 10% sucrose, 2000 p.p.m. sodium metabisulfite, 0.2% citric acid, 0.1% (v/v) apricot synthetic aroma and 2% of CMC and starch gel mixture (2:1).

4.2.3. Dehydration of carrot and apricot sheets blends

The mixtures were poured on oiled trays and then dehydrated by using a Fisher oven at 65°C for 6 hr, then temperature reduced to 50°C.for about 23 hr.

4.2.4. Packaging and storage of carrot and apricot sheets

The obtained sheets were tightly packed in polyethylene pouches under atmospheric pressure and stored at room temperature for 9 months. Samples were withdrawn at intervals of 3 months for analysis.

4.2.5. Enzymatic treatment of mango and carrot purées

Mango and carrot purée (1 kg for each separately) were warmed to 40°C thereafter enzyme solution was added. Pectinex Ultra SPL , Ceullubrix L and a mixture (1:1) of both enzymes were applied at a concentration of 250 ppm. for mango purée and 350 ppm. for carrot purée for an incubation period of 120 min.

4.2.6. Concentration of mango and carrot purées

Mango and carrot puree either enzymaticaly treated or untreated were concentrated by vacuum evaporation method using vacuum evaporator (RE 100, England) at 50°C. During concentration samples were withdrawn at intervals of 20 min., total soluble solids (T.S.S.) content of each sample was determined and the rate of increasing T.S.S. was plotted according to **Yu and Chiang (1986).**

4.2.7. Analytical methods

4.2.7.1. Moisture content

The moisture content was determined by drying samples under vacuum at 60°C according to the method described by the **A.O.A.C (2000)**.

4.2.7.2. Total soluble solids content (T.S.S.)

The total soluble solids were determined using Abbe refractometer at 25±2°C according to **A.O.A.C (2000).**

4.2.7.3. Total titratable acidity

Total titratable acidity was determined according to the method described by **A.O.A.C. (2000)**. Results obtained were expressed as grams of citric acid per 100g sample.

4.2.7.4. pH value

The pH value was measured using Consort P107 pHmeter at 25°C as described by **A.O.A.C (2000).**

4.2.7.5. Ascorbic acid content

Ascorbic acid content was determined using 2,6–dichlorophenol indophenol according to the method described by **A.O.A.C. (2000)**. The results were expressed as mg. ascorbic acid per 100mg of sample.

4.2.7.6. Sugars content

Reducing sugars and non-reducing sugars and total sugars content were assayed according to **Somogy´**s method as outlined in **A.O.A.C. (2000)**.

4.2.7.7. Determination of sugars by HPLC technique

Analysis of mango and carrot concentrates to determine glucose, fructose and sucrose were carried out using HPLC technique according to the method of **Ahmed *et al.* (1995)**. A Hewlett Packard (*hp*) series 1050 Liquid Chromatograph (LC) equipped with autosampler *hp*-1050 and 1050 four channel pump was used. The LC was connected to an *hp*-1047 RI detector. The column was a *hp*-phenomenax Razex RPM mono saccharide (300 x 7.8 mm). The injection volume was 15µl.. The mobile phase used was deionized water at a flow rate of 0.1 ml/min.. The column temperature used was 85°C . Identification and quantification were carried out with external standards consisting of solution of gloucose, fractouse and sucrose at a concentration of 0.162, 0.123 and 0.164%, respectively. Five g of sample were blended with 50 ml deionized water, before filtration through filter paper Whatman No.2 and washed with deionized water to a final volume of 100 ml.. The final solution was passed through 0.2 µm filter membrane (5061 -3366 HP, Germany) before injection.

4.2.7.8. Total carotenoids content

The total carotenoids were determined according to **Askar and Treptow (1993)** method as follows:

Ten grams of sample were mixed with 30 ml of 85% acetone in a dark bottle and left to stand for 15 hrs. at room temperature then filterd through glass wool into a 100 ml volumetric flask, and made up to volume with 85% acetone solution. The absorbance of the acetone extract was measured at 440,644 and 662 nm against 85% acetone as a blank using Shimadzu spectrophotometer.The amount of the total caotenoids were caculated according to the following equations:

Chlorophyll (A) = (9.784 x E_{662}) – (0.99 x E_{644}) = mg/litre
Chlorophyll (B) = (21.426 x E_{644}) – (4.65 x E_{662}) = mg/litre
Carotenoids = (4.695 X E_{440}) – 0.268 (Chl.A + Chl.B) = mg/litre

Where E= optical density of sample at the indicated wave length.
Results were expressed as mg/100 g sample.

4.2.7.9. Determination of β-carotene by HPLC technique

Analysis of carrot and mango untreated and enzyme treated purées to determine β-carotene were carried out using HPLC technique according to the method of **Heinonen (1990).** A Varian Vista 5500 liquid chromatograph (Varian) was equipped with a Varian UV-200 detector and aVarian 4270 integrator. The column was a Zorbax ODS (5-6µm, 25 × 0.46 cm(id)) (DuPont) preceded by a guard column (5 × 0.46 cm(id)) packed with

Bondapak AX/Corasil(37-50µm)(Waters). The elution mixture was acetonitrile-dichloromethane-methanol (70:20:10),the flow rate was 1mL/min, and the running temperature was 30˚C. The UV detection was set at 450 nm. Both standards and samples were injected via full loop, approximately 55µL. Identification was carried out by comparing the β-carotene retention time with the retention time of authentic standard. Quantitation was based on an external standared method where the calibration curves ranged from 70 to 2100 µg/mL. Three grams of sample were blended with acetone (100ml) using NaSO2 (20g) as desiccant, vacuum filtered, and concentrated . The samples were extracted two to three times to remove all color.

4.2.7.10. Ash content

The samples were ashed in a Muffle furnace at 550°C till constant weight according to **A.O.A.C (2000).**

4.2.7.11. Viscosity

Viscosity was measured at 25±1°C using Brookfield viscometer model DV-III Rheometer using spindle No.4 for mango and carrot purée. The viscosity was expressed as centipoise.

4.2.7.12. Determination of non-enzymatic browning

Non-enzymatic browning of the alcohol extracts of dried and concentrated samples were determined according to the method of **Ranganna (1977)** as follows :

Ten g of the fresh sample, ten ml of distilled water and 30 ml of ethyl alcohol 95% were added, mixed throughly and filtered through Whatman paper No.1. Dried samples (5g) were extracted using 100ml of 60% ethyl

alcohol for 12 hrs. And filtered. The absorbance of the clear solution was measured at 420nm against 60% aqueous ethyl alcohol as blank.

4.2.7.13 Total sulfur dioxide

Total sulfur dioxide as (p.p.m) was determined using the iodine titration method as described by **Ranganna (1977)** as follows:

Two similar aliquots of sample, five ml of 5 N NaOH were added to each and gently stirred, allowed to stand for 20 min., seven ml of 5 N HCl and 1 ml of 1% starch solution as indicator were added with stirring to the samples and immediately one of the samples were titrated with 0.02 N iodine to a definite dark blue color this value will be *C*. Ten ml of formaldehyde 40% were added to the second sample and allowed to stand for 10 min.and then rapidly titrared after addition of 1 ml of 1% starch solution until a dark blue color persists for at least 15 sec.this value will be *D*. Volume of iodine used by the total SO2 present in the sample is equal to(*C-D*) ml. The amount of the total SO2 were caculated according to the following equations:

1 ml of 0.02 N iodine = 0.64 mg of SO2
SO2 in p.p.m = Titre × 0.64 × 1000 /weight of sample

4.2.7.14. Determination of minerals content

The following minerals: sodium, calcium and potassium were determined using the Flame Photometer (Gallenkamp, FGA 330, England). Iron and magnesium were determined using Perkin Elmer Atomic Absorption Spectrophotometer (model 80, England) as described in **A.O.A.C. (2000).**

4.2.7.15. Rehydration ratio

Ten grams of dried samples were immersed separately in a beaker containing 100 ml distilled water at room temperature (25˚C±2). After 1 hour the sample was removed from each beaker, drained, excess water was discarded from the surface using filter paper before weighing. Rehydration ratio was expressed as the ratio between the drained weight of the rehydrated sample and the weight of the dried sample before rehydration according to **Von Loeseck (1955).**

4.2.7.16. Sensory evaluation

Dried carrot and apricot sheets after rehydration, and concentrated carrot and mango puree after reconstitution were subjected to sensory evaluation test. Ten panelists evaluated each rehydrated sample on a specific scale of 10 for taste, color, texture and odor according to **Ranganna (1977).** The concentrated purees were evaluated after reconstituted for color, taste, flavor and mouth feel according to **Larmond (1982)**.

4.2.7.17. Statistical analysis

The obtained results of sensory evaluation were statistically analyzed using Duncane´s multiple range test as reported by **Snedecor and Cochran (1980).**

5.Results and discussion

5.1.Chemical composition of fresh carrot, apricot and mango purées

5.1.1. Chemical composition of fresh carrot

Results in Table (1) showed that moisture content of fresh carrot was 91.39%. this result agree with those reported by **Saad (1989)**, **El-Gharably (1993) and Dyab (2003)**. In the same Table (1) results showed that total soluble solids (T.S.S) of fresh carrot was 7.8%. This result is in the range of the data obtained by **Van Deelen (1986)** and **Dyab (2003)** who reported that total soluble solids of carrot were 7.5% and 7.9%, respectively.

Results in Table (1) showed that reducing sugars content of fresh carrot was 42.04% (on dry weight basis). This result is in the range of the data obtained by **Saad (1989)** and **Rizk (2003)** who found that reducing sugars content of fresh carrot were 34.86% and 45% (on dry weight basis), respectively. Also, in the same Table (1) results indicated that non-reducing sugars content was 24.04% (on dry weight basis). Such finding coincide with those obtained by **El-Nemr *et al.* (1995)** who found that non-reducing sugars content of fresh carrot was 23.65% (on dry weight basis).

Results in the same Table (1) showed that total sugars content of fresh carrot was 66.09% (on dry weight basis). This value was higher than those found by **Awad (1988)** and **Matuk *et al.* (1996)** for Chentenay variety who reported that total sugars of fresh carrot were 57.14% and 62.39% (on dry weight basis), respectively. These differences may be due to the differences in maturity stage and harvesting time.

Table (1) : Chemical composition of fresh carrot, apricot and mango purées (on dry weight basis).

Parameters \ Fruit type	Carrot (Chentenay)	Apricot (Hamawy)	Mango (Baladi)
Moisture %	91.39	84.02	80.77
T.S%	8.61	15.98	19.23
T.S.S%	7.8	13.9	16.4
Reducing sugars%	42.04	19.27	25.48
Non-reducing sugars%	24.04	44.56	49.87
Total sugars%	66.09	63.83	75.35
Ash%	4.41	5.22	3.15
Crude fiber%	6.09	7.19	6.29
Titratable acidity (as citric acid)%	1.61	12.33	2.74
pH value	5.7	3.2	3.9
Ascorbic acid (mg/100g)	188.04	90.76	206.36
Carotenoids (mg/100g)	60.74	19.4	14.50
Minerals (mg/100g)			
K	349	175.29	793.31
Ca	301.86	9.16	60.27
Na	49.59	8.96	687.27
Mg	11.46	14.53	65.14
Fe	3.45	8.14	3.3

Results in Table (1) showed that ash content of carrot was 4.41% (on dry weight basis). This result was higher than those reported by **Matuk *et al.* (1996)** and **El-Sayed (2000)** who found that ash content of carrot were 3.88% and 3.93% (on dry weight basis), respectively. While it was lower than those reported by **Bao and Chang (1994)** who found that it was 5.7% (on dry weight basis). This variation may be due to the variation in varieties and harvesting time.

Results in Table (1) indicated that crude fiber content of fresh carrot was 6.09% (on dry weight basis). This result is in the range of the data obtained by **Matuk *et al.* (1996)** and **Dyab (2003)** who reported that crude fiber content of fresh carrot were 5.71% and 7.58% (on dry weight basis), respectively .

Results in the same Table (1) indicated that total titratable acidity of fresh carrot was 1.61% (ascitric acid) (on dry weight basis). **El-Nemr *et al.* (1995) and Rizk (2003)** reported that titratable acidity of carrot (Chentenay Red Core variety) was 1.22 and 1.77% (as citric acid) (on dry weight basis), respectively. Also, results showed that pH value of fresh carrot was 5.7. This result is lower than those reported by **El-Gharably (1993)** and **Sanad (1991)** who reported that pH value of carrot juice was 5.8 and 6.35, respectively.

Results in the same Table (1) showed that ascorbic acid content of carrot was 188.04 mg/100g dry matter. This result is in the range of the data obtained by **El-Gharably (1993)** and **Rizk (2003)** who found that ascorbic acid content of fresh carrot were 314.33 and 92.31 mg/100g dry matter, respectively.

In the same Table (1) results showed that total carotenoids content of carrot was 60.74 mg/100g dry matter. This result is close with those obtained by **Della Monica and McDowell (1965)** and **Bao and Chang (1994)** Who reported that total carotenoids content of fresh carrot were 53.4 and 62.2 mg/100g dry matter, respectively.

Results in Table (1) showed that potassium was the predominant element. It was 349 mg/100g dry matter. **Shouk and Yassen (2000)** found that potassium content of carrot was 360 mg/100g dry matter. In the same Table (1) results indicated that calcium content of carrot was 301.86 mg/100g dry matter. **Matuk *et al.*, (1996)** and **Abou Arab and Abou Arab (2005)** found that calcium content of fresh carrot was 250 and 317.68 mg/100g dry matter, respectively. also, in the same Table (1) results showed that sodium and magnesium content of fresh carrot were 49.59 and 11.46 mg/100g dry matter, respectively. **El-Nemr *et al.* (1995)** reported that sodium and magnesium content of fresh carrot were 40.55 and 10.05 mg/100g dry matter, respectively. While, **Shouk and Yassen (2000)** reported that sodium and magnesium of fresh carrot were 65 and 14 mg/100g dry matter , respectively.

In the same Table(1) results showed that iron content of fresh carrot was 3.45 mg/100g dry matter. **Shouk and Yassen (2000)** found that iron content of fresh carrot was 3.8 mg/100g dry matter.

5.1.2. Chemical compositon of fresh apricot purée

Results in Table (1) indicated that moisture content of fresh apricot was 84.02%. this result was in accordance with those reported by **Hamed (1980)** and **El-Gharably *et al.* (2004)** who found that it was 83.84% and 84.5%, respectively. Data in Table(1) illustrated that total soluble

solids of fresh apricot was 13.9%.This result is in the range of the data reported by **El-Nemr *et al.* (1995)** and **Ahmed (1995)** who found that T.S.S. of apricot were 13% and 17%, respectively.

Results in Table (1) showed that reducing sugars content of fresh apricot was 19.27% (on dry weight basis). This result was in accordance with those reported by **Sanad (1991)** and **Dyab (2003)** who found that reducing sugars content of fresh apricot were 19.67 and 18.31% (on dry weight basis), respectively.

Results in the same Table (1) illustrated that non-reducing sugars content of fresh apricot was 44.56% (on dry weight basis). This result is higher than those obtained by **Ahmed (1995)** and **Hamed *et al.* (1999)** who found that non-reducing sugars content of fresh apricot were 40.02 and 39.88%(on dry weight basis), respectively.

Results in Table (1) showed that total sugars content of fresh apricot was 63.83% (on dry weight basis). This result is in the range of data reported by **Ahmed (1995)** and **Nagib *et al.* (2003)** who found that total sugars content of fresh apricot were 80.62 and 59.88% (on dry weight basis), respectively. this difference may be due to the difference in the variety.

Results in the same Table (1) indicated that ash content of apricot was 5.22% (on dry weight basis). **Sanad (1991)** and **Ahmed (1995)** found that ash content of fresh apricot was 5.47 and 4.74% (on dry weight basis), respectively.

Results in Table (1) showed that crude fiber content of apricot was 7.19% (on dry weight basis). **Bayoumy *et al.* (1990)** and **El-Gharably *et al.* (2004)** reported that

crude fiber of fresh apricot was 6.83 and 7.74% (on dry weight basis), respectively.

Results in Table (1) showed that titratable acidity of apricot was 12.33% (as citric acid) (on dry weight basis). **Ibrahim (1990), Hamed *et al.* (1999)** and **Ali (2000)** found that titratable acidity of apricot was 13.42, 11.92 and 12.30% (as citric acid) (on dry weight basis), respectively. Data in Table(1) indicated that pH value of fresh apricot was 3.2. This result is in agreement with the result reported by **Sanad (1991)** who found that pH value of apricot was 3.25.

Results in the same Table(1) showed that ascorbic acid content of fresh apricot was 90.76 mg/100g dry matter. **Rizk (2003)** reported that ascorbic acid content of fresh apricot was 92.31 mg/100g dry weight.

Results in the same Table (1) indicated that carotenoids content of apricot was 19.4 mg/100g dry matter. This result is lower than those reported by **Salem and Hegazi (1973)** and **Dyab (2003)** who found that total carotenoids content of fresh apricot was 23.40 and 25.76 mg/100g dry matter, respectively. This variation may be due to apricot cultivar.

Minerals content (potassium, calcium, sodium, magnesium and iron) of apricot were determined and results were tabulated in Table (1). These results showed that K, Ca and Mg content were 175.29, 9.16 and 14.53 mg/100g dry matter. **Dyab (2003)** found that potassium, calcium and magnesium content of fresh apricot were 160.65, 18.56 and 10.32 mg/100g dry matter, respectively. **Sanad (1991)** reported that calcium content of apricot was 7.5 mg/100g dry matter.

Results in Table (1) indicated that sodium content of apricot was 8.96 mg/100g dry matter. **Sanad (1991)** found that sodium content of fresh apricot was 10.23 mg/100g dry weight. Also, in the same Table (1) results showed that iron content of fresh apricot was 8.14 mg/100g dry matter. **El-Gharably *et al.* (2004)** reported that iron content of apricot was 7.74 mg/100g dry matter.

5.1.3. Chemical composition of fresh mango purée

Results in Table (1) illustrated that moisture content of mango fruit was 80.77%. **Zeid (1996)** and **Meky (1999)** found that moisture content of mango fruit was 80.9 and 79.06%, respectively. In Table(1) results indicated that T.S.S. of fresh mango was 16.4%. This result is in agreement with those reported by **Askar (1966)** and **El-Gharably *et al.* (2004)** who found that T.S.S. of mango (Baladi variety) was 16.3%.

Results in Table (1) illustrated that reducing sugars content of fresh mango was 25.48% (on dry weight basis). This result is in the range of the data obtained by **El-Mokadem (1999)** and **Abdou (2001)** who found that reducing sugars content of mango Alphonso variety ranged from 12.65 to 33.90% (on dry weight basis). These variations may be due to the mango variety.

In the same Table (1) results indicated that non-reducing sugars content was 49.87% (on dry weight basis). **Khalil (1962)** and **Meky (1999)** found that non-reducing sugars content of mango fruit (Baladi variety) was 52.08 and 44.41% (on dry weight basis), respectively.

Results in Table (1) showed that total sugars content of mango fruit was 75.35% (on dry weight basis). This result is in the range of data obtained by **Khalil (1962)** for

Baladi variety and **El-Mokadem (1999)** for Alphonso variety who found that total sugars content of mango fruit were 80.11 and 59.59% (on dry weight basis), respectively. This difference may be due to the difference in the variety.

Results in the same Table (1) showed that ash content of fresh mango was 3.15% (on dry weight basis). **Meky (1999)** and **El-Gharably *et al.* (2004)** reported that ash content of mango Baladi variety was 2.39 and 3.43% (on dry weight basis), respectively. These variations may be due to the difference in maturity stage , variety and harvesting time.

Results in Table (1) indicated that crude fiber content of fresh mango was 6.29% (on dry weight basis). **Abdou (2001)** found that crude fiber of mango Alphonso variety was 5.34% (on dry weight basis). This difference may be due to the difference in the variety.

Results in Table (1) showed that total titratable acidity content of mango (Baladi variety) was 2.74% (as citric acid) (on dry weight basis). **Khalifa (1983)** and **El-Gharably *et al.* (2004)** reported that titratable acidity (as citric acid) of mango fruit (Baladi variety) was 3.93 and 2.57% (on dry weight basis), respectively. Also, results showed that pH value of fresh mango was 3.9. This result is in good agreement with those reported by **Avena and Luh (1983)** and **El-Mokadem (1999**) who found that pH value of mango juice was 3.96 and 3.90, respectively. These differences may be due to the difference in the maturity stage and harvesting time.

Results in same Table (1) indicated that ascorbic acid content of fresh mango was 206.36 mg/100g dry weight. **Avena and Luh (1983)** and **El-Mokadem (1999)** found that ascorbic acid content of fresh mango Kent and

Alphonso variety was 221.36 and 359.78 mg/100g dry matter, respectively. These differences may be due to the difference in the variety.

Results in the same Table (1) showed that carotenoids content of fresh mango was 14.50 mg/100g dry matter. **Afifi (1995)** reported that total carotenoids content of mango fruit (Baladi variety) was 13.73 mg/100g dry matter.

Results in Table (1) showed that potassium was the predominant element. Data revealed that potassium content was 793.31 mg/100g dry matter. **Khalil (1962)** and **Anon (1993)** found that potassium content of mango ranged from 474.55 to 852.46 mg/100g dry matter.

Results in Table (1) indicated that calcium and iron content of mango were 60.27 and 3.3 mg/100g dry matter, respectively. These results were in accordance with those reported by **El-Gharably *et al.* (2004)** who found that calcium and iron content of mango were 62.86 and 3.43 mg/100g dry matter, respectively.

Results in Table (1) illustrated that sodium and magnesium content of mango were 697.27 and 65.14 mg/100g dry matter, respectively. **Khalil (1962)** and **Anon (1993)** reported that sodium and magnesium content of mango Baladi variety were 670.15 and 49.19 mg/100g dry matter, respectively.

Generally, it could be concluded from previous results that carrot purée is the highest in the moisture content and total carotenoids content, while mango is the lowest in both constituents. These results show that carrot can be considered as an excellent source of carotene which have been known as the pro-vitamin A for the human body.

In this concern, the carotene content of carrot provided about 174.33% of the human Recommended Daily Intake (RDI) per 100g fresh weight of carrot according to **Goldbohm-Alexandrat *et al.* (1998)** who mentioned that the mean intake of β-carotene was 3.0 mg/day for both men and women.

Also, it could be noticed that apricot purée is the highest in the total acidity, while the carrot is the lowest. Moreover, the mango purée is the highest in the total sugars and the ascorbic acid content while, apricot purée is the lowest. These results show that mango can be considered as an excellent source of vitamin C. It could be noticed that mango can provide the human body by 132.27% of the RDI per 100g fresh weight of mango by calculation as mentioned by **Latham (1979)** who estimated the acceptable daily intake of ascorbic acid to be 30 mg.

5.2. Moisture content, T.S.S and sulfur dioxide content of the carrot and apricot purées and their mixtures

Carrot and apricot purées and their mixtures were prepared using previous fresh carrot purée or fresh apricot purée or their mixtures and sucrose, sodium metabisulfite, CMC and starch gel mixture, citric acid and apricot synthetic aroma as described in table (2).

Results in Table (2) show moisture content, T.S.S and sulfur dioxide content of the carrot and apricot purées and their mixtures.

Results in Table (2) indicated that the moisture content of the prepared purées differed according to the carrot percentage. A decrease in the moisture content of all treated samples was observed when compared with carrot

Table(2): Moisture content , total soluble solids and sulfur dioxide content of apricot and carrot purées and their mixtures.

Treatments	Moisture content %	T.S.S%	SO_2 (p.p.m)
Apricot purée	69.80	22.4	1221
Carrot purée	75.15	17.2	1254
Cas	75.10	17.2	1246
25% of carrot	71.52	22.1	1207
33% of carrot	71.80	21.9	1215
40% of carrot	72.26	21.8	1213
50% of carrot	73.00	20.6	1239
60% of carrot	73.51	20.4	1247
67% of carrot	73.58	20.1	1230
75% of carrot	74.17	19.3	1232

Apricot purée=apricot purée+10%sucrose+0.2%sodium metabisulfite+ 1%CMC and starch gel(2:1).
Carrot purée=carrot purée+10%sucrose+0.2%sodium metabisulfite+0.2%citric acid+2%CMC and starch gel(2:1).
Cas=carrot purée+10%sucrose+0.2%sodium metabisulfite+0.2%citric acid+2%CMC and starch gel(2:1)+0.1%(v/v)apricot synthetic aroma.
25%of carrot=25%carrot purée+75%apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMCand starch gel(2:1).
33,40,50,60,67and75%of carrot=33,40,50,60,67and75%carrot purée+67,60,50,40,33 and25%apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).

puréee , the lowest moisture content was observed in the control apricot puréee then 25% of carrot, it was 69.80 and 71.5%, respectively. For mixture puréees the lowest decrease was in the puréees with high carrot percentage. This may be due to the high initial moisture content of fresh carrot 91.39%.

From data in Table (2) it could be noticed that T.S.S content in control carrot and apricot puréee were 17.2 and 22.4%, respectively. Different carrot percentage were found to have a slight effect on T.S.S of the samples, the T.S.S content decreased slightly by increasing the carrot percentage in the mixture puréees. The highest T.S.S content was 22.1% for the puréee contained 25% of carrot, while it was the lowest 19.3% for the puréee contained 75% of carrot.

Results in Table (2) indicated that different carrot puréee percentage has no effect on sulfur dioxide content of treated puréees. The SO_2 content ranged from 1207 to 1254 p.p.m.

5.3. Effect of drying process on chemical constituents of dehydrated sheets.

5.3.1. Moisture content

The moisture content is considered the most important factor which controls and regulates the deterioration of sensitive quality attributes in dried fruits. The main purpose of drying is to reduce the moisture content to a level that can prevent growth of microorganisms and causing food spoilage

The obtained data about the moisture content changes as affected by drying process are tabulated in Table (3). It could be noticed that drying process was capable to reduce the moisture content of dehydrated sheets produced from apricot and carrot purées or mixtures of them to between 14 and 16.15%. these levels of moisture are within the permitted range of the dried products in Egypt as reported by the **Egyptian Standards (1986)**, and in agreement with **Hamed (1980), Sanad (1991)** and **Tawfik (2001).**

5.3.2. Sugars content

Sugars content is one of the most important characters to be considered in determining the quality of the dried fruit products. The data of sugars content in the dried sheets of carrot and apricot are presented in Table (3).

From results in Table (3) it could be noticed that adding 10% sucrose to the carrot and apricot purées increased its content of total sugars content in all treatments. Total sugars content ranged from 75.53% to 79.95% in the dried sheets.

These results are in agreement with those reported by **Galal *et al.* (1989), Sanad (1991)** and **Tawfik (2001)** who stated that addition of sucrose to fruit juices before dehydration increased total sugars in the produced sheets.

5.3.3. Total acidity

Total acidity as citric acid of dried sheets as affected by drying process is shown in Table (3).

Results in Table (3) revealed that total acidity

of apricot puróee decreased after drying. Carrot and carrot puróee with synthetic aroma had an increament in its acidity after drying 1.75 and 1.73% (on dry weight basis), respectively. This is due to the addition of 0.2% citric acid to its puróees. Samples with more carrot percentage had a noticeable decrease in its total acidity content. This decrease is due to the low initial acidity of fresh carrot. These results are in agreement with those reported by **Nezam El-Din (1978)** and **Hassan (1995)** who reported that such decrease in acidity during drying process may be attributed to the utilization of these acids in hydrolysis of high molecular weight carbohydrates.

5.3.4. Ascorbic acid

From results in Table (3) it could be noticed that drying process had a severe effect on ascorbic acid since a pronounced decrease in its content was occurred in all samples. This decrease could be caused by the oxidization of ascorbic acid during drying as reported by **Galal *et al.* (1989)**. These results are in agreement with **Rizk (2003)** and **Piga *et al.* (2004)**.

The least decrease was found in the apricot sheet (39.6%) and the highest decrease was in the carrot sheet (77.7%). Furthermore, dehydration reduced the ascorbic acid content of carrot and apricot puróees by different rates depending upon the apricot puróee rate added to the carrot : apricot mixture. The more apricot puróee was added the least decrease was noticed between the carrot : apricot mixture sheets.

5.3.5. Carotenoids

The carotenoids are a group of yellow, orange and orange-red fat soluble pigments. Some of the carotenoids

are important in nutrition precursors for the synthesis of vitamin A in the body. One molecule of β-carotene is converted into two molecules of vitamin A **(Ranganna, 1977)**. Besides their pro-vitamin A activity, α- and β-carotene are considered to act as antioxidants in the diet and they may have important effects in cancer prevention and reduction of the risk of heart disease (**Graham *et al.* 1988).**

Results in Table (3) indicate that total carotenoids (as β-carotene) decreased sharply in all samples after drying. The total carotene content ranged between 10.65 and 29.64 mg/100g dry matter. These results are in agreement with those reported by **Tawfik (2001)**. The % decrease of total carotene in carrot sheets was higher than apricot sheet, it was found to be 51.2% for carrot sheet and 45.1% for apricot sheet. The decrease in total carotene may be due to the long period of dehydration or to some oxidation reactions as reported by **Morton and Weston (1988).**

Sheets with high carrot percentage had the high carotene content. This may be due to the high initial carotene of fresh carrot than apricot. **Sanad (1991)** reported that addition of 25% carrot juice to apricot juice to prepare a dried sheet caused an apparent increase in the β-carotene content.

5.3.6. Sulfur dioxide

The results of sulfur dioxide determination in the dried sheets are shown in Table (3). From these results it could be noticed that drying process had a great effect on sulfur dioxide content. In general, large quantities of SO_2 was lost during drying process of carrot and apricot purées. Such decrease was amounted to (52.36-57.06%) from the initial amount of SO_2 before drying. The residual

amount of SO2 after drying ranged between (529-586 p.p.m). These results agree with those reported by **Hamed (1980)** and **Tawfik (2001).**

5.4. Sensory evaluation of the dried sheets

Results in Table (4) showed that color scores of rehydrated carrot, apricot and mixture sheets prepared by adding 10% sucrose, 0.2% sodium metabisulfite, 1-2% CMC and starch gel (2:1) and 0.2% citric acid for carrot and carrot with apricot synthetic aroma were acceptable, results indicated that carrot and carrot with apricot synthetic aroma were higher than other rehydrated sheets . The same results in Table(4) showed that adding more carrot percentage to the mixture rehydrated sheets had a significant effect on the color of the sheets. It could be noticed that rehydrated sheets with 75% carrot puree was higher than that of rehydrated 25% carrot puree sheets. Meanwhile, rehydrated apricot sheet had the lowest color score when compared with other treatments.

Results in Table (4) indicated that taste scores of the rehydrated apricot sheets was higher than those of rehydrated carrot sheets (with and without apricot synthetic aroma). And that rehydrated carrot sheet with apricot synthetic aroma was significantly higher than carrot sheet. Results in Table(4) showed that adding more carrot puree percentage to the mixture rehydrated sheets had a significant effect on the taste of the sheets. Rehydrated sheet with 25% carrot purée had higher scores than 75% carrot purée.

With regard to odor of rehydrated carrot and apricot sheets results in Table (4) indicated that the highest odor scores were recorded for the rehydrated apricot sheet. And that rehydrated carrot sheet with apricot synthetic aroma

was significantly higher than carrot sheet. Results in Table (4)showed that rehydrated sheet with 25% carrot purée recorded higher scores than mixture sheets with higher carrot purée percentage.A significant difference was recorded between such treatment (25% carrot purée) and each 60, 67 and 75% carrot purée.

Results in Table (4) indicated that texture scores of the rehydrated apricot sheets was higher than rehydrated carrot sheets. But it could be noticed that rehydrated sheet with 25% carrot purée had higher scores than mixture sheets with higher carrot purée percentage. A significant difference was recorded between such treatment (25% carrot purée) and each 50, 60, 67 and 75% carrot purée.

Results in Table (4) indicated that overall acceptability scores of the rehydrated apricot sheet and 25,33, 40, 50 and 60% carrot purée were significantly superior to those of the rehydrated carrot,carrot with apricot synthetic aroma. Moreover, results showed that carrot with apricot synthetic aroma had significantly higher scores than carrot sheet. While, rehydrated sheet with 25% carrot purée was significantly higher than rehydrated carrot, carrot with apricot synthetic aroma and mixture sheets with higher carrot purée percentage (67% and 75% carrot purée).

5.5.Effect of storage on chemical constituents of the dried sheets

5.5.1. Moisture content :

Moisture gain or loss from dried foods during storage depends on moisture content of foods, package permeability and storage conditions such as temperature, relative humidity and storage period **(Labuza,1982).**

Results in Table (5) showed that extending storage time of dried carrot, apricot and carrot : apricot sheets to 9 months at room temperature was accompanied by a slight decrease in moisture content. This decrease in moisture content during storage was probably due to permeability of the package material as reported by **Ibrahim *et al.* (1990)** and **Abd El-Moitte (1996)** on dried plums and figs. From results in Table (5) it could be observed that the moisture content was 10.91and 14.17% for carrot and apricot sheets, respectively, and ranged between 11.74-13.34% for carrot : apricot sheets at the end of storage period. The percent decrease 12.2-22.4% was found to be of its original value at zero time of storage.

5.5.2 Sugars content

Changes in total sugars content during storage were determined at regular intervals (every 3 months) for the dried sheets. The data are presented in Table (6).

Results in Table (6) indicate that total sugars decreased slightly as the storage period increased. This decrease might be due to Millard reactions that took place between the reducing sugars and the total free amino acids during storage as reported by **Foda *et al*. (1972)** for apricot sheets and **Cañellas *et al*. (1993)** for risins. From results in Table (6) it could be noticed that the decrease in total sugars was 1.31, 0.39 and 1.06% for apricot, carrot and carrot with synthetic aroma, respectively. Also, the decrease in total sugars for carrot : apricot sheets ranged between 1.58 – 1.65%. These results are in conformity with those obtained by **Hamed *et al*. (1999)** on dried plum and apricot sheets and **Ali (2000)** on dried apricot and peach sheets.

After storage for 9 months apricot sheet recorded the lowest total sugars content while carrot sheet recorded the highest content. This may be due to the low initial total sugars of fresh apricot and the high initial total sugars of fresh carrot. By this reason mixture sheets with more carrot percentage had the highest total sugars, since 75% of carrot sheet had 77.69% of total sugars, while 25% of carrot sheet had 75.80% of total sugars at the end of storage period.

5.5.3 Total titratable acidity

Results in Table (7) show that storage of dried sheets at room temperature for 9 months was accompanied by a slight and gradual decrease in total titratable acidity (as citric acid) by 3.75 - 6.79% of its original value at zero time of storage .The decrease in total acidity may be attributed to the possibility of incorporation of organic acids or other acidic compounds in the browning reaction that naturally occurs during storage. These acids combine with nitrogenous or sugar fractions forming sugars mono-esters between sugars and organic acids especially malic acid. **(Reynolds, 1965; Hassan, 1995** and **Tawfik, 2001).** These results are in agreement with those reported by **Elewa (1982)** on dried apricot sheets, **Ali (2000)** on dried apricot and peach sheets and **Rizk (2003)** on dried prickly pear and carrot sheets.

The highest percentage of total acidity after storage for 9 months was for apricot sheet. While, the lowest percentage was for carrot and carrot with synthetic aroma. This may be due to the low initial total acidity of fresh carrot and the high initial total acidity of fresh apricot, by this reason it could be noticed that by increasing the carrot percentage in the mixture sheets the total acidity decrease. 25% of carrot sheet had the highest total acidity 7.61% as

citric acid, while 75%of carrot sheet had the lowest total acidity 3.81% as citric acid at the end of storage period.

5.5.4. Ascorbic acid

Results in Table (8) declared that ascorbic acid content of dried sheets decreased during storage period (9 months) by 34.74, 35.96 and 36% for apricot, carrot and carrot with synthetic aroma sheets, respectively. Also, it could be noticed that ascorbic acid content of carrot: apricot sheets decrement ranged between 35.16 - 45.37%. The interpretation of these results may agree with **Khan *et al*. (1994)** who stated that the reduction of ascorbic acid could be due to its complete oxidation and /or its changing into dehydroascorbic acid.

These results are in accordance with those reported by **Matuk *et al.* (1997), Ali (2000)** and **Rizk (2003).**

The highest ascorbic acid content was in the apricot sheet 35.79 mg/100mg at the end of storage time, while the 75% of carrot sheet represented the lowest ascorbic acid content it reached 18.95mg/100g.

5.5.5. Total carotenoids content

The storage period for 9 months at room temperature effect on the total carotenoids content of apricot, carrot and their mixture sheets and results are presented in Table (9).

Results in Table (9) appeared some degradation in total carotenoids of all dried samples during storage. Total carotenoids content of dried sheets at the end of storage time ranged between 6.61 and 24.19 mg/100g. This degradation could be attributed to some oxidation reaction

cell wall by Pectinase action, thus cellulose microfiberlils are liberated and exposed to cellulase action **(Voragen *et al.*, 1980).**

Viscosity of all investigated mango purées recorded sharp decrements. Results presented in Fig. (6) showed the viscosity of the untreated mango purée and that treated with Pectinex, Cellubrix and Pectinex + Cellubrix enzymes. It could be noticed that viscosity of the untreated mango purée was higher than the enzyme treated ones (148.1 cp.) while viscosity of mango purée treated with Pectinex was lower than those of the other treatments (41.6 cp.). However, viscosity of mango purée treated with Pectinex + Cellubrix and Cellubrix enzymes were 43.9 and 58.9 cp., respectively. These results are in accordance with those reported by **Struebi *et al.* (1978)** who stated that since the apparent viscosity of the apple pulp continued to drop during Irgazyme M-10 enzyme treatment, it appears that solublized pectin fractions which contribute to the viscosity were degraded. **Al-Hooti *et al.* (2002)** found that there was almost 100% reduction in viscosity values among all date pulp samples treated by pectinase/cellulase enzyme preparations.

5.6.4.	**Effect of enzymatic treatment on β-carotene content of carrot and mango purées**

The effect of enzymatic treatments with Pectinex Ultra SPL, Cellubrix L and Pectinex + Cellubrix on β-carotene content of carrot and mango purées were determined using HPLC technique and the data was tabulated in Table (15) and Fig.(7and8).

Results in Table (15) indicated that an increase in β-carotene content was recorded as a result of enzyme

treatments of carrot and mango purées. These results are in

of carotenoids by oxygen during storage as reported by **Morton and Weston (1988)**. From results in Table (9) it could be concluded that carotenoids content decreased by 18.39 and 37.93% for carrot and apricot sheets ,respectively, and ranged between 17.06 - 25.83% for carrot : apricot sheets. These results are in agreement with those reported by **Hamed (1980)** and **Tawfik (2001**)

The apricot sheet had the lowest carotene content it was 6.61mg/100g at the end of storage time, while carrot sheet had the highest carotene content (24.19mg/100g). This may be due to that fresh carrot had a higher initial total carotene content than fresh apricot. It could be noticed that by increasing the carrot percentage added to the mixture sheets the total carotene content will increase.In this concern, it could be noticed that the 75% of carrot sheet contains the highest carotene content in the mixture sheets (19.79%), while the 25%of carrot sheet had the lowest carotene content (12.06%) at the end of storage period.

5.5.6. Sulfur dioxide content

Sulfur dioxide is considered to be one of the most important factors that affects quality attributes and prevents color and quality deterioration of the dried fruit products **(Ponting *et al.* 1973)**. Residual sulfur dioxide in dried apricot and carrot sheets were determined during storage period and the obtained data were tabulated in Table (10) .

Results in Table (10) illustrated that the residual amount of sulfur dioxide in the dried sheets was highly diminished by storage at room temperature for 9 months. The loss of SO_2 in the dried sheets reached 60.50 and 54.47% in apricot and carrot sheets, respectively and ranged between 48.81-62.38% in carrot : apricot sheets

.These losses could be due to the permeability of polyethylene pouches to the oxygen which causes high loss in SO_2 as reported by **Davis *et al.* (1973)** who stated that headspace oxygen contributes to the loss of SO2 from packaged dried fruits. The losses in SO_2 are in agreement with those reported by **Zhao and chang (1995)** and **Masoud (1998)**. Moreover, **Hamed (1980)** and **Tawfik (2001)** found that the loss of sulfur dioxide in dried apricot ranged between 59.6 % and 70%.

The residual sulfur dioxide was slightly high in the 67% of carrot sheet it reached 300 p.p.m., while it was 199 p.p.m. in the 75% of carrot sheet which represented the lowest residual of SO_2 .

5.5.7 Color

The increase in optical density (O.D) is a real indication of deterioration of color and development of browning. The effect of storage period on the color (measured at 420 nm as optical density) of dried apricot and carrot sheets was determined and the results were tabulated in Table (11).

Results in Table (11) show that the optical density (O.D) of dried sheets increased gradually during storage. Whereas, the values of optical density in dried sheets at zero time of storage ranged between 0.134-0.199. While, during storage up to 9 months the O.D values increased and ranged between 0.233-0.271.These results are in confermity with those reported by **(Aguilera *et al.* 1987 ; Sanad ,1991** and **Ali , 2000).**

The data show that the 50% of carrot sheet was the ligher sample in color which recorded the lowest value of

O.D 0.233, while apricot sheet had the highest reading of O.D 0.271. Such increase in O.D of the dried sheets during storage at room temperature is a real indication of deterioration of color which may be due to the development of browning reaction as reported by **Labuza(1973).**

5.5.8. Rehydration ratio

The rehydration ratio of dried sheets was determined every 3 months during storage period (9 months) and the data are presented in Table (12).

Result in Table (12) showed that rehydration ratio of all dried sheets increased gradually as the storage period increase up to 9 months. The rehydration ratio was 1.97,1.63 and 1.60 for apricot , carrot and carrot with synthetic aroma sheets, respectively at zero time of storage period , subtending by 2.20, 1.79 and 1.72 at the end of storage period . As for carrot : apricot sheets the rehydration ratio ranged between (1.70 - 1.87) at zero time of storage period, subtending by (1.91 - 2.14) at the end of storage period. These results are in accordance with those reported by **Hassan (1995)** and **Tawfik (2001)**.

The apricot sheet had more tendency to absorb than other sheets it reached 2.20 then the 25% of carrot representing 2.14, while carrot with synthetic aroma sheet had the lowest rehydration ratio 1.72 at the end of storage period.

Generally, it could be concluded that addition of different carrot purée percentage to the mixture of apricot purée, sucrose, CMC, starch gel, citric acid and sodium metabisulfite resulted in an improvement in some physical, chemical and sensorial properties of the produced dehydrated sheets.

5.6.Enzymatic treatment of carrot and mango purées

The addition of depectinizing enzymes reduces the viscosity by hydrolyzing the soluble pectin and causing the electrostatic charges of particles in suspension to neutralize. This causes the insoluble solids in the juice to agglomerate and sediment. Filtration becomes much easier to accomplish and the juice can be further concentrated without gel or precipitates forming. **(Faigh, 1995)**

The combination of suitable cellulase with maceration enzyme (pectic enzymes) results in a pronounced digestion of the fruit tissue high-molecular-weight pectin which functions as a "cement" substance between the cells, is attacked and dissolved. **(Urlaub, 1992).**

5.6.1. Effect of enzymatic treatments on some characteristics of carrot and mango purées

Carrot and mango purées were incubated with (350 and 250 p.p.m), respectively, of Pectinex Ultra SPL, Cellubrix and a mixture of both enzymes for 120 min. at 40ºC Fig. (1 and 2). The resultants of these treatments were investigated and the data was tabulated in Table (13).

Results in Table (13) indicated that total soluble solids (T.S.S) content as a result of enzymatic treatment increased. Total soluble solids of mango purée increased from 16.10% for untreated purée to 19.40, 18.40 and 19.43% after enzymatic treatments by Pectinex SPL, Cellubrix and Pectinex + Cellubrix, respectively. Also, total soluble solids of carrot purée increased from 7.30 to 8.00,

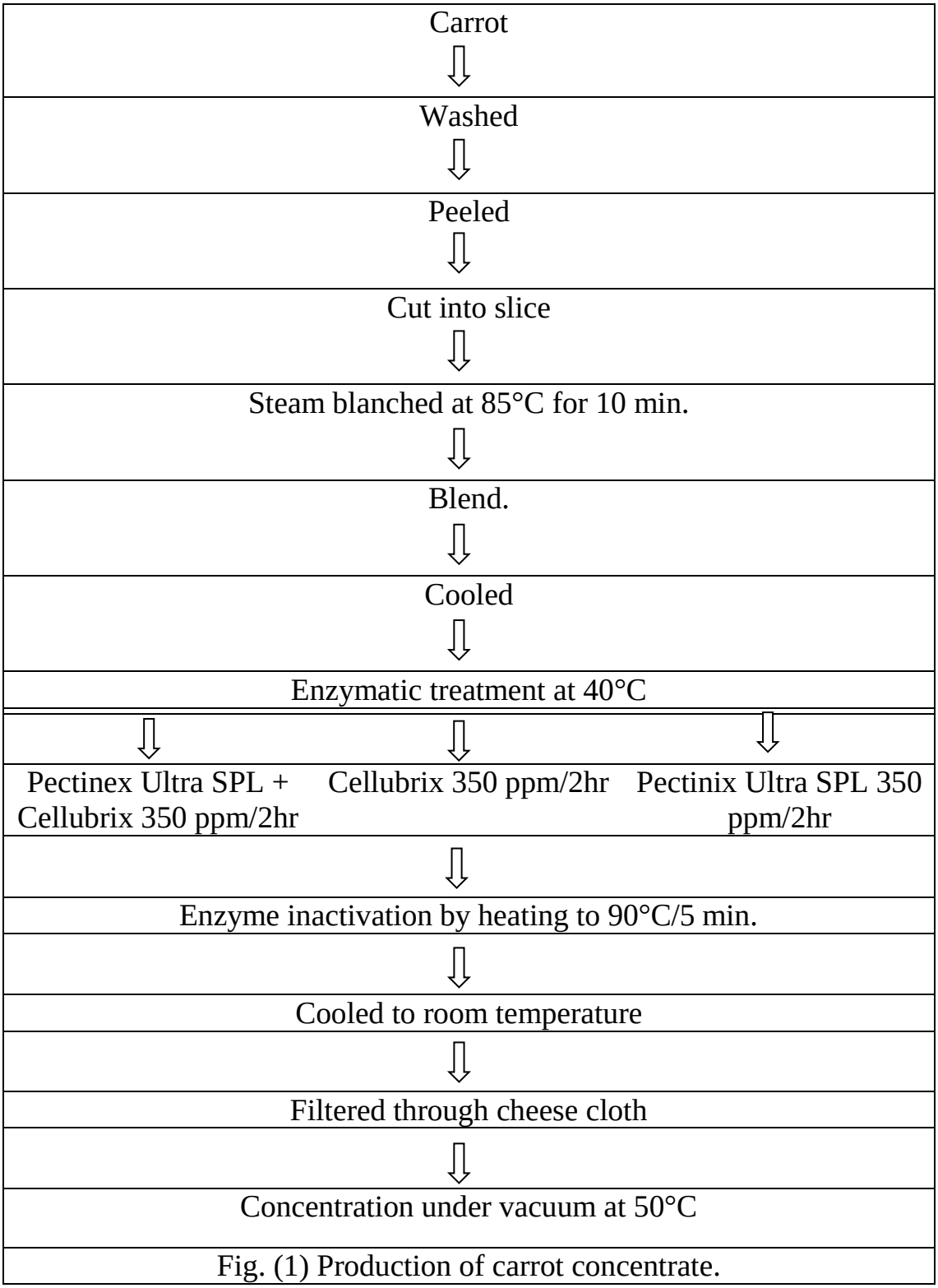


Fig. (1) Production of carrot concentrate.

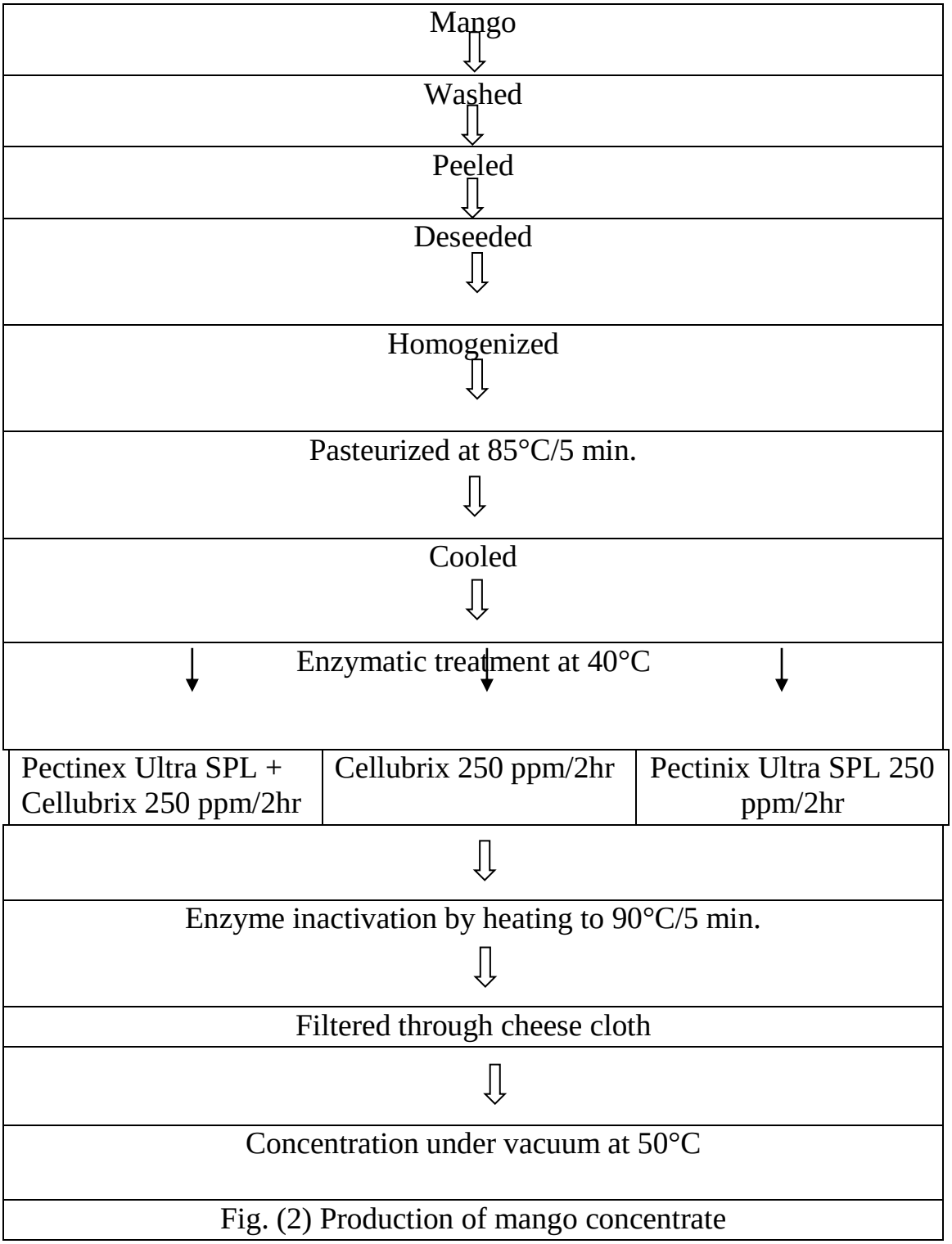


Fig. (2) Production of mango concentrate

7.80 and 8.00% for untreated, Pectinex, Cellubrix and Pectinex + Cellubrix enzymes treated carrot puróee, respectively.

These results are in agreement with those reported by **El-Zoghbi *et al.* (1992)** who stated that the total soluble solids of enzyme treated guava puróee were higher than the untreated puróee. The increase may be due to conversion of insoluble pectin by pectinolytic enzymes, and the action of arabinase and cellulase on araban and cellulose to produce the soluble sugars : arabinose and cellubiose. **Habiba (2001)** reported that T.S.S of carrot juice prepared from enzyme treated carrots by Citrozym and Pectinol were slightly increased.

Data in the same Table (13) showed high increment in the total acidity (as citric acid) of enzyme treated carrot and mango puróees. Total acidity of untreated carrot puróee increased from 0.19 to 0.27, 0.20 and 0.27% after enzymatic treatment by Pectinex, Cellubrix and Pectinex + Cellubrix, respectively. Moreover, total acidity of mango puróee increased from 0.54 to 0.94, 0.75 and 0.85% for untreated, Pectinex, Cellubrix and Pectinex + Cellubrix treated mango puróee, respectively. Also, the pH values decreased in all enzyme treatments, it was 5.75 for untreated carrot pureóe and decreased to 5.40, 5.60 and 5.40 for Pectinex, Cellubrix and Pectinex + Cellubrix treated carrot puróee, the same trend was observed in the mango pureóe, the pH value decreased from 3.80 in untreated mango puróee to 3.75, 3.75 and 3.80 in Pectinex, Cellubrix and Pectinex + Cellubrix treated puróee, respectively. These results are in accordance with those reported by **Foda *et al.* (1985)** for carrot puróee and **Chang *et al.* (1994)** for plum juice. The increament in total acidity may be due to the release of carboxyl groups and

galacturonic acid from pectic substances **(El-Zoghbi *et al.*, 1992)**.

The enzyme treatments with Pectinex and Pectinex + Cellubrix slightly decreased the ascorbic acid content of carrot puróee after treatment from 10.36mg/100g in untreated carrot puróee to 10.01, 9.19 and 10.00 mg/100g, respectively. Also, ascorbic acid content of mango puróee decreased from 19.47mg/100g in untreated mango puróee to 19.01, 19.13 and 19.13 mg/100g for mango pureóe treated with Pectinex Ultra SPL, Cellubrix and Pectinex + Celubrix, respectively. These results are in agreement with those reported by **Crandall *et al.* (1987)** and **Siliha *et al.* (1994)** who stated that the control sample of banana puróee and orange juice had slightly higher vitamin C content than pectic enzymes treated ones. The decrease of ascorbic acid content may by due to the oxidation process which was rapid when the enzymes breakdown the cell wall **(Meky, 1999).**

From results in Table (13) it could be observed that enzymatic treatments affected the color of carrot and mango puróees.

Results in Table (13) indicated that the color of carrot puróee increased from 0.142 in untreated sample to 0.166, 0.149 and 0.159 after enzymatic treatment by Pectinex, Cellubrix and Pectinex + Cellubrix, respectively. Moreover, the color of mango puróee increased from 0.107 in untreated one to 0.178, 0.156 and 0.172 for Pectinex, Cellubrix and Pectinex + Cellubrix treated puróees, respectively. These results are in accordance with those reported by **Crandall *et al.* (1986)** who stated that absorbance at 420nm for the 0, 70 and 350 p.p.m pectic enzyme treated orange juice were 0.174, 0.168 and 0.185, respectively. **Sims *et al.* (1993)** reported that carrot juice

color increased by a commercial pectinase/hemicellulase preparation. **Neubeck (1975)** studied the extraction of red grape juice from the pectin-rich Concord grape by the enzymatic process, and found that the better release of anthocyanins of red fruits into the juice, achieved by cell wall destruction, is another advantage of the pulp enzyme process. **Sreenath and Santhanam (1992)** investigated the usefulness of pectinase and cellulase enzymes treatment of some fruit pulps, particularly blue grapes and found that the color was pleasant due to increased extraction of anthocyanins.

5.6.2. Effect of enzymatic treatment on sugar fraction of carrot and mango purées

Sugar fractions of carrot and mango purées, control and enzyme treated purées, which determined by HPLC are given in Table (14) and Fig. (3 and 4). Sucrose was found to be the major sugar in carrot and mango untreated and enzyme treated samples. It represented 7.93, 5.24, 4.91 and 5.16% in untreated, Pectinex, Cellubrix and Pectinex + Cellubrix treated carrot purées, respectively. Moreover, Sucrose represents 9.13, 6.42, 4.42 and 5.06% in untreated, Pectinex, Cellubrix and Pectinex + Cellubrix treated mango purée, respectively.

The percentage of fructose was 1.29, 1.49, 1.35 and 1.46% in the untreated, Pectinex, Cellubrix and Pectinex + Cellubrix treated carrot purée, respectively. While, it represented 1.27, 1.85, 1.71 and 1.67% in untreated, Pectinex, Cellubrix and Pectinex + Cellubrix enzyme treated mango purée, respectively.

Results in Table (14) showed that glucose content of carrot purée represented 1.26, 1.91, 1.46 and 1.58% in untreated, Pectinex, Cellubrix and Pectinex + Cellubrix

treated purées, respectively. On the other hand, glucose represented 0.94, 0.98, 0.95 and 0.96% in untreated,

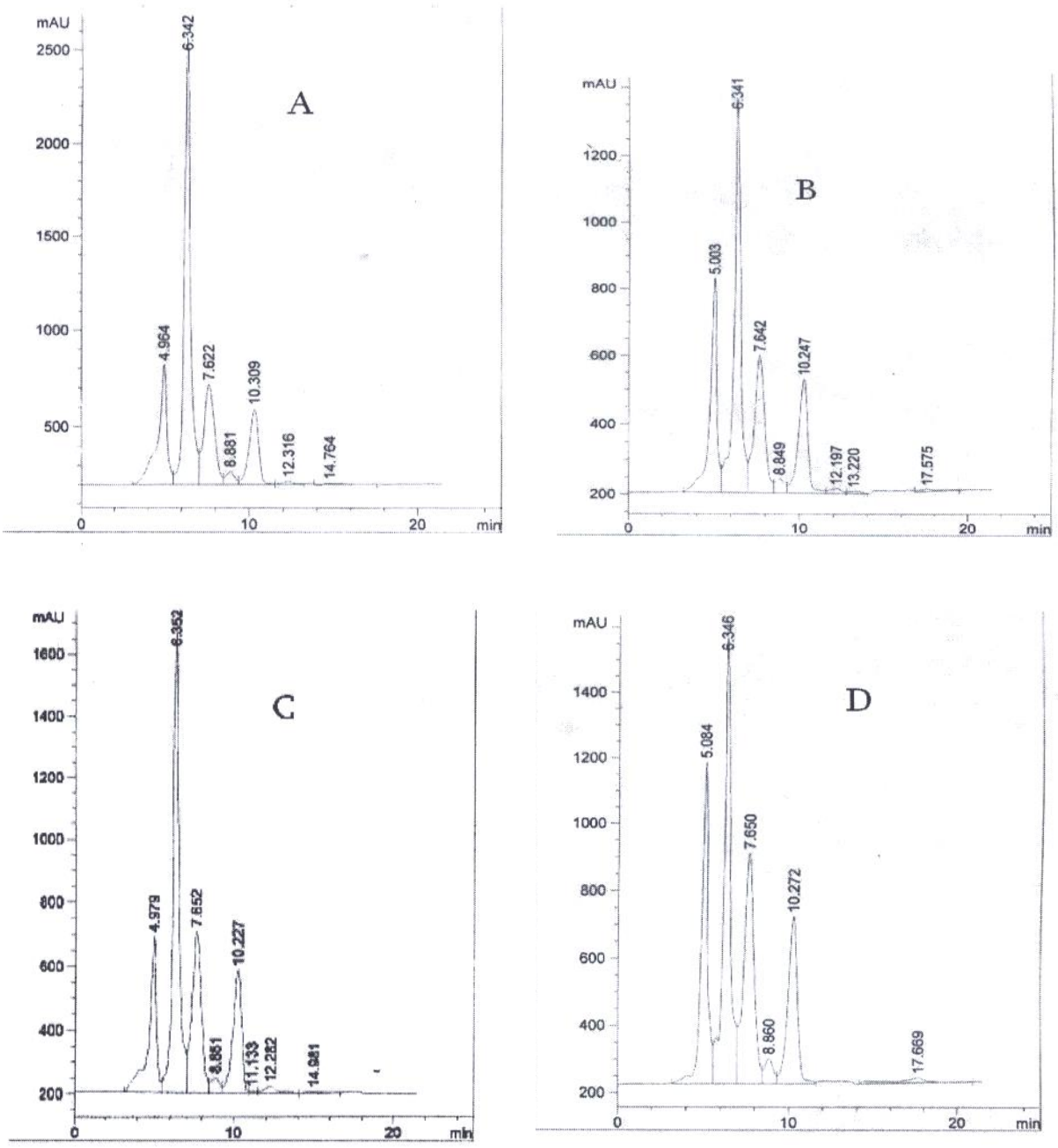
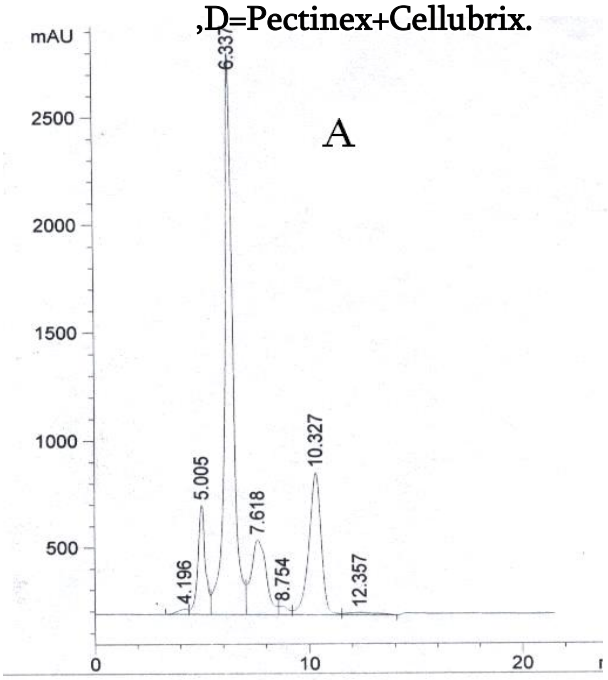
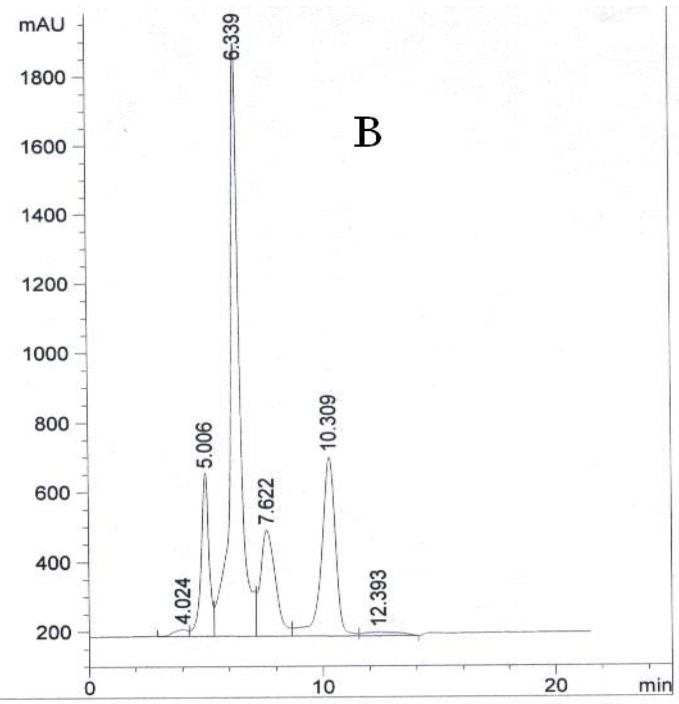
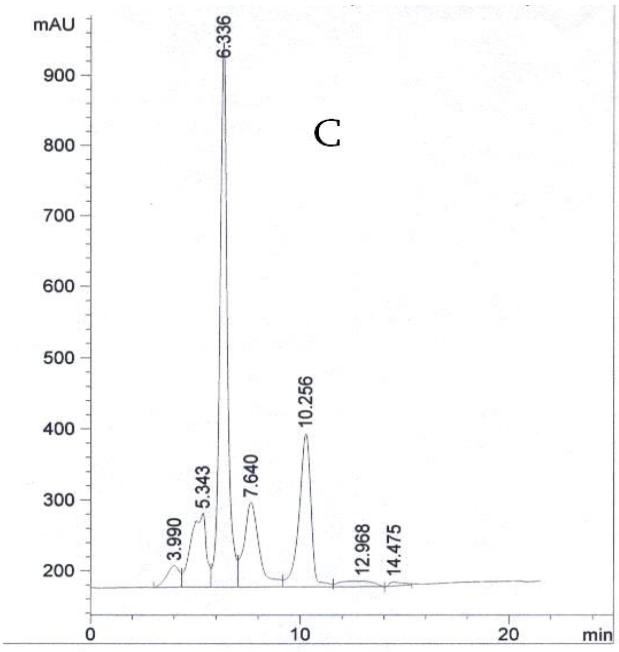


Fig (3) High Performance Liquid Chromatograms of sugar

fractions of carrot puree prepared from enzymaticaly treated puree :A=control,B=Pectinex Ultra SPL ,C=Cellubrix ,D=Pectinex+Cellubrix.







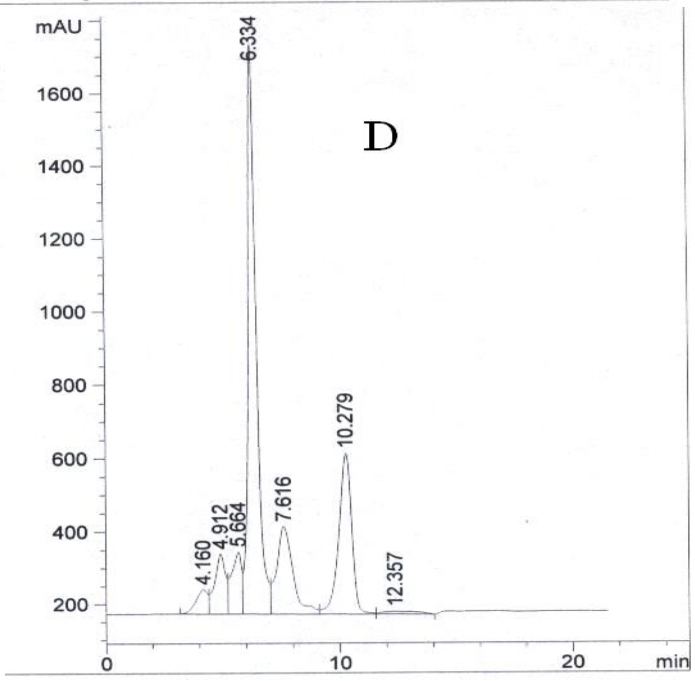


Fig.(4) High Performance Liquid Chromatograms of sugar fractions of mango puree prepared from enzymaticaly treated puree:A=control,B=Pectinex Ultra SPL ,C=Cellubrix ,D=Pectinex+Cellubrix

Pectinex, Cellubrix and Pectinex + Cellubrix treated mango puree, respectively. These results are in accordance with those reported by **Siliha *et al.* (1995)** who found that considerable amount of glucose, which is mainly contributed by cellulose, was released from cell walls by Rohament K compared to Pectinex Ultra SPL. **Grassin (1992)** reported that enzymatic liquefaction of fruits and vegetables consists of a hydrolysis of cell wall polysaccharides and insoluble material, thus forming soluble components of a lower molecular weight, aromatic components and colored pigments.

From the same Table (14) it could be noticed that galactose was not detected in all mango puree samples, untreated and enzyme treated ones. While, galactose represented the lowest percentage of sugars in the untreated and enzyme treated carrot puree, it represented 0.13, 0.18, 0.19 and 0.19% in the untreated, Pectinex, Cellubrix Pectinex + Cellubrix treated carrot puree, respectively .

5.6.3. Effect of enzymatic treatment on viscosity of carrot and mango purees

The effect of enzymatic treatments by Pectinex Ultra SPL, Cellubrix and Pectinex + Cellubrix on the viscosity of carrot and mango purees are shown in Fig. (5 and 6).

From Fig (5) it could be noticed that the viscosity of untreated carrot puree recorded high value of viscosity (1.47 cp.) followed by carrot puree treated with Cellubrix and Pectinex + Cellubrix enzymes (1.40 and 1.24 centipoise, respectively.). While, viscosity of carrot puree treated by Pectinex Ultra SPL recorded the lowest value of

viscosity (1.11 cp.). These enzymes decrease viscosity wherever they hydrolyze the high molecular weight chains to low molecular weight chains. Pectin is removed from

was 0.24 and 0.69 % as citric acid, respectively. On the other hand, total acidity of carrot and mango concentrates produced by Pectinex was higher than other treatments it represented 0.42 and 1.20 as citric acid, respectively. This increament in total acidity may be due to the release of carboxyl and galacturonic acid from pectic substances of carrot and mango purées during the enzymatic treatment as reported by **(El-Zoghbi *et al.*, 1992).** These results are in accordance with those reported by **EL–Gharably (2000)** who stated that the total acidity of Pectinex enzyme treated peach juice concentrate was higher than that of control .

In assessing the ascorbic acid in carrot and mango concentrates, results in Table (16) indicated an increment in all carrot and mango concentrates untreated and treated ones when compared with unconcentrated samples in Table (13). These results are in accordance with those reported by **Abd El–Latif *et al.* (2000)** for pomegranate concentrate. Ascorbic acid content of the control carrot and mango concentrates was higher than the enzyme treated ones it was 51.60 and 38.08 mg/100g for untreated samples, respectively. While it represented 49.70, 47.93 and 48.54mg/100g for Pectinex, Cellubrix and Pectinex + Cellubrix carrot puree concentrates. Also, ascorbic acid content was 31.80, 30.15 and 30.97 mg/100g for Pectinex, Cellubrix and Pectinex + Cellubrix treated mango purée concentrates. These results are in agreement with those reported by **Meky (1999)**. This may be due to the action of enzymes on the cell wall and the release of ascorbic acid and as a result of this the probability of the oxidation of ascorbic acid increases .

Color, which measured as optical density (O.D) at 420nm of the untreated and treated carrot and mango concentrates are tabulated in Table (16).

Form these results it could be noticed that (O.D) values of carrot and mango untreated and enzyme treated concentrates increased by concentration. These results are in agreement with those reported by **Fellows (2000)**. Untreated carrot and mango concentrates had lower (O.D) values than those concentrates produced by enzymatic treatments it was 0.157 and 0.130 for untreated samples, respectively. On the other hand it represented 0.175, 0.163 and 0.171 for Pectinex , Cellubrix and Pectinex + Cellubrix treated carrot purée concentrates, respectively. For mango puree concentrates (O.D) values reached 0.189 , 0.172 and 0.182 for Pectinex, Cellubrix and Pectinex + Cellubrix treated ones , respectively. These results are in agreement with those reported by **EL-Gharably (2000)** who stated that treated tomato juice concentrates showed higher browning value than did the control. This increase in non enzymatic browning could be attributed to the release of mono– saccharides by enzyme action on the cell wall polysaccharides which reacted with free amino groups (Millard Reaction) **(Meky,1999).**

5.7.2. Rate of increasing T.S.S. during concentration of carrot and mango purées.

5.7.2.1. Concentration of carrot purée .

Results presented in fig (9) showed the rate of increasing T.S.S during concentration of carrot purée by vacuum evaporation. The data indicated that carrot purée formerly treated with Pectinex Ultra SPL enzyme had the highest rate followed by carrot purée treated with Pectinex + Cellubrix enzymes. While the untreated carrot purée (control) had the lowest rate. After 120 min the total soluble solids of the untreated carrot purée and that treated with Pectinex Ultra SPL, Cellubrix and Pectinex + Cellubrix

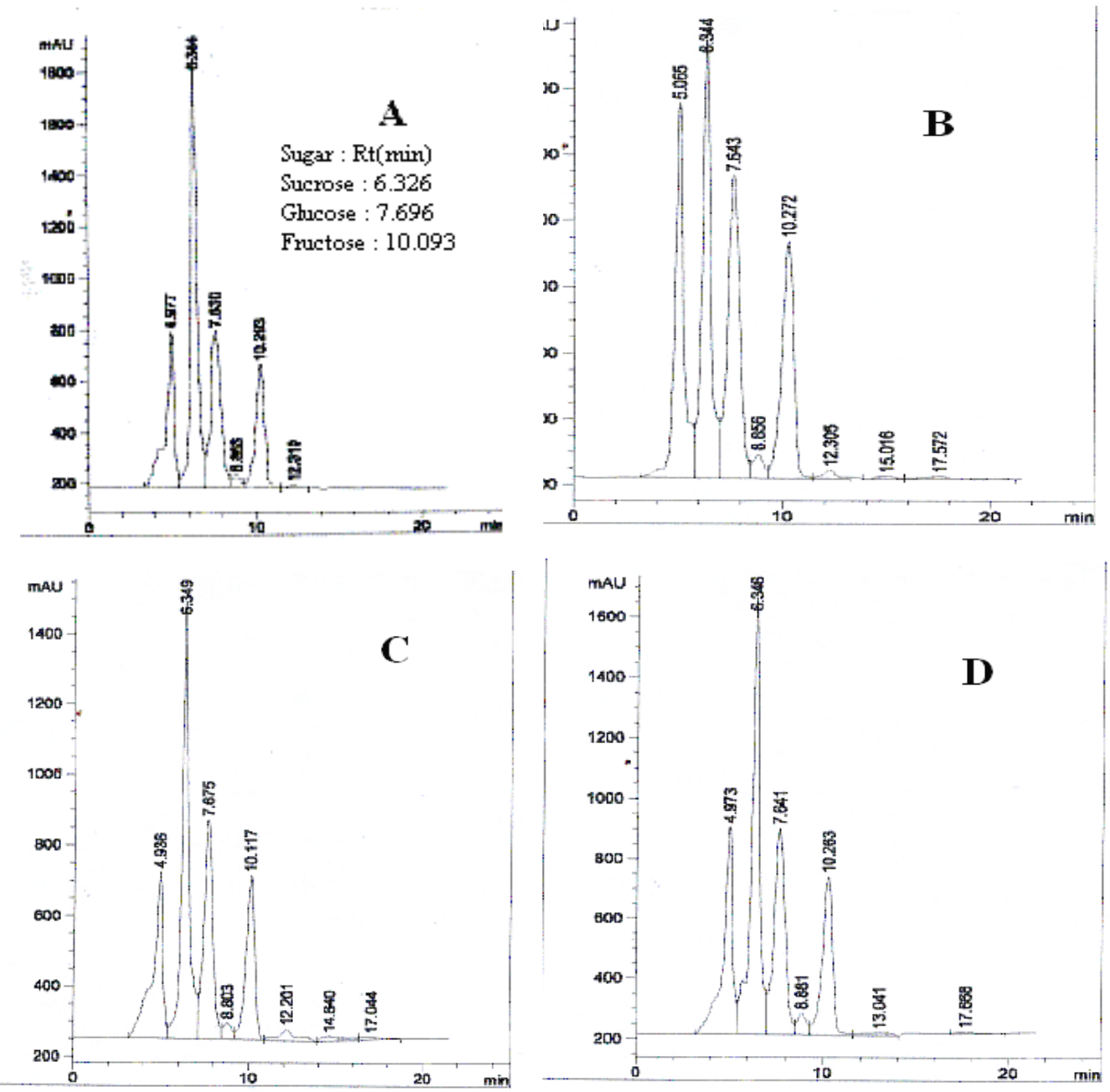


Fig.(11) High Performance Liquid Chromatograms of sugar fractions of carrot concentrates prepared from enzymaticaly treated puree: A= control, B= Pectinex Ultra SPL, C= Cellubrix L. , D= Pectinex+Cellubrix.

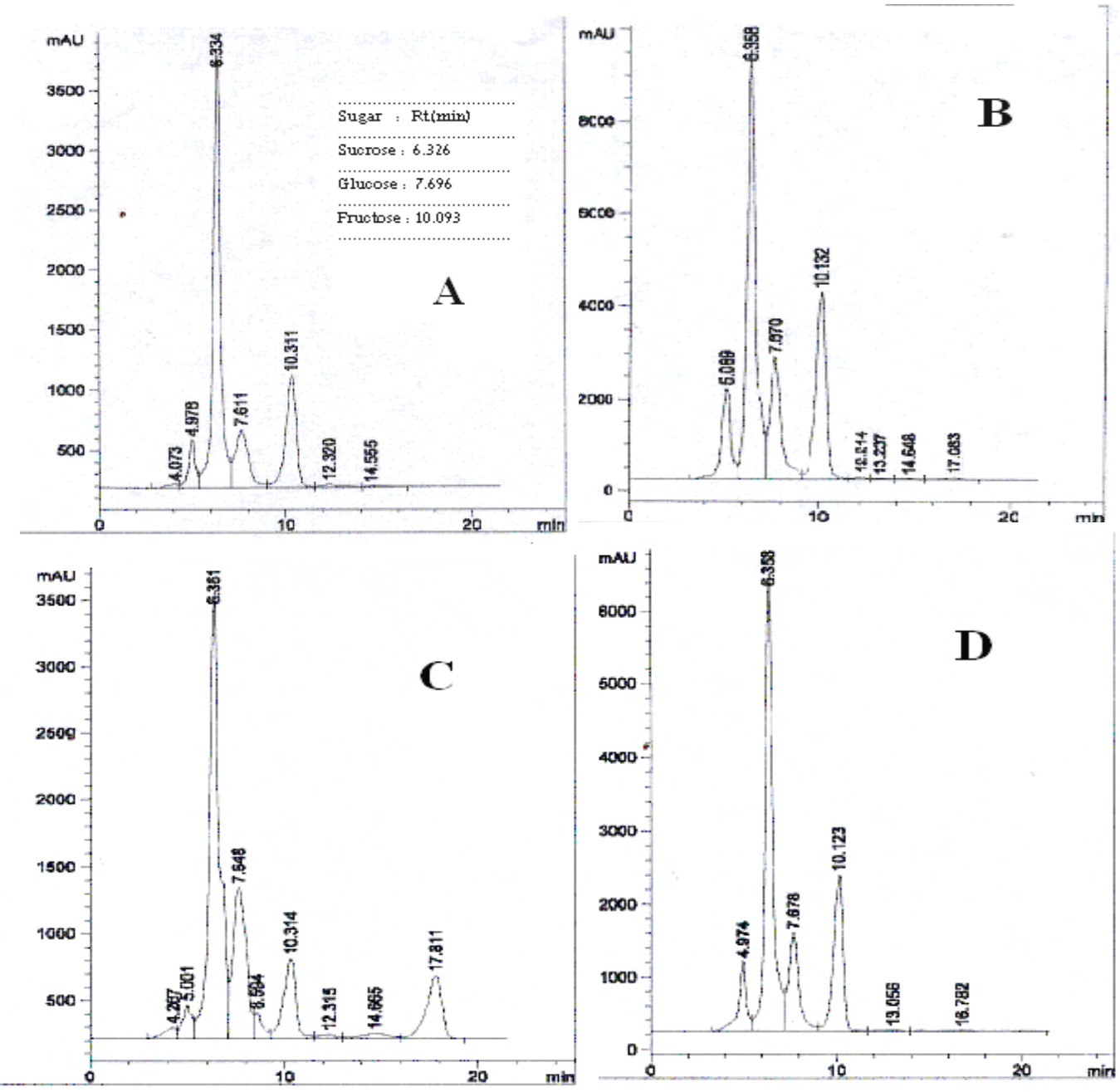


Fig.(12) High Performance Liquid Chromatograms of sugar fractions of mango concentrates prepared from enzymaticaly treated purée: A= control , B = Pectinex Ultra SPL ,C =Cellubrix , D = Pectinex+ Cellubrix.

using HPLC. Data in Table (17) showed that sucrose was found to be the major sugar in carrot and mango concentrates of untreated and enzyme treated purées. It represented 20.27, 15.58, 12.12 and 15.11 % in the untreated, Pectinex , Cellubrix and Pectinex + Cellubrix treated carrot purée concentrates. While represented 12.68, 14.62, 10.86 and 11.45% in the untreated mango purée concentrates, Pectinex, Cellubrix and Pectinex + Cellubrix treated mango purée concentrates .

Results in Table (17) showed that fructose content of carrot concentrates was 5.69, 7.11, 5.76 and 6.69% in untreated, Pectinex Ultra SPL, Cellubrix L and Pectinex + Cellubrix treated carrot purée concentrates. On the other hand, fructose represented 2.16 , 2.37 , 2.31 and 2.13 % in untreated mango purée, Pectinex, Cellubrix and Pectinex + Cellubrix treated mango purée concentrates, respectively .

Glucose percentage of untreated carrot puree concentrate , Pectinex Ultra SPL, Cellubrix L and Pectinex + Cellubrix treated carrot purée concentrates represented 5.18, 5.98, 4.12 and 4.16 % , respectively. While , glucose percentage was 1.29 , 1.41 , 1.39 and 1.40 % in untreated, Pectinex ultra SPL, Cellubrix and Pectinx + Cellubrix treated mango purée concentrates, respectively .

From the same table it was found that galactose was not detected in mango concentrates untreated or enzyme treated as this sugar was not detected in mango purées untreated or enzyme treated. However, galactose represented 0.32, 0.39, 0.33 and 0.36% in untreated ,Pectinex Ultra SPL, Cellubrix L and Pectinex + Cellubrix treated carrot purée concentrates , respectively .

From previous results, it could be noticed that untreated carrot and mango purée concentrates recorded higher

percentage in sucrose, than treated concentrates. This may be a result of the enzyme treatment of carrot and mango purees before concentration. While, fructose was higher in the Pectinex and Cellubrix treated carrot and mango purée concentrates than the untreated purée concentrates. Glucose was higher in the treated mango purée concentrates. The increment in reducing sugars is due to the depolymerization of pectin, cellulose, hemicellulose and starch **(Siliha *et al.*, 1994).**

5.7.4. Sensory evaluation of reconstituted carrot and mango concentrates

Tables (18 and 19) showed the sensory evaluation for color, taste, odor, mouth feel and overall acceptability of the reconstituted carrot and mango concentrates prepared from untreated and enzymaticaly treated carrot and mango purées.

Results in Table (18)indicated that color scores of the reconstituted carrot concentrate prepared from Pectinex and Pectinex+ Cellubrix treated carrot purée was significantly higher than untreated (control), Cellubrix and followed by untreated purées reconstituted concentrates.

Results in Table (18) illustrated that the highest taste scores were recorded for the Pectinex and Pectinex + Cellubrix trearted carrot purée reconstituted concentrate, followed by Cellubrix and control purées reconstituted concentrates.

Results in Table (18) showed that odor scores of the reconstituted carrot concentrate from enzyme treated carrot purée concentrates was higher than untreated (control), Cellubrix and Pectinex + Cellubrix treated purées

6.Summary

This study was carried out to produce an improved dehydrated sheets from carrot and apricot blends characterized by long shelf-life and high qualities and the utilization of synthetic apricot aroma in the production of the sheets instead of the natural apricot puree.

Also, to produce an improved mango and carrot concentrates with special reference to good physical, chemical and sensorial properties using commercial enzymes to reduce the viscosity of mango and carrot purées to facilitate the concentration process and to achieve the highest Brix.

Results could be summarized as follows:-

1-Results indicated that carrot purée was the highest in the moisture content and total carotenoids, while mango was the lowest in both constituents. Also, it could be observed that apricot purée was the highest in the total acidity, while carrot was the lowest. Mango purée was the highest in the total sugars and ascorbic acid content, while apricot purée was the lowest.

2- Results showed that moisture contents of carrot and apricot purées were 91.39 and 84.02%, respectively. It decreased to be 14 and 16.15% in

dried apricot and carrot sheets after the addition of 10% sucrose, 0.2% sodium metabisulfite and 1-2% CMC and starch gel(2:1).

3- Results illustrated that total sugars content increased by the addition of 10% sucrose. Ascorbic acid contents of carrot and apricot purées were 188.04 and 90.76 mg/100g, respectively. Dehydration reduced the ascorbic acid content to be 41.94 and 54.84 mg/100g, respectively, but the least decrease was observed in the sheets with more apricot purée rate.Carotenoids content decreased sharply in apricot, carrot and carrot percentage sheets after drying, but sheets with high carrot percentage had the lowest decrease. The SO_2 content decreased by drying process.

4- Results indicated that color of rehydrated mixture sheets with high carrot purée percentage were significantly higher than other sheets. While, taste and odor of rehydrated mixture sheets with high apricot purée ratio were significantly higher than other sheets. Moreover, texture and over all acceptability scores of rehydrated apricot and 25% carrot purée were significantly higher than other sheets.

5- Results indicated that extending storage of dried carrot and apricot sheets to 9 months at room temperature was accompanied by a decrease in moisture content and total sugars content, sheets

with high carrot purée percentage had the highest total sugars content. Color and rehydration ratio increased during storage.

6- Results illustrated that storage of dried sheets for 9 months at room temperature caused a gradual decrease in total acidity, ascorbic acid content and carotenoids. It could be observed that sheets with high carrot purée percentage had the highest carotene content and the lowest total acidity.

7- Results showed that physical and chemical characteristics of carrot and mango purées were affected by the incubation with (pectinase and cellulase enzymes) Pectinex Ultra SPL, Cellubrix L and a mixture of both enzymes for 120 min. at 40 C. T.S.S values of untreated carrot purée was 7.30% and increased by enzymatic treatment to 8.86, 8.84 and 8.44% for purées produced with Pectinex, Cellubrix and Pectinex and Cellubrix treatments, respectively. Concentration process of untreated carrot purée (control) under vaccum at 50°C for 2hr gave a concentrate of 40.20% T.S.S. However, concentration of carrot purée to reach 51.90, 49.50 and 48.08% was facilitated using Pectinex, Cellubrix and Pectinex and Cellubrix enzyme, respectively.

8- Results showed that T.S.S values of untreated mango purée was 16.10% increased to 19.40, 18.40 and 19.43% for purées treated with Pectinex,Cellubrix and Pectinex and Cellubrix,

respectively. Concentration of untreated mango purée produced a concentrate of 28.30% T.S.S, while enzyme treated purées reached 37.40, 29.30 and 37.30% for Pectinex, Cellubrix and Pectinex and Cellubrix treated purées, respectively.

9- Results indicated that total acidity increased in carrot and mango purées as a result of enzyme treatments, total acidity was higher in Pectinex and Pectinex and Cellubrix treated carrot and mango purées than untreated and Cellubrix treated purées, while ascorbic acid contents decreased in all enzymatic treated carrot and mango purées. Non enzymatic browning increased in carrot and mango treated purées espicially in the Pectinex treated purée.

10- HPLC analysis of untreated and treated carrot and mango purées indicated that sucrose was the predominant sugar, it represented 7.93, 5.24, 4.91 and 5.16% for untreated, Pectinex, Cellubrix and Pectinex and Cellubrix treated carrot purées, respectively. On the other hand, sucrose represented 9.13, 6.42, 4.42 and 5.06% for untreated, Pectinex, Cellubrix and Pectinex and Cellubrix treated mango purées. It could be noticed that galactose was detected in all carrot purée samples, untreated and enzyme treated ones. While, it was not detected in all mango purée samples, untreated and enzyme treated ones.

11- Results illustrated that viscosity of all investigated carrot and mango purées treated with enzymes decreased. Viscosity of carrot and mango purées treated with Pectinex enzyme recorded the lowest viscosity followed by Pectinex and Cellubrix , while untreated carrot and mango purées recorded the highest viscosity values.

12- Results showed that a slight increase in β-carotene content was observed as a result of enzyme treatments of carrot and mango purées. For carrot and mango purée β-carotene content was the highest in the Cellubrix treated purées it was 1643 µg/100g for untreated carrot purée and reached 1797µg/100g and it was 579µg/100g for the untreated mango purée and then reached 684µg/100g for treated mango purée.

13-Results showed the changes occurred during concentration process of carrot and mango purées untreated and enzymaticaly treated ones. An increase was observed in total soluble solids, total acidity and O.D values in all enzyme treated carrot and mango purées, while ascorbic acid was decreased.

14-Results indicated that rate of increasing T.S.S. during concentration process of untreated and treated carrot and mango purées was the highest in the Pectinex treated purées.

15- Results showed that color, taste, texture, mouth feel and over all acceptability scores of reconstituted enzyme treated carrot and mango purées concentrates were significantly higher than untreated ones. Results indicated that color and over all acceptability of reconstituted carrot and mango purées concentrates prepared from Pectinex and Pectinex and Cellubrix treated purées were significantly higher than control and Cellubrix treated purées. While, mouth feel scores of reconstituted carrot and mango purées concentrates prepared from Pectinex + Cellubrix treated purées were significantly higher than control and other carrot and mango treated purées concentrates. Also, non significant difference was found in odor between enzyme treatments in reconstituted carrot purée concentrates. And non significant difference was found in taste between enzyme treatments in reconstituted mango purée concentrates.

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reconstituted concentrates, followed by Pectinex + Cellubrix treated purée reconstituted concentrate. Non significant difference was found in odor between enzyme treatments

Results in Table (18) showed that mouth feel scores of the reconstituted carrot concentrate Pectinex + Cellubrix and Pectinex treated carrot purée concentrates were significantly higher than untreated (control) and the Cellubrix enzyme treated purée reconstituted concentrates.

Results in Table (18)indicated that over all acceptability scores of the reconstituted carrot concentrates prepared from Pectinex and Pectinex + Cellubrix treated carrot purée were significantly superior to those prepared from untreated (control) and Cellubrix treated carrot purées reconstituted concentrates.

Results in Table (19)indicated that color scores of the reconstituted mango concentrates prepared from Pectinex and Pectinex + Cellubrix treated mango purées were significantly higher than untreated (control) and Cellubrix treated mango purées reconstituted concentrates.

Results in Table (19) illustrated that the highest taste scores were recorded for the enzymes trearted mango purées reconstituted concentrates, and non significant difference was observed between them, followed by control sample.

Results in Table (19) showed that odor scores of the reconstituted mango concentrate from Pectinex and Pectinex + Cellubrix treated mango purées concentrates were significantly higher than untreated (control) and Cellubrix treated purées reconstituted concentrates.

Results in Table (19) showed that mouth feel scores of the reconstituted mango concentrate Pectinex + Cellubrix and Pectinex treated mango purée concentrate were significantly higher than untreated (control) and the other enzyme treated mango purée reconstituted concentrate(Cellubrix).

Results in Table (19)indicated that over all acceptability scores of the reconstituted mango concentrates prepared from Pectinex and Pectinex + Cellubrix treated mango purée were significantly superior to those prepared from untreated (control) and Cellubrix treated mango purées reconstituted concentrates.

Finally, it could be concluded that using enzymes as processing aids in the production of fruit and vegetable juices facilitated the concentration of the juice as a result of the reduction of viscosity by enzyme liquefaction on pectin and cellulose in the juice, and improved the physical, chemical and sensorial properties of the produced juice and concentrates.

enzyme increased from 7.3, 8.0, 7.8 and 8.0% to 40.2 , 51.9 , 49.5 and 51.6 %, respectively.

5.7.2.2. Concentration of mango purée .

Results in fig (10) showed the rate of increasing T.S.S during concentration of untreated mango purée and that treated with Pectinex Ultra SPL, Cellubrix and Pectinex + Cellubrix. It could be noticed that mango puree treated with Pectinex enzyme had the highest rate followed by mango purée treated with Pectinex + Cellubrix enzyme. While the untreated mango purée (control) had the lowest rate. After 120 min T.S.S. values of the untreated and treated with Pectinex Ultra SPL Cellubrix L and Pectinex+ Cellubrix enzymes mango purée increased from 16.1, 19.4, 18.4 and 19.43% to 28.3 , 37.4 , 29.3 and 37.3 %, respectively. This increase of T.S.S may be due to the degradation of the pectic substances by the enzymes used. The pectin, which is hydrocolloid capable of binding high amount of water, lost its water binding capacity when it was degraded to smaller fragments by the action of pectolytic enzymes used. These results are in agreement with those reported by **Meky (1999)** and **Soliman (1999)** who found that enzyme treatment (pectolytic and cellulytic enzymes) of mango, cantaloupe and citrus peels extracts facilitated the water removal during concentration process .

5.7.3. Effect of concentration process on sugar fraction of carrot and mango concertrates.

Table (17) and Fig. (11 and 12) showed sugar fraction of untreated carrot and mango concentrates and of those treated with Pectinex Ultra SPL ,Cellubrix and Pectinex + Cellubrix enzymes which were determined

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Contents

Table (5): Effect of storage on moisture content (%) in dried Sheets (on dry weight basis).

Samples / Storage period(month)	A. purée	C. purée	Cas	25% of carrot	33% of carrot	40% of carrot	50% of carrot	60% of carrot	67% of carrot	75% of carrot
0	16.15	14.00	14.06	14.49	14.61	14.82	14.87	15.27	15.41	15.40
3	15.16	12.52	12.56	13.21	13.51	13.63	13.81	14.04	14.32	14.57
6	14.68	11.35	11.24	12.19	12.63	12.69	12.92	13.25	13.61	14.91
9	14.17	10.91	10.90	11.74	11.78	12.18	12.39	12.69	12.97	13.34

A.pure=apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).
C.pure=carrot purée+10%sucrose+0.2%sodium metabisulfite+0.2%citric acid+2%CMC and starch gel(2:1).
Cas=carrot purée+10%sucrose+0.2%sodium metabisulfite+0.2%citric acid+2%CMC and starch gel(2:1)+0.1%(v/v)apricot synthetic aroma.
25%of carrot=25%carrot purée+75%apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).
33, 40, 50, 60, 67 and 75%of carrot=33, 40, 50, 60, 67 and 75%carrot purée+67, 60, 50, 40, 33, and 25%apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).

Table (6): Effect of storage on total sugars content (%) in dried sheets (on dry weight basis).

Samples / Storage period(month)	A. purée	C. purée	Cas	25% of carrot	33% of carrot	40% of carrot	50% of carrot	60% of carrot	67% of carrot	75% of carrot
0	75.53	79.95	79.34	76.83	77.13	77.63	77.52	78.34	78.89	78.99
3	75.34	79.66	79.19	76.58	76.77	77.32	77.25	78.09	78.21	78.60
6	75.14	79.41	78.71	76.24	76.35	77.35	77.01	77.88	77.66	78.10
9	74.54	79.21	78.50	75.80	75.91	76.84	76.60	77.54	77.07	77.69

A.pure=apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).
C.pure=carrot purée+10%sucrose+0.2%sodium metabisulfite+0.2%citric acid+2%CMC and starch gel(2:1).
Cas=carrot purée+10%sucrose+0.2%sodium metabisulfite+0.2%citric acid+2%CMC and starch gel(2:1)+0.1%(v/v)apricot synthetic aroma.
25%of carrot=25%carrot purée+75%apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).
33, 40, 50, 60, 67 and 75%of carrot=33, 40, 50, 60, 67 and 75%carrot purée+67, 60, 50, 40, 33, and 25%apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).

Table (8): Effect of storage on ascorbic acid content (mg /100g) in dried sheets(on dry weight basis).

Samples / Storage period(month)	A. purée	C. purée	Cas	25% of carrot	33% of carrot	40% of carrot	50% of carrot	60% of carrot	67% of carrot	75% of carrot
0	54.84	41.94	41.86	41.75	40.68	39.46	38.46	36.16	36.39	34.69
3	47.15	35.56	35.51	34.37	43.46	33.24	31.48	30.06	28.63	28.12
6	42.13	33.38	33.29	30.11	30.51	28.56	27.81	25.83	24.45	25.12
9	35.79	26.86	26.79	23.64	23.15	21.96	21.42	20.98	22.49	18.95

A.pure=apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).
C.pure=carrot purée+10%sucrose+0.2%sodium metabisulfite+0.2%citric acid+2%CMC and starch gel(2:1).
Cas=carrot purée+10%sucrose+0.2%sodium metabisulfite+0.2%citric acid+2%CMC and starch gel(2:1)+0.1%(v/v)apricot synthetic aroma.
25%of carrot=25%carrot purée+75%apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).
33, 40, 50, 60, 67 and 75%of carrot=33, 40, 50, 60, 67 and 75%carrot purée+67, 60, 50, 40, 33, and 25%apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).

Table(9): Effect of storage on total carotenoids content (mg/100g) in dried sheets (on dry weight basis).

Samples / Storage period(month)	A. purée	C. purée	Cas	25% of carrot	33% of carrot	40% of carrot	50% of carrot	60% of carrot	67% of carrot	75% of carrot
0	10.65	29.64	29.50	16.26	17.79	18.87	21.87	22.34	23.64	25.29
3	9.59	28.21	28.20	16.42	16.82	17.58	20.57	21.02	22.20	23.93
6	8.42	27.05	27.00	14.18	15.56	16.37	19.37	19.76	20.95	22.89
9	6.61	24.19	24.05	12.06	14.74	15.44	18.14	17.98	18.01	19.79

A.pure=apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).
C.pure=carrot purée+10%sucrose+0.2%sodium metabisulfite+0.2%citric acid+2%CMC and starch gel(2:1).
Cas=carrot purée+10%sucrose+0.2%sodium metabisulfite+0.2%citric acid+2%CMC and starch gel(2:1)+0.1%(v/v)apricot synthetic aroma.
25%of carrot=25%carrot purée+75%apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).
33, 40, 50, 60, 67 and 75%of carrot=33, 40, 50, 60, 67 and 75%carrot purée+67, 60, 50, 40, 33, and 25%apricot purée+ 10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).

Table(18) :Sensory evaluation of reconstituted carrot puree concentrates (± standard deviation)

Treatments	Color 10	Taste 10	Odor 10	Mouth feel 10	Overall acceptability 40
Control	b 8.0 ± 0.81	c 6.4 ± 0.51	b 6.3 ± 0.67	b 7.5 ± 0.52	c 28.2 ± 0.95
Pectinex Ultra SPL	a 9.1 ± 0.87	a 7.2 ± 0.42	a 7.5 ± 0.70	ab 8.0 ± 0.66	a 31.8 ± 0.98
Cellubrix L	ab 8.4 ± 0.69	bc 6.7± 0.67	a 7.0 ± 0.66	b 7.7 ± 0.94	bc 29.8 ± 0.98
Pectinex + Cellubrix	a 8.8 ± 0.78	ab 7.0 ± 0.47	a 7.3 ± 0.67	a 8.4 ± 0.69	ab 31.5 ± 0.99

Values within column followed by same letter or letters are not significant difference at 0.05% level.

Table (19) :Sensory evaluation of reconstituted mango puree concentrates (± standard deviation)

Treatments	Color 10	Taste 10	Odor 10	Mouth feel 10	Overall acceptability 40
Control	c 7.3 ± 0.48	b 8.1 ± 0.73	c 8.0 ± 0.66	b 8.2 ± 0.78	b 31.6 ± 0.74
Pectinex Ultra SPL	a 8.2 ± 0.63	a 9.0 ± 0.66	a 9.0 ± 0.66	ab 8.6 ± 0.69	a 34.8 ± 0.72
Cellubrix L	bc 7.5 ± 0.52	ab 8.4 ± 0.65	bc 8.30± 0.67	b 8.3 ± 0.67	b 32.5 ± 0.71
Pectinex + Cellubrix	ab 7.9 ± 0.56	a 8.8 ± 0.63	ab 8.8 ± 0.63	a 9.1 ± 0.73	a 34.6± 0.76

Values within column followed by sameletter or letters are not significant difference at 0.05% level.

Table (4) : Sensory evaluation of the rehydrated sheets (±standard deviation)

Treatments	Color 10	Taste 10	Odor 10	Texture 10	Overall acceptability 40
A. purée	d 7.7 ± 0.94	a 9.0 ± 0.66	a 9.2 ± 0.63	abc 8.5 ± 0.97	a 34.4 ± 0.98
C. purée	a 8.8 ± 0.42	g 6.5 ± 0.52	f 6.2 ± 0.63	d 7.8 ± 0.63	d 29.3 ± 1.18
Cas	a 8.8 ± 0.62	f 7.7 ± 0.48	e 7.1 ± 0.73	d 7.8 ± 0.66	c 31.4 ± 0.83
25% of carrot	cd 8.0 ± 0.81	ab 8.8 ± 0.42	ab 8.8 ± 0.63	a 8.7 ± 0.67	a 34.3 ± 0.71
33%of carrot	bcd 8.1 ± 0.87	abc 8.7 ± 0.82	abc 8.7 ± 0.67	ab 8.6 ± 0.69	a 34.1 ± 0.78
40% of carrot	abcd 8.3 ± 0.82	abcd 8.5 ± 0.52	abc 8.6 ± 0.69	abcd 8.4 ± 0.65	ab 33.8 ± 0.66
50% of carrot	abc 8.4 ± 0.69	bcde 8.4 ± 0.69	bcd 8.4 ± 0.84	bcd 8.2 ± 0.78	ab 33.4 ± 0.73
60% of carrot	abc 8.5 ± 0.70	cdef 8.2 ± 0.78	cd 8.1 ± 0.73	bcd 8.1 ± 0.87	ab 32.9 ± 0.76
67% of carrot	abc 8.6 ± 0.69	def 7.9 ± 0.73	d 7.9 ± 0.73	bcd 8.0 ± 0.66	bc 32.4 ± 0.72
75% of carrot	ab 8.7 ± 0.82	ef 7.8 ± 0.63	d 7.8 ± 0.63	cd 7.9 ± 0.73	bc 32.2 ± 0.79

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Values within column followed by same letter or letters are not significant difference at 0.05% level

Table (7): Effect of storage on titratable acidity (%) (as citric acid) in dried sheets (on dry weight basis).

Samples / Storage period(mon	A. purée	C. purée	C as	25% of carrot	33% of carrot	40% of carrot	50% of carrot	60% of carrot	67% of carrot	75% of carrot
0	10.48	1.75	1.74	7.99	6.98	6.94	6.34	6.00	4.56	4.02
3	10.20	1.72	1.70	7.85	6.80	6.83	6.27	5.88	4.41	3.93
6	10.09	1.68	1.67	7.76	6.68	6.75	6.19	5.79	4.32	3.86
9	9.86	1.65	1.63	7.61	6.59	6.68	6.01	5.61	4.25	3.81

A.pure=apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).
C.pure=carrot purée+10%sucrose+0.2%sodium metabisulfite+0.2%citric acid+2%CMC and starch gel(2:1).
Cas=carrot purée+10%sucrose+0.2%sodium metabisulfite+0.2%citric acid+2%CMC and starch gel(2:1)+0.1%(v/v)apricot synthetic aroma.
25%of carrot=25%carrot purée+75%apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).
33, 40, 50, 60, 67 and 75%of carrot=33, 40, 50, 60, 67 and 75%carrot purée+67, 60, 50, 40, 33, and 25%apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).

Table (10): Effect of storage on sulfur dioxide content (p.p.m.)in dried sheets (on dry weight basis)

Samples / Storage period (month)	A. purée	C. purée	Cas	25% of carrot	33% of carrot	40% of carrot	50% of carrot	60% of carrot	67% of carrot	75% of carrot
0	557	571	563	579	558	541	544	551	586	529
3	394	401	412	411	353	399	369	393	481	387
6	302	290	311	330	284	298	319	281	363	256
9	220	260	229	215	220	211	202	200	300	199

A.pure=apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).
C.pure=carrot purée+10%sucrose+0.2%sodium metabisulfite+0.2%citric acid+2%CMC and starch gel(2:1).
Cas=carrot purée+10%sucrose+0.2%sodium metabisulfite+0.2%citric acid+2%CMC and starch gel(2:1)+0.1%(v/v)apricot synthetic aroma.
25%of carrot=25%carrot purée+75%apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).
33, 40, 50, 60, 67 and 75%of carrot=33, 40, 50, 60, 67 and 75%carrot purée+67, 60, 50, 40, 33, and 25%apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).

Table (11) : Effect of storage on color (O.D at 420nm) in dried sheets

Samples / Storage period (month)	A. purée	C. purée	Cas	25% of carrot	33% of carrot	40% of carrot	50% of carrot	60% of carrot	67% of carrot	75% of carrot
0	0.134	0.198	0.180	0.140	0.143	0.162	0.148	0.199	0.183	0.183
3	0.183	0.231	0.226	0.185	0.180	0.195	0.162	0.220	0.225	0.207
6	0.225	0.246	0.238	0.236	0.213	0.227	0.196	0.247	0.240	0.229
9	0.271	0.260	0.254	0.251	0.246	0.255	0.233	0.269	0.263	0.252

A.pure=apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).
C.pure=carrot purée+10%sucrose+0.2%sodium metabisulfite+0.2%citric acid+2%CMC and starch gel(2:1).
Cas=carrot purée+10%sucrose+0.2%sodium metabisulfite+0.2%citric acid+2%CMC and starch gel(2:1)+0.1%(v/v)apricot synthetic aroma.
25%of carrot=25%carrot purée+75%apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).
33, 40, 50, 60, 67 and 75%of carrot=33, 40, 50, 60, 67 and 75%carrot purée+67, 60, 50, 40, 33, and 25%apricot purée+10%sucrose+0.2%sodium metabisulfite+1%CMC and starch gel(2:1).

Table (13): Effect of enzymatic treatment on some characteristics of carrot and mango purées (on fresh weight basis).

Treatments / Parameters	Carrot				Mango			
	Control	**Pectinex ultra SPL**	**Cellubrix**	**Pectinex + Cellubrix**	**Control**	**Pectinex Ultra SPL**	**Cellubrix**	**Pectinex + Cellubrix**
T.S.S %	7.30	8.00	7.80	8.00	16.10	19.40	18.40	19.43
Moisture %	92.46	91.14	91.16	91.56	77.80	77.40	79.68	78.69
Total titratable acidity % (as citric acid)	0.19	0.27	0.20	0.27	0.54	0.94	0.75	0.85
pH value	5.75	5.40	5.60	5.40	3.80	3.75	3.75	3.80
Ascorbic acid (mg/100g)	10.36	10.01	9.19	10.00	19.47	19.01	19.13	19.13
Non-enzymatic browning (420 nm)	0.142	0.166	0.149	0.159	0.107	0.178	0.156	0.172

Table (14): Sugar fractions of enzymatically treated carrot and mango purées.

Treatments / Sugar fractions		Carrot				Mango			
		Control	**Pectinex ultra SPL**	**Cellubrix**	**Pectinex + Cellubrix**	**Control**	**Pectinex Ultra SPL**	**Cellubrix**	**Pectinex + Cellubrix**
Sucrose	**%**	7.93	5.24	4.91	5.16	9.13	6.42	4.42	5.06
Fructose	**%**	1.29	1.49	1.35	1.46	1.27	1.85	1.71	1.67
Glucose	**%**	1.26	1.91	1.46	1.58	0.94	0.98	0.95	0.96
Galactose	**%**	0.13	0.18	0.19	0.19	-----	-----	-----	-----

Table (16): Effect of concentration on some characteristics of carrot and mango purées (on fresh weight basis).

Treatments / Parameters	Carrot				Mango			
	Control	**Pectinex ultra SPL**	**Cellubrix L**	**Pectinex + Cellubrix**	**Control**	**Pectinex Ultra SPL**	**Cellubrix L**	**Pectinex + Cellubrix**
T.S%	48.70	52.13	50.44	51.92	28.90	38.90	31.19	39.15
T.S.S %	40.20	51.90	49.50	51.60	28.30	37.40	29.30	37.30
Moisture %	51.30	47.87	49.56	48.08	71.10	60.10	68.81	60.58
Total titratable acidity % (as citric acid)	0.24	0.42	0.29	0.41	0.69	1.20	1.08	1.17
Ascorbic acid(mg/100g)	51.60	49.70	47.93	48.54	38.08	31.80	30.15	30.97
Non-enzymatic browning (420 nm)	0.157	0.175	0.163	0.171	0.130	0.189	0.172	0.182

Table (17): Sugar fractions of carrot and mango concentrates.

Treatments / Sugar fractions		Carrot				Mango			
		Control	**Pectinex ultra SPL**	**Cellubrix L**	**Pectinex + Cellubrix**	**Control**	**Pectinex Ultra SPL**	**Cellubrix L**	**Pectinex + Cellubrix**
Sucrose	**%**	20.27	15.58	12.12	15.11	12.68	14.62	10.86	11.45
Fructose	**%**	5.69	7.11	5.76	6.69	2.16	2.37	2.31	2.13
Glucose	**%**	5.18	5.98	4.12	4.16	1.29	1.41	1.39	1.40
Galactose	**%**	0.32	0.39	0.33	0.36	……	.....	.....	.....

نموذج رقم (٤)

اسم الطالب: حنان أبو الفتوح محمد على **الدرجة :** ماجستير

عنوان الرسالة : تأثير بعض المعاملات التكنولوجيا على جودة بعض العصائر المجففة والمركبة

المشرفون: د/ محمد محمد أحمد النقيطى

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أ.د/ ليلي ضياء الدين المهدى

قسم / الصناعات الغذائية **تاريخ منح الدرجة:** ٢٠٠٦/٩/١٤م

المستخلص العربي

تناولت هذه الدراسة تأثير نسبة الإضافة من بيوريه الجزر على الخصائص الطبيعية والكيميائية للفائف المشمش خلال تخزينها حتى ٩ شهور على درجة حرارة الغرفة ، بالإضافة إلى دراسة الصفات الحسية للفائف بعد استرجاعها . ودراسة تأثير استخدام المعاملات الإنزيمية لإنتاج مركزات جزر ومانجو ذات صفات طبيعية و كيميائية جيدة.

أوضحت النتائج أن إضافة بيوريه الجزر إلى المشمش أدى إلى خفض محتوى اللفائف المجففة من الحموضة وحمض الاسكوربيك بينما زاد محتواها من الكاروتين بزيادة النسبة المضافة من بيوريه الجزر.

أوضحت النتائج أن تخزين اللفائف المجففة أثر على الخصائص الكيميائية حيث أدى إلى خفض المحتوى الرطوبى ، المحتوى السكري ، الحموضة، حمض الاسكوربيك، الكاروتين وثاني أكسيد الكبريت. ولكن اللفائف التي تحتوى على نسبة عالية من بيوريه الجزر كانت أعلى في محتواها من السكريات والكاروتين عن باقي اللفائف.

أوضحت نتائج تحليل الصفات الطبيعية و الكيميائية لبيوريه الجزر و المانجو و مركزاتها أن المعاملات الإنزيمية أدت إلي زيادة في المواد الصلبة الكلية ، المواد الصلبة الذائبة الكلية والحموضة الكلية مقارنة بالعينات غير المعاملة إنزيميا . كما تبين أن نسبة حمض الأسكوربيك ورقم الأس الهيدروجينى وقيم اللزوجة في المركزات المنتجة بواسطة المعاملات الإنزيمية كانت أقل منها في المركزات غير المعاملة إنزيميا .

وأوضحت نتائج تفريد السكريات لمركزات الجزر والمانجو باستخدام جهاز HPLC أن السكروز هو السكر الرئيسي يليه الفركتوز . وقد تم التعرف على سكر الجلاكتوز فى بيوريه الجزر ومركزاته ،بينما لم يتم التعرف عليه في بيوريه المانجو ومركزاته.

يوصى بإجراء معاملات غير ضارة بالصحة وفى ذات الوقت تحافظ على خواص المنتج وتجعله أكثر صلاحية للتصدير،وهى المعاملة بالإنزيمات البكتينية والسليلوزية التجارية.

(مطبعة جامعة القاهرة ١٥٢٣ / ١٩٨٤ / ٥٠٠٠٠)

الملخص العربي

أجرى هذا البحث بهدف إنتاج لفائف مجففة محسنة من الجزر و المشمش ذات فترة صلاحية طويلة، صفات جودة عالية وبالإضافة للإستفادة من طعم و رائحة المشمش الصناعية في إنتاج لفائف مجففة بدلاً من بيوريه المشمش الطبيعي. وكذلك إنتاج مركزات محسنة من بيوريه الجزر و المانجو ذات صفات جودة طبيعية و كيميائية وحسية جيدة باستخدام الإنزيمات التجارية لخفض لزوجة بيوريه الجزر و المانجو لتسهيل عملية التركيز وإمكانية الوصول إلى تركيزات مرتفعة.
وتم الحصول على النتائج التالية:

١- احتوى بيوريه الجزر على أعلى نسبة من المحتوى الرطوبى و الكاروتينات، بينما احتوى بيوريه المانجو على أقل نسبة من كلاهما.كما احتوى بيوريه المشمش على أعلى نسبة من الحموضة الكلية، بينما الجزر هو الأقل في الحموضة الكلية. كما وجد أن بيوريه المانجو احتوى على أعلى نسبة من السكريات الكلية و نسبة حمض الاسكوربيك، بينما يحتوى بيوريه المشمش على أقل نسبة من كلاهما.

٢- وجد أن المحتوى الرطوبى لبيوريه الجزر و المشمش كان ٩١,٣٩ و ٨٤,٠٢% على التوالي. و قد انخفضت هذه النسبة الى١٤ و١٦,١٥% في اللفائف المجففة من الجزر والمشمش بعد إضافة ١٠% سكروز،٠,٢% صوديوم ميتابايسلفيت و ١-٢% كربوكسى ميثيل سليلوز و نشا بنسبة (٢-١).

٣- كما ارتفعت نسبة السكريات الكلية في لفائف الجزر و المشمش و لفائف المشمش ذات النسب المختلفة من بيوريه الجزر(٢٥، ٣٣، ٥٠,٤٠ ، ٦٠، ٦٧ ،٧٥% من بيوريه الجزر) نتيجة لإضافة ١٠% سكروز. أدت عملية التجفيف إلى انخفاض نسبة حمض الاسكوربيك في الجزر و المشمش إلى ٤١,٩٤ و٥٤,٨٤ مجم/١٠٠جم. وكانت اللفائف المحتوية على نسبة أعلى من بيوريه المشمش الأقل انخفاضاً.

٤- أوضح التحليل الإحصائى لنتائج الإختبارات الحسية (اللون، الطعم، الرائحة، القوام والقبول العام) للفائف المسترجعة أن اللفائف المحتوية على نسبة أعلى من بيوريه الجزر كانت أفضل بدرجة معنوية عن باقى اللفائف المسترجعة المحتوية على نسبة

أعلى من بيوريه المشمش. بينما كان الطعم والرائحة أفضل بدرجة معنوية للفائف المسترجعة المحتوية على نسبة أعلى من بيوريه المشمش. كما أن القوام والقبول العام للفائف المشمش و اللفائف المسترجعة المحتوية على نسبة ٢٥% من بيوريه الجزر كانت أفضل بدرجة معنوية عن اللفائف الاخرى.

٥- كما لوحظ انخفاض المحتوى الكاروتينى في لفائف الجزر و المشمش و اللفائف ذات النسب المختلفة من بيوريه الجزر بعد عملية التجفيف بينما اللفائف المحتوية على نسبة أعلى من بيوريه الجزر كانت اقل انخفاضاً في محتواها من الكاروتين كما أن محتوى جميع اللفائف من ثانى اكسيد الكربريت انخفض بصورة كبيرة أثناء عملية التجفيف

٦- تبين أن إطالة فترة التخزين للفائف الجزر و المشمش و خلائطها لمدة ٩ شهور على درجة حرارة الغرفة قد صاحبها انخفاض في المحتوى الرطوبى و نسبة السكريات الكلية و ارتفاعا في درجة اللون و معدل الاسترجاع في كل اللفائف بإستثناء اللفائف المحتوية على نسبة أعلى من بيوريه الجزرفقد احتوت على أعلى نسبة من السكريات الكلية

٧- وجد أن تخزين اللفائف ا لمجففة لمدة ٩ شهور على درجة حرارة الغرفة أدى إلى انخفاض تدريجي في نسبة الحموضة الكلية ، حمض الاسكوربيك و الكاروتينات إلا أن اللفائف التي تحتوى على نسبة أعلى من بيوريه الجزر احتوت على أعلى نسبة من الكاروتينات و اقل نسبة حموضة كلية.

٨- تأثرت الصفات الطبيعية و الكيميائية لبيوريه الجزر و المانجو بعد إضافة إنزيمات (بكتينية و سليولوزيه) ال Pectinex و ال Cellubrix و خليط من كلا الإنزيمين و التحضين لمدة ١٢٠ دقيقة على درجة حرارة ٤٠ م° حيث زادت نسبة المواد الصلبة الذائبة الكلية لبيوريه الجزر الغير معامل من ٧,٣٠% لتصل الى ٨,٨٦ ، ٨,٨٤ و ٨,٤٤ % بعد المعاملة الانزيمية لبيوريه الجزر بال Pectinex و ال Cellubrix و خليط من كلا الإنزيمين على التوالي كما أن إجراء عملية تركيز تحت تفريغ على درجة حرارة ٥٠ م° لمدة ساعتين لبيوريه الجزر الغير معامل إنزيميا أدت إلى أنتاج مركز تصل نسبة المواد الصلبة الذائبة الكلية له الى ٤٠,٢٠% بينما وصلت

بنسبة المواد الصلبة الذائبة الكلية إلى ٥١,٩٠ ، ٤٩,٥٠ ، ٤٨,٥٨ % باستخدام إنزيمات Pectinex ، Cellubrix و خليط من كلا الإنزيمين على التوالي

٩- ارتفعت نسبة المواد الصلبة الذائبة الكلية لبيوريه المانجو غير المعامل إنزيميا كانت ٦١,١٠% إلى ١٩,٤٠ ، ١٨,٤٠ و ١٩,٤٣ % بعد معاملتها بإنزيمات Pectinexو Cellubrix و خليط منهما على التوالي .كما أدت عملية تركيز بيوريه المانجو غير المعامل تحت تفريغ على درجة حرارة ٥٠ م لمدة ساعتين إلى إنتاج مركز تصل نسبة المواد الصلبة الذائبة الكلية فيه الى ٢٨,٣٠% بينما أدت المعاملة الإنزيمية باستخدام Pectinex و Cellubrix و خليط منهما على التوالي إلى إنتاج مركزات تصل نسبة المواد الصبة الذائبة الكلية فيها إلى ٣٧,٤٠ ، ٢٩,٣٠ ، ٣٧,٣٠ % على التوالي.

١٠– ارتفعت نسبة الحموضة الكلية لبيوريه الجزر و المانجو قد ارتفعت نتيجة للمعاملة الإنزيمية . حيث زادت نسبة الحموضة الكلية بصورة أعلى في بيوريه الجزر و المانجو المعامل بانزيم ال Pectinex . بينما انخفضت نسبة حمض الاسكوربيك في كل العينات المعاملة إنزيميا كما لوحظ زيادة فى قيم التلون البني الغير انزيمى في كل العينات المعاملة إنزيميا خاصة المعاملة بإنزيم Pectinex نتيجة لتدمير جدر الخلايا.

١١ – أظهرت نتائج تفريد السكريات باستخدام التحليل الكروماتوجرافى ذو الأداء العالي لبيوريه الجزر و المانجو المعامل إنزيميا أن السكروز هو السكر الرئيسي حيث كانت نسبته ٧,٩٣ ، ٥,٢٤ ، ٤,٩١ ، ٥,١٦ % لبيوريه الجزرغير المعامل والبيوريه المعامل بإنزيمات Pectinex و Cellubrix و خليط منهما على التوالي . و قد كانت نسبة السكروز تمثل ٩,١٣ ، ٦,٤٢ ، ٤,٤٢ و ٥,٠٦ % في بيوريه المانجو غير المعامل ، المعامل بإنزيمات Pectinex و Cellubrix و خليط منهما على التوالي كما لوحظ أن سكر الجلاكتوز لم يتم التعرف عليه فى بيوريه المانجو المعامل و غير المعامل بينما تم التعرف عليه في بيوريه الجزر المعامل وغير المعامل.

١٢ – انخفضت لزوجة عينات بيوريه الجزر و المانجو المعاملة إنزيميا.حيث سجل بيوريه الجزر و المانجو المعامل بإنزيم Pectinex اقل لزوجة بينما سجل بيوريه الجزر و المانجو غير المعامل أعلى لزوجة.

١٣-إرتفعت نسبة البيتاكاروتين لكل من بيوريه الجزر و المانجو قد نتيجة للمعاملة الإنزيمية . حيث سجل بيوريه الجزر المعامل بانزيم ال Cellubrix أعلى محتوى من البيتاكاروتين ١٧٩٧ ميكروجرام / ١٠٠مم بينما كان ١٦٤٣ ميكروجرام / ١٠٠مم لبيوريه الجزر غير المعامل .وسجل بيوريه المانجو المعامل بانزيم Cellubrix أعلى محتوى من البيتاكاروتين ٦٨٤ ميكروجرام / ١٠٠مم بينما كان ٥٧٩ ميكروجرام / ١٠٠ مم لبيوريه المانجو غير المعامل.

١٤ – أوضحت النتائج التغيرات التي تحدث أثناء عملية التركيز لبيوريه الجزر و المانجو المعامل و الغير معامل إنزيميا .حيث لوحظ زيادة في نسبة المواد الصلبة الكلية ، و المواد الصلبة الذائبة الكلية ، الحموضة الكلية ، و قيم الكثافة الضوئية في كل عينات بيوريه الجزر و المانجو المعاملة إنزيميا. بينما انخفضت نسبة حمض الاسكوربيك فى تلك العينات المعاملةإنزيمياً.

١٥ –سجل معدل زيادة نسبة المواد الصلبة الذائبة الكلية بالنسبة للزمن أثناء عملية التركيز لبيوريه الجزر و المانجو غير المعامل و المعامل إنزيميا أعلى قيمة بالنسبة للعينات المعاملة بإنزيم ال Pectinex .

١٦- أوضح التحليل الإحصائى لنتائج الإختبارات الحسية (اللون، الطعم، الرائحة، القوام والقبول العام) لمركزات بيوريه الجزر و المانجوالمسترجعة غير المعامل و المعامل إنزيمياً أن مركزات بيوريه الجزر و المانجوالمسترجعة المعامل إنزيمياً كانت أفضل بدرجة معنوية فى هذه الخصائص الحسية. حيث وجد أن اللون والقبول العام مركزات بيوريه الجزر و المانجو المعامل بإنزيم الPectinex وخليط من Pectinexو Cellubrix كانت أفضل بدرجة معنوية من مركزات بيوريه الجزر و المانجو غير المعامل و المعامل بإنزيم الCellubrix . بينما كانت مركزات بيوريه الجزر و المانجو المعامل بإنزيم الPectinex+Cellubrix أفضل بدرجة معنوية من مركزات بيوريه الجزر و المانجو الغير معامل و المركزات المسترجعة الاخرى. أيضاً لم تكن هناك فروق معنوية بين المركزات المعاملة إنزيمياً للرائحة والطعم فى مركزات بيوريه الجزر و المانجوالمسترجعة على التوالى.