Annals of Agricultural Science, Moshtohor (ASSJM)
https://assjm.journals.ekb.eg/
www.fagr.bu.edu.eg

ISSN:1110-0419
Original Article Vol. 61(1) (2023), 201 – 208 DOI: 10.21608/assjm.2023.309921

Physical and Chemical Properties of Indian Fig Opuntia Fruits

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Received: October 26, 2022 / Revised: January 10, 2023 / Accepted: January 25, 2023

Abstract

The main aim of this work was to study the physical and chemical properties of Indian fig opuntia fruits. The results indicated that the length, width, and thickness of Indian fig opuntia fruits were 66.68, 46.09, and 43.39 mm, respectively. The geometric mean diameter and arithmetic mean diameter of the Indian fig opuntia fruits were 51.06 and 52.05 mm, respectively. The Indian fig opuntia fruit mass, volume and true density were 68.61 g, 69.39 cm^3 and 989.47 kg m^{-3}, respectively. The Indian fig opuntia fruit surface area was 103.68 cm^2. The sphericity and moisture content of the Indian fig opuntia fruits were 76.85 and 86.34 %, respectively. The Indian fig opuntia peel, pulp, and seed mass were 29.50, 34.19, and 4.92 g, respectively. The crude protein, ether extract, crude fiber, ash, and total carbohydrates for the raw Indian fig opuntia pulp were 0.81, 0.31, 0.39, 0.43, and 10.95%, respectively. The total solids and total soluble solids of Indian fig opuntia pulp were 13.52 % and 11.21 °Brix, respectively. The titratable acidity was 0.072 % (as citric acid) and pH value was 5.72. Total, reducing and non-reducing sugars of Indian fig opuntia pulp were 10.71, 10.67, and 0.13 %, respectively. The nitrogen, phosphorus, potassium, calcium, and magnesium contents of Indian fig opuntia pulp were 289.5, 136.9, 827.2, 331.2 and 187.1, respectively.

Keywords: Indian fig opuntia, Physical properties, Chemical properties, Dimensions, Surface area, Volume, density and TSS.

Introduction

Indian fig opuntia (Prickly pear) is a plant belonging to the family Cactaceae, which is characterized by considerable genetic diversity, including 2,000 species springing from over 20 to 30 genera. It is native to the arid and semi-arid areas of Mexico. It has been cultivated in Africa since the sixteenth century **(Arab and Sharoua, 2010)**.

The Indian fig opuntia is an important component of the human diet due to its organoleptic and nutritional properties. It also has considerable potential for use in the pharmaceutical and cosmetic industries. In addition to its cladodes and flowers, its fruits have high sugar content and low acidity that make them delicious. Moreover, prickly pear fruits contain betalain pigments (betacyanins and betaxanthins), as reported in earlier published data **(Dubeux Jr *et al*., 2006)**.

Cactus pear fruit (prickly pear) is a fleshy berry, varying in shape, size, and color, and has a consistent number of hard seeds. It is characterized by a high sugar content (12–17%) and low acidity (0.03–0.12%). It has higher vitamin C, potassium, calcium and sodium **(Murugesan *et al.*, 2007)**. Prickly pears are considered a rich source of yellow–orange betaxanthins and red-violet betacyanins, and the red and purple-colored prickly pears contain high amounts of total phenols and purple-skinned fruits contain the highest amounts of flavonoids, which are responsible for the color of *Opuntia* spp. and have radical-scavenging and reducing properties **(Koocheki *et al.*, 2009)**. The betalain content of the cactus pear fruit is found to have an application in low-acid foods as a natural colorant **(Huiping *et al.*, 2007)**. Cactus pear fruit pulp exhibits a high pH value (5.6–6.5) and total soluble solids content ranging from 11 to 17 °brix, and this property makes the pulp highly susceptible to microbial spoilage **(Kumar *et al.*, 2008)**.

Prickly pear has been grown in Egypt for many years ago, especially in sandy areas in various parts of Egypt because it is extremely drought tolerant. The trees are grown not only for their fruits but also as fences and windbreakers, or for erosion control in deforested areas **(Abdel-Nabey, 2001)**. Prickly pear fruits are also very susceptible to microbial spoilage because of the low acid and high sugar content of the pulp, so the storage life of the fruit in the fresh state is limited. The presence of spines makes prickly pears difficult to peel. Minimal processing might be an important way to increase the acceptability of this fruit.

The production of Indian fig opuntia fruits in Egypt has increased in recent years due to the increase in the producing area. The corresponding production increased from 10,233 tons in 1994 to 27796 tons in 2020 **(MALR, 2020)**. The producing area increased from 1471 faddan in 1994 to 4723 in 2020. It is cultivated in many areas, such as belbis, Sinai, Abo-Zabal, and the reclaimed areas at El-Nubaria, El-Bostan, and Elbanger **(Abdel-Nabey, 2001)**.

Knowledge of the dimensions, volume, surface area and mass of the product is necessary to: (a) the design of sorting and grading machines (b) predict amounts of surface applied chemicals and (c) describe heat and mass transfer during thermal processes and in the quantification of the bruise, abrasion and damage in handling process. The shape of some fruits is important in determining their suitability for processing and retail value. Much research has been carried out on the physical and engineering properties of many agricultural products **(Khater and Bahnasawy, 2016)**. Information on size, density, and crushing strength is required for the development of grading system for barriers and for the pulpers **(Gosh, 1969)**. The physical and mechanical properties such as size, friction angle, and angle of repose, crushing strength and bulk density are important in the design of the handling system and grading **(Chandrasekar and Viswanathan, 1999)**.

A study of the physical properties of biomaterials is essential for the design of processing machines, storage structures and environmental parameter controls. Such data are useful in the analysis and determination of the efficiency of a machine or an operation, the development of new products and new equipment and the final quality of new products **(Mohsenin, 1986)**. The size of agricultural materials such as grains, pulses and oil seeds have been described by measuring their principal axial dimensions **(Oje *et al.*, 2001 and Perez–Alegria *et al.*, 2001)**. Geometrical mean of the axial dimensions have also been shown to be adequate for calculating Reynold’s number, projected areas and drag coefficient of food grain. These parameters are needed in the design of machine for pneumatic conveying, fluidization and separation of ground straw mixtures **(Gorial and O’Callaghan, 1990)**. Density and specific gravity of biomaterials play important roles in many applications and are useful in the drying and storage of hay products, the design of silos, and storage bins.

Physical indices will help to determine the fruit optimal harvest time. These are mass, size, shape, color, firmness, and number of days after flowering. Information on the fruit mechanical properties is also important to determine the fruit's degree of maturation. Consequently, compression tests may be employed to obtain force-deflection curves to check fruit firmness **(Khater *et al.*, 2014)**.

The design of processing machines, storage structures and environmental parameter controls depend on the properties of bio-materials. These properties are useful in the analysis and determination of the efficiency of a machine or an operation, development of new products and new equipment and final quality of new products **(Mohsenin, 1986 and Khater and Bahnasawy, 2016)**.

Export problems are mainly from the lack of physical and mechanical properties knowledge. Physical and mechanical properties are important in many problems associated with the design of machines and the analysis of the behaviour of the product during agricultural processing operations such as handling, planting, harvesting, milling, threshing, cleaning, grading, sorting and drying, therefore, the main aim of this investigation is to study some physical and mechanical properties of the fruits of Indian fig opuntia.

Materials and methods

The experiment was carried out at Agricultural and Bio-Systems Engineering Department and Horticulture, Faculty of Agriculture, Moshtohor, Benha University, during July and August 2021.

1.1. Materials

Indian fig opuntia fruits (*Opuntia ficus of indica*) were carefully harvested at the same maturity stage. The Indian fig opuntia fruits were used in this study to measure and determine their physical and chemical properties.

1.2. Methods

1.2.1. Physical and chemical properties

1.2.1.1. Physical properties

For each Indian fig opuntia fruit, three principal diameters (axial dimension); major diameter (a), intermediate diameter (b) and minor diameter (c) were measured using a digital vernier caliper (Model TESA 1p65- Range 0-150 mm ± 0.01 mm, Swiss) and the average was taken. The geometric mean diameter (Dg) of samples was found using the following formula given by **Kacharu *et al.* (1994)**:

$$D_g = \sqrt[3]{abc} \quad (1)$$

Where: D_g is the geometric mean diameter, mm a is the major diameter of Indian fig opuntia fruits, mm b is the intermediate diameter of Indian fig opuntia fruits, mm c is the minor diameter of Indian fig opuntia fruits, mm

The arithmetic means diameter was determined from the three principal diameter using the relationship by **(Sunmonu *et al.*, 2015)**:

$$D_a = \frac{a+b+c}{3} \quad (2)$$

Where:

D_a is the arithmetic mean diameter, mm

The surface area was determined by using the following equation as cited by **Sacilik *et al.*, (2003)**:

$$S = \pi (D_g)^2$$

Where:

S is the fruit surface area, mm^2

The sphericity of the Indian fig opuntia fruit was calculated by using the following relationship **(Sunmonu *et al.*, 2015)**:

$$\phi = \frac{D_g}{a} \times 100$$

Where:

ϕ is the fruit sphericity, %

The mass of the fruit Indian fig opuntia was measured by electric digital balance (Model Vibra – Range 0-12000 g ± 0.01 g, Japan). The water displacement method was used for determining the fruits measured volume (V_m). The real density was a measurement of a Indian fig opuntia fruits mass per unit volume. For each case, the determination was replicated three times and the mean was considered.

The criteria projected area (CPA) was calculated as suggested by **Mohsenin (1986)**:

$$CPA = \frac{AP_1 + AP_2 + AP_3}{3}$$

Where:

PA_1 is the projected area perpendicular to the L direction of the fruit, mm^2

PA_2 is the projected area perpendicular to the T direction of the fruit, mm^2

PA_3 is the projected area perpendicular to the W direction of the fruit, mm^2

Oblate spheroid (V_{osp}) and ellipsoid (V_{ellip}) shapes were calculated as:

$$V_{osp} = \frac{4\pi}{3}\left(\frac{L}{2}\right)\left(\frac{W}{2}\right)^2$$

$$V_{ellip} = \frac{4\pi}{3}\left(\frac{L}{2}\right)\left(\frac{W}{2}\right)\left(\frac{T}{2}\right)$$

Where:

V_{osp} is the oblate spheroid volume, mm^3

V_{ellip} is the ellipsoid shape volume, mm^3

The moisture content of randomly selected Indian fig opuntia fruits was determined according to **ASAE Standard (1984)**. Three samples of each Indian fig opuntia fruits were randomly selected and weighed on an electric digital balance. Drying oven (Model 655F Cat. No. 13-245-655, range 50 to 300 ºC, Canada) at 70°C until a constant weight was used to measure the moisture content.

1.2.2. Chemical properties:

Total solids, ash, crude protein, ether extract and crude fiber content were determined according to the methods described by the **A.O.A.C. (1995)**. Available carbohydrates were calculated by difference.

The total soluble solids were determined by using Abbe refractometer Model 1T at 20°C according to **A.O.A.C. (1995)**.

Total titratable acidity was determined according to **Luh *et al.* (1964)**. Results were reported as milliequivalent NaOH per 100 g sample. The pH values were measured by using pH meter Model Consort P107. The formol titration obtained by means of a potentiomtric titration as described by **Intoni *et al.* (1959)**.

Ascorbic acid was determined by using the 2, 6-dichlorophenol indophenol dye titration method described by **A.O.A.C. (1995)**.

Total sugar and reducing sugar were determined by the method described in **A.O.A.C. (1995)**, while non-reducing sugars were calculated by difference.

Carotenoids were determined according to **Wettestein (1957)** as follows:

A suitable sample was mixed with 30 ml of acetone solution 85% in dark bottle and left to stand for 15 hrs at room temperature. The sample was filtered on glass wool into a 100 ml volumetric flask and made up to volume by 85% acetone solution. The optical density of the sample was then measured by using a CE 599 Universal Automatic Scanning Spectrophotometer at 440, 644 and 662 nm. Acetone solution (85%) was used as a blank at each Wavelength.

The carotenoids were calculated as beta caroteine according to the equation given by **Wettestein (1957)**.

- Chlorophyll a (mg/l) = (9.784 x E 662) – (0.99 x E 644)

- Chlorophyll b (mg/l) = (21.426 x E 644) – (4.65 x E 662)

- Carotenoids (mg/l) = (4.695 x E 440) – 0.268 (Chl. a + Chl. b)

E = sample optical density at the indicated wavelength.

Color index of all juices were determined by the method of **Meydow *et al.* (1977)** as follows:

Juice was centrifuged at 2000 rpm for 20 min to precipitate the substances causing turbidty. The supernatant was then diluted to 1 : 1 with 95% ethyl alcohol and filtered through Whatman No. 42 filter paper to obtain a fully clarified extract. The percent transmission (T%) of light for such an extract was measured at a Wavelength of 420 nm (the maximum O.D. were at 476 nm) using one cm cell by a CE 599 Universal Automatic Scanning Spectrophotometer. The blank was consisted of an equal mixture of ethyl alcohol 95% and distilled water.

Total content of macro elements were evaluated after being digested according to **Chapman and Partt (1961)**. Nitrogen was determined by Kjeldahl digestion apparatus **(Bremmer and Mulvaney, 1982)**. Potassium, calcium and magnesium were determined by Photofatometer (Model Jenway PFP7 – Range 0 - 160 mmol L^{-1}, USA) and phosphorus (P) was determined colorimetrically following the **Murphy and Riley (1962)** method.

Results and Discussions

1.3. Physical properties

Table (1) shows the dimensions (length, width and thickness) of Indian fig opuntia fruits, geometric mean diameter and arithmetic mean diameters of the Indian fig opuntia fruits. It could be seen that the length, width and thickness of Indian fig opuntia fruit value were 66.68 ± 9.59, 46.09 ± 2.87 and 43.39 ± 1.19 mm, respectively. The coefficient of variation (CV) values of length, width and thickness of Indian fig opuntia fruits were 0.144, 0.062 and 0.027 respectively. These dimension data are very important in handling, packing and storage capacity determination.

The results also indicate that, the geometric mean diameter and arithmetic mean diameter of the Indian fig opuntia fruits were 51.06 ± 3.45 and 52.05 ± 4.03 mm, respectively. The coefficient of variation (CV) values of geometric mean diameter and arithmetic mean diameter of Indian fig opuntia fruits were 0.068 and 0.077, respectively.

Table 1. The mean, standard deviation and coefficient of variation for some physical properties of Indian fig opuntia fruits.

Properties	Main	SD	CV
Length (mm)	66.68	9.59	0.144
Width (mm)	46.39	2.87	0.062
Thickness (mm)	43.39	1.19	0.027
Geometric mean diameter (mm)	51.06	3.45	0.068
Arithmetic mean diameter (mm)	52.05	4.03	0.077

Table (2) shows the fruit mass, volume, true density, surface area, sphericity and moisture content of the Indian fig opuntia fruits. It could be seen that the Indian fig opuntia fruit mass was 68.61 ± 11.61 g, while the coefficient of variation (CV) value was 0.169. The Indian fig opuntia fruit volume was 69.39 ± 12.87 cm^3, while the coefficient of variation (CV) value was 0.185. The true density of the Indian fig opuntia fruits was 989.47 ± 26.45 kg m^{-3}. The coefficient of variation (CV) values of true density of Indian fig opuntia fruits was 0.027. The Indian fig opuntia fruit surface area was 103.68 ± 36.14 cm^2, while the coefficient of variation (CV) value was 0.027.

The sphericity and moisture content of the Indian fig opuntia fruits were 76.85 ± 6.57 and 86.34 ± 2.36 %, respectively. The coefficient of variation (CV) values of sphericity and moisture content of Indian fig opuntia fruits were 0.085 and 0.027, respectively.

Table 2. The mean, standard deviation and coefficient of variation for some physical properties of Indian fig opuntia fruits.

Properties	Main	SD	CV
Fruit mass (g)	68.61	11.61	0.169
Volume (cm^3)	69.39	12.87	0.185
True density (kg m^{-3})	989.47	26.45	0.027
Surface area (cm^2)	103.68	36.14	0.349
Sphericity (%)	76.85	6.57	0.085
Moisture content (%)	86.34	2.36	0.027

Table (3) shows the mass of peel, pulp and seeds of Indian fig opuntia fruits. It could be seen that the Indian fig opuntia peel mass was 29.50 ± 6.27 (43.00%) g, while the coefficient of variation (CV) value was 0.031. The Indian fig opuntia pulp mass was 34.19 ± 5.91 (49.83%) g, while the coefficient of variation (CV) value was 0.044. The Indian fig opuntia seeds mass was 4.92 ± 1.06 (7.17%) g, while the coefficient of variation (CV) value was 0.068.

Table 3. The mean, standard deviation and coefficient of variation for mass of peel, pulp and seeds of Indian fig opuntia fruits.

Mass (g)	Main	SD	CV	%
Peel	29.50	6.27	0.031	43.00
Pulp	34.19	5.91	0.044	49.83
Seeds	4.92	1.06	0.068	7.17

Table 4 shows the projected area, criteria projected area, oblate spheroid volume and ellipsoid shape volume of the Indian fig opuntia fruits. It could be seen that the projected area perpendicular to L, T and W directions of fig fruit were 30.94 ± 5.65, 29.13 ± 4.46 and 20.10 ± 1.57 cm^2, respectively, while the coefficient of variation (CV) value were 0.182, 0.153 and 0.078 for the projected area perpendicular to L, T and W directions, respectively. The criteria projected area of the fig fruits was 68.61 ± 11.61 g, while the coefficient of variation (CV) value was 0.169.

The oblate spheroid volume and ellipsoid shape volume of the Indian fig opuntia fruits were 75.56 ± 17.38 and 71.12 ± 13.62 %, respectively. The coefficient of variation (CV) values of the oblate spheroid volume and ellipsoid shape volume of the Indian fig opuntia fruits were 0.230 and 0.192, respectively.

Table 4. The mean, standard deviation and coefficient of variation for some physical properties of Indian fig opuntia fruits.

Properties	Main	SD	CV
AP1 (cm^2)	30.94	5.65	0.182
AP2 (cm^2)	29.13	4.46	0.153
AP3 (cm^2)	20.10	1.57	0.078
CAP (cm^2)	26.72	3.73	0.140
V_{osp} (cm^3)	75.56	17.38	0.230
V_{ellip} (cm^3)	71.12	13.62	0.192

1.4. Chemical properties:

Table 5 shows the chemical composition of the raw Indian fig opuntia pulp for crude protein, ether extract, crude fiber, ash and total carbohydrates. It could be seen that the crude protein, ether extract, crude fiber, ash and total carbohydrates for the raw Indian fig opuntia pulp were 0.81 ± 0.05, 0.31 ± 0.03, 0.39 ± 0.02, 0.43 ± 0.02 and 10.95 ± 0.39%, respectively. The coefficient of variation (CV) values of the raw Indian fig opuntia pulp for crude protein, ether extract, crude fiber, ash and total carbohydrates were 0.035, 0.052, 0.121, 0.263 and 0.098, respectively. These results were in agreement with those obtained by **Mousa (2004).**

Table 5. The mean, standard deviation and coefficient of variation for some chemical properties of Indian fig opuntia pulp.

Properties	Main	SD	CV
Crude protein (%)	0.81	0.05	0.035
Ether extract (%)	0.31	0.03	0.052
Crude fiber (%)	0.39	0.02	0.121
Ash (%)	0.43	0.02	0.263
Available carbohydrates (%)	10.95	0.39	0.098

Table 6 shows the total solids, total soluble solids, acidity, pH, total sugar, reducing sugar, non-reducing sugar, ascorbic acid and Carotenoides as β-caroteine. It could be seen that the total solids and total soluble solids of Indian fig opuntia pulp were 13.52 ± 0.08% and 11.21 ± 0.02 °Brix, respectively. The coefficient of variation (CV) values of the total solids and total soluble solids contents were 0.101 and 0.179, respectively. The total solids and total soluble solids contents are important factors in the production of fruit juice. It is well established that the higher the total solids, the best is the quality of juice. These results are in agreement with **Parish and Felker (1997)**. They found that the total solids content was 10.23-14.06°Brix, while the results of

Pimienta (1990) ranged from 12 to 17°Brix of Indian fig opuntia juice.

Table 6. The mean, standard deviation and coefficient of variation for some chemical properties of Indian fig opuntia pulp.

Properties	Main	SD	CV
Total solids (%)	13.52	0.08	0.101
Total soluble solids (°Brix)	11.41	0.02	0.179
Acidity (as citric acid) (%)	0.076	0.002	0.019
pH value	5.81	0.29	0.305
Total sugar (%)	10.71	0.04	0.132
Reducing sugar (%)	10.67	0.04	0.127
Non reducing sugar (%)	0.13	0.004	0.099
Ascorbic acid (vit. C) (mg/100 g)	13.75	0.59	0.274
Carotenoides as β-caroteine (mg/100 g)	0.86	0.02	0.091

In the same table, data showed that the titratable acidity was 0.072 ± 0.002% (as citric acid) and pH value was 5.72 ± 0.29 and it is known that the Indian fig opuntia juice had high pH value and these attributes put the product in the low acid food group. The coefficient of variation (CV) values of the titratable acidity and pH were 0.019 and 0.305, respectively. Titratable acidity and pH value would be of great importance, since the ratio of total soluble solids to acidity will affect flavor. The obtained results agree with **Sepulveda and Saenz (1990)**.

The sugars were the major soluble solids of the prickly pear fruits. Sucrose content was relatively lower than glucose and fructose contents in pulp and juice **(Kuti and Galloway, 1994)**. Total, reducing and non-reducing sugars of Indian fig opuntia pulp were 10.71 ± 0.04, 10.67 ± 0.04 and 0.13 ± 0.004%, respectively. The coefficient of variation (CV) values of the total, reducing and non-reducing sugars were 0.132, 0.127 and 0.099, respectively. These results were in agreement with **Mousa (2004)**. They found that total sugars were in the range from 10.5 to 12.8% (on fresh weight). Also, **Singh and Felker (1998)** found that the reducing sugars were 11.8% (glucose 7% and fructose 4.8%) while the non-reducing was 0.2% sucrose.

Ascorbic acid retention is considered as a good indication for high quality. In addition, it has a high nutritive value being one of the important vitamins. As showed in Table (6), the ascorbic acid (Vit. C) content was 13.75 ± 0.59 mg/100 g of raw prickly pear juice. These results agree with **Soliman (1996)**. Also, **Kuti (2004)** reported that Vit. C in *Opuntia lindheimer* was 12.1 mg/100 g (121 µg/g) on fresh weight and lower than those reported by **Singh and Felker (1998)**, (22 mg/100 g). On the other hand, the carotenoids content was 0.83 ± 0.02 mg/kg. These results agree with **Sepulveda and Saenz (1990)**. They reported a carotenoid content of 0.53 mg/ 100g.

Table 7 shows the nitrogen, phosphorus, potassium, calcium and magnesium contents of Indian fig opuntia pulp. It could be seen that the nitrogen, phosphorus, potassium, calcium and magnesium contents of Indian fig opuntia pulp were 289.5 ± 0.83, 136.9 ± 0.69, 827.2 ± 4.03, 331.2 ± 3.07 and 187.1 ± 1.98, respectively. The coefficient of variation (CV) values of the nitrogen, phosphorus, potassium, calcium and magnesium contents of Indian fig opuntia pulp were 0.438, 0.210, 0.152, 0.205 and 0.181, respectively.

Table 7. The nitrogen, phosphorus, potassium, calcium and magnesium contents of Indian fig opuntia pulp.

Properties	Main	SD	CV
Nitrogen (mg/kg)	289.5	0.83	0.438
Phosphorus (mg/kg)	136.9	0.69	0.210
Potassium (mg/kg)	837.2	4.03	0.152
Calcium (mg/kg)	331.2	3.07	0.205
Magnesium (mg/kg)	187.1	1.98	0.181

Conclusion

An experimental study was carried out successively to determine the physical and chemical properties of Indian fig opuntia fruits. The obtained results can be summarized as follows:

The length, width and thickness of Indian fig opuntia fruit value were 66.68, 46.09 and 43.39 mm, respectively. The geometric mean diameter and arithmetic mean diameter of the Indian fig opuntia fruits were 51.06 and 52.05 mm, respectively. The Indian fig opuntia fruit mass, volume and true density were 68.61 g, 69.39 cm^{-3} and 989.47 kg m^{-3}, respectively. The Indian fig opuntia fruit surface area was 103.68 ± 36.14 cm^2. The sphericity and moisture content of the Indian fig opuntia fruits were 76.85 and 86.34 %, respectively. The Indian fig opuntia peel, pulp and seeds mass were 29.50, 34.19 and 4.92 g, respectively. The crude protein, ether extract, crude fiber, ash and total carbohydrates for the raw Indian fig opuntia pulp were 0.81, 0.31, 0.39, 0.43 and 10.95%, respectively. The total solids and total soluble solids of Indian fig opuntia pulp were 13.52 % and 11.21 °Brix, respectively. The titratable acidity was 0.072 % (as citric acid) and pH value was 5.72. Total, reducing and non-reducing sugars of Indian fig opuntia pulp were 10.71, 10.67 and 0.13 %, respectively. The nitrogen, phosphorus, potassium, calcium and magnesium contents of Indian fig opuntia pulp were 289.5, 136.9, 827.2, 331.2 and 187.1, respectively.

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الخصائص الطبيعية والكيميائية لثمار التين الشوكى

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يهدف هذا البحث الى دراسة الخصائص الطبيعية والكيميائية لثمار التين الشوكى. وكانت اهم النتائج المتحصل عليها: كان كلا من الطول والعرض والسمك لثمار التين الشوكى 66.68 و46.09 و43.39 مم، على التوالى. وكان كلا من متوسط القطر الهندسى ومتوسط القطر الحسابى لثمار التين الشوكى 51.06 و52.05 مم، على التوالى. كان كلا من الوزن الكلى للثمار والحجم والكثافة الحقيقية لثمار التين الشوكى هى 58.61 جم و69.39 سم^3 و989.47 كجم م$^{-3}$، على التوالي في حين كان متوسط المساحة السطحية لثمار التين الشوكى هى 103.68 سم^2. كان متوسط الكروية والمحتوى الرطوبى لثمار التين الشوكى هو 76.85 و86.34%، على التوالى. بينما كان متوسط وزن القشر واللب والبذور لثمار التين الشوكى هو 29.50 و34.19 و4.92 جرام على التوالى. كان متوسط البروتين الخام ومستخلص الاثير والألياف الخام و الرماد والكربوهيدرات الكلية هو 0.81 و0.31 و0.39 و0.43 و10.95 % على التوالي. كان متوسط المواد الصلبة الكلية والمواد الصلبة الذائبة الكلية لثمار التين الشوكى هو 13.52 و11.21 % درجة بركسل على التوالى. وكان متوسط رقم الحموضة لثمار التين الشوكى هو 7.72. كان متوسط السكريات الكلية والسكريات المختزلة والغير مختزلة هو 10.71 و10.67 و0.13% على التوالي. وكان متوسط محتوى ثمار التين الشوكى من النيتروجين والبوتاسيوم والفوسفور والكالسيوم والماغنسيوم 289.5 و136.9 و827.2 و331.2 و187.1 % على الترتيب.

الكلمات المفتاحية: التين الشوكى – الخصائص الطبيعية – الخصائص الكيميائية – الأبعاد – المساحة السطحية – الحجم – الكثافة – المواد الصلبة الذائبة الكلية.