

Determination of Engineering Properties of Cactus Pear (Opuntia)

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ABSTRACT- Wild cactus pears (*Opuntia* spp.) were collected from five locations on Turkey's southeastern coast, in the Mediterranean region. The fruit and seed characteristics were hugely affected by the site. Colletotrichum species of fungi produce anthracnose, particularly harms cactus pears in particular. A wet light brown rot with light pink, spore-producing pustules on the surface is a sign of infection. Cactus pears available in a multitude of tastes, textures, and colours, with some of them proving beneficial to health and used in drug and cosmetic items. The measurement of engineering properties of cactus fruit can be beneficial for designing various processing and harvesting equipment, product development, food quality control, and food processing. Cactus (*Opuntia*) has stood commercially exploited for example medicinal, energy, fruit, vegetable, forage besides dye yielding crop cutting-edge the dry besides half-dry parts of the world. This study focus on engineering properties and textural property of Cactus pear fruit namely length, width, thickness, equivalent diameter, weight, sphericity, volume, density, and firmness, ripeness of Cactus pear were observed/determined, which can be useful for the further processing of cactus pear.

KEYWORDS: Cactus Pear, Cactus Fruits, Engineering Properties, Food, Plant, Water

I. INTRODUCTION

Prickly cactus pear, also called as nopal, is the edible fruit of many class of flat-stemmed spiky cacti in the genus *Pontiac* (domestic *Cactaceae*). Prickly pear cactus remain native to the Western Hemisphere, and numerous varieties remain extensively refined, such as the Indian, which is a basic meal aimed at numerous people in tropical besides subtropical areas. The Indian cactus pear grows to a height of 5.50 metres (18.0 feet) and is bushy to treelike. It has big yellow flowers with a size of 7.50 to 10.0 cm (3.0 to 4.0 inches), which are followed through yellow, or reddish-purple fruits, white. It remains extensively grown as a forage crop and aimed at the fruit besides comestible paddles in warmer climates. Crop oil is made from the hard seeds. The stalks, particularly of spineless types, remain rummage-sale as emergency stock feed throughout drought because to their high water content.[1]. In a half-dry environment of India, the replies of cactus pear to agronomic methods (establishing timing, irrigation, and chemical fertilizer) were assessed to determine the

potential aimed at fodder manufacture besides livestock feed. Assessed 4 planting periods (October February, March and July) besides 2 agronomic organisations (by besides deprived of irrigation besides fertilizer application) throughout two thousand sixteen-two thousand twenty at Jhansi, India. Because the favourable soil moisture and temperature, cactus pear founding and development enhanced through establishing time in July besides October. Plant tallness (19.0 cm) and cladode heaviness (118.00 g) were, however, superior cutting-edge July than in October. The previous plantings of February besides April, on either hand, had higher nutrient acceptance besides crude protein contents than the later plantings of June and October. Except aimed at plant width besides cladode length, irrigation besides nutrient delivery had little consequence on cactus pear plant development. [2]. Cactus pear can be planted without agronomic intervention on moderately fertile soils during July cutting-edge half-dry parts of India, besides it has the prospective to be an actual alternative source of feed aimed at animals throughout the summer months. India remains the world's second-largest fruit producer, accounting for 12% of global fruit production. From 12.7700 million hectares in nineteen ninety one – nineteen ninety two to 23.6900 million hectares in two thousand twelve-thirteen, the area under gardening crops has raised dramatically. During this time, total production has grown by nearly 2.8 times, while productivity has increased by 1.5 times. [3]. In many Latin American cultures, the cactus plant is a staple. This arid-loving plant can be discovered in arid parts of Latin America, Southern California, and Arizona. The cactus fruit (prickly pear) and the flat cactus pad are the two parts of the cactus that are widely eaten (nopales). Can eat the fruits and pads of the cactus raw, cook them into recipes, or squeeze them into juice. can either gather them or buy them at a market place.[4].

A. Variety of Cactus Pears

Many varieties of Cactus pears are available, some of them dissimilar in taste, structure, colors, and beneficial for health, using in drug and cosmetic products [5]–[7]. Generally, Cactus stands growing in the desert area, but some of the variety of Cactus grow cutting-edge normal rainy areas.

B. Eastern prickly pear

The *Cactaceae* (Cactus) family comprises eastern prickly pear. There are about 1,800 species in this family, but only

one or two are native to the New World. The *Opuntia* domestic has about 150 species of prickly pears, making it an ancient cactus family. It may be originate from Novel Mexico besides Montana east to Florida besides Massachusetts, and it has the major range of any cactus cutting-edge the United States. It may also be originate fashionable the ontario. Eastern prickly pear can grow in large colonies or as a single individual. [8]. In grownup botanical manuals, it stays often listed as *Opuntia compressa*. This is a typical cactus with a photosynthetic stalk that also serves as a leaf. This stem could also be used to hold water. It can withstand the cold temperatures of the northern and middle states because to specific antifreeze chemicals in its cells. The stems, also called as pads, can vary in length from 5 to 17 centimetres (2 to 7 inches) and width from 4 to 12 centimetres (1.5 to 5 inches). Pads can be attached in a straight or branched pattern. The plants are generally no more than 0.5 metres (19 inches) tall and sprawl on the ground. [9]. Some Florida plants stay shrub-like besides may reach two meters (6.5 feet) high.

C. Bunny Pear Cactus

A very attractive Cactus, *Opuntia* is a perennial bushy with round flattened pads that are extremely cute. This cactus is a favorite among indoor and outdoor succulent growers. The green pads of this cacti form shrubs [10]. The pads do not even have spines, but rather white or yellow aureoles that mimic cotton tufts. Although they seem to be soft, they are barbed and thinner than the finest human hairs, and they detach in large numbers when stroked. They will cause considerable skin irritation if not removed, thus the plants must be treated with caution. Stem offsets and cuttings can easily be used to propagate Bunny Ears Cacti. This succulent is a real beauty for any plant lover and the pride of our plant nursery [10].

D. *Opuntia monacantha* Cactus

To prevent rot, cactus require bright sunlight, proper drainage, and infrequent water. Usage well-draining cactus besides succulent soil with 70 percent to 80 percent inorganic grit, such as coarse, pumice, sand or perlite, in containers with drainage holes. Before watering again, soak the soil deeply and allow to dry fully. [11].

E. Eltham Indian-fig Cactus

Ficus benghalensis is a common name for several plants, included *Ficus benghalensis*, a species of banyan tree also known as Indian fig. *Ficus benghalensis* is a common name for several plants, notably *Ficus benghalensis*, a species of banyan tree also known as East Indian fig. *Opuntia ficus-indica* is a cactus species which is also known as Indian fig *Opuntia*. *Opuntia humifusa* is a cactus species which is also known as eastern prickly pear. Cactus has been commercially exploited as a fruit, vegetable, fodder, energy, medicinal, and dye-yielding crop in arid and semi-arid regions of the world. Brazil, Argentina, South Africa, Israel, the U.S., Italy, and many other Latin American countries are one of the countries where cactus is grown as a cultivated crop and commercially exploited. [12]. The Indian subcontinent is familiar in cactus cultivation as a commercial crop. In the wasteland, only the wild cactus grows as a hedge around agricultural areas to protect crops from wildlife. The plant has ample scope for introduction and cultivation in rain-fed and dry areas of India, where

two third of the poor rural population is settled, due to its highest water use efficiency per unit dry matter production. Cactus is particularly important in drought-prone areas of the nation, where it may help augment food and fodder requirements, preventing cattle from migrating to other places. It has the potential for soil and water conservation when grown on slopes in hilly terraces in rain-fed areas of the nation, in addition to its remarkable value as cattle and human food. Cactus is used for human use as a fruit and vegetable, as well as feed for cattle and as a red dye. [13]. Numerous other uses of cactus remain in control of diabetes, ethanol production, besides as a live fence. Cactus pear fruit is used as a juice, beverages, jam, as well as natural cocologels, in pharmaceutical industries and for increasing hemoglobin in the blood.

F. Heath benefit

Cactuses were high in vitamins C, E, and A, and also iron, calcium, and other elements. This broad array of nutrients, and others, can aid in the decrease of inflammation in the body. Cactuses are very well for their nutritional and medicinal qualities. Both the pads and the fruit of the cactus can help fight infections and alleviate symptoms range from hangovers to high cholesterol. Both the cactus pad and the cactus fruit are high in fibre, which can help lower blood cholesterol levels. Cacti consumption was found to decrease body fat, blood pressure, and cholesterol levels in a study.[14]. Cactus fruits can assist lower risk of sicknesses similar stroke and coronary heart disease by introducing it to diet. Cactus fruits, in particular, are decent basis of Vitamin c, which is single of the greatest immune boosters. Vitamin C boosts the manufacture of snowy blood cubicles, making less likely to get sick and assisting body in combating viruses if do get sick.

II. DISCUSSION

The following engineering properties of the most common variety of Cactus pear grown cutting-edge the Saurashtra (Gujarat) region were determined as follows:

A. Physical properties of Cactus pear Size

The Vernier calliper, which may be rummage-sale to measure the outside size of a Cactus, is made up of a couple of jaws, single devoted to a fixed scale or key scale besides the other devoted to a descending (Vernier) scale for determining the amount dime the tension of mature Cactus. The width of a cactus is determined by placing it between the jaws of a calipers. The size of ripe Cactus pear was determined cutting-edge terms of length (l), width (b), and thickness (t) by use of Vernier caliper as shown in Figure 1.



Figure 1: Illustrating the Measurements the size of Cactus Pear by using a digital Vernier caliper

Herein the Digital Calliper is used to determine the accurate dimension of Cactus pear in digital form, these devices accommodate with battery. This battery provided D.C current to operate the digital Vernier Calliper[15]. The size of each fruit cutting-edge terms of corresponding diameter (De) was also determined through using Following formula:

$$De = \frac{l}{3} \dots \dots (1) \dots (1) \text{ Verniar Calliper}$$

Where,
l = major intercept (mm), i.e. maximum interrupt

b = major intercept perpendicular to l (mm), i.e. intermediate interrupt
t = major intercept perpendicular to l and b (mm), i.e. least interrupt

Sphericity of Cactus pear

Sphericity can be measured by using the following formula:

$$\text{Sphericity (S)} = \frac{(lbs)^{1/3}}{1}$$

Different Shape of Cactus Pear:

The figure of the Cactus pear fruit was determined by the charted standard method of fruit shape. The different shapes of Cactus pear collect and cut it's in a longitudinal and cross-sectional manner and analysis the inner shape and size of Cactus pear. The Standard chart is shown in Figure 2.

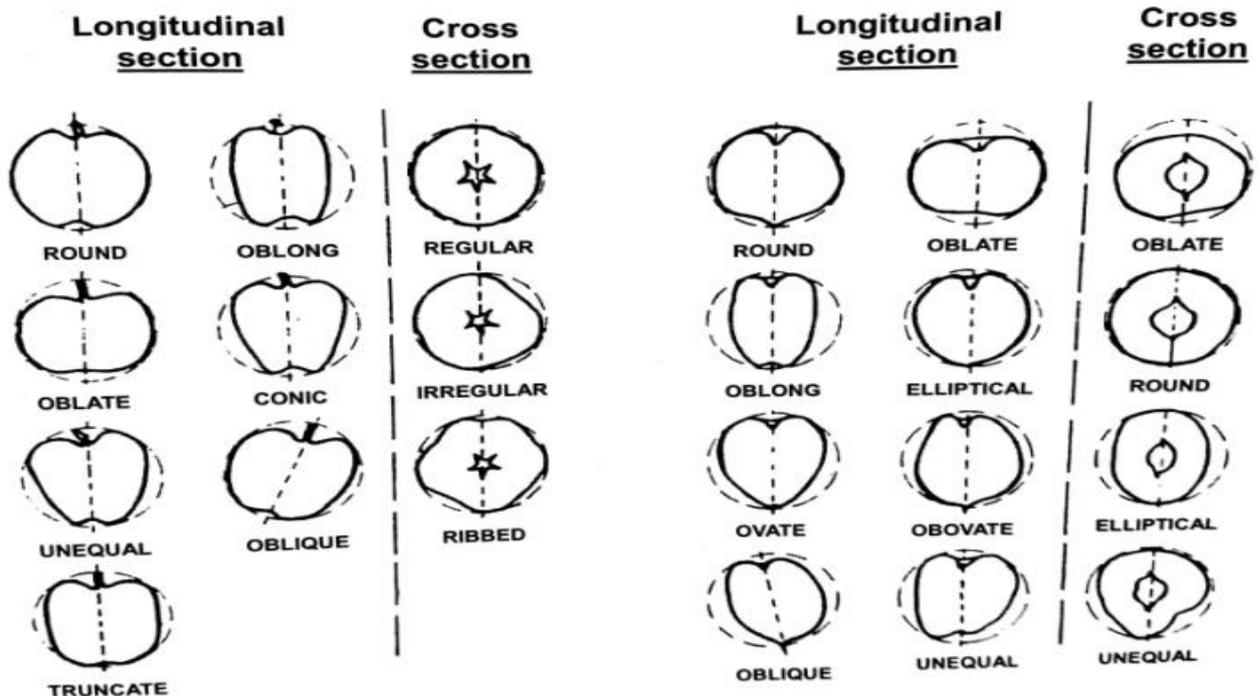


Figure 2: Illustrating the Chart for Standard Shapes of Cactus Fruits.

B. Volume, True density, and Specific gravity of Cactus pear

a. Volume

The amount of 3-dimensional space surrounded by a closed superficial stays described as a scalar quantity named volume. Aimed at example, the space filled or enclosed by a material (solid, liquid, gas, or plasma). The SI-derivative unit, the cubic metre, is often rummage-sale to measure volume statistically.

b. Density

Mass per unit volume remains the concept of thickness. It is a complete quantity using the SI unit kg m-3.0 or kg/m3. The proportion of a material's density to that of aquatic at

4 degrees Celsius remains called as specific gravity (SG) (where it remains most thick besides stays occupied to have the value 999.97400 kg m-3). As a result, it remains a comparative quantity with no units.[16]. To convert a specific gravity to a density, multiply the SG by the reference density on which it was determined. Most of the times, this is the density of water, thus multiply the SG by 1 to have the density in g/cm3.

c. Specific gravity

The proportion of an object's thickness to an orientation substance remains known as specific gravity. The specific gravity may express us if an object will sink or float cutting-edge our orientation substance based on its value. The platform scale method was rummage-sale to

determine the volume, true density, besides specific gravity of fruit as shown in figure 3.



Figure 3: Shows the Measurement of volume, true density, and specific gravity of Cactus Pear.

$$\text{Volume (cm}^3\text{)} = \frac{\text{Weight of displaced fluid (g)}}{\text{Density of fluid (g/cm}^3\text{)}} \dots\dots (2)$$

$$\text{True density (g/cm}^3\text{)} = \frac{\text{Weight of sample in air (g)}}{\text{Volume of displace fluid (cm}^3\text{)}} \dots\dots (3)$$

$$\text{Specific gravity} = \text{fluid weight} \dots\dots (4)$$

d. Textural Property:

The textural assets of a nutrition remain a collection of physical physiognomies that rise from the physical parts of the nutrition and remain related to the deformation, disintegration, besides flow of the nutrition below a force, besides remain objectively measured via mass and time functions.

e. Firmness

The crispness of a fruit is its firmness. Applying pressure is one of the easiest methods to determine it. Pressure testers and penetrometers are two instruments that can be used to determine firmness. Since a probe is put into the fruit or pressure is applied to distort a fruit, they are destructive.[17]. The firmness of ripe fruit was measured by using the firmness tester instrument as shown in Figure 4.



Figure 4: Illustrating the Measurement firmness, Ripeness and Textural property of fruit.

The sharp metallic nib is inserted inside the ripen cactus pear after in few fractions of a second this device measures the Firmness of Cactus fruits. The firmness of fruit expresses the fruits are how much to ripen, sour and raw.

C. Properties of Ripen Cactus Pear

When cactus pears turn a deep, nearly magenta red, they're ready to eat. Birds pecking at the fruit and fruit falling to the ground are two more signs of peak ripeness beyond the simple color test. If pick a pear besides get green flesh at the wound, the fruit is not quite prepared as shown in Table 1. The cactus fruit, sometimes named "Prickly Pears" remain very sweet besides may be eaten raw, right off of the plant[18].

Table 1: Represents the Engineering Properties of Ripen Cactus Pear.

Sr. No	Engineering property	Minimum Value	Maximum Value	Average Value	
1	Size	Length, mm	31.75	51.52	42.15
		Width, mm	24.03	36.50	31.40
		Thickness, mm	21.83	36.41	29.93
		Equivalent diameter, mm	27.23	39.27	34.04
2	Sphericity	0.67	0.90	0.81	
3	Fruit weight, g	10.33	33.77	22.20	
4	Firmness, kg/cm ²	6.88	15.25	11.01	
5	The volume of ripe fruit, (cm ³)	12.20	28.70	19.52	
6	The density of ripe fruit, (g/cm ³)	0.97	1.06	1.01	
7	The specific gravity of ripe fruit.	0.97	1.06	1.01	
8	Shape	Oblong			
9	Colour	Red			

III. CONCLUSION

The dissimilar form of Cactus pear gather besides expurgated its cutting-edge longitudinal and a cross-sectional way for analysis the inner shape and size of Cactus pear. Now is the season to harvest them. By mid-August, the bulk of the fruit has ripened. Pick those that don't have green ends and are a full ruby colour. They should pop off the pad and dribble a little juice as twist them off. The determination of bodily dimension of ripe Cactus using the Vernier caliper, which may be cast-coast off sure the external size of a Cactus. The extent of ripe Cactus pear is determined accurately cutting-edge terms of length (l), width (b), besides thickness (t) by use of the Vernier caliper. Using the equation and Instrument to determine accuracy ate the volume, true den, city, and specific gravitate y of Cactus rip the end pear, Physical properties of the cactus pear, i.e. length, width, thickness, ness, and equivalent diameter were observed 42.15 mm, 31.40 mm, 29.93 mm and 34.04 mm respectively. Sphericity, weight, v, volume, and density of cactus fruit were observed at 0.81, 22.20 g, 19.52 cm³, and 1.01 g/cm³

respectively. Textural property, i.e. firmness of cactus fruit was orbs at served 11.01The oblong.

The oblong shape was found for cactus fruit by charted standard method and by visual observation red color was observed. The crispness of a fruit is determined by its firmness. Putting on the pressure is among the ways to gauge the puttinthe in this. Pressure testers and penetrometers are two tools that can be used to assess hardness. Cactuses are high in iron, calcium, and other vitamins. This wide range of nutrients, and others, can help to reduce inflammation in the body. These are the most effective immune enhancers. Vitamin C the production of white blood cells when consumed on a regular basis. Cactus fruits and pads contain anti-inflammatory vitamins and nutrients that can help lessen the risk of significant health conditions like diabetes and heart disease. Cactus fruit is known as tunas in Spanish. The thick skin of the fruit is covered in small spines and grows on the rounded edges of cactus paddles. As cut these open, discover soft, juicy meat inside, and a lot of dark, round seed. Fruit hardness tester or Fruit Penetrometer: used to determine the adulthood of fruits, to nurture decent diversities, to test the rigidity of pears, watermelons, bananas, apples and other fruits, to determine export transportation, picking time, processing time, harvest storage besides other sensible time control Fruit hardness is a widely acknowledged indication of maturity. The produce the force required to drive a plunger tip (of a specific size) into fruit and vegetables is assessed with a penetrometer that accurately measures fruit hardness. The Cactus plants are generally found in desert areas and agriculture of this plant in the desert area is possible because this plant required less water, their branches and leaves are Prickly whenever the sunlight falls on the Cactus plant and then the prickly structure of this plant emits less water in vapour form from this branch and leaves. The Cactus plant is very beneficial for the patient which is suffering from some sickness, this plant provides the extra vitamin and fiber.

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