

FORMULATION AND EVALUATION OF ENERGY DRINK USING CACTUS FRUIT

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Abstract

Betalanin and carotenoids are present within the peel and pulp of various ecotypes which have shown antioxidant Cactus fruit, commonly known as prickly pear, is the edible fruit of the cactus plant belonging to the genus *Opuntia*. It is widely grow. The cactus pear fruit derived from Cactaceae family plant, morphologically distinct plant families. Cactus fruit is abundantly found in Mexico and the United States, but is also grown in Africa, Madagascar, Australia, Sri Lanka and India. It contains protein, fat, fiber etc., similar to other common fruits. The whole content of free amino acid is more than compared to different fruits, contains high level of serine, g-amino butyric acid, glutamine, proline, arginine and histidine and also contains methionine. It is also rich in calcium and phosphorus. Pigments are found mainly within the fruit, in arid and semi-arid regions of the world, including Mexico, the Mediterranean, the Middle East, Africa, and parts of Asia. The fruit typically has a bright outer skin that can be green, yellow, orange, red, or purple, depending on the variety. Inside, it contains juicy pulp filled with small edible seeds. The taste is mildly sweet and refreshing, often compared to a blend of watermelon and berries.

INTRODUCTION [1,2]

Energy drinks are beverages formulated to increase alertness, energy, and concentration. They typically contain stimulants and other performance-enhancing ingredients. Energy drinks represent a rapidly expanding segment of the global beverage market, marketed primarily for their ability to enhance alertness, concentration, and physical performance. Formulated with varying combinations of simple carbohydrates, amino acids like taurine, and micronutrients, these beverages act as stimulants that influence both cognitive and physiological functions. Despite their popularity among adolescents, athletes, and working adults, the long-term health implications of energy drink consumption.

Cactus fruit

Cactus (*Opuntia ficus-indica*), commonly known as prickly pear, belongs to the family Cactaceae. It has high water-use efficiency, drought tolerant, survive under erratic and low rainfall and highly useful in arid and semiarid environments, particularly during prolonged dry spells or failure of the monsoon.

OBJECTIVES [2,3]

1. Provide natural energy likes vitamins, minerals.
2. Deliver sustained energy for daily activities, workouts.
3. Reduce fatigue and tiredness naturally.
4. Help in hydration.

MATERIALS AND METHODS [4]



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Figure 1. Cactus Fruit

Plant Profile: Cactus

Botanical name – *Opuntia ficus Indica*

Common name – pinkly pear, cactus fruit.

Plant type – evergreen, small fruit tree

Family – Cactaceae

Lemon Fruit:



Figure 2. Lemon fruit

Scientific name- *citrus lemon*

Family – rutaceae

Plant type – evergreen small fruit tree

Preparation of Cactus Fruit Pulp: [5]

Mechanical extraction:

1. Add cactus pieces to blender. Add distilled water
2. Blend for 2–3 minutes until homogenized.
- 3 Filter through muslin cloth.
4. Centrifuge filtrate at 5000 rpm for 10 min.
5. Collect supernatant → this is the juice extract.

IDENTIFICATION TEST [6]

1. Alkaloids Test

The alkaloid test is performed to detect the presence of alkaloids in the cactus fruit energy drink. Alkaloids are naturally occurring nitrogen-containing compounds that may possess physiological and medicinal activities. Examples of alkaloids include caffeine, quinine, morphine, and nicotine.

2. Glycoside Test

Glycosides are naturally occurring compounds found in many plants and fruits. They consist of a sugar part linked to a non-sugar component called aglycone. Some cactus fruits .flavonoid glycosides and phenolic glycosides which contribute to antioxidant activity and health benefits.

PREPARATION OF ENERGY DRINK: [7]

1. Wash and peel cactus fruits carefully (remove spines).
2. Extract pulp and filter through muslin cloth.
3. Prepare sugar syrup separately.
4. Mix pulp + water + syrup under continuous stirring.
5. Add citric acid, ascorbic acid, and preservative.
6. Adjust pH to 3.5-4.0.
7. Pasteurize at 85°C for 15 minutes.
8. Cool and fill into sterilized bottles.
9. Store at room temperature or refrigeration

FORMULATION TABLE

Table 1. Formulation of Batches

Sr.no	Ingredients	Batch 1	Batch 2	Batch 3	Batch 4	Batch 5
1	Cactus fruit pulp	62	50	40	20	20
2	Lemon juice	3.0	3.0	2.2	1.2	1.2
3	Sugar	30	30	17	9.5	9.5
4	Sodium chloride	0.125	0.125	0.75	0.17	0.17
5	Sodium benzoate	0.40	0.40	0.25	0.10	0.10
6	Natural flavor a) Orange b) Peppermint c) My pan chocolate d) Cardamom	4.5	6.5	1.3 7.5	1.4 9.5	1.4 7.5
7	Distilled water	150	158	130	58	60
	Total	250	250	200	100	100
	Results				Pass	Pass

EVALUATION PARAMETER [3,7,8]

1. Physical evaluation

1. pH Test: pH is the measure of acidity or alkalinity of a solution.

Principle: The pH of the cactus fruit energy drink is measured using a digital pH meter. The pH meter measures hydrogen ion concentration in the beverage and displays the acidity level.

2. Viscosity Test: Viscosity is the measure of resistance of a liquid to flow. It indicates the thickness or fluidity of the cactus fruit energy drink. Low viscosity liquids flow easily, while high viscosity liquids flow slowly.

Principle: The viscosity of the energy drink is measured using a Brookfield viscometer or Ostwald viscometer. The instrument measures the internal resistance offered by the liquid during flow.

3.Colour: The color of the formulation was checked by visual inspection.

4. Odour: The formulation was tested to ensure that it had a pleasant, fruit aroma odour.

5. Appearance: Clear and uniform.

6. Taste: Sweet

7.Texture: Smooth and mouth refreshing.

8. Clarity: Clarity indicates the absence of suspended particles, turbidity, or sediment in the drink. A clear beverage is considered more acceptable and visually appealing.

9.Density: Density is the mass per unit volume of a liquid. It is calculated by measuring the weight of a known volume of the drink.

2. Chemical evaluation: [1,9]

1.Carbohydrates Test: Carbohydrates are organic compounds present in the cactus fruit energy drink mainly in the form of sugars. They provide energy and improve the taste of the beverage.

2. Electrolyte Test: Electrolyte test is performed to determine the presence and concentration of minerals such as sodium, potassium, chloride, calcium, and magnesium present in the cactus fruit energy drink. Electrolytes help maintain body fluid balance, nerve function, and muscle activity.

3. Protein Test: Protein test is performed to identify the presence of proteins or amino acids in the cactus fruit energy drink. Proteins are important nutrients required for body growth, tissue repair, and enzyme formation.

4. Sterility tests: The sterility test is performed to check whether the energy drink is free from viable microorganisms such as bacteria, fungi, and yeast. The sample is incubated in suitable culture media under controlled conditions and observed for microbial growth.

5. Stability: Stability testing is an important quality control test performed to determine the shelf life, safety, and quality of the cactus fruit energy drink during storage. It helps to evaluate whether the formulation maintains its physical appearance, chemical composition, taste, nutritional value, and microbial safety over a specified period under different environmental conditions.

6. Shelf life: Shelf life testing is performed to determine the period during which the cactus fruit energy drink remains safe, effective, and acceptable for consumption under specified storage conditions. The shelf life of a product depends on its physical stability, chemical composition, microbial safety, packaging, and storage conditions.

7. In Vitro Activity of Cactus Fruit (Opuntia Ficus Indica) As an Immunity Booster. [9]

Principle: Cactus fruit contains betalains, flavonoids, polyphenols, vitamin C, and antioxidants that can enhance immune function by protecting cells from oxidative stress and stimulating immune responses.

Procedure

1. Preparation of Cactus Fruit Extract

- ❖ Wash and peel the cactus fruits.
- ❖ Grind the pulp into a smooth paste.
- ❖ Extract with distilled water or 70% ethanol.
- ❖ Filter and centrifuge the extract.
- ❖ Collect the supernatant and store at 4°C.

2. Antioxidant Activity Assay (DPPH Method)

- ❖ Prepare DPPH solution.
- ❖ Add different concentrations of cactus fruit extract.
- ❖ Incubate in the dark for 30 minutes.

- ❖ Measure absorbance at 517 nm.
- ❖ Calculate percentage radical scavenging activity.

RESULT AND DISCUSSION

Physical Evaluation

Table 2. Physical Evaluation

Batch no.	Colour	Odour	Taste	Clarity	pH
F1	Reddish	Dark	Sweet	Clear	3.0
F2	Faint Plink	Dark	Sweet	Clear	4
F3	Reddish	Pleasant	Sweet	Clear	4.2
F4	Bright pink	Chocolate aroma	Sweet	Clear	4.2
F5	Bright pink	Aromatic	Sweet	Clear	4.2

Table 3. Physical Evaluation

Batch no	Viscosity	Density	Texture	Appearance
F1	Moderate	1.02	Smooth	Attractive
F2	Moderate	1.02	Uniform	Attractive
F3	Moderate	1.05	Uniform	Attractive
F4	Moderate	1.02	Smooth	Attractive
F5	Moderate	1.05	Smooth	Attractive

2. Sterility Evaluation

Table 4. Sterility Evaluation

Formulation	Room Temp.	Freezing Temp.	Excessive Temp.
F1	Unstable	Unstable	Unstable
F2	Unstable	Stable	Unstable
F3	stable	Stable	Unstable
F4	Stable	Stable	Stable
F5	Stable	Stable	Stable

Chemical Evaluation:

Figure 3. Protein test



Figure 4. Carbohydrate Test



In Vitro Activity of Cactus Fruit (*Opuntia Ficus Indica*) As an Immunity Booster

Result: Higher scavenging activity indicates stronger antioxidant and immunity-supporting potential.

3. Phagocytic Activity Assay

- ❖ Isolate macrophages or neutrophils from blood.
- ❖ Treat cells with cactus fruit extract.
- ❖ Incubate for 24 hours.
- ❖ Add latex beads or yeast cells.
- ❖ Observe under a microscope and count engulfed particles.

Result: Increased phagocytosis indicates enhanced immune cell activity.

4. Nitric Oxide Production Assay

- ❖ Incubate macrophages with cactus fruit extract.
- ❖ Collect culture supernatant.
- ❖ Add Griess reagent.
- ❖ Measure absorbance at 540 nm.

Result: Increased nitric oxide production suggests activation of immune cells.

- ❖ High antioxidant activity
- ❖ Increased phagocytic index
- ❖ Enhanced nitric oxide production
- ❖ Improved immune cell stimulation

Figure 5. Energy Drink



CONCLUSION:

The cactus fruit energy drink is a novel and nutritious functional beverage developed using cactus fruit along with suitable energy-enhancing and electrolyte-containing ingredients. The formulation combines the natural health benefits of cactus fruit with the refreshing and energizing properties required in an energy drink. Due to the presence of natural sugars, vitamins, minerals, antioxidants, and bioactive compounds, the drink serves as a

healthy alternative to synthetic commercial energy beverages.

The Cactus Fruit Energy Drink (Batch No. F5) successfully passed all the evaluated quality control tests. The results obtained for parameters such as appearance, pH, density, viscosity, phytochemical screening, and other analytical tests were within acceptable limits. Therefore, Batch 5 meets the required quality standards and is considered suitable for consumption and

further application as an energy drink with potential immunity-boosting properties. The product was found to be stable, safe, and of acceptable quality based on the tests performed.

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