

Formulation and Evaluation of Natural Antioxidant Jellis containing Lemon Juice

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Abstract: *This study looks at creating and testing a natural antioxidant jelly that includes lemon juice as a key ingredient. Free radicals can cause oxidative stress, which is linked to several health problems. Because of this, there's a growing need for natural antioxidants in both food and medicine. Lemon, or Citrus limon, is packed with active compounds like vitamin C, flavonoids, and phenolics, all of which have strong antioxidant effects.*

In this research, antioxidant jelly was made using fresh lemon juice, sugar, purified water, and agar to help it set. The jelly was then checked for different physical and functional qualities, such as how it looks and tastes, its pH level, how evenly it weighs, its texture, how long it takes to set, and its antioxidant power, measured using the reducing power test.

The results showed that the jelly had good sensory qualities—like a nice color, a lemony smell, and a firm yet soft texture. The pH of the jelly was between 3.0 and 3.4, which is acidic because of the citric acid in lemon juice. Each batch had a consistent weight and formed a proper gel. The antioxidant tests showed strong reducing power, meaning the jelly contains effective antioxidant materials.

In summary, this study shows that lemon juice can be used to make a jelly that is rich in antioxidants and has good quality. This product could be a useful functional food that offers health benefits, and it's a natural, affordable, and environmentally friendly substitute for artificial antioxidants.

Keywords: *natural antioxidant jelly*

I. INTRODUCTION

Today, oxidative stress is a major concern in our modern lives. It can be caused by things like polluted air, smoking, UV rays, and how people live. This kind of stress can damage cells and is connected to several health issues, such as skin inflammation, skin cancer, and premature aging. One key use of natural plant extracts in beauty products is their ability to fight oxidative stress by acting as antioxidants. Natural antioxidants are usually safer and less likely to cause allergic reactions, making them perfect for making products that are gentle on the skin. These extracts also tend to have antimicrobial properties, which can help fight harmful bacteria. Even though we still don't fully understand how different plant extracts work as antioxidants and antimicrobials, scientists are studying more, especially looking at plants that haven't been explored much before. Oxidative damage in food, especially in fats and oils, can lead to bad smells and tastes, reduce the food's nutrition, and even create harmful substances. To stop this from happening, it's important to add antioxidants to help keep food fresh, maintain its color, and protect vitamins from breaking down. Citrus peels are a great source of natural antioxidants because citrus is a widely grown crop, with about 80 million tons produced every year. In the food industry, citrus is mostly used for making fresh juice and drinks. However, during processing, a lot of peel is left over, and this waste can be a rich source of natural flavonoids. Citrus peels are also high in phenolic compounds, which are known for their antioxidant abilities. While flavonoids are found in many plants, certain types, like flavanones, flavanone glycosides, and polymethoxylated flavones, are unique to citrus and aren't commonly found in other plants. Usually, natural materials are extracted using organic solvents, but some of these solvents can be harmful. For this study, food-grade ethanol is often used instead of methanol when extracting phenolic



compounds from citrus peels. Researchers have looked into how different factors, such as how the peels are prepared, whether the extraction is repeated, the type and strength of solvents, and the temperature, affect the overall extraction process. In this study, the extraction of lemon peels using ethanol-water mixtures is examined. The effect of ethanol concentration and the size of the peel particles on the amount of extract, the levels of phenolic compounds, and the antioxidant activity of the extracts is analyzed.

Advantages of Antioxidants Extracted from Lemon:

1. Helps prevent oxidative stress in the body.
2. Strengthens the immune system.
3. Keeps the heart healthy.
4. Supports brain function and health.
5. Acts as a natural preservative for food.
6. Promotes healthy skin.
7. Is eco-friendly and affordable.
8. Has antimicrobial and anti-inflammatory benefits.

Disadvantages of Antioxidants Extracted from Lemon:

1. The amount obtained is low.
2. The process of extracting them can be expensive.
3. There may be leftover chemicals from the extraction process.
4. They may not be stable over time.
5. They have a shorter lifespan once made.
6. The quality can vary from batch to batch.
7. Using too much could lead to side effects.

JELLY

Jelly is a type of semi-solid food that forms when a liquid, typically fruit juice, is mixed with gelling agents such as pectin, gelatin, agar, or starch. It has a smooth, firm, and slightly wobbly texture and is usually sweetened and may also have a flavor. In some cases, especially in pharmaceuticals or functional foods, jellies can include nutrients, antioxidants, or medicinal ingredients, making them a pleasant way to deliver these active components.

Advantages of Pharmaceutical Jelly:

1. It helps patients take their medicine more regularly.
2. It gets absorbed into the body quickly.
3. It can deliver different types of drugs in various ways.
4. It allows for adjusting the dose as needed.
5. It helps protect the drug from breaking down.
6. It looks appealing and can be more pleasant for patients.
7. It is easy to take and use.

Disadvantages of Pharmaceutical Jelly:

1. Not all medicines work well with jelly.
2. It doesn't last as long as other forms.
3. It can be unstable and hard to keep consistent.
4. It can hold only a limited amount of drugs.
5. It can be difficult to package properly.
6. It may cost more than other forms.



Antioxidants used in Cosmetic :-

Cosmetics are products made to improve the look of skin and body scent, and they come in forms like creams, lotions, and powders. Their main functions are to clean, protect, and moisturize the skin. These days, people are looking for products that are kinder and safer for their skin. Many drug companies have started making cosmetics, which mix the benefits of cosmetics and medicines. These products not only help with beauty but also offer health benefits for the skin. Antioxidant-based cosmetics especially help protect the skin from harm caused by sunlight and harmful substances called free radicals [20].

Antioxidant ingredients are important for both the pharmaceutical and cosmetic industries because they help fight free radicals.

But many antioxidants are not very stable, which can make it hard to use them in cosmetics. So, it's important to pick the right kind and amount of antioxidants. In recent years, natural antioxidants from plants have become more popular than man-made ones. This is because plant extracts usually have many active ingredients that work together. This teamwork often makes the products more effective and less harmful.

Natural antioxidants:

Natural antioxidants are divided into two main groups: primary (natural) antioxidants and secondary (synthetic) antioxidants. Primary antioxidants include minerals such as selenium, copper, iron, zinc, and manganese, as well as vitamins like C and E, and compounds called phytoantioxidants. These minerals often help enzymes that fight oxidation. Secondary antioxidants, which are man-made, work by catching free radicals and stopping the chain reaction that leads to cell damage. Examples of these synthetic antioxidants are specially designed chemicals used for this purpose [18].

PLANT PROFILE

1. Biological Source: Lemon consists of the fresh or dried fruit and peel of Citrus limon (L.)Burm.
2. Family: Rutaceae
3. Genus: Citrus
4. Species: C. limon (L.) Burm.
5. Synonyms: Yellow citrus ,Nimbu (Hindi) ,Limbu (Marathi),Limon (Spanish/French variation)

Plant Part Used :-

1. Fruits (mainly juice and peel)
2. Leaves (for essential oils)
3. Seeds (contain fixed oils)

Chemical Constituents :-

1. Citric acid
2. Vitamin C (Ascorbic acid)
3. Flavonoids – Hesperidin, Eriocitrin, Diosmin
4. Essential oils – Limonene, Citral, Linalool
5. Pectin, Sugars, and Minerals

Uses / Importance :-

1. Acts as a natural antioxidant and flavoring agent.
2. Used in cosmetics, pharmaceuticals, and food industries.
3. Possesses antimicrobial, anti-inflammatory, and skin-protective properties.



Antioxidant Constituents in Lemon :-

1. Vitamin C (Ascorbic Acid)
2. Flavonoids (Polyphenolic compounds)

Key antioxidant flavonoids include:-

1. Hesperidin
2. Eriocitrin
3. Naringin
4. Diosmin
5. Rutin
6. Phenolic Compounds
7. Essential Oils
8. Carotenoids (like β -carotene)

Mechanism of action of Antioxidants:

The way antioxidants work is by stopping free radicals and reactive oxygen species (ROS) from causing damage to cells and tissues. They do this by giving away electrons or hydrogen atoms to these harmful molecules, which makes them less reactive and stops them from continuing to cause damage. Often, after an antioxidant neutralizes a free radical, it becomes a less harmful radical itself, which can then be dealt with by other antioxidants. For example, vitamin C and vitamin E work together to neutralize radicals and help each other stay active. Antioxidants can also stop the early stages of oxidative reactions by blocking the formation of radicals or stopping metal ions from speeding up these reactions. The body's antioxidant system also includes enzymes that help break down ROS, keeping their levels in check and reducing the harm they can do to cells under stress.

MATERIALS AND EQUIPMENT

Materials (Ingredients & Chemicals)

Natural Ingredients

1. Fresh lemon juice (source of natural antioxidants)
2. Sugar (sweetening agent)
3. Purified water
4. Natural flavoring agent (optional)
5. Natural food color (optional)

Gelling Agents (any one or combination)

1. Agar-agar

Preservatives (optional)

1. Aloe Vera Gel

Antioxidant Analysis Reagents (for evaluation)

1. Phosphate buffer
2. Potassium ferricyanide
3. Ferric chloride
4. Ethanol
5. Distilled water



Equipment

Preparation Equipment

1. Beakers (50, 100, 250, 500 mL)
2. Measuring cylinder
3. Electronic weighing balance
4. Hot plate or water bath
5. Glass stirring rod / magnetic stirrer
6. Thermometer
7. pH meter
8. Stainless steel vessel

Filtration & Molding

1. Muslin cloth / filter paper
2. Jelly molds
3. Spatula

Evaluation & Analysis Equipment

1. Test tubes and test-tube stand
2. Pipettes and micropipette

Storage

1. Airtight containers
2. Refrigerator

Formulation Table

| Sr. No | Name of content | F1 | F2 | F3 |
|--------|------------------------------|-------------------|-------------------|-------------------|
| 1 | Fresh Lemon juice | 28 ml | 30 ml | 32 ml |
| 2 | Sugar | 25 gm | 25 gm | 25 gm |
| 3 | Aloe Vera Gel (Preservative) | 2 to 3 drops | 2 to 3 drops | 2 to 3 drops |
| 4 | Purified water | Quantity required | Quantity required | Quantity require |
| 5 | flavoring agent (optional) | Quantity required | Quantity required | Quantity required |
| 6 | food color (optional) | Quantity required | Quantity required | Quantity required |

METHOD AND EVALUATION

Method of Preparation of Natural Antioxidant Jelly Containing Lemon Juice

1. Collection and Preparation of Lemon Juice

Fresh lemons are washed well with distilled water.

The juice is squeezed by hand and then filtered through a muslin cloth to remove any pulp and seeds.

2. Preparation of Gelling Agent Solution

The chosen gelling agent, such as pectin, gelatin, or agar-agar, is measured carefully and mixed with a specific amount of purified water.

This mixture is heated continuously at a temperature between 60 to 70 degrees Celsius until it becomes clear and fully dissolved.



3. Sugar Solution Preparation

A set amount of sugar is dissolved in warm purified water on its own to create a clear syrup.

4. Mixing

The sugar syrup is slowly added to the gelling agent solution while continuously stirring to ensure everything is well mixed.

5. Addition of Lemon Juice

The filtered lemon juice is added step by step to the mixture while keeping the temperature below 50 degrees Celsius to avoid breaking down the antioxidant properties.

6. pH Adjustment and Preservation

Citric acid is added to bring the pH level to between 3.0 and 3.5.

If needed, preservatives are added in amounts that are allowed by regulations.

7. Molding and Setting

The hot jelly mixture is poured into clean, dry molds and left to cool at room temperature. After that, it is placed in the refrigerator until it hardens completely.

8. Storage

The finished jelly is kept in airtight containers and stored in the fridge for further testing and evaluation.

EVALUATION OF NATURAL ANTIOXIDANT JELLY

Organoleptic evaluation

| Parameters | Observation |
|------------|---|
| Color | Red and Yellow |
| Odor | Strong citrus smell |
| Test | Sour, slightly bitter |
| Texture | Moderately firm Good gel formation Slightly springy Smooth, no lumps |



pH Determination

Bach A = 32 ml Lemon juice \approx 3.4

Bach B = 30 ml Lemon juice \approx 3.2

Bach C = 28 ml Lemon juice \approx 3.0

pH does NOT increase when the quantity of lemon juice increases.

When you add more lemon juice, you are adding more citric acid.

More acid \rightarrow higher acidity \rightarrow pH decreases.



Weight Uniformity

Individual jelly units are weighed using an electronic balance. Average weight and Deviations are calculated.

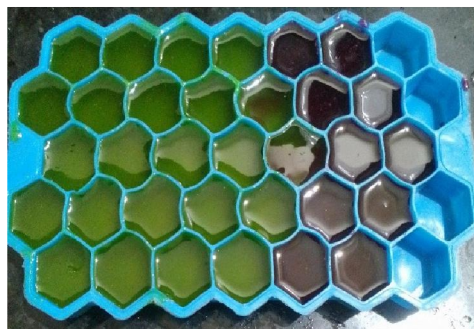
\sim 6.2 to \sim 6.9. (Of all the batch.)



Setting Time

Time required for the jelly to completely set after pouring into molds is recorded.

- At room temperature (25–30°C) : Sets within 30–60 minutes.



Antioxidant Activity (Reducing Power Assay)

Principle :

The reducing power assay measures the antioxidant capacity of a sample based on its ability to Donate electrons. Antioxidants reduce Fe^{3+} (ferric ion) to Fe^{2+} (ferrous ion). The Fe^{2+} then forms a Colored complex, and the intensity of this color indicates the antioxidant strength.

Procedure :

Mix sample (e.g., plant extract) (1 ml) with phosphate buffer (2.5 ml) and potassium Ferricyanide (2.5 ml).

Incubate the mixture (usually at 50°C for 20 min).

Add Trichloroacetic acid (TCA) to stop the reaction. (Ethanol / Methanol)(2.5 ml).

Centrifuge and collect the supernatant. (10 min)

Add ferric chloride ($FeCl_3$) (2.5 ml).

Measure absorbance using a UV–Visible spectrophotometer at ~700 nm.

RESULT AND DISCUSSION

Result

The formulated antioxidant jelly containing lemon juice was successfully prepared using agar as a Gelling agent. The prepared batches (A, B, and C) showed uniform appearance and acceptable Physical characteristics.

Organoleptic properties:

The jelly exhibited an attractive red-yellow color, strong citrus odor, and a sour taste with slight Bitterness. The texture was moderately firm, smooth, and slightly elastic, indicating proper gel Formation.

pH evaluation:

The pH values of different batches were found to be:

Batch A (33 ml lemon juice): pH 3.0

Batch B (30 ml lemon juice): pH 2.9

Batch C (27 ml lemon juice): pH 3.4

This confirms that increasing lemon juice concentration decreases pH due to higher citric acid Content.

Weight uniformity:

All jelly samples showed consistent weights in the range of 6.2–6.9 g, indicating uniform Distribution of formulation.

Texture/consistency:

All batches showed good gel formation, smooth texture, and no lumps, confirming proper Preparation technique.

Setting time:

The jelly set within 30–60 minutes at room temperature, which is acceptable for jelly formulations.



Antioxidant activity (Reducing Power Assay):

The sample showed measurable absorbance at 700 nm, indicating the presence of antioxidant activity. Higher absorbance confirms stronger Reducing power due to lemon antioxidants such as vitamin C and flavonoids.

Discussion

The study demonstrates that lemon juice can be effectively utilized to formulate antioxidant-rich Jelly with desirable physicochemical properties.

The decrease in pH with increasing lemon juice concentration is due to the presence of citric acid, Which enhances acidity. This acidic environment is beneficial as it:

- Improves gel formation
- Enhances preservation
- Stabilizes antioxidant compounds

The uniform weight and consistent texture across all batches indicate good mixing, proper gelling, And reproducibility of the formulation process.

The organoleptic properties such as color, odor, and taste were acceptable, making the product palatable and suitable for consumption as a functional food.

The reducing power assay results confirm that the formulated jelly possesses significant Antioxidant activity. This is mainly due to:

- Vitamin C (ascorbic acid)
- Flavonoids (hesperidin, eriocitrin, etc.)

These compounds donate electrons to reduce Fe^{3+} to Fe^{2+} , demonstrating strong Antioxidant potential.

Additionally, the study supports the idea that natural antioxidants from citrus sources can be Incorporated into food products, offering:

Health benefits (reducing oxidative stress)

Functional food applications

Eco-friendly utilization of natural resources

However, slight bitterness and acidity may affect taste acceptability, which can be optimized by Adjusting sugar concentration.

SUMMARY

This study was carried out to formulate and evaluate natural antioxidant jelly using lemon juice as A source of bioactive compounds. Lemon is rich in vitamin C, flavonoids, and phenolic Compounds, which exhibit strong antioxidant activity.

The jelly was prepared using agar as a gelling agent along with sugar and purified water. The Formulation process involved extraction of lemon juice, preparation of gel base, mixing, molding, And setting.

The prepared jelly was evaluated for various parameters such as:

- Organoleptic properties (color, odor, taste, texture)
- pH
- Weight uniformity
- Texture and consistency
- Setting time
- Antioxidant activity (reducing power assay)

The results showed that the jelly had good appearance, acceptable taste, proper gel consistency, And uniform weight.

The pH was found to be acidic due to the presence of citric acid. The reducing power assay confirmed that the jelly possesses significant antioxidant activity.



Overall, the study highlights the potential of lemon juice as a natural, cost-effective, and eco-Friendly source of antioxidants for functional food formulation.

II. CONCLUSION

The present study concludes that natural antioxidant jelly containing lemon juice can be Successfully formulated with desirable physicochemical and sensory properties.

The formulated jelly demonstrated:

- Good stability and gel formation
- Acceptable organoleptic characteristics
- Significant antioxidant activity

Lemon juice proved to be an effective natural antioxidant source due to its rich content of vitamin C and flavonoids. The incorporation of such natural ingredients enhances the nutritional and Functional value of the product.

Furthermore, the study supports the use of citrus-based materials in developing functional foods And nutraceutical products, promoting health benefits such as reduction of oxidative stress.

Thus, antioxidant jelly prepared from lemon juice can be considered a promising, safe, and Sustainable alter Anative to synthetic antioxidant products.

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