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# EVALUATION OF ANTIOXIDANT AND CHOLESTEROL LOWERING ACTIVITY OF DARK CHOCOLATE AND BETEL LEAF EXTRACT

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## Abstract :

Chronic conditions like cardiovascular disease, atherosclerosis, and hypercholesterolemia are largely caused by oxidative stress and abnormal lipid metabolism. The human body's overproduction of free radicals can cause inflammation, cellular damage, and impaired metabolic processes. Antioxidants are crucial for scavenging free radicals and preventing oxidative damage to biological systems. In recent years, there has been growing interest in the use of natural products and plant-derived compounds as potential antioxidant and cholesterol-lowering agents due to their safety, availability, and therapeutic potential. It is well known that dark chocolate made from Theobroma cacao is high in bioactive substances such polyphenols, flavonoids, and catechins. Strong antioxidant, anti-inflammatory, and cardioprotective qualities have been observed in these compounds. Cocoa flavonoids have been shown in numerous studies to enhance endothelial function, lower oxidative stress, and raise HDL cholesterol levels while lowering LDL oxidation. Similarly, betel leaf obtained from Piper betle has been widely used in traditional medicine due to its diverse pharmacological properties. Numerous phytochemical components found in betel leaves, including hydroxychavicol, eugenol, and chavibetol, are known to have lipid-lowering, antibacterial, anti-inflammatory, and antioxidant properties. The current study has been designed to develop and evaluate herbal dark chocolate Enhanced with betel leaf extract, as well as to Investigate its antioxidant and cholesterol-lowering properties. The herbal chocolate formulation was created by mixing a defined amount of betel leaf extract into melted dark chocolate utilizing a controlled manner. The liquid was homogenized before being molded into chocolate forms, which were then cooled and solidified. The physicochemical properties of the prepared herbal chocolate were then determined, including color, flavor, taste, pH, melting point, hardness, and moisture content. The results revealed that the combination formulation had better lipid-lowering action than the individual extracts. These data suggest that incorporating betel leaf extract into dark chocolate may improve the medicinal effect of the formulation. In conclusion, the current study shows that herbal dark chocolate mixed with betel leaf extract has strong antioxidant and cholesterol-lowering benefits. The results highlight the potential of combining natural dietary sources to develop functional foods with added health benefits. Such formulations may help prevent and control oxidative stress and lipid-related diseases.

## Keywords :

Piper betle Extract, Herbal Dark Chocolate, Antioxidant Activity, Cholesterol-Lowering Activity, Nutraceutical Formulation, Functional Food.

## Introduction :

Oxidative stress results from the body's excessive production of free radicals. These free radicals can harm lipids, Proteins and DNA which can result in a number of Disorders such as Atherosclerosis, Cardiovascular Diseases And Hypercholesterolemia. Free Radicals are neutralized by Antioxidants, which also protect the organism from oxidative stress. Natural Antioxidants derived from plant have gained Popularity due to they are safer and have numerous therapeutic benefits. Theobroma cacao is the main source of Dark Chocolate, which is rich in Flavonoids like catechin, epicatechin and procyanidins which have potent Antioxidant and Cardioprotective Qualities. Traditional Medicines Makes Extensive use of betel leaf, which comes from Piper Betle. It Contains Phenolic chemicals including Eugenol and Hydroxychavicol. These substances have cholesterol- lowering, antibacterial and antioxidant properties. Thus, the purpose of this study is to Evaluate the Antioxidant and Cholesterol Lowering Activity Of Dark chocolate And Betel Leaf Extract.

## Literature Review :

### 1. Oxidative Stress and Antioxidants

When the body's antioxidant defense system and free radical generation are out of balance results in oxidative stress. Reactive Oxygen Species (ROS) And Other free radicals can harm lipids, Proteins and DNA in cells. A number of Disorders including as Atherosclerosis, Cardiovascular Diseases and Hypercholesterolemia are linked to this damage. Antioxidants are chemicals that stop oxidative damage and neutralize free radicals. Compared to Synthetic antioxidants, Natural Antioxidants produced from plant sources Especially Polyphenols and Flavonoids, have gained attention because of their therapeutic potential and safety.

### 2. Dark Chocolate as a Natural Antioxidant

Theobroma Cacao is the source of cocoa beans used to make Dark Chocolate. It has high concentrations of bioactive substances such as procyanidins, Flavonoids, Catechins ans epicatechin. Cocoa polyphenolos have been shown in numerous studies to have potent antioxidant Qualities. These Substances have the ability to scavenge free radicals, lower oxidative stress and shield lipoproteins from oxidative damage. It has been demonstrated that eating Dark chocolate raises plasma's overall antioxidant capacity. Additionally, studies have shown that frequent dark chocolate consumption promotes cardiovascular health by lowering oxidative stress and improving endothelial function.

### 3. Effect of Dark Chocolate on Cholesterol

Lipid Metabolism is significantly impacted by the flavonol rich chemicals found in Dark Chocolate. Cocoa flavonoids have the ability to raise levels of High-Density Lipoprotein(HDL) Cholesterol and Decreases the Oxidation of Low-Density Lipoprotein(LDL) Cholesterol. A number of Clinical Trials have demonstrated that Moderate consuming of dark chocolate improves Lipid Profiles including lowering LDL and Total

Cholesterol. This Impact Lowers the risk of cardiovascular conditions linked to high cholesterol. Cocoa Polyphenols decrease cholesterol by improving vascular function and Inhibiting Lipid Peroxidation.

## 4. Betel Leaf (Piper Betle)

In Several Asian Nations, traditional medicines makes extensive use of betel leaf which is derived from PIPER BETLE. Numerous physiologically active substances, including hydroxychavicol, eugenol, chavibetol, and allylpyrocatechol, are found in the leaves. These phytochemicals have a variety of pharmacological actions, including as cardioprotective, antibacterial, anti-inflammatory, and antioxidant properties. Betel leaves have been utilized in traditional medical systems to treat a variety of illnesses, including infections, respiratory issues, and digestive disorders.

## 5. Antioxidant Activity of Betel Leaf

Phenolic components are present in betel leaf extract, it has been found to have strong antioxidant properties. Research has demonstrated that the leaf extract significantly reduces lipid peroxidation and has strong free radical scavenging activity. Betel leaves contain phenolic chemicals that donate hydrogen atoms to neutralize free radicals and shield biological molecules from oxidative harm. The significant antioxidant capacity of betel leaf extracts has been verified by experimental research employing in vitro antioxidant tests including DPPH and ABTS.

## 6. Cholesterol-Lowering Activity of Betel Leaf

Studies indicate that betel leaf extract can lower cholesterol and enhance lipid metabolism. The phenolic compounds present in betel leaves helps to prevent oxidation of LDL cholesterol, which is a cause in the development of atherosclerosis. According to these results, betel leaf may be crucial in reducing cardiovascular conditions associated with elevated cholesterol.

## 7. Need for the Present Study

While a number of studies have documented the antioxidant and cholesterol-lowering qualities of betel leaf and dark chocolate separately, limited Research has been done on their combined effects. Thus, the current study is to assess the antioxidant capacity and cholesterol-lowering activity of betel leaf and dark chocolate, as well as Investigate whether their combination results in improved therapeutic effects.

## Objectives :

- To formulate herbal dark chocolate containing betel leaf extract.
- To incorporate medicinal plant extract from Piper betle.
- To study the nutraceutical potential of herbal chocolate.
- To evaluate physicochemical parameters of the formulation.
- To assess organoleptic properties such as color, taste, odor, and texture.
- To determine antioxidant activity of the formulation.
- To evaluate cholesterol-lowering activity in vitro.
- To study the synergistic effect of cocoa and betel leaf compounds.
- To support cardiovascular health through dietary antioxidants.
- To provide scientific data for future research and nutraceutical development.

## Composition Of Herbal Dark Chocolate :

| Ingredients | Quantity | Role |
|---|---|---|
| Dark Chocolate | 100 gm | Main Base |
| Betal Leaf | 10 gm | Provides Antioxidants & Cholesterol Lowering |
| Gulkand | 22 gm | Flavoring Agent |
| Fennel | 7 gm | Enhances Taste |

## Methadology :

1. **Preparation of Chocolate Base**
   - Break the dark chocolate into small pieces.
   - Place the chocolate pieces in a stainless steel bowl.

2. **Melting Process**
   - Melt the chocolate using a double boiler or water bath at about 45–50°C.
   - Stir continuously until the chocolate becomes smooth and completely of the herbal extract.

3. **Addition of Cocoa Butter**
   - Add a small quantity of cocoa butter to improve texture and consistency.
   - Mix thoroughly until it is completely blended.

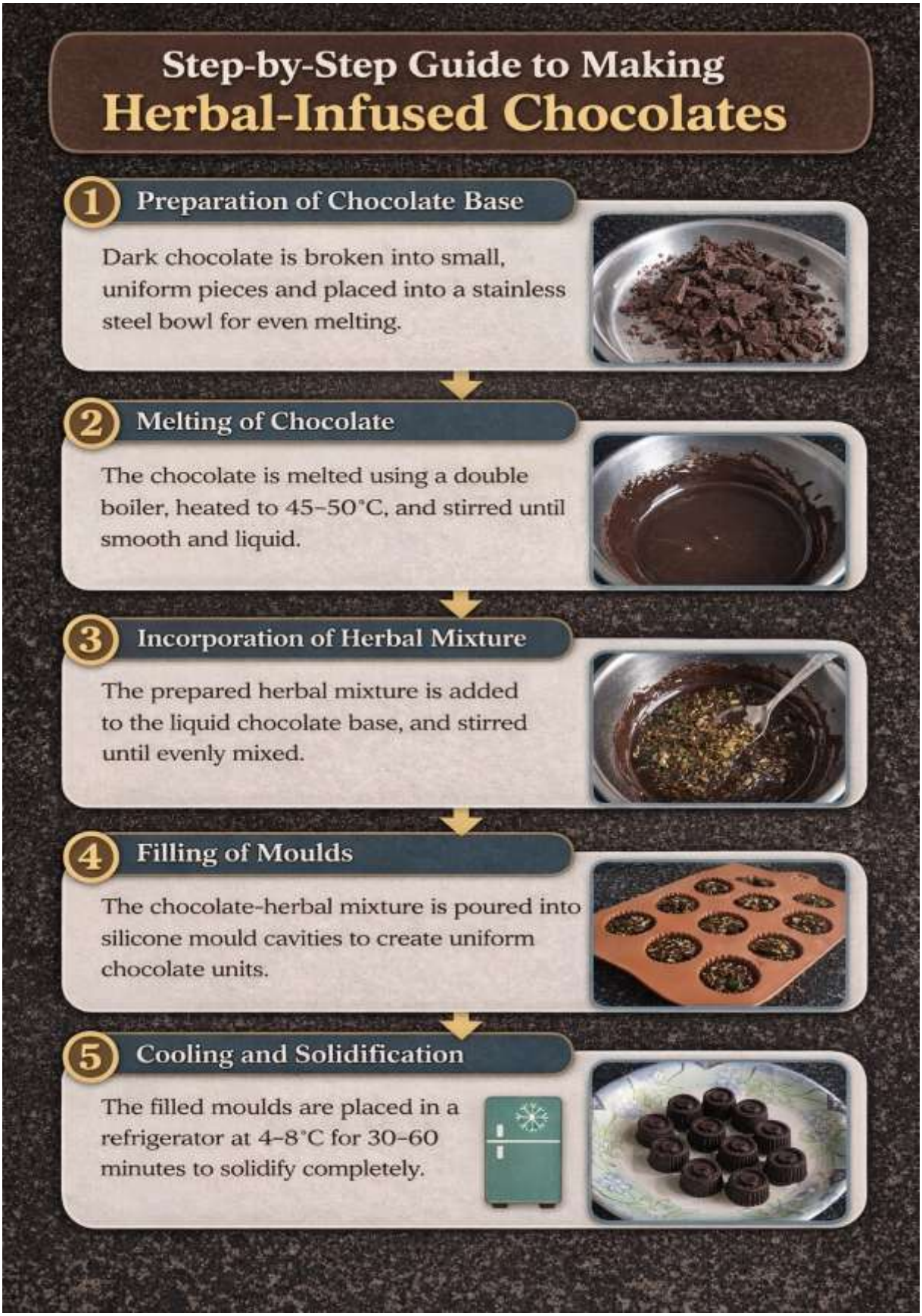
4. **Addition of Herbal Extract**
   - Add a measured amount of betel leaf extract to the melted chocolate.
   - Stir continuously to ensure uniform distribution of the herbal extract.

5. **Mixing and Homogenization**
   - Mix the formulation properly to obtain a smooth and homogeneous mixture.

6. **Moulding**
   - Pour the prepared mixture into chocolate moulds.

7. **Cooling and Solidification**
   - Place the moulds in a refrigerator at 4–8°C for about 30–60 minutes until the chocolate solidifies.

8. **Demoulding and Storage**
   - Remove the solidified herbal dark chocolate from the moulds.
   - Store in airtight containers in a cool and dry place.


Step-by-Step Guide to Making
Herbal-Infused Chocolates
1 Preparation of Chocolate Base
Dark chocolate is broken into small, uniform pieces and placed into a stainless steel bowl for even melting.
2 Melting of Chocolate
The chocolate is melted using a double boiler, heated to 45–50°C, and stirred until smooth and liquid.
3 Incorporation of Herbal Mixture
The prepared herbal mixture is added to the liquid chocolate base, and stirred until evenly mixed.
4 Filling of Moulds
The chocolate-herbal mixture is poured into silicone mould cavities to create uniform chocolate units.
5 Cooling and Solidification
The filled moulds are placed in a refrigerator at 4–8°C for 30–60 minutes to solidify completely.

## Physiochemical Evaluation Of Herbal Dark Chocolate :

| Sr. No. | Parameter | Method Used | Results Obtained |
|---|---|---|---|
| 1. | Color | Visual Observation | Dark Brown |
| 2. | Odor | Organoleptic Test | Characteristic Chocolate Odor |
| 3. | Taste | Sensory Evaluation | Sweet with Mild Herbal |
| 4. | Texture | Manual Examination | Smooth and Firm |
| 5. | pH | Digital pH Meter | 5.7 |
| 6. | Melting Point | Melting Point Apparatus | 32°C |
| 7. | Hardness | Texture Analyzer | 4.4 kg/cm² |
| 8. | Moisture Content | Hot Air Oven Method | 1.7% |

## Conclusion :

In this study, cocoa from Theobroma cacao and betel leaf extract from Piper betle were successfully combined to create and assess herbal dark chocolate. The developed formulation demonstrated acceptable physicochemical attributes such as color, taste, texture, pH, and melting point, confirming the product's quality and stability. In addition, the herbal chocolate formulation demonstrated promising cholesterol-lowering efficacy in vitro. These advantageous biological benefits may be attributed to the presence of phenolic chemicals in betel leaf and flavonoids in cocoa. These chemicals help to lower oxidative stress and improve lipid metabolism. Overall, the results of this study indicates to the possibility of using herbal dark chocolate enhanced with betel leaf extract as a functional food with cardioprotective and antioxidant qualities. However, further in-vivo studies and clinical investigations are required to confirm its therapeutic efficacy and safety for long-term use.

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