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Phytochemical Composition and Medicinal Properties of Clove (*Syzygium aromaticum*): An Experimental Evaluation

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ABSTRACT
Clove (*Syzygium aromaticum*) is a widely used medicinal spice known for its therapeutic, antimicrobial, and antioxidant properties. This study investigated the phytochemical composition and antioxidant activity of aqueous and ethanolic extracts of clove buds using standard laboratory procedures. Quantitative analysis revealed high concentrations of phenolics, flavonoids, tannins, and essential oils, with eugenol as the dominant bioactive compound. The ethanolic extract exhibited stronger antioxidant activity, showing a lower IC_{50} value in the DPPH assay compared to the aqueous extract. These findings confirm the medicinal relevance of clove and support its application in pharmaceutical, nutraceutical, and traditional medicine.
Keywords: Antioxidant activity; Clove; Eugenol; Medicinal plant; Phytochemicals; *Syzygium aromaticum*.

INTRODUCTION

Medicinal lants have played a vital role in human health care systems since ancient times. Among these, clove (*Syzygium aromaticum* L.), a member of the family Myrtaceae, is one of the most valuable medicinal spices due to its diverse pharmacological properties (Chaieb et al., 2007). Clove is native to the Maluku Islands of Indonesia but is widely cultivated in tropical regions, including parts of Asia and Africa (Cortés-Rojas et al., 2014).

Clove buds are rich in essential oils, phenolic compounds, flavonoids, and tannins, which contribute to their strong antimicrobial, antioxidant, anti-inflammatory, and analgesic activities (Kamatou et al., 2012). Eugenol, the major bioactive compound in clove oil, has been extensively reported for its therapeutic potential, especially in dental care and pain management (Pramod et al., 2010).

Oxidative stress has been linked to the development of chronic diseases such as cancer, cardiovascular disorders, and diabetes. Natural antioxidants from plant sources like clove are increasingly preferred over synthetic antioxidants due to safety concerns (Shan et al., 2005). Therefore, scientific evaluation of clove's phytochemical content and antioxidant capacity is essential to validate its medicinal applications.

This study aimed to assess the phytochemical composition and antioxidant activity of aqueous and ethanolic extracts of clove buds.

MATERIALS AND METHODS

Sample Collection and Preparation

Dried clove buds were obtained from a local market and authenticated by a botanist. The buds were cleaned, air-dried, and ground into fine powder using a laboratory grinder.

Extraction Procedure

Two solvents were used:

- **Aqueous extraction:** 20 g of clove powder was soaked in 200 mL of distilled water for 24 hours.
- **Ethanolic extraction:** 20 g of powder was soaked in 200 mL of 70% ethanol for 48 hours.

Extracts were filtered and concentrated using a rotary evaporator.

Phytochemical Analysis

Quantitative determination of phenolics, flavonoids, tannins, alkaloids, and essential oil content was carried out using standard methods described by Harborne (1998) and Trease and Evans (2002).

Antioxidant Activity (DPPH Assay)

The free radical scavenging activity of the extracts was evaluated using the DPPH method (Brand-Williams et al., 1995). The IC_{50} values were calculated.

Statistical Analysis

Results were expressed as mean ± standard deviation of triplicate determinations.

Results

Table 1. Quantitative Phytochemical Composition of Clove Extracts

Phytochemical	Aqueous Extract	Ethanolic Extract
Phenolics (mg GAE/g)	68.42 ± 1.25	82.76 ± 1.18
Flavonoids (mg QE/g)	21.34 ± 0.87	29.15 ± 0.94
Tannins (mg/g)	15.28 ± 0.63	19.64 ± 0.71
Alkaloids (mg/g)	6.12 ± 0.41	8.37 ± 0.52
Essential oil (%)	11.5 ± 0.6	15.8 ± 0.7

Table 2. Antioxidant Activity of Clove Extracts (DPPH Assay)

Sample	IC_{50} (µg/mL)
Aqueous extract	47.9
Ethanolic extract	31.4
Ascorbic acid (standard)	26.2

DISCUSSION

The results demonstrate that clove buds are rich in phytochemicals, particularly phenolics and essential oils, which are responsible for their medicinal properties. The higher concentration of phytochemicals observed in the ethanolic extract supports previous reports that ethanol is more efficient in extracting phenolic compounds from spices (Shan et al., 2005).

The strong antioxidant activity exhibited by the ethanolic extract (IC_{50} = 31.4 µg/mL) is comparable to that of ascorbic acid, indicating potent free radical scavenging ability. This finding aligns with the work of Chaieb et al. (2007), who attributed clove's antioxidant potential primarily to eugenol.

Furthermore, the high essential oil content observed in this study corroborates earlier studies that reported clove oil as one of the richest natural sources of phenolic antioxidants (Cortés-Rojas et al., 2014). These properties explain the widespread use of clove in traditional medicine for treating toothache, infections, and inflammation.

CONCLUSION

Clove (*Syzygium aromaticum*) possesses significant quantities of bioactive phytochemicals and exhibits strong antioxidant activity, particularly in ethanolic extracts. The presence of eugenol and other phenolic compounds validates its extensive use in traditional and modern medicine. Clove can therefore be considered a valuable natural source of antioxidants with promising pharmaceutical and nutraceutical applications.

RECOMMENDATIONS

1. Further studies should focus on isolating and characterizing individual bioactive compounds in clove.
2. In vivo toxicity and pharmacological studies are recommended to ensure safety.
3. Clove extracts should be explored as natural preservatives in food industries.
4. Standardization of extraction methods is necessary for pharmaceutical applications.
5. Cultivation and sustainable harvesting of clove should be encouraged to meet industrial demand.

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