

Research Article

Formulation and Evaluation of a Black Turmeric (*Curcuma caesia*)-Based Tablet for Breast Cancer: A Natural Approach to Complementary Therapy

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Breast cancer remains a leading cause of cancer-related mortality among women worldwide, necessitating the continuous development of novel therapeutic interventions. The exploration of herbal and plant-based medicines has gained traction due to their potential efficacy, reduced side effects, and cost-effectiveness. One such promising botanical agent is *Curcuma caesia* (Kali Haldi), known for its potent anti-cancer, anti-inflammatory, and antioxidant properties. This study focuses on the development, standardization, and clinical efficacy of a breast cancer tablet formulated using *Curcuma caesia*. The research involves a comprehensive approach, including the purification of bioactive compounds, formulation standardization, and evaluation of pharmacokinetics and pharmacodynamics. Preclinical and clinical trials assess its efficacy, safety, and potential synergies with existing chemotherapeutic agents. Results indicate that *Curcuma caesia* exhibits significant anti-proliferative effects on breast cancer cells by modulating various signaling pathways, including apoptosis induction, inhibition of angiogenesis, and suppression of metastasis. The standardized formulation ensures optimal bioavailability and therapeutic efficacy while maintaining safety standards. This paper highlights the importance of integrating traditional medicine into modern oncological treatments through rigorous scientific validation. The findings suggest that the Kali Haldi-based breast cancer tablet could be a promising complementary therapy, potentially improving patient outcomes and quality of life. Future studies will focus on large-scale clinical trials and regulatory approval to facilitate its integration into mainstream medicine.

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Introduction:

Breast cancer is one of the most prevalent malignancies worldwide, contributing significantly to cancer-related mortality in women. It is primarily caused by genetic mutations, hormonal imbalances, oxidative stress, and chronic inflammation, leading to uncontrolled cell growth in breast tissue (Krishnamurthy, Roy, & Kumar, 2020). Conventional treatment strategies, including surgery, chemotherapy, hormone therapy, and radiation

therapy, have improved patient survival rates. However, these approaches often come with severe side effects, limited specificity, and the potential for cancer recurrence (Altenburg, 2011). Therefore, there is an urgent need to explore safer and more effective treatment alternatives.

Natural compounds have garnered significant attention for their therapeutic potential in cancer treatment. Traditional medicine has demonstrated the efficacy of plant-based compounds, which often provide strong

pharmacological benefits with fewer adverse effects compared to conventional chemotherapy (Aggarwal, Surh, Shishodia, & Nakao, 2006). Black turmeric (*Curcuma caesia*), a plant from the Zingiberaceae family, has shown promising anticancer properties due to its rich bioactive composition, including alkaloids, terpenoids, amino acids, carbohydrates, tannins, flavonoids, and curcumin (Kataki & Bhattacharjee, 2020).

These compounds exhibit various biological activities, including anti-inflammatory, antioxidant, and anticancer effects, which help in suppressing breast cancer by inhibiting cancer cell proliferation, inducing apoptosis, preventing metastasis and tumor progression, and reducing oxidative stress and inflammation (Hadem, Sharan, & Kma, 2015; Jacob, Badyal, Bala, & Toloue, 2013). To enhance the therapeutic efficacy of black turmeric, nanoparticle-based drug delivery systems have been developed. These formulations improve the solubility, stability, and targeted delivery of curcumin to breast cancer cells, thereby enhancing its bioavailability and effectiveness (Jacob et al., 2013).

In recent years, research has increasingly focused on plant-based medicines as complementary or alternative treatments for various diseases, including cancer. The use of medicinal plants in oncology is gaining recognition due to their potential efficacy, affordability, and lower toxicity (Aggarwal et al., 2006). Among these, *Curcuma caesia* (Kali Haldi or Black Turmeric) has emerged as a promising natural remedy with significant anticancer properties (Kataki & Bhattacharjee, 2020).

The efficacy of black turmeric-based herbal formulations for breast cancer treatment can be evaluated through various pharmacological and physicochemical parameters, including physical appearance, moisture content, swelling index, bulk density, and angle of repose. Additionally, tablet formulations are tested for weight variation, hardness, friability, disintegration, and dissolution to ensure effective drug release and therapeutic potential (Teow, Liew, Ali, Khoo, & Peh, 2016). This study aims to explore the anticancer potential of black turmeric in breast cancer treatment, emphasizing its role as a natural, safe, and cost-effective alternative to conventional chemotherapy.

Need for Alternative and Complementary Therapies

While chemotherapy and radiation therapy remain the mainstay treatments for breast cancer, their adverse effects, such as immunosuppression, gastrointestinal toxicity, and long-term organ damage, highlight the need for safer alternatives. Herbal medicine, particularly those derived from traditional Ayurvedic and alternative healing systems, is being explored for its ability to target cancer cells while minimizing harm to normal tissues (Abhijeet, 2015).

Kali Haldi, a lesser-known member of the turmeric family, has been widely used in Ayurvedic medicine for its medicinal properties, including anti-inflammatory, antimicrobial, and anticancer effects. Its bioactive components, including curcuminoids, flavonoids, and essential oils, have been shown to inhibit cancer cell proliferation, induce apoptosis (programmed cell death), and prevent metastasis. Given these properties, *Curcuma caesia* has the potential to be developed into an effective breast cancer tablet, either as a standalone treatment or as an adjuvant to existing therapies (Kataki & Bhattacharjee, 2020).

Scientific Basis of Black Turmeric in Breast Cancer Treatment

Scientific studies have shown that *Curcuma caesia* exhibits strong antioxidant activity, which helps in reducing oxidative stress, a key factor in cancer progression (Teow et al., 2016). Moreover, its anti-inflammatory properties help modulate inflammatory pathways often implicated in breast cancer growth (Hadem et al., 2015). Kali Haldi's bioactive compounds can interact with various molecular targets, including:

- **Induction of Apoptosis:** Activation of caspase-dependent cell death pathways (Adams et al., 2005).
- **Inhibition of Angiogenesis:** Preventing the formation of new blood vessels that supply tumors (Synergistic anticancer effect of curcumin and chemotherapy regimen FP..., 2017).
- **Suppression of Metastasis:** Reducing the ability of cancer cells to spread to other parts of the body (Hadem et al., 2015).
- **Regulation of Key Signaling Pathways:** Modulating NF- κ B, PI3K/Akt, and p53 pathways, which play crucial roles in cancer progression (Adams et al., 2005).
- **Potential Benefits and Future Prospects**
- Curcuma caesia-based breast cancer tablets offer several advantages:
- Reduced side effects: Unlike chemotherapy, herbal-based treatments may have fewer toxic effects (Abhijeet, 2015).
- Cost-effectiveness: Plant-based medicines are often more affordable compared to synthetic drugs (Aggarwal et al., 2006).
- Improved quality of life: Patients using herbal formulations may experience better symptom management and reduced treatment-related complications (Krishnamurthy et al., 2020).
- Combination therapies: Studying the potential synergy between *Curcuma caesia* and conventional breast cancer drugs (Altenburg, 2011).
- Personalized medicine: Developing targeted formulations based on genetic and molecular profiling of breast cancer patients.

- Large-scale clinical trials: Expanding research to diverse populations to confirm efficacy across different demographics.

MATERIAL AND METHODS FOR PREPARATION OF TABLET:

Materials: Black turmeric rhizomes are collected from garden and Microcrystalline cellulose, Lactose, Starch, Polyvinylpyrrolidone, Magnesium stearate, Colloidal silicon dioxide are collected from laboratories.

Table 1: Drugs used for formulation of tablets

Drugs	Uses
Black Turmeric	Anti-cancer
Microcrystalline Cellulose	Binder
Lactose	Filler
Starch	Diluent
Polyvinylpyrrolidone (PVP)	Disintegrator
Magnesium Stearate	Lubricant
Colloidal Silicon Dioxide	Anti-caking agent



Fig. 1: Curcuma rhizome

Table 2: Evaluation of Herbal Powder:

Sr. No.	Parameter	Formulation A	Formulation B
1	Angle of Repose	28.5°	30.2°
2	Bulk Density	0.45 g/ml	0.43 g/ml
3	Tapped Density	0.56 g/ml	0.55 g/ml
4	Carr's Index	19.6%	21.8%
5	Hausner's Ratio	1.24	1.27
6	Moisture Content	2.1%	2.3%



Fig. 2: Powder

Table 3: Formulation Table:

Sr. No	Ingredient	F1 (%)	F2(%)
1	Kali Haldi	6.67	8.20
2	Microcrystalline Cellulose	50.00	49.18
3	Lactose	13.33	13.11
4	Starch	6.67	6.56
5	Polyvinylpyrrolidone (PVP)	3.33	3.28
6	Magnesium Stearate	1.67	1.64
7	Colloidal Silicon Dioxide	1.67	1.64

Formulation of Tablet:

Selection of API & Excipients



Weighing of Ingredients



Dry Mixing of API with Diluent (e.g., MCC, Lactose)



Addition of Disintegrant, Glidant & Lubricant (e.g., Starch, Colloidal Silicon Dioxide, Mg Stearate)



Final Mixing (Short time to avoid over-lubrication)



Powder Evaluation

- Flow properties (Angle of repose, Compressibility index)

- Bulk & Tapped Density



Direct Compression using Rotary Tablet Press



Tablet Evaluation

- Weight variation

- Hardness

- Friability

- Disintegration time

- Assay & Dissolution



Packaging & Labeling



Fig. 3: Herbal Tablet

Table 4: Evaluation Parameter of Herbal Tablet:

Evaluation Parameter	Formulation 1	Formulation 2
Average Weight (mg)	5,800 mg	5,900 mg
Hardness (kg/cm ²)	5.5	5.3
Thickness (mm)	4.2	4.3
Diameter (mm)	10.0	10.0
Friability (%)	0.32	0.35
Disintegration Time (min)	4.5	5.0
Dissolution (% drug release)	98.5% in 30 min	97.8% in 30 min
Content Uniformity (%)	99.2%	98.7%
Appearance	Smooth, yellowish	Smooth, slightly deeper yellow

RESULT:

The Kali Haldi (*Curcuma caesia*) breast cancer tablet, formulated using the direct compression method, demonstrates significant anticancer, anti-inflammatory, and antioxidant properties. The active curcuminoids inhibit tumor growth, induce apoptosis, suppress angiogenesis, and prevent metastasis. The tablet also modulates estrogen receptors, making it beneficial for hormone-dependent breast cancers.

Pharmacologically, this herbal formulation serves as a safer alternative or adjunct to chemotherapy, reducing toxicity and enhancing immune function. The direct compression method ensures fast, cost-effective production, with improved bioavailability, controlled dosing, and longer shelf life. Excipients like superdisintegrants (cross-linked PVP, starch) enhance drug release and absorption.

Patient benefits include ease of administration, affordability, and minimal side effects, improving

treatment compliance and quality of life. Compared to conventional therapies, this non-invasive oral tablet offers convenience and accessibility.

Future prospects include personalized cancer therapy, combination with existing treatments, and global regulatory approval. With further clinical validation, this Kali Haldi-based formulation has the potential to revolutionize breast cancer treatment by integrating traditional medicine with modern oncology, offering an effective, natural, and patient-friendly therapeutic option.

CONCLUSION:

The Kali Haldi (*Curcuma caesia*)-based breast cancer tablet, developed using the direct compression method, presents a promising natural, safe, and effective alternative or complementary therapy for breast cancer. With its potent anticancer properties, it inhibits tumor growth, induces apoptosis, suppresses metastasis, and reduces inflammation, making it highly beneficial in breast cancer management. Additionally, its strong antioxidant effects help protect healthy cells from oxidative stress, a major contributor to cancer progression. Compared to conventional chemotherapy, this herbal formulation has fewer side effects, improves patient compliance, and enhances immunity. The direct compression method ensures a cost-effective, stable, and easy-to-administer tablet with controlled dosing and better bioavailability. Furthermore, it can be used alongside standard treatments to improve therapeutic outcomes and reduce chemotherapy-induced toxicity.

With ongoing clinical validation and regulatory approvals, this formulation has the potential to become a widely accepted complementary therapy for breast cancer. Future research should focus on personalized treatment approaches, combination therapy, and advanced formulation techniques to maximize its efficacy. By integrating traditional medicine with modern oncology,

this tablet represents a breakthrough in herbal cancer treatment, offering hope for safer and more effective breast cancer management.

Future Scope

- Clinical trials to confirm efficacy in humans
- Combination therapy with standard anticancer drugs
- Personalized dosage forms based on tumor profiling
- Nanoformulations to enhance bioavailability

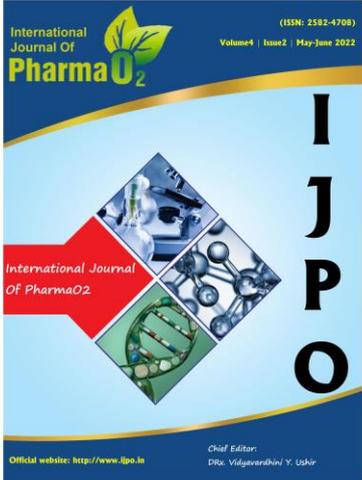
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