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Review Article

Effectiveness of Curcumin in Treatment of Gastric Cancer-A Systematic Review

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ABSTRACT:

Background: Gastric cancer is a major global health concern and one of the leading causes of cancer-related deaths. Given the limitations of current treatment modalities, there is a growing interest in the potential of natural compounds, such as curcumin, to serve as adjunctive therapies. **Objective:** This systematic review aims to evaluate the effectiveness of curcumin in the treatment of gastric cancer, focusing on its mechanisms of action, clinical outcomes, safety profile, and limitations. **Methods:** A comprehensive literature search was conducted across multiple databases, including PubMed, Scopus, and Web of Science, for studies published in the last decade that investigated curcumin's effects on gastric cancer. Both in vitro and clinical studies were included, with a focus on dose-response relationships, bioavailability, and treatment efficacy. **Results:** Curcumin exhibits significant anticancer properties, including the ability to inhibit cell proliferation, induce apoptosis, and reduce metastasis. Its action is mediated through various signalling pathways, particularly the NF-κB and PI3K/AKT pathways. Although preclinical studies show promising results, clinical data are limited and variable. Curcumin's poor bioavailability remains a significant challenge; however, innovative formulations, such as nanoparticles and liposomes, have demonstrated enhanced absorption and therapeutic potential. Most studies report a favourable safety profile, with minor gastrointestinal side effects being the most common adverse events. **Conclusions:** While curcumin shows promise as a complementary treatment for gastric cancer due to its multiple biological activities, further research is necessary to establish its clinical efficacy. Large-scale, randomized controlled trials are required to confirm its benefits and optimize delivery methods. If these challenges are addressed, curcumin could be integrated into gastric cancer treatment protocols, potentially improving patient outcomes.

Keywords: Curcumin, Treatment, Gastric Cancer, Effectiveness

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INTRODUCTION

Gastric cancer is known to be among the most common cancers in most countries today, and, as a condition, it falls among the common causes of death among cancer victims, and the prognosis is generally poor with few treatment options available[1]. Gastric cancer is diagnosed at an advanced stage mainly. Conventional treatments, such as surgery, chemotherapy, and radiation therapy, are not particularly effective due to the aggressive type of cancer and its tendencies towards resistance to various treatments[2]. There is a serious need for alternative therapeutic interventions that can complement conventional therapy to better the prognosis of patients. A significant amount of research has been conducted by the authors over the past decade on phytochemicals and probiotics that prevent cancer, including gingerol, citrus peel extract, and fermented rice[3-5].

Curcumin is the major component of turmeric, Curcuma long-a, and it has been extensively studied lately for its putative anticancer properties. This polyphonic compound shows a lot of biological activities, such as anti-inflammatory, antioxidant, and anti-proliferative activity, which places it among the most promising molecules in the context of cancer therapy[6]. Its interference with multiple pathways related to the development of cancer has been

demonstrated in various studies. Illustrating the interference of cur-cumin with nuclear factor kappa B (NF-κB), mitogen-activated protein kinase (MAPK), and phosphoinositide 3-kinase/Akt pathways, as demonstrated[7,8]. Curcumin has anticancer effects through several mechanisms which includes, Inhibition of Cell Proliferation, Curcumin is found to inhibit the proliferation of gastric cancer cells through various cell cycle arrest at different phases. As shown in research, cur-cumin arrested MGC-803 gastric cancer cells in G1 phase, leading to reduced cell division and proliferation[9].

Curcumin induces cancerous cell death in cancer cells through both intrinsic and extrinsic apoptotic pathways. The compounds increase the level of pro-apoptotic proteins while lowering the anti-apoptotic factors that eventually result in increased apoptosis within gastric cancer cells[10].Anti-inflammatory: It is widely noted that chronic inflammation is the risk factor for gastric cancer. Cur-cumin has antagonistic effects on inflammatory cytokines and enzymes, such as cyclooxyrgenase-2 (COX-2) and interleukin-6 (IL-6), thus inhibiting the pro-inflammatory microenvironment favouring Tumour proliferation[11]. It modulates signalling pathways: Curcumin interrupts various signalling pathways, which are crucial for the survival and proliferation of cancer cells. For instance, it targets the NF-κB pathway that, in gastric cancer, is generally persistently active and reduces the expression of genes participating in cell survival and proliferation.Curcumin has been described to inhibit the migration and invasion of gastric cancer cells. It reduces matrix metalloproteinases and other molecules related to the metastatic process, thus potentially reducing metastasis[12].

Despite preclinical studies underlining the therapeutic potential of cur-cumin in the treatment of gastric cancer, the clinical translation is quite difficult. The primary hindrance is curcumin's poor bioavailability as a result of rapid metabolism leading to systemic elimination. Bioavailability has been enhanced by exploiting strategies such as nanoparticles, liposomes, and combination with other agents[13,14]. Recent clinical studies have also investigated cur-cumin as a concomitant treatment with conventional chemotherapy. The aim of the study was to evaluate the effectiveness of curcumin in the treatment of gastric cancer, focusing on its mechanisms of action, clinical outcomes, safety profile, and limitations.

MATERIALS AND METHODS

Study design: A systematic review about clinical trials was done using curcumin as an effective agent against gastric cancer

Search strategy: The following electronic databases were used to find published article on the effectiveness of curcumin in the treatment of gastric cancer PubMed

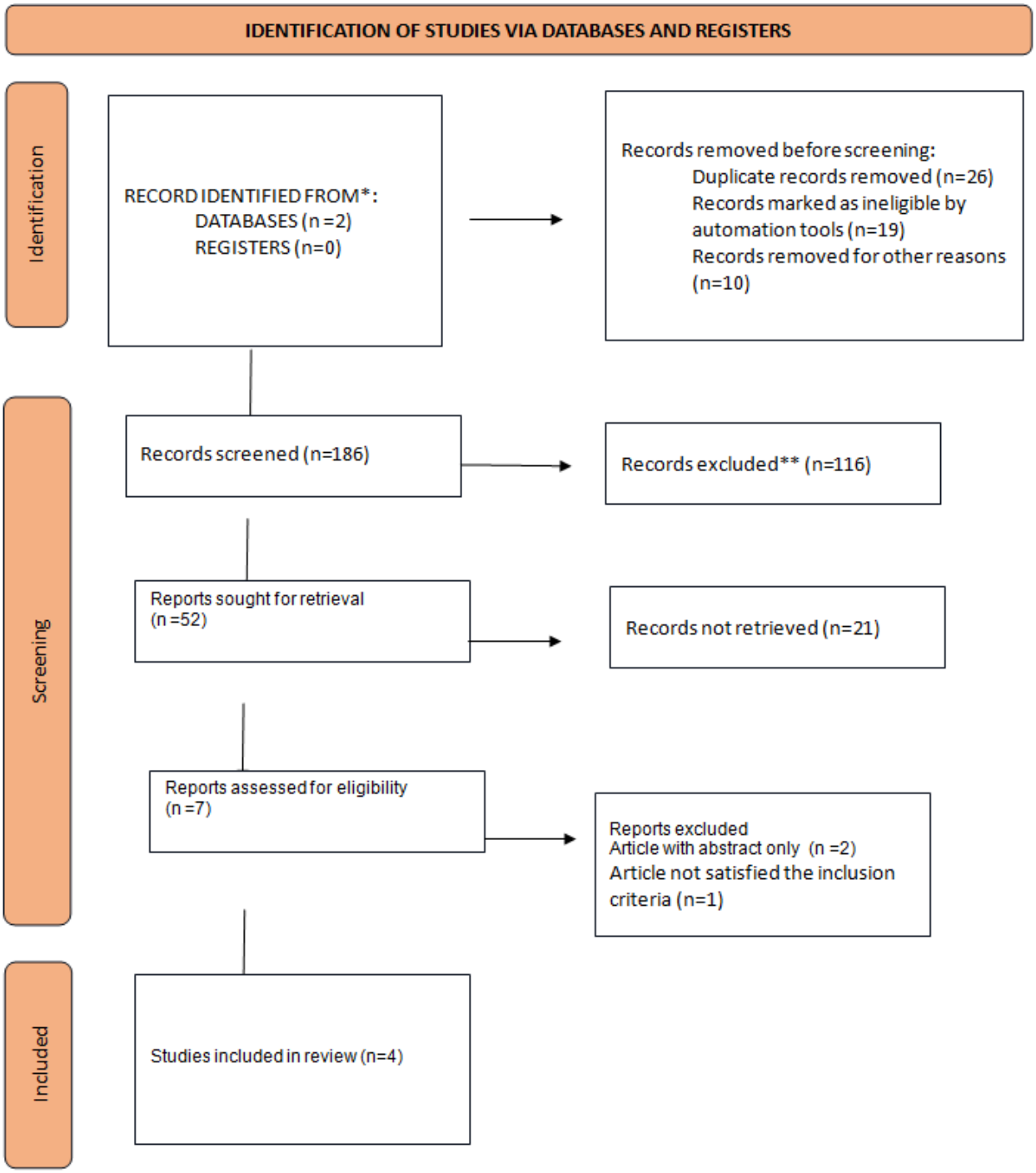
Eligibility criteria

Inclusion criteria:

1. Studies published in English
2. Articles on the effectiveness of curcumin in gastric cancer
3. Clinical trial studies
4. Full-text articles
5. Publications over the years

Exclusion criteria:

1. Articles published in other languages
2. Only abstracts available
3. Unrelated articles
4. Animal studies
5. In-vitro studies



RESULT

Table 1: Characteristics Of The Interventions In The Included Studies

SI.NO	AUTHOR	YEAR	SAMPLE SELECTION	PREPARATION USED	INTERVENTIONS
1	Chunlin Sun	2019	samples selected are,control,curcumin, miR-34a agomir, miR-34a agomir negative control, and curcumin combinedmiR-34a antagomir.	Curcumin-0.2%	Curcumin was found to be effective in anticancer therapy and confirms the anti tumour effect
			Samples selected are	Curcumin	Curcumin inhibits gastric cancer

2	Shufen zhou	2017	based on the extract of curcumin.	dissolved in DMSO-2%	cell proliferation and induces cell apoptosis
3	Xiao zhang	2020	Samples selected are HFF extract of curcumin	SGC-7901,% si-Gli1 Curcumin-2%.	When stimulated with Curcumin,cell showed decreased cellular migration and invasion,while enhanced apoptosis
4	Ali Emami	2021	Samples selected are AGS cancerous and HFF-2 non-cancerous cells	Gemini-Cur and curcumin-1%	Curcumin possess antioxidant, anti-inflammatory, and anticancer effects and its applicability in cancer therapy has been limited due to its poor cellular uptake.

Table 2: Outcome Data As Reported In Clinical Studies

SI.NO	AUTHOR	YEAR	OUTCOME	RESULT
1	Chunlin Sun	2019	Curcumin was found to be effective in anticancer therapy	The results showed that curcumin markedly increased the content of miR-34a microRNA (mRNA) in SGC-7901 cell. Curcumin could inhibit the proliferation and induce apoptosis of SGC-7901 cells
2	Shufen zhou	2017	Dose dependent curcumin suppressed the growth of gastric cancer	The results showed that curcumin reduces gastric secretion by gastric cancer cells, curcumin acts as an antagonist and inhibits cancer cell proliferation
3	Xiao zhang	2020	curcumin suppressed the expression of Shh, Glil and Foxml in the Shh signaling pathway, and the expression of B-catenin,cellular migration, invasion and cytoskeletal remodeling ability decreased.	The results showed that curcumin plays an anti-tumor role through Glil-B-catenin pathway in gastric cancer SGC-7901 cells.
4	Ali Emami	2021	Curcumin applicability in cancer therapy has been limited due to its poor cellular uptake. Gemini-Cur has the potential to be considered as an anticancer agent	The results showed that Gemini-Cur treated cells was significantly reduced in a time- and dose-dependent manner.

DISCUSSION

The exploration of curcumin as a treatment for gastric cancer highlights both the promise of natural compounds in oncology and the challenges of translating in vitro findings to clinical practice. Curcumin, derived from Curcuma longa (turmeric), has shown potential in several studies due to its anti-inflammatory, antioxidant, and anticancer properties[15,16]. This systematic review synthesizes findings from recent research, evaluating the effectiveness, mechanisms, and clinical implications of curcumin in the treatment of gastric cancer. The mechanisms by which curcumin exerts anticancer effects are diverse and complex, indicating that it operates on multiple biological pathways associated with cancer cell growth, metastasis, and apoptosis. One primary mechanism is curcumin's ability to inhibit the NF-κB signaling pathway, a crucial pathway in cancer cell proliferation, inflammation, and survival[17,18]. By suppressing NF-κB, curcumin limits cancer cell survival and promotes programmed cell death, or apoptosis, which is essential in controlling tumor growth. In addition to NF-κB inhibition, curcumin has demonstrated the ability to induce oxidative stress within cancer cells, increasing reactive oxygen species (ROS) levels and leading to cellular damage in malignant cells. Furthermore, curcumin has shown a capacity to modulate other signaling pathways, including PI3K/AKT and MAPK, which are involved in cell survival, proliferation, and migration. These actions suggest that curcumin's anticancer effects are broad, potentially making it an effective adjunctive therapy alongside conventional gastric cancer treatments like chemotherapy and radiotherapy[19,20].

Despite promising in vitro and animal studies, clinical data on the effectiveness of curcumin in treating gastric cancer remain limited, and further research is necessary to confirm its therapeutic potential[21]. Clinical trials that have incorporated curcumin as a

complementary therapy for gastric cancer treatment have shown mixed outcomes. Some studies indicate improved patient outcomes when curcumin is combined with chemotherapy, such as reduced tumor size and fewer metastases, while others have reported only modest or inconclusive results. One challenge in clinical application is curcumin's poor bioavailability, as it is poorly absorbed, metabolized quickly, and has limited reach to target tissues in therapeutic concentrations[22]. Various strategies, such as formulating curcumin in liposomal, nanoparticle, or phospholipid complexes, have been attempted to enhance its bioavailability and, consequently, its clinical efficacy. Results from preliminary studies with enhanced formulations are encouraging, but these formulations have yet to be widely adopted or validated in larger-scale clinical trials[23].

Curcumin's safety profile is another area explored in this review, as it is crucial for assessing its viability as a long-term adjunct treatment. Most studies report that curcumin is generally well-tolerated, with minor gastrointestinal side effects being the most commonly noted adverse events. However, high doses or long-term use could pose potential risks, such as interactions with other medications or an increased risk of bleeding in patients taking anticoagulants[24]. Therefore, while curcumin appears to be relatively safe at moderate doses, careful monitoring is essential, especially when used alongside other therapeutic agents. This systematic review reveals several limitations in the current body of research on curcumin as a treatment for gastric cancer. First, many studies are limited by small sample sizes, lack of randomized controlled trials, and short follow-up periods. Additionally, variability in curcumin dosages, formulations, and modes of administration across studies complicates comparisons and makes it difficult to establish standardized guidelines for curcumin use in clinical practice. Future research should focus on large-scale, randomized controlled trials to confirm curcumin's effectiveness in gastric cancer treatment[25]. Additionally, further exploration into optimized formulations and delivery systems could address the bioavailability challenges and enhance therapeutic outcomes. Moreover, examining curcumin's effects on specific gastric cancer subtypes could provide insights into personalized treatment approaches. The potential of curcumin as a synergistic agent in multimodal therapy strategies, combined with traditional treatments, also warrants exploration.

CONCLUSION

In summary, curcumin holds considerable potential as a therapeutic adjunct in gastric cancer treatment due to its multiple anticancer mechanisms, generally safe profile, and ability to interact with key cancer-related pathways. However, limitations in bioavailability and inconsistent clinical results highlight the need for further research before curcumin can be incorporated into standardized cancer treatment protocols. If future studies continue to demonstrate its effectiveness and address current limitations, curcumin could become a valuable component in the broader therapeutic landscape for gastric cancer.

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