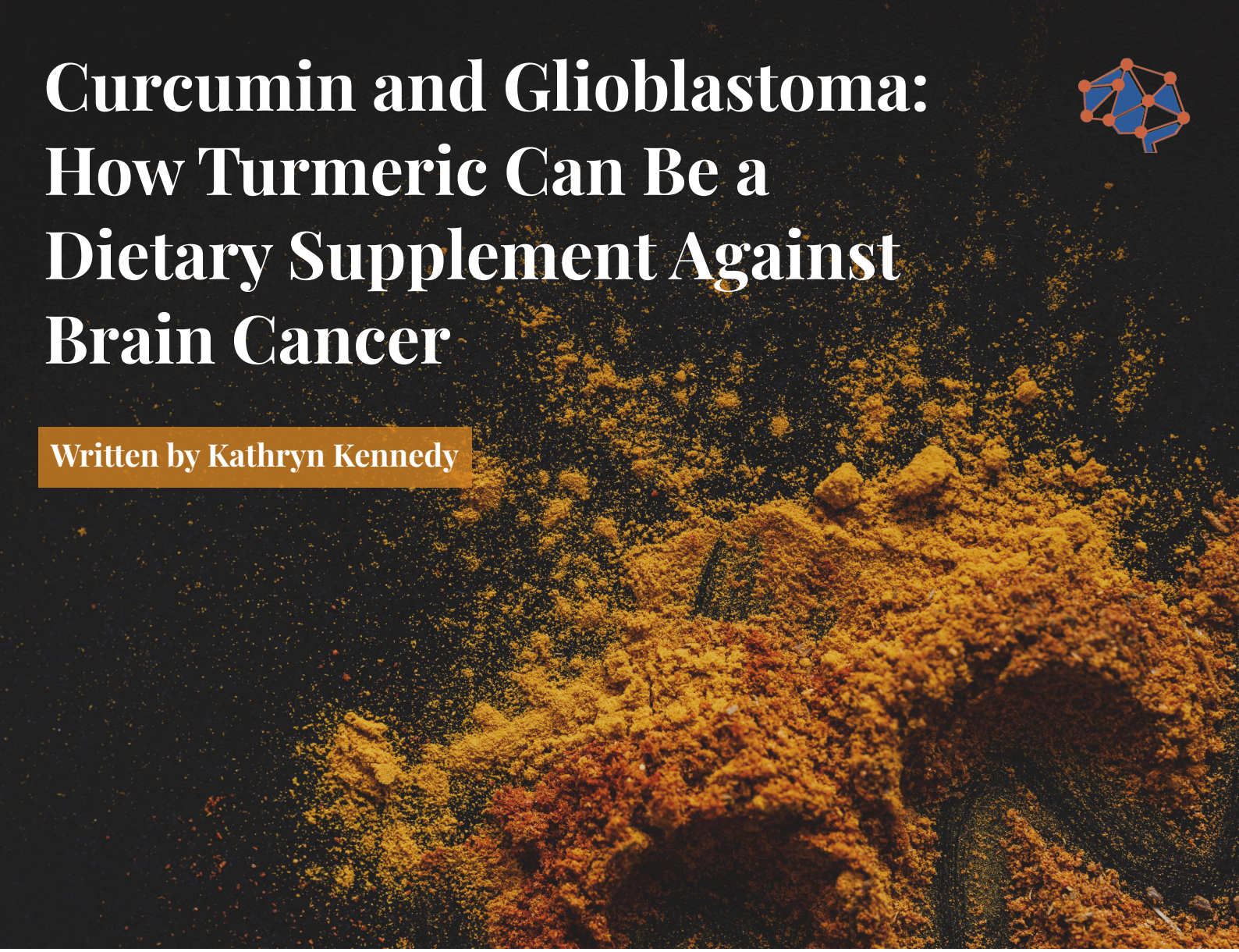
Curcumin and Glioblastoma: How Turmeric Can Be a Dietary Supplement Against Brain Cancer



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Introduction

Imagine a brain tumor so aggressive that it can resist both chemotherapy and surgery, causing an alarming survival expectancy of only 12 to 18 months after diagnosis. This intimidating and complex disease is glioblastoma (GBM), the most common and deadliest brain tumor in adults (Yalamarty, et al., 2023). Researchers are urgently exploring new methods to prevent this serious disease. One particular intriguing dietary supplement researchers have studied as a means to reduce GBM tumor cell development is increased curcumin intake. Understanding how curcumin affects GBM cell mechanisms and how to incorporate turmeric into a diet are key components to taking advantage of this fascinating scientific breakthrough.

A Promising Supplement

Curcumin is a compound found within turmeric, a relatively accessible root vegetable native to India and Southeast Asia. Curcumin has been known to possess antioxidant, anti-inflammatory, neuroprotective, and antiproliferative properties, leading researchers to explore curcumin's potential anticancer mechanisms.

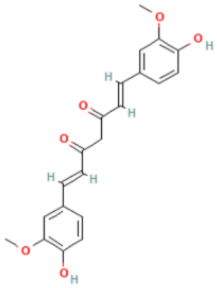

Figure 1. 2D Structure of Curcumin. National Center for Biotechnology Information.

In a recent meta-analysis of studies involving curcumin's specific role in preventing and mitigating the danger of GBM cells, Dr. Ângelo Luís et al. identified that a compelling attribute of curcumin is that it can target signaling pathways properties and can modulate pathways involved in GBM cell growth. Notably, curcumin impacts GBM cell proliferation, cell death, and tumor cell mobility, among other functions (Luís, et al., 2024). To come to this conclusion, Dr. Luís et al. analyzed the efficacy of curcumin on the tumor volume in animal subjects before and after curcumin consumption across 24 studies. Another study conducted by researchers Zexia Wang et al. at the Hubei

University of Science and Technology found that after comparing GBM tumor volume in mice before and after curcumin consumption, curcumin was effective at reducing the volume of the tumors. These results suggest that curcumin can be a useful supplement in preventing cancer cell growth, specifically for GBM (Wang et al., 2020). To better understand how curcumin has these effects, it is important to explore its molecular mechanisms.

Effect on Specific GBM Pathways

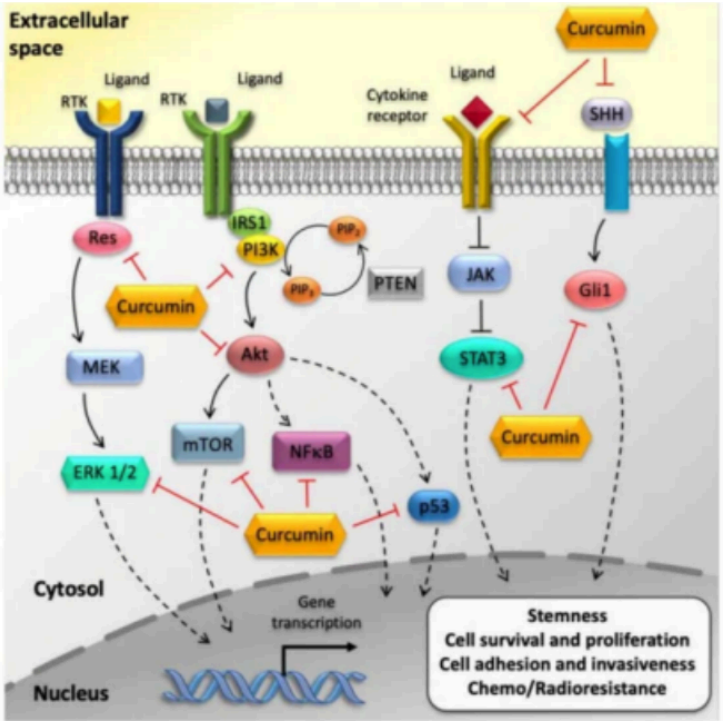

Figure 2. Effects of curcumin on GBM cancer stem cells (GSCs). Molecules.

Curcumin has been found to have pleiotropic effects, meaning it can modulate a number of signaling pathways, specifically major GBM pathways. It hinders cell growth and proliferation by inhibiting tumor-promoting pathways such as nuclear factor κB (NF-kB) and phosphoinositide 3-kinases/Akt/mammalian target of rapamycin (PI3K/Akt/mTOR). The NF-kB pathway also plays a role in enhancing proinflammatory genes, so curcumin's ability to inhibit this pathway contributes to its anti-inflammatory properties. As an antioxidant, curcumin protects cells from damage caused by free radicals, a major source of oxidative stress, which is known to activate the PI3K pathway. By reducing oxidative stress, curcumin is able to inhibit the Pl3K pathway, and therefore suppress tumor cell proliferation. The compound has also been shown to influence pathways involving cell cycle arrest, chemo-sensitizing effects, and cell migration and invasion (Ryskalin et al., 2020), though further research is needed to determine the specific quantity of curcumin necessary to maximize these effects.

Phytochemical Properties

Curcumin is also known to be a type of phytochemical, which are "plant-based bioactive compounds produced by plants for their protection... [that] can be derived from various sources such as whole grains, fruits, vegetables, nuts, and herbs" (Kumar, et al., 2023). As a phytochemical, curcumin has been widely studied for its potential properties associated with other phytochemicals, such as its benefits to counteract stress, mitochondrial damage, synaptic dysfunction, and neuro-inflammation. Phytochemicals also play a role in protecting against major diseases such as diabetes, obesity, cancer, cardiovascular diseases, and lung and prostate cancers. The vast health benefits of phytochemicals, and therefore curcumin, are fascinating, and stress the importance and reward of knowing how to effectively increase curcumin intake.

Figure 3. Ground turmeric. Marco Verch.

Incorporating Curcumin in a Diet

Knowing how to effectively incorporate curcumin into a diet is crucial for maximizing its vast health benefits. Mary-Eve Brown, an oncology clinical dietitian at Johns Hopkins Medicine, provides recommendations on how to safely increase curcumin intake through turmeric. She notes that consuming too much curcumin can be risky, so it is wise to avoid turmeric supplements and instead boost curcumin intake by including turmeric into meals. She recommends adding turmeric to stews, chilis, chicken soup, and making tea with turmeric root. She also encourages frequently finding and cooking healthy recipes online that contain turmeric as an ingredient (Brown, 2024).

GBM currently remains a dangerous and complex disease, and its resistance to current treatment stresses the urgent need for further GBM research and new prevention methods. The intriguing and relatively recent finding of curcumin's anticancer properties may be a promising step forward as a supplement to aid the prognosis of GBM. However, it is crucial to note that curcumin is not a

treatment for GBM – it cannot replace chemotherapy and surgery. Instead, it may complement these treatments as a dietary supplement. Further research in how this compound can target GBM signaling pathways can determine how to maximize its effect in humans. Though curcumin's full anticancer potential is unknown, taking advantage of its known properties can support health benefits.

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About the Author

Kathryn Kennedy is a freshman studying Biology with minors in Health Technology and Spanish. She joined Brain Matters to learn more about neuroscience, psychology, and improve her writing and editing skills. Outside of the journal, she is involved in Global Medical Training and Education and Training 4 Health. She also dances with PSA Barkada, sings with the St. John's church choir, and plays guitar in her free time. Her career goal is to be a pediatrician.