Medicinal Properties of Curcumin: A Review

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Abstract **- Natural plants with medicinal properties are used from centuries in various medicinal systems. The medicinal properties of these herbs are studied extensively. Turmeric is one of such popularly known natural remedies. With varied uses of turmeric, it is extensively used after injury for healing purposes. Antimicrobial agents present in it give it antibacterial and antifungal properties. It is a good antioxidant and used widely. Turmeric contains various anti-inflammatory chemicals and acts to reduce local inflammation. Recently the turmeric studies showed its activity as an anticancer agent. From ancient era to the modern ages turmeric is in the center for medicinal research from herbal sources. Turmeric is currently used in various cosmetics and Pharmaceutical products.**

Index Terms **- Turmeric, Herbal Medicines, Curcumin, Anti-inflammatory, Anti-microbial, Anti-cancer.**

INTRODUCTION

Among one of the most common and almost daily used spices of the Indian subcontinent, is the golden yellow colored and full of healing properties - TURMERIC. It is used both in powdered form and whole rhizome form. This domestic use of the spice dates centuries ago, along with its use in Ayurveda, an ancient medicinal and healing system originated in India. However, recent studies prove that oral intake of Turmeric has several health benefits and medicinal properties such as antioxidant, anti-inflammatory, immunostimulant, hepatoprotective, anti-mutagenic, antiseptic, anti-cancer, analgesic [1].

Chemically, turmeric contains flavonoid called curcumin, along with some volatile oils like zingiberene, turmerone, atlantone [1]. It also contains some resins, sugars, and proteins [1]. However, the polyphenol, curcumin is the most actively researched compound since it is non-toxic and also has numerous health benefits. This curcumin has been recognized and widely used due to its health benefits and as a coloring agent, along with preservative effects for instance, Indian subcontinent uses it as a spice and as ointment, in some cases [2].

1. Composition: Turmeric is made up of various chemical constituents. The root part mainly contains volatile oils with Turmerone. The identical color of turmeric is due to chemical constituents called as Curcuminoids [3]. Many natural antioxidants like curcumin demethoxycurcumin, dihydrocurcumin and 5'-methoxycurcumin are present in Turmeric [4], [5]. Diarylheptanoids are main phytoconstituents present in the turmeric that are termed as curcuminoids [6]. Turmeric consists of a total 34 essential oils [7]. Volatile oils like d-sabinene, sesquiterpenes, zingiberene, d-α-phellandrene, borneol and cinol are present [8]. Turmeric gets its characteristic aroma from α−turmerone, β−turmerone and Ar-turmerone [9].

Table I. Percentage Composition of Turmeric Powder [10].

Constituents	Percentage Composition
1. Carbohydrates	60-70%
2. Water	6-13%
3. Proteins	6-8%
4. Fat	3-7%
5. Essential oils	3-7%
6. Dietary minerals	3-7%
7. Dietary fibers	2-7%
8. Curcuminoids	1-6%

1. Turmeric as a Remedy:

Turmeric is an herbal medicine used as remedy for various ailments like wound healing, Arthritis, Liver issues, conjunctivitis, and urinary tract infections [11]. It has effective action against digestive irregularities, menstrual difficulties, and jaundice [12]. Ayurveda uses turmeric as medicine to energize the body, improve digestion, treating gallstones and menstrual regulation. Turmeric has Antimicrobial, anti-inflammatory, and carminative properties [13]. Patients with arthritis are recommended to take 8-60 g of turmeric root thrice in a day [14]. Turmeric extract with hydroethanolic recently showed inhibition of the

human cell against cytokines causing inflammation [15]. 5 percent concentration of garlic mixed extract of garlic and turmeric showed inhibition of growth in bacteria such as Bacillus cereus and Proteus mirabilis [16]. When various extracts like oregano oil, chilli, turmeric and cumin are tested against Helicobacter pylori, Turmeric was the most effective among all [17].

2. Antimicrobial Agent:

Various past experiments proved antimicrobial activity of turmeric. The turmeric is an excellent antibacterial, antifungal and antiviral [18]. Turmeric is used in various medicine methods such as Ayurveda, Chinese medicine and other ancient medicine systems. It is applied on wounds to prevent microbial growth around the injury. Natural antimicrobial agents like Neem and Turmeric are also taken orally as medication due to its antimicrobial action in the gut. Turmeric extract shows antibacterial and antifungal properties [18]. 6 percent ethanolic extract of turmeric showed effect against Mycobacterium tuberculosis [20]. The different concentration and dosages of turmeric extracts with various solvents have been observed to be effective against many microbes. Chemical constituents present in turmeric are responsible for its broad antimicrobial activity. Turmeric is a highly effective and most extensively used natural antimicrobial agent.

3. Antibacterial Properties:

Turmeric is effective against many bacterial pathogens. The extracts of turmeric (Hexane and Methanol) show antibacterial properties against 13 different bacteria [1]. Due to antibacterial properties of turmeric, it is now added in various antimicrobial wound dressing gels and ointments [21]. When it is studied on Helicobacter pylori, it showed antibacterial activity with minimum inhibitory concentration (MIC) of range 5 to 50 μg/mL [22]. In Bacillus subtilis it showed suppression of cytokinetic Z-ring formation [23]. Division prokaryotic cell is disrupted because of curcumin by suppression of FtsZ assembly in Escherichia coli and Bacillus subtilis [24]. Methanolic turmeric extract showed antibacterial properties against Staphylococcus aureus and Bacillus subtilis [25]. Turmeric is a powerful antibacterial agent and has shown its inhibitory action on methicillin resistant Staphylococcus aureus (MRSA) [26]. One of the key constituents of turmeric, curcuminoids exhibited effective antibacterial property against 8 bacteria like Staphylococcus aureus, Bacillus subtilis, Edwardsiella tarda, Bacillus cereus, Staphylococcus epidermidis, Streptococcus agalactiae, Staphylococcus intermedius and Aeromonas hydrophila [27]. 0.3% (w/v) of curcumin when added in cheese showed reduction in Salmonella typhimurium, Pseudomonas aeruginosa, and Escherichia coli [1]. 0.1%-10% of hexane extract of turmeric exhibited a negative effect of multiplication of Salmonella typhimurium [28]. Curcumin also produces synergistic effect with ciprofloxacin on methicillin resistant Staphylococcus aureus (MRSA) [29]. Bacteriocin subtilosin with curcumin exhibited synergism against Listeria monocytogenes [30].

4. Antifungal Properties:

Turmeric is extensively used in cuisine due to its antimicrobial properties. Various studies have been conducted to analyse the effect of it on fungi. Curcumin and turmeric oil have antifungal properties against fungi like Helminthosporium oryzae and Fusarium solani [31]. Curcumin showed notable results when tested on Paracoccidioides brasiliensis [32]. Turmeric oil exhibited antifungal activity against Fonsecaea pedrosoi, Sporothrix schenckii, Scedosporium apiospermum and Exophiala jeanselmei [33]. Turmeric extract solubilized in methanol revealed antifungal action on Candida albicans and Cryptococcus neoformans [34]. Turmeric extract in ethyl acetate showed inhibitory action on fungi like Puccinia recondite, Rhizoctonia solani, Phytophthora infestans and Botrytis cinerea. The mechanism behind the antifungal action is denaturation of ERG3. Resulting into lack of ergosterol in fungal cells, which ultimately leads to accumulation precursors used in biosynthesis of ergosterol [35]. Antifungal activity of curcumin reduces secretion of proteinase and alters membrane properties [36].

5. Antioxidant Properties:

Turmeric Exhibits two primary properties of antioxidant and anti-inflammatory [37]. Curcuminoids present in turmeric have strong antioxidant properties. Turmeric is used in food to increase its shelf life. The chemical constituents present in it like flavonoids, tannins and ascorbic acid are good antioxidants.

Curcumin improves oxidative stress in systemic markers [38]. Curcumin works by various free radical scavenging mechanisms. Curcumin scavenges reactive Oxygen and reactive Nitrogen free radicals [39]. Reactive oxygen generating enzymes like xanthine hydrogenase and cyclooxygenase [40]. Curcumin is chain breaking antioxidant as it effectively scavenges peroxyl radicals [41]. It regulates activity of SOD enzymes, catalase and Glutathione (GSH) [42].

6. Anti-Inflammatory Properties:

Asian countries have been using turmeric as a medical herb due to its antioxidant and anti-inflammatory properties since ages now [43]. A mixture of turmeric and slaked lime (as a paste) has been used to treat wounds and inflammation, in Indian households [44]. Inflammatory disorders like ulcerative colitis (UC), a gastro-intestinal disease, having very less definitive therapies and hence, is difficult to manage and treat [45]. Studies show that an interesting group of oils in turmeric, called Essential Turmeric Oils (ETO), which comprise of α-turmerone, β-turmerone and α-santalene possess notable anti-inflammatory and antioxidant properties [45]. Since the star compound - curcumin, is poorly absorbed after ingestion, studies reveal that a mixture of curcumin-ETO improves its systemic bioavailability [45]. In the same context, it is also found that the curcumin-ETO complex has an increased bioavailability up to 7-10 times compared to standard curcumin alone [46], [47]. Although curcumin is a well-established anti-inflammatory compound, the exact mechanisms by which it suppresses inflammatory burden in different diseases is yet to be known [45].

7. Anti-Cancer Properties:

According to the WHO, the second leading cause of death globally, is cancer. Out of every 6 deaths, 1 is due to cancer [48]. Modern medical technologies teamed up with ancient treasure of knowledge about natural products have found a strong research ground. Although it is proved that curcumin-ETO improves the systemic bioavailability, a study by Aggarwal et.al shows some anticancer activities of curcumin free turmeric (CFT) [49]. The compound element in turmeric is used for treating cancer in China [49]. However, curcumin is extensively screened for its potential anticancer activities, along with other compounds and methods to improve the same. Also, research indicates that curcumin may have anti-cancer properties by modifying different biological pathways related to apoptosis, mutagenesis, cell cycle regulation, tumorigenesis, and metastasis [50].

Many in-vitro and in-vivo studies have proved that curcumin manages carcinogenesis by suppressing two major processes: Angiogenesis and tumor growth [51]. The release of antigenic factors stored in the extracellular matrix (ECM) is also prevented by turmeric [52]. Curcumin induces cell death in various cancers using apoptosis [53]. Apparently, it also induces cell death in various cell lines which are resistant to cell death. Numerous animal systems and cell lines have been studied in the context so far and found curcumin to be a strongly potent ant carcinogen. Some such tests are effects of curcumin on liver cancer, skin cancer, pancreatic cancer, prostate cancer, ovarian cancer, lung cancer, head, and neck cancer [50].

CONCLUSION

Turmeric, and more precisely curcumin has been seeking attention worldwide and in the last decade, it has been started being consumed even in the regions where it was totally unknown previously its major health benefits appear to act primarily as an antioxidant and anti-inflammatory agent. These benefits of curcumin are best achieved when combined with other non-curcuminoids compounds like ETO. Along with prevention of further complexity of a disease or cure for the disease, when administered in relatively lower doses, turmeric has been proved to provide health benefits for people who have not been diagnosed with health conditions. It is said to be a quest of treasure which has just begun and potentially, has numerous more advantages for human wellbeing.

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