Hop and Medicinal Plants, Year XXVIII, No. 1-2, 2020
ISSN 2360-0179 print, ISSN 2360-0187 electronic

TURMERIC (GEN. *CURCUMA*) – A SPICE WITH BENEFICIAL EFFECTS FOR FOOD AND HEALTH

FOSTOC Georgiana, Andruța Elena MUREȘAN*, Vlad MUREȘAN, Romina MARC, Georgiana MARȚIȘ, Ioana Elena MURESAN (VIMAN), Bianca Vasilica BELDEAN (TĂTAR), Maria-Evelina BORDEAN, Mădalina Alexandra MATEESCU, Sevastita MUSTE
University of Agricultural Science and Veterinary Medicine,
Faculty of Food Science and Technology, Department of Food Engineering,
3-5 Calea Mănăştur Street, 400372, Cluj-Napoca, Romania
*Corresponding author e-mail: andruta.muresan@usamvcluj.ro

Abstract: This review summarizes recent research on the potential of turmeric extracts for the food industry and the biological aspects of curcumin. This spice has attracted great interest in recent decades due to its biological activity. Turmeric is a non-toxic, highly promising natural antioxidant compound with a wide range of biological functions that has been used in Ayurvedic medicine and Chinese medicine since ancient times. Nowadays, turmeric is broadly used as food additives due to its properties (flavouring, preservation and colouring). More than that, turmeric and its derivatives have varied biological actions, including antioxidant, antimicrobial, anticancer, neuroprotective and cardioprotective effect.

***Keywords*:** turmeric, additives, preservative, natural antioxidant, bioactive curcuminoids, curcumin, antimicrobial, anticancer.

Introduction

Turmeric is native to Southeast Asia, where many related species appear, although it itself occurs in the wild. It is grown mainly in India, followed by Bangladesh, China, Malaysia, Indonesia, Philippines and Thailand. Indian turmeric is considered the best in the world due to its high curcumin content, which is why India is regarded the as one of the extensive manufacturers and traders of turmeric (Ravindran e*t al*., 2007).

The rhizomes of the plant are oblong, pyri-form, ovate, often short branched and have lance-shaped leaves and spike of yellow flower that grow in fleshy rhizome or in underground stem. The orange pulp contained inside the rhizome is a good source of turmeric (Eigner and Scholz, 1999).

Turmeric varieties

***Curcuma longa* L.**

Curcuma longa is also renowned as 'turmeric', 'kurkum' and 'haldi'. It is widely cultivated all over the world though is authentic to The Southeast Asia. Turmeric can be consumed as a whole rhizome (dried or crisp) in powder form or extracts and oleoresins. The spice is famous for its culinary and medicinal effects (it is used for treating more affection such as: infections, gastritis, hypertension, diabetic wounds or cough (Awasthi and Dixit, 2009).

***Curcuma zedoaria* (Christm.) Roscoe**

Curcuma zedoaria also well- known as 'white turmeric', 'zedoary' or 'er – jyur' and it's original to northeast India and Indonesia (Purkayastha *et al.,* 2006). The rhizome of *C. zedoaria* is as a ginger from the outside (wrinkled gray, color ash) and as a turmeric from the inside (colour brownish red-yellow). Aroma is less intense that can be assessed between turmeric and mango. Different parts have been used for treating digestive problems, skin diseases, haematological and circulatory abnormalities and various infectious. Also, the powder is used for culinary purposes due to its unique smell, although it has a pungent taste (Lobo *et al.,* 2009).

***Curcuma aromatica* Salisb**

Curcuma aromatica is cultivated in China, Japan and India, grows in tropical and subtropical regions and is known as wild turmeric (Xiang *et al.*, 2017). This plant has anti-inflammatory, antioxidative, anticancer and antimicrobial activities and it is used as a colouring and flavouring agent and protecting against liver diseases (Al-Reza *et al.,* 2010).

***Curcuma amada* Roxb**

Curcuma amada is authentic to East India. It is also familiar as 'mango ginger' due to its mango flavour, which it is assigned to the presence of δ-3-carene, myrcene, and (*Z*)-β-ocimene (Varadarajan *et al.*, 2018). This variety is a source of starch; it is used in culinary preparations and in medicine (Policegoudra *et al.*, 2011). Other curcuma species: *C. aeruginosa* Roxb.; *C. alismatifolia* Gagnep.;. *C. amada* Roxb.; *C. angustifolia* Roxb.; *C. aromatica* Salisb; *C. aurantiaca* Zijp; *C. bicolor* Mood & K. Larsen; *C. cochinchinensis* Gagnep; *C. comosa* Roxb.; *C.*

ecomata Craib, etc. There are almost 90–100 accepted *Curcuma* species, despite the exact number of species is yet insecure.

Chemical composition

The chemical composition of turmeric is: protein (6.3%), fat (5.1%) carbohydrates (69.4%), minerals (3.5%) and moisture (13.1%). The essential oil (5.8%) obtained by steam distillation has a-phellandrene (1%), sabinene (0.6%), cineol (1%), borneol (0.5%), zingiberene (25%) and sesquiterpines (53%) (Kapoor, 1990).

Turmeric rhizome, the greatest part of the plant contains: phenolic curcuminoids and essential oil (Mau *et al*., 2003; Jayaprakasha *et al.,* 2005), and the composition of the both depends on the environment, crop season, dry process and storage conditions and genotype. The volatile oil is responsible for aroma and taste and while the curcuminoids are responsible for the yellow color (Chatterjee *et al.,* 2000). Curcuminoids (curcumin, demethoxycurcumin, and bisdemethoxycurcumin) are polyphenolic derivatives of turmeric which have many biological activities (Itokawa *et al*., 2008). The most studied curcuminoid found in turmeric is curcumin, which is appreciated as the most responsible compound for most beneficial effects.

The essential oil has a large variety of pharmacological properties, including antidiabetic, anti-inflammatory, antimicrobial, antiviral, antioxidant, anticancerous, antihepatotoxic, antidiarrheal, diuretic, antirheumatic, hypotensive (Afzal *et al.,* 2013). Also are known to accelerate toxin elimination, promote blood circulation, boost immune function and stimulate digestion (Raut and Karuppayil, 2014). Essential oils are obtained by hydro-or steam distillation of fresh or dried rhizome (Weiss, 2002), but as another option, they can be obtained by extracting the solvent or extracting the supercritical liquid from the rhizome powder (Gopalan *et al*., 2000).

In recent times, has been used solid-phase microextraction (SPME) as a solvent-free technique to extract and concentrate volatiles from different plant parts. Industrially, turmeric oil is produced during the processing of oleoresin (Jayaprakasha *et al*., 2001).

Differences in the oil chemical profile may be due to several factors, such as: extraction and analysis methods, variety, genotype, differential geography, cultivation practices, climate, season, stage of fertilization, fertilizer application, stress during growth or maturity, harvest time, storage (Burt, 2004; Sanghamitra *et al*., 2015).

The potentials of turmeric extracts for the food industry

In 1975, the Scientific Committee for Food (SCF) evaluated and accepted the use of curcumin as a food colouring without further research. In 2010 the group for food additives and nutrient sources agreed with JECFA that curcumin is not toxic or carcinogenic (EFSA Panel on Food Additives and Nutrient Sources Added to Food, 2010).

Since ancient time the turmeric has been used as a spice and food additive and, being used for its antioxidant potential, storage stability and to improve the taste (Surojanametakul *et al*., 2010). Presently, turmeric and curcumin (the code of E100) are generally utilized as food additives with colouring, preservative and flavouring properties (e.g., in butter, cheese, mustard, margarine, beverages and pasta). As a food additive, is resistant in dry foods and during thermal treatment and it is susceptible to reactions with other ingredients and in reactions with chlorides, phosphates and bicarbonates (Stankovic, 2004). For nutritional purposes, curcumin is recommended a dose of 5-500 mg/kg, depending on the food category. Turmeric is especially used in dairy products, mustard, cereals, beverages, sausages, eggs, food concentrates, ice cream, bakery products, pickles, meat and fish (Lakshmi, 2014; Solymosi *et al*., 2015). Many researchers have shown that curcumin has antimicrobial effects, for example, in a study reported by Liang *et al*. (2007) it was shown that curcumin has good preservative effects on bread, curd and boiled mutton. In another study, Abdeldaiem (2014) showed that curcumin led to increased oxidative stability of soybean oil and reduced the total number of bacterial molds and the number of yeasts in chicken breast fillet samples. Gul and Bakht (2015) also demonstrated that chicken flour treated with curcumin-wealthy curcumin oil (1% or 2%) was stored without microbiological contamination for 90 days and safely.

Curcumin on health and disease prevention

Curcumin and its derivatives have multiple biological effects such as: antioxidants, anti-inflammatory, antimicrobial, cardioprotective, hepatoprotective, neuroprotective and anticancer effects. It has powerful antioxidant and anti-inflammatory activities when used as a remedy for treatment of chronic diseases (He *et al*., 2015).

The antioxidant activity of curcumin has been reported since 1975 (Sharma, 1976). For the antioxidant ability is responsible the chemical structure of curcumin which includes carbon-carbon double bonds, β-diketet group and phenyl rings with hydroxyl and o-methoxy groups (Wright, 2002) or mechanisms as electron donors to neutralize free radicals, hydrogen atom donors and binding free radicals (Jovanovic *et al*., 1999).

Neuroprotective effect

Some studies say that curcumin has been used for various neurological conditions, such as multiple sclerosis and Huntington's disease (HD), dementia, AD, PD, due to its antioxidant, anti-inflammatory and anti-protein aggregation abilities (Ye and Zhang, 2012; Song *et al*., 2016). Also, some research shows that curcumin has good effects on brain health through several mechanisms, such as antioxidant, neurogenesis activity, anti-inflammatory, amyloid β binding, metal chelation and promoting synaptogenesis (Salehi *et al*., 2020).

Anticancer effect

Several studies have shown the ability of curcumin to target several cancer cell lines, such as the antitumor activity of curcumin on breast cancer, lung cancer, prostate cancer and brain tumours (Anand *et al*., 2008). The main methods of action by which curcumin manifests its anticancer activity include invasion of tumours by suppressing a variety of cellular signalling pathways, inhibiting proliferation and inducing apoptosis (Kunnumakkara *et al*., 2017).

Curcumin has also been studied for its hepatoprotective and cardioprotective properties. Several agents, such as pollutants, alcohol, parasites, drugs, and dietary components, can trigger acute and chronic liver damage, including liver fibrosis, non-alcoholic, steatohepatitis, nonalcoholic liver disease, and even cirrhosis. In a study, Afrin *et al.* (2015) found that curcumin treatment was able to decrease oxidative stress, inflammation and lipogenesis and attenuated fibrosis, and translocation and HMGB1-NF-κB signalling. It has also been shown that curcumin has the ability to reduce cirrhosis and liver fibrosis (Zhang *et al*., 2014).

Antibacterial effect of turmeric

The antibacterial activity of curcumin was first reported in *Nature* in 1949 (Schraufstätter *et al*., 1949) and in 1974, some researchers published in the journal Planta Medica information on the effects of curcumin and essential oil of the *C. longa* rhizome against 65 reference and clinical strains representing 56 bacterial and fungal taxa. Turmeric has been shown to have a high in vitro action for some Gram-negative bacteria (*Acinetobacter lwoffii, Alcaligenes faecalis*) Gram-positive shells (*Staphylococcus aureus,* *S. epidermidis, Streptococcus pyogenes, Micrococcus tetragenus, M. luteus*), spores-forming bacilli (*Bacillus* and *Clostridium* species), and fungi (e.g. *Candida stellatoidea, Cryptococcus neoformans, Microsporum gypseum, Saccharomyces cerevisiae, Scopulariopsis brevicaulis*) (Lutomski *et al*., 1974) also its beneficial effects against Gram-negative uropathogens (*Pseudomonas aeruginosa*, *Escherichia coli*, *Serratia marcescens* and *Proteus mirabilis*) (Packiavathy *et al*., 2014).

Despite its poor solubility in water, low bioavailability and pharmacokinetic profile, modern studies have confirmed the strong antimicrobial potential of curcumin (Kotha and Luthria, 2019).

Conclusions

In nowadays, the food industry focuses on developing innovative strategies to meet both organoleptic requirements (taste, smell, appearance and attractiveness) and health (impact on quality of life and aging health). Due to its chemical composition, curcumin, the main bioactive substance of turmeric, can be considered a promising ingredient for new functional foods and helps prevent various diseases. Thus, turmeric also has the ability to evolve modern medicine for the treatment of various diseases.

Acknowledgements

This work was supported by a grant of the Romanian Ministry of Education and Research, CCCDI - UEFISCDI, project number PN-III-P2-2.1-PED-2019-5346, within PNCDI III.

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