Chapter 12
Pharmacological Properties of Curcumin:
Solid Gold or Just Pyrite?

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ABSTRACT

Curcumin, the polyphenol natural product, is a constituent of the traditional medicine known as turmeric. Extensive research over the last 50 years has indicated that this polyphenol displays potent pharmacological effects by targeting many critical cellular factors through a diverse array of mechanisms of action. However, there are some obstacles that prevent this wonder molecule to be effective in clinical settings and limit its use to topical applications only. Curcumin has recently been classified as both PAINS (panassay interference compounds) and an IMPS (invalid metabolic panaceas) candidate. Due to likely false activity of curcumin in vitro and in vivo has resulted unsuccessful clinical trial of curcumin against several disease. The chapter will review the essential medicinal chemistry of curcumin as well as envisage a compilation and discussion on the poor bioavailability of curcumin.

INTRODUCTION

The natural products are secondary metabolites belongings to structurally diverse categories which are produced by the plants by evolutionary and adaptive processes over millions of years. Natural products (secondary metabolites) have been the most

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vital source of potential drug and their pharmacological properties have been well documented from ancient times. The different ethnic societies and experience of many generations of physicians is the root for the use of natural products to prevent or to cure diseases (Dias *et al.,* 2012; Bernardini *et al.,* 2018). At present, only 20% of people can afford modern medicine, the main concern is that most of them are ineffective and has numerous side effects. Although over hundreds of natural products from plant sources are used in modern medicine but in most of the cases their scientific evidence is lacking. However, today it is an unmet need to provide scientific evidence as to whether or not it is justified to use a plant or its active principles. Further, the characterization of bioactive plant preparations is must to validate their pharmacological activity and toxicity followed by clinical studies.

Thus, it is essential to correlate the pharmacological mechanism under *in vitro* and *in vivo settings* of any natural drug with clinical studies which can be achieved through healthy human volunteers. These clinical studies should be in a controlled manner, to verify the fact that whether or not active components of the plant would prevent or treat diseases in man. Having this in mind the author reviewed the literature available on *C. longa* and tried to critically evaluate the scientific data (David *et al.,* 2015; Patridge *et al.,* 2016; Sarkar *et al.,* 2019).

BACKGROUND

Turmeric is well known as Haldi (in Hindi), a spice which is one of the main constituents curcumin, a polyphenolic secondary metabolite. It is obtained from the rhizome of perennial herb *C. longa* related to Zingiberaceae family. Ravindran *et al.,* (2007); reported that more than 100 Curcuma species are listed in botanical sources; and among them, *C. longa* is the best one. *C. aromatic*, *C. phaeocaulis*, *C. zedoaria* and *C. caesia* are the other sources of curcumin. Aggarwal *et al.,* (2007), reported several synonyms of curcumin on the basis of its appearance and uses (**Table 1**).

Curcumin is widely cultivated in tropical and subtropical areas such as Southeast Asia mostly in India and China. India is the main producer of the turmeric and produces nearly the whole world's crop and uses 80% of it (Bao *et al.,* 2010; Labban, 2014). In the traditional medicine system of India, various *Curcuma* species have been used for the treatment of different diseases and health-related disorders. It has been also received interest from both the medical/scientific world and from culinary enthusiasts. Some of the uses of *Curcuma* species listed in **Table 2 (***Ayati et al., 2019)*.