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# A Concise Review on Absorption and Metabolism of Curcumin

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**Abstract:** ***Curcumin commonly known as turmeric, obtained from the rhizomes of Curcuma longa, one of the species from Zingiberaceae family and exhibits characteristic golden yellow colour. Today there is some 120 known species of turmeric. Curcumin, in Ayurveda being use as drug for different diseases and common health problems like skin diseases, aches, inflammation, wound (as anti-septic) and liver disorders. Pharmacological importance of turmeric elevated after modern science reveals its antioxidant properties. The main hurdle identified curcumin as 'Super Drug' is its low bio-availability. To overcome this factor it is become necessity to study absorption and metabolism of Curcumin. Derivatisation Curcumin, especially introducing heterocyclic scaffold is another accepted method to increase bioavailability. Present review work is a tiny attempt to understand metabolism of Curcumin. Common observation during all metabolic study is that Curcumin does not show any cell toxicity even in high amount consumption.***

**Keywords:** Curcumin Metabolism, Bioavailability of Curcumin, Ancient Indian Drug, Curcuma longa

## 1. Introduction

The Latin word '*Curcuma*' came from Arabic '*Kourkoum*' means saffron, with respect to its yellow colour appearance and similar taste**.** Curcumin commonly known as turmeric, obtained from the rhizomes of *Curcuma longa*, one of the species from *Zingiberaceae* family (**Figure 1**) and exhibits characteristic golden yellow colour. Today there is some 120 known species of turmeric. Curcumin used as yellow colour curry pigment in all over Indian subcontinent. Curcuma needs a humid, hot climate to grow and excess of water. It is now established as major crop in tropical and subtropical regions, particularly in India and China along with South East Asia (Indonesia, Thailand, Vietnam, and the Philippine) **[1].** Today significant cultivation areas are in India, where Curcuma is also known as *Haldi***.** India is the largest worldwide producer, consumer and exporter of Curcuma. The production of Curcuma in India has grown by approximately 40% in the last ten years, and annual production in 2008–2009 was about 900000 tons.

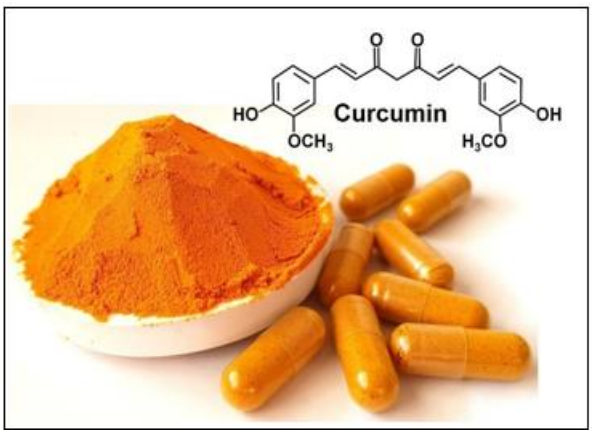


**Figure 1:** Curcumin (Source: *Google*)

Ancient Ayurveda has routine practice consists of use of plants as medicinal remedies. Curcumin, in Ayurveda being use as drug for different diseases and common health problems like skin diseases, aches, inflammation, wound (as anti-septic) and liver disorders. Pharmacological importance of turmeric elevated after modern science reveals its antioxidant properties.

**Metabolic Study of Curcumin:**

The pharmacological safety of curcumin opens an opportunity to be a potential scaffold for curing and prevention of a numbers of human diseases. But still curcumin is not established as approved therapeutic agent. This could be easily understand by focusing the relative bioavailability of curcumin is poor and this comes forward as a major problem for established Curcumin as recognized therapeutic agent. Bioavailability of any substance depends mainly upon following metabolic process, 1) Absorption 2) Distribution 3) Metabolism 4) Excretion Literature survey consists of few reports on study done to found some relation between poor bioavailability of curcumin and related metabolism. Very first report was study of uptake, distribution and excretion of Curcumin was done by Wahlstrom and Blennow in 1978 [2], during the experiment, 1gm/kg of Curcumin was introduced to rat orally. Study reveals that very low amount of curcumin was absorbed in gut (Food track upto the digestive system), experiment also involved 5gm/kg as a mega dose but results was found steady. Analysis of urine and blood plasma level for Curcumin sample was done to conclude this study. Wahlstrom and Belnnow was also report an observation in favours of Curcumin, those high doses of Curcumin does not exhibits any toxic effect on mice. Pharmacokinetic study of Curcumin was performed by Pan et al., [3] and observation on curcumin administrated by orally as well as intraperitoneal (i.p.) in mice. Oral administration method found very low (0.13 µg/ml) curcumin plasma level detected after 15 minutes, maximum curcumin plasma level (0.22 µg/ml) observed after 1 hour this level gradually then decreases. Result obtained after intraperitoneal (i.p.) administration was significantly differ from oral one. On i.p. administration, Curcumin plasma level only after 15 minutes boost upto 2.25µg/ml and then rapidly falls down with time. Another recent study by Yang et al., [4] examined pharmacokinetics of Curcumin in mice model using both Oral as well as i.p. administration method. Including used

radiolabelled curcumin for easy of analysis which was done by HPLC method, shows administration of curcumin 10mg/kg in mouse reflect maximum serum level 0.36µg/ml, whereas almost 50-times more curcumin oral dose has 0.06µg/ml of curcumin serum level. Curcumin, when get absorb, its distribution in body tissues is one of the significant factors for established curcumin has potent or non-potent pharmacokinetic properties. A few studies have been reported about distribution of curcumin at tissue or body level. Ravindranath et al., [5] studied on oral administration of curcumin upto 400mg. It was observed that 30 minutes after curcumin administration to mouse 90% of curcumin was found in the stomach and small intestine. Samples were collected after 24 hours from stomach and small intestine contains only 1% of curcumin. Later on, precisely after one year later study was reported by same group performed an in-vitro study in which sacs of rat intestine were incubated with series of concentration of curcumin (50-570 µl) with incubation medium. Experiment shown that less than 3% of curcumin were available at tissue level [6]. Rabindranath's study with distribution of curcumin at tissue level when done with tritium-labeled curcumin drug, outcomes after detecting samples from organs like blood, liver and kidney exhibits radioactivity was observed, means curcumin was found. Same results were obtained when curcumin administration doses was 400mg, 80mg and 10mg. Significant amount of Curcumin were found when dose was 400mg, at this reading of presence of curcumin was detectable upto 12 days after administration of curcumin. This study also highlights facts that change in amount of curcumin dose do not changes rate of absorption and has no effect on concentration of curcumin at tissue level. At any concentration (400mg, 80mg and 10mg) absorbed curcumin was 60-66% [7]. These results underline the basic limitation of Curcumin as low bioavailable drug. Physically introduction of higher dose do not elevate amount of curcumin at cellular level. Pan et al., [3] in mice model used 0.1g/kg of curcumin dose using i.p. method. After one hour of injection, maximum amount of curcumin was 117µg/g in the intestine. In the Liver, kidney and spleen curcumin was found 26.9µg/g,7.5µg/g and 26.1µg/g respectively. On analysis of brain, another recent study by Yang et al., [4] examined pharmacokinetics of Curcumin in mice model using both oral as well as i.p. administration method. Including used radiolabelled curcumin for easy of analysis which was done by HPLC method, shows administration of curcumin 10mg/kg in mouse reflect maximum serum level 0.36µg/ml, whereas almost 50-times more curcumin oral dose has 0.06µg/ml of curcumin serum level. 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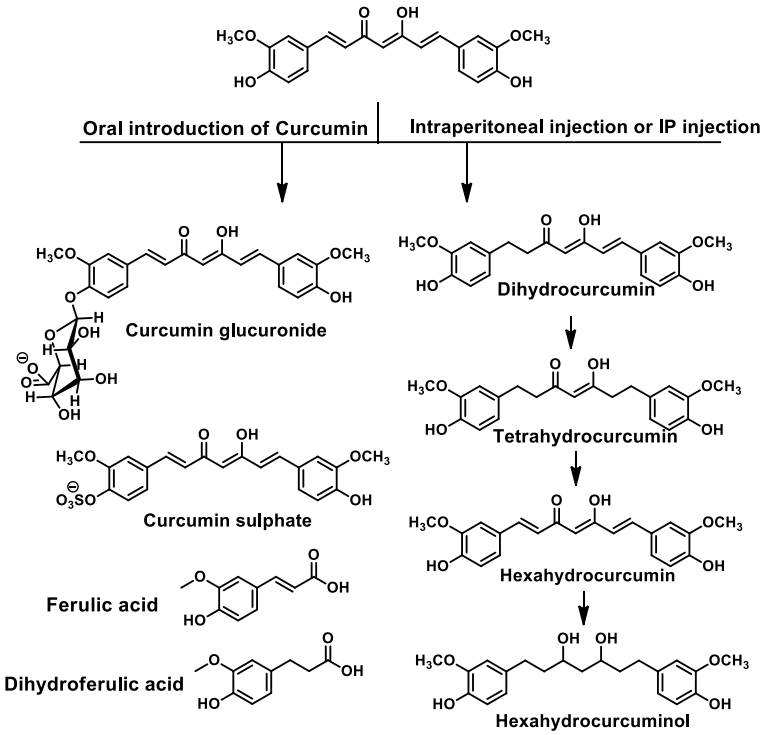


**Figure 2:** Showing pathway of Metabolism of curcumin and structures of metabolite

In literature numbers of study have been reported, for metabolism of Curcumin. On absorption of curcumin in animal as well as human model were studies. First report of metabolism of Curcumin was study by using mouse model and curcumin was introduced orally [15]. It was reported that Liver is the main organ responsible for metabolism of curcumin [15, 8 and 9]. Major metabolites of curcumin were found as glucuronides of tetrahydrocurcumin (THC) and hexahydrocurcumin (HHC) [Figure 2]. After analysis and systematic study of rat urine found sulfate conjugate metabolites. It was also mention that 99% of curcumin present at plasma level are in the form of glucurnoide conjugate Asai et al., [10], evaluate the orally introduced curcumin in again mouse model. Hydrolysis of plasma samples with the help of enzyme exhibits that predominant metabolites in plasma were glucuronides and or sulfates of curcumin. During metabolism curcumin undergoes various reduction type reactions, predominantly catalyzed by enzyme alcohol dehydrogenase followed by conjugation. [Figure 2]

Further study of, thus formed metabolites of curcumin and its activity are not performed in details, as no literature reports were found. But few reports [11,12] stated that curcumin metabolites glucuronides and Tetrahydrocurcumin are less active than curcumin. Curcumin metabolite activity study in another study was completely contrasted [13,14]. Result obtained to check activity of curcumin metabolites against candidate for antidiabetic and antioxidant purpose, proven more active than its parent compound, particularly type-2 diabetic case. Species generated during curcumin metabolism are found responsible to reduced ability to inhibit COX-2 expression. Variations of results obtained may be due to the different methods and pathways followed by different researchers and this can be further limited extend because lack of availability of curcumin metabolites quantitatively for study purpose.

## 2. Conclusion

In conclusion, it can be stated that major outcome of metabolic study has significant effect of way of experiment and experimental condition applied during observation. Curcumin exhibits poor absorption which directly effects on its cellular distribution. Fast metabolism and subsequently elimination study of curcumin are the fundamental reasons or hurdles to establish curcumin as Novel drug. Perhaps, Curcumin heterocyclic analogues could be the smart option to increase bioavailability. But significant threat of changing Curcumin backbone with hetero atom like Nitrogen, Oxygen may not offer Curcumin like versatile bioactivity.

A recent study of metabolism of nano curcumin [16] exhibits promising results for glucometabolic, lipid, blood pressure compare to Curcumin but found non-significant towards total body fat, insulin etc. However, Curcumin metabolic study significantly depends upon age, total body mass, rate of consumption and lifestyle.

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