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### OPINION/COMMENTARY

## Curcumin: The Indian Gold for Prevention and Treatment of Chronic Maladies

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### 1. Introduction

Chronic diseases or non-communicable diseases such as arthritis, cancer, cardiovascular diseases, diabetes, different inflammatory diseases, neurological disorders, obesity etc. are major health concerns in the present day world(1; 2; 3; 4) . It has been estimated that, approximately 60% of deaths worldwide are due to chronic diseases which shows the gravity of these maladies. As these are slow-growing diseases, highly specific diagnostic markers for early detection of these diseases have not been developed. In addition, most of the drugs developed for the prevention and treatment of these diseases are not effective top to bottom(5; 6). Moreover, these medications invariably cause many unfavourable side effects and cannot be affordable for majority of the population around the world(5; 6). Many risk factors have been identified in the pathogenesis of these diseases such as tobacco, alcohol, microbial infections, poor hygiene, unhealthy diet, lack of physical activity, aging etc. It is now well established that all the above mentioned risk factors result in the development of these diseases by inducing inflammation and in certain cases, obesity(3). Accumulating pieces of evidences shed light into the multi factorial nature of these diseases which proves that multiple molecular alterations orchestrate the initiation, development and progression of these diseases. Therefore, majority of Food and Drug Administration (FDA) approved mono-targeted therapies are not effective for the management of these maladies(6). Hence, the development of safe, highly effica-

cious and affordable multi-targeted approaches may provide a ray of hope for the management of these diseases.

### 2. Curcumin and Chronic Diseases

Research over the past couple of decades witnessed the emergence of food-derived drugs or supplements collectively known as nutraceuticals, for the management of non-communicable diseases. Turmeric, green tea, cruciferous vegetables, red grapes, oil palm and their active ingredients have been proven as safe and multi-targeted agents for the prophylaxis and therapy of these diseases. For example, over 18,000 pre-clinical and clinical studies have been published on the biological properties of curcumin, the main ingredient of turmeric for management of different diseases including cancer, obesity, inflammatory bowel disease, rheumatoid arthritis, chronic immune nephritis, lung fibrosis etc. Interestingly, over 400 clinical trials that have been published strongly recommend the safety and efficacy of this compound in the prevention and treatment of different ailments(1; 6; 7). Several clinical studies showcased the efficacy of curcumin better than many approved drugs. For instance, the efficacy of this compound has been well studied for different oral diseases such as periodontitis, oral lichen planus, gingivitis, oral cancer etc. Many clinical trials also showed the effectiveness of this compound in oral health in different parts of the world(1). Many clinical studies also showcased the effectiveness of this compound in the management of arthritis, one of the

most prevalent chronic inflammatory diseases in the world. Similarly, green tea polyphenols, resveratrol, silybin, silymarin, tocotrienols, -carotene etc. have been proved as miraculous agents for handling different ailments. It has been shown that, many of these agents, especially curcumin have been useful in the prevention and treatment of the current day pandemic, COVID-19(7). For example, a recent clinical trial(8) on combination of curcumin with piperine showed that this formulation synergistically reduced the morbidity and mortality of COVID-19 patients. Besides, many clinical trials are in progress to prove the efficacy of curcumin in the management of COVID-19. A riveting fact is that during this pandemic situation, the export of turmeric from India has been increased by 171 lakh tonnes in 2020-2021 as compared to the export in previous year <https://www.pjtsau.edu.in/files/AgriMkt/2021/june/Turmeric-june-2021.pdf>. India, being the largest producer of turmeric, contributes approximately 70% of world's turmeric production. The export of this spice and its active component curcumin has been increasing day by day. In addition, it has been estimated that over 2000 products of curcumin/turmeric are available in the market, which also showcase the miraculous properties of this nutraceutical. However, the hydrophobic nature of curcumin limits its potential as this hinders absorption, membrane permeability and cellular uptake of the compound. This paved the way for the development of many formulations in order to mitigate these issues(9). These formulations can be broadly divided into three categories; first generation, second generation and third generation. Curcumin is easily inactivated by different enzymes present in liver such as UDP-glucuronyl transferase, cytochrome P450, hepatic aryl hydrocarbon hydroxylase and mixed function oxygenases. Therefore, in the first generation, different adjuvants have been added such as piperine, turmeric oil, quercetin etc. to suppress these detoxification enzymes thereby improving the bio availability of the compound. In the second generation, different strategies have been experimented to increase the solubility of this compound by using synthetic emulsifiers and water dispersible forms. In the third generation, formulations have been developed to increase membrane permeability and cellular uptake without using synthetic emulsifiers(10). However, there is still a room for improvement to increase bioavailability and absorption of this compound by using different formulations. Overcoming these limitations would help to develop this nutraceutical for the prevention and treatment of many chronic diseases.

### 3. Conclusion

“Let food be the medicine and medicine be the food” as educated by Hippocrates (460-370 BC) literally points to the importance of curcumin/turmeric in our daily lives. Therefore, this nutraceutical would emerge as a golden remedy for many chronic diseases in the world in near future.

**Conflict of Interest** The authors declare no conflict of Interest in this reported communication.

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