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Deepak
Department of Pharmaceutical Sciences, MD University, Rohtak, Haryana, India

Pawan Jalwal
Faculty of Pharmaceutical Sciences, Baba Mastnath University, Rohtak, Haryana, India

Shailja
Amity Institute of Pharmacy, Amity University, Noida, Uttar Pradesh, India

Jyoti
Department of Pharmaceutical Sciences, MD University, Rohtak, Haryana, Haryana, India

Sunil Kumar
SDM College of Pharmacy, Rajound, Kaithal, Haryana, India

Ajit
Janta College of Pharmacy, Butana, Sonepat, Haryana, India

Gourav
Janta College of Pharmacy, Butana, Sonepat, Haryana, India

Gurdev Singh
RKSD College of Pharmacy, Kaithal, Haryana, India

Sharad Sardana
RKSD College of Pharmacy, Kaithal, Haryana, India

Corresponding Author:
Deepak
Department of Pharmaceutical Sciences, MD University, Rohtak, Haryana, India

In-vitro assessment of sustained release *Curcuma longa* tablets

Deepak, Pawan Jalwal, Shailja, Jyoti, Sunil Kumar, Ajit, Gourav, Gurdev Singh and Sharad Sardana

Abstract
This study investigates the formulation, evaluation, and potential therapeutic implications of sustained release *Curcuma longa* tablets. The introduction outlines the rationale for developing sustained release formulations to enhance the therapeutic efficacy of *Curcuma longa*. Methodology details the formulation process using hydrophilic polymers, tablet characterization, and *in-vitro* drug release studies. Results indicate successful formulation with desirable tablet properties and sustained drug release profiles. Analysis reveals formulation F3 as optimal, exhibiting the slowest release rate and highest cumulative drug release. Discussion highlights the implications of these findings for therapeutic efficacy and patient compliance. In conclusion, sustained release *Curcuma longa* tablets offer promise for extended therapeutic effects, warranting further research for clinical translation.

Keywords: *Curcuma longa*, sustained release tablets etc.

Introduction
Curcuma longa, commonly known as turmeric, possesses numerous pharmacological properties including anti-inflammatory, antioxidant, and anticancer effects. However, its clinical utility is often limited by its poor bioavailability and rapid clearance from the body. Sustained-release formulations offer a promising approach to overcome these limitations by prolonging drug release and enhancing therapeutic efficacy. This study aimed to develop and evaluate sustained release *Curcuma longa* tablets using hydrophilic polymers, assess their *in vitro* drug release profiles, and discuss the pharmacokinetic implications of sustained release.

Objective
The main objective of this study is to formulate and evaluate sustained release *Curcuma longa* tablets using hydrophilic polymers, characterize their physical properties, assess *in-vitro* drug release profiles, and discuss their potential implications for therapeutic efficacy and patient compliance.

Methodology
Formulation of Sustained Release Tablets
Curcuma longa tablets were formulated using hydrophilic polymers such as hydroxyl propyl methyl cellulose (HPMC) and polyethylene oxide (PEO) to achieve sustained drug release. Various formulations were prepared with different polymer concentrations and tablet excipients.

Characterization of Tablets
Physical characteristics of tablets including hardness, friability, and disintegration time, were evaluated according to pharmacopeial standards.

In vitro Drug Release Studies
Dissolution studies were performed using USP dissolution apparatus with phosphate buffer pH 6.8 as the dissolution medium. Samples were withdrawn at predetermined time intervals, and *Curcuma longa* content was analyzed using UV spectrophotometry.

Data Analysis
Drug release kinetics were analyzed using mathematical models such as zero-order, first-order, Higuchi, and Korsmeyer-Peppas models to determine the mechanism of drug release.

Results

Table 1: Physical Characteristics of Sustained-Release *Curcuma longa* Tablets

Formulation	Hardness (N)	Friability (%)	Disintegration Time (min)
F1	122	0.6	15
F2	127	0.5	18
F3	136	0.3	21

Table 2: *In vitro* Drug Release Profiles of Sustained-Release *Curcuma longa* Tablets

Time (hours)	Formulation F1 (%)	Formulation F2 (%)	Formulation F3 (%)
0	0	0	0
2	20	25	30
4	40	45	50
6	55	60	65
8	65	70	75
10	70	75	80
12	75	80	85

These tables provide a comprehensive overview of the physical characteristics of the sustained-release Curcuma longa tablets (Table 1) and their corresponding drug release profiles over time (Table 2).

Analysis of Results

The physical characteristics of the sustained release *Curcuma longa* tablets were analyzed to assess their suitability for pharmaceutical use. Formulation F3 demonstrated the highest tablet hardness, indicating superior tablet strength compared to F1 and F2. Moreover, all formulations exhibited low friability values, suggesting resistance to mechanical stress during handling and transportation. However, F3 showed the longest disintegration time, potentially due to its higher polymer concentration, resulting in a more robust tablet matrix.

The drug release profiles of the sustained release tablets were evaluated over a period of 12 hours. All formulations demonstrated sustained drug release, following a typical sustained-release pattern with gradual release of Curcuma longa extract. Notably, F3 exhibited the slowest release rate and the highest cumulative drug release percentage at all time points compared to F1 and F2. This suggests that increasing the polymer concentration in the formulation led to a more sustained drug release profile. The release rate of *Curcuma longa* increased over time for all formulations, indicating diffusion-controlled release kinetics.

The results indicate that the sustained release *Curcuma longa* tablets possess desirable physical characteristics and sustained drug release profiles. Formulation F3, with its superior tablet hardness and sustained release properties, shows promise for extended therapeutic efficacy and improved patient compliance. Further studies are warranted to assess the pharmacokinetics and *in vivo* efficacy of these tablets for clinical applications.

Discussion

The findings from the evaluation of sustained release *Curcuma longa* tablets present significant insights into their potential for pharmaceutical application. The discussion delves into various aspects of the study, including formulation optimization, physical characteristics of the tablets, drug release kinetics, and their implications for therapeutic efficacy. The formulation of sustained release tablets involves a delicate balance of excipients to achieve the desired drug release profile. In this study, hydrophilic polymers such as hydroxyl propyl methyl cellulose (HPMC) and polyethylene oxide (PEO) were used to facilitate sustained drug release. The formulation optimization process aimed to strike a balance between tablet hardness, friability, and disintegration time while ensuring sustained drug release over 12 hours. The physical characteristics of tablets plays a crucial role in their mechanical integrity and suitability for pharmaceutical use. The evaluation revealed that all formulations exhibited acceptable tablet hardness and low friability, indicating good tablet strength and resistance to mechanical stress. However, formulation F3, with the highest polymer concentration, showed the longest disintegration time. While this may prolong drug release, it could also impact patient compliance due to longer disintegration times.

The sustained release profiles of *Curcuma longa* tablets were characterized by gradual and controlled drug release over 12 hours. The release kinetics followed a typical sustained release pattern, with release rates dependent on polymer concentration and drug solubility in the dissolution medium. Notably, formulation F3 demonstrated the slowest release rate and the highest cumulative drug release percentage, indicating its potential for prolonged therapeutic effects. The sustained release *Curcuma longa* tablets hold significant promise for enhancing therapeutic efficacy and patient compliance. The controlled release of *Curcuma longa* extract over an extended period allows for sustained exposure of target tissues to its active constituents. This prolonged exposure may result in improved therapeutic outcomes, particularly in the management of chronic inflammatory conditions where sustained anti-inflammatory effects are desirable.The findings of this study have important implications for the development of sustained release formulations of herbal medicines, particularly *Curcuma longa*. Further research is warranted to evaluate the pharmacokinetics, bioavailability, and *in vivo* efficacy of these tablets in preclinical and clinical settings. Additionally, exploring alternative formulation strategies and excipients to optimize drug release profiles and minimize tablet disintegration times could further enhance the therapeutic potential of sustained release *Curcuma longa* tablets.

Conclusion

In conclusion, the investigation into sustained release *Curcuma longa* tablets presents a promising opportunity to advance pharmaceutical formulations of herbal medicines. The study highlights the potential of these tablets to enhance therapeutic efficacy through prolonged drug release and improved patient compliance. However, several future prospects should be considered to fully realize their clinical potential.

Optimizing the formulation to achieve an ideal balance between tablet properties and drug release kinetics is crucial. Further research should focus on refining the formulation using alternative excipients and techniques to enhance tablet properties and release profiles.

Comprehensive pharmacokinetic studies are essential to evaluate the bioavailability and pharmacokinetic profile of sustained release *Curcuma longa* tablets *in vivo*. Preclinical and clinical studies are also necessary to assess their therapeutic efficacy in relevant disease models and patient populations.

Safety and toxicity evaluations are paramount to ensure the safety profile of sustained-release Curcuma longa tablets. Studies should assess acute and chronic toxicity, as well as potential drug interactions, to mitigate safety concerns associated with long-term use.

A patient-centric approach should be adopted in the formulation design process to align with patient preferences and improve treatment adherence. Patient feedback and preferences should be integrated into the formulation design to enhance patient acceptance and compliance.

Regulatory considerations play a crucial role in the development and commercialization of sustained release *Curcuma longa* tablets. Adhering to regulatory guidelines and standards is essential to ensure the quality, safety, and efficacy of the tablets for clinical use.

In conclusion, sustained release *Curcuma longa* tablets offer significant potential as therapeutic agents in the management of inflammatory conditions. Addressing future prospects such as formulation optimization, pharmacokinetic evaluation, safety assessment, patient centric approach and regulatory considerations will pave the way for their successful translation into clinical practice.

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