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DEVELOPMENT AND CHARACTERIZATION OF CURCUMIN LOADED CHITOSAN-PECTIN COMPOSITE BIO-SCAFFOLDS FOR WOUND HEALING ACTIVITY

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ABSTRACT:
Background: The study aimed to formulate Curcumin-loaded chitosan-pectin composite bioscaffolds and determined its wound healing activity on animals. Chitosan, proved as a potential candidate for wound healing applications. Pectin in its hydrogel form can maintain a moist environment conducive to wound healing. Curcumin, a natural polyphenolic compound extracted from the turmeric plant (Curcuma longa), is the drug candidate. The prepared bioscaffold was characterized for physicomechanical properties, morphological studies, FT-IR and *in vitro* drug release study. *In vitro* antibacterial activity was determined using the agar diffusion method and *in vivo* wound healing activity was evaluated using the excision wound healing model.
Results: Five blank composite bioscaffolds were prepared by increasing the number of parts of chitosan, keeping pectin constant (CP1 to CP5). The results of *in vitro* parameters showed the increased thickness, folding endurance, swelling behavior, tensile and texture parameters with increase in chitosan proportion. Curcumin drug loaded scaffolds (CCP5) has shown maximum inhibition against all tested bacteria. The FT-IR spectra of curcumin loaded scaffolds demonstrated the compatibility between drug and polymers use4d in the study. The *in vivo* studies were revealed that, there was a significant ($p<0.05$) difference in percentage of wound contraction between untreated group and treated group. 100% of wound contraction was observed in groups treated with best drug loaded films (CCP5) within 21 days.
Conclusion: It can be concluded from the study that encapsulating curcumin in a biocompatible matrix can enhance its stability and bioavailability and can maximize its therapeutic potential. Curcumin composite bio scaffolds may be significantly more effective scaffolds than drug alone and blank scaffolds in healing excision wounds.
Keywords: Excision wound; antibacterial; tensile strength, Curcumin, Chotosan and Pectin.

INTRODUCTION:

Biopolymer scaffolds are assured as effective materials for wound repair due to their capacity to mimic the extracellular matrix; they support cell adhesion and deliver bioactive compounds (1-5). Wound healing (6-10) is a multistep process which can be managed through various approaches like traditional involving bandages, topical agents, Advanced wound care products such as hydrogels, hydrocolloids, alginate dressings, Biological and bioengineered

approaches such as Growth Factors, Cytokines, Skin Substitutes, Grafts and Tissue Engineering, Nanotechnology(11-15) and Drug Delivery Systems like Nanoparticles and Nanofibrous Scaffolds, Cell-Based Therapies such as Stem Cell Therapy and Platelet-Rich Plasma (PRP), Biopolymer-Based Scaffolds involving use of Chitosan, Pectin and more than two biopolymers in the form of Composite Scaffolds. Smart Dressings and Sensors like Responsive Dressings and Wearable Sensors, Gene Therapy and Phototherapy using Low intensity Lasers or light-emitting diodes (LEDs) and Photodynamic Therapy (PDT): These approaches are often used in combination to address the complex needs of different wound types and patient conditions, aiming to achieve faster and more effective healing outcomes. One among several approaches is Biopolymer-Based Scaffolds which is now put forward to wound management. The bio polymer chosen for the research is Chitosan. Chitosan, possess several characteristics which made that a suitable candidate for wound healing applications. Pectin, with its ability to form hydrogels, can maintain a moist environment conducive to wound healing (16-20). Curcumin, a natural polyphenolic compound extracted from the turmeric plant (Curcuma longa), is renowned for its anti-inflammatory, antioxidant, and antimicrobial properties. Traditional wound care methods often fall short in providing optimal healing environments, leading to a growing interest in advanced wound care materials. In that thrust of fabrication, this study aimed to develop composite bioscaffolds integrating Chitosan, Pectin, and Curcumin,(21-25) and to characterize their physical, chemical, and biological properties. The current research investigates the structural integrity, mechanical strength, swelling behaviour and curcumin release profile of the bioscaffolds. Additionally, the study evaluates the *in vitro* and *in vivo* wound healing efficacy of the composite materials, providing insights into their potential application in clinical settings.

MATERIALS AND METHODS

Materials:

Curcumin, Chitosan and Pectin were obtained from Himedia laboratory Pvt.Ltd, Nashik, India Agar-agar, peptone, beef extract and other media components were obtained from Qualigens fine chemicals, Mumbai, India. All Solvents used in the work were procured from Molychem Pvt. Ltd. Mumbai, India.

METHODS:

Step-1 Preparation of chitosan-pectin composite bioscaffolds (26-28**):**

Chitosan (1%) and pectin (0.1%) solutions in acetic acid solvents were prepared individually. The solutions were mixed thoroughly in different ratios as given in the table no. 1 and added 0.1ml propylene glycol. The solutions were filtered and sonicated. The solutions were poured into Petri plates and dried at room temperature.

Step-2 Preparation of Curcumin loaded composite bioscaffolds (29-30)

Curcumin was dissolved in ethanol and the solution was added before the addition of plasticizer to chitosan-pectin solution at different concentrations shown in table no.1 by following similar procedure as in step-1.

Table no. 1: Composition of different composite bioscaffolds

S. No	Code of scaffolds	No of parts	
		Chitosan(1%)solution	Pectin (0.1%)
Blank composite scaffolds			
1.	CP1	2	1
2.	CP2	3	1
3.	CP3	4	1
4.	CP4	6	1
5.	CP5	12	1
Curcumin loaded composite scaffolds			
S. No	**Code of scaffolds**	**Amount of drug loaded in CP5 blank Scaffolds (gms)**	
6	CCP1	0.1	
7	CCP2	0.3	
8	CCP3	0.5	
9	CCP4	0.7	
10	CCP5	1	

Characterization of scaffolds

The prepared scaffolds were characterized for physic mechanical properties and evaluated for *in vitro* and *in vivo* parameters.

A. Physico-mechanical properties (28,31**):**

All the parameters except tensile parameters were conducted in triplicate by random selection of 6-inch x 4.5-inch film from three different places of the prepared scaffolds.

a) Thickness: The thickness of the scaffolds influences the amount of active ingredients available and also the time required to absorb the scaffolds in to the body. Thus, it was determined to find the uniformity of the scaffolds. The thickness of the scaffolds was measured using screw gauge in triplicate and the average value was determined in µm.

b) Folding endurance: The flexibility of the scaffolds is needed to handle the scaffolds easily and for comfortable, secured application of the scaffolds on the wound. Thus, folding endurance test is used to find the flexibility of scaffolds. It was determined by repeatedly folding one scaffold at same place till it breaks or folded up to 300 times manually. The number of times the scaffolds could be folded at the same place without breaking gives the value of folding endurance.

c) Swelling behavior: The swelling behavior of scaffolds was investigated at room temperature by exposing them to PBS solution. A known weight of scaffold (Wd) material was placed in the PBS solution for 30 min. The wet weight of the scaffold (Ww) was determined after blotting the scaffold surface with filter paper to remove

excess surface water. The percentage of water absorption (Ww) known as degree of swelling of the scaffold was calculated from below expression.

$$(Wsw) = (Ww - Wd) / Wd \times 100$$

d) **Tensile parameters:** Tensile parameters measure the ability of scaffolds to withstand rupture mechanical pressure or the force required to break the scaffolds. Tensile strength of the scaffolds was determined by using texture analyzer (TA-XT PLUS stable system analyzer) then maximum force (N), maximum elongation at break (sec), and tensile strength (mpa) were calculated.

e) **Texture parameters:** The scaffolds may expose to force/pressure that cause deformation or rupture during manufacturing, packaging and transportation. This strength of a scaffold was quantified using the (TA-XT PLUS) texture analyzer by a penetration test using a 5mm cylinder probe and the burst strength (rupture point) and burst time (time at which burst) were determined.

f) **Drug content:** It is measured to find the amount of drug (Curcumin) loaded into and uniformity in distribution of drug in scaffold. Drug content and uniformity was determined in triplicate for each scaffold by placing the one square inch area of the film in water for 2 hours and the quantity of drug in solution was determined by UV/Visible spectrophotometer after filtration. Films were selected in triplicate from three different areas of prepared scaffolds and taken the average drug content.

B .Calculation of Overall Desirability (OD) or Desirability Function (DF)

The OD or DF was used for selection of the best desired bioscaffold by combining all the responses in order to get desired characteristics. Best scaffold should have maximum swelling behavior, folding endurance and tensile strength. The individual desirability of each scaffold was calculated using the following method (32).

The desirability functions of these responses were calculated using the equation:1

$$ID1, ID2 \& ID3 = Yi - Ymin/Ytarget - Ymin \ldots\ldots\ldots (1)$$

$$ID1, ID2\&ID3 = 1 \text{ for } Yi/Ytarget$$

Where ID1, ID2 & ID3 are the individual desirability of swelling behavior, folding endurance, and tensile strength. The overall desirability values (OD) for each scaffold were calculated from the individual desirability values by using the equation 2:

$$OD = (ID1\ ID2\ ID3 \ldots\ldots IDn)1/n \ldots\ldots\ldots (2)$$

Where, n = number of desirability responses of the experiment.

By calculating OD from the results of physico-mechanical parameters of bioscaffolds, the best blank and curcumin loaded bioscaffolds were selected.

C. *In Vitro* Anti-Bacterial Activity (33):

In vitro anti-bacterial activity of the best selected blank and curcumin loaded scaffolds was estimated by agar disc diffusion method using two grams positive (*Bacillus subtilis, Staphylococcus aureus*) and two grams negative bacteria (*Escherichia coli, Pseudomonas aeruginosa*).

i. **Agar disc diffusion method:** The selected scaffolds were evaluated for anti-bacterial activity against four different strains with agar plate disc diffusion method by measuring

the zone of growth inhibition of bacteria by following procedure. The nutrient medium was poured in the boiling tubes and sterilized. After sterilization, two gram positive and gram negative organisms were inoculated aseptically separately into the tubes and it was poured into the sterile petriplates aseptically. Then it was allowed for solidification. After solidification, the composite scaffolds which were made into discs were placed on the solidified agar medium. The Petri plates were incubated for 24 hours at 37+/-1˚C. The anti-bacterial activity was evaluated by measuring diameter of zone of inhibition using antibiotic zone reader. This was done in triplicate for the best selected scaffolds with each bacteria and average diameter was noted.

D. Drug polymer compatibility studies : FT-IR studies

FT-IR spectra of Curcumin and Curcumin loaded scaffolds were recorded using FT-IR spectrophotometer (Broker Alpha-T, Switzerland). This study was performed to find the compatibility between drug and polymer. Samples & KBr were taken in the ratio of 1:100 in a mortar and triturated. A small amount of triturate was taken into a pellet marker & was compressed to form a transparent pellet using a hydraulic press. The pellet was kept in a sample holder and scanned from 4000cm⁻1 to 400cm⁻₁ in FT-IR spectrophotometer. The compatibilities between drug & polymer were assessed by comparing FT-IR spectra of pure drug and scaffolds.

E. *In vitro* drug release studies (28,31)

i. Diffusion studies: Diffusion studies were conducted with selected Curcumin loaded scaffolds and to find out the time taken to release the total drug. The diffusion studies were carried out using diffusion cell with and pH 7.4 buffers. For every 10 minutes, 5 ml of sample was withdrawn from the receiving component of diffusion cell. The concentration of drug in the samples was estimated using UV/Visible spectrophotometer at 421 nm wavelength. An equal volume of fresh buffer was replaced after with drawl of each sample. It was conducted in triplicate and average values were recorded.

F. *In vivo* studies: (26-31)

The best selected blank and Curcumin loaded scaffolds based on the performance of *in vitro* tests were used to study the *in vivo* wound healing activity on albino rats by excision wound model after taking approval by IAEC NO. 1677/PO/Res/S/2012/CPCSEA/IASE/22/23-02-19. Pathogen free adult female albino rats weighing 150 – 200 grams were selected. The rats were housed in polypropylene cages under standard laboratory conditions with 12-hour light and dark cycle. The rats were fed with standard laboratory chow (Hindustan Lever Limited, Mumbai) and water and were treated as per protocol shown in table no 2.

Table no.2 Protocol for *in vivo* studies

S. No	Group no	Purpose	No of animals
1.	I	Wound control (untreated)	6
2.	II	Treated with blank composite bioscaffold	6
3.	III	Treated with best Curcumin loaded Composite bioscaffold	6

Procedure: The anaesthetized animal was placed on the operation table in normal position. The dorsal fur of the animals was shaved with an electric clipper and the anticipated area (2cms. length and 2cm width) of the wound to be created was outlined on the back of the animals on inter-scapular region i.e., 5mm. away from ears. Full thickness skin from the demarked area was excised to get a wound area of 2 sq cm. after achieving homeostasis, the wound was blotted with sterile gauze in control group and the respective scaffolds were placed on the wound of animals in treatment groups (groups III and IV) and covered with sterile gauze. Then, the following parameters were determined at specific time intervals.

i. Percentage of wound contraction: This was measured to determine the reduction in wound area at different periods of treatment. It was determined by graphical method. Wound area was calculated on 7^{th}, 14^{th}, 21^{st} and 28^{th} post wounding day by counting number of squares of retraced wound area on graph paper. The degree of wound contraction was calculated as % closure of the wound area from the original wound using a formula.

$$\% \text{ Closure} = 1-(Ad / A0) \times 100$$

A0 – wound area on zero day: Ad – wound area on corresponding day

ii. Tensile strength: The skin tissue samples of normal skin, treated skin were collected at the end of the study i.e., after complete healing of the wound and tensile strength of these samples was measured.

iii. Histopathological studies: Biopsy specimens for histopathological examination were collected at 7^{th}, 14^{th} day post treatment from all three (II, III and IV) groups and preserved in 10% buffered formalin. They were processed by routine paraffin embedding technique. i.e., 5 to 6 microns thick section were cut and stained with hematoxylin and eosin. The specimens were collected by trephining that involved skin tissue of both healing and normal skin using corneal trephiner.

iv. Gross studies

The photographs of wounds from different groups were taken at specific intervals for visual comparison under gross studies.

G. Statistical analysis

RESULTS:

A. Physico-mechanical properties of composite bio-scaffolds

The results obtained for Thickness, Folding endurance, Swelling behavior, Tensile parameters Texture parameters Drug content and content uniformity of scaffolds were mentioned in the table no 3.

Table no.3 Results of different physico-mechanical parameters of prepared composite bioscaffolds

S. No	Code of Scaffold	Thickness (µm) mean ±SD	Folding Endurance Mean±	Swelling Behavior Mean	Tensile Parameters			Texture Parameters			
					Max For	Max elongation at	Tensile Stren	Burst Stre	Burst tim	Overall desira	Drug Content

			SD	±SD (%)	ce (N)	break (sec)	gth (Mpa)	ngth (kg)	e (min)	bility (OD)	%
BLANK COMPOSATE BIOSCAFFOLDS											
1.	CP1	23.6±1.52	35.3±3.60	36.3±2.38	0.0059	0.433	0.0059	0.0058	0.9165	0	-
2.	CP2	25.3±2.30	49.7.3±3.05	30.2±3.76	0.0062	1.248	0.0065	0.0061	1.276	0.196	-
3.	CP3	26±0.57	65.6±2.08	33.2±1.21	0.0065	1.327	0.0069	0.0063	1.429	0.37	-
4.	CP4	25±2.39	78±2.51	47.5±2.4	0.0069	1.425	0.0073	0.0067	1.465	0.269	-
5.	CP5	27±2.0	86±2.51	63±5.69	0.0075	1.529	0.0079	0.0073	1.877	1	-
CURCUMIN LOADED SCAFFOLDS											
6.	CCP1	30±2.0	112±2.56	41.8±6.23	0.066	0.041	0.8	0.0058	0.85	0	79.6±3.13
7.	CCP2	30.3±1.527	84.6±4.50	37.3±5.76	0.075	0.069	1.22	0.0062	0.93	0	84.9±1.80
8.	CCP3	35.6±2.30	152±3.60	76.8±1.94	0.152	0.078	1.29	0.0069	1.62	0.717	87.16±1.69
9.	CCP4	41.3±3.24	211.3±2.5	60±5.39	0.490	0.109	1.35	0.0073	1.85	0.584	89.13±1.01
10.	CCP5	42.8±3.85	216.5±3.05	114±1.3	1.28	0.1107	1.76	0.0079	2.37	1	91.82±0.84

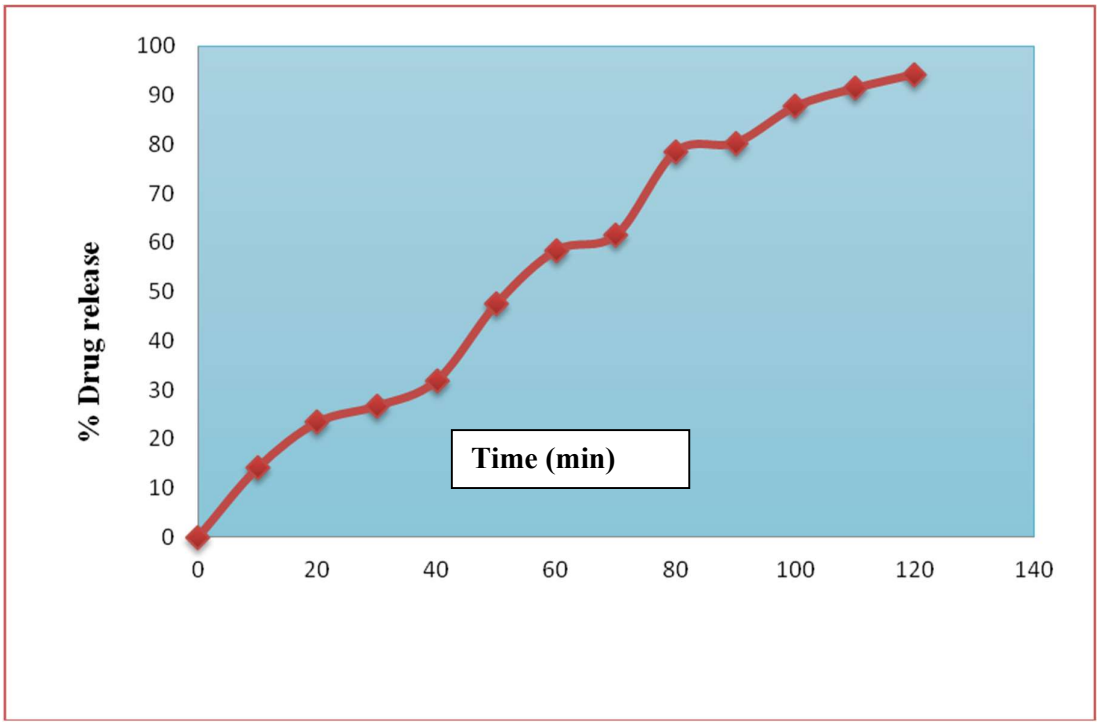
B.Anti bacterial activity: The zone of inhibitions (in cm) with selected best scaffolds is given in table no 4.

Table no. 4 Antibacterial activity of best composite drug loaded scaffolds against different organisms

Code of scaffolds	Diameter of zone of inhibition (in cms) (Mean±S.D)			
	Bacillus subtilis	***Staphylococcus Aureus***	***Escherichia coli***	***Pseudomonas aeruginosa***
Blank Scaffolds				
CP5	1.35±0.051	1.57±0.073	1.63±0.082	1.75±0.09
Curcumin loaded Scaffolds				
CCP5	2.39±0.035	3.15±0.049	3.21±0.055	3.27±0.059

C. *In vitro* drug release studies: The diffusion study was performed for selected best Curcumin loaded scaffolds CCP5 and the results are shown in table no 9. The % drug release versus time plot is shown in figure no.1.

Figure no.1 Curcumin percentage drug release from selected drug loaded films in diffusion study.



D. Compatibility studies

FT-IR studies: The blank and the best curcumin loaded scaffolds were analyzed by FT-IR for the confirmation of functional groups in its structure and are shown in figure no.4 and 5 respectively.

Figure no.4 FT-IR Spectrum of Curcumin

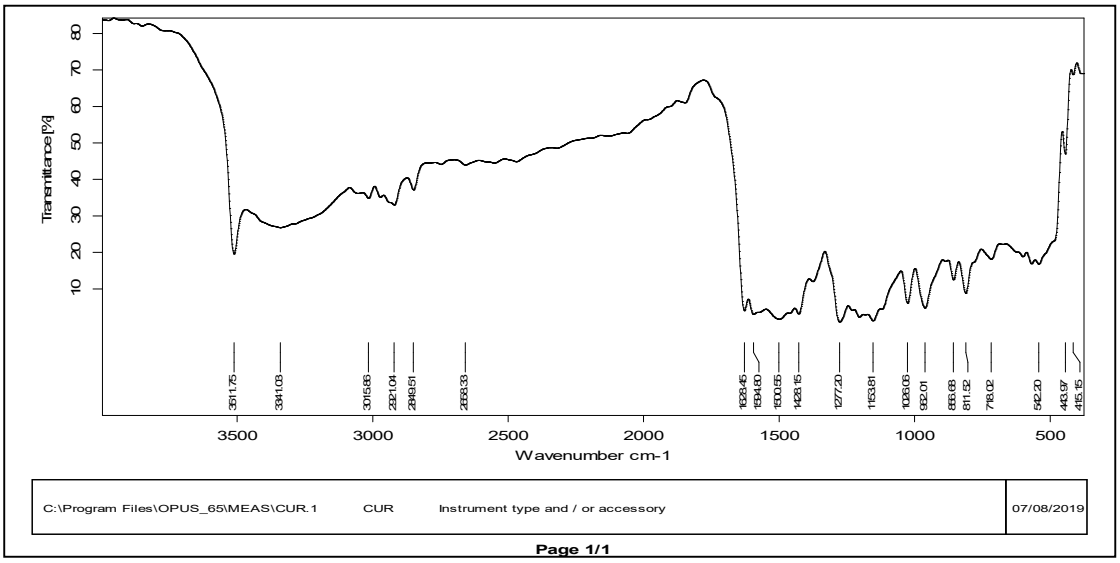
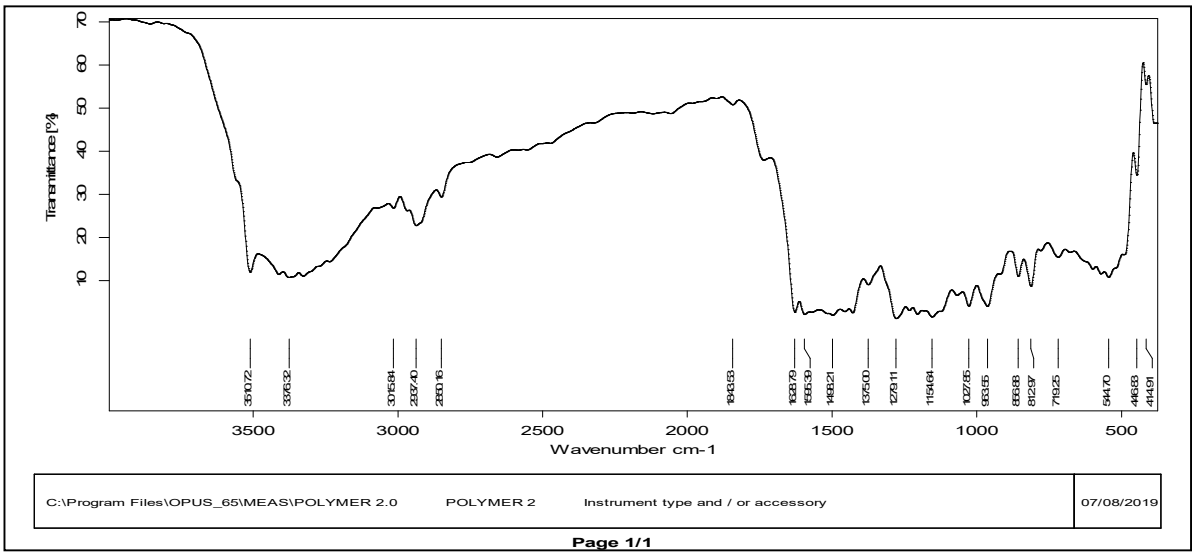


Figure no.5 FT-IR spectrum of best Curcumin loaded scaffolds



x) *In vivo* studies

A. Percentage of wound contraction

The percentage of wound contraction in untreated and treated groups was measured on 7th, 14th, 21st and 28th post wounding day and the results are shown in table no 5.

Table no.5 Percentage of wound contraction at different time intervals in different groups

GROUP	(%) Wound contraction (Mean±S.D)			
	7th day	**14th day**	**21st day**	**28th day**
Group I wound Control (untreated)	21.57±1.35	52.7±2.9	73.5±1.97	92.5±1.49
Group II treated with blank composite bioscaffolds	52.7±1.72	75.4±1.97	89.9±1.25	Completely healed
Group III treated with Best curcumin loaded composite bioscaffolds	64±1.0	88.7±1.27	Completely Healed	Completely Healed

B. Tensile Strength

The tensile strength parameters like maximum load (neutrons), maximum extension (mm), elongation at break (% strain), tensile strength (mpa), (stress) were measured in samples of normal skin of rat and skin from wound after healing by application of best drug loaded scaffolds (at 28th day post application). The tensile strength (mpa) of normal skin was 0.0145 mpa. elongation skin was 2.73 (sec) and the tensile strength of treated skin was 0.0148 mpa elongation was 3.0 (sec).

B. Gross Studies

The photographs of showing wounds and healing of wounds at different time periods (0, 7th, 14th, 21st, 28th day) in different groups is shown in the figures no 8-10.

Figure No.6: Photographs of wounds on different days in group I (wound control)

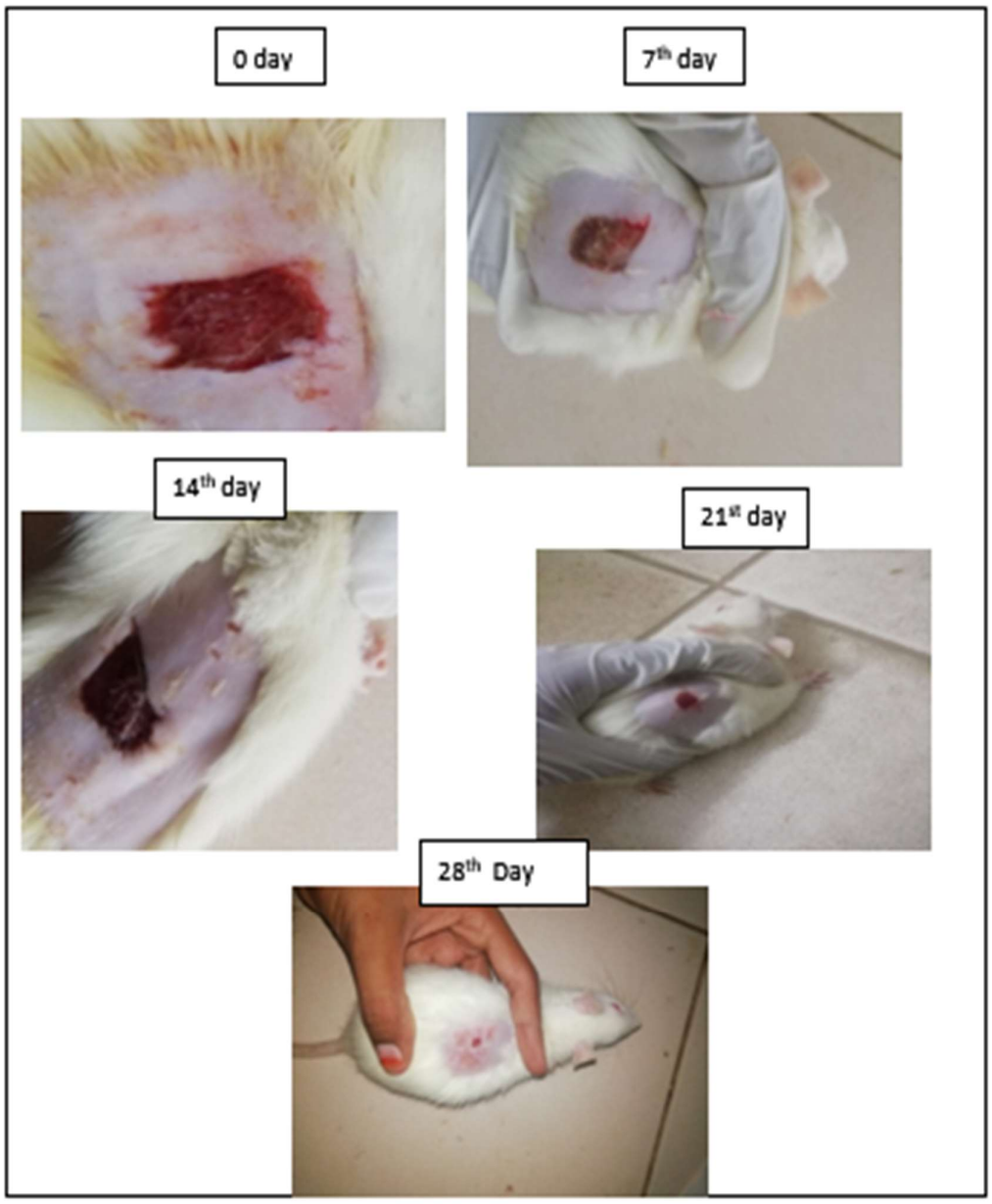


Figure No.7: Photographs of wounds on different days in Group II (Treated with blank composite bioscaffolds)

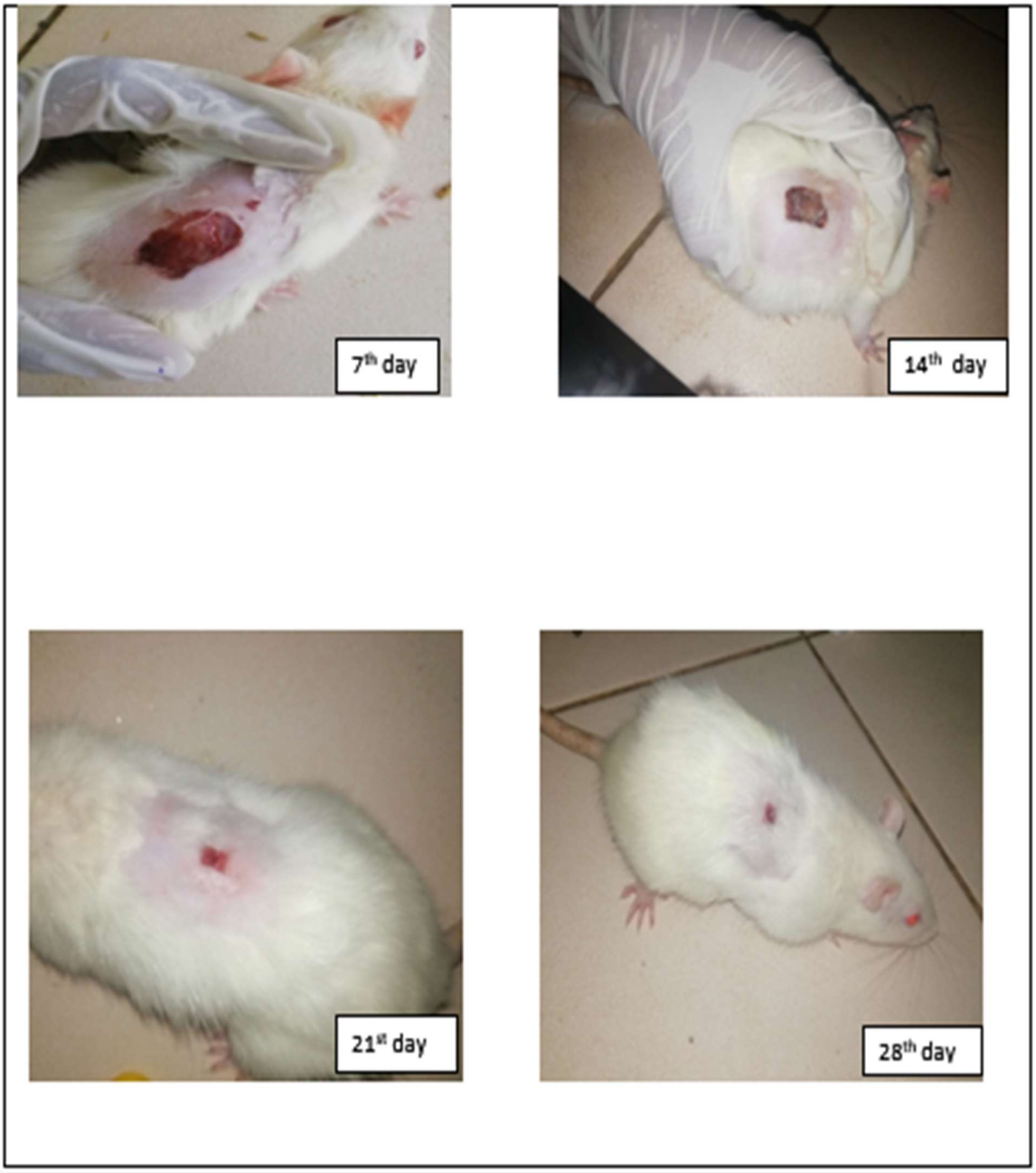
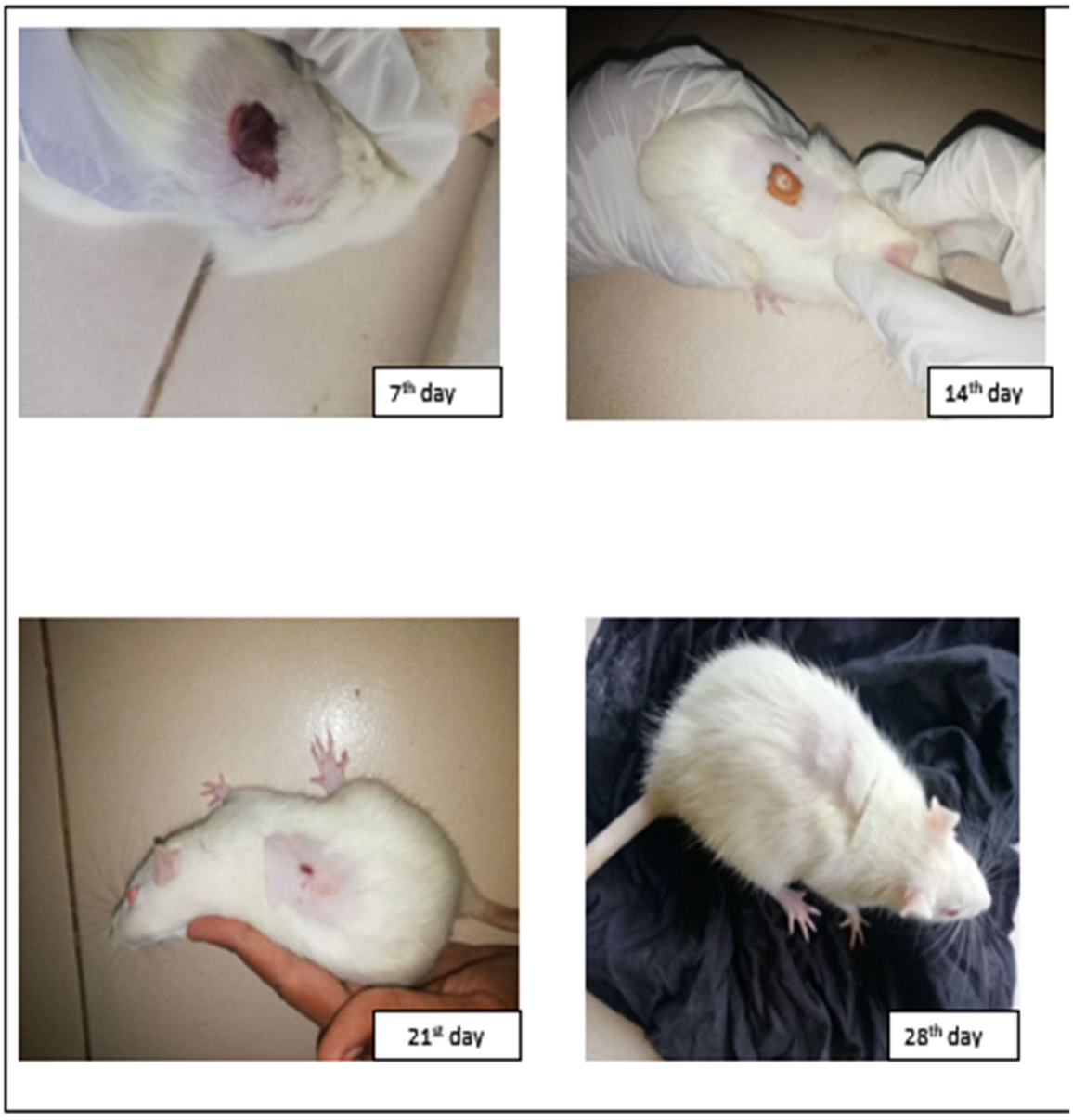


Figure no.8. Photographs of wounds in group III (treated with best curcumin loaded composite bioscaffolds).



DISCUSSION

Natural polymers are used as lead compounds for design of therapeutic drugs in the treatment of different ailments. Synthetic polymers are not preferred because of their disadvantages like poor biocompatibility and release of acidic degradation products (31). Thus, natural polymers are preferred, as these overcome the drawbacks of synthetic polymers and degrade into biologically accepted compounds (34).

In the present work chitosan-pectin composite bioscaffolds were prepared by solvent casting method for wound healing activity. Five blank composite bioscaffolds were prepared by increasing the number of parts of chitosan, keeping pectin constant (CP1 to CP5). The results

of *in vitro* parameters as shown in table no 3, showed the increased thickness, folding endurance, swelling behavior, tensile and texture parameters with increase in chitosan proportion which might be due to its mechanical strength and fluid absorption capacity with increased molecular mass of polymer.

The Overall desirability was calculated for all five blank scaffolds from which it was found that 'CP5' scaffolds has the highest 'OD' (table no.3). Hence, it was selected for loading of curcumin.

Then, curcumin was loaded into 'CP5' in different quantities and prepared five curcumin loaded scaffolds (CCP1-CCP5). The results of physico-mechanical properties of CCP1-CCP5 have shown significantly increased thickness, folding endurance with increased quantity of curcumin.

The swelling behavior of CCP1-CCP4 was almost equal to blank scaffolds (CP1-CP5) but 'CCP5' at highest amount of curcumin shown significantly increased swelling behavior.

The tensile and texture parameters of curcumin loaded (CCP1-CCP5) scaffolds (table no 3) were not significantly changed compared to blank scaffolds which indicated curcumin has not shown any influence on mechanical strength of chitosan-pectin composite scaffolds which made the curcumin loaded scaffolds suitable for application on to wounds by easy handling.

Uniform distribution of drug in films was determined by estimating the curcumin content in definite area of film taken from three different areas of curcumin loaded film. About mean percentage of 79-91% of curcumin was incorporated into their respective films. Among curcumin loaded film (CCP5) shown maximum percentage (91.8%) of drug loading as given in table no 3. It was found that, though the percentage of drug content was also increased with increase in proportion of curcumin but no significant change was observed in drug content of CCP1-CCP5 scaffolds (table no 3).

The percentage of drug content in three areas of drug loaded film was compared to estimate the uniform distribution of drug in the film by two-way anova test ($p<0.05$). There was no significant difference in percentage of drug loaded at three different areas of films, confirmed the uniform distribution of drug. Then OD was calculated for all curcumin loaded scaffolds and CCP5 has shown the highest OD, thus selected as the best drug loaded scaffolds.

In vitro drug release studies were conducted for the best curcumin loaded bioscaffolds (CCP5) for 120 minutes. The result of the diffusion studies revealed that, after 120 minutes CCP5, showed 94.27% of drug release.

The zone of inhibition with best curcumin loaded scaffolds (CCP5) and best blank scaffolds (CP5) against four different bacterial species was different in agar disc diffusion technique. Curcumin drug loaded scaffolds (CCP5) has shown maximum inhibition against all tested bacteria. The antibacterial activity of drug loaded scaffolds was more than the blank scaffolds against all tested bacteria. It confirmed that the high antibacterial activity of the curcumin loaded scaffolds than blank scaffolds, so drug loaded scaffolds can show fast wound healing property than blank scaffolds. (Table no.4)

The *in vivo* studies were conducted for best blank composite scaffolds (CP5), and best loaded scaffolds (CCP5) as per protocol given in table no.5. The percentage of wound contraction in all groups was measured at 7^{th}, 14^{th}, 21^{st} and 28^{th} post wounding day to estimate the reduction in the wound area. There was significant ($p<0.05$) difference in percentage of wound contraction between untreated group and treated group. 100% of wound contraction was

observed in groups treated with best drug loaded films (CCP5) within 21 days. (Table no 5) It indicated that curcumin loaded chitosan-pectin scaffolds have improved wound healing activity than blank chitosan-pectin scaffolds. There was significantly increased wound contraction with curcumin loaded scaffolds than blank composite scaffolds. The group III animals treated with CCP5 (curcumin loaded scaffolds) shown complete healing by 21st day, which was earlier than in animals untreated and treated with blank scaffolds.

Gross study involved the photography of wound site on animals, to assess the wound contraction and wound size for visual comparison. Gross study was conducted on 7th, 14th, 21st and 28th day of the *in-vivo* study. The interpretation of gross study was as follows, the size of wound was predominantly decreased in all treated groups when compared to control groups.

Based on the photography, the wound size was decreased in all groups on 7th day, 14th day, 21st day and 28th day when compared to 0th day. Wound was recovered into normal skin in all groups by 28th day. On 7th, 14th and 28th day, more decrease in wound size was observed in group treated with curcumin loaded chitosan-pectin composite bioscaffolds(CCP5) when compared to groups treated with blank scaffolds (CP5). It indicated that the combination of curcumin with chitosan-pectin showed better wound healing property.

The size of wound was more decreased in group treated with Curcumin loaded scaffold when compared to all other groups on respective days which indicated that loading of drug into composite scaffolds augmented the healing of wound than blank composite scaffolds. This might be due to less antibacterial activity of Curcumin which reduces infections and thus fastens the healing of wound.

The tensile strength parameters were measured for the samples of normal skin and treated skin. The increase in maximum extension of treated skin indicted that improved flexibility of skin after treatment. Effect of stress on elongation of skin has shown positive results for treated skin.

The FT-IR spectra of curcumin loaded scaffolds demonstrated the characteristic absorption peaks at 3363.70 cm^{-1} for O-H stretching, at 2924.90 cm^{-1} for C-H asymmetric stretching 1628.38 cm^{-1} consist of distinct characteristics, i..e. v(C=C) stretching and v(C=C) 1427.09 cm^{-1} for C=C stretching, 1280.03 cm^{-1} for C=CH bending. C-O stretching, 1032.46 cm^{-1} for C-O stretching 855.10cm^{-1} for C-H bending which are almost similar to that of pure drug.

CONCLUSION

The composite bioscaffolds were prepared using chitosan and pectin. Curcumin was loaded in to the best blank bioscaffolds. All the prepared scaffolds were evaluated for physico-mechanical properties and best scaffolds were selected based on O.D. values calculated from the results of *in vitro* parameters. The best selected scaffolds were used in *in vivo* studies for the treatment of wound healing. From this, it was concluded that curcumin with the combination of biomaterials have shown rapid wound healing progress. This work through a light on the further combinations of drug and biomaterials, which promote wound healing activity in the form of novel biodegradable wound dressings. Through this work, the authors seek to contribute to the advancement of wound care technologies, offering a novel solution that combines the benefits of natural biopolymers and bioactive compounds to promote effective and accelerated wound healing. . However, its clinical application is limited by poor water solubility and rapid degradation under physiological conditions. Encapsulating curcumin

in a biocompatible matrix can enhance its stability and bioavailability, thus maximizing its therapeutic potential.

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