Anuradha Tiwari *et al*, Int. Journal of Pharmaceutical Sciences and Medicine (IJPSM),
Vol.4 Issue. 7, July- 2019, pg. 1-21

ISSN: 2519-9889
Impact Factor: 3.426

GEL LOADED DENTAL IMPLANT: A DEMIURGIC DRUG DELIVERY SYSTEM FOR TREATMENT OF GINGIVITIS

Anuradha Tiwari*; Deepak Kumar Gupta[@]; Raju Choukse; Sourabh Jain; Rakesh Patel; Karunakar Shukla

DR. APJ ABDUL KALAM UNIVERSITY, BYPASS ROAD, ARANDIA VILLAGE, POST JHALARIA, INDORE (M.P) – 452016

[@] Cemoon06@gmail.com, Tel- +918827666607

ABSTRACT- The main objective of the project was to develop a dental implant for the patients suffering from oral gingivitis caused by bacterial infection, trauma etc. Person suffering from Gingivitis has chance to miss the medication during travel. For optimization of formula for the gel six batches were taken in which different amount of drug and polymer were added and observation were recorded. Six batches of gel were prepared by changing the polymer ratio. Six batches of gel were prepared by changing the polymer ratio. Three batches consist of carbopol whereas three batches consist of chitosan. Triclosan was added in all gel was subjected to in-vitro characterization it was observed that the in case batches containing chitosan, the gel formed by hazy and it contain come particulate matter also whereas the gel formed in case of carbopol were clear. Formulation f1 and f2 were less viscous and gel did not formed completely whereas formulation f4, f5, and f6, the gel formed was also less viscous as well as hazy. This could be due to the incorporation of chitosan in f4, f5, and f6 formulation which derived from chitin and it may not imbibe large amount of water to result in formulation of efficient gel. Obtained formula (f3) was characterized and it was found that viscosity of gel (f3) was highly viscous whereas drug content was 91.48 %. The gel was subjected to in-vitro drug release it was found that 59% drug was released in the end of 72 hr. This may be due to the efficient gel forming capacity of carbopol which was further enhanced by incorporation of triclosan. Formulation F3 was selected as optimum formulation with desired properties and was subjected to further studies.

KEYWORDS- Dental Implant, Gingivitis, Dental diseases, Demiurgic drug delivery system

Anuradha Tiwari *et al*, Int. Journal of Pharmaceutical Sciences and Medicine (IJPSM),
Vol.4 Issue. 7, July- 2019, pg. 1-21

ISSN: 2519-9889
Impact Factor: 3.426

I. INTRODUCTION

Dental disease is one of the major causes of tooth loss in India. These include pathological conditions of the supporting structures of the teeth, i.e. gingival, alveolar bone, periodontal ligament and cementum. Gingival disease progresses to periodontal disease, if not checked in time (Shah *et al*).

Gingivitis is the most common and mild form of oral/dental disease. Gingivitis is characterized by inflammation and bleeding of the gums. Because gingivitis is rarely painful in its early stages, it often goes unnoticed until severe irritation or receding gums occur. Gingivitis may lead to a more serious condition called periodontitis, in which the inner gum and bone pull away from teeth and form pocket. These pockets can collect bacteria and debris, and become infected or abscessed. The ultimate outcome is tooth loss.

1.1 Classification of Dental Disease: Various types of DD can be broadly classified as Fig.1

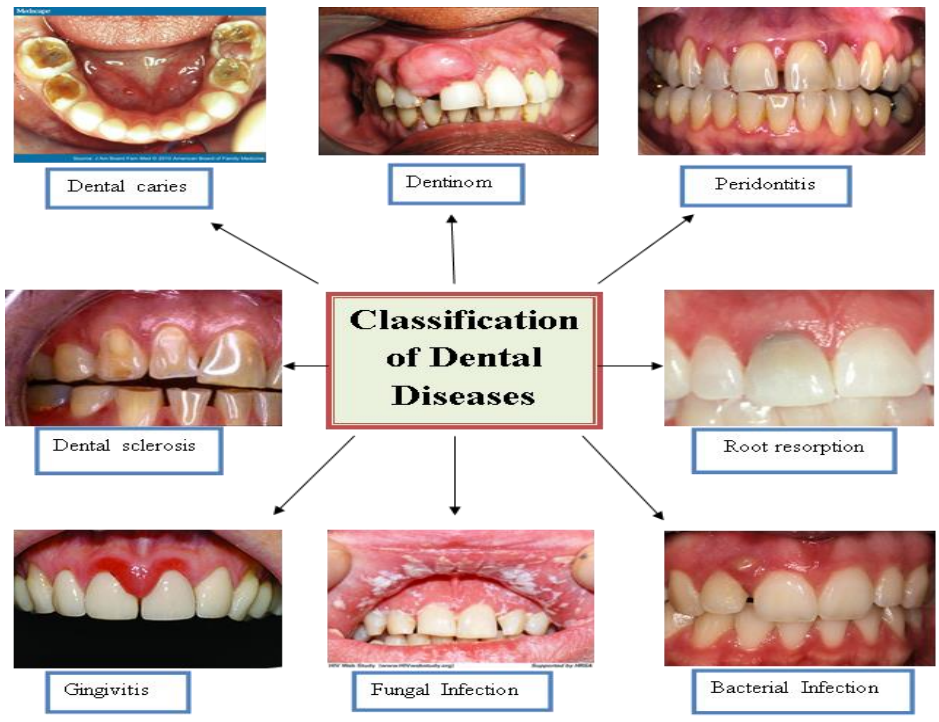
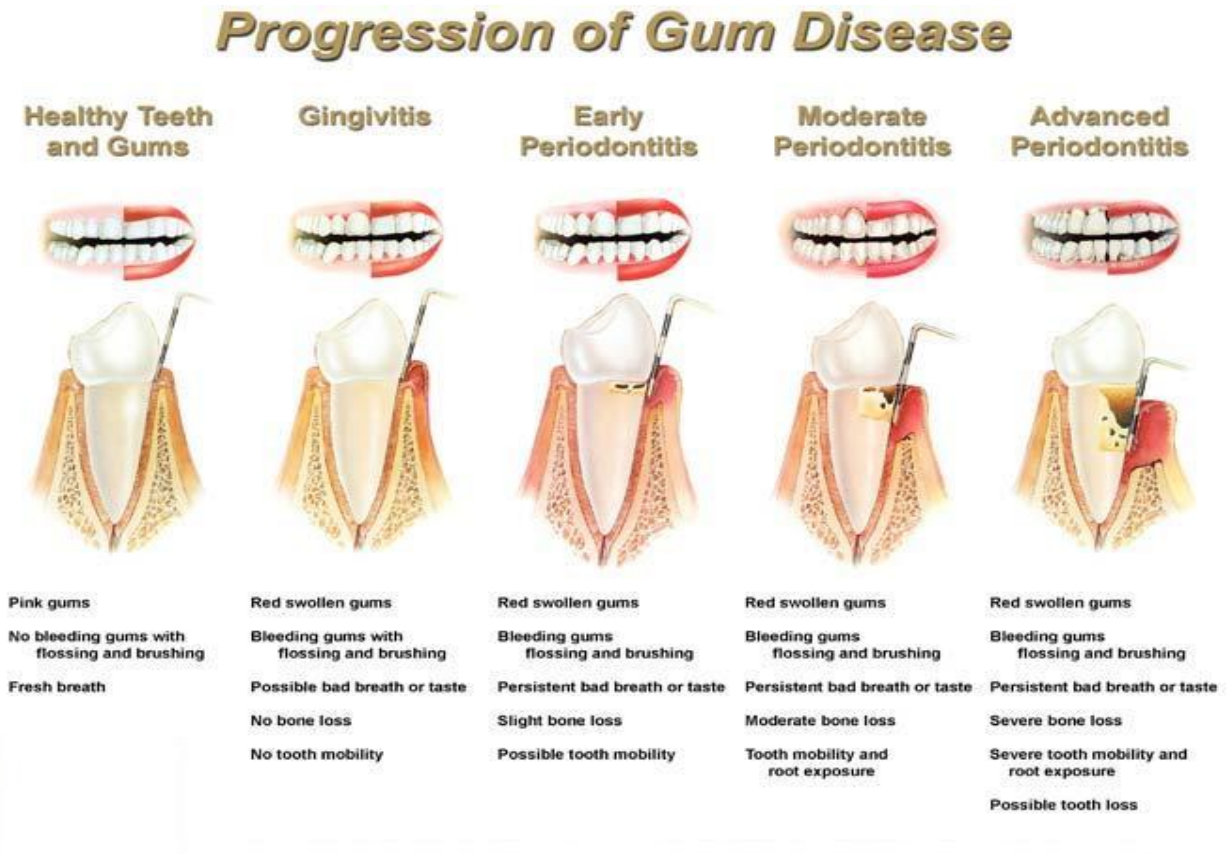


Fig. 1 Showing classification of multifaours dental diseases

ISSN: 2519-9889
Impact Factor: 3.426

Gingivitis and Periodontitis: Gingivitis and periodontitis are the two major forms of inflammatory diseases affecting the periodontium. General progression steps of gum diseases are shown in Fig.1.2. Gingivitis is inflammation of the gingiva that does not result in clinical attachment loss. Periodontitis is inflammation of the gingival and the adjacent attachment apparatus and is characterized by loss of connective tissue attachment and alveolar bone. Appropriate supportive periodontal maintenance that includes personal and periodontal maintenance that includes personal and professional care is important in preventing reinitiation of inflammation. Therapeutic approaches for periodontitis fall into two major categories:

1) Anti-infective treatment -: It is designed to halt the progression of periodontal attachment loss by removing etiologic factors.
2) Regenerative therapy -: It includes anti-infective treatment and is intended to restore structures destroyed by disease (S.Pragati *et al*).



ISSN: 2519-9889
Impact Factor: 3.426

A chronic inflammatory disease of the gingiva and periodontium results in destruction of gingival connective tissue, periodontal ligament, and alveolar bone. Clinically, inflammation is seen as redness, swelling, and bleeding upon probing. The main provoking factor that induces inflammation of gingival tissue is the presence of bacterial biofilm (dental plaque) on the teeth/gingival interfaces. Inflammation is the localized, protective response of the body to injury or infection. The classic clinical signs that characterize inflammation are heat, redness, swelling, pain and loss of function. During inflammation, cells and their secreted chemicals attempt to destroy, dilute, or wall off the injurious agent. A series of biochemical events cause the blood vessels to dilate and become more permeable, resulting in the activation of the complement, clotting, and kinin systems. The end result of inflammation is the return of function by the regeneration or repair of the affected tissue.

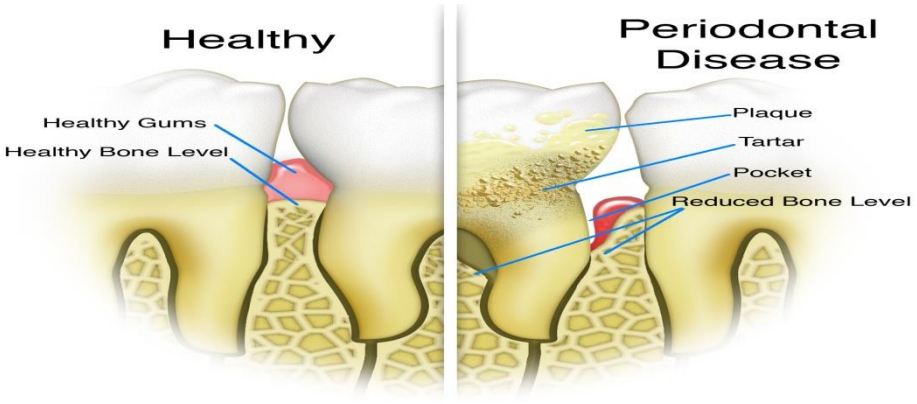


Fig. 1.2 Progression of Gum Disease

1.2 Gingivitis:

Gingivitis is an infection of the gums. If left untreated, it can become a more severe infection known as periodontitis. The gingivitis and periodontitis are the major causes of tooth loss in adults. Gingivitis is a form of periodontal disease. Periodontal disease is inflammation and infection that destroys the tissues that support the teeth. This can include the gums, the periodontal ligaments, and the tooth sockets (alveolar bone) (Lights *et al*).

ISSN: 2519-9889
Impact Factor: 3.426

1.2.1 Classification of Gingivitis:

There are two primary categories of gingival diseases, each with numerous subgroups:

1) Dental plaque-induced gingival diseases.
    a) Gingivitis associated with plaque only
    b) Gingival diseases modified by systemic factors
    c) Gingival diseases modified by medication
    d) Gingival diseases modified by malnutrition
2) Non-plaque induced gingival lesions
    a) Gingival diseases of specific bacterial origin
    b) Gingival diseases of viral origin
    c) Gingival diseases of fungal origin
    d) Gingival diseases of genetic origin
    e) Gingival manifestations of systemic conditions
    f) Traumatic lesions
    g) Foreign body reactions (Gary *et al*)

1.2.2 Etiology of Gingivitis

Gingivitis is due to the long-term effects of plaque deposits on the teeth. Plaque is a thin film of bacteria. It constantly forms on the surface of the teeth. As plaque advances, it hardens and becomes tartar. When plaque extends below the gum line, infection can occur. Plaque is a sticky material made of bacteria, mucus and food debris that builds up on the exposed parts of the teeth. It is also a major cause of tooth decay. If plaque is not removed, it turns into a hard deposit called tartar that becomes trapped at the base of the tooth. Plaque and tartar irritate and inflame the gums. Bacteria and toxins produced cause the gums to become infected, swollen, and tender (James *et al*).

The following raises risk for gingivitis:

- Certain infections and body-wide (systemic) diseases
- Poor dental hygiene
- Pregnancy (hormonal changes increase the sensitivity of the gums)
- Uncontrolled diabetes
- Misaligned teeth, rough edges of filling and unclean mouth appliances (such as braces, dentures, bridges and crowns)

ISSN: 2519-9889
Impact Factor: 3.426

- Use of certain medications, including phenytoin, bismuth and some birth control pills
- Smoking or chewing tobacco

1.3 Dental Implant (D.I): Tooth loss is very common and it can happen as a result of disease and trauma; therefore the use of D.I to provide support for replacement of missing teeth has a long and multifaceted history. D.I has created a revolution in the routine approach to dental care for patients missing one or more teeth. (Clark *et al*).

Research on dental implant designs, material and techniques has increased in the past few years and is expected to expand in the future. Structure of Dental implant is shown in Fig. 1.4.

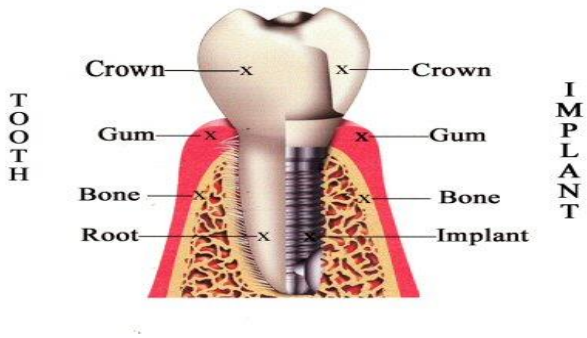


Fig. 1.4 Dental Implant

II. RESEARCH ENVIZAGED

The main objective of the project was to develop a dental implant for the patients suffering from oral gingivitis caused by bacterial infection, trauma etc. Person suffering from Gingivitis has chance to miss the medication during travel. For such patients dental implant is can be effectively utilized. The implant releases the drug in sustained manner near infected part. Drug released provides localized action for long duration and hence drug medication will not have to be administered frequently.

III. MATERIAL AND METHODS

Following Drugs & materials are used in this method- Diclofenac Sodium, Triclosan, Carbopol p934, Chitosan, Propylene Glycol etc.

ISSN: 2519-9889
Impact Factor: 3.426

IV. EXPERIMENTAL WORK

Preformulation Studies

The preformulation studies were carried out in terms of tests for identification (Physical appearance, melting point, IR spectra and UV spectra), Solubility profile, Drug-Excipient interaction, and quantitative estimation of drug.

4.1 Test for identification

(a) Physical appearance:- A white or almost white crystalline powder.

(b) Melting point: Melting point was determined by taking small amount of drug in a capillary tube whose one end was closed by melting. The capillary tube was placed in the electrical melting point apparatus. The temperature was slowly increased with simultaneous observation of the sample. The temperature at which the drug starts melting was recorded as melting point. This process was performed three times. The mean of three readings was recorded.

The melting point of diclofenac sodium was determined using open capillary method. The melting point was found to 275-285°C.

(c) Infrared Spectrophotometry:

The IR spectrum of drug was recorded on a Shimadzu IF Affinity-1FTIR spectrophotometer and is presented in fig.4.1 and the interpretation of their spectrum bands is given in table 4.1.

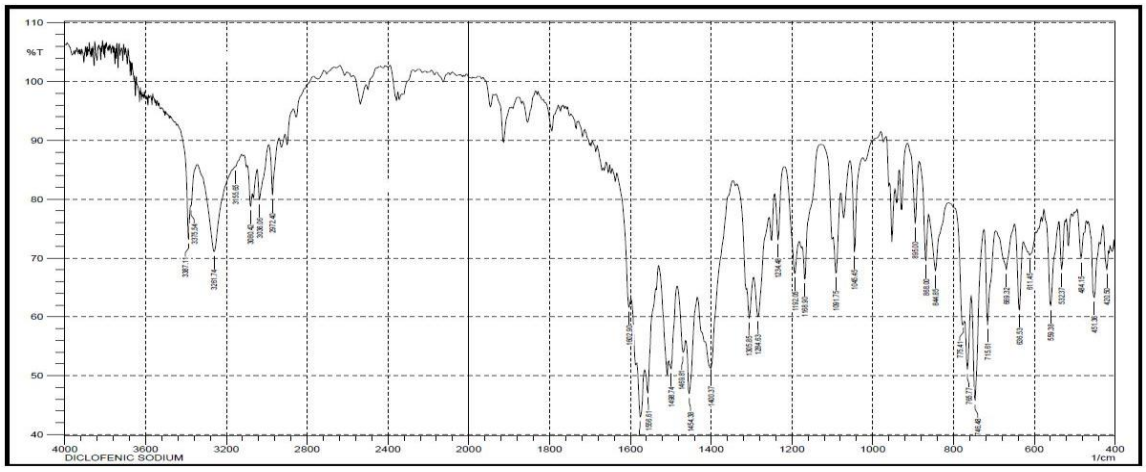


Fig 4.1: FTIR Spectrum of Diclofenac sodium

ISSN: 2519-9889
Impact Factor: 3.426

Table 4.1: Interpretations of infrared spectrum bands of diclofenac sodium sample

IR Spectrum	Standard peaks value cm^{-1}	Observed peaks value cm^{-1}	Groups	Stretching/ deformation
Diclofenac sodium	1600-1475	1556.61,1498.74	C=C (Aromatic)	Stretching
	1320-1210	1305.85	C-O Stretching	Stretching
	1556	1556.61	Diclorophenyl ring	Stretching
	1300-1000	1284.63	C-CO-C Stretching	Stretching

(d) UV Spectrophotometric analysis of Diclofenac sodium

100 mg of drug was weighed accurately and transferred to 100 ml volumetric flask and dissolved in small amount of methanol, after that volume was made up to 100 ml with distilled water so as to obtain stock solution of 1000 µg/ml. From this stock solution, dilution of 20µg/ml was made with distilled water and the sample was scanned between 200 nm to 400 nm on a double beam UV/Visible spectrophotometer(Shimadzu® 1800) The UV spectrum of diclofenac sodium is shown in fig.4.2.

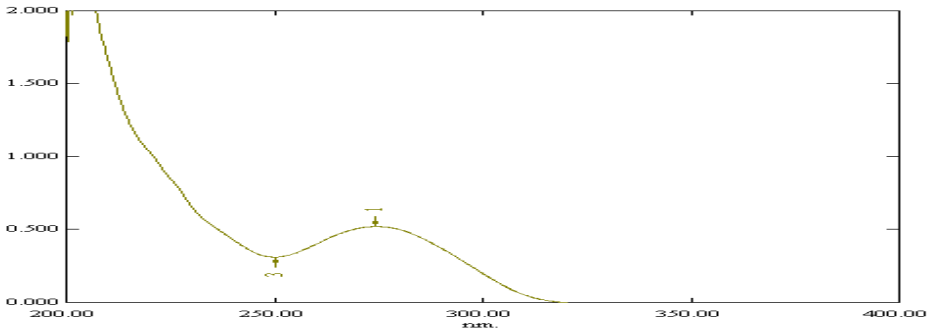


Fig 4.2: UV spectrum of diclofenac sodium in Distilled water

The Diclofenac sodium was obtained as gift sample from Pure Pharma Ltd. Indore. The physical appearance and melting point of drug were found close to that mentioned in IP (2007) which shows purity of sample Melting point was found to be 275-285^{o}C which is same as reported in the literature. Identification of drug was performed using FTIR spectrophotometry. All the characteristic peaks of the Diclofenac sodium matched with the

ISSN: 2519-9889
Impact Factor: 3.426

peaks in the spectrum obtained from FTIR spectrophotometry. Diclofenac sodium exhibited λ_{max} at 276 nm. The λ_{max} was found to be same as reported in literature.

4.2 Solubility Profile:

Solubility may be defined as the spontaneous interaction of two or more substances to form a homogenous molecular dispersion. Solubility is a chemical property referring to the ability for a given substance, the solute, to dissolve in a solvent.

The solubility of Diclofenac sodium was tested in various common solvents. A small quantity of drug was dissolved in 10 ml, until the drug was saturated of each investigated solvents at room temperature. The solubility was observed by the visual inspection. The observations are shown in Table 4.2.

Table 4.2: Solubility profile of Diclofenac sodium in aqueous and non-aqueous solvents:

S.No	Solvents	Solubility
1.	Distilled water	Poorly soluble
2.	Ethanol	Soluble
3.	Acetone	Freely soluble
4.	Dichloromethane	Freely soluble
5.	N-Butanol	Springly soluble
6.	2-Butanol	Freely soluble
7.	Octanol	Springly soluble

Solubility of Diclofenac sodium was determined in various aqueous and non-aqueous solvents. The drug was found to be freely soluble in acetone, dichloromethane, 2-Butanol and soluble in ethanol and poorly soluble in water (Table 4.2).

ISSN: 2519-9889
Impact Factor: 3.426

4.3 Drug Excipient compatibility studies

Diclofenac sodium powder was mixed with various excipients in the ratio of 1:1 and the resulting physical mixture was kept in sealed glass vials. These vials were placed at 50°C for 7 days and at 37°c for 14 days. Physical characteristics evaluation parameters were employed to study the interaction between the drug and the excipients. Therefore the content of each vial were observed for any change in their physical characteristics

Table 4.3: Drug excipients compatibility study in solid state kept at different condition of temperature

S. No.	Drug-Excipient (1:1)	Initial Observation	Observation of at 37°C after 14 days	Observation of at 50°C after 7 days
1	Diclofenac sodium + Triclosan	White powder	No change	White Semisolid
2	Diclofenac sodium + chitosan	White powder	No change	No change
3	Diclofeanac sodium + Carbopol	White powder	No change	No change

Drug - excipients compatibility study was performed for 1:1 ratios of drug and excipents. Formulations were kept at 50°c for 7 days and 37°C for 14 days. At 50°c no change was found with other excipients. At 37°C after 14 days no change was found with any excipient. (Table no 4.3).

4.4 Preparation of standard curve in pH 7.2 : For preparation of calibration curve in pH 7.2. 50 mg of Diclofenac sodium was weighed accurately and transferred to 500 ml volumetric flask. Then small amount of methanol was added in order to dissolve the drug and the volume was made up to mark with the distilled water so as to obtained stock solutions of and 100 µg/ml Appropriate dilutions from the stock solutions were made with the distilled water to give solution containing 10, 20, 30, 40 and 50µg/ml. The absorbance of the resulting drug solutions were read on UV/VIS spectrophotometer (Shimadzu® 1800) at about 276 nm against the respective blank. The data are recorded in table 5.4 and graphically represented in fig. 4.3.

ISSN: 2519-9889
Impact Factor: 3.426

Table 4.4: Absorbance data for calibration curve of Diclofenac sodium in pH 7.2 at 276 nm

S. No.	Concentration (µg/ml)	Absorbance (Mean ±SD) (n=3)	Regration value
1.	0	0.000±0.000	0
2.	2	0.075±0.001	0.061
3.	4	0.113±0.002	0.117
4.	6	0.171±0.002	0.173
5.	8	0.243±0.001	0.229
6.	10	0.317±0.003	0.285
7.	12	0.339±0.001	0.341
8.	14	0.410±0.002	0.397
9.	16	0.461±0.001	0.453
10.	18	0.518±0.002	0.509
11.	20	0.593±0.003	0.565

An absorption maximum of drug was determined by UV visible spectrophotometer (Shimadzu® 1800). It has been found that λmax for drug in distilled water was 276 nm (Fig 6.3).

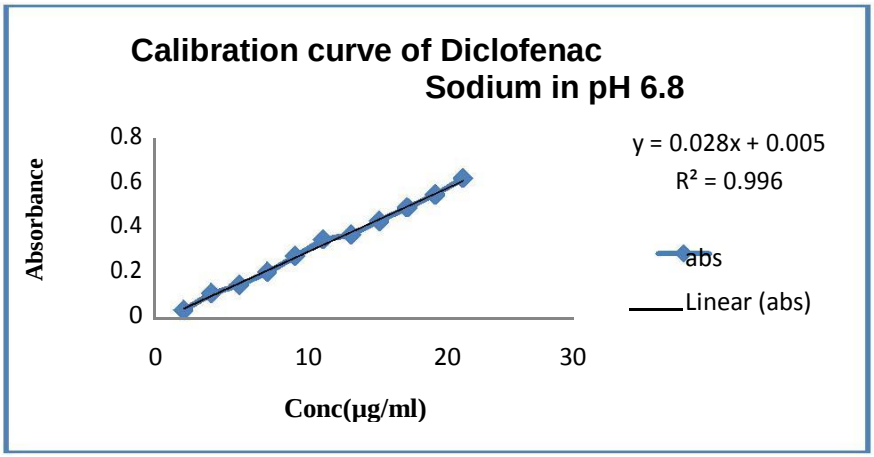


Fig 4.3 Calibration curve of Diclofenac sodium in pH 7.2.

ISSN: 2519-9889
Impact Factor: 3.426

The standard curves of drug were prepared in distilled water in the concentration range of 10-50µg/ml (Table 5.4). A straight line with Regression coefficient (r^2) = 0.991 in distilled water was obtained which indicates that drug follows Beer's –lamberts law.

Result: From the above preformulation data it is clear that the obtained drug is diclofenac sodium.

Formulation and Development of Drug Product: To deliver to drug at the targeted site, or for the treatment of gingivitis we have to develop dental implant with sol-gel technique containing diclofenac sodium.

The dental implant containing diclofenac sodium has been formulated by following steps:

1. Selection and procurement of drug and excipients.
2. Formula optimization of sol-gel.
3. Formulation of sol-gel.
4. Inserting of gel in dental cavity (crown).
5. Setting of dental crown on implant.

4.5 Selection and procurement of drug and excipients:

Selection of drug:

Diclofenac sodium: Diclofenac sodium is having anti-inflamatory, analgesic and antipyretic properties that is necessary for patients having gingivitis to relief from pain. Diclofenac sodium was obtained as a gift sample from Pure Pharma Ltd., Indore

Selection of Excipients:

Triclosan: Triclosan is having anti-bacterial properties which help to kill or removes the bacterial that causes the gingivitis.
Triclosan was obtained as a gift sample from Dev implex Pharma Ltd., Gujrat.

Carbopol P934: Carbopol is a polymer and use as gelling agent, to prepare sol gel.
Carbopol was obtained from college Sri Aurobindo Institute of Pharmacy ., Indore

Propylene glycol: It is solubilizing agent use as a solubilizer for many drug agent.

ISSN: 2519-9889
Impact Factor: 3.426

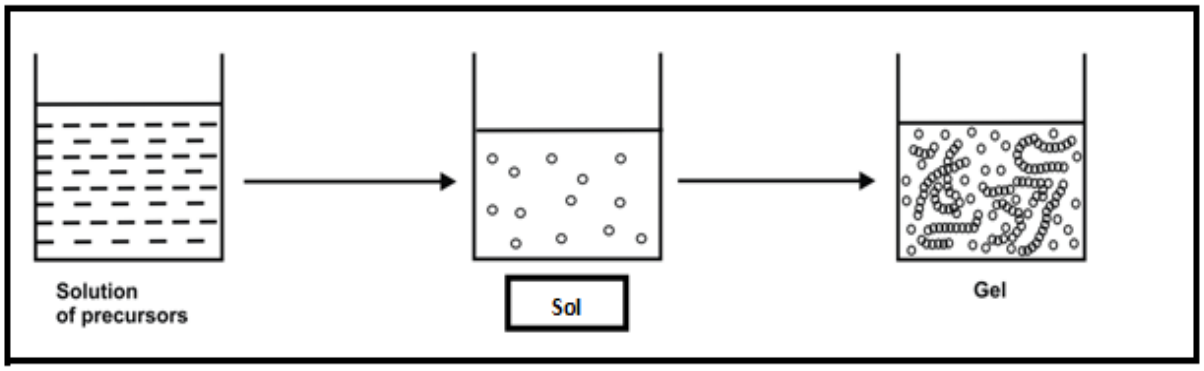
Propylene glycol was obtained from college Sri Aurobindo Institute of Pharmacy, Indore

Chitosan: Chitosan is a crosslinked polymer. This chitosan get entrapped with the drug and made sustained release formulation.
Chitosan was obtained from college, Sri Aurobindo Institute of Pharmacy, Indore

4.6 Formulation of sol-gel:

The Sol-gel process is a method for producing solid materials from small molecules. The process involves conversion of monomers into a colloidal solution (sol) that acts as the precursor for an integrated network (or gel) of either discrete particles or network polymers.

In this chemical procedure, the 'sol' (or solution) gradually evolves towards the formation of a gel-like system. During reaction, objects will grow. As the sol aggregates the viscosity will increase until a gel is formed. The sol-gel transition (gel-point) is reached when a continuous network is formed. The gel-time is determined as the time when all fluid is kept in the gel, and the volume is maintained.



4.6.1 Mechanics of gelation: In a static sense, the fundamental difference between a liquid and a solid is that the solid has elastic resistance against a shearing stress while a liquid does not. Gels have been described by born as liquids in which an elastic resistance against shearing survives, yielding both viscous and elastic properties.

4.7 Formula optimization for gel: For optimization of formula for the gel six batches are taken in which different amount of drug and polymer are taken and observation are recorded.

ISSN: 2519-9889
Impact Factor: 3.426

Table.4.5 Showing Formula optimization for gel

Drug and excipient	F1	F2	F3	F4	F5	F6
Carbopol 934	100 mg	150 mg	200 mg	-	-	-
Diclofenac sodium	100 mg	100 mg	100 mg	100 mg	100 mg	100 mg
Triclosan	100 mg	100 mg	100 mg	100 mg	100 mg	100 mg
Chitosan	-	-	-	100mg	150 mg	200 mg
Propylene glycol	10 ml	10 ml	10 ml	10 ml	10 ml	10 ml
Observation	pH: 5.4 with less viscosity	pH: 4.9 with low viscosity	pH:6.5 with desired viscosity	pH:4.2 with chelated problem	pH: 5.7 with less viscosity	pH: 5.1 with hazy viscous

Observation: In formulation F1 and F2 , the gel are less viscous. Formulation F4,F5, and F6 possessed problem of chelates formation. Formulation F3 was observed as gel with desired properties.

4.7.1 Evaluation and characterization of gel:

a. **Viscosity:** Viscosity of gel was studied under Brookfield viscometer by using spindle number 3 at 60 rpm.

   Result and conclusion: The gel was found to be great viscous.

b. **pH:** An acidic or alkaline formulation is bound to cause irritation on the mucosal membrane and hence this parameter assumes significance while developing formulation. A digital glass electrode pH meter was used for this purpose. pH was noted by bringing the electrodes near the surface of the formulation and allowing it to equilibrium for 1 min.

   Result and conclusion: After doing pH test the gel. The pH is found to be 6.0-6.5.

c. **Transition of sol-gel temperature:** It is the temperature at which the solutions become gel. This temperature is calculated by keeping the solution at temperature above 20 ^{o}C. The temperature at which it turns is noted.

   Result and conclusion: The transition temp. of gel is found to be 25-30 ^{o}C.

ISSN: 2519-9889
Impact Factor: 3.426

d. Drug content: 1 ml of formulation was taken in 10 ml volumetric flask diluted with solvent. Volume was adjusted to 10 ml. The absorbance was measured at 276 nm.

Table 4.6 Showing drug content of gel

S. No.	formulations	λ max	Sample	concentration	% drug content
1.	Diclofenac sodium	276	unknown	91.48ug/ml	91.48%

e. In-vitro Drug release: The release study were performed using the dialysis method. 1 gm of gel was placed in a dialysis tube. The dialysis tube was then placed in a dialysis in a beaker containing 100 ml phosphate buffer pH 7.2 stirred at 100 rpm. Sample was collected periodically and replaced with fresh medium of phosphate buffer. After filtration through the watsman filter paper the concentration of drug was determined by spectrophotometric method at 276 nm.

Table 4.7 Showing % drug release of gel

S.no.	Time	% drug release at phosphate buffer pH 7.2 Values reported are mean±SD (n=3)
1.	0 hr	0 ± 0.002
2.	1 hr	4 ± 0.001
3.	2 hr	5 ± 0.023
4.	3 hr	6.8 ± 0.21
5.	5 hr	10 ± 0.014
6.	24 hr	27 ± 0.003
7.	48 hr	42 ± 0.004
8.	72 hr	59 ± 0.001

4.8 Other parameter:

Table 4.8 Showing evaluation parameter

S.no.	Parameter	Observation
1.	Colour	Clear, slightly translucent
2.	pH	6.0 - 6.5
3.	Transition sol-gel temp.	25 – 30 ^{o}C
4.	Drug content	91.48 %
5.	Viscosity	Highly viscous

ISSN: 2519-9889
Impact Factor: 3.426

4.9 Inserting of Gel in dental cavity (Crown)

With the help of syring having 16 Gauge needle the gel is inserted into the dental cavity or crown.

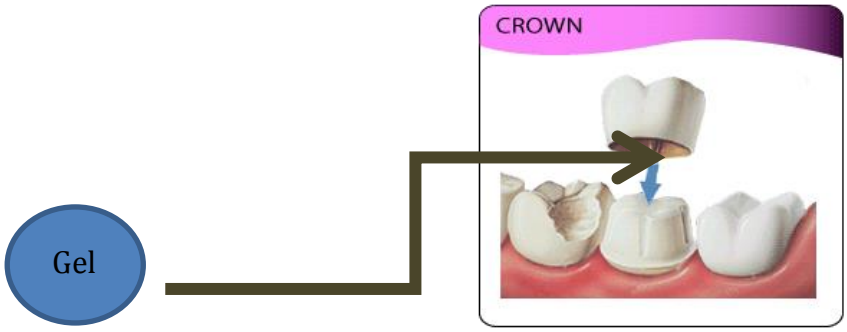


Fig. 4.4 showing insertion of gel in dental cavity (crown)

4.10 Setting of dental crown on implant;

1. The implant and crown is selected by to the Dentists according to the patient condition or infected part of oral part.
2. Now the implant was set to patient's jaw as root planning.
3. The crown filled with sol gel is set on the implant from where the drug release in sustained manner.

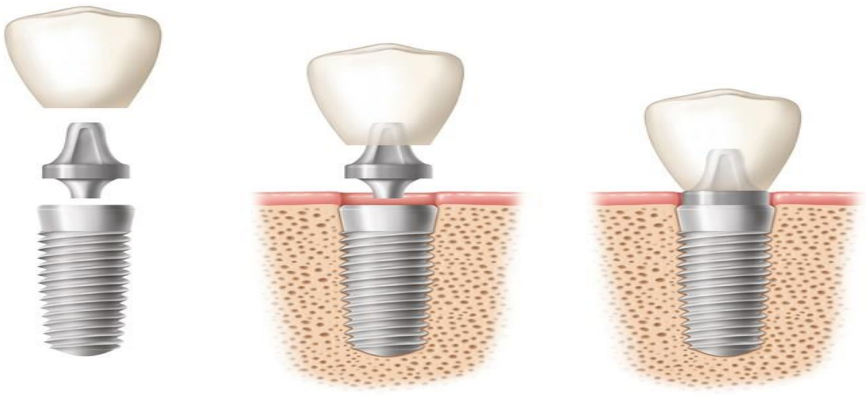


Fig.4.5 showing setting of dental crown on implant

ISSN: 2519-9889
Impact Factor: 3.426

4.11 Working of dental implant:

1. Gel releases the drug in controlled rate from the crown.
2. Diclofenac sodium helps to decrease the pain
3. Triclosan helps to kill or decrease the bacteria which causes gingivitis.
4. Slowly a plaque has been removed.
5. And patient get relieve from gingivitis.

5. RESULT AND DISCUSSION: Dental Implant is a Demiurgic drug delivery system. Once implant it shows its effect for long period of time. It releases the drug with a controlled rate for a long constant period of time. It shows its effect at a targeted site and by-pass the systemic route. It provide local therapeutic effect to the site of application. Small amount of drug provide long term effect. It is uses as a targeted release of drug at a desired site. With the Dental implant the release of drug should be in controlled rate. It help to treat many oral diseases causes by bacterial infection and other sources.

Six batches of gel were prepared by changing the polymer ratio. Three batch consist of carbopol whereas three batches consist of chitosan. Triclosan was added in all formulation since it is antibacterial polymer and it also favors gelling. All the six batches of gel was subjected to in-vitro characterization it was observed that the in case batches containing chitosan, the gel formed by hazy and it contain come particulate matter also whereas the gel formed in case of carbopol were clear.

Formulation f1 and f2 were less viscous and gel did not formed completely whereas formulation f4, f5, and f6 , the gel formed was also less viscous as well as hazy. This could be due to the incorporation of chitosan in f4, f5, and f6 formulation which derived from chitin and it may not imbibe large amount of water to result in formulation of efficient gel. Hence on the basis of preliminary observation formula f3 was selected for further evaluation.

Obtained formula (f3) was characterized and it was found that viscosity of gel (f3) was highly viscous whereas drug content was 91.48 %.The gel was subjected to in-vitro drug release it

ISSN: 2519-9889
Impact Factor: 3.426

was found that 59% drug was released in the end of 72 hr. This may be due to the efficient gel forming capacity of carbopol which was further enhanced by incorporation of triclosan.

6. SUMMARY AND CONCLUSION: For optimization of formula for the gel six batches were taken in which different amount of drug and polymer were added and observation were recorded. Six batches of gel were prepared by changing the polymer ratio. Three batch consist of carbopol whereas three batches consist of chitosan. Triclosan was added in all formulation since it is antibacterial polymer and it also favors gelling. All the six batches of gel was subjected to in-vitro characterization it was observed that the in case batches containing chitosan, the gel formed by hazy and it contain come particulate matter also whereas the gel formed in case of carbopol were clear.

Formulation f1 and f2 were less viscous and gel did not formed completely whereas formulation f4, f5, and f6 , the gel formed was also less viscous as well as hazy. This could be due to the incorporation of chitosan in f4, f5, and f6 formulation which derived from chitin and it may not imbibe large amount of water to result in formulation of efficient gel. Hence on the basis of preliminary observation formula f3 was selected for further evaluation.

Obtained formula (f3) was characterized and it was found that viscosity of gel (f3) was highly viscous whereas drug content was 91.48 %. The gel was subjected to in-vitro drug release it was found that 59% drug was released in the end of 72 hr. This may be due to the efficient gel forming capacity of carbopol which was further enhanced by incorporation of triclosan. Formulation F3 was selected as optimum formulation with desired properties and was subjected to further studies.

Evaluation parameters of gel:

S.no.	**Parameter**	**Observation**
1.	Colour	Clear, slightly translucent
2.	pH	6.0 - 6.5
3.	Transition sol-gel temp.	25 – 30 ^{o}C

ISSN: 2519-9889
Impact Factor: 3.426

4.	Drug content	91.48 %
5.	Viscosity	Highly viscous

Dental Implant is a Demiurgic drug delivery system. Once implanted it shows its effect for long period of time. It releases the drug with a controlled rate for a long constant period of time. It shows its effect at a targeted site and by-pass the systemic route. Provides local therapeutic effect to the site of application. The gel prepared can be incorporated in a dental implant or dental crown. This implant when inserted into the cavity will release the drug in a sustained pattern and therefore the gel in implant system can prove as a future tool for the treatment of gingivitis and other oral infections.

REFERENCES

1. Ahmed M.G, Harish NM, Charyulu R.N, Prabhu P. Formulation of chitosan-based ciprofloxacin and diclofenac film for periodontitis therapy. "Trop J Pharm Res". 2009;8(1):33-41.
2. Banerjee N, Singh S. Dental Implants: As an Alternative for Tooth Replacement. "Journal of Pharmaceutical and Scientific Innovation". 2013;2(4):29-36.
3. Born M., The Stability of Crystal Lattices, "J. Chem. Phys.". 1939;7:591-9
4. Clark M.S. Surface Modification of Biomedical and Dental Implants and the Processes of Inflammation, Wound Healing and Bone Formation. "Int. J. Mol. Sci.". 2010;11:354-369.
5. Deshani J.M, Savaliya P.R, Vanaliya S. Recent Advancement in Periodental Drug Delivery. "Ph.Tech/Med". 2013;2(1).
6. Gaffar A, Volpe A. Gingivitis:An Inflammatory Periodontal Disease. "Compendium". 2004;25(7).
7. Gary C. Development of a Classification System for Periodontal Diseases and Conditions. "Annals of Periodontology". 1999;4(1):1-6.
8. Gaviria L, Salcido J.P, Guda T, Ong J.L. Current trends in dental implants. "J Korean Assoc Oral Maxillolac Surg". 2014;40:50-60.

ISSN: 2519-9889
Impact Factor: 3.426

9. Grandin H.M, Berner S, Dard M. A Review of Titanium Zirconium (TiZr) Alloys for Use in Endosseous Dental Implants. "Materials". 2012;5:1348-1360.
10. Han HS. Design of new root-form endosseous dental implant and evaluation of fatigue strength using finite element analysis. The University of lowa:2009.
11. Hence, L.L, J.K. The Sol-gel Process. "Chemical Review".1990;90:33
12. Huang L.H, Lynn J, Wang H.L. Dental implants for orthodontic anchorage. "American Journal of Orthodontics and Dentfacial Orthopedics". 2005;127:713-22.
13. James O, Veronica, David J, William G, Michael. Bacterial Community Development in Experimental Gingivitis. "Plos one". 2013;8(8).
14. Jane-S.E, Lopez J.L, Llabres X.R, Argueta O.F.R, Kustner E.C. Relationship between oral cancer and implants:clinical cases and systematic literature review. "Med Oral Patol Oral Cir Bucal". 2012;17(1).
15. Jum'ah A.A, Beekmans B.M.N, Wood D.J, Maghaireh H. Zirconia Implants: The New Arrival in the Armoury of Successful Aesthetic Implant Dentistry. "Smile Dental Journal". 2012;7(2).
16. Kahn, Michael A. Basic Oral and Maxillfacial pathology. 2001:1.
17. Kamath K, Shripathy D, Shabharaya A.R. Formulation and Evaluation of Biodegradable Dental Implants Containing Antibacterial Agents for Periodontitis. PHARMBIT 2010;22
18. Karunakar B, Udupa N. Design and evaluation of norflaxacin dental implants."Ind J Pharma Sci"1993;55:68-9.
19. Kenneth SK. Controlled-release local delivery of antimicrobials in periodontics: prospects for the future. "J. Periodontol".1993;64:782-91.
20. Kothari S, Gnanaranjan G, Kothiyal P. Formlation and Evaluation of Erythromycin Dental Implants for Periodontitis. "Int. J. Res. Tech". 2012;2(5):407-410.
21. Larsen T. *In-vitro* release of doxycycline from bio-absorbable materials and acrylic strips. "J Periodontol".1990;61:30-4
22. Lee JH, Frias V, Lee KW, Wright RF. Effect of implant size and shape on implant success rates: A literature review. "J Prosthet Dent". 2005;94:377-81.

ISSN: 2519-9889
Impact Factor: 3.426

23. Lights V, Boskey E. Gum Disease (Gingivitis): Causes, Risk Factors & Symptoms. http://www.healthline.com/health/gingivitis#Description1(2012).
24. Mastiholimath VS., Dandagi PM., Gadad AP., Patil MB., Chandur VK. Formulation and Evaluation of Ornidazole Dental Implants for Periodontitis. "Indian Journal of Pharmaceutical Sciences". 2006;68(1):68-71.

