International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 1 Jan - Feb 2025, pp: 890-898 www.ijprajournal.com ISSN: 2456-4494

Formulation and Standardation of Omeprazole Nanoparticles

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Date of Submission: 05-02-2025 Date of Acceptance: 15-02-2025

ABSTRACT
Formulation F1 was determined to be the best formulation as it satisfied all requirements and performed exceptionally well across the board. In order to treat duodenal ulcers, the results of this study highlight the potential of enteric-coated omeprazole nanoparticle as a controlled release formulation. Omeprazole's efficient and regulated release in the intestines, together with its good protection in the stomach, demonstrate the formulation's potential to improve treatment results for patients with duodenal ulcers. This work opens the door for more investigation and advancement in the field of drug delivery systems based on nanoparticles, providing a viable strategy for enhancing the effectiveness and security of oral drugs.

Key words: Omeprazole, Nanoparticles, Drug delivery, Oral drugs, Acidity.

I. INTRODUCTION

Antacids have traditionally been used to relieve the symptoms of peptic ulcers. It's well-known that too much stomach acid can cause peptic ulcers and other issues like acid reflux. To help ulcers heal, reducing stomach acid is usually the main approach, either through surgery or medication [1]. New medications have been developed to more effectively reduce stomach acid. These include drugs that block specific receptors or chemicals in the stomach, like muscarinic antagonists (such as Pirenzepine) and histamine-receptor antagonists (like cimetidine) [2]. Recently, scientists have also created prostaglandin analogues, which were thought to protect the stomach lining and aid in healing. However, these prostaglandins only work for ulcers when they are used in high doses that also reduce stomach acid [3].

In the last ten years, scientists discovered an enzyme called H^+/K^+-ATPase enzyme. which is found in the top part of stomach cells and acts as a "proton pump" to create stomach acid [4]. This discovery has led to a lot of interest in developing drugs that can block this enzyme to treat ulcers. The enzyme's special location in the cell, where it helps separate the neutral inside of the cell from the acidic inside of the stomach, makes it a unique target for these treatments [5].

Other types of ATPases, which are enzymes that move hydrogen ions, are different in structure and function. This difference makes them good targets for designing specific drugs. Recently, a group of drugs called pyridylmethylsulfinyl benzimidazoles (PSBs) have been found to be very effective at blocking a particular enzyme in the stomach that helps produce acid [6]. Omeprazole, one of these drugs, is especially strong at stopping this enzyme, which makes it a powerful treatment for reducing stomach acid [7].

The parietal cells in the stomach are responsible for making stomach acid. These cells get activated by three main things: histamine, acetylcholine, and gastrin.Histamine plays the biggest role in making the stomach acid. The H^+ /K^+ -ATPase enzyme exchanges hydrogen ions for potassium ions, leading to an increase in stomach acid (HCl) [8].Omeprazole blocks the enzyme in the stomach wall that produces acid. By doing this, it decreases the amount of acid, providing relief from symptoms like heartburn and allowing any damaged areas of the stomach or esophagus to heal [9].

Methodology:

Sample collection: The drug sample was arranged at the Laboratory, Somics Lifesciences Pvt. Ltd. Bareilly for the study.

Pre-Formulation studies:

Organolepetic Properties: Observe the physical properties of the omeprazole powder and record its appearance, Color, melting point and odor [11].

1. **Appearance**: Omeprazole usually looks like a white or slightly off-white powder. The color and appearance of the capsules or tablets it comes in can affect how people feel about the quality of the medicine [12].

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2. **Taste**: Omeprazole has a bitter taste. To make it taste better, it is often covered with a special coating or mixed with other ingredients that hide the bitterness. This is especially important for making it easier for children and older adults to take.
3. **Smell:** Pure omeprazole normally doesn't have any noticeable smell. If it does smell different, it could mean there's a problem with the medicine, like it's breaking down or has impurities, which is important to check for quality [13-15].
4. **Texture:** The texture of omeprazole (whether it's in granules, tablets, or capsules) can affect how it feels in the mouth, which is important to make sure people are comfortable taking it and continue using it as prescribed [16].

λ max determination:10 mg omeprazole was dissolved in 100 ml methanol and then incubated at 45℃ for 1 hour, and the filtered using syringe filter. Further the sample was diluted by taking 1 ml sample from stock solution to 10 ml respective solvent. The absorbance was taken between 200 nm and 400 nm for omeprazole. Use the same solvent (methanol or water) as a blank to calibrate the instrument, spectrophotometer [17].

Calibration Curve: Prepare a 10 mg/ml solution of omeprazole by dissolve it in methanol. Incubate the solution at 45C for 1 hour. Further incubate the solution at 37C. filter the solution using a microfilter. Prepare a standard curve by measuring the absorbance at λmax for different concentration of omeprazole [18].

Formulation Nanoparticles: 0.001 gm CuSO4 was dissolved in 10 ml PBS buffer and allowed for stirring for 1 hour at room temperature. Then the solution of drug 0.01g/ml was added to the solution drop wise drop at 90 ℃. Once the drug was finished the solution was allowed for stirring and then few drops of NaOH was added to it. Colour change indicates the formation of nanoparticles. The nanoparticles were washed using sterilized distilled water 3 time, and then dried at room temperature. The sample were further used for characterization [19].

Evaluation of Nanoparticles

UV analysis:: Afterbeingdissolvedin10mlofdistilledwater,the0.01-gramsamplewasshakenatroomtemperature for 24 hours before being used. After the samples were filtered, absorbance measurements were made at various wavelengths between 200 and 400nm.

SEM analysis: Morphology and structure of SAMPLE will be examined using scanning electron microscopy (SEM JSM-6360 (JEOL Inc. Japan) from the samples a small drop of SAMPLE will be air dried by oven drying and sprinkled on SEM stub (pins) using double side adhesive tape and coated with aluminium at 20mA for 6minute through sputter-coater (Ion-Sputter JFC100). A scanning electron microscope with secondary detector will be used to obtain digital images of samples at an accelerating voltage of 15kV.

Antimicrobial activity: Sterilized nutrient agar media was prepared and then poured to petri-plates and allowed for solidification.20µl Pseudomonas aeruginosa (Pa) S. aureus (Sa) was spread and then 3-4 wells were prepared using sterilize tips.500µg samples were loaded to each wells and plates were incubated at 37℃ for 24 hours. ZOI was calculated.

Drug content estimation:10 mg/ml nanoparticles suspension was prepared and then incubated at 45 C for 1 hour and then 37 C for overnight. The sample was filtered and then absorbance was taken at λmax.

Invitro drug release study:10 mg/ml nanoparticles suspension was prepared and then incubated at 45 C for 1 hour and then 37 C for overnight. The sample was filtered and then transferred in the dialysis bag. The dialysis bag was dipped in PBS buffer and then allowed for continuous stirring. The buffer sample was collected at 15 min. of time interval regularly and the absorbance was taken at λmax.

Invitro antacid study of nanoparticles:0.01 gm nanoparticles was dissolved in 30 ml PBS solution and then 10 ml 1N HCl was added drop wise during stirring at room temperature. When the HCl was finished the solution was left for continuous stirring at room temperature for 30 minutes. Further few drops of phenol red was added and then the solution was titrated with 0.1N NaOH, uptocolour change occurs [20].

II. RESULTS AND DISCUSSIONS

Preformulation testing is the initial stage in the logical development of dosage forms for amedicinalingredient.Pharmaceuticalcharacterizationinvolvesstudyingtheofatherapeutic component both on its own and when mixed with other substances calledexcipients. The primary goal of pre-formulation testing is to gather pertinent informationthatwillaidtheformulatorincreatingthataresuitablefor large-scaleproduction.

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Table1:Organoleptic properties of drug

S.No.	Tests	Outcome
1	Physicaldescription	Solid powder
2	Color	White
3	MeltingPoint	155℃

Fig 1: Collected omeprazole sample

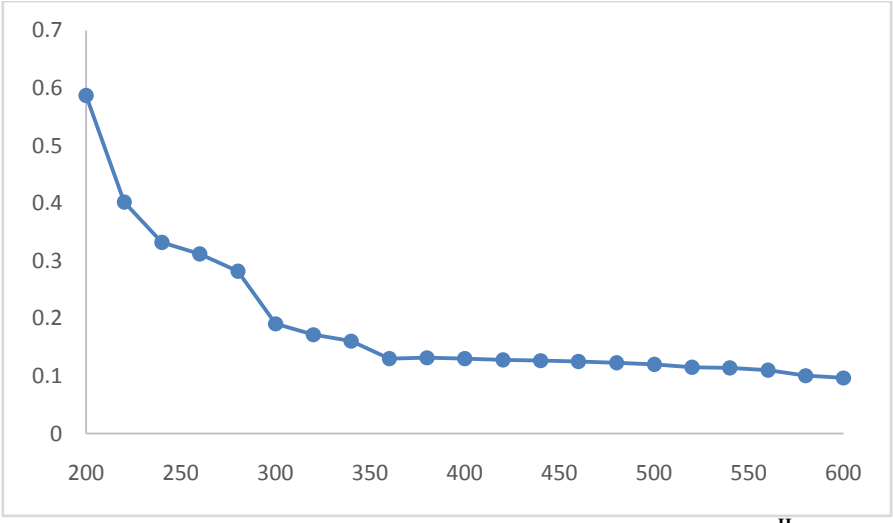

Fig.2:Lamdamax for Omeprazole sodium in phosphate buffer p^H6.8.

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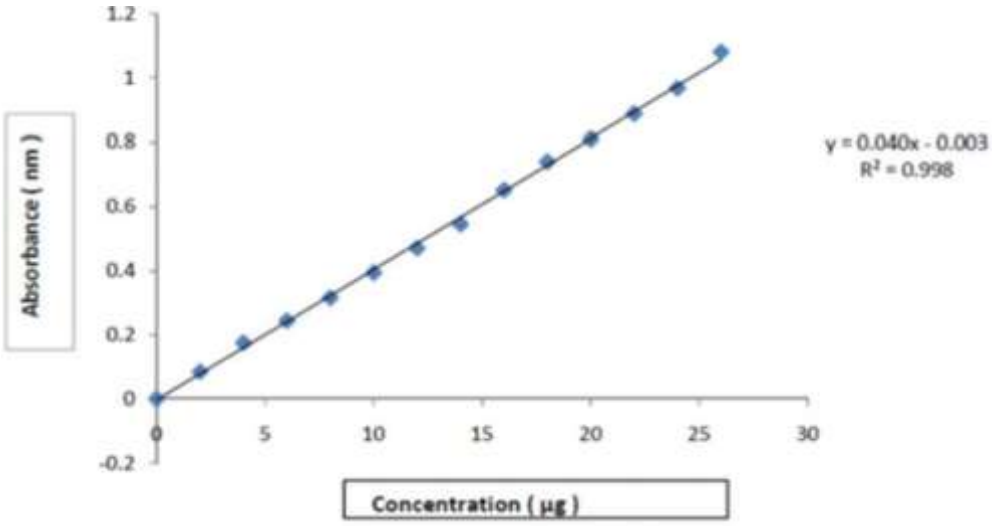

Fig3: Calibration curve of omeprazole

To determine the concentration of omeprazole in various formulations, a standard graph(calibrationcurve)isoftenprepared.Thisinvolve screatingsolutionsofknownconcentrations of omeprazole, measuring their absorbance at a specific wavelength, and then plotting these values to establish are lationship between concentration and absorbance.

The formulated nanoparticles [F1, F2 & F3] was successfully synthesised and then evaluation was done, the successfully outcome was mention in below tables and figures.

Fig 4: Synthesis of nanoparticles

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Evaluation of synthesised nanoparticles

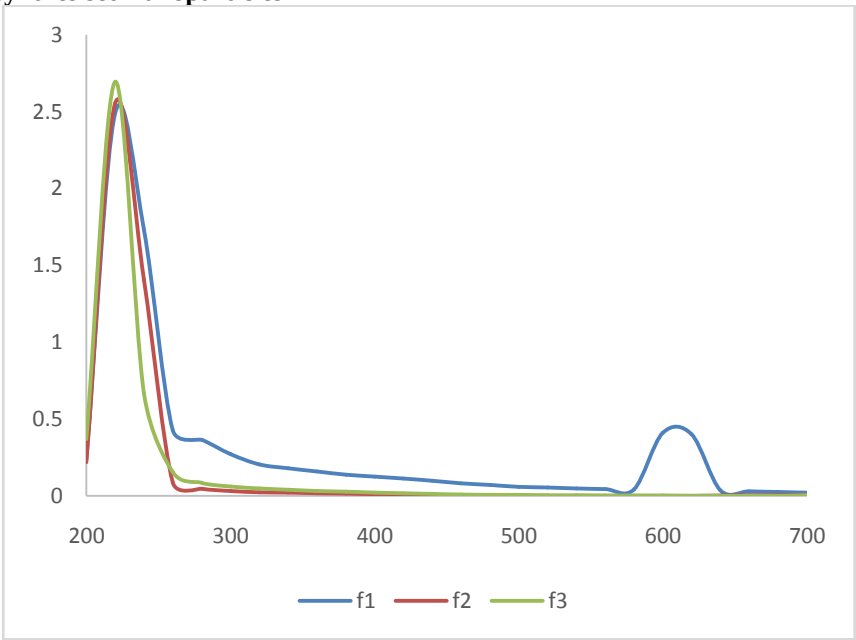

Fig5: Graphical representation of the UV analysis of all 3 formulated nanoparticles.

While the scanning electron microscope is used for the morphology study and the size characterization of the prepared nanoparticles. The outcomes indicate the size of 75 nm as mention in figure 6.

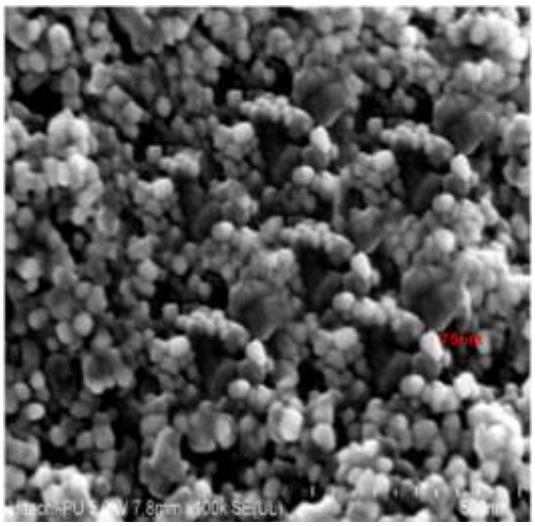

Fig 6: SEM analysis of the F1 nanoparticles

The antibacterial property of the nanoparticles were carried out and found the effective results in F1 formulation which shows the maximum zone of inhibition, represents through clear zone, as shown in figure 7 & 8.

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Fig 7: Antibacterial testing of the drug and the synthesised nanoparticles

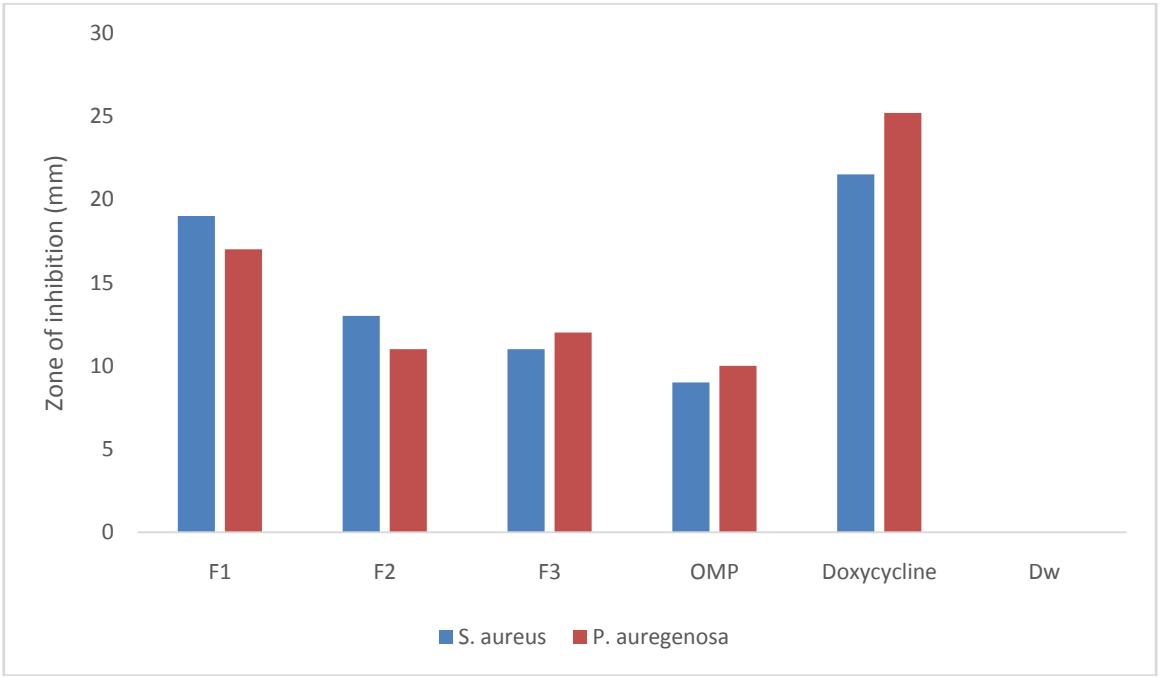

Fig 8: Graphical representation of Antibacterial testing of the drug and the synthesised nanoparticles.

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Table 2: Drug content estimation in the formulated nanoparticles.

Sample	Drug content
F1	59 ug/ml
F2	22 ug/ml
F3	3 ug/ml

Table3:Invitro Drug ReleaseStudy pH(6.8)

Time(min)	F3(%)	F2(%)	F1(%)
4	18	20	21
6	32	40	41
8	41	52	56
10	48	62	62
12	59	70	88

Table 4: Acid neutralizing capacity study of sample

S. No.	Sample	ANC per gm of antacid
1	F1	15.5
2	F2	11.5
3	F3	10.8
4	OMP	38.6

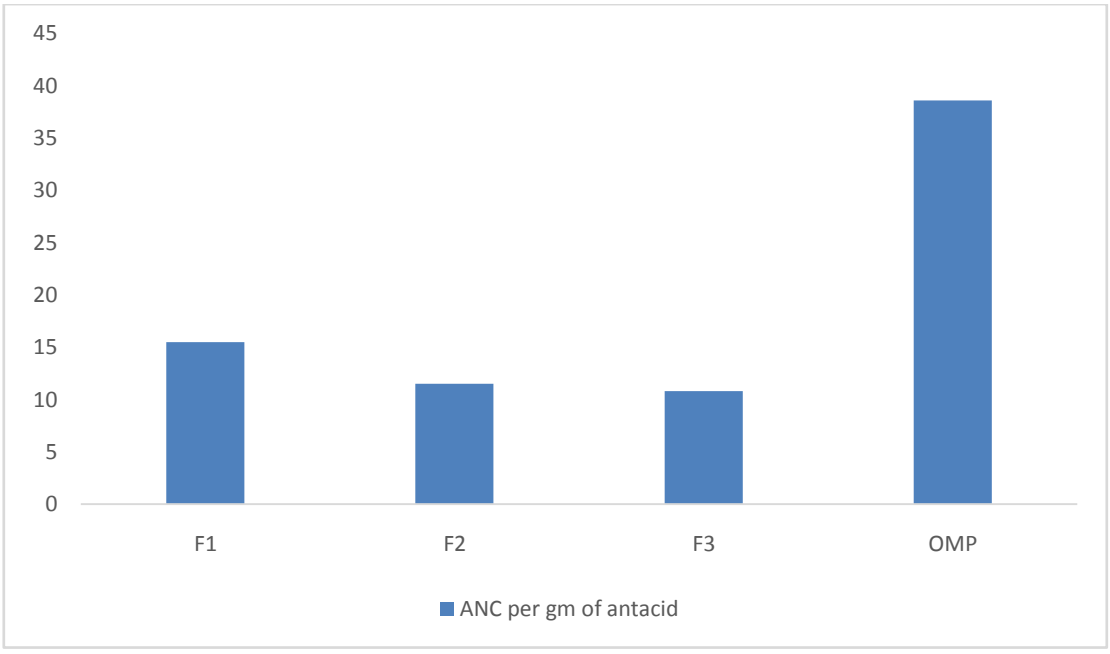

Fig9: Graphical analysis of Acid neutralizing capacity study of sample

The use of omeprazole as an anta-acid was pivotal in achieving the desired protection in the acidic environment of the stomach while ensuring efficient release in the intestinal pH. This dual functionality is crucial for maintaining the drug's integrity and maximizing its therapeutic efficacy.

Particularly noteworthy is the performance of F1, which emerged as the most promising formulation among those tested. This batch demonstrated negligible drug release in 0.1NHCl,effectively protecting the drug from degradation in the stomach. This characteristic is essential for proton pump inhibitors like omeprazole, which are highly susceptible to acid-induced degradation. Additionally, batch F4 exhibited an impressive98% drug release after 12 hours in phosphate buffer, highlighting its ability to provide

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asustainedandcontrolledreleaseintheintestines,where thedrugcanbeoptimallyabsorbed.

Thestudy'sfindingsunderscoretheformulation'srobustness,notonlyinmaintainingdrugstabilitybutalsoinensuringacontrolledreleaseprofilethatadheres tozero-orderkinetics.Thisindicatesaconsistentdrugreleaserate, independent of the drug concentration, which is beneficial for achieving a steady therapeutic effect and enhancing patient compliance. The incorporation of the Peppas model further elucidates the complex release mechanism involving diffusion, erosion, and swelling processes, providing a comprehensive understanding of the drug release dynamics.

III. CONCLUSION:

In conclusion, batch F1was identified as the optimal formulation as it met all the specified criteria and demonstrated exceptional performance in all evaluated parameters. The findings of this study underscore the potential of enteric-coated omeprazole nanoparticletablets as a controlled release preparation for the treatment of duodenal ulcers. The effective protection of omeprazole in the stomach, combined with its efficient and controlled release in the intestines, highlights the formulation's capability to enhance the rapeutic outcomes for patients suffering from duo denalulcers. This study paves the way for further research and development in the field of nanoparticle-based drug delivery systems, offering a promising approach for improving the efficacy and safety of oral medications.

REFERENCES:

[1]. Djagny KB, Wang Z, Xu S. Gelatin: A Valuable Protein for Food and Pharmaceutical Industries: Review. Critical Reviews in Food Science and Nutrition. 2001;41(6):481-492.

[2]. Exploratory Study of 3D Printed Biodegradable Cervical Interbody Fusion Cage. Case Medical Research. 2019.

[3]. Salmani MM, Hashemian M, Yekta HJ, Nejad MG, Saber-Samandari S, Khandan A. Synergic Effects of Magnetic Nanoparticles on Hyperthermia-Based Therapy and Controlled Drug Delivery for Bone Substitute Application. Journal of Superconductivity and Novel Magnetism. 2020;33(9):2809-2820.

[4]. Tavan H, Sayehmiri K, Abangah G, Kalvandi G, Aazami S. Prevalence of peptic ulcer in Iran: Systematic review and meta-analysis methods. J Res Med Sci. 2018;23(1):8.

[5]. Abdellahi M, Najfinezhad A, Saber-Samanadari S, Khandan A, Ghayour H. Zn and Zr co-doped M-type strontium hexaferrite: Synthesis, characterization and hyperthermia application. ChJPh. 2018;56(1):331-339.

[6]. Manjunath K, Venkateswarlu VJ. Pharmacokinetics, tissue distribution and bioavailability of clozapine solid lipid nanoparticles after intravenous and intraduodenal administration. J Control Release, 2005; 107:215-228.

[7]. Puglia C, Blasi P, Rizza L, Schoubben A, Bonina F, Rossi C, Ricci M. Lipid nanoparticles for prolonged topical delivery: an in vitro and in vivo investigation. Int J Pharm. 2008; 357(1-2):295-304.

[8]. Mei Z, Li X, Wu Q, Hu S, Yang X. The research on the antiinflammatory activity and hepatotoxicity of triptolide-loaded solid lipid nanoparticle. Pharmacol Res. 2005 Apr; 51(4):345

[9]. Pandey R, Sharma S, Khuller GK. Oral solid lipid nanoparticlebased antitubercular chemotherapy. Tuberculosis (Edinb). 2005; 85(5-6):415-20.

[10]. Tabatt K, Sameti M, Olbrich C, Müller RH, Lehr CM. Effect of cationic lipid and matrix lipid composition on solid lipid nanoparticle-mediated gene transfer. Eur J Pharm Biopharm. 2004; 57(2):155-62.

[11]. D.L. Avner, Clinical experience with pantoprazole in gastroesophageal reflux disease, Clin. Ther. 22 (10) (2000 Oct) 1169e1185 discussion 1149e1150.

[12]. S.M. Cheer, A. Prakash, D. Faulds, H.M. Lamb, Pantoprazole: an update of its pharmacological properties and therapeutic use in the management of acidrelated disorders, Drugs 63 (1) (2003) 101e133.

[13]. Poole P. Pantoprazole, Am. J. Health-Syst. Ph. 58 (11) (2001 Jun 1) 999e1008.

[14]. M. Ramachandraiah, Y.V. Rami Reddy, Method development and validation of HPLC for the determination and quantification of pantoprazole, Bull Environ. Pharmacol. Life Sci. 1 (8) (2012 Jul) 39e42.

[15]. N.R. Thomas, D.R. Jack, Histamine and anti histaminic agents, in: O.W. Charles,

G. Ole, H.B. John, M.B. John (Eds.), Text Book of Organic Medicinal and Pharmaceutical Chemistry, eleventh ed., Lippincott Williams& Wilkins, Pennsylvania, 2004, pp. 696e730.

[16]. K.S. Kaye, L.A. Petty, A.F. Shorr, M.D. Zilberberg, Current epidemiology, etiology, and burden of acute skin infections in the United States, Clin. Infect. Dis. 68 (2019) S193–S199.

[17]. D. Simões, S.P. Miguel, M.P. Ribeiro, P. Coutinho, A.G. Mendonça, I.J. Correia, Recent advances on antimicrobial wound dressing: a review, Eur. J. Pharm. Biopharm. 127 (2018) 130–141,

[18]. R. Sridhar, R. Lakshminarayanan, K. Madhaiyan, V.A. Barathi, K.H.C. Limh, S. Ramakrishna, Electrosprayed nanoparticles and electrospun nanofibers based on natural materials: applications in tissue regeneration, drug delivery and pharmaceuticals, Chem. Soc. Rev. 44 (2015) 790–814,

[19]. V. Agrahari, V. Agrahari, J. Meng, A.K. Mitra, Electrospun nanofibers in drug delivery: fabrication, advances, and biomedical applications, emerging nanotechnologies for diagnostics, Drug Delivery and Medical Devices (2017) 189–215.

[20]. S. Saghazadeh, C. Rinoldi, M. Schot, S.S. Kashaf, F. Sharifi, E. Jalilian, K. Nuutila, G. Giatsidis, P. Mostafalu, H. Derakhshandeh, K. Yue, W. Swieszkowski, A. Memic, A. Tamayol, A. Khademhosseini, Drug delivery systems and materials for wound healing applications, Adv. Drug Deliv. Rev. 127 (2018) 138–166.