

**PREFORMULATION STUDIES OF ATORVASTATIN WITH PHARMACEUTICAL EXCIPIENTS TO DEVELOPMENT CREAM FOR ENHANCED DIABETIC WOUND HEALING AS NOVEL DRUG DELIVERY SYSTEMS****Abdalwali Ahmed Saif<sup>1</sup>, Mahmoud Mahyoob Alburyhi\*<sup>1</sup>, Mohammed A. AlKhawlani<sup>2</sup>, Maged Alwan Noman<sup>1</sup>, Sami Ahmed Saeed<sup>3</sup>**<sup>1</sup>Professor Dr. of Pharmaceutics and Industrial Pharmacy, Department of Pharmaceutics and Industrial Pharmacy, Faculty of Pharmacy, Sana'a University, Sana'a, Yemen.<sup>2</sup>Assistant Professor Dr. of Pharmacology and Toxicology, Faculty of Pharmacy, Sana'a University, Sana'a, Yemen.<sup>3</sup>Assistant Professor Dr. of Pharmaceutics and Industrial Pharmacy, Sana'a, Yemen.**\*Corresponding Author: Mahmoud Mahyoob Alburyhi**

Professor Dr. of Pharmaceutics and Industrial Pharmacy, Department of Pharmaceutics and Industrial Pharmacy, Faculty of Pharmacy, Sana'a University, Sana'a, Yemen.

DOI: <https://doi.org/10.5281/zenodo.20022413>**How to cite this Article:** Abdalwali Ahmed Saif<sup>1</sup>, Mahmoud Mahyoob Alburyhi\*<sup>1</sup>, Mohammed A. AlKhawlani<sup>2</sup>, Maged Alwan Noman<sup>1</sup>, Sami Ahmed Saeed<sup>3</sup>. (2026). Preformulation Studies Of Atorvastatin With Pharmaceutical Excipients To Development Cream For Enhanced Diabetic Wound Healing As Novel Drug Delivery Systems. World Journal of Pharmaceutical and Medical Research, 12(5), 285–308F.

This work is licensed under Creative Commons Attribution 4.0 International license.



Article Received on 05/04/2026

Article Revised on 25/04/2026

Article Published on 05/05/2026

**ABSTRACT**

Chronic diabetic wounds are challenging to treat due to combined issues of impaired tissue repair and high infection risk. Atorvastatin (a statin with pleiotropic effects) and Fusidic acid (an antibiotic effective against skin pathogens including MRSA) each address different facets of diabetic wound pathology. The main objective of the present study was to the preformulation studies were performed to know the development of formulation and evaluation of Atorvastatin Cream NDDS for topical application. In the present study that the compatibility was assessed by, FTIR spectroscopy, and melting point apparatus, preformulation parameters. Results showed that physical mixtures of Atorvastatin and various excipients such as cetostearyl alcohol, stearic acid, Vaseline (petroleum jelly), liquid paraffin, antioxidant: butylated hydroxyanisole (BHA), preservative: chlorocresol, aqueous phase components: propylene glycol, and emulsifier: Tween 80 were evaluated for preformulation studies parameters were investigated by FTIR it was detected that there was no variation or minor deviation in the characteristic peaks in FTIR spectroscopy. It was concluded that the drug Atorvastatin was found to be compatible with various excipients which were selected for the formulation development of the Atorvastatin Cream NDDS. These formulations favorable properties and efficacy indicate it as a promising strategy for improving outcomes in infected diabetic wounds. Formulation scientist from his experience and knowledge have to significantly in the preformulation study stage and is an important factor in the ADDS (Advanced Drug Delivery Systems) product development process.

**KEYWORDS:** Atorvastatin, NDDS, Compatibility, Excipients, Development, Preformulation, Cream, Infected Diabetic Wounds.**INTRODUCTION****Background<sup>[1-40]</sup>**

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by hyperglycemia due to insulin deficiency or resistance. Affecting 589 million adults globally, with projections reaching 853 million by 2050, with an estimated 44.7% of cases remaining undiagnosed. Chronic hyperglycemia is a primary driver of systemic complications, including neuropathy, retinopathy, and

cardiovascular disease. Among these, impaired wound healing is a devastating consequence, affecting an estimated 19% to 34% of diabetic patients and contributing to prolonged recovery, and mortality. This compromised healing capacity is further exacerbated by a markedly increased risk of infection; diabetic patients are 1.5 to 4 times more likely to develop infections compared to their non-diabetic counterparts, with the extremities being particularly vulnerable.

Mechanistically, hyperglycemia induces oxidative stress and advanced glycation end-products (AGEs), which impair collagen synthesis, angiogenesis, and macrophage function. These systemic defects create a microenvironment resistant to repair, prolonging inflammation and elevating infection risks, with *Staphylococcus aureus* being the most commonly isolated pathogen in chronic diabetic wounds. Delayed healing culminates in severe complications: over 60% of non-traumatic lower-limb amputations are diabetes-related, with a 5-year mortality rate exceeding 50% and 70% post-amputation.

Current clinical treatments for diabetic wounds inadequately address the multifactorial pathology of delayed healing. Topical antibiotics, such as silver sulfadiazine, reduce bacterial load but impair epithelialization and exacerbate oxidative stress, prolonging recovery. Growth factor-based therapies, including recombinant platelet-derived growth factor (PDGF-BB), enhance angiogenesis but lack antimicrobial activity, leaving wounds vulnerable to infection. Hydrogel dressings, though widely used for moisture retention, fail to resolve hyperglycemia-driven collagen degradation or chronic inflammation, even advanced modalities like negative pressure wound therapy (NPWT) struggle with biofilm persistence and high recurrence rates. These therapies target isolated aspects of healing, neglecting the dual challenges of infection and impaired tissue repair. Consequently, 50% of chronic diabetic wounds fail to heal within 12 weeks, often progressing to amputations.

Atorvastatin, a widely prescribed member of the statin class of drugs, is primarily known for its efficacy in lowering cholesterol levels by inhibiting HMG-CoA reductase. However, a growing body of evidence has illuminated a range of pharmacological actions, termed pleiotropic effects, that extend beyond its lipid-modulating capabilities and hold considerable promise for tissue repair and regeneration. These effects, which are independent of cholesterol reduction, include potent anti-inflammatory, antioxidant, and pro-angiogenic activities—all of which are highly pertinent to addressing the dysregulated processes in diabetic wounds. Preclinical studies investigating the topical application of atorvastatin have demonstrated its potential to accelerate tissue repair and modulate key healing pathways. This exploration of atorvastatin for wound healing exemplifies a drug repurposing strategy, wherein the "off-target" or secondary pharmacological properties of an established drug are harnessed for a novel therapeutic indication, offering a potentially accelerated path to new treatment options.

Fusidic acid is a steroidal antibiotic characterized by a unique mechanism of action involving the inhibition of bacterial protein synthesis by binding to elongation factor G (EF-G), thereby preventing peptide translocation and ribosome disassembly. It is primarily

bacteriostatic and exhibits a spectrum of activity predominantly against Gram-positive bacteria of particular relevance to diabetic wounds is its potent efficacy against *Staphylococcus aureus*, including methicillin-resistant *S. aureus* (MRSA) strains, which are among the most common and problematic pathogens colonizing and infecting these wounds. Fusidic acid has a long history of successful use in topical formulations, such as creams and ointments, for the treatment of various primary and secondary skin infections. Its established antimicrobial profile against key pathogens implicated in the infection of diabetic wounds makes it a logical and rational candidate for the antibiotic component in a combination therapy aimed at improving healing outcomes.

### Pharmaceutical Research Paths<sup>[41-111]</sup>

Pharmaceutical research is characterized by having both a natural source and synthetic source for primary active raw materials and excipients, each source is mainly prepared to the effectiveness and safety of the drug.

The Pharmaceutical Research Paths include: Pharmacognosy deals with natural sources of drug, Pharmaceutical Chemistry specializes in synthetic sources of drug, Pharmaceutics specializes in designing of pharmaceutical dosage forms and drug delivery systems from natural and synthetic sources of active pharmaceutical ingredients and excipients that help in developing dosage forms and drug delivery systems.

The Pharmaceutical Research Paths link steps are manufacturing and development of drug according to the standard parameters evaluation such as physiochemical properties, preformulation, formulation, evaluation, drug stability, Pharmaceutical analysis, pre-clinical, post-clinical stages, pre-marketing, post-marketing, Pharmacovigilance, Pharmacoeconomics, Pharmacy Management, Pharmacology, Toxicology, Therapeutics, Pharmaceutical Care, Health Care, Advanced Industrial Pharmacy, Biopharmaceutics and Pharmacokinetics, Advanced Clinical Pharmacokinetics, Pharmaceuticals Cosmetics, Pharmaceutical Biotechnology, Drug Design, Pharmacy Law and Ethics, Pharmacogenomics, Good Manufacturing Practice, and Good Pharmacy Practice etc.

All of these Pharmaceutical Research Paths are interconnected, and whenever the link between them is made in a scientific relationship and the goal of pharmaceutical care is achieved gradually according to plan of a scientific pharmaceutical research path.

Pharmaceutical Research Paths are the scientific methods through which the scientific relationship between the pharmaceutical team, research, supervisor or specialist researcher, the scientific research materials, equipment's, scientific institution, pharmaceutical companies, reference standards, and the goals of pharmaceutical

research improve and development of community services of pharmaceutical care and health care.

Pharmaceutical Scientists are considering natural sources and medicinal herbs in the pharmaceutical industry an important part of drug development because natural sources of drugs have properties that are greater than industrial sources of drugs in NDDS. And the pharmaceutical industry strategies depend on the development of different pharmaceutical dosage forms and recent novel drug delivery systems. Using medicinal herbs and natural sources as important goals of drug development. It is part of the art of innovation in drug development with different of novel drug delivery systems and pharmaceutical care for patients and society, it's the basic of development of the new pharmaceutical industry by developing different novel drug delivery systems from different sources.

### Compatibility Studies<sup>[112-160]</sup>

Preformulation is essentials of pharmaceutical science that utilizes biopharmaceutical principles in the determination of physicochemical properties of the drug substance. Prior to the development of any dosage form new drug, it is essential that certain fundamental physical and chemical properties of drug powder are determined. This information may dictate many of subsequent event and approaches in formulation development. The safety, efficacy, quality and stability of a formulation are major concepts of any API development process. In API development process, a detailed characterization of the API and other formulation components is usually carried out during the preformulation stage. Formulation scientist from his experience and knowledge have to significantly in the preformulation study stage and is an important factor in the ADDS (Advanced Drug Delivery Systems) product development process.

One of the objectives of this study is to development of drug delivery systems by building scientific pharmaceutical research information depend on formulation scientists to join the knowledge and experience as well as experimental and practical results of this study with regard to information in previous studies, and approved references. It was found to be that the most important concepts and basics of preformulation studies such as definitions, methods, conclusion, idea, and types of pharmaceutical analysis techniques using in evaluation of preformulation studies parameters, in this study that we focused on developing drug delivery systems and linking the formulation development to establish the basics of pharmaceutical research in studying the drug-excipient compatibility, dug with various excipients, which is important for the safety, effectiveness, quality, formulation, stability, bioavailability, and pharmacokinetics of the drug etc.

Determination of physical chemical properties of API substance with the goal of developing a new drug which is safe stable and efficacious, each API, has intrinsic

chemical and physical properties that were considered prior to the development of pharmaceutical formulation, the purpose of preformulation study is to generate useful information for the formulator in the development of stable and bioavailable dosage form, inappropriate preformulation study results in poor stability of active ingredients increase the overall cost of development and increased development time, preformulation studies help to fortify the pharmaceutical scientific foundation of the guidance, provide regulatory relief and conserve resources in the drug development and evaluation process, enhance public safety standards, improve product quality, promote the implementation of new technologies, aids policy development and regulatory decision making and after compiling all data it is transferred to the development pharmacist and for the day work on formulation of dosage form.

**Preformulation Study Objectives:** To establish the Physico-chemical parameters of a new API entity, determine its kinetics and stability, establish its compatibility with common excipients, it provides insights into how drug products should be processed and stored to ensure their quality, estimate problem may arise during formulation that is stability problem poor *in-vivo* dissolution, poor bioavailability, to interpret BCS classification of drugs and its significance and develop optimal drug delivery system.

**Drug-Excipient Compatibility Study:** The primary objective of this investigation was to identify a stable storage condition for API in solid state and identification of compatible excipients for its formulation. Incompatibilities are major concerns in formulation development. Selection of the proper excipient during preformulation studies is of prime importance.

**Dosage Forms:** DF contain API and pharmaceutical excipients, which are intended to generate an ideal formulation and manufacturability of pharmaceutical products, thereby enabling a much safer and more effective administration. Pharmaceutical excipients are ideally inactive and have no impact on the stability or therapeutic effect of the active ingredient. On the other hand, there are studies that have presented that some pharmaceutical excipients are just allegedly described as inactive ingredient. Some pharmaceutical excipients have the capacity to affect API, efficacy by affecting its pharmacokinetics. Excipients can affect the physical and chemical form of pharmaceuticals by several factors such as hydrogen bond interaction, polymorphic conversion, and others. Accordingly, drug-excipient compatibility should be conducted so as to determine any drug-excipient interactions that may obstruct the stability, bioavailability, and manufacturability of pharmaceutical dosage forms.

### Importance of Drug-Excipient Compatibility

Studies of active pharmaceutical ingredient (API)-excipient compatibility represent an important study in

the preformulation stage of the development of new dosage forms, stability of the dosage form can be maximized, any physical or chemical interaction between API, and excipient can affect bioavailability and stability of drug, it helps to avoid the surprise problem, by performing drug excipient compatibility studies (DECS) we can know the possible reaction before formulating final dosage form, DECS data is essential for IND (investigational new drug) submission, and now, USFDA has made it compulsory to submit DECS data for any new coming formulation before its approval.

The potential physical and chemical interactions between an API, and the excipients can affect the chemical nature, the stability and bioavailability of the former and, consequently, its therapeutic efficacy and safety, solid dosage forms are generally less stable than their API components and despite the importance of API-excipient compatibility testing, there is no universally accepted protocol to assess such interactions.

**Pharmaceutical Excipients:** Excipients are additive substances used to improve the bulkiness, disintegration, dissolution rate, and bioavailability of a formulation etc. Different dosage forms like powders, granules, capsules, tablets, oral liquids, injectable products, implants, eye products, nasal products, inhalers, topical creams, ointments, gels, transdermal patches and suppositories etc, contains different types of excipients. To make it acceptable and compatible various pharmaceutical excipients are added in pharmaceutical dosage form for their direct therapeutic action, manufacturing process, to protect, support or enhance stability, for bioavailability or patient compliance. These must be physiologically and chemically stable, must not have any incompatibility with the API, and must meet the standards of regulatory requirements.

### Evaluation of Drug-Excipient Compatibility

The compatibility study of API and excipients is important to predict the stability of the API, in the final pharmaceutical product. It's the first time that API was compatible with excipients promoted physical and chemical compatibility studies was achieved by thermal and non-thermal methods. As a part of preformulation study, a compatibility study of API with the other excipients was carried out using physical blends in analytical techniques for the evaluation of drug-excipient interactions. The most commonly used pharmaceutical analytical techniques include, thermal techniques such as Differential Scanning Calorimetry (DSC), Thermogravimetric Analysis (TGA), Isothermal Microcalorimetry (IMC) and Hot stage microscopy (HSM) etc, and non-thermal techniques such as UV-Visible Spectrophotometric (UV), Infrared, Near-Infrared and Raman Spectroscopy (FT-IR), (NIR), Powder X-Ray Diffraction (PXRD), Solid-State Nuclear Magnetic Resonance Spectroscopy (ssNMR), Microscopic techniques: Scanning Electron Microscopy (SEM), Chromatographic techniques: Thin Layer

Chromatography (TLC), and High-Performance Liquid Chromatography (HPLC) etc.

**Preformulation Parameters:** According to dosage form of API, mainly solid state, particle size, shape, pKa, pH determination, common ion effect, temperature, partition coefficient, solubility studies, dissolution rate, melting point, powder flow properties, crystallinity, polymorphism, hygroscopicity, stability study and drug-excipient compatibility etc. While other dosage forms according to important of preformulation parameters used in study before start in development of formulation.

Drug-excipient compatibility and formulation stability is not depended on API only but also its affected by excipient. Excipient play important role in dosage form but side by side it also increases compatibility problem so proper selection of excipient is very important in development of formulation. Incompatibility can be result mainly in any of following changes: Changes in organoleptic properties, changes in dissolution performance, decrease in potency, and increase in degradation rate etc.

Drug excipient physicochemical characterization is a systematic approach towards design of therapeutically active and stable dosage forms. The rapid advancements in novel drug delivery systems development have led to an interest by formulation scientists in the role and functionality of the excipients.

In the present study, it was proposed to Atorvastatin - excipient compatibility studies of the safety, efficacy, quality and stability of a formulation are major concepts of any API development process. In API development process, a detailed characterization of the API and other formulation components is usually carried out during the preformulation stage, with commonly different excipients using for formulation development of Atorvastatin Cream NDDS for topical application. These formulations favorable properties and efficacy indicate it as a promising strategy for improving outcomes in infected diabetic wounds.

### MATERIALS AND METHODS

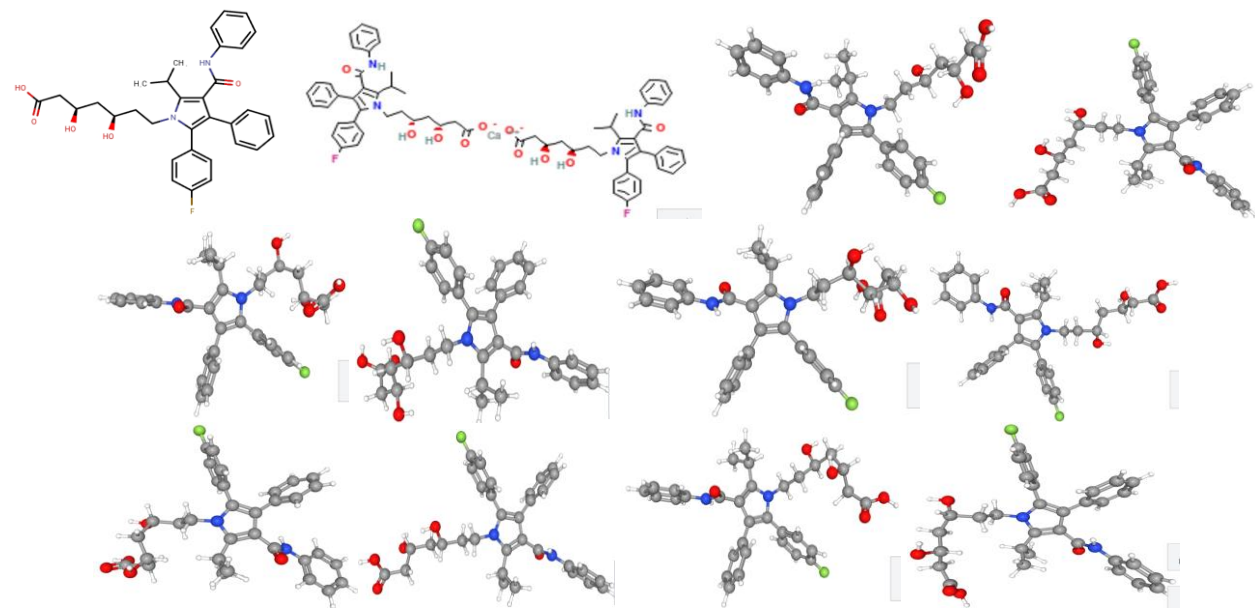
All raw materials, including active pharmaceutical ingredients (APIs), excipients, and analytical reagents, were kindly provided by Modern Pharma Industry (Sana'a, Yemen). Atorvastatin calcium trihydrate (AT) and Fusidic acid (FA) were used as APIs. Excipients employed in the formulations include oil phase components: cetostearyl alcohol, stearic acid, Vaseline (petroleum jelly), liquid paraffin, antioxidant: butylated hydroxyanisole (BHA), preservative: chlorocresol, aqueous phase components: propylene glycol, and emulsifier: Tween 80. Reagents for analytical procedures and buffer preparation, including methanol (HPLC grade), hydrochloric acid (HCl), sodium hydroxide (NaOH), potassium dihydrogen phosphate (KH<sub>2</sub>PO<sub>4</sub>), and glacial acetic acid, were of analytical grade.

**Equipment and Instruments**

Major analytical instruments included a Varian 50 Conc. UV-Visible Spectrophotometer (Varian, USA) and a

Varian 2000 scimitar series FTIR Spectrophotometer (Varian, USA). A Stuart SMP1 melting point apparatus (Stuart Scientifics, UK) was used for MP assessment.

**Evaluation of Drug-Excipient Compatibility Studies Methods<sup>[141-206]</sup>****Table 1: Atorvastatin Data.**

Characterization of Atorvastatin			
			
<b>Chemical Structure</b>	Calcium bis((3 <i>R</i> ,5 <i>R</i> )-7-[2-(4-fluorophenyl)-3-phenyl-4-(phenylcarbamoyl)-5-propan-2-ylpyrrol-1-yl]-3,5-dihydroxyheptanoate)	<b>Appearance</b>	Is a crystalline, amphiphilic molecule
<b>Chemical Formula</b>	$C_{66}H_{68}CaF_2N_2O_{10}$	<b>Drug Solubility</b>	Solubility: That is very slightly soluble in water, acetonitrile, and freely soluble in methanol and slightly soluble in ethanol, with high lipophilicity ( $\log P \approx 5.6$ ) and $pK_a$ of 4.46. <b>Melting Point:</b> 156-158 °C.
<b>Molecular Weight</b>	1155.3g/mol	BCS	Class-II Drug
<b>Drug Action and Use</b>	<p>Atorvastatin is an HMG-CoA reductase inhibitor used to lower lipid levels and reduce the risk of cardiovascular disease including myocardial infarction and stroke.</p> <p>Atorvastatin is a lipophilic, selective, and reversibly HMG-CoA reductase inhibitor widely used for hyperlipidemia. By blocking HMG-CoA reductase, atorvastatin decreases mevalonate and downstream isoprenoid intermediates, (e.g. farnesyl pyrophosphate (FPP) and GGPP), which not only lowers cholesterol biosynthesis but also mitigates inhibitory signaling on keratinocyte migration and epithelialization. In addition to lipid-lowering, atorvastatin exerts well-documented pleiotropic effects: it improves endothelial function and plaque stability and exerts anti-inflammatory, immunomodulatory, antioxidant, and antibacterial actions.</p> <p>Atorvastatin is an oral antilipemic agent that reversibly inhibits HMG-CoA reductase. It lowers total cholesterol, low-density lipoprotein-cholesterol (LDL-C), apolipoprotein B (apo B), non-high density lipoprotein-cholesterol (non-HDL-C), and triglyceride (TG) plasma concentrations while increasing HDL-C concentrations. High LDL-C, low HDL-C and high TG concentrations in the plasma are associated with increased risk of atherosclerosis and cardiovascular disease. The total cholesterol to HDL-C ratio is a strong predictor of coronary artery disease, and high ratios are associated with a higher risk of disease. Increased levels of HDL-C are associated with lower cardiovascular risk. By decreasing LDL-C and TG and increasing HDL-C, atorvastatin reduces the risk of cardiovascular morbidity and mortality.</p>		
<b>Atorvastatin Pharmacokinetics</b>			

<b>Drug Absorption</b>	Atorvastatin presents a dose-dependent and non-linear pharmacokinetic profile. It is very rapidly absorbed after oral administration. After the administration of a dose of 40 mg, its peak plasma concentration of 28 ng/ml is reached 1-2 hours after initial administration with an AUC of about 200 ng·h/ml. Atorvastatin undergoes extensive first-pass metabolism in the wall of the gut and the liver, resulting in an absolute oral bioavailability of 14%. Plasma Atorvastatin concentrations are lower (approximately 30% for C <sub>max</sub> and AUC) following evening drug administration compared with morning. However, LDL-C reduction is the same regardless of the time of day of drug administration.	<b>Drug Distribution</b>	<b>Volume of Distribution:</b> The reported volume of distribution of atorvastatin is of 380 L. <b>Protein binding:</b> Atorvastatin is highly bound to plasma proteins and over 98% of the administered dose is found in a bound form.
<b>Drug Metabolism</b>	Atorvastatin is highly metabolized to ortho- and parahydroxylated derivatives and various beta-oxidation products, primarily by Cytochrome P450 3A4 in the intestine and liver. Atorvastatin's metabolites undergo further lactonization via the formation of acyl glucuronide intermediates by the enzymes UGT1A1 and UGT1A3. These lactones can be hydrolyzed back to their corresponding acid forms and exist in equilibrium.	<b>Drug Excretion</b>	<b>Route of Elimination:</b> Atorvastatin and its metabolites are mainly eliminated in the bile without enterohepatic recirculation. The renal elimination of Atorvastatin is very minimal and represents less than 1% of the eliminated dose. <b>Clearance:</b> The registered total plasma clearance of Atorvastatin is of 625 ml/min.
<b>The Elimination Half-Life (T<sub>1/2</sub>)</b>	Plasma elimination half-life: The half-life of Atorvastatin is 14 hours while the half-life of its metabolites can reach up to 30 hours.	<b>Availability</b>	Tablets: 10,20,40, and 80mg.

Table 2: Pharmaceutical Excipients Data.

Nonproprietary Name	Synonyms	Functional Category	Incompatibilities
<b>Cetostearyl alcohol</b>	Alcohol cetylicus et stearylicus; cetearyl alcohol; cetyl stearyl alcohol; Crodacol CS90; LanetteO; Speziol C16-18 Pharma; TegoAlkanol1618; TegoAlkanol6855.	Emollient; emulsifying agent; viscosity-increasing agent.	Incompatible with strong oxidizing agent and metal salts.
<b>Stearic acid</b>	Acidum stearicum; cetylacetic acid; Crodacid; CristalG; CristalS; Dervacid; E570; Edenor; Emersol; ExtraAS; ExtraP; ExtraS; Extra ST; 1-heptadecanecarboxylic acid; Hystrene; Industrene; Kortacid1895; Pearl Steric; Pristerene; stereophanic acid; Tego stearic.	Emulsifying agent; solubilizing agent; tablet and capsule lubricant.	Stearic acid is incompatible with most metal hydroxides and may be incompatible with bases, reducing agents, and oxidizing agents. In ointment bases made with stearic acid, many show evidence of drying out or lumpiness due to such a reaction when compounded with zinc or calcium salts.
<b>Petrolatum</b>	<b>Merkur; mineral jelly; petroleum jelly; Silkolene; Snow White; Soft White; vaselinum flavum; yellow petrolatum; yellow petroleum jelly.</b>	Emollient; ointment base.	Petrolatum is an inert material with few incompatibilities.
<b>Butylated hydroxyanisole (BHA)</b>	BHA; tert-butyl-4-methoxyphenol; butylhydroxyanisolum; 1,1 dimethylethyl-4-methoxyphenol; E320;	Antioxidant.	Butylated hydroxyanisole is phenolic and undergoes reactions characteristic of phenols. It is

	NipanoxBHA; Nipantiox 1-F; TenoxBHA.		incompatible with oxidizing agents and ferric salts. Trace quantities of metals and exposure to light cause discoloration and loss of activity.
<b>Chlorocresol</b>	Aptal; Baktol; chlorocresolum; 4-chloro-m-cresol; p-chloro-m cresol; 1-chloro-4-hydroxy-2-methylbenzene; 2-chloro-5-hydroxy toluene; 6-chloro-3-hydroxytoluene; 4-chloro-3-methylphenol; 3-methyl-4-chlorophenol; Nipacide PC; parachlorometacresol; PCMC.	Antimicrobial preservative; disinfectant.	Chlorocresol can decompose on contact with strong alkalis, evolving heat and fumes that ignite explosively. It is also incompatible with oxidizing agents, copper, and with solutions of calcium chloride, codeine phosphate, diamorphine hydrochloride, papaveretum, and quinine hydrochloride. Chlorocresol may be lost from solutions to rubber closures, and in contact with polyethylene may initially be rapidly removed by sorption and then by permeation, the uptake being temperature dependent. Chlorocresol may also be taken up by polymethylmethacrylate and by cellulose acetate. Losses to polypropylene or rigid polyvinyl chloride are usually small.
<b>Propylene glycol</b>	1,2-dihydroxypropane, E1520, 2-hydroxypropanol; methylethyleneglycol, methyl glycol, propane-1,2diol, propylglycol.	Antimicrobial, preservative, disinfectant, humectant, plasticizer, solvent, stabilizing agent, water miscible cosolvent.	Propylene glycol is incompatible with oxidizing reagents such as potassium permanganate
<b>Tween 80</b>	Monolaurates, polyoxyethylene sorbitan, polysorbate	Emulsifying agent for the preparation of stable oil-in-water emulsions.	Incompatible with alkalis, heavy metal salts, phenols, tannic acid.
<b>Purified water</b>	Filtered water, Distilled water, Deionized water, Purified H <sub>2</sub> O, Clear water, Pure water, clean water, Pristine water, Crystal-clear water, Treated water	solvent	In pharmaceutical formulations, water can react with drugs and other excipients that are susceptible to hydrolysis (decomposition in the presence of water or moisture) at ambient and elevated temperatures. Water can react violently with alkali metals and rapidly with alkaline metals and their oxides, such as calcium oxide and magnesium oxide. Water also reacts with anhydrous salts to form hydrates of various compositions, and with certain organic materials and calcium carbide.

According to Atorvastatin and excipients data as shown in Tables 1 and 2, it was selected that the different excipients to preformulation study with Atorvastatin in the present study,

#### Pre-Formulation Studies

Pre-formulation studies were conducted to establish the fundamental physicochemical properties of the APIs and to ensure their compatibility with the selected excipients, a critical prerequisite for rational dosage form design.

#### Qualitative Characterization of API

The identity and purity of the incoming AT and FA raw materials were verified using standard pharmacopeial methods prior to their use in formulations.

#### UV-Vis Spectrophotometer Analysis of Atorvastatin

UV spectrophotometry was conducted in accordance with United States Pharmacopeia (USP) General Chapter <857> Ultraviolet-Visible Spectroscopy to confirm the identity of the API (USP). A stock solution of Atorvastatin (1 mg/100 mL) was prepared in methanol; 1

mL aliquot of this stock was further diluted to 25 ml with methanol from which a working solution of 0.4 µg/mL was made. The absorbance spectra of these solutions were recorded from 200 to 400 nm using a Shimadzu UV-1800 spectrophotometer with 1-cm quartz cuvettes against a methanol blank. The observed maximum absorption wavelengths ( $\lambda$ -max) were compared to reference values, of 243-246 nm for Atorvastatin, and 203-205 nm with characteristic weak.

### Melting Point

Melting point of the Atorvastatin was determined by capillary method; one sided closed capillary filled with drug and put into the Melting Point Apparatus. Temperature was noted at which solid drug changed into liquid. Melting point analysis was performed using the capillary method as described in USP General Chapter <741> Melting Range or Temperature to assess API melting point. using an Electrothermal 9100 apparatus (USP-NF). Samples were heated at 1°C per minute. The temperature range from the onset of melting to complete liquefaction was recorded and compared to the established standards for each API. Standard values are 159-161°C for Atorvastatin.

### Pre-Formulation Study

A stage of development during which the physicochemical properties of the drug substance are characterized and established. A complete knowledge of the relevant therapeutic and physicochemical properties of the drug enables determination of its proper formulation and delivery method. Preformulation study is to develop the elegant (stable, effective, and safe) dosage form by establishing kinetic rate profile,

compatibility with the other ingredients and establish physico-chemical parameter of new drug substance. Solubility Study A qualitative assessment of the solubility of Atorvastatin was conducted at ambient laboratory temperature (22–25 °C) in a range of aqueous and non-aqueous media. This step is fundamental to preformulation, as it informs the selection of appropriate solvents and excipients to achieve a stable and effective formulation. For aqueous solubility assessment, 100 mg of each API was individually dispersed in 1 mL of three different media: purified water, 0.1 N HCl, acetate buffer (pH 4.5), and phosphate buffer (pH 6.8) prepared according to (USP). Each mixture was manually stirred for 5 minutes and sonicated for 10 minutes to facilitate dissolution. If the API did not fully dissolve, portions of the corresponding medium were added incrementally to achieve total volumes of 10 mL, 30 mL, 50 mL, 100 mL, and up to 600 ml. Solubility was qualitatively classified based on the volume of solvent required for complete visual dissolution (USP). Non-aqueous solubility was assessed by dispersing 100 mg of each API into 1 mL of glycerin, 1% & 2% (w/v) Tween 80, binary mixtures comprising 1mL of propylene glycol (PG) with 1mL of 1% or 2% Tween 80. Each sample was manually stirred, sonicated for 5 minutes, and visually examined for homogeneity, phase separation, creaming, foaming, or floating aggregates. No quantitative solubility measurements were performed; observations were recorded qualitatively to determine apparent solubility and dispersion behavior. This comprehensive solubility assessment establishes fundamental data for subsequent formulation optimization work as shown in Table 3.

**Table 3: Solubility Specification of Drugs.**

Descriptive Term	Parts of Solvent Required for 1 Part of Solute:
Very Soluble	Less than 1
Freely Soluble	From 1 to 10
Soluble	From 10 to 30
Sparingly Soluble	From 30 to 100
Slightly Soluble	From 100 to 1000
Very Slightly Soluble	From 1000 to 10000
Practically Insoluble, or Insoluble	Greater than or equal to 10,000.

### Drug and Excipients Compatibility Study

Drug and drug-excipients compatibility study is a critical step in preformulation; to de-risk the development process by identifying potential detrimental interactions early, and to ensure the Physicochemical stability of the APIs in the presence of selected excipients. compatibility studies were conducted visually, and by Fourier-Transform Infrared (FTIR) spectroscopy. Drug physical mixtures of Atorvastatin were prepared with the selected excipients in a 1:1 ratio. Each mixture was sealed in borosilicate glass ampoules and stored under accelerated conditions at 40 ± 2°C and 75% relative humidity (RH) for 14 days. Control samples containing the pure APIs were also prepared. This stress-testing protocol is

designed to accelerate degradation reactions and predict long-term stability issues.

### FTIR Spectroscopy Study

IR study was aimed to study the compatibility of excipients with Atorvastatin in room condition. Each excipient was mixed with Atorvastatin in equal amounts, then from each sample a small amount was taken (approx. 1:1 %) and mixed with about 100 mg of potassium bromide. The KBr- sample mixtures were grinded separately for each sample using agate mortar and pestle. The grinded powders were compressed into discs under pressure of about 10000 pounds per square inch. The tablets were mounted in IR compartment and analyzed. The infrared spectra of the drug - excipient

mixtures were recorded over a wave number of  $4000\text{ cm}^{-1}$  to  $500\text{ cm}^{-1}$ . On analysis of the IR spectra of the reference spectra given in British Pharmacopoeia and

pure drug, no major differences were observed in the characteristic absorption peak pattern as shown in Table 4.

**Table 4: The Drug and Excipients Compatibility Studies.**

Sample Code	Drug with Excipients	Ratio (Drug: Excipient)
1	Atorvastatin Calcium	1
2	Fusidic Acid	1
3	Atorvastatin Calcium +Fusidic Acid	1:1
4	Mixture with BHA	1:1
5	Mixture with Vaseline	1:1
6	Mixture with Chlorocresol	1:1
7	Mixture with Cetostearyl Alcohol	1:1
8	Mixture with Propylene Glycol	1:1
9	Mixture With Stearic Acid	1:1
10	Mixture with Liquid Paraffin	1:1
11	Mixture with Tween 80	1:1

## RESULTS AND DISCUSSION

### Pre-Formulation Studies

For qualitative Characterization of API, Solubility measure and compatibility study:

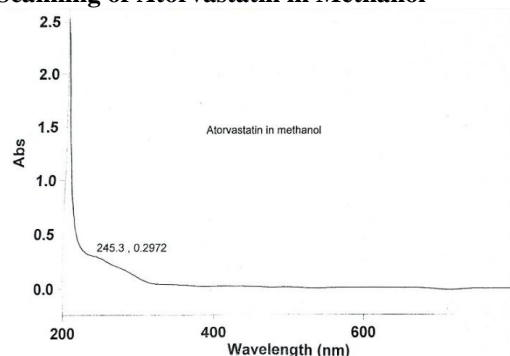
### Qualitative Characterization of API

#### UV Spectrophotometry

UV spectrophotometric analysis of Atorvastatin in methanol exhibited a maximum absorption wavelength ( $\lambda$ -max) of 245.3 nm. This observed value is consistent with the established reference range of 243–246 nm for Atorvastatin in the same solvent. The spectral profile for drug showed no evidence of extraneous peaks within the scanned range (200–400 nm). as shown in Figure 1.

### Characterization of Atorvastatin by UV Spectroscopy

#### UV Scanning of Atorvastatin in Methanol



**Fig. 1: Wavelength of Atorvastatin in UV Spectrophotometer.**

### Solubility Study

The dissolution characteristics of Atorvastatin were systematically investigated in multiple solvent systems at ambient temperature ( $25\pm 1^\circ\text{C}$ ). The study employed a dropwise addition method with continuous agitation to determine saturation points, with solubility categorization according to USP standards, as shown in **Error! Reference source not found..** The solubility of atorvastatin was evaluated in various aqueous and non-aqueous media at  $25^\circ\text{C}$ . Solvent (aqueous or non-

aqueous) was added dropwise under constant stirring until no further API dissolution was observed; total volume was then adjusted to 600 mL. Solubility classifications follow USP guidelines: Practically insoluble:  $< 0.1\text{ mg/mL}$ , sparingly soluble:  $0.1\text{--}1\text{ mg/mL}$  and slightly soluble:  $1\text{--}10\text{ mg/mL}$ . Aqueous media (0.1 N HCl, phosphate buffer pH 4.5, purified water, phosphate buffer pH 6.8): Drug API was classified as practically insoluble ( $< 0.1\text{ mg/mL}$ ) in all media (Table 5). A relative ranking, based on the minimum detectable solubility.

**Table 5: Qualitative Solubility Ranking of Atorvastatin in Aqueous Media.**

Medium	Atorvastatin
0.1 N HCl	Practically insoluble
pH 4.5 buffer	Practically insoluble
Purified water	Practically insoluble
pH 6.8 buffer	Practically insoluble
Relative ranking	pH 4.5 > H <sub>2</sub> O > pH 6.8 > HCl

Although neither API achieved true molecular dispersion, atorvastatin showed a slight enhancement under mildly acidic conditions (pH 4.5). Non-aqueous media (glycerin; propylene glycol; propylene glycol + Tween 80; liquid paraffin, liquid paraffin + Tween 80 + propylene glycol (PG), Neither API dissolved in glycerin alone. Addition of surfactant (Tween 80) with or without co-solvent (PG) yielded stable milky/creamy dispersions with visible foam or floating phases (Table ), indicative of emulsification rather than true solubilization.

**Table 6: Visual Appearance of Atorvastatin in Non-Aqueous Dispersions.**

Medium	Atorvastatin
Glycerin	Insoluble
1% Tween 80	Cream-like dispersion; floated
2% Tween 80	Cream-like dispersion; floated
1% Tween 80 + PG	Cream-like dispersion
2% Tween 80 + PG	Cream-like dispersion; foam

### Melting Point Determination of Atorvastatin Calcium

Melting point of pure **Atorvastatin Calcium** was determined by open capillary method. The capillary tube was closed at one end by fusion and was filled with **Atorvastatin Calcium** by repeated tapings. The capillary tube was placed in a digital melting point apparatus. The instrument was set to automatically increase the temperature of the heating bath. The rise in

temperature was viewed through screen. The temperature at which the drug started melting was recorded. The melting point range of **Atorvastatin Calcium** was identical to reference melting point stated in MP (159–161°C). The sample started to melt at 159°C, and turned into liquid at 161°C, indicating that the sample used is pure. That reading has stated in melting point tester, as shown in Table 7.

**Table 7: Results of Melting Point of Atorvastatin Calcium.**

Test	Temp Rang Analyzed (Melting )	Results
Test I Atorvastatin Calcium	(159–161°C)	161°C
Test II Atorvastatin Calcium	(159–161°C)	161°C

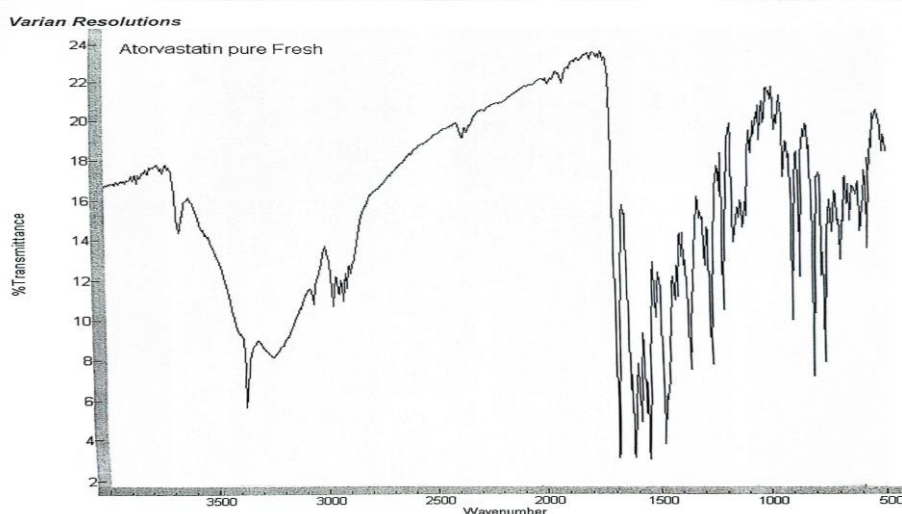
### Excipient and Drug Compatibility Study

Physical mixtures of Atorvastatin calcium trihydrate (1:1 ratio) with all excipients and pure API controls maintained their initial physical state following 14-day storage under accelerated conditions ( $40 \pm 2^\circ\text{C}$ , 75% RH). No color changes, liquefaction, caking, or gas evolution were observed in any sample.

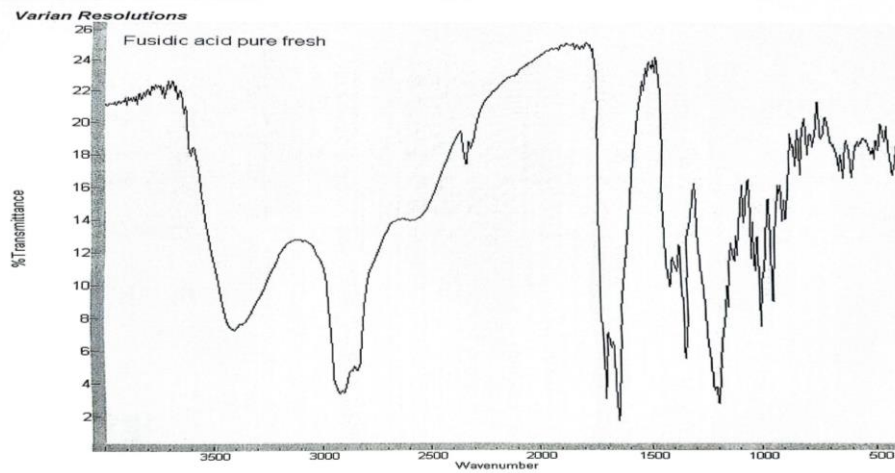
### Characterization of Atorvastatin by FTIR

FTIR spectrum studies indicated that major functional groups present in **Atorvastatin** show characteristic peaks

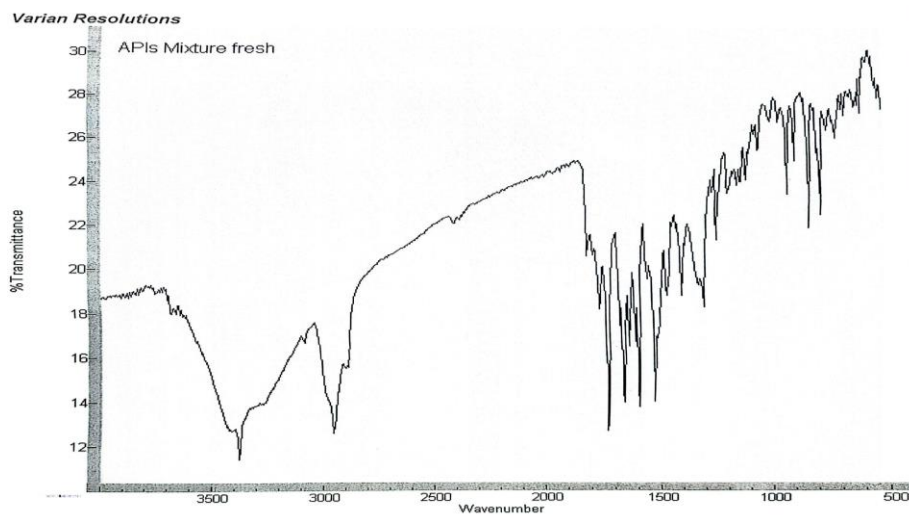
in IR spectrum. Figures (2) to (14) show peaks observed at different wave numbers and the functional group associated with these peaks for drug and drug with different excipients. The major peaks are identical to functional group of **Atorvastatin**. Hence, it was confirmed that there was compatibility between drug and various excipients, thus conforming that no interaction of drug occurred with the components of the formulation excipients.



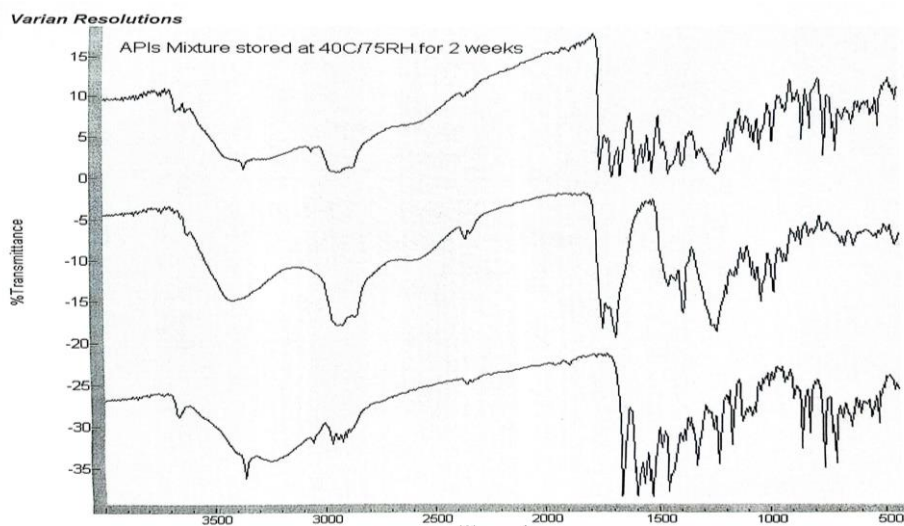
**Fig. 2: FTIR Spectra of Pure Atorvastatin Calcium STD.**



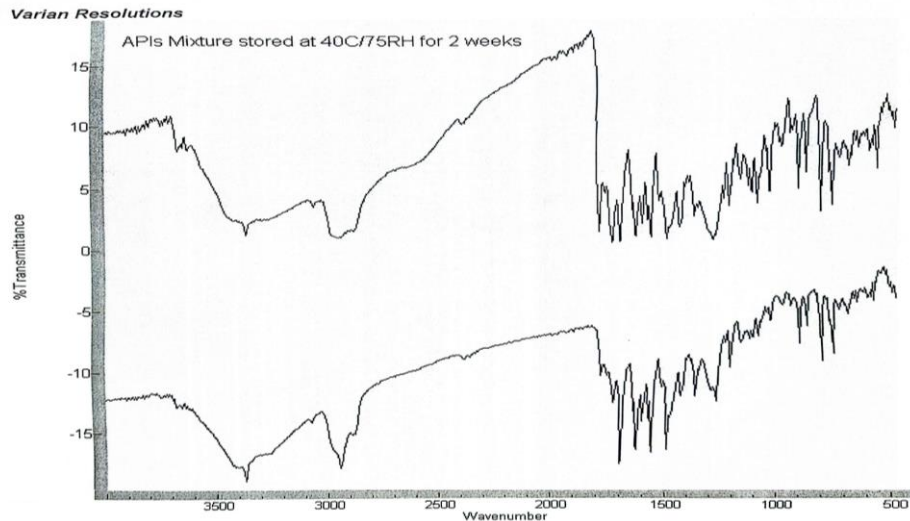
**Fig. 3: FTIR Spectra of Pure Fresh Fusidic Acid.**



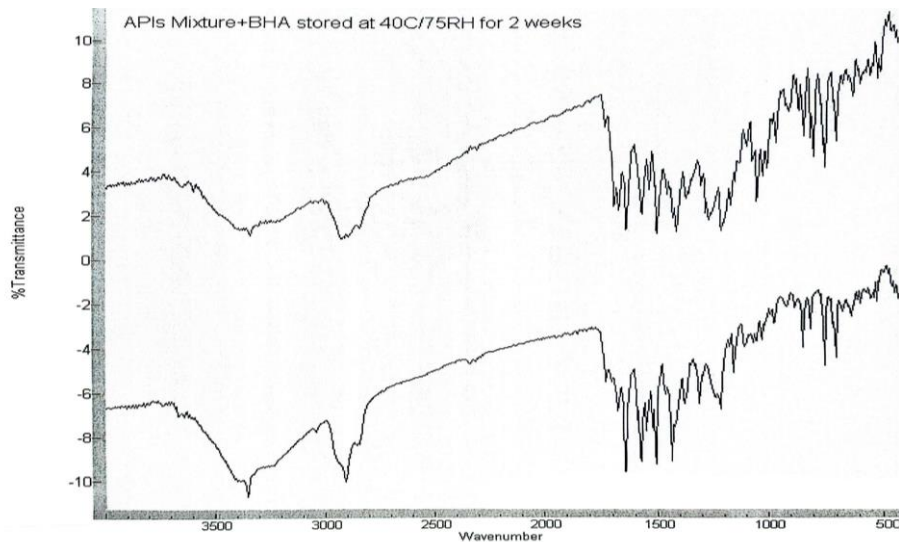
**Fig. 4: FTIR Spectra of APIs Mixture.**



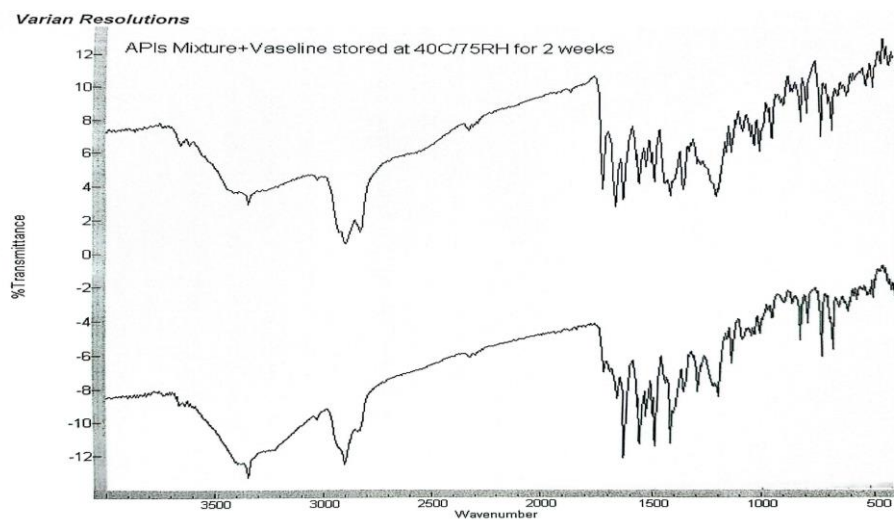
**Fig. 5: Comparative FTIR Spectra of Atorvastatin (bottom), Fusidic Acid (middle), and Their Stored Mixture After Accelerated Storage (Top).**



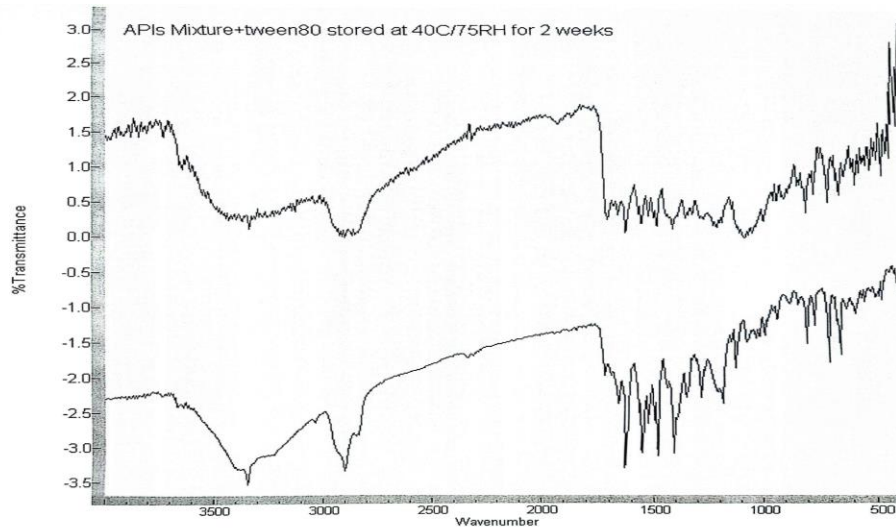
**Fig. 6: Comparative FTIR Spectra of Fresh APIs Mixture (Bottom), and Their Stored Mixture After Accelerated Storage (Top).**



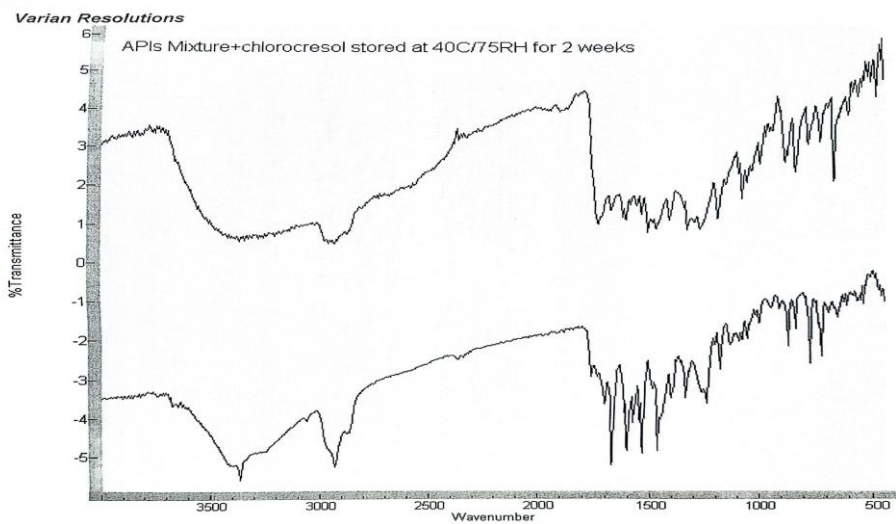
**Fig. 7: FTIR Overlay Comparing the API Mixture (Bottom) to The Stored Drug-Excipient Mixture with BHA (Top).**



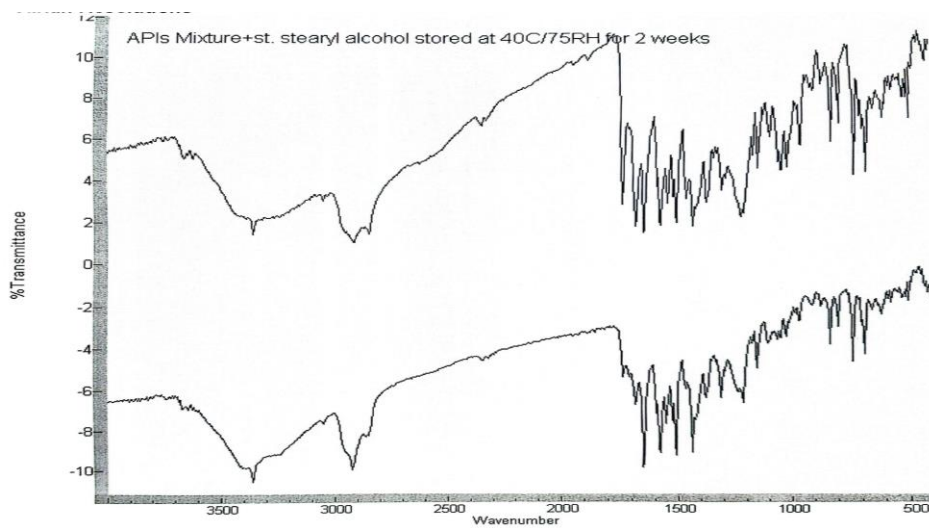
**Fig. 8: FTIR Overlay Comparing the API Mixture (Bottom) to The Stored Drug-Excipient Mixture with Vaseline (Top).**



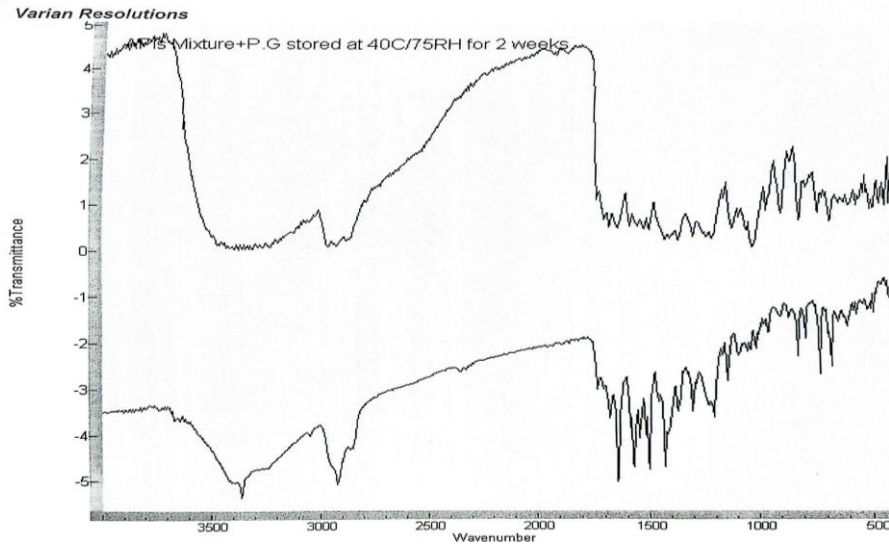
**Fig. 9: FTIR Overlay Comparing the API Mixture (Bottom) to The Stored Drugs-Excipient Mixture with Tween 80 (Top).**



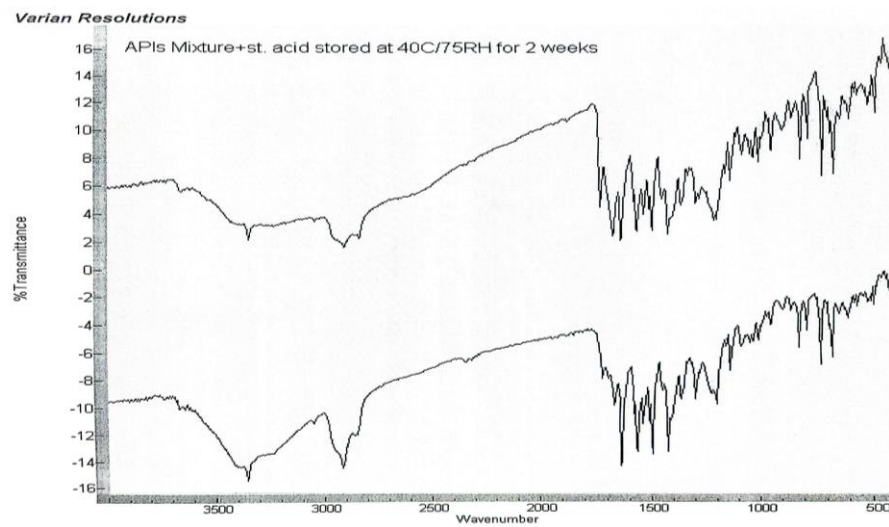
**Fig. 10: FTIR Overlay Comparing the API Mixture (Bottom) to The Stored Drug-Excipient Mixture with Chlorocresol (Top).**



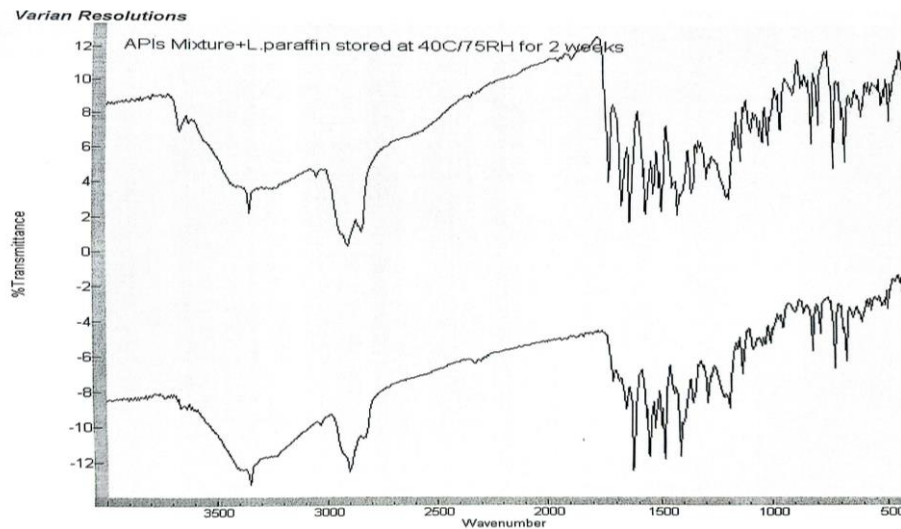
**Fig. 11: FTIR Overlay Comparing the API Mixture (Bottom) to The Stored Drug-Excipient Mixture with Cetostearyl Alcohol (Top).**



**Fig. 12: FTIR Overlay Comparing the API Mixture (Bottom) to The Stored Drug-Excipient Mixture with Propylene Glycol (Top).**



**Fig. 13: FTIR Overlay Comparing The API Mixture (Bottom) to The Stored Drug-Excipient Mixture With Stearic Acid (Top).**



**Fig. 14: FTIR Overlay Comparing the API Mixture (Bottom) to The Stored Drug-Excipient Mixture with Liquid Paraffin (Top).**

## DISCUSSION

The FTIR spectrum of pure Atorvastatin was obtained to establish characteristic absorption regions for subsequent drug–excipient compatibility assessments (Figure 2). Spectra of both freshly prepared Atorvastatin and the sample subjected to accelerated storage conditions ( $40 \pm 2^\circ\text{C}$ , 75 % RH for 14 days) were recorded and found to be superimposable, confirming chemical stability under the applied stress conditions. The absorption regions exhibited in the spectrum of fresh Atorvastatin as shown in Figure 2, are presented in **Error! Reference source not found.**

Fourier-transform infrared spectroscopy confirmed the structural integrity of both active pharmaceutical ingredients. Fresh atorvastatin calcium trihydrate displayed diagnostic absorptions at  $3365\text{ cm}^{-1}$  (O-H/N-H stretching),  $1655\text{ cm}^{-1}$  (lactone C=O), and  $1590\text{ cm}^{-1}$  (aromatic C=C) (**Error! Reference source not found.**). Fresh Fusidic acid exhibited characteristic peaks at  $3360\text{ cm}^{-1}$  (O-H stretching),  $1708\text{ cm}^{-1}$  (carboxylic acid C=O), and  $1050\text{ cm}^{-1}$  (C-O stretching (**Error! Reference source not found.**)). The spectrum of the fresh API physical mixture demonstrated strict superposition of these signature peaks without any noticeable positional

deviations. Post-storage spectra of the API mixture revealed no shifts  $>2\text{ cm}^{-1}$  in diagnostic peaks, no alterations in relative intensities, no peak broadening, and no emergence of new absorption bands within  $4000\text{--}500\text{ cm}^{-1}$  (**Error! Reference source not found.**4 -14).

Comparative analysis of stored API-excipient mixtures showed no evidence of incompatibilities. For butylated hydroxyanisole (BHA), Vaseline, chlorocresol, Tween 80, stearyl alcohol, propylene glycol, stearic acid, and liquid paraffin mixtures: all spectra retained the fundamental absorption patterns of the APIs (Table ), and **Error! Reference source not found.** to **Error! Reference source not found.** shows their IR spectrums. Observed spectral variations were attributable solely to excipient-specific absorptions, with no detectable covalent interaction signatures. Minor intensity fluctuations in hydroxyl and carbonyl regions were consistent with expected hydrogen bonding effects and remained within pharmacopeial acceptance thresholds for compatibility. Overall, no physical or spectroscopic evidence indicated incompatibilities between the APIs or with any tested excipient under accelerated storage conditions.

**Table 8: FTIR spectral observations of drug-excipient compatibility after 14-day storage at  $40^\circ\text{C}/75\% \text{RH}$ .**

Excipient	Key Spectral Observations	Compatibility Assessment
BHA	API peaks retained; no new bands beyond characteristic BHA aromatic/O-H signals	Compatible
Vaseline	API signatures persistent despite hydrocarbon masking; no reaction-specific peaks	Compatible
Chlorocresol	API spectral profile maintained; C-Cl absorptions distinct from API peaks	Compatible
Tween 80	API absorption regions identifiable; no covalent interaction evidence despite surfactant spectral interference	Compatible
Cetostearyl alcohol	API peaks preserved alongside strong alcohol-derived O-H/C-H vibrations	Compatible
Propylene glycol	API patterns retained; O-H region variations consistent with H-bonding	Compatible
Stearic acid	Carbonyl region superposition observed; no acid-base reaction indicators	Compatible
Liquid paraffin	API peaks identifiable without positional shifts; hydrocarbon dominance caused partial masking without peak alterations	Compatible

## CONCLUSION

The compatibility studies of physical mixtures of Atorvastatin with different used excipients such as cetostearyl alcohol, stearic acid, Vaseline (petroleum jelly), liquid paraffin, antioxidant: butylated hydroxyanisole (BHA), preservative: chlorocresol, aqueous phase components: propylene glycol, and emulsifier: Tween 80 were evaluated for preformulation studies parameters were investigated by FTIR it was detected that there was no variation or minor deviation in the characteristic peaks in FTIR spectroscopy. It was concluded that the drug Atorvastatin was found to be compatible with various excipients which were selected for the formulation development of the Atorvastatin

Cream NDDS. These formulations favorable properties and efficacy indicate it as a promising strategy for improving outcomes in infected diabetic wounds. Formulation scientist from his experience and knowledge have to significantly in the preformulation study stage and is an important factor in the NDDS (Novel Drug Delivery Systems) product development process.

## ACKNOWLEDGEMENT

The authors are thankful to Modern Pharmaceutical Industry Company-Yemen, for support and facilities.

## REFERENCES

1. Abootorabi, S., Akbari, J., Saeedi, M., Seyedabadi, M., Ranaee, M., Asare-Addo, K., & Nokhodchi, A. Atorvastatin Entrapped Noisome (Atrosome): Green Preparation Approach for Wound Healing. *AAPS PharmSciTech*, 2022; 23(3): 81. <https://doi.org/10.1208/s12249-022-02231-x>
2. ADA. (2023). Erratum: Standards of Care in Diabetes—Abridged for Primary Care Providers. *Clin Diabetes*, 2023; 41: 4–31. *Clinical Diabetes*, 2023; 41(2): 328-328. <https://doi.org/10.2337/cd23-er02a>
3. Al-Mahrizi, M. A., & Nakhi, M. B. Unmet needs in managing Diabetic Foot and it's complications: Recommendations for the Gulf region, 2025.
4. Alba-Loureiro, T. C., Hirabara, S., Mendonca, J., Curi, R., & Pithon-Curi, T. C. Diabetes causes marked changes in function and metabolism of rat neutrophils. *Journal of endocrinology*, 2006; 188(2): 295-303.
5. Alburyhi, M., Noman, M., & Faisal, A. PREFORMULATION STUDIES OF CEFIXIME FOR DISPERSIBLE TABLETS DELIVERY SYSTEM DEVELOPMENT. *World Journal of Pharmacy and Pharmaceutical Sciences*, 2024; 13: 75-99.
6. Alkakhn, W., Farrar, N., Sikora, V., Emecen-Huja, P., Huja, S. S., Yilmaz, Ö., & Pandruvada, S. N. Statins Modulate Microenvironmental Cues Driving Macrophage Polarization in Simulated Periodontal Inflammation. *Cells*, 2023; 12(15). <https://doi.org/10.3390/cells12151961>
7. Allen, L. V., & McPherson, T. B. *Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems*. Wolters Kluwer Health. 2021. <https://books.google.com/books?id=9BY-EAAAQBAJ>
8. Almadani, Y. H., Vorstenbosch, J., Davison, P. G., & Murphy, A. M. Wound Healing: A Comprehensive Review. *Semin Plast Surg*, 2021; 35(3): 141-144. <https://doi.org/10.1055/s-0041-1731791>
9. Alzahrani, D. A., Alsulami, K. A., Alsulaihem, F. M., Bakr, A. A., Booq, R. Y., Alfahad, A. J., Aodah, A. H., Alsudir, S. A., Fathaddin, A. A., Alyamani, E. J., Almomen, A. A., & Tawfik, E. A. Dual Drug-Loaded Coaxial Nanofiber Dressings for the Treatment of Diabetic Foot Ulcer. *Int J Nanomedicine*, 2024; 19: 5681-5703. <https://doi.org/10.2147/ijn.S460467>
10. Armstrong, D. G., Boulton, A. J. M., & Bus, S. A. Diabetic Foot Ulcers and Their Recurrence. *N Engl J Med.*, 2017; 376(24): 2367-2375. <https://doi.org/10.1056/NEJMr1615439>
11. Armstrong, D. G., Tan, T.-W., Boulton, A. J., & Bus, S. A. Diabetic foot ulcers: a review. *Jama*, 2023; 330(1): 62-75.
12. Bandyopadhyay, D. Topical Antibacterials in Dermatology. *Indian Journal of Dermatology*, 2021; 66(2): 117–125.
13. Barnes, T. M., Mijaljica, D., Townley, J. P., Spada, F., & Harrison, I. P. Vehicles for Drug Delivery and Cosmetic Moisturizers: Review and Comparison. *Pharmaceutics*, 2021; 13(12). <https://doi.org/10.3390/pharmaceutics13122012>
14. Barrientos, S., Stojadinovic, O., Golinko, M. S., Brem, H., & Tomic-Canic, M. Growth factors and cytokines in wound healing. *Wound Repair and Regeneration*, 2008; 16(5): 585-601.
15. Bharat, S., Vidyasrilekha, Y., Mantosh, S., Praveen, K., & Veera, K. Preclinical models of diabetic wound healing A critical review. *Biomedicine & Pharmacotherapy*, 2021; 142: 111946. <https://doi.org/10.1016/j.biopha.2021.111946>
16. Bitto, A., Minutoli, L., Altavilla, D., Polito, F., Fiumara, T., Marini, H., Galeano, M., Calò, M., Cascio, P. L., & Bonaiuto, M. Simvastatin enhances VEGF production and ameliorates impaired wound healing in experimental diabetes. *Pharmacological Research*, 2008; 57(2): 159-169.
17. Bowers, S., & Franco, E. Chronic Wounds: Evaluation and Management. *Am Fam Physician*, 2020; 101(3): 159-166.
18. Bowler, P., Duerden, B., & Armstrong, D. G. Wound microbiology and associated approaches to wound management. *Clinical microbiology reviews*, 2001; 14(2): 244-269.
19. Brem, H., & Tomic-Canic, M. Cellular and molecular basis of wound healing in diabetes. *The Journal of clinical investigation*, 2007; 117(5): 1219-1222.
20. Brownlee, M. The pathobiology of diabetic complications: a unifying mechanism. *Diabetes*, 2005; 54(6): 1615-1625.
21. Brunton, L., & Knollmann, B. *Goodman and Gilman's The Pharmacological Basis of Therapeutics, 14th Edition*. McGraw Hill LLC. 2022. <https://books.google.com/books?id=8BSMEAAAQBAJ>
22. Burgess, J. L., Wyant, W. A., Abdo Abujamra, B., Kirsner, R. S., & Jozic, I. Diabetic Wound-Healing Science. *Medicina (Kaunas)*, 2021; 57(10). <https://doi.org/10.3390/medicina57101072>
23. ChemicalBook. *Fusidic Acid (CB8431174)*. ChemicalBook. Retrieved June 14, 2025. [https://www.chemicalbook.com/ChemicalProductProperty\\_EN\\_CB8431174.htm](https://www.chemicalbook.com/ChemicalProductProperty_EN_CB8431174.htm)
24. Chen, P., Vilorio, N. C., Dhatariya, K., Jeffcoate, W., Lobmann, R., McIntosh, C., Piaggese, A., Steinberg, J., Vas, P., & Viswanathan, V. Guidelines on interventions to enhance healing of foot ulcers in people with diabetes (IWGDF 2023 update). *Diabetes/metabolism research and reviews*, 2024; 40(3): e3644.
25. Cherksey, B. D., & Altszuler, N. On the mechanism of potentiation by morphine of thiopental sleeping time. *Pharmacology*, 1974; 12(6): 362-371. <https://doi.org/10.1159/000136560>

26. Dallo, M., Patel, K., & Hebert, A. A. Topical Antibiotic Treatment in Dermatology. *Antibiotics*, 2023; 12(2): 188.
27. Darby, I. A., Laverdet, B., Bonté, F., & Desmoulière, A. Fibroblasts and myofibroblasts in wound healing. *Clinical, cosmetic and investigational dermatology*, 2014; 301-311.
28. Donlan, R. M., & Costerton, J. W. Biofilms: survival mechanisms of clinically relevant microorganisms. *Clinical microbiology reviews*, 2002; 15(2): 167-193.
29. Dumville, J. C., Lipsky, B. A., Hoey, C., Cruciani, M., Fiscon, M., & Xia, J. Topical antimicrobial agents for treating foot ulcers in people with diabetes. *Cochrane Database of Systematic Reviews*, 2017; 6. <https://doi.org/10.1002/14651858.CD011038.pub2>
30. Edwards, E., & Yosipovitch, G. (2025). *Skin Manifestations of Diabetes Mellitus* (K. R. Feingold, S. F. Ahmed, & B. Anawalt, Eds. Updated 2025 Mar 21 ed.). MDText.com, Inc. <https://www.ncbi.nlm.nih.gov/books/NBK481900>
31. Eita, A. S., A, M. A. M., Anter, A., & Khalil, I. A. Repurposing of atorvastatin emulsomes as a topical antifungal agent. *Drug Deliv*, 2022; 29(1): 3414-3431. <https://doi.org/10.1080/10717544.2022.2149898>
32. Eming, S. A., Martin, P., & Tomic-Canic, M. Wound repair and regeneration: mechanisms, signaling, and translation. *Science translational medicine*, 2014; 6(265): 265sr266-265sr266.
33. Eriksson, E., Liu, P. Y., Schultz, G. S., Martins-Green, M. M., Tanaka, R., Weir, D., Gould, L. J., Armstrong, D. G., Gibbons, G. W., Wolcott, R., Olutoye, O. O., Kirsner, R. S., & Gurtner, G. C. Chronic wounds: Treatment consensus. *Wound Repair Regen*, 2022; 30(2): 156-171. <https://doi.org/10.1111/wrr.12994>
34. Everett, E., & Mathioudakis, N. Update on management of diabetic foot ulcers. *Annals of the New York Academy of Sciences*, 2018; 1411(1): 153-165.
35. Falanga, V. Wound healing and its impairment in the diabetic foot. *The Lancet*, 2005; 366(9498): 1736-1743. [https://doi.org/10.1016/S0140-6736\(05\)67700-8](https://doi.org/10.1016/S0140-6736(05)67700-8)
36. Farsaei, S., Khalili, H., Farboud, E. S., Karimzadeh, I., & Beigmohammadi, M. T. Efficacy of topical atorvastatin for the treatment of pressure ulcers: a randomized clinical trial. *Pharmacotherapy*, 2014; 34(1): 19-27. <https://doi.org/10.1002/phar.1339>
37. Farsaei, S., Khalili, H., & Farboud, E. S. Potential role of statins on wound healing: Review of the literature. *International Wound Journal*, 2012; 9(3): 238-247. <https://doi.org/https://doi.org/10.1111/j.1742-481X.2011.00888.x>
38. FDA, U. S. F. a. D. A., Center for Drug Evaluation and Research. *Clinical pharmacology and biopharmaceutics review(s) (Application No. NDA, 2013; 200-153: Orig1s000)*. [https://www.accessdata.fda.gov/drugsatfda\\_docs/nda/2013/200153Orig1s000ClinPharmR.pdf](https://www.accessdata.fda.gov/drugsatfda_docs/nda/2013/200153Orig1s000ClinPharmR.pdf)
39. Felton, L. A. *Remington: Essentials of Pharmaceutics* (23 ed.). Pharmaceutical Press. 2013. [https://books.google.com/books?id=1Pr2wAEACA\\_AJ](https://books.google.com/books?id=1Pr2wAEACA_AJ)
40. Fernandes, P. Fusidic Acid: A Bacterial Elongation Factor Inhibitor for the Oral Treatment of Acute and Chronic Staphylococcal Infections. *Cold Spring Harb Perspect Med.*, 2016; 6(1): a025437. <https://doi.org/10.1101/cshperspect.a025437>
41. Raweh SM, Noman MA, Alburyhi MM, Saif AA. Formulation and Evaluation of Anti-acne Gel of Azadirachta Indica Extract Herbal Product. *European Journal of Pharmaceutical and Medical Research*, 2024; 11(2): 427-433.
42. El-Shaibany A, Noman MA, Alburyhi MM, Saif AA, et al. Global Burden, Pathophysiology, and Emerging Herbal Management Strategies for Diabetic Foot Ulcers: A Narrative Review. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2026; 15(4): 1130-1138.
43. Noman MA, Alburyhi MM, Saif AA, Yahya TAA. Formulation and Evaluation of Polyherbal Extract for Skin Hyperpigmentation as Gel Advanced Delivery Systems. *World Journal of Pharmaceutical Research.*, 2024; 13(22): 1260-1280.
44. Saif AA, Noman MA, Alburyhi MM. Formulation and Evaluation of Salicylic Acid and Kojic Acid as Gel Novel Drug Delivery Systems for Treatment of Acne and Whitening Skin Effect. *World Journal of Pharmaceutical and Medical Research.*, 2025; 11(9): 538-548.
45. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Aloe Vera Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Controlling Diabetes. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2024; 13(4): 1408-1423.
46. Alburyhi MM, El-Shaibany A. Formulation and Evaluation of Antitumor Activity of Artemisia Arborescence Extract Capsules as Dietary Supplement Herbal Product Against Breast Cancer. *World Journal of Pharmaceutical Research.*, 2024; 13(3): 95-114.
47. Saif AA, Noman MA, Alburyhi MM, Yahya TAA. Evaluation and Drug Stability Studies Some Levocetirizine Tablets Brands Available in Sana'a Market Yemen. *World Journal of Pharmaceutical Research.*, 2024; 13(24): 1009-1022.
48. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Aloe Vera Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Cancer. *World Journal of Pharmaceutical Research.*, 2024; 13(8): 1052-1072.
49. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Dictyota Dichotoma Extract Medicinal Seaweed Capsules Delivery

- System as an Advanced Phytotherapy Approach for Cancer. *European Journal of Biomedical and Pharmaceutical Sciences.*, 2024; 11(4): 63-70.
50. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Celery Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Gout. *World Journal of Pharmaceutical Research.*, 2024; 13(11): 2383-2404.
51. Othman AM, Alburyhi MM, Al-Hadad GH. Formulation and Evaluation of Captopril Mouth Dissolving Tablets. *European Journal of Pharmaceutical and Medical Research*, 2024; 11(1): 18-28.
52. El-Shaibany A, Noman MA, Alburyhi MM, Saif AA, et al. The Evolution and Therapeutic Potential of Polyherbal Gels and Key Botanical Extracts in Diabetic Foot Ulcer Management: A Comprehensive Narrative Review. *European Journal of Biomedical and Pharmaceutical Sciences*, 2026; 13(4): 368-374.
53. Alburyhi MM, El-Shaibany A. Formulation and Evaluation of Effervescent Granules of Artemisia Arborescence Herbal Product for Foodborne Illness. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2023; 12(12): 1429-1444.
54. Alburyhi MM, Noman MA, Saif AA, Alemad AF. Dispersible and Orodispersible Tablets Delivery Systems for Antibacterials Development. *World Journal of Pharmaceutical Research.*, 2025; 14(1): 1229-1257.
55. Noman MA, Alburyhi MM, Saif AA, Yahya TAA. Evaluation and Drug Stability Studies Some Atorvastatin Tablets Brands Available in Sana'a Market Yemen. *World Journal of Pharmaceutical and Medical Research.*, 2024; 10(12): 231-236.
56. Noman MA, Alburyhi MM, Saif AA. Knowledge and Perception about Pharmacovigilance Among 4Th and 5Th Levels Pharmacy Students in Some Public and Private Universities, Sana'a Yemen. *World Journal of Pharmaceutical and Medical Research.*, 2023; 9(11): 14-19.
57. Alburyhi MM, El-Shaibany A. Formulation and Evaluation of Anti-peptic Ulcer Capsules of Curcuma Longa Herbal Product. *World Journal of Pharmaceutical Research.*, 2023; 12(22): 76-96.
58. Noman MA, Alburyhi MM, El-Shaibany A, Alwesabi NA. Preformulation and Characterization Studies of Pandanus Odoratissimus L Extract Active Ingredient in Treatment of Nocturnal Enuresis. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2024; 13(2): 1603-1620.
59. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Chamomile Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Gout. *World Journal of Pharmaceutical and Life Sciences.*, 2025; 11(04): 215-228.
60. Othman AM, Alburyhi MM, Al-Hadad GH. Captopril-Excipient Preformulation Studies for Mouth Dissolving Tablets Development. *World Journal of Pharmaceutical Research*, 2025; 14(10): 1398-1420.
61. Alburyhi MM, Saif AA, Noman MA, Al-Ghorafi MA. Comparative Study of Certain Commercially Available Brands of Paracetamol Tablets in Sana'a City, Yemen. *European Journal of Pharmaceutical and Medical Research.*, 2018; 5(12): 36-42.
62. Noman MA, Alburyhi MM, El-Shaibany A, Alwesabi NA. Formulation and Evaluation of Pandanus Odoratissimus L Extract for Treatment of Nocturnal Enuresis as Orodispersible Tablets Delivery System. *World Journal of Pharmaceutical Research.*, 2024; 13(5): 56 -71.
63. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Tribulus Terrestris Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Controlling Diabetes. *World Journal of Pharmaceutical Research.*, 2024; 13(7): 1264-1282.
64. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Pandanus Odoratissimus Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Hepatoprotective. *European Journal of Pharmaceutical and Medical Research.*, 2024; 11(4): 06-13.
65. El-Shaibany A, Noman MA, Alburyhi MM, Saif AA, et al. A Hepatoprotective and Anti-inflammatory Polyherbal Approach: The Synergistic Potential of Acalypha fruticosa and Tribulus terrestris Extract. *European Journal of Pharmaceutical and Medical Research.*, 2026; 13(4): 520-524.
66. Saif AA, Alburyhi MM, Noman MA. Evaluation of Vitamin and Mineral Tablets and Capsules in Yemen Market. *Journal of Chemical Pharma Research.*, 2013; 5(9): 15-26.
67. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Plicosepalus Acacia Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Hepatoprotective. *World Journal of Pharmaceutical Research.*, 2025; 14(8): 1309-1334.
68. Alburyhi MM, El-Shaibany A. Formulation and Evaluation of Oral Pharmaceutical Solution of Pandanus Odoratissimus L Extract Herbal Product in Treatment of Nocturnal Enuresis. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2024; 13(1): 1840-1851.
69. Alburyhi MM, El-Shaibany A. Formulation and Evaluation of Antibacterial Orodispersible Tablets of Artemisia Arborescence Extract Herbal Product. *European Journal of Pharmaceutical and Medical Research.*, 2024; 11(2): 409-417.
70. Al Ghoury AA, Al-Ghorafi MA, Alburyhi MM, Noman MA. Antimicrobial Susceptibility Patterns of Staphylococcus Aureus to Different Antimicrobial Agents Isolated as Clinical Samples at Certain General Hospitals in Sana'a City, Yemen. *World*

- Journal of Pharmaceutical Research., 2024; 13(16): 35-47.
71. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of *Acalypha fruticosa* Extract Tablets Delivery System as an Advanced Phytotherapy Approach for Controlling Diabetes. *World Journal of Pharmaceutical Research.*, 2024; 13(8): 1073-1091.
  72. Noman MA, Alburyhi MM, Saif AA, Yahya TAA. Assessment of Knowledge, Attitude, and Practice of Pharmacovigilance Among Pharmacists and Health care Professionals in Four Government Hospitals at Sana'a City, Yemen. *European Journal of Biomedical and Pharmaceutical Sciences.*, 2025;12(5): 250-267.
  73. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Ginger Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Controlling Diabetes. *World Journal of Pharmaceutical and Medical Research.*, 2025; 11(6): 400-415.
  74. Noman MA, Alburyhi MM, Yahya TAA, Saif AA. Evaluation and Drug Stability Studies of Different Brands of Clopidogrel Tablets Available in Sana'a City Market, Yemen. *European Journal of Biomedical and Pharmaceutical Sciences*, 2025; 12(7): 181-191.
  75. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of *Plicosepalus acacia* Extract Capsules as Naturaceutical Novel Drug Delivery Systems for Controlling Diabetes. *World Journal of Pharmaceutical and Life Sciences.*, 2025; 11(6): 323-337.
  76. Alburyhi MM, El-Shaibany A. Recent Innovations of Novel Drug Delivery Systems for Formulation, Development and Evaluation of *Pandanus odoratissimus* Extract Capsules as Naturaceutical for Breast Cancer. *World Journal of Pharmaceutical Research.*, 2024; 13(8): 1092-1112.
  77. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of *Tribulus terrestris* Extract Capsules as Naturaceutical Novel Drug Delivery Systems for Kidney Stones. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2024; 13(5): 1425-1443.
  78. El-Shaibany A, Noman MA, Alburyhi MM, Saif AA, et al. Pharmacological and Formulation Advances in the Management of Hepatic and Inflammatory Disorders: A Review of *Acalypha fruticosa* and *Tribulus terrestris*. *World Journal of Pharmaceutical and Life Sciences.*, 2026; 12(4): 260-264.
  79. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of *Capsicum* Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Tonic and Natural Stimulant. *European Journal of Pharmaceutical and Medical Research.*, 2025; 11(6): 323-337.
  80. Alburyhi MM, Raweh SM, AlGhoury ABA, Alkhawlan MA, Noman MA, Saif AA. Recent Innovations of Novel Drug Delivery Systems for Formulation, Development and Evaluation of *Grewia tenax* Extract Naturaceutical Ointment for Antimicrobial Activity. *World Journal of Pharmaceutical and Medical Research.*, 2025; 11(7): 413-426.
  81. Alburyhi MM, Raweh SM, Al-Ghorafi MA, Saif AA, Noman MA. Formulation and Evaluation of *Argemone ochroleuca* Extract Cream Naturaceutical Delivery Systems as Antimicrobial and Wound Healing Activity. *European Journal of Pharmaceutical and Medical Research.*, 2025; 12(7): 445-459.
  82. Mohamed YAS, Alkhawlan MA, Wadi ZAS, Yahya TAA, Faisal A, Alburyhi MM. Modern Analytical Techniques for Authentication of Yemeni Ambergris. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2025; 14(8): 686-697.
  83. Alburyhi MM, Mohamed YAS. Formulation, Development and Evaluation of Cosmeceutical Natural Pigmented Lipstick from *Opuntia dillenii* Fruit Extract. *European Journal of Biomedical Pharmaceutical and Medical Sciences.*, 2025; 12(9): 466-479.
  84. El-Shaibany A, Noman MA, Alburyhi MM, Saif AA, et al. Synergistic Potential of *Pandanus odoratissimus* and *Curcuma longa* in the Management of Nocturnal Enuresis: A Comprehensive Narrative Review of Botanical, Pharmacological, and Formulation Strategies. *World Journal of Pharmaceutical Research.*, 2026; 15(7): 1934-1948.
  85. Al-Ghorafi MA, Alburyhi MM, Muthanna MS. Effect of Rosemary and Myrtus Extracts Combination on Androgenetic Alopecia: A Comparative Study with Minoxidil. *European Journal of Pharmaceutical and Medical Research.*, 2023; 10(10): 35-39.
  86. Alburyhi MM, El-Shaibany A, Al-Wajih AM, Almlhani AN, Alqadhi AA. Innovative Approaches in Herbal Drug Delivery Systems Enhancing Efficacy and Reducing Side Effects. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2025; 14(1): 919-929.
  87. Alburyhi MM, El-Shaibany A, Al-Wajih AM, Alqadhi AA, Almlhani AN. Advancements in Nano-Formulation Systems for Enhancing the Delivery of Herbal Ingredients. *European Journal of Pharmaceutical and Medical Research.*, 2025; 12(1): 212-231.
  88. Alburyhi MM, Moharram BA. Formulation and Evaluation of *Aloe niebuhriana* Extract as Naturaceutical Effervescent Granules Novel Drug Delivery Systems for Antidiabetic Activity. *World Journal of Pharmaceutical Research.*, 2025; 14(18): 1147-1175.
  89. Al-Ghorafi MA, Alburyhi MM, Muthanna MS. Chemical Incompatibilities of IV Admixture Combinations in ICU, Orthopedic and Emergency Units of Various Hospitals and Medical Centers in

- Sana'a, Yemen. *European Journal of Pharmaceutical and Medical Research.*, 2023; 10(10): 416-425.
90. Al-Ghorafi MA, Alburyhi MM. Formulation and Evaluation of Novel Antiaging Cream Containing Dragon's Blood Extract. *European Journal of Pharmaceutical and Medical Research.*, 2024; 11(1): 239-244.
91. Saif AA, Alburyhi MM, Noman MA, Almaktari AM. Formulation and Evaluation of Trimetazidine Hydrochloride and Clopidogrel Bisulphate Multi-unit Solid Dosage Forms. *Journal of Chemical Pharm Research.*, 2014; 6(2):421-426.
92. Al-Ghorafi MA, Alburyhi MM. Evaluation and Formulation of Antifungal Activity of Dragon Blood Extract and Inorganic Salts on Dermatophytosis and Candidiasis. *European Journal of Pharmaceutical and Medical Research.*, 2024; 11(1): 09-17.
93. Othman AM, Alburyhi MM, Al-Hadad GH. Formulation and Stability Studies Evaluation of the Selected Captopril Mouth Dissolving Tablets MDTs. *World Journal of Pharmaceutical and Medical Research.*, 2025; 11(11): 275-284.
94. Alburyhi MM, Moharram BA. Formulation and Evaluation of *Jatropha Variiegata* Extract as Antibacterial Naturaceutical Cream Novel Drug Delivery Systems for Wound Healing Activity. *World Journal of Pharmaceutical and Life Sciences.*, 2025; 11(10): 177-190.
95. Noman MA, Alburyhi MM, Saif AA. Formulation and Evaluation of Skin Whitening Naturaceutical Composition Gel as Advanced Drug Delivery Systems. *World Journal of Pharmaceutical and Medical Research*, 2025; 11(10): 400-414.
96. El-Shaibany A, Noman MA, Alburyhi MM, Saif AA, et al. *Punica granatum* Flower and *Hibiscus sabdariffa* Calyx: A Narrative Review of Phytochemistry, Antioxidant Mechanisms, and Synergistic Potential in Oxidative Stress Management. *World Journal of Pharmaceutical and Medical Research.*, 2026; 12(4): 418-427.
97. Al-Samawi HM, El-Shaibany A, Alburyhi MM. Review Article: The Therapeutic Potential of *Micromeria Biflora*: A Comprehensive Review. *World Journal of Pharmaceutical Research.*, 2024;13(6): 7-11.
98. Alburyhi MM, Moharram BA. Formulation and Evaluation of Aloe Inermis Extract for Wound Healing Activity as Antibacterial Naturaceutical Cream Novel Drug Delivery Systems. *European Journal of Pharmaceutical and Medical Research.*, 2025; 12(10): 297-308.
99. Al-Wajih AM, El-Shaibany A, Alburyhi MM, Abdelkhalek AS, Elaasser MM, Raslan AE. Comparative Study of Phytochemical Composition, Oral Toxicity, Antioxidant, and Anticancer Activities of Both Aloe Vera and Aloe Vacillans (*Asphodelaceae* Family) Flowers Extract: In Vitro, In Vivo, and in Silico Studies. *Trends in Phytochemical Research.*, 2025; 9(1): 1-22.
100. Al-Samawi HM, El-Shaibany A, Alburyhi MM. Review Article: The Pharmacological Potential of The Genus *Micromeria*. *World Journal of Pharmaceutical Research.*, 2024; 13(6): 1-6.
101. Noman MA, Alburyhi MM, Saif AA. Effect of Chewing Khat on Nutritional Status Among Female Students at Undergraduate Level in Sana'a, Yemen. *World Journal of Pharmaceutical Research.*, 2023; 12(20): 75-88.
102. Al-Samawi HM, El-Shaibany A, Alburyhi MM. Review Article: Phytochemistry and Pharmacological Activities of *Micromeria* Species. *World Journal of Pharmaceutical Research.*, 2024; 13(15): 1335-1347.
103. El-Shaibany A, Noman MA, Alburyhi MM, Saif AA, et al. Pharmacological Insights and Pharmaceutical Formulations of *Pandanus odoratissimus* Peduncle and *Curcuma longa*: A Narrative Review of Therapeutic Applications from 2010 to 2025. *European Journal of Biomedical and Pharmaceutical Sciences*, 2026; 13(4): 375-381.
104. Al-Ghani AM, Alkhawlani MA, Alburyhi MM, Alwosabi A. Formulation and Evaluation of Yemeni *Zizyphus Spina-Christi* Leaves Extracts as Anti-Bacterial and Anti-Dandruff Serum. *European Journal of Pharmaceutical and Medical Research.*, 2024; 11(10): 40-46.
105. Mohamed YAS, Hamidaddin MA, Yahya TA, Alkhawlani MA, Alburyhi MM. Phytochemical and Physicochemical Analysis of Yemeni *Kalanchoe Marmorata* Baker. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2025; 14(9): 1024-1033.
106. Noman MA, Alburyhi MM, Saif AA. Knowledge, Attitude and Practice Regarding the Proper Use, Risks and Resistance of Antibiotics Among Undergraduate Level Medical and Health Sciences Students in Sana'a, Yemen. *European Journal of Pharmaceutical and Medical Research.*, 2025; 12(12): 414-425.
107. Almamari A, Alburyhi MM, Alhag S. Species-Species Prevalence of Vaginal Candidiasis with Type 1 and Type 2 Diabetes Mellitus Among Women in Sana'a City. *Journal of Chemical and Pharmaceutical Research.*, 2013; 5(8): 217-224.
108. El-Shaibany A, Alburyhi MM, Aoun MA, Ghallab HA. Pharmacological Evaluation of Marine Macroalgae from Yemeni Coastal Waters: Expanded Investigation into Their Antimicrobial and Antioxidant Activities. *World Journal of Pharmaceutical Research.*, 2025; 14(13): 1763-1770.
109. Al-Ghani AM, Alkhawlani MA, Alburyhi MM. Formulation Evaluation of Effect of Yemeni *Allium Sativum* (Garlic) in Treatment of Oral Candidiasis. *European Journal of Pharmaceutical and Medical Research.*, 2024; 11(8): 14-19.
110. Noman MA, Saif AA, Alburyhi MM. The Impact of Vitamin D Deficiency and Nutritional Habits

- on Height and Health Among Yemeni Adult Female Students in Sana'a, Yemen. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2026; 15(3): 855-875.
111. El-Shaibany A, Noman MA, Alburyhi MM, Saif AA, et al. Punica granatum Flower and Hibiscus sabdariffa Calyx: A Narrative Review of Phytochemistry, Antioxidant Mechanisms, and Therapeutic Potential. *World Journal of Pharmaceutical Research.*, 2026; 15(7): 1949-1966.
  112. Stuart BH. *Infrared Spectroscopy: Fundamentals and Applications.* 1st ed. Wiley., 2004; S168.
  113. Bharate SS, Bharate SB, Bajaj AN. Interactions and Incompatibilities of Pharmaceutical Excipients with Active Pharmaceutical Ingredients: A Comprehensive Review. *J Excip Food Chem.*, 2010; 1: 3-26.
  114. Moyano MA, Broussalis AM, Segall A. Thermal Analysis of Lipoic Acid and Evaluation of the Compatibility with Excipients. *J Therm Anal Cal.*, 2010; 99: 631-637.
  115. Ceresole R, Han Y, Rosasco MA, Orelli LR, Segall AI. Drug-Excipient Compatibility Studies in Binary Mixtures of Avobenzone. *J Cosmet Sci.* 2013; 64: 317-328.
  116. Chadha R, Bhandari S. Drug-Excipient Compatibility Screening—Role of Thermoanalytical and Spectroscopic Techniques. *J Pharm Biomed Anal.*, 2014; 87: 82-97.
  117. O'Neill MA, Gaisford S. Application and Use of Isothermal Calorimetry in Pharmaceutical Development. *Int J Pharm.*, 2011; 417: 83-93.
  118. Ferraz Pinto M, Afonso de Moura E, Santos de Souza F, Oliveira Macêdo R. Thermal Compatibility Studies of Nitroimidazoles and Excipients. *J Therm Anal Cal.*, 2010; 102: 323-329.
  119. Oliveira Santos AF, Basilio Jr ID, Souza FS, Medeiros AFD, Ferraz Pinto M, de Santana DP. Application of Thermal Analysis of Binary Mixtures with Metformin. *J Therm. Anal Cal.*, 2008; 93: 361-364.
  120. Chou YP, Huang JY, Tseng JM, Cheng Y, Shu CM. Reaction Hazard Analysis for The Thermal Decomposition of Cumene Hydroperoxide in The Presence of Sodium Hydroxide. *J Therm Anal Cal.*, 2008; 93: 275-280.
  121. Mura P, Furlanetto S, Cirri M, Maestrelli F, Marras AM, Pinzauti S. Optimization of Glibenclamide Tablet Composition Through the Combined Use of Differential Scanning Calorimetry and D-Optimal Mixture Experimental Design. *J Pharm Biomed Anal.*, 2005; 37: 65-71.
  122. Araújo AAS, Storpirtis S, Mercuri LP, Carvalho FMS, dos Santos Filho M, Matos JR. Thermal Analysis of The Antirretroviral zidovudine (AZT) and Evaluation of The Compatibility with Excipients Used in Solid Dosage Forms. *Int J Pharm.*, 2003; 260: 303-314.
  123. Matos APS, Costa JS, Boniatti J, Seiceira RC, Pitaluga Jr A, Oliveira DL, Visçosa AL, Holandino C. Compatibility Study Between Diazepam and Tablet Excipients. *J Therm Anal Cal.*, 2017; 127: 1675-1682.
  124. Liltorp K, Larsen TG, Willumsen B, Holm R. Solid State Compatibility Studies with Tablet Excipients Using Non Thermal Methods. *J Pharm Biomed Anal.*, 2011; 55: 424-428.
  125. Verma RK, Garg S. Selection of Excipients for Extended-Release Formulations of Glipizide Through Drug-Excipient Compatibility Testing. *J Pharm Biomed Anal.*, 2005; 38: 633-644.
  126. Verma RK, Garg S. Compatibility Studies between Isosorbide Mononitrate and Selected Excipients Used in The Development of Extended-Release Formulations. *J Pharm Biomed Anal.*, 2004; 35:449-458.
  127. Veiga A, Oliveira PR, Bernardi LS, Mendes C, Silva MAS, Sangoi MS, Janissek PR, Murakami FS. Solid-State Compatibility Studies of A Drug Without Melting Point. *J Therm Anal Cal.*, 2018; 131: 3201-3209.
  128. Rus LM, Tomuta I, Iuga C, Maier C, Kacso I, Borodi G, Bratu I, Bojita M. Compatibility Studies of Indapamide/Pharmaceutical Excipients Used in Tablet Preformulation. *Farmacia.*, 2012; 60: 92-101.
  129. Tomassetti M, Catalani A, Rossi V, Vecchio S. Thermal Analysis Study of The Interactions between Acetaminophen and Excipients in Solid Dosage Forms and in Some Binary Mixtures. *J Pharm Biomed Anal.*, 2005; 35: 949-955.
  130. Ding T, Chen L, Zhai LH, Fu Y, Wang-Sun B. Compatibility Study of Rivaroxaban and Its Pharmaceutical Excipients. *J Therm Anal Cal.*, 2017; 130: 1569-1573.
  131. Raymond C. R, Sheskey PJ, Owen CS. *Handbook of Pharmaceutical Excipients Fifth Edition* Edited.
  132. Shivangi S, Navneet V. Taste Masked Orodispersible Tablets. A highly patient Compliant Dosage Form. *Asian J Pharm Clin Res.*, 2016; 9: 385-91.
  133. Anupam R. Orodispersible Tablets: A Review. *Asian J Pharm Clin Res.*, 2016; 9:19-26.
  134. Abdelbary G, Eouani C, Prinderre P, Joachim J, Reynier J, Piccerelle P. Determination of The Invitro Disintegration Profile of Rapidly Disintegrating Tablets and Correlation with Oral Disintegration. *Int J Pharm.*, 2005; 292: 29-41.
  135. Anusha P, Nirajana A, Mohammed S, Jilani S, Murali C, Harish G. Development and Evaluation of Drotaverine Taste Masked Tablets with Improved Dissolution Efficiency Using Soild Dispersion Technique. *IJRPB.*, 2013; 1: 275-80.
  136. Srikanth M, Uhumwangho M, Sunil S, Sreenivasa N, Ravi C, Ramana Murthy K. Design and Revaluation of Taste Masked Drotaverine HCl Orodispersible Tablets Using Polymethacrylate Polymers. *Der Pharmacia Lett.*, 2010; 2: 223-31.

137. Shirwaikar AC. Galan Fast Disintegrating Tablets of Famotidine by Dry Granulation Method. *Ind J Pharm Sci.*, 2004; 66: 422-426.
138. Venkateswarlu B, et al. Formulation and Evaluation of Famotidine Fast Dissolving Tablets by Direct Compression Method. *Indian Journal of Research in Pharmacy and Biotechnology.*, 2013; 9-10(609): 609-613.
139. Prathyusha CH, Murthy TEGK. Compatibility Studies of Donepezil with Different Excipients by Using HPLC and FTIR. *J Adv Pharm Tech Res.*, 2013; 3:273-278.
140. Jangde R, Singh D. Compatibility Studies of Quercetin with Pharmaceutical Excipients used in The Development of Novel Formulation. *Research J Pharm and Tech.*, 2014; 7:1101-1105.
141. Shirwaikar AC. Galan Fast Disintegrating Tablets of Famotidine by Dry Granulation Method. *Ind J Pharm Sci.*, 2004; 66: 422-426.
142. Chauhan I, Yasir M, Verma M, Singh AP. Nanostructured Lipid Carriers: A Groundbreaking Approach for Transdermal Drug Delivery. *Advanced Pharmaceutical Bulletin.*, 2020; 10(2): 150.
143. Jones TM. *Preformulation Studies.*, 2018.
144. <https://go.drugbank.com/drugs/DB01076>
145. <https://pubchem.ncbi.nlm.nih.gov/compound/Atrovastatin-Calcium>
146. Pereira MN, Schulte HL, Duarte N, Lima EM, Sá-Barreto LL, Gratieri T, Cunha-Filho MS. Solid effervescent formulations as new approach for topical minoxidil delivery. *European Journal of Pharmaceutical Sciences.*, 2017; 96: 411-419.
147. Bary AA, El-Gazayerly ON, Alburyhi MM. A Pharmaceutical Study on Lamotrigine. Ph.D. Thesis, Faculty of Pharmacy, Cairo University., 2009.
148. Alburyhi MM, Saif AA, Noman MA, Abudunia A, Yassin SH, Abdullah JH. Formulation, Development and Evaluation of Amoxicillin Fast Dissolving Tablets. *World Journal of Pharmaceutical and Life Sciences.*, 2025; 11(7): 183-197.
149. Alburyhi MM, Salim YA, Saif AA, Noman MA. Furosemide-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. *World Journal of Pharmaceutical Research.*, 2024; 13(22): 1178-1219.
150. Alburyhi MM, Saif AA, Noman MA. Lornoxicam-Excipient Compatibility Studies for Microsponge-Based Drug Delivery Systems Development. *World Journal of Pharmaceutical and Medical Research.*, 2025; 11(4): 70-81.
151. Alburyhi MM, Noman MA, Saif AA. Formulation and Evaluation of Natural Herbal Anti-acne as Gel Delivery Systems. *World Journal of Pharmaceutical Research.*, 2024; 13(21): 1447-1467.
152. Alburyhi MM, Yahya TAA, Saif AA, Noman MA. Formulation and Evaluation of Lornoxicam Microsponge-Based Gel as A Transdermal Drug Delivery Systems. *World Journal of Pharmaceutical and Life Sciences.*, 2025; 11(5): 200-217.
153. Alburyhi MM, Hamidaddin MA, Noman MA, Saif AA. Recent Innovations of Novel Drug Delivery Systems for Formulation, Development and Evaluation of Metronidazole Medicated Chewing Gum Tablets. *European Journal of Biomedical and Pharmaceutical Sciences.*, 2025; 12(6): 353-370.
154. Alburyhi MM, Noman MA, Saif AA, Al-Ghorafi MA, Al Khawlani MA, Yahya TAA. Formulation and Evaluation of Anti-acne Spironolactone Emulgel Novel Trend in Topical Drug Delivery System. *World Journal of Pharmaceutical Research.*, 2023; 12(22): 96-119.
155. Alburyhi MM, Noman MA, Saif AA, Salim YA, Hamidaddin MA, Yahya TA, Al-Ghorafi MA, Abdullah JH. Lisinopril-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. *World Journal of Pharmaceutical Research.*, 2024; 13(16): 59-111.
156. Alburyhi MM, Saif AA, Noman MA. Compatibility Studies of Sulfadoxine with Pharmaceutical Excipients for the Development of Suppositories Novel Drug Delivery Systems. *World Journal of Pharmaceutical and Life Sciences.*, 2025; 11(9): 189-207.
157. Alburyhi MM, Saif AA, Noman MA, Saif RM. The Importance of Stability Testing in Pharmaceutical Development of Ceftriaxone Implant Biodegradable Tablets. *Matrix Science Pharma (MSP).*, 2025;9(2): 58-63.
158. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Curcuma Longa Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Cancer. *European Journal of Biomedical and Pharmaceutical Sciences.*, 2024; 11(6): 37-43.
159. Alburyhi MM, Saif AA, Noman MA, AlGhoury ABA. Compatibility Studies of Chloroquine Phosphate with Pharmaceutical Excipients for the Development of Suppositories Novel Drug Delivery Systems. *World Journal of Pharmaceutical Research.*, 2025; 14(14): 1325-1360.
160. Alburyhi MM, Saif AA, Noman MA, Yassin SH. Compatibility Studies with Pharmaceutical Excipients of Simvastatin for the Development of Novel Drug Delivery Systems. *World Journal of Pharmaceutical Research.*, 2024; 13(19): 1463-1512.
161. Hamidaddin MA, Alburyhi MM, Noman MA, Saif AA. Formulation and Evaluation of Rosuvastatin Fast Dissolving Tablets. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2023; 12(9): 2293-2303.
162. Alburyhi MM, Hamidaddin MA, Noman MA, Saif AA, Yahya TA, Al-Ghorafi MA.

- Rivaroxaban-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. *European Journal of Pharmaceutical and Medical Research.*, 2024; 11(9): 370-404.
163. Alburyhi MM, Noman MA, Saif AA, Hamidaddin MA, Yahya TA, Al-Ghorafi MA. Rosuvastatin Calcium-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. *World Journal of Pharmaceutical Research.*, 2024; 13(13): 1549-1582.
164. Bary AA, El-Gazayerly ON, Alburyhi MM. Formulation of Immediate Release Lamotrigine Tablets and Bioequivalence Study. *Journal of Chemical Pharm Research.*, 2013; 5(10): 266-271.
165. Alburyhi MM, Saif AA, Noman MA. Stability Study of Six Brands of Amoxicillin Trihydrate and Clavulanic Acid Oral Suspension Present in Yemen Markets. *Journal of Chemical Pharm Research.*, 2013; 5(5): 293-296.
166. Saif AA, Alburyhi MM, Noman MA, Yahya TA, Al-Ghorafi MA. Famotidine-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. *World Journal of Pharmaceutical Research.*, 2024; 13(18): 1346-1408.
167. Alburyhi MM, Saif AA, Noman MA, Yahya TA. Formulation, Development and Evaluation of Famotidine Orodispersible Tablets. *European Journal of Pharmaceutical and Medical Research.*, 2023; 10(10): 56-62.
168. Al-Ghorafi MA, Alburyhi MM, Saif AA, Noman MA, Yahya TA. Drotaverine-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. *World Journal of Pharmaceutical Research.*, 2024; 13(18): 1285-1340.
169. Alburyhi MM, Saif AA, Noman MA. Ticagrelor-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2024; 13(10): 1081-1132.
170. Alburyhi MM, Noman MA, Saif AA, Al-Ghorafi MA, Yahya TA, Yassin SH, AlKhawlani MA. Diclofenac-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. *World Journal of Pharmaceutical Research.*, 2024; 13(14): 1297-1333.
171. Alburyhi MM, Saif AA, Noman MA, Salim YA, Hamidaddin MA. Formulation and Evaluation of Lisinopril Orally Disintegrating Tablets. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2023; 12(9): 357-369.
172. Alburyhi MM, Hamidaddin MA, Saif AA, Noman MA. Formulation and Evaluation of Rivaroxaban Orodispersible Tablets. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2024; 13(2): 2066-2092.
173. Alburyhi MM, Saif AA, Noman MA, Saif RM. Recent Innovations of Delivery Systems for Antimicrobial Susceptibility Study of Ciprofloxacin Biodegradable Formulations for Post-Operative Infection Prophylaxis. *European Journal of Pharmaceutical and Medical Research.*, 2023; 10(9): 32-36.
174. Alburyhi MM, Noman MA, Aboghanem A. Effect of Different Excipients on Formulation of Immediate Release Artemether/Lumefantrine Tablets. *Journal of Chemical Pharm Research.*, 2013; 5(11): 617-625.
175. Alburyhi MM, Saif AA, Noman MA. Formulation and Evaluation of Ticagrelor Orodispersible Tablets. *World Journal of Pharmaceutical Research.*, 2024; 13(5): 26-55.
176. Alburyhi MM, Saif AA, Noman MA, Yahya TA, Al-Ghorafi MA. Formulation and Evaluation of Drotaverine Orally Disintegrating Tablets. *World Journal of Pharmaceutical Research.*, 2023; 12(18): 66-79.
177. Al-Ghorafi MA, Alburyhi MM, Saif AA, Noman MA. Meloxicam-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. *World Journal of Pharmaceutical and Medical Research.*, 2025; 11(1): 87-106.
178. Alburyhi MM, Saif AA, Saif RM. Preformulation Study of Ceftriaxone and Ciprofloxacin for Lipid Based Drug Delivery Systems. *EJUA-BA*, 2022; 3(4): 339-350.
179. Noman MA, Alburyhi MM, Alqubati MA. Preformulation and Characterization Studies of Clopidogrel Active Ingredient for Orodispersible Tablets Development. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2024; 13(3): 996-1015.
180. Alburyhi MM, Noman MA, Alemad AF. Preformulation Studies of Cefixime for Dispersible Tablets Delivery System Development. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2024; 13(12): 75-99.
181. Alburyhi MM, Noman MA, Saif AA. Formulation and Evaluation of Meloxicam Emulgel Delivery System for Topical Applications. *World Journal of Pharmaceutical Research.*, 2025; 14(4): 1324-1337.
182. Bary AA, El-Gazayerly ON, Alburyhi MM. A Pharmaceutical Study on Methocarbamol. MSc Thesis, Faculty of Pharmacy, Cairo University., 2006.
183. Alburyhi MM, Saif AA, Noman MA, Saeed SA. Compatibility Studies of Chlorhexidine with Pharmaceutical Excipients for the Development of Gel Novel Delivery Systems. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2026; 15(4): 1071-1109.
184. Alburyhi MM, Saif AA, Noman MA, Saif RM. Recent Innovations of Delivery Systems for Antimicrobial Susceptibility Study of Ceftriaxone Biodegradable Formulations for Post-Operative Infection Prophylaxis. *European Journal of Pharmaceutical and Medical Research.*, 2023; 10(8): 95-99.

185. Alburyhi MM, Saif AA, Noman MA. Domperidone-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. *World Journal of Biomedical and Pharmaceutical Sciences.*, 2025; 12(3): 250-269.
186. Alburyhi MM, Saif AA, Noman MA. Spironolactone-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2025; 14(3): 871-910.
187. Saif AA, Alburyhi MM, Noman MA. Ketoprofen-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2025; 14(4): 92-123.
188. Alburyhi MM, Saif AA, Noman MA, Yassin SH. Formulation and Evaluation of Simvastatin Orodispersible Tablets. *World Journal of Pharmaceutical Research.*, 2023; 12(16): 1033-1047.
189. Alburyhi MM, Saif AA, Noman MA, Al Ghoury AA. Formulation and Evaluation of Antimalarial Drugs Suppositories. *World Journal of Pharmaceutical Research.*, 2023; 12(20): 89-108.
190. Alburyhi MM, Yahya TAA, Saif AA, Noman MA, Alshoba N, Saeed SA. Acyclovir-Excipient Compatibility Studies for Gel Novel Drug Delivery Systems Development. *World Journal of Pharmaceutical Research.*, 2026; 15(6): 1247-1292.
191. Alburyhi MM, Saif AA, Noman MA, Saeed SA, Al-Ghorafi MA. Formulation and Evaluation of Diclofenac Orodispersible Tablets. *European Journal of Pharmaceutical and Medical Research.*, 2023; 10(9): 01-06.
192. Saif AA, Alburyhi MM, Noman MA. Formulation and Evaluation of Ketoprofen Fast Dissolving Tablets. *International Journal of Sciences.*, 2018; 7(09): 27- 39.
193. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Chamomile Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Gout. *World Journal of Pharmaceutical and Life Sciences.*, 2025; 11(04): 215-228.
194. Alburyhi MM, Noman MA, Saif AA. Metronidazole-Excipient Compatibility Studies for Medicated Chewing Gum Delivery Systems Development. *European Journal of Pharmaceutical and Medical Research.*, 2025; 12(4): 567-589.
195. Alburyhi MM, Saif AA, Noman MA, Alkhawlan MA. Formulation and Evaluation of Bisoprolol Fast Dissolving Tablets. *World Journal of Pharmaceutical Research.*, 2023; 12(16): 01-10.
196. Alburyhi MM, Noman MA, Saif AA, Salim YA, Abdullah JH. Formulation and Evaluation of Domperidone Orodispersible Tablets. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2024; 13(3): 49-68.
197. Alburyhi MM, Saif AA, Noman MA, Hamidaddin MA. Formulation and Evaluation of Clopidogrel Orodispersible Tablets. *World Journal of Pharmaceutical Research.*, 2024; 13(6): 42-64.
198. Alburyhi MM, Saif AA, Noman MA, Al Khawlan MA. Bisoprolol-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. *World Journal of Pharmaceutical and Medical Research.*, 2024; 10(10): 304-324.
199. Saif AA, Abdullah JH, Alburyhi MM, Noman MA, Saeed SA. Sildenafil-Excipient Compatibility Studies for Pharmaceutical Oral Suspensions Advanced Drug Delivery Systems Development. *World Journal of Pharmaceutical Research.*, 2026; 15(6): 869-908.
200. Saif AA, Alburyhi MM, Noman MA, Abudunia A. Amoxicillin-Excipient Compatibility Studies for Advanced Drug delivery Systems Development. *European Journal of Pharmaceutical and Medical Research.*, 2025; 12(6): 530-562.
201. Alburyhi MM, Mohamed YAS, Saif AA, Noman MA, Abdullah JH, Yahya TAA. Recent Innovations of Novel Drug Delivery Systems for Formulation, Development and Evaluation of Amlodipine and Furosemide Orodispersible Tablets. *World Journal of Pharmaceutical and Medical Research.*, 2025; 11(5): 358-378.
202. Alburyhi MM, Mohamed YAS, Saif AA, Noman MA. Compatibility Studies with Pharmaceutical Excipients of Amlodipine for the Development of Novel Delivery Systems. *World Journal of Pharmacy and Pharmaceutical Sciences.*, 2024; 13(11): 95-136.
203. Alburyhi MM, Saif AA, Noman MA. Compatibility Studies with Pharmaceutical Excipients of Clopidogrel for the Development of Novel Delivery Systems. *World Journal of Pharmaceutical Research.*, 2025; 14(06): 1448-1486.
204. Alburyhi MM, Saif AA, Noman MA. Compatibility Studies of Pyrimethamine with Pharmaceutical Excipients for the Development of Suppositories Novel Drug Delivery Systems. *European Journal of Pharmaceutical and Medical Research.*, 2025; 12(9): 394-412.
205. Sunada H, Bi YX. Preparation, Evaluation and Optimization of Rapidly Disintegrating Tablets. *Powder Technol.*, 2002; 188-198.
206. Reddy RA, Ramesh B. Kishan V. Drug-Excipient Interaction During Formulation Development In - Vitro and In -Vivo Evaluation of Gastroretentive Drug Delivery System for Nizatidine. *Int J Pharm Sci Nanotech.*, 2013; 6: 2281-2293.