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Design & Development Of Nano Formulations Of Various Anti Arthritic Agents For Arthritis.

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Abstract:
Zaltoprofen and Cataflam are the NSAIDs category of drugs which could be used for the Arthritis for pain management. These are COX2 inhibitors, basically interfere with the prostaglandin synthesis and thus are able to reduce the sensation of pain in joints. Orally in the form of tablets or any other dosage forms, desired action could not be achieved hence here an attempt is being made to prepare nano formulation of these anti arthritic agents by using Spray Drying technique with the help of Spray Dryer. The formulations were prepared by using aqueous dispersion method by using HPMC and SLS in the concentration 0.5 % and 1% respectively. Initially 8 batches were prepared and checked for zeta potential as well as particle size. To check the crystallinity selected batch F3, F7 & F8 were sent for XRD analysis, which confers the crystalline nature of the formulations.

Keywords: Nanocrystals, Zaltoprofen, Cataflam

INTRODUCTION of ARTHRITIS

Prevalence

"Arthritis" literally means joint inflammation. Although joint inflammation is a symptom or sign rather than a specific diagnosis, the term arthritis is often used to refer to any disorder that affects the joints. Joints are places where two bones meet, such as your elbow or knee. There are different types of arthritis. In some diseases in which arthritis occurs, other organs, such as your eyes, heart, or skin, can also be affected. Fortunately, current treatments allow most people with arthritis to lead active and productive lives.

Approximately 350 million people worldwide have arthritis (www.medicinenet.com › home › arthritis center › arthritis az list, last accessed on 20th June 2015). This disease affects about 15% people i.e. over 180 million people in India. This prevalence is higher than many well known diseases such as diabetes, AIDS and cancer (http://www.arthritis-india.com/ accessed on 20th June 2015). “Arthritis” is an informal way of referring to joint pain or joint disease. There are more than 100 different types of arthritis and related conditions (http://www.orthop.washington.edu/?q=patient-care/articles/arthritis/research-on- thritis.html, last accessed 30thMay 2016). People of all ages,

sexes and races can and do suffer from arthritis.

Worldwide estimates are that 9.6% of men and 18.0% of women aged over 60 years have symptomatic osteoarthritis. Rheumatoid arthritis (RA) is an inflammatory arthritis thatdevelops in about 1% of the population, regardless of race or country of origin, affectingwomen 2 to 3 times more often than men. It tends to affect during the ages of 20 and 40, themost productive years of adulthood, and is a chronic disabling condition often causing pain and deformity. (www.who.int/chp/topics/rheumatic/en/, last accessed on 20th June 2015) ***Symptoms***

Arthritis is most common among women and occurs more frequently as people get older. Common arthritis joint symptoms include swelling, pain, stiffness and decreased range of motion. Severe arthritis can result in chronic pain, inability to do daily activities and make it difficult to walk or climb stairs. Arthritis can cause permanent joint changes. Some types of arthritis also affect the heart, eyes, lungs, kidneys and skin as well as the joints.

Types of arthritis (*http://www.arthritis.org,* last accessed on 20th June 2015)

Degenerative Arthritis- e.g. Osteoarthritis is the most common type
Inflammatory Arthritis- e.g. Rheumatoid Arthritis
Infectious Arthritis- A bacterium, virus or fungus can enter the joint and triggerinflammation.
Metabolic Arthritis- Gout

The most common types of arthritis are Osteoarthritis and Rheumatoid arthritis. Structure *Of The Joint*

A joint is created where two or more bones meet (also known as a bony articulation) and are held together by ligaments. Muscles aid in stabilizing the joint and are attached to bone by tendons. Joints comprise the weakest part of the skeleton and are susceptible to injury (http://www.doctorabel.us/anatomy-physiology/types-of-joint.html, last accessed 20th April 2016)

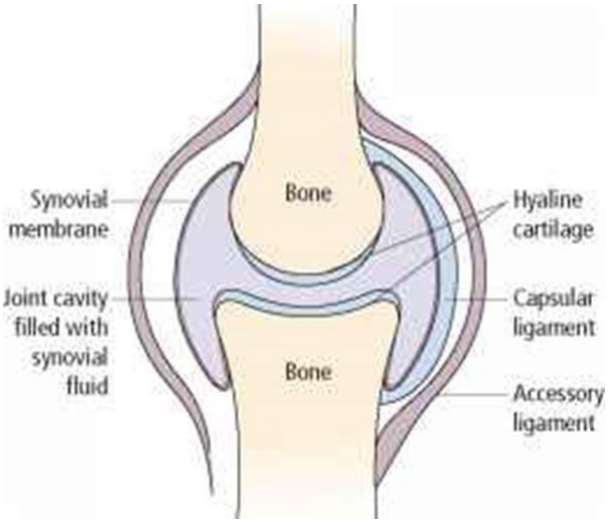


Figure 1.1 a. Structure of a typical synovial joint

(source: http://www.doctorabel.us, last accessed, 20th April 2016)The three main types of joints are:

Fibrous – Immoveable joint
Cartilagenous – Partially moveable joint
Synovial (Diarthrosis) – Freely moveable joint.

Synovial joints are the most common joints of the human body and allow various types of movement based on their unique structure. All synovial joints have three structures: the articular capsule, articular surface and synovial cavity, Figure 1.1a.
Synovial joints are surrounded by the fibrous articular capsule. This capsule is *avascular* (noblood vessels) but it is innervated, so it is sensitive to movement. Hyaline cartilage surrounds the articular surface, which covers the bones of the joint. It is avascular and it is not innervated. Synovial fluid lubricates the cartilage in order to enable the joints to move freely. The synovial cavity is located between the articular surfaces and it holds the synovial fluid.

Osteoarthritis **(**www.who.int/chp/topics/rheumatic/en/, last accessed on 20th June 2015) Osteoarthritis is a degenerative joint disease, which mainly affects the articular cartilage. It is associated with ageing and will most likely affect the joints that have been continually stressed throughout the years including the knees, hips, fingers, and lower spine region.
Degeneration of joint cartilage occurs in oeteoarthritis and the surrounding bone gets thicker, Figure 1.2a**.** Any factor (repeated trauma, advanced age, obesity etc.) that causes the breakdown of joint eventfully results in loss of joint shape and alignment. Also, the ends ofthe bones thicken and form bony growths called 'spurs'. The degenerated small bits of cartilage or bone may float within the joint space causing stiffness, pain and loss of mobilityin joints. The most common areas of occurrence of osteoarthritis are fingers, thumbs, neck, lower back, knees, and hips.
Osteoarthritis involves an inflammatory component which is marked by symptoms such as joint pain, swelling and stiffness. Inflammatory cytokines, chemokines, and other inflammatory mediators are produced by the synovium and chondrocytes and can be measured in the synovial fluids of osteoarthritis patients. Chondrocytes are the unique cellularcomponent of adult human articular cartilage which function to maintain the matrix components under normal, low turnover conditions. These chondrocytes become activated in osteoarthritis as a result of abnormal environmental stress, including high-magnitude mechanical stress, inflammatory cytokines or altered amounts or organization of matrix proteins, including degradation products (Goldring MB and Otero M, 2011). An activation of the inflammatory pathways occurs in cartilage whatever be the primary determinant of stress e.g. aging, genetic predisposition, metabolic syndrome or trauma. Chondrocytes express numerous cytokine and chemokine receptors.. Chondrocytes produce inflammatory mediators responsible for cartilage damage and adjacent joint tissue alterations, thus establishing a vicious cycle leading to the progression of osteoarthritis (Houard X *et al.*, 2013).
Thus, osteoarthritis is a whole joint disorder. It affects all joint tissues that communicate at the cellular level by releasing and responding to inflammatory mediators. Several symptoms of osteoarthritis are triggered by synovial inflammation via release of soluble factors. These factors increase and perpetuate cartilage damage by promoting destruction and impairing the ability of repair.

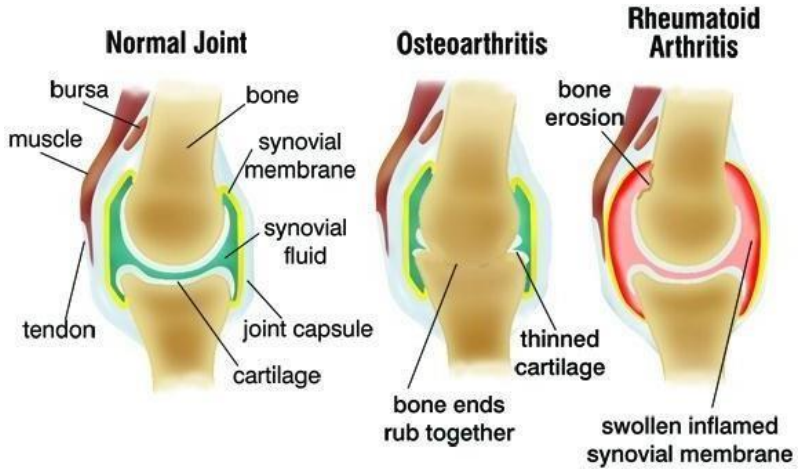


Figure 1.2a. Normal and arthritic joints

(source:http://www.practicalpainmanagement.com/pain/myofascial/inflammatory-arthritis/pain-management-inflammatory-arthritis, last accessed on 24thJune 2016)

The lifestyle effects of osteoarthritis include
Depression
Anxiety
Feeling of helplessness
Limitations on daily activities
Job limitations
Trouble participating in everyday personal and family joys and responsibilities (ArthritisTreatment in India _ Arthritis in India.htm, last accessed on 20th June 2015).
Rheumatoid Arthritis (RA)
It is considered an autoimmune disease. Components of the immune system attack the soft tissue that lines the joints, that is the synovial tissue, and can also attack connective tissue in many other parts of the body, such as the blood vessels and lungs. Eventually, erosion of the cartilage, bone, and ligaments results leading to deformity, instability and scarring within the joint, Figure 1.2a.This results in deterioration of the joints (https://www.merckmanuals.com, last accessed on 20th June 2015*). Inflammation and subsequent destruction of synovial joints is the hallmark of rheumatoid arthritis.* The inflammatory process involves both, mediators that initiate and maintain inflammation and thus is a tightly regulated process, Figure 1.3a. An imbalance between the two mediators in chronic inflammation leaves inflammation unchecked causing cellular damage. The synovial membrane in patients with rheumatoid arthritis is characterized by hyperplasia, increased vascularity and an infiltrate of inflammatory cells. The inflammatory cells are primarily the CD4+ T cells which are the main orchestrator of cell mediated responses (Choy EHS and Panayi GS, 2001).
RA is a progressive inflammatory autoimmune disease with articular and systemic effects. The exact cause of RA is unknown, but genetic and environmental factors are contributory. Pathophysiology of RA involves T cells, B cells and the orchestrated interaction of pro- inflammatory cytokines. The influx and/or local activation of mononuclear cells as well as theformation of new blood vessels at the synovial membrane results in synovitis; here joint damage is initiated. The osteoclast-rich portion of the synovial membrane is called the pannus. These osteoclasts which form within the pannus through fusion of monocytic precursors, invade bone and cause periarticular erosions. The enzymes secreted by synoviocytes and chondrocytes degrade cartilage. The release of cytokines, especially TNF-α, IL-6 and IL-1, causes synovial inflammation. In addition to their articular effects,

pro- inflammatory cytokines promote the development of systemic effects, including production of acute-phase proteins (such as CRP), anaemia of chronic disease, cardiovascular disease and osteoporosis. The fatigue and depression in arthritic patients is the result of influence of the pro-inflammatory cytokines on the hypothalamic–pituitary–adrenal axis (Choy E, 2012). Inflammation of the synovial tissue involves interactions between macrophages, T and B lymphocytes, synovial fibroblasts, and other cells of the inflamed synovium such as mast cells, dendritic cells and plasma cells. Neutrophils are rare in RA synovial tissue but abundant in RA synovial fluid. Concurrently osteoclasts, which can form within the pannus through fusion of monocytic precursors, invade bone and cause periarticular erosions (Kahlenberg JM and Fox DA, 2011).

Rheumatoid arthritis is thus characterized by symmetric polyarticular inflammation of the synovium, typically of the small joints of the hands (MCP and PIP), wrists and feet. This inflammation results in pain and stiffness, and can lead progressively to joint damage causing deformities and loss of function. Associated organ damage also contributes to severe disability. Chronic inflammation secondary to RA, additionally, may result in an increased risk of cardiovascular disease and changes in bone metabolism. RA if left untreated may progress to joint destruction, subluxation and severe disability

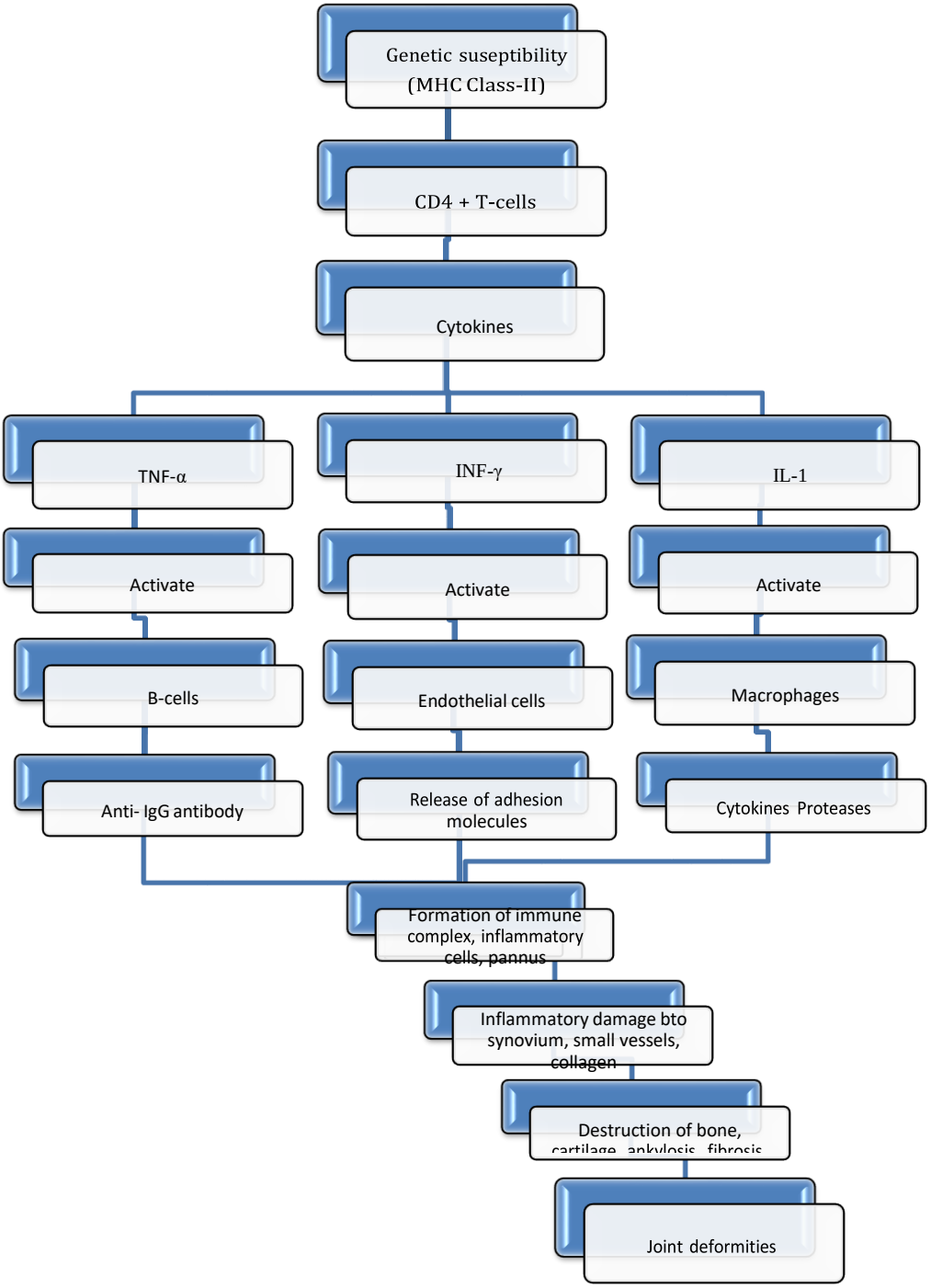


Figure 1.3a. Inflammation pathway to rheumatoid arthritis

Management of arthritis

Table 1.1a gives classes of drugs and examples of the medicines used for management of arthritis:

Table 1.1a. Drugs used for management of arthritis

Treatment	Example
Analgesics (Pain relievers)	Aspirin, codeine, acetaminophen
NSAIDs(Nonsteroidal Anti-inflammatoryDrugs)	Ibuprofen, flurbiprofen, meloxicam, tolmetin diclofenac
Non biological DMARDs	Methotrexate
Biological Response Modifiers (BRMs orbiological DMARDs)	Etanercept, adalimumab, anakinra, abdacept
Glucorticoids (Cortisone-Related Drugs)	Dexamethasone, prednisolone, methylprednisolone
Osteoporosis Medications	Risedronate, calcitonin, raloxifene

Figure 1.4a. gives the treatment modalities in rheumatoid arthritis. Physical therapy can be helpful for some types of arthritis. Exercises can improve range of motion and strengthen the muscles surrounding joints. In some cases, splints or braces may be warranted. If conservativemeasures don't help, surgery such as joint replacement and joint fusion may be suggested. Many people use alternative remedies for arthritis. The promising alternative remedies for arthritis include acupuncture, glucosamine, transcutaneous electrical nerve stimulation (TENS), yoga or tai chi and massage. Lifestyle and home remedies include weight loss, exercise. Heating pads or ice packs may help relieve arthritis pain (http://www.mayoclinic.org, last accessed on 20th June 2015).

Non-steroidal anti-inflammatory drugs (NSAIDs)

Amongst the above mentioned therapies NSAIDs are still the first line treatment option to manage inflammation and associated pain related to arthritis. NSAIDs are among the most widely used medications in the world because of their demonstrated efficacy in reducing inflammation and resulting pain. Their efficacy has been documented in a number of clinical disorders, including osteoarthritis, rheumatoid arthritis, ankylosing spondylitis, gout, dysmenorrhea, dental pain and headache.

However, NSAIDs are associated with a number of adverse effects. These include alterations in renal function, effects on blood pressure, hepatic injury and platelet inhibition which may result in increased bleeding. However, the most important adverse effects of NSAIDs are the gastrointestinal adverse effects. Most of the commonly used NSAIDs are associated with severe gastrointestinal adverse effects when administered orally. Important upper gastrointestinal complications include dyspepsia, gastric erosions and peptic ulcers and complications such as bleeding, perforation or gastric outlet obstruction. Dyspeptic symptoms may occur without correlation to endoscopic findings. Topical injury and COX-1 inhibition resulting in gastric prostaglandin suppression are two commonly postulated mechanisms of gastroduodenal damage. The deleterious gastrointestinal effects of NSAIDs may be frequent and serious and hence are a cause of concern (Ong CKS *et al.*, 2007)(Peng S and Duggan A, 2005).

A desire to avoid systemic side effects of pain killers, particularly of the NSAIDS have led to interest in the use of topical NSAIDS. Also, from the perspective of patients with arthritis, application of medicament directly at the site of inflammation or soreness stands an advantagedue to convenience of administration.

Introduction to Nano Formulations [7-12]:

The polymeric nano formulations (PNFs) are prepared from biocompatible and biodegradable

polymers in size between 10-1000 nm where the drug is dissolved, entrapped, encapsulated or attached to a matrix. Depending upon the method of preparation nanocrystals, nanoparticles, nanospheres or nanocapsules can be obtained. Nanocapsules are systems in which the drug is confined to a cavity surrounded by a unique polymer membrane, while nanospheres are matrix systems in which the drug is physically and uniformly dispersed [7,8] . The field of polymer nano formulations (PNFs) is quickly expanding and playing an important role in a wide spectrum of areas ranging from electronics, photonics, conducting materials, sensors, medicine, biotechnology, pollution control and environmental technology [9,10]. PNFs are promising vehicles for drug delivery by easy manipulation to prepare carriers with the objective of delivering the drugs to specific target, such an advantage improves the drug safety[11]. Polymer-based nano formulations effectively carry drugs, proteins, and DNA to target cells and organs. Their nanometer-size promotes effective permeation through cell membranes and stability in the blood stream. Polymers are very convenient materials for the manufacture of countless and varied molecular designs that can be integrated into unique nanoformulations constructs with many potential medical applications [12].

Advantages of nano formulations [13,14]

Increases the stability of any volatile pharmaceutical agents, easily and cheaply fabricated in large quantities by a multitude of methods.

They offer a significant improvement over traditional oral and intravenous methods of administration in terms of efficiency and effectiveness.

Delivers a higher concentration of pharmaceutical agent to a desired location.

The choice of polymer and the ability to modify drug release from nano formulations havemade them ideal candidates for cancer therapy, delivery of vaccines, contraceptives and delivery of targeted antibiotics.

Nano formulations can be easily incorporated into other activities related to drug delivery,such as tissue engineering.

Mechanisms of drug release [15]

The polymeric drug carriers deliver the drug at the tissue site by any one of the three general physico-chemical mechanisms.

By the swelling of the polymer nanoparticles by hydration followed by release throughdiffusion.

By an enzymatic reaction resulting in rupture or cleavage or degradation of the polymer atsite of delivery, there by releasing the drug from the entrapped inner core.

Dissociation of the drug from the polymer and its de-adsorption/release from the swelled nanoparticles.

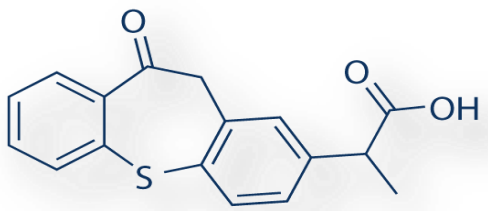
ZALTOPROFEN PROFILE: [21-24]

Description: Zaltoprofen is a non-steroidal anti-inflammatory drug (NSAIDS) with powerful analgesic action on inflammatory pain.

Chemical formula : $C_{17}H_{14}O_3S$

Chemical Name : {(±)-2-(10, 11-dihydro-10-oxo-dibenzo [b, f] thiepin-2-yl)- propionic acid}

Structure:



BSC class: Class II
pka value: 4.21

Categories: Non-steroidal anti-inflammatory drug (NSAID).

Mechanism of action: Zaltoprofen is a preferential COX-2 inhibitor. The drug selectively inhibits PGE_2 (Prostaglandin E2) that mediates the pain pathway. Zaltoprofen inhibits bradykinin-induced pain responses without interfering with the bradykinin receptors.
Absorption: After oral administration of zaltoprofen, it is almost completely absorbed82 % in GIT.
Bioavailability: 84 %

Protein binding: 98% of drug is bound to plasma proteins.

Metabolism: The drug is mostly metabolized by hepatic UGT2B7 and CYP2C9. The drug is metabolized into conjugates and S-oxide forms. No systemic accumulation has been reported. About 62% of the administered drug is excreted via the urine as drug conjugates.
Route of elimination: About 62% of the administered drug is excreted via the urine as drug conjugates.
Half life: 4 to 8 Hours.

Toxicity: Zaltoprofen is contraindicated in patients with an allergy to NSAIDs, ulcerative Cohn's disease, dysemia, peptic ulcer with or without perforations, asthma,hepatic or renal disorders and CVD.
Solubility: Slightly soluble in water, freely soluble in Acetone, chloroform, Solution in methanol.
Identification: Determine by infrared absorption spectrophotometry.

CATAFLAM PROFILE: [25-26]

Category: NSAIDs
Description: Cataflam is a non-steroidal anti-inflammatory drug (NSAIDs) withpowerful analgesic action on inflammatory pain.
Chemical formula: $C_{14}H_{10}Cl_2KNO_2$
Chemical Name: potassium;2-[2-(2,6-dichloroanilino)phenyl]acetate
BSC class: Class II
pka value: 4.21
Categories: Non-steroidal anti-inflammatory drug (NSAID).

Mechanism of action: Cataflam inhibits cyclooxygenase-1 and -2, the enzymes responsible for production of prostaglandin (PG) G2 which is the precursor to other PGs. These molecules have broad activity in pain and inflammation and the inhibition of their production is the common mechanism linking each effect of diclofenac.

Absorption: Diclofenac potassium is completely absorbed from the GI tract but likely undergoes significant first pass metabolism with only 60% of the drug reaching systemic circulation unchanged. Many topical formulations are absorbed percutaneous and produce clinically significant plasma concentrations.
Bioavailability:

Protein binding: Cataflam is over 99.7% bound to serum proteins, primarily albumin.[7] It is undergoes limited binding to lipoproteins as well with 1.1% bound to HDL, 0.3% to LDL, and 0.15% to VLDL.

Metabolism: Cataflam undergoes oxidative metabolism to hydroxy metabolites as well as conjugation to glucuronic acid, sulfate, and taurine. The primary metabolite is4'-hydroxy diclofenac which is generated by CYP2C9.

Route of elimination: Cataflam is mainly eliminated via metabolism. Of the total dose, 60-70% is eliminated in the urine and 30% is eliminated in the feces. No significant enterohepatic recycling occurs.

Half life: The terminal half-life of Cataflam is approximately 2 hr.

Toxicity: Symptoms of overdose include lethargy, drowsiness, nausea, vomiting, and epigastric pain, and gastrointestinal bleeding.

Solubility: Slightly soluble in water, freely soluble in Acetone, chloroform, Solution in methanol.

Identification: Determine by infrared absorption spectrophotometry.

OBJECTIVES:
- Selection and identification of two anti arthritic agents Zaltoprofen and Cataflam
- Formulation of Nanocrystals by Spay Drying Technique by using Spray Dryer
- Selection of process parameters for Spray Dryer
- Selection of Aqueous Dispersion method for formulation
- Measurement of Particle Size and Zeta Potential of prepared nano crystals

- Measurement for crystallanity of prepared nano crystals

EXPERIMENTAL WORK:

PRELIMINARY STUDIES:

Characterization of Zaltoprofen:

Drug was characterized according to I.P.
Appearance: Physical appearance of the powder was checked for color, odor and nature of the material.
Solubility: Solubility of the Zaltoprofen was checked in water as well as 0.1 N HCl, PBS pH 6.8 and PBS pH 7.4.
Identification by Infrared absorption spectroscopy: FTIR spectrum of Zaltprofen was taken using KBr dispersion method and compared with reference spectrum of Zaltoprofen I.P.
Melting point determination: Melting point of Zaltoprofen was determined by usingcapillary method.
Differential Scanning Colorimetry: DSC of Zaltoprofen was performed.

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Melting point determination: Melting point of Cataflam was determined by usingcapillary method.
Differential Scanning Colorimetry: DSC of Cataflam was performed.

FORMULATIONS – Nanocrystals

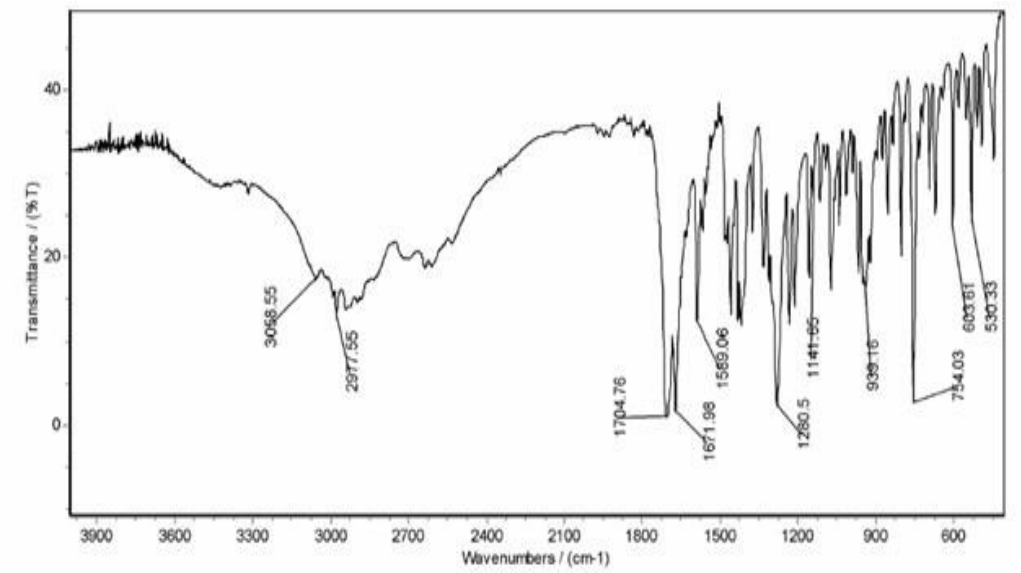
After selection and identification of Zaltoprofen & Cataflam by using Spray Dryer and aqueous dispersion method nanocrystals have been prepared by optimizing some of the process parameters. Total 08 trial batches were preparedby using two different stabilizers Hydroxy Propyl Methyl Cellulose (HPMC) E15 andSodium Lauryl Sulphate (SLS) in concentration of 0.5 % and 1 % and measured for their particle size and zeta potential, because it has been believed that few process parameters affect its particle size of the nano formulations. 3 optimized batches were sent for XRD analysis and after confirmation of crystallanity could be incorporated into gel base for formulation of Nanoemulgel.

RESULT AND DISSCUSION:

Preliminary Studies:

Characterization of Zaltoprofen:
The physical appearance: Zaltoprofen was checked for color odor and appearance. The results are in accordance with the data supplied by the manufacturer.
Solubility: Solubility of Zaltoprofen in water was (0.022 ± 0.005 mg/ml).

Identification by Fourier transform Infrared spectroscopy: Zaltoprofen (pure drug) FTIR Spectra was compare to standard FTIR spectra of Zaltoprofen. It Indicate that functional group frequencies of sample drug were in the reported range which indicates that the obtained sample was Zaltoprofen and was pure. The major peaks obtained in the FTIR spectra of Zaltoprofen were found to be correlating with the functional groups present in the structure of the drug.



Identification by DSC: Zaltoprofen showed sharp endothermic peak that corresponds to its melting point 134-138 ^{0}C.

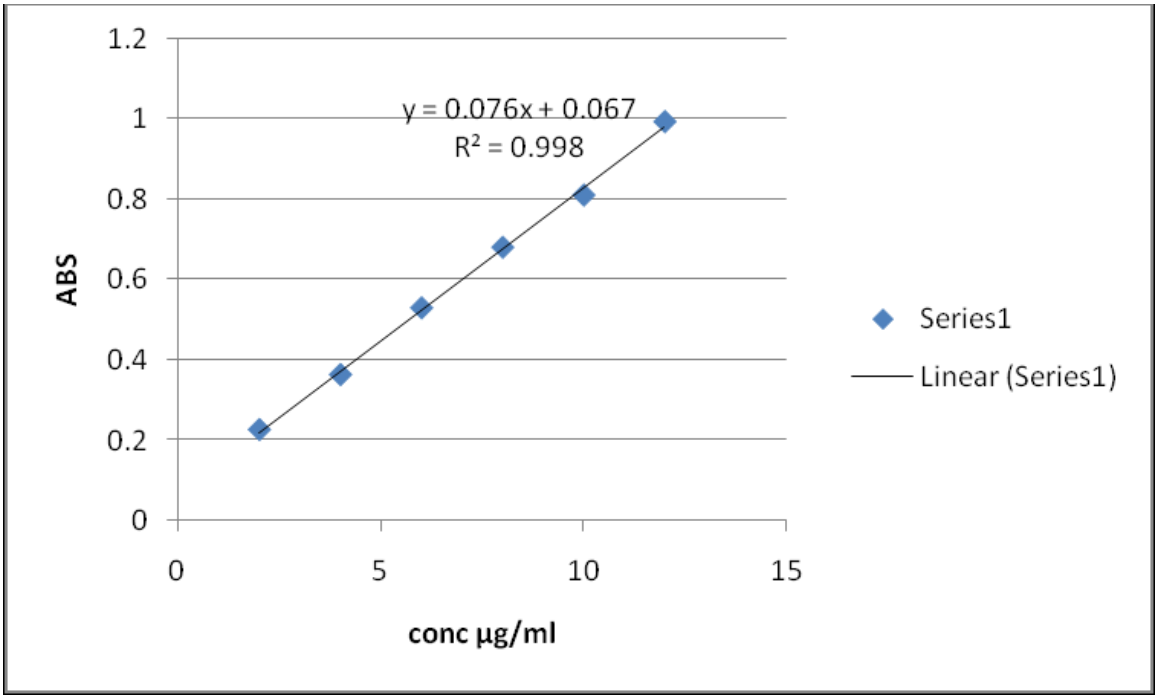
Melting point: The melting point of Zaltoprofen was determined by capillary method and was found to be 133-136 ^{0}C (reported value:-134 - 138 ^{0}C).

ANALYTICAL METHOD:

Scanning of · max of Zaltoprofen by UV spectroscopy:

The UV spectrum of Zaltoprofen in phosphate buffer pH 7.4 (100 · g/ml) was recordedin the range of 200 - 400 nm. The absorbance maximum at 228 nm was obtained.

Standard curve of Zaltoprofen:



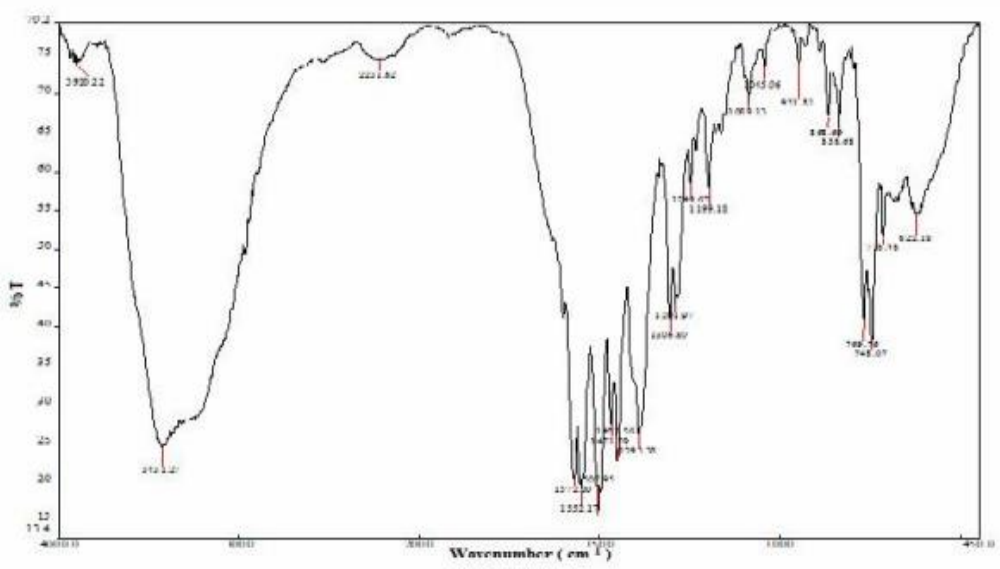
The value of concentration and absorbance of Zaltoprofen solution were plotted to obtain the standard curve in phosphate buffer pH 7.4 and data collected. The drug was found to obey Beer Lambert's law with regression co-efficient (R^2) value 0.9980 in 7.4 pH phosphate buffer, the regression equation for 7.4 pH phosphate buffer is Y=0.076 + 0.067 which was further utilized for calculation of amount of drug.

Characterization of Cataflam:

The physical appearance: Cataflam was checked for color odor and appearance. Theresults are in accordance as per COA supplied by manufacturer.

Solubility: Solubility of Cataflam in water was (35.90±1.26 mg/ml).

Identification by Fourier transformed Infrared spectroscopy:



Cataflam (pure drug) FTIR Spectra was compare to standard FTIR spectra of Cataflam.It Indicate that functional group frequencies of sample drug were in the reported range which indicates that the obtained sample was Cataflam and was pure. The major peaks obtained in the FTIR spectra of Cataflam were found to be correlating with the functional groups present in the structure of the drug.

Identification by DSC: Cataflam showed sharp endothermic peak that corresponds to itsmelting point 150 – 156 ^{0}C.

Melting point: The melting point of Cataflam was determined by capillary method and was found to be 150 – 156 ^{0}C (reported value:-152 – 158 ^{0}C).

ANALYTICAL METHOD:

Scanning of · max of Cataflam by UV spectroscopy:

The UV spectrum of Cataflam in phosphate buffer pH 7.4 (100 ·g/ml) was recorded in the range of 200-400 nm. The absorbance maximum at 282 nm was obtained.

Standard curve of Cataflam:

The value of concentration and absorbance of Cataflam solution were plotted to obtain thestandard curve in phosphate buffer pH 7.4 and data collected. The drug was found to obeyBeer Lambert's law with regression co-efficient (R^2) value 0.9920 in 7.4 pH phosphate buffer, the regression equation for 7.4 pH phosphate buffer is Y=0.078 + 0.089 which wasfurther utilized for calculation of amount of drug.

Method of Formulation – Nanocrystals:

Spray Dryer

Aqueous Dispersion Method:

Nanocrystals of Zaltoprofen & Cataflam were prepared successfully using different polymeric stabilizers viz. Sodium Lauryl Sulphate, HPMC E15 (by using aqueous dispersion method). 1000 mg of pure drug was dispersed in 100 ml of Distilled water (Solution I). Stabilizing agents were dissolved

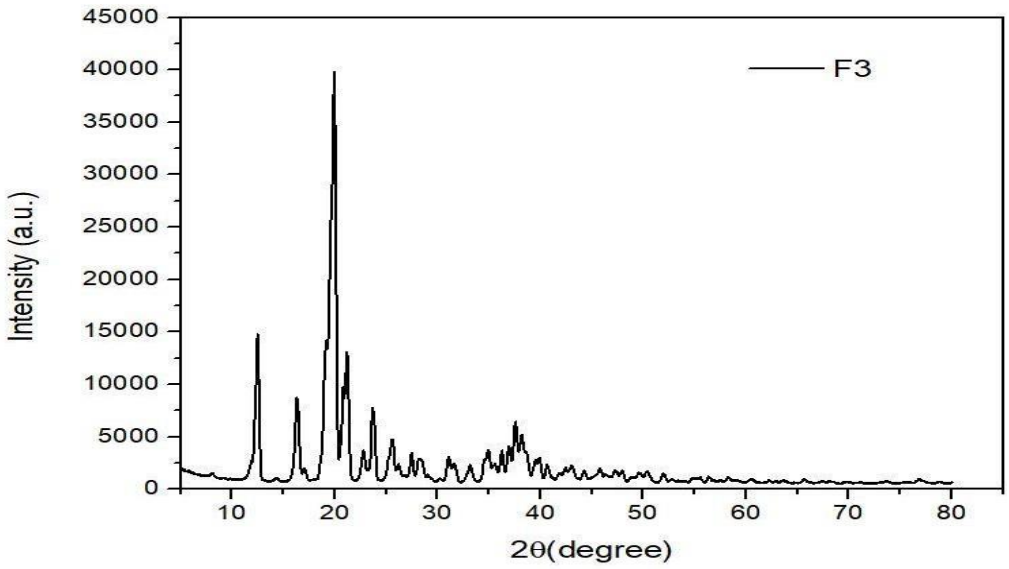
in 100 ml of distilled water (Solution II), then, drug solution (Solution I) and Stabilizer Solution and Tween 80 (Solution II) which is placed on magnetic stirrer with continuous stirring was injected simultaneously in spray dryer through peristaltic pump. Total 12 batches were formulated by using HPMC E15 and SLS in the concentration range of 0.5 % and 1 %.All the formulations were evaluated for particle size and zeta potential. Based on the results 03 formulations (F3, F7 & F8) were found satisfactory as far as particle size and zeta potential were concerned.

Composition of various Formulation

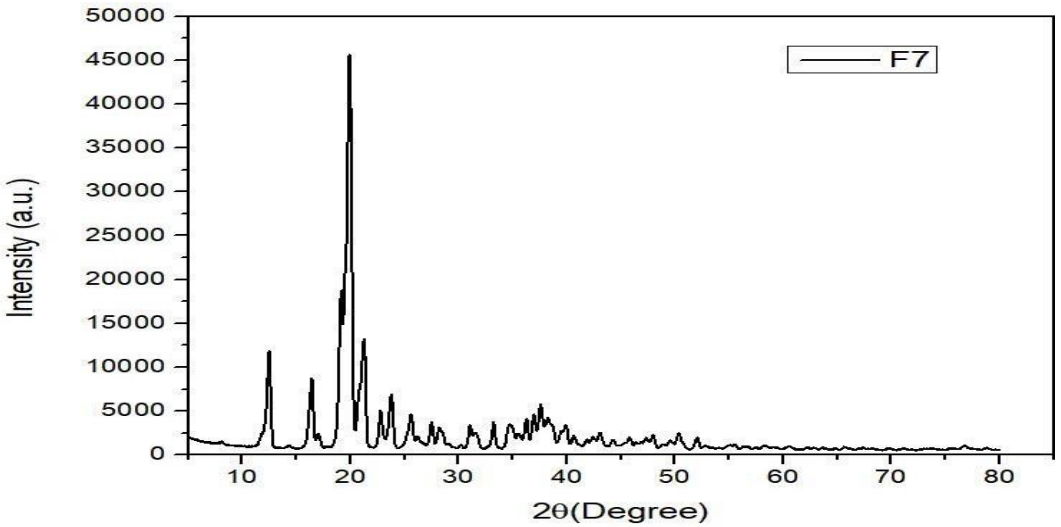
Formulation	Formulationcode	Stabilizer	Percentage of stabilizer Used
1	F1 Zal	HPMC E 15	0.5
2	F2 Zal	HPMC E 15	1.0
3	F3 Zal	SLS	0.5
4	F4 Zal	SLS	1.0
5	F5 CF	HPMC E 15	0.5
6	F6 CF	HPMC E 15	1.0
7	F7 CF	SLS	0.5
8	F8 CF	SLS	1.0

Estimation of Particle Size Distribution and Zeta Potential (ZP)

Formulation code	Stabilizer	Conc.	Particle Size	Zeta Potential
F1 Zal	HPMC	0.5	344	-12.35
F2 Zal		1	321	-11.12
F3 Zal	SLS	0.5	465	-15.18
F4 Zal		1	427	-21.36
F5 CF	HPMC	0.5	1126	- 9.25
F6 CF		1	559	- 10.50
F7 CF	SLS	0.5	289	-15.64
F8 CF		1	327	-16.55



Facilities used: PURSE – DST Centre for Interdisciplinary Science & Technology



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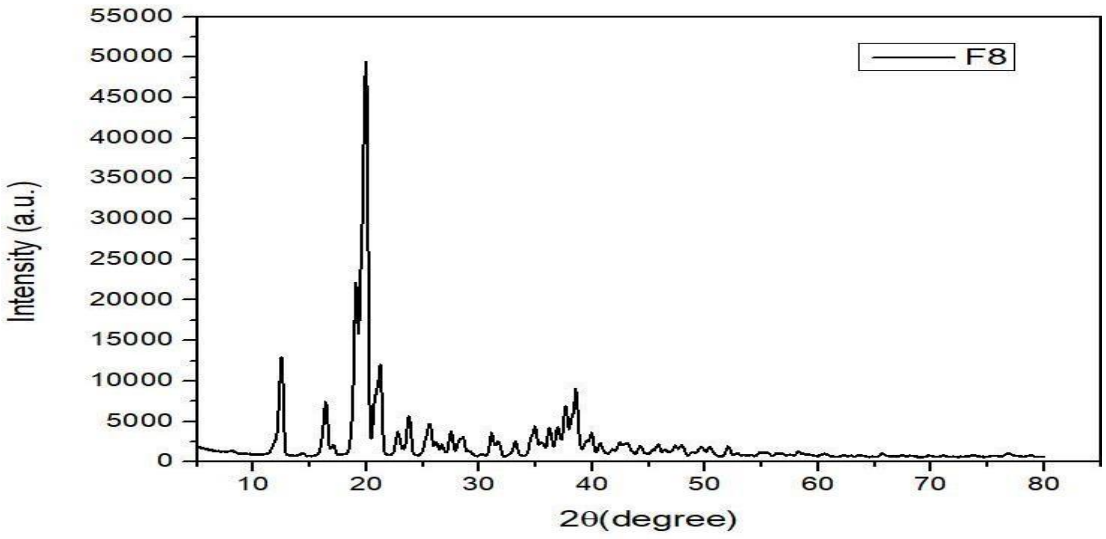

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CONCLUSION:

- All the anti arthritic agents like Zaltoprofen & Cataflam could be successfully prepared in the form of nanocrystals with particle size below 1000 nm.
- These nanocrystals to be dispensed in appropriate dosage form and route of administration, could be to formulate in the form of nanoemulgel for topical administration.
- Spray dryer is used to formulate nanocrystals by aqueous dispersion method.
- Initially 08 (F1 to F8) batches of nanocrystals were prepared and evaluated for various parameters, based on the particle size, 03 batches (F3, F7 & F8) were further can be processed for final conversion into nanoemulgel as final product.
- All the nano crystals were prepared successfully and shown good particle size (below 1000 nm) as well as good crystallinity.

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