

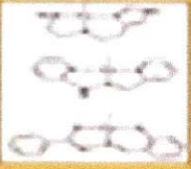



AJPC

ASIAN JOURNAL OF PHARMACEUTICAL AND  
CLINICAL RESEARCH



[www.ajpc.com](http://www.ajpc.com)

Home | About | Login | Register | Search | Current | Archives | Editorial Board |  
Submission | Instructions to Authors | Contact Us

USER

Search Articles

All

Search

Username

Password

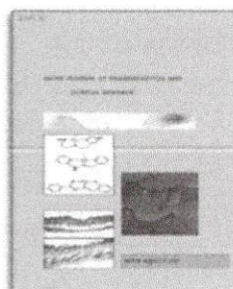
Remember me

Login

## Vol 10 Issue 6 June 2017

### Table of Contents

#### Case Study(s)



**Impact (Cites per doc)- 0.49**  
(SCImago, SJR 2016)

**ICV 2016 = 104.84**

**Print ISSN- 0974-2441**

**Online ISSN- 2455-3891**



SCOPUS™



#### A CASE REPORT ON CHRONIC LEAD POISONING FROM OCCUPATIONAL EXPOSURE

Dhivya K, Nazma M, Divya Sree P, Lakshmi Prasanna S

**Abstract** || **View PDF** || **Download PDF** || DOI: 10.22159/ajpcr.2017.v10i6.18061

Pages: 1-2 | [Share](#)

#### KERATOCYSTIC ODONTOGENIC TUMOR OF THE MAXILLARY ANTERIOR REGION MASQUERADING AS A RADICULAR CYST

Byakodi Sanjay Satappa, Datar Uma Vasant, Sampada Kaniitkar, Mamata Kamat

**Abstract** || **View PDF** || **Download PDF** || DOI: 10.22159/ajpcr.2017.v10i6.17513

Pages: 3-4 | [Share](#)

#### Review Article(s)

#### CHEMOTHERAPY OF LEISHMANIASIS – A REVIEW

Borah Uttam, Dash Biswajit, Dash Suvakanta

**Abstract** || **View PDF** || **Download PDF** || DOI: 10.22159/ajpcr.2017.v10i6.18863

Pages: 5-10 | [Share](#)

#### THE ROLE OF THE CLINICAL AND MOLECULAR ASSAYS IN PROSTATE CANCER DETECTION

Fatemeh Mansouri

**Abstract** || **View PDF** || **Download PDF** || DOI: 10.22159/ajpcr.2017.v10i6.17490

Pages: 11-15 | [Share](#)

#### HAVING A GO AT SPINAL MUSCULAR ATROPHY WITH SPINRAZA

Balaji O, Amita D, Sreen Rt, Navin Ap

**Abstract** || **View PDF** || **Download PDF** || DOI: 10.22159/ajpcr.2017.v10i6.17502

Pages: 16-18 | [Share](#)

## JOURNAL METRICS

Source Normalized  
Impact per Paper  
(SNIP): 0.492

Impact per  
Publication  
(IPP): 0.588

SCImago Journal  
Rank (SJR): 0.22

Cite Score: 0.49

Print ISSN: 0974-  
2441

Online ISSN:  
2455-3891

## MOST DOWNLOADED ARTICLES

- PREGELATINIZED CASSAVA STARCH...
- ANTIBACTERIAL ACTIVITY OF HYDROLYZED...
- BUCCAL PENETRATION ENHANCERS-AN OVERVIEW
- Upper Thoracic spine(D2-D3)...
- ANTI-CANCER ACTIVITY OF DATURA METEL...
- ANTIBACTERIAL ACTIVITY OF THE...
- A REVIEW: LOVASTATIN PRODUCTION AND...
- DIPEPTIDYL PEPTIDASE-IV INHIBITORY...

## PHYTOCHEMISTRY AND ETHNOPHARMACOLOGY OF THE SEA GRASS CYMODOCEACEA FAMILY- A REVIEW

Pushpa Bharathi Namadevan, Vanitha V

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.18078

Pages: 19-23 | [Share](#)

## PROGNOSTIC BIOMARKERS IN TRIPLE NEGATIVE BREAST CANCER AS A POTENTIAL TARGET FOR FUTURE DRUG DISCOVERY

Mekhla Gupta, Sanjeev Kumar Gupta, Rajesh Kumar Singh, Seema Khanna

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17727

Pages: 24-28 | [Share](#)

## THE ROLE OF HEALTH INFORMATION SYSTEM IN MATERNAL AND CHILD HEALTHCARE SERVICES

Rakhi Chowdhury, Leena Kumari, Subhamay Panda

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.15918

Pages: 29-31 | [Share](#)

## VANCOMYCIN INTERMEDIATE AND VANCOMYCIN RESISTANT STAPHYLOCOCCUS AUREUS - MECHANISMS, CLINICAL SIGNIFICANCE AND DETECTION

Gopalkrishna K Bhat, Jyoti Kumari, Shalini M Shenoy, Ashwini Hegde, Chakrapani M, Vidyalakshmi K

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.15993

Pages: 32-38 | [Share](#)

## CHEWING GUM: CONFECTIONARY TO A POPULAR TRANSBUCCAL DOSAGE FORM

Bharat Jhanwar, Bhupendra Singh Tomar, Surajpal Verma

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.18307

Pages: 39-48 | [Share](#)

## FICUS CARICA AND ITS CONSTITUENTS ROLE IN MANAGEMENT OF DISEASES

Arshad H Rahmani, Yousef H Aldebasi

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17832

Pages: 49-53 | [Share](#)

## MAGNETIC MICROSPHERE AN EMERGING DRUG DELIVERY SYSTEM

Diksha Sharma, Abhishek Sharma

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17284

Pages: 54-58 | [Share](#)

## POLYMER GRAFTING AND APPLICATIONS IN PHARMACEUTICAL DRUG DELIVERY SYSTEMS - A BRIEF REVIEW

Mahesh S Sakhare, Hrishikesh H Rajput

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.18072

Pages: 59-63 | [Share](#)

## DEFLUORIDATION TECHNIQUES- A CRITICAL REVIEW

Nausheen Mobeen, Pradeep Kumar

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.13942

Pages: 64-71 | [Share](#)

## Original Article(s)

• TURMERIC:  
NATURE'S  
PRECIOUS  
MEDICINE.  
•  
ETHNOBOTANICAL  
STUDIES ON  
SELECTED...

AMELIORATING THE METABOLIC DISORDER IN STREPTOZOTOCIN-INDUCED DIABETIC RATS BY HAEMATOCOCCUS PLUVIALIS EXTRACT

Farouk Kamel Elbaz, Hanan F Aly

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17785

Pages: 72-77 | [Share](#)

---

MULTIPLE ANTIBIOTIC RESISTANCE INDEXING OF NON- FERMENTING GRAM NEGATIVE BACILLI

Bhuvaneshwari Gunasekar

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17717

Pages: 78-80 | [Share](#)

---

RAPID IN VITRO CALLOGENESIS AND PHYTOCHEMICAL SCREENING OF LEAF, STEM AND LEAF CALLUS OF MUSSAENDA FRONDOSA LINN. - A MEDICINAL PLANT.

Manasa Dj, Chandrashekar Kr, Bhagya N

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17527

Pages: 81-86 | [Share](#)

---

SURVEILLANCE OF MORTALITY: FROM A TERTIARY CARE TEACHING HOSPITAL OF EASTERN INDIA IN PERSONS WITH AND WITHOUT DIABETES MELLITUS

Shobhitendu Kabi, Shrikant Kumar Dhar, Baikuntha Nath Panda, Chandan Das, Kamal Kant Jena, Mahesh Chandra Sahu

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17430

Pages: 87-90 | [Share](#)

---

COCRYSTALLIZATION ACYCLOVIR-SUCCINIC ACID USING SOLVENT EVAPORATION METHODS

Agnes Nuniek Winantari, Dwi Setyawan, Siswando Siswodihardjo, Sundono Nuroso Soewandhi

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.16369

Pages: 91-94 | [Share](#)

---

OXIDATIVE STRESS REDUCING AND LIVER PROTECTIVE EFFICACY OF ETHYL ACETATE FRACTION ISOLATED FROM PAJANELIA LONGIFOLIA (WILLD) K. SCHUMAN

Suparna Datta, Manabendra Dutta Choudhury

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.16898

Pages: 95-99 | [Share](#)

---

EFFECTS OF ORAL ALFACALCIDOL ON MATURATION OF DENDRITIC CELLS IN GRAVES' DISEASE PATIENTS: A DOUBLE-BLINDED RANDOMIZED CLINICAL TRIAL

Dyah Purnamasari, Samsuridjal Djauzi, Siti Setiati, Alida Harahap, Tjokorda Gde Pemayun, Joedo Prihartono, Pradana Soewondo

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.16110

Pages: 100-104 | [Share](#)

---

MEAL INDUCED OXIDATIVE STRESS LEVELS IN CONTROLLED AND POORLY CONTROLLED DIABETES

Sulekha Sinha, Poomima A Manjrekar, Anupama Hegde, Rukmini Ms

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17814

Pages: 105-107 | [Share](#)

---

DEVELOPMENT OF MOLECULAR IMPRINTED POLYMER SOLID PHASE EXTRACTION (MISPE) FOR SEPARATION NITROFURANTOIN RESIDUE IN CHICKEN EGGS

Sophi Damayanti, Untung Gunawan, Slamet Ibrahim

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17109

Pages: 108-111 | [Share](#)

---

#### ASSOCIATION OF SERUM URIC ACID AND LIPID PROFILE IN TYPE 2 DIABETIC PATIENTS WITH AND WITHOUT DIABETIC RETINOPATHY

Ramesh Venkatachalam, Rathna Kumar, Ramachandran Kaliaperumal, Anitha Devaraj, Anebaracy V, Buvana Balamugundan, Poovitha R, Geetha Rajagopalan

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17029

Pages: 112-114 | [Share](#)

---

#### ANTICHOLINESTERASE ACTIVITY OF OCTA PEPTIDES RELATED TO HUMAN HISTATIN 8: IN-SILICO DRUG DESIGN AND IN-VITRO

Pandurangan Perumal, Mani Vasudevan, Sridevi Chigurupati, Manikandan Selvaraj

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17697

Pages: 115-117 | [Share](#)

---

#### USE OF TISSUE DOPPLER IMAGING TO DETECT RIGHT VENTRICULAR MYOCARDIAL DYSFUNCTION IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Jyothi Samanth, Padmakumar R, Ashwinikumar Mohapatra, Krishnananda N, Navin Patil, Kartthik Rao, Vidya Nayak, Balaji Ommurugan, Dipanjan Bhattachariya, Rahul Kotian

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17517

Pages: 118-124 | [Share](#)

---

#### COMPARATIVE MUCOPENETRATION ABILITY OF METRONIDAZOLE LOADED CHITOSAN AND PEGYLATED CHITOSAN NANOPARTICLES

Sukhbir Kaur, Chawla V, Narang R K, Aggarwal G

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17643

Pages: 125-130 | [Share](#)

---

#### ANTIBIOTIC UTILIZATION PATTERN AT THE SURGERY DEPARTMENT OF A TERTIARY CARE HOSPITAL

Asawari Raut, Tirezah Cherian, Shreepa Chauhan, Atmaram Pawar

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.18099

Pages: 131-134 | [Share](#)

---

#### EFFECT OF POST-ISOMETRIC RELAXATION AND RECIPROCAL INHIBITION IN OSTEOARTHRITIS KNEE

Sushmita Singh, Vaishali Krishnat Jagtap, Poovishnu Devi T

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17720

Pages: 135-138 | [Share](#)

---

#### ANTIMICROBIAL AND ANTHELMINTIC ACTIVITIES OF SOME NEWLY SYNTHESIZED TRIAZOLES

Jeetendra Kumar Gupta, Pradeep Mishra

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17800

Pages: 139-145 | [Share](#)

---

#### ANTIBIOGRAM AND MOLECULAR CHARACTERIZATION OF VIBRIO CHOLERAE ISOLATED FROM MARINE FISH

Rwarinda U Angelo, Samiraj Ramesh Ramesh

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17883

Pages: 146-149 | [Share](#)

---

STANDARDIZATION OF MODEL OF INDUCTION OF HEPATOTOXICITY WITH ANTI-TUBERCULOSIS DRUGS IN WISTAR ALBINO RATS

Sarita M Kaggate, Abhijit B Patil

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.11971

Pages: 150-153 | [Share](#)

---

FORMULATION AND EVALUATION OF IN-SITU GEL CONTAINING CIPROFLOXACIN HYDROCHLORIDE IN THE TREATMENT OF PERIODONTITIS.

Gorle Ashish, Yadav Rahul, Rathod Mukesh, Mali Prakash

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17558

Pages: 154-159 | [Share](#)

---

ASSESSMENT OF ANTI-INFLAMMATORY ACTIVITY AND CYTOTOXICITY OF FREEZE DRIED HYDROALCOHOLIC EXTRACT OF BIDENS ANDICOLA ON ISOLATED NEUTROPHILS

Vinúeža D, López E, Acosta K, Abdó S

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17574

Pages: 160-163 | [Share](#)

---

AWARENESS, KNOWLEDGE AND ATTITUDE TOWARDS PHARMACOVIGILANCE AMONG MEDICAL GRADUATES IN A TERTIARY CARE TEACHING HOSPITAL IN SOUTH INDIA.

Arul Amutha Elizabeth L, Arvinth A, Sushimtha R, Sowmiya P

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.18129

Pages: 164-167 | [Share](#)

---

ASSOCIATION BETWEEN MENARCHE AGE AND MENOPAUSAL SYMPTOMS

Muharam R, Muhammad Ikhsan, Herdinda Erudite Rizkinya

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17706

Pages: 168-170 | [Share](#)

---

EFFECTS OF HOME EXERCISE PROGRAMME ON SHOULDER PAIN AND FUNCTIONAL STATUS IN MALE CONSTRUCTION WORKERS

Malarvizhi D, Divya D, Sivakumar Vpr

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17080

Pages: 171-174 | [Share](#)

---

PARTICULATE DELIVERY SYSTEM OF CHITOSAN - DITERPENE LACTONE FRACTION OF SAMBILOTO (ANDROGRAPHIS PANICULATA NEES): PREPARATION, CHARACTERIZATION AND IN VITRO DRUG RELEASE

Retno Sari, Widji Soeratri, Esti Hendradi

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.6161

Pages: 175-179 | [Share](#)

---

NEUROPROTECTIVE ROLE OF BIMOCLOMOL IN ECTOPIC CELL CYCLE IN PARKINSON'S DISEASE: NEW INSIGHTS

Renu Sharma, Pravir Kumar

**Abstract** || [View PDF](#) || [Download PDF](#) || DOI: 10.22159/ajpcr.2017.v10i6.17971

Pages: 180-183 | [Share](#)

---

ANTIOXIDANT POTENTIAL PROFILE OF PAJANELIA LONGIFOLIA (WILLD.) K. SCHUMAN.; POTENTIAL NEW SOURCES OF NATURAL ANTIOXIDANT.

Priyanka Saha, Anupam Das Talukdar, Manabendra Dutta Choudhury

**PARTICULATE DELIVERY SYSTEM OF CHITOSAN - DITERPENE LACTONE FRACTION OF SAMBILOTO (*ANDROGRAPHIS PANICULATA* NEES): PREPARATION, CHARACTERIZATION AND *IN VITRO* DRUG RELEASE**

RETNO SARI\*, WIDJI SOERATRI, ESTI HENDRADI

Department of Pharmaceutics, Faculty of Pharmacy, Airlangga University, Dharmawangsa Dalam, Surabaya 60286, Indonesia.

Email: retno-s@ff.unair.ac.id/retno\_1963@yahoo.com

Received: 15 April 2015, Revised and Accepted: 22 March 2017

**ABSTRACT**

**Objective:** This paper was aimed to study the effect of chitosan, sodium tripolyphosphate (TPP) as crosslinker, and diterpene lactone fraction of sambiloto (FDTL) from *Andrographis paniculata* Nees which contained 75.9% andrographolide on the characteristics of the FDTL-chitosan particulate system. Those characteristics were the physicochemical interaction, physical state, morphology, and drug entrapment efficiency. The *in vitro* drug release of the selected FDTL-chitosan particulate system was also evaluated.

**Methods:** The particulate system of FDTL-chitosan was prepared by ionic gelation-spray drying method with the various amounts of TPP, chitosan, and FDTL. The physical characteristics were evaluated using Fourier transform infrared (FTIR), differential thermal analyzer (DTA), and X-ray diffraction, scanning electron microscope. *In vitro* drug release was performed in 0.1% sodium lauryl sulfate media at 37°C.

**Results:** The results of FTIR and DTA analysis were in accordance with the results of morphology evaluation which indicated that chitosan-TPP ratio 10:8 could produce chitosan particles with a spherical and smooth surface. FDTL has been trapped in chitosan particulate systems, and the crystallinity of FDTL changed. Particulate systems with FDTL-chitosan-TPP ratio - 4:10:8 showed better characteristics compared to others with entrapment efficiency of 33.82%. The dissolution efficiency at 360 minutes ( $ED_{360}$ ) of particulate systems FDTL-chitosan was higher up to 1.5 times compared to FDTL.

**Conclusion:** The difference in the ratio of chitosan and TPP affected the morphology of chitosan particles since the amount of drug loaded, and the amount of chitosan affected the drug entrapment. The  $ED_{360}$  of FDTL of FDTL-chitosan-TPP increased up to 1.5 times compared to the FDTL.

**Keywords:** Chitosan, Diterpene lactone fraction, Particulate systems, Tripolyphosphate, Physical characteristics, Drug release.

© 2017 The Authors. Published by Innovare Academic Sciences Pvt Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>) DOI: <http://dx.doi.org/10.22159/ajpcr.2017.v10i6.6161>

**INTRODUCTION**

Drug carrier system has been developed in the past decade because it can deliver hydrophilic and hydrophobic drug molecules. Drug carrier system can be used for various purposes such as improving bioavailability, improve stability, lower toxicity, reduced side effects, and prevent drug interactions. Carrier used will affect the interaction of the drug with a carrier where the drug can be trapped in a carrier or form covalent bonds with the carrier. Type of drug carrier systems is a cellular carrier, the lipid carrier, carrier, and other particulate matter [1,2].

Chitosan particulate system is a common drug carrier that can be used to enhance the dissolution of the poorly soluble drug. As a result, the drug bioavailability will also increase hence results in better drug efficacy. Chitosan is a polycationic polysaccharide which is copolymers of glucosamine and N-acetylglucosamine. This material is biodegradable, biocompatible, and nontoxic. Chitosan has primary amine group ( $-NH_2$ ) on the main backbone structure that causes chitosan to have positively charged surface and enables preparation of the particulate system (microparticles or nanoparticles) using ionic gelation method. The ionic gelation method is based on the crosslinking reaction between chitosan and a polyanionic substance such as tripolyphosphate (TPP) as the crosslinker. The ratio of polymer and crosslinker is related with  $NH_3^+$  protonated from chitosan that could interact with  $P_3O_{10}^{5-}$  of TPP. The electrostatic interaction between  $NH_3^+$  and  $-P_3O_{10}^{5-}$  will affect the physicochemical characteristics including the physical and chemical interactions, matrix density, morphology, particle size, and drug entrapment, which could further affect the drug release, bioavailability, and effectiveness of the drug [3-8].

Sambiloto (*Andrographis paniculata* Nees) is a medicinal plant that has many activities such as analgesic, antipyretic, anti-inflammatory, hepatoprotective, antiviral, antithrombotic, and anticancer [9,10]. The diterpene lactone compound of sambiloto is andrographolide, which has low oral bioavailability due to its high lipophilicity ( $\log P=2.632$ ), low solubility in water ( $3.29\pm 0.73$  mg/L), and short biological half-life [11,12]. Andrographolide is known to inhibit the growth of malaria parasite, *Plasmodium sergei* [13]. Nevertheless, the poor solubility of this plant compounds hinders its effectiveness to treat this disease effectively. Entrapment of the poorly soluble substance in the hydrophilic polymers, such as the chitosan particulate system, could improve dissolution of this poorly soluble plant compound hence increases its bioavailability and effectiveness.

This research is aimed to enhance the characteristics of diterpene lactone fraction of sambiloto (FDTL) containing 75.9% andrographolide which is poorly soluble substance by forming a particulate system with chitosan. The particulate system was prepared by ionic gelation-spray drying method in the various amounts of chitosan, FDTL, and TPP as a crosslinker. The interaction between the polymer and crosslinker, thermodynamics, solid state, morphology, drug content, and *in vitro* drug release of the formed chitosan particulate system was studied.

**MATERIALS AND METHODS****Materials**

FDTL containing 75.9% andrographolide was obtained from Pharmacognosy and Phytochemistry Department, Faculty of Pharmacy, University Airlangga. Low viscosity chitosan (DD 85%, pharmaceutical

grade) was purchased from Biotech Surindo, and pentasodium TPP (analytical grade) was obtained from Nacal Tesque. Acetic acid glacial (Emsure®) and all other reagents used in this experiment were of analytical grade.

## Methods

### Preparation of chitosan particles

The unloaded chitosan particles were produced by ionic gelation-spray drying methods with the ratio of chitosan:TPP (as a crosslinker) vary from 10:1 to 10:10. Chitosan solution was prepared by dissolving 100 mg chitosan in 100 ml of 0.15% acetic acid solution. Various concentrations of TPP solution were prepared by dissolving TPP (10-100 mg) in 80 ml aqua dest. TPP solution was then added dropwise into chitosan solution while stirring at 500 rpm. The mixture was continuously stirred for 1 hr. Following to this, each mixture of chitosan-TPP was then spray-dried using SD-Basic Labplant spray dryer. The spray drying process was performed with using 0.5 mm nozzle diameter at inlet temperature 100°C, the flow rate of 5 ml/min and pressure at 2 mBar. The dry particles were collected and analyzed by Fourier transform infrared (FTIR), differential thermal analyzer (DTA), and scanning electron microscope (SEM). From the results obtained, one optimum composition of chitosan-TPP was then selected and used for the preparation of FDTL loaded chitosan particles.

### Preparation of FDTL loaded chitosan particles

The drug-loaded particles were prepared with compositions as detailed in Table 1. Chitosan solution was added into FDTL solution in ethanol. Then, the TPP solution was added dropwise to the mixture solution of FDTL-chitosan while stirring at 500 rpm. The mixture was stirred continuously for 1 hr. Then, the process was continued as mentioned above.

### Fourier transform infrared (FTIR)

FTIR spectra analysis was performed for the unloaded chitosan particles, and FDTL loaded chitosan particles. Before analysis, about 2 mg samples was mixed with 300 mg KBr powder then pressed to form a pellet. The KBr pellet was observed at 400-450/cm using Jasco FT-IR 5300, Easton MD, USA.

### Particles size and morphology

The particles size and morphology were evaluated using SEM FEI, Type Inspect S-50 in various magnifications. Particles were dried and coated with gold palladium before the SEM analysis.

### DTA

Thermal analysis of FDTL, chitosan and the FDTL-chitosan particles obtained were performed with DTA (FP-65 P900 Thermal, Mettler Toledo, USA). Approximately 5 mg samples were scanned from 50 to 250°C with a heating rate of 5°C/min.

### X-ray diffraction (XRD)

The diffraction pattern of unloaded particles and loaded particles of chitosan were recorded using X-ray diffractometer (X'Pert analytical, The Netherlands). The analysis was conducted at room temperature at 40 kV voltages and 40 mA current. The angle of  $2\theta$  was set between 5 and 40°.

Table 1: Composition of FDTL-chitosan particles

Formula	Chitosan (mg)	TPP (mg)	FDTL (mg)
A	100	80	30
B	100	80	40
C	100	80	50
D	100	80	40
E	125	100	40
F	150	120	40

FDTL: Diterpene lactone fraction of sambilitoto

### Drug loading and entrapment efficiency

About 5 mg sample was dissolved in 10 ml ethanol then filtered and analyzed by high-performance liquid chromatography (HPLC) (Agilent 1100 Series), HPLC column (Merck LiChrospher® 100 RP 18, 4 mm × 250 mm, 5 µm). The mobile phase consists of methanol: Orthophosphoric acid pH 3=50:50. The flow rate was set at 0.75 µl/min. The sample was measured at wavelength 228 nm. The assays were performed in triplicate. The drug loading and entrapment efficiency were calculated using the following equations:

$$\% \text{ Drug content} = \frac{\text{Drug amount}}{\text{Particle weight}} \times 100\% \quad (1)$$

$$\% \text{ Entrapment efficiency} = \frac{\text{Actual drug amount}}{\text{Theoretically drug amount}} \times 100 \quad (2)$$

### In vitro drug release

The *in vitro* drug release test was carried out in 0.1% w/v sodium lauryl sulfate (SLS) in water. SLS was used to improve the dissolution of andrographolide [14]. FDTL-chitosan particles equivalent with 1 mg FDTL was weighed accurately and sprinkled in the medium. The test was conducted in 25 ml medium at 37±0.5°C in water bath shaker. 0.5 ml sample was taken at a predetermined time during 24 hrs and analyzed by HPLC (Agilent 1100 Series), HPLC column (Merck LiChrospher® 100 RP 18, 4 mm × 250 mm, 5 µm) using ethanol - orthophosphate pH 3=5:5. Replacement of the medium was done at each sampling time with the same volume of the withdrawn sample.

## RESULTS AND DISCUSSION

In this study, unloaded chitosan particles prepared with ionic gelation-spray drying with various amount of TPP to study the effect of TPP amount on chitosan particles formation. The dry particles obtained were analyzed using FTIR spectrophotometer, SEM, and DTA.

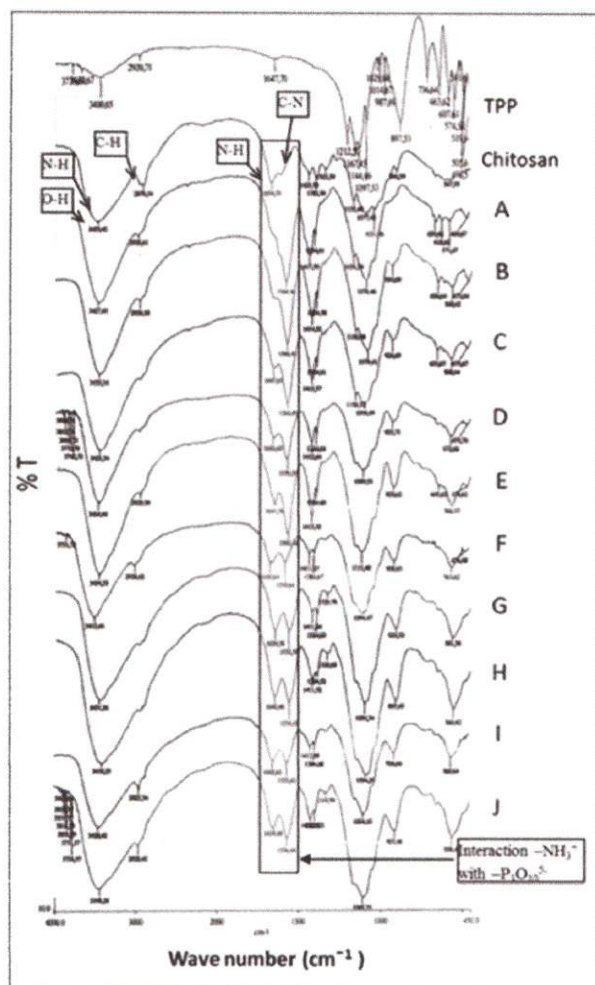
### FTIR

As showed in Fig. 1, the FTIR spectra indicated that increasing TPP amount changed the vibrational pattern of the infrared spectra. The spectra of particles with chitosan-TPP at ratio 10:3 showed a new absorption band at 1640-1650/cm. This indicates the bond between  $\text{NH}^+$  ions of chitosan with  $-\text{P}_3\text{O}_{10}^{5-}$  of TPP. The intensity of the absorption band at 1640-1650/cm was higher as TPP amount increased. This result indicated an increase in the crosslinking degree and inter- and intramolecular interactions of chitosan. As chitosan-TPP ratio >10:5, the intensity of the ionic interaction between  $-\text{NH}^+$  cations of chitosan and multivalent anions  $-\text{P}_3\text{O}_{10}^{5-}$  of TPP increased along with the availability of  $-\text{P}_3\text{O}_{10}^{5-}$ . Increasing the ionic interaction caused an increase in the density of inter- and intramolecular bonds of the cross-linked chitosan. This resulted in strengthening the density of cross-linked chitosan structure that generates spherical particles with a smooth surface structure.

### Particles size and morphology

The morphology of unloaded particles was showed in Fig. 2. Morphology of chitosan particulate systems observed by SEM showed that the particles produced from chitosan-TPP with ratio 10:1-10:5 had a hollow structure. In ratio chitosan-TPP=10:1 particles had rough surface structure, and aggregate mass showed that the cross-linked bond between chitosan and TPP did not occur and the particles formed was more affected by the amount of chitosan compared with TPP. Furthermore, as the chitosan-TPP ratio was higher than 10:6, the unloaded chitosan particles had spherical and smooth surface. Increasing TPP amount strengthened the crosslinking between  $-\text{NH}^+$  ions of chitosan with  $-\text{P}_3\text{O}_{10}^{5-}$  of TPP as shown by the FTIR spectra in Fig. 1. Increasing TPP amount formed more solid particles with a fewer hollow. The ratio of chitosan-TPP=10:8 could form particles with a spherical shape and smooth surface structure (Fig. 2). The addition of FDTL in the chitosan particles did not affect the morphology of the particles as shown in Fig. 3.



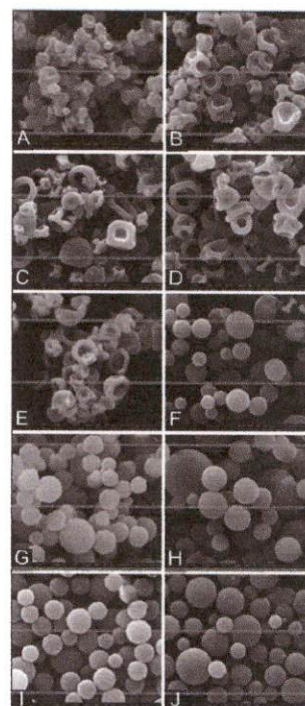


**Fig. 1:** Fourier transform infrared spectra of tripolyphosphate (TPP), chitosan and unloaded chitosan particles with chitosan-TPP ratio: 10:1 (A), 10:2 (B), 10:3 (C), 10:4 (D), 10:5 (E), 10:6 (F), 10:7 (G), 10:8 (H), 10:9 (I), 10:10 (J)

#### DAT

The results of the DTA as in Fig. 4 showed that the unloaded particles of chitosan-TPP with the ratio of 10:1-10:3 had melting range lower than chitosan and broad endothermic peak as chitosan. Furthermore, in particles with a ratio of chitosan-TPP=10:4 and 10:5, the endothermic peak broadened. As the ratio of chitosan-TPP increased, thermogram pattern became narrower due to the interaction between the molecules of chitosan and TPP which form ionic bonds so that the molecular structure of chitosan particulate system changed. Particles with chitosan-TPP ratio 10:8 had a sharp endothermic peak, indicating an optimal chemical interaction between the  $\text{-NH}_3^+$  and  $\text{-P}_3\text{O}_{10}^{5-}$  resulting in more ordered structure than the other compositions. This is confirmed by the data of FTIR spectra (Fig. 1) in which the intensity of the absorption band at wavenumber  $1640/\text{cm}$  was higher. Chitosan is a polysaccharide that is able to absorb the water and in the solid state has an irregular structure that is easily hydrated. The intensity of crosslinking in different degrees will lead to differences in the water absorption of the particulate system that affect the crystallinity of chitosan. The presence of hydrogen bonds, ionic intramolecular and intermolecular bonding in the structure of the particles will form a strong bond that requires higher energy to dehydration [15].

Evaluation of the FTIR and DTA results was in accordance with the results of morphology evaluation by SEM. From the details of SEM



**Fig. 2:** Scanning electron microscope photograph of unloaded chitosan particles with chitosan-tripolyphosphate ratio: 10:1 (A), 10:2 (B), 10:3 (C), 10:4 (D), 10:5 (E), 10:6 (F), 10:7 (G), 10:8 (H), 10:9 (I), 10:10 (J) (magnification,  $\times 20,000$ )

analysis on Fig. 2, the particle surface structure and sphericity proved that the ratio of chitosan-TPP 10:8 could form particles with good physical characteristics in terms of the interaction between chitosan and TPP, their sphericity as well as the surface structure. However, the particles sizes were in wide ranges of 500 nm to 5  $\mu\text{m}$ .

Furthermore, the results of thermal analysis with DTA in Fig. 5 showed that the FDTL loaded chitosan particulate system with chitosan-FDTL-TPP with ratio of 10:3:8 and 10:5:8 had lower melting point ( $144^\circ\text{C}$ ) with broadening endothermic peaks compared to the unloaded system with chitosan-TPP ratio 10:8 ( $157^\circ\text{C}$ ). The addition of FDTL altered the arrangement of chitosan particulate system molecular structure. The thermogram of particles with FDTL-chitosan-TPP ratio=10:4:8 was different from other systems. The thermogram showed a sharper endothermic peak with lower melting range ( $181.6^\circ\text{C}$ ) compared to FDTL. This indicated that the particulate system with FDTL-chitosan-TPP ratio=10:4:8 had more stable and ordered molecular structure than the other formulas.

#### XRD

The XRD in Fig. 6 showed that FDTL has sharp peaks indicated a crystalline structure of FDTL while chitosan had no sharp peaks that denoted as an amorphous structure. From diffractogram of FDTL-chitosan particulate systems, it was seen that crystalline peak of FDTL disappeared, whilst the sharp peak of FDTL in the physical mixture of FDTL-chitosan still observed. This verified that FDTL had been trapped in chitosan particulate systems and the crystalline structure altered due to the recrystallization barriers of cross-linked chitosan. Entrapping FDTL in cross-linked chitosan and rapid drying during spray drying also hindered the growth of crystals so that drug particles trapped in the smaller size. Since a crystalline form of a drug has low solubility, therefore change in crystalline structure to the amorphous structure/unordered structure would be advantageous. Since the amorphous form has a higher solubility than the crystalline form, this change could increase the bioavailability of the drug [16].

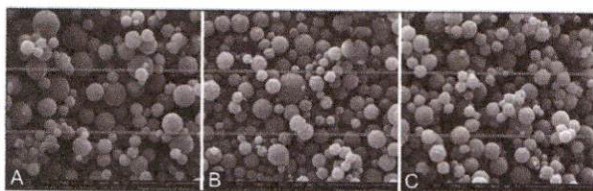


Fig. 3: Scanning electron microscope photograph of diterpene lactone fraction of sambiloto (FDTL) loaded chitosan particles with FDTL-chitosan-tripolyphosphate ratio: 3:10:8 (A), 4:10:8 (B), 5:10:8 (C) (magnification,  $\times 10,000$ )

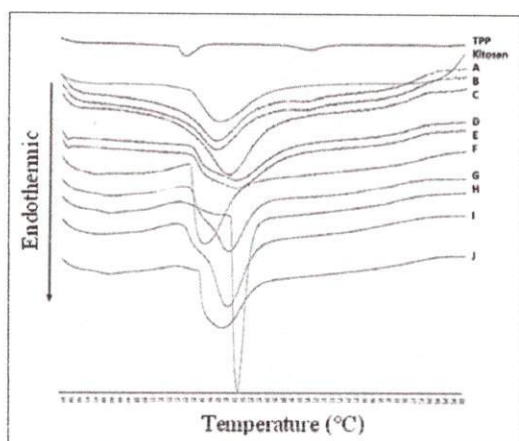


Fig. 4: Differential thermal analyzer thermogram of unloaded chitosan particles: 10:1 (A), 10:2 (B), 10:3 (C), 10:4 (D), 10:5 (E), 10:6 (F), 10:7 (G), 10:8 (H), 10:9 (I), 10:10 (J)

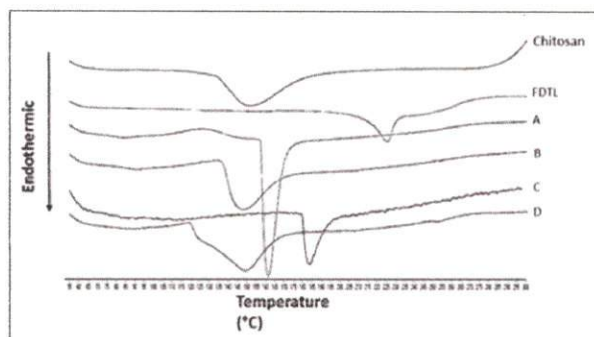


Fig. 5: Differential thermal analyzer thermogram of chitosan, diterpene lactone fraction of sambiloto (FDTL), and unloaded particles (A), FDTL loaded particles with FDTL-chitosan-tripolyphosphate ratio 3:10:8 (B), 4:10:8 (C), 5:10:8 (D)

#### Drug loading and entrapment efficiency

Particulate systems of FDTL-chitosan-TPP were prepared with various amounts of chitosan and FDTL to investigate the capability of the system to entrap drug. From evaluation of the entrapment efficiency, it was found that increasing FDTL amount will lead to an increase in the entrapment efficiency. From the statistical analysis of one-way ANOVA followed by least significant difference test, it was known that formula A to B and A to C was significantly different, but there was no significant difference between B and C (Table 2).

Increasing the amount of polymer will increase the viscosity of the polymer result in a better ability of drug entrapment of particulate systems [3]. However, the results showed that increase in chitosan

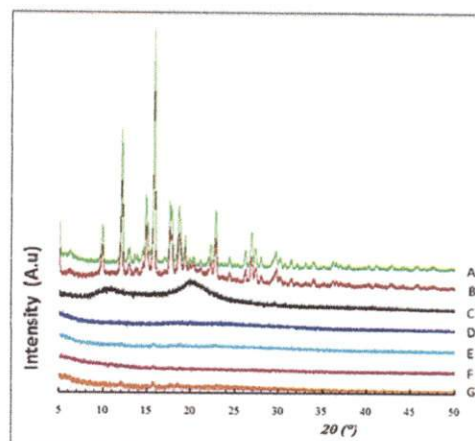


Fig. 6: X-ray diffractogram of the diterpene lactone fraction of sambiloto (FDTL) (A), physical mixture FDTL-chitosan (B), chitosan (C), unloaded particles (D), FDTL loaded particles with FDTL-chitosan-tripolyphosphate ratio 3:10:8 (E), 4:10:8 (F), 5:10:8 (G)

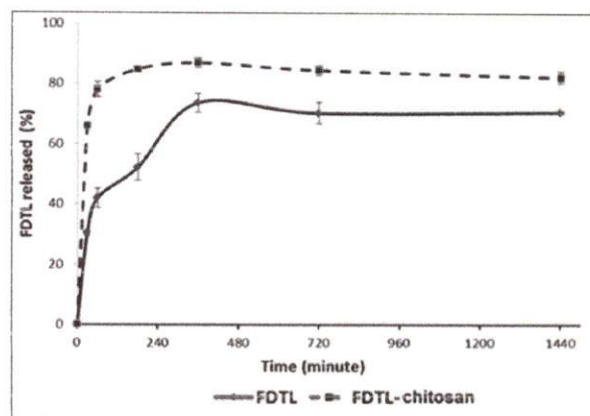


Fig. 7: The release profile of the particulate system diterpene lactone fraction of sambiloto (FDTL)-chitosan-tripolyphosphate and FDTL in 0.1% sodium lauryl sulfate in water medium at  $37 \pm 0.5^\circ\text{C}$  ( $n=3$ )

concentration did not improve the entrapment ability of chitosan particulate systems (Table 3). This can be explained that the particles with chitosan-TPP ratio 10:8 have cross-linked structure that could entrap drug/substance in a limited amount. From the results of particles characterization SEM and the entrapment efficiency, it was known that the particulate systems with FDTL-chitosan-TPP ratio=4:10:8 had optimal characteristics. Chitosan particles of this composition were further evaluated for its *in vitro* drug release.

#### *In vitro* drug release

From *in vitro* release study, it was known that the FDTL dissolved from the chitosan particles was higher than FDTL itself. The entrapment of FDTL in the chitosan particulate system changed the crystallinity of FDTL as revealed Fig. 7. This change from the ordered structure into unordered molecular structure caused lower melting point hence will enhance dissolution rate. Dissolution efficiency at 360 minutes ( $ED_{360}$ ) of the particulate systems FDTL-chitosan-TPP and FDTL was 78.82% and 51.41%, respectively. From the paired t-test analysis, it was known that  $ED_{360}$  of FDTL-chitosan particulate systems and FDTL was significantly different (Table 4).

**Table 2: One-way ANOVA test (p=0.05) to determine the effect of FDTL amount on the entrapment efficiency of FDTL-chitosan particles**

Formula	N	Entrapment efficiency±SD	ANOVA	
			Result	Conclusion
A	3	29.43±0.25 <sup>a</sup>	F=34.702 p=0.001	Significantly different
B	3	33.82±0.38 <sup>b</sup>		
C	3	33.47±1.16 <sup>b</sup>		

The ratio of the FDTL-chitosan-TPP=3:10:8 (A), 4:10:8 (B), 5:10:8 (C).

<sup>a,b</sup>Signs mean that there is no difference between the groups. N=Sample number, TPP: Tripolyphosphate, FDTL: Diterpene lactone fraction of sambiloto

**Table 3: One-way ANOVA (p=0.05) to determine the effect of chitosan amount on the entrapment efficiency of FDTL-chitosan particles**

Formula	N	Entrapment efficiency±SD	ANOVA	
			Result	Conclusion
D	3	33.82±0.38 <sup>a</sup>	F=78.895 p=0.000	Significantly different
E	3	26.58±0.49 <sup>b</sup>		
F	3	25.65±1.38 <sup>b</sup>		

The ratio of FDTL: chitosan: TPP ratios are 4:10:8 (D), 4:12.5:10 (E) and 4:15:12 (F). <sup>a,b</sup>Signs refer to no difference between the groups. N=Sample number, FDTL: Diterpene lactone fraction of sambiloto

**Table 4: Paired t-test (p=0.05) for ED<sub>360</sub> of FDTL-chitosan particulate system and FDTL**

Formula	N	Mean ED <sub>360</sub> ±SD	Paired t-test	
			Result	Conclusion
FDTL-chitosan	3	78.82±0.38 <sup>a</sup>	t=8.567 p=0.025	Significantly different
FDTL	3	51.41±0.49 <sup>b</sup>		

<sup>a,b</sup>Signs refer to no difference between the groups. N=sample number  
ED<sub>360</sub>: Efficiency dissolution at 360 minutes, FDTL: Diterpene lactone fraction of sambiloto

## CONCLUSIONS

- The difference in the ratio of chitosan and TPP had a high correlation of the morphology of chitosan particles such as the shape and surface structure
- The amount of drug loaded and the amount of chitosan affected the drug entrapment ability of chitosan particles
- The particulate system of FDTL-chitosan-TPP was able to improve the ED<sub>360</sub> of FDTL up to 1.5 times compared to the FDTL. To sum up, the results obtained in this study can be used as a guidance to develop a

particulate system of chitosan and also for developing other polymers of the particulate system.

## ACKNOWLEDGMENT

This research was financially supported by Competitive University Research Grant, Airlangga University, 2012-2013.

## REFERENCES

- Miladi K, Ibraheem D, Iqbal M, Sfar S, Fessi H, Elaissari A. Particles from preformed polymers as carriers for drug delivery. *EXCLI J* 2014;13:28-57.
- Srikanth K, Gupta RM, Manvi SR, Devanna N. Particulate carrier systems: A review. *Int Res J Pharm* 2012;3(11):22-6.
- Sinha VR, Singla AK, Wadhawan S, Kaushik R, Kumria R, Bansal K, et al. Chitosan microspheres as a potential carrier for drugs. *Int J Pharm* 2004;274(1-2):1-33.
- Harish Prashanth KV, Tharanathan RN. Crosslinked chitosan-preparation and characterization. *Carbohydr Res* 2006;341(1):169-73.
- Vauthier C, Bouchemal K. Methods for the preparation and manufacture of polymeric nanoparticles. *Pharm Res* 2009;26(5):1025-58.
- Sonia TA, Sharma CP. Chitosan and its derivatives for drug delivery perspective. In: Jayakumar K, Prabahan M, Muzzarelli RA, editors. *Chitosan for Biomaterials I*. New York: Springer; 2011. p. 24-49.
- Kumar BP, Chandiran IS, Bhavya B, Sindhuri M. Microparticulate drug delivery system: A review. *Indian J Pharm Sci Res* 2011;1(1):19-37.
- Agnihotri SA, Mallikarjuna NN, Aminabhavi TM. Recent advances on chitosan-based micro - And nanoparticles in drug delivery. *J Control Release* 2004;100(1):5-28.
- Jarukamjorn K, Nemoto N. Pharmacological aspects of *Andrographis paniculata* on health and its major diterpenoid constituent andrographolide. *J Health Sci* 2008;54(4):370-81.
- Mishra K, Dash AP, Dey N. Andrographolide: A novel antimalarial diterpen lactone compound from *Andrographis paniculata* and its interaction with curcumin and artesunate. *J Trop Med* 2011;2011:6.
- Chellampillai B, Pawar AP. Improved bioavailability of orally administered andrographolide from pH-sensitive nanoparticles. *Eur J Drug Metab Pharmacokinet* 2011;35(3-4):123-9.
- Prakash SE, Manavalan R. Development, characterization and/toxicity evaluation of nanoparticles of andrographolide. *Int J Pharm Pharm Sci* 2012;4(1):497-501.
- Widyawaruyanti A, Hafid AF, Tantular I, Dachliyat L, Santosa MH. Development of malaria phytopharmaca of diterpene lactone fraction of sambiloto (*Andrographis paniculata* Nees). National Strategic Research Competitive Grant Report, Batch I Airlangga/2010. Director General of Higher Education; 2010.
- Ghosh VK, Bhoje SG, Kuber VV, Gaikwad PS, Patil MJ. Development and validation of dissolution test method for andrographolide from film coated polyherbal tablet formulation. *Int J Pharm Pharm Sci* 2012;4(3):307-11.
- Bhumkar DR, Pokharkar VB. Studies on effect of pH on cross-linking of chitosan with sodium tripolyphosphate: A technical note. *AAPS PharmSciTech* 2006;7(2):E50.
- Murphy DK, Rabel S. Thermal analysis and calorimetric methods for the characterization of new crystal forms. In: Adeyeye MC, Brittain HG, editors. *Preformulation in Solid Dosage Form Development*. New York: Informa Healthcare USA, Inc.; 2008; p. 279-321.

Home

About

Login

Register

Search

Current

Archives

Editorial Board

Submission

Instructions to Authors

Contact Us

All

Search

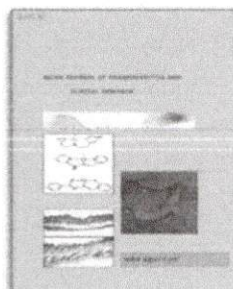
## USER

Username

Password

Remember me

Login



**Impact (Cites per doc)- 0.49**  
(SCImago, SJR 2016)

**ICV 2016 = 104.84**

**Print ISSN- 0974-2441**

**Online ISSN- 2455-3891**



**SCOPUS™**



## Editorial Board

### Editorial Board

AJPCR is committed to have dynamic and potential advisory-editorial board. Those established in the field can directly send their resume. New people are first needed to serve as referee before being considered member of advisory-editorial board. Email your resume to [editor@ajpcr.com](mailto:editor@ajpcr.com)

### Editor-in-Chief

Dr. Anurekha Jain  
Dept. of Pharmaceutical Sciences, Jyoti Mahila Vidyapeeth University, Jaipur, Rajasthan  
Email: [editor@ajpcr.com](mailto:editor@ajpcr.com)

### Associate Editor

Dr. Neeraj Upmanyu  
Peoples Institute of Pharmacy & Research Center, Bhopal, MP, India  
Email: [drneerajupmanyu@gmail.com](mailto:drneerajupmanyu@gmail.com)

Dr. Vikas Sharma  
Shri Rawatpura Sarkar Institute of Pharmacy, Datiya, MP, India  
Email: [vikassharma15@gmail.com](mailto:vikassharma15@gmail.com)

### Assistant Editor

Dr. Vimal Kumar Jain  
Institute of Pharmacy, Nirmal University, Ahemdabad, Gujarat, India  
Email: [cognosy@gmail.com](mailto:cognosy@gmail.com)

Dr. Rupesh Kumar Gautam  
ADINA Institute of Pharmaceutical Sciences, Sagar, MP, India  
Email: [drrupeshgautam@gmail.com](mailto:drrupeshgautam@gmail.com)

### Editorial Board Members

- Dr. Debasish Maiti  
Suryamaninagar, Tripura West, Agartala, Tripura, India
- Dr. Rashad Mohammed Musleh  
University of Thamar, Yemen

## JOURNAL METRICS

Source Normalized  
Impact per Paper  
(SNIP): 0.492

Impact per  
Publication  
(IPP): 0.588

SCImago Journal  
Rank (SJR): 0.22

Cite Score: 0.49

Print ISSN: 0974-  
2441

Online ISSN:  
2455-3891

## MOST DOWNLOADED ARTICLES

- PREGELATINIZED CASSAVA STARCH...
- ANTIBACTERIAL ACTIVITY OF HYDROLYZED...
- BUCCAL PENETRATION ENHANCERS-AN OVERVIEW
- Upper Thoracic spine(D2-D3)...
- ANTI-CANCER ACTIVITY OF DATURA METEL...
- ANTIBACTERIAL ACTIVITY OF THE...
- A REVIEW: LOVASTATIN PRODUCTION AND...
- DIPEPTIDYL PEPTIDASE-IV INHIBITORY...

- Dr. Shubhamoy Ghosh  
Dept. of Pathology & Microbiology, Mahesh Bhattacharyya Homeopathic Medical College & Hospital, Govt. of West Bengal, India
- Mohd Abdul Hadi  
Bhaskar Pharmacy College Affiliated To Jawaharlal Nehru Technological University, Hyderabad, India
- Dr. Amer A. Taqa  
Department of Dental Basic Science, College of Dentistry, Mosul University, Iraq
- Mr. Atul Kabra  
Department of Pharmacy, Manav Bharti University, Solan (H.P.), India
- Mr. Siddharth Kaushal Tripathi  
Doctoral Research Associate National Center For Natural Products Research, School of Pharmacy, University of Mississippi, India
- Dr. Brajesh Kumar  
Escuela Politécnica Del Ejército, Sangolqui, Ecuador, Latin America
- Dr. Farhan Ahmed Siddiqui  
Faculty of Pharmacy, Federal Urdu University Arts, Science And Technology Karachi, Sindh, Pakistan
- Dr. Deepak Kumar Mittal  
Iasca Department of Itm-Universe, Gwalior, India
- Dr. Jesse Joel Thathapudi  
Karunya University (Deemed To Be University), Coimbatore, Tamil Nadu, India
- Dr. Kumaran Shanmugam  
Analytical Chemistry, Academic Faculty, (Senior Scale) & International Co-Ordinator, Department of Biotechnology, Periyar Maniammai University, Vallam, Thanjavur-613 403, India
- Dr. Javad Sharifi Rad  
Department of Pharmacognosy, Faculty of Pharmacy, Zabol University of Medical Sciences, P.O. Box 61615-585 Zabol, Iran
- Dr. Rajesh Mohanraj  
Dept. of Pharmacology, CMHS, UAE
- Dr. P. Thillai Arasu  
Department of Chemistry, Kalasalingam University, Srivilliputhur 626190, India
- Ms Vasundhra Saxena  
Gautam Buddha Technical University Lucknow, India
- Ms Vinit Dattatray Chavhan  
Sinhgad Technical Education Society'S Smt. Kashibai Navale College of Pharmacy, Kondhwa-Saswad Road, Kondhwa (BK), India
- Dr. Sami Saqf El Hait  
Junior Executive - Quality Control At Jamjoom Pharmaceuticals Company Limitedjeddah, Saudi Arabia
- Md. Moklesur Rahman Sarker  
Faculty of Medicine, University of Malaya, Malaysia

•. TURMERIC:  
NATURE'S  
PRECIOUS  
MEDICINE.

•  
ETHNOBOTANICAL  
STUDIES ON  
SELECTED...

- Dr. Ahmed Hashim Mohaisen Al-Yasari  
Department of Physics, College of Education For Pure Science, University of Babylon, Hilla, Iraq
- Dr. Arun Kumar  
Director & Dean, Faculty of Marine Sciences Faculty of Marine Sciences Cas In Marine Biology Cas In Marine Biology, Parangipettai- 608502 Parangipettai- 608502 Tamil Nadu, India
- Dr. Ashraf Ahmed  
Dept. of Chemistry, Aligarh Muslim University, Uttar Pradesh 202001, India
- Dr. S. Bala Murugan  
Dept. of Biotechnology, Bharathiar University, Coimbatore-641046, Tamil Nadu, India
- Dr. Sukhen Som  
Department of Pharmaceutical Chemistry, M.M.U College of Pharmacy, K.K.Doddi, Ramadevara Betta Road, Ramanagara- 562159 State- Karnataka India
- Dr. Sheikh Shoib  
Department of Psychiatry, Institute of Mental Health And Neurosciences Kashmir (Imhans K), Srinagar, India
- Dr. Hao Wu  
Postdoctoral Fellow At Ngm Biopharmaceuticals, Inc, South San Francisco, CA 94080, USA
- Dr. Payal Bhaskar Joshi  
Assistant Professor Department of Chemical Engineering, Mukesh Patel School of Technology Management & Engineering (Mumbai Campus), Svkm'S Nmims (Deemed-To-Be-University), India
- Dr. Nagarajan Kayalvizhi  
Assistant Professor Department of Zoology, Periyar University, Salem, Tamilnadu, India
- Dr. Madhu Bala  
Scientist 'F' And Joint Director, Institute of Nuclear Medicine And Allied Sciences (INMAS), India
- Prof. Dr. Mamdouh Moawad Ali  
Biochemistry Department, Genetic Engineering And Biotechnology, India
- Dr. Mohanraj Rathinavelu  
Department of Pharmacy Practice, Raghavendra Institute of Pharmaceutical Education & Research, Riper, India
- Dr. (Mrs.) Neeru Nathani  
Dept. of Swasthavritta And Yoga, Faculty of Ayurveda, Institute of Medical Sciences, Banaras Hindu University, India
- Dr. Rohini Karunakaran  
Unit of Biochemistry, Faculty of Medicine, Aimst University Batu 3 1/2, Bukit Air Nasi, Jalan Semeling, 08100 Bedong Kedah Darul Aman, Malaysia
- Dr. Imran Ahmad Khan  
Royal Institute of Medical Sciences Multan, Pakistan
- Dr. Jitendra Gupta  
Sper Timer (Publication Committee ) Regional Head U.P. State, India

- Dr. Kamal A. Badr  
Lecturer of Pharmaceutics And Industrial Pharmacy & Member of Quality Assurance Unit-  
Faculty of Pharmacy- Delta University For Science And Technology, India
- Mr. Gurpreet Singh  
Department of Pharmaceutical Sciences Guru Nanak Dev University, Amritsar, Punjab  
(India) 143005
- Dr. Pranav Kumar Prabhakar  
Lovely Faculty of Applied Medical Sciences, Lovely Professional University, Jalandhar-Delhi  
G.T. Road
- Dr. Raj Mohan Raja Muthiah  
Research Fellow (Harvard Medical School) 172 Hosmer Street, Apt 7. Marlborough, Ma  
01752
- Dr. Sandip Narayan Chakraborty  
Research Asst li, Translational Molecular Pathology, Ut Md Anderson Cancer Center, Life  
Sciences Plaza, Houston, TX 77030
- Dr. Anup Naha  
Dept. of Pharmaceutics "Swarna Kutir ", Ramnagar Road No.4, Mcops, Manipal-576 104,  
Karnataka, India
- Dr. Tushar Treembak Shelke  
Vice Principal , Head of Department of Pharmacology And Research Scholar, In  
Jspms Charak College of Pharmacy & Research, Gat No. - 720(1&2), Pune, India
- Anindya Banerjee  
Indian Pharmacopoeia Commission, Ministry of Health & Family Welfare  
Govt of India
- Dr. Vijay Mishra  
Lovely Institute of Technology (Pharmacy), Lovely Professional University, Phagwara,  
Punjab, India
- Dr. Praveen Kumar Sharma  
Department of Chemistry, Lovely Professional University, Punjab (India)-144411
- Deepansh Sharma  
School of Bioengineering & Biosciences Lovely Professional University, Phagwara Punjab,  
India
- Sai Prachetan Balguri  
ORISE Research Fellow at U.S. FDA
- Dr. Mohd Abdul Hadi  
Department of Pharmaceutics, Bhaskar Pharmacy college, Yenkapally (V), Moinabad (M),  
R.R (Dt), Hyderabad-500 075, Telangana, India
- Tanay Pramanik  
Department of Chemistry in Lovely Professional University, Punjab, India
- Dr. D. Nagsamy Venkatesh  
Department of Pharmaceutics, JSS College of Pharmacy, Ooty, TN India

**Editorial office**

Asian Journal of Pharmaceutical and Clinical Research

B-11, In front of Beema Hospital, Nayi Awadi, Mandasaur 458001, MP, India  
E-mail:editor@ajpcr.com

[Our Journals](#) || [Open Access Policy](#) || [Publication Ethics](#)

The publication is licensed under a Creative Commons License (CC BY) . [View Legal Code](#)

Copyright © 2017 All Rights Reserved: **Innovare Academic Sciences** || Powered By **CyberDairy**