



# Source details

## Artificial Cells, Nanomedicine and Biotechnology

Formerly known as: Artificial Cells, Blood Substitutes, and Immobilization Biotechnology

Open Access ⓘ

Scopus coverage years: from 2013 to Present

Publisher: Taylor & Francis

ISSN: 2169-1401 E-ISSN: 2169-141X

Subject area: Pharmacology, Toxicology and Pharmaceutics: Pharmaceutical Science Medicine: Medicine (miscellaneous)  
Engineering: Biomedical Engineering Biochemistry, Genetics and Molecular Biology: Biotechnology

Source type: Journal

CiteScore 2021

13.6 ⓘ

SJR 2021

0.884 ⓘ

SNIP 2021

1.188 ⓘ

[View all documents >](#)

[Set document alert](#)

[Save to source list](#)

[CiteScore](#) [CiteScore rank & trend](#) [Scopus content coverage](#)

### i Improved CiteScore methodology ⓘ

CiteScore 2021 counts the citations received in 2018-2021 to articles, reviews, conference papers, book chapters and data papers published in 2018-2021, and divides this by the number of publications published in 2018-2021. [Learn more >](#)

CiteScore 2021 ▾

$$13.6 = \frac{16,291 \text{ Citations } 2018 - 2021}{1,199 \text{ Documents } 2018 - 2021}$$

Calculated on 05 May, 2022

CiteScoreTracker 2022 ⓘ

$$13.6 = \frac{8,907 \text{ Citations to date}}{656 \text{ Documents to date}}$$

Last updated on 05 September, 2022 • Updated monthly

### CiteScore rank 2021 ⓘ

Category	Rank	Percentile
Pharmacology, Toxicology and Pharmaceutics Pharmaceutical Science	#6/171	96th
Medicine Medicine (miscellaneous)	#10/276	96th

[View CiteScore methodology >](#) [CiteScore FAQ >](#) [Add CiteScore to your site ↗](#)

## About Scopus

[What is Scopus](#)  
[Content coverage](#)  
[Scopus blog](#)  
[Scopus API](#)  
[Privacy matters](#)

## Language

[日本語版を表示する](#)  
[查看简体中文版本](#)  
[查看繁體中文版本](#)  
[Просмотр версии на русском языке](#)

## Customer Service

[Help](#)  
[Tutorials](#)  
[Contact us](#)

---


## ELSEVIER

[Terms and conditions](#) ↗ [Privacy policy](#) ↗

Copyright © [Elsevier B.V](#) ↗. All rights reserved. Scopus® is a registered trademark of Elsevier B.V.

We use cookies to help provide and enhance our service and tailor content. By continuing, you agree to the [use of cookies](#) ↗.



also developed by scimago:  SCIMAGO INSTITUTIONS RANKINGS

**SJR** Scimago Journal & Country Rank

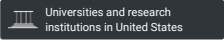
Home Journal Rankings Country Rankings Viz Tools Help About Us

**Champions of customer service**

Customer service is everywhere. That's why Zendesk creates conversational experiences

Zendesk [Learn More](#)


## Artificial Cells, Nanomedicine and Biotechnology

COUNTRY	SUBJECT AREA AND CATEGORY	PUBLISHER	H-INDEX
United States 	Biochemistry, Genetics and Molecular Biology ↳ Biotechnology Engineering ↳ Biomedical Engineering Medicine ↳ Medicine (miscellaneous) Pharmacology, Toxicology and Pharmaceutics ↳ Pharmaceutical Science	Informa Healthcare	<b>57</b>
PUBLICATION TYPE	ISSN	COVERAGE	INFORMATION
Journals	21691401, 2169141X	2013-2021	<a href="#">Homepage</a> <a href="#">How to publish in this journal</a> <a href="mailto:IANB-peerreview@journals.tandf.co.uk">IANB-peerreview@journals.tandf.co.uk</a>



### SCOPE

In 2013, we changed the name of this journal to Artificial Cells, Nanomedicine and Biotechnology . Artificial Cells, Nanomedicine and Biotechnology covers the frontiers of interdisciplinary research and application, combining artificial cells, nanotechnology, nanobiotechnology, biotechnology, molecular biology, bioencapsulation, novel carriers, stem cells and tissue engineering. Emphasis is on basic research, applied research, and clinical and industrial applications of the following topics: -artificial cells -blood substitutes and oxygen therapeutics -nanotechnology, nanobiotechnology, nanomedicine -tissue engineering -stem cells -bioencapsulation -microencapsulation and nanoencapsulation -microparticles and nanoparticles -liposomes -cell therapy and gene therapy -enzyme therapy -drug delivery systems -biodegradable and biocompatible polymers for scaffolds and carriers -biosensors -immobilized enzymes and their uses -other biotechnological and nanobiotechnological approaches Rapid progress in modern research cannot be carried out in isolation and is based on the combined use of the different novel approaches. The interdisciplinary research involving novel approaches, as discussed above, has revolutionized this field resulting in rapid developments. This journal serves to bring these different, modern and futuristic approaches together for the academic, clinical and industrial communities to allow for even greater developments of this highly interdisciplinary area.

 Join the conversation about this journal



### IJISAE Scopus Journal

Original Research Articles are invited from Professors, Scientists and Scholars.

International Journal...

[Open >](#)

Quartiles



### IJISAE Scopus Journal

Original Research Articles are invited from Professors, Scientists and Scholars.

International Journal...

[Open >](#)

#### FIND SIMILAR JOURNALS ?

options :

1 <b>International Journal of Nanomedicine</b> NZL  <b>64%</b> similarity	2 <b>Nanomedicine</b> GBR  <b>61%</b> similarity	3 <b>Journal of Drug Targeting</b> GBR  <b>59%</b> similarity	4 <b>Nanomedicine: Nanotechnology, Biology, and</b> USA  <b>59%</b> similarity	5 <b>Journal of Nanobiotechnology</b> GBR  <b>57%</b> similarity
--	---	--	---	---

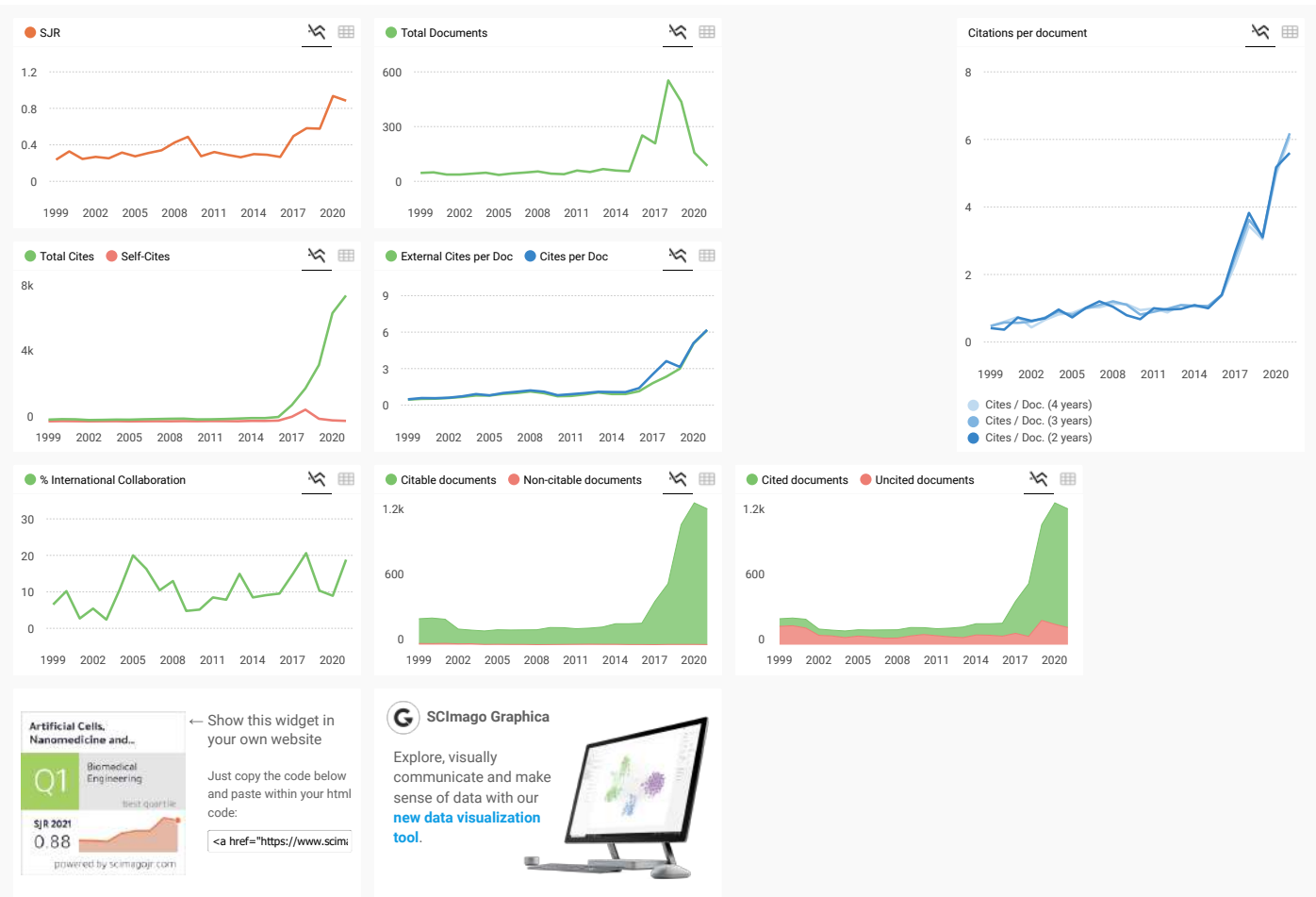


### IJISAE Scopus Journal

Original Research Articles are invited from Professors, Scientists and Scholars.

International Journal...

[Open >](#)



Artificial Cells, Nanomedicine and...

Q1

Biomedical Engineering

SJR 2021

0.88

powered by scimagojr.com

← Show this widget in your own website

Just copy the code below and paste within your html code:

`<a href="https://www.scimagojr.com/journalsearch.php?q=21100241807&tip=...">`

SCImago Graphica

Explore, visually communicate and make sense of data with our [new data visualization tool](#).



IJISAE Scopus Journal

Original Research Articles are invited from Professors, Scientists and Scholars.

International Journal...


[Open >](#)

Metrics based on Scopus® data as of April 2022

**Leave a comment**

Name

Email   
(will not be published)

I'm not a robot   
reCAPTCHA  
Privacy - Terms

The users of Scimago Journal & Country Rank have the possibility to dialogue through comments linked to a specific journal. The purpose is to have a forum in which general doubts about the processes of publication in the journal, experiences and other issues derived from the publication of papers are resolved. For topics on particular articles, maintain the dialogue through the usual channels with your editor.

Developed by:



Powered by:



Follow us on @ScimagoJR

Scimago Lab, Copyright 2007-2022. Data Source: Scopus®

EST MODUS IN REBUS  
Historia Illustration 1.1.10a[Edit Cookie Consent](#)

[Home](#) ▶ [All Journals](#) ▶ [Artificial Cells, Nanomedicine, and Biotechnology](#) ▶ [List of Issues](#) ▶ [Volume 48, Issue 1](#)

# Artificial Cells, Nanomedicine, and Biotechnology

[Publish with us](#)[Submit an article](#) ▼[About this journal](#) ▼[Explore](#)[Browse all articles & issues](#) ▼[Latest issue](#)[Subscribe](#)[Alerts & RSS feed](#) ▼ Taylor & Francis Online[Log in](#) | [Register](#)

Artificial Cells,  
Nanomedicine,  
and Biotechnology

An International Journal

## Browse this journal

[▶ Current issue](#)[▶ List of issues](#)[▶ Special issues](#)[▶ Most read articles](#)[▶ Most cited articles](#)

Sample our  
Medicine, Dentistry, Nursing  
& Allied Health Journals

>> [Sign in here](#) to start your access  
to the latest two volumes for 14 days

## Artificial Cells, Nanomedicine, and Biotechnology, Volume 48, Issue 1 (2020)

[See all volumes and issues](#)[Vol 50, 2022](#)[Vol 49, 2021](#)[Volume 48, 2020](#)[Vol 4](#) [Issue  
1](#)

# Artificial Cells, Nanomedicine, and Biotechnology


[Download citations](#)
[Download PDFs](#)

Publish with us

[Submit an article](#) ▼

[About this journal](#) ▼

Explore

[Browse all articles & issues](#) ▼

[Latest issue](#)

Subscribe

[Alerts & RSS feed](#) ▼

Article

## The protective effects of bexarotene against advanced glycation end-product (AGE)-induced degradation of articular extracellular matrix (ECM) >

Zhuqing Zha, Qingmin Han & Shaochuan Huo

Pages: 1-7

**Published online:** 18 Dec 2019

1904

Views

4

CrossRef citations

1

Altmetric



Article

## The protective role of omentin-1 in IL-1 $\beta$ -induced chondrocyte senescence >

Bin Chai, Zi-Hui Zheng, Xiang Liao, Kang-Yang Li, Jiang-Shan Liang, Yong-Xiang Huang, Chang-Jun Tong, Di-Jun Ou & Jun Lu

Pages: 8-14

**Published online:** 18 Dec 2019

2726

Views

13

CrossRef citations

0

Altmetric



Article

## Quantitative assessment of lncRNA H19 polymorphisms and cancer risk: a meta-analysis based on 48,166 subjects >

Xu Liu, Yating Zhao, Ying Li & Jian Zhang

Pages: 15-27

**Published online:** 18 Dec 2019

2038

Views

4

CrossRef citations

0

Altmetric



Article

## Gellable silk fibroin-polyethylene sponge for hemostasis >

Wei Wei, Jian Liu, ZhiBin Peng, Min Liang, YanSong Wang & XiaoQin Wang

Pages: 28-36

**Published online:** 18 Dec 2019

2714

Views

10

CrossRef citations

0

Altmetric



Article

## RETRACTED ARTICLE: PHD2 acts as an oncogene through activation of Ras/Raf/MEK/ERK >





# Artificial Cells, Nanomedicine, and Biotechnology

2607 | 3

Publish with us

[Submit an article](#) ▼[About this journal](#) ▼

Explore

[Browse all articles & issues](#) ▼[Latest issue](#)

Subscribe

[Alerts & RSS feed](#) ▼

Article

## [New nanoprobe for breast cancer cell imaging based on low-density lipoprotein](#) >

Mehdi Mirzaei, Mojdeh Mohseni, Neda Iranpour Anaraki, Elham Mohammadi, Sepideh Safari, Bitra Mehravi, Alireza Ghasempour &amp; Omid Pourdakan

Pages: 46-52

**Published online:** 18 Dec 2019

2077

Views

3

CrossRef citations

Altmetric



Article

## [Gramicidin inhibits cholangiocarcinoma cell growth by suppressing EGR4](#) >

Xiaoli Gong, Liming Zou, Miaomiao Wang, Yingheng Zhang, Shuxian Peng, Mingtian Zhong, Jiankui Zhou, Xun Li &amp; Xiaodong Ma

Pages: 53-59

**Published online:** 18 Dec 2019

1919

Views

5

CrossRef citations

Altmetric



Article

## [RETRACTED ARTICLE: Silencing UNC5B antisense lncRNA 1 represses growth and metastasis of human Colon cancer cells via raising miR-622](#) >

Yan Zhang, Zhen Li &amp; Zhi Lan

Pages: 60-67

**Published online:** 18 Dec 2019

1805

Views

8

CrossRef citations

Altmetric



Article

## [Novel mulberry silkworm cocoon-derived carbon dots and their anti-inflammatory properties](#) >

Xiaoke Wang, Yue Zhang, Hui Kong, Jinjun Cheng, Meiling Zhang, Ziwei Sun, Suna Wang, Jiaying Liu, Huihua Qu &amp; Yan Zhao

Pages: 68-76

**Published online:** 18 Dec 2019

2777

Views

19

CrossRef citations

Altmetric



# Artificial Cells, Nanomedicine, and Biotechnology

Adrian Villalba, Silvia Rodriguez-Fernandez, Rosa-Maria Ampudia, Mary Cano-Sarabia, David Perna-Barrull, Cesc Bertran-Cobo, Clara Ehrenberg, Daniel Maspocho & Marta Vives-Pi

Publish with us

[Submit an article](#) ▼

[About this journal](#) ▼

Explore

[Browse all articles & issues](#) ▼

 [Latest issue](#)

Subscribe

[Alerts & RSS feed](#) ▼

2836

Views

8

CrossRef citations

Altmetric

Article

## Cytisine exerts anti-tumour effects on lung cancer cells by modulating reactive oxygen species-mediated signalling pathways >

Wan-Ting Xu, Tian-Zhu Li, Shu-Mei Li, Cheng Wang, Hao Wang, Ying-Hua Luo, Xian-Ji Piao, Jia-Ru Wang, Yu Zhang, Tong Zhang, Hui Xue, Long-Kui Cao & Cheng-Hao Jin

Pages: 84-95

**Published online:** 18 Dec 2019

2964

Views

16

CrossRef citations

Altmetric

Article

## Wound healing activity of neferine in experimental diabetic rats through the inhibition of inflammatory cytokines and nrf-2 pathway >

Juan Li, Haiyan Chou, Lei Li, Hao Li & Zhengjun Cui

Pages: 96-106

**Published online:** 18 Dec 2019

4697

Views

24

CrossRef citations

Altmetric

Article

## The protective effects of aloperine against ox-LDL-induced endothelial dysfunction and inflammation in HUVECs >

Weiwei Li, Yanshu Li, Yi Zhao & Lina Ren

Pages: 107-115

**Published online:** 18 Dec 2019

2400

Views

15

CrossRef citations

Altmetric

Article

## Design and construction of a magnetic targeting pro-coagulant protein for embolic therapy of solid tumors >

Mingyuan Zou, Peilan Xu, Li Wang, Lanlan Wang, Tingting Li, Cong Liu, Lei Shi, Jun Xie, Wanyun Li, Shengyu Wang, Guoqiu Wu, Fanghong Luo, Ting Wu & Jianghua Yan

Pages: 116-128

**Published online:** 18 Dec 2019

# Artificial Cells, Nanomedicine, and Biotechnology

[Publish with us](#)[Submit an article](#) ▼[About this journal](#) ▼[Explore](#)[Browse all articles & issues](#) ▼[Latest issue](#)[Subscribe](#)[Alerts & RSS feed](#) ▼

Shuyu Jia, Ximei Yang, Xirong Yang &amp; Fei Zhang

Pages: 129-136

**Published online:** 18 Dec 2019

1563

Views

10

CrossRef citations

Altmetric

Article

## CYLD expression in dendritic cells involved in the immunoregulation of pulmonary adenocarcinoma via NF- $\kappa$ B pathway >

Qinghua Yu, Yujie Lei, Yunchao Huang, Jiguang Zhang, Yangming Chen, Kai Chen, Jianbin Lin, Shihui Sun &amp; Xing Lin

Pages: 137-142

**Published online:** 18 Dec 2019

1519

Views

1

CrossRef citations

Altmetric

Article

## c(RGDyk)-modified nanoparticles encapsulating quantum dots as a stable fluorescence probe for imaging-guided surgical resection of glioma under the auxiliary UTMD >

Qi-Long Wu, He-Lin Xu, Cui Xiong, Qing-Hua Lan, Ming-Ling Fang, Jin-Hua Cai, Hui Li, Shu-Ting Zhu, Jing-Hong Xu, Fang-Yi Tao, Cui-Tao Lu, Ying-Zheng Zhao &amp; Bin Chen

Pages: 143-158

**Published online:** 18 Dec 2019

2036

Views

4

CrossRef citations

Altmetric

Article

## Osteopontin acts as a negative regulator of autophagy accelerating lipid accumulation during the development of nonalcoholic fatty liver disease >

Min Tang, Yan Jiang, Haoyu Jia, Bhuvanesh Kinish Patpur, Bo Yang, Jing Li &amp; Changqing Yang

Pages: 159-168

**Published online:** 18 Dec 2019

3472

Views

11

CrossRef citations

Altmetric

Article

## Construction of dual nanomedicines for the imaging and alleviation of atherosclerosis >

Shuihua Zhang, Wan Xu, Peng Gao, Wenli Chen &amp; Quan Zhou

# Artificial Cells, Nanomedicine, and Biotechnology

[Publish with us](#)[Submit an article](#) ▼[About this journal](#) ▼[Explore](#)[Browse all articles & issues](#) ▼[Latest issue](#)[Subscribe](#)[Alerts & RSS feed](#) ▼

## Collaborative optimization and molecular docking exploration of novel ACE-inhibitory peptides from bovine milk by complex proteases hydrolysis >

Li Chen, Wenfei Shangguan, Chunju Bao, Guowei Shu &amp; He Chen

Pages: 180-187

**Published online:** 18 Dec 2019

1449

Views

7

CrossRef citations

Altmetric

Article

## RETRACTED ARTICLE: Silencing hsa\_circ\_PVT1 (circPVT1) suppresses the growth and metastasis of glioblastoma multiforme cells by up-regulation of miR-199a-5p >

Guonan Chi, Fuwei Yang, Donghui Xu &amp; Weiming Liu

Pages: 188-196

**Published online:** 22 Dec 2019

1909

Views

22

CrossRef citations

Altmetric

Article

## miR-155 is high-expressed in polycystic ovarian syndrome and promotes cell proliferation and migration through targeting PDCD4 in KGN cells >

Huanjun Xia &amp; Yaxian Zhao

Pages: 197-205

**Published online:** 18 Dec 2019

3008

Views

20

CrossRef citations

Altmetric

Article

## EPO could be regulated by HIF-1 and promote osteogenesis and accelerate bone repair >

Yijun Yu, Lan Ma, He Zhang, Weibin Sun, Lichun Zheng, Chao Liu &amp; Leiyong Miao

Pages: 206-217

**Published online:** 18 Dec 2019

2633

Views

13

CrossRef citations

Altmetric

# Artificial Cells, Nanomedicine, and Biotechnology

Construction ►

Qing Yao, Ya-Wen Zheng, Hui-Long Lin, Qing-Hua Lan, Zhi-Wei Huang, Li-Fen Wang, Rui Chen, Jian Xiao, Longfa Kou, He-Lin Xu

Publish with us

Submit an article ▼

About this journal ▼

Explore

Browse all articles & issues ▼

 Latest issue

Subscribe

Alerts & RSS feed ▼

2437

Views

18

CrossRef citations

Altmetric

Article

**Effect of micropore/microsphere topography and a silicon-incorporating modified titanium plate surface on the adhesion and osteogenic differentiation of BMSCs** ►

Wuchao Zhou, Tiesheng Wang, Yanzi Gan, Jian Yang, Hongshui Zhu, Anxun Wang, Yujiang Wang & Weihong Xi

Pages: 230-241

**Published online:** 18 Dec 2019

[Graphical abstract](#)

1778

Views

9

CrossRef citations

Altmetric

Article

**Bimetallic nickel-ferrite nanorod particles: greener synthesis using rosemary and its biomedical efficiency** ►

Hajar Q. Alijani, Shahram Pourseyedi, Masoud Torkzadeh-Mahani, Alexander Seifalian & Mehrdad Khatami

Pages: 242-251

**Published online:** 18 Dec 2019

[Graphical abstract](#)

3471

Views

33

CrossRef citations

Altmetric

Article

**Taraxasterol protects hippocampal neurons from oxygen-glucose deprivation-induced injury through activation of Nrf2 signalling pathway** ►

Yun He, Kaifu Jiang & Xue Zhao

Pages: 252-258

**Published online:** 18 Dec 2019

2551

Views

19

CrossRef citations

Altmetric

Article

**Genetically modified *Pichia pastoris*, a powerful resistant factory for gold and palladium bioleaching and nanostructure heavy metal biosynthesis** ►

Fatemeh Elahian, Razieh Heidari, Vahid Reza Charghan, Elham Asadbeik & Seyed Abbas Mirzaei

Pages: 259-265

# Artificial Cells, Nanomedicine, and Biotechnology

Publish with us

Submit an article ▼

About this journal ▼

Explore

Browse all articles &amp; issues ▼

 Latest issue

Subscribe

Alerts &amp; RSS feed ▼

## response surface methodology >

Beibei Hu, Haipeng Yan, Yanping Sun, Xi Chen, Yujuan Sun, Sanming Li, Yongshuai Jing &amp; Heran Li

Pages: 266-275

Published online: 18 Dec 2019

1949

Views

14

CrossRef citations

Altmetric



Article

## MicroRNA-15a, microRNA-15b and microRNA-16 inhibit the human dopamine D1 receptor expression in four cell lines by targeting 3'UTR -12 bp to +154 bp >

Xue Wu, Feng-ling Xu, Xi Xia, Bao-jie Wang &amp; Jun Yao

Pages: 276-287

Published online: 20 Dec 2019

1777

Views

8

CrossRef citations

Altmetric



Article

## Construction of an immune-related genes nomogram for the preoperative prediction of axillary lymph node metastasis in triple-negative breast cancer >

Weige Tan, Xinhua Xie, Zhongying Huang, Lun Chen, Wei Tang, Renjie Zhu, Xigang Ye, Xiaoshen Zhang, Lingxiao Pan, Jin Gao, Hailin Tang &amp; Wenbo Zheng

Pages: 288-297

Published online: 20 Dec 2019

2952

Views

11

CrossRef citations

Altmetric



Article

## Fyn gene silencing reduces oligodendrocytes apoptosis through inhibiting ERK1/2 phosphorylation in epilepsy >

Xinming Luo, Zhengyu Li, Jing Zhao, Yan Deng, Yuqin Zhong &amp; Ming Zhang

Pages: 298-304

Published online: 18 Dec 2019

1524

Views

3

CrossRef citations

Altmetric



Article

## Improving radio-chemotherapy efficacy of prostate cancer by co-delivering docetaxel and



# Artificial Cells, Nanomedicine, and Biotechnology

1869 | 9

Publish with us

Submit an article ▼

About this journal ▼

Explore

Browse all articles &amp; issues ▼

 Latest issue

Subscribe

Alerts &amp; RSS feed ▼

Article

## miR-324-5p inhibits gallbladder carcinoma cell metastatic behaviours by downregulation of transforming growth factor beta 2 expression >

Xinrong Zhang, Lei Zhang, Ming Chen &amp; Dongying Liu

Pages: 315-324

Published online: 20 Dec 2019

2155

Views

15

CrossRef citations

Altmetric

Correction

## Correction >

Page: 325

Published online: 24 Dec 2019

577

Views

0

CrossRef citations

Altmetric

Article

## Long non-coding RNA HULC exerts oncogenic activity on papillary thyroid cancer *in vitro* and *in vivo* >

Zhijia Yang, Guoqing Li, Chao Ding, Wencong Sun &amp; Ji Zhang

Pages: 326-335

Published online: 27 Dec 2019

1248

Views

6

CrossRef citations

Altmetric

Article

## Cytoplasmic p27 is a novel prognostic biomarker and oncogenic protein for nasopharyngeal carcinoma >

Yaoshu Teng, Linping Hu, Bo Yu, Xiao Li, Manman Chen, Xiao Fu, Jin Zhang, Yueqiu Gao, Rujun Xu &amp; Jin Zhu

Pages: 336-344

Published online: 28 Dec 2019

1700

Views

6

CrossRef citations

Altmetric

Article

## Prokineticin 2 relieves hypoxia/reoxygenation-induced injury through activation of

# Artificial Cells, Nanomedicine, and Biotechnology

1822 | 12

Publish with us

[Submit an article](#) ▼[About this journal](#) ▼

Explore

[Browse all articles & issues](#) ▼[Latest issue](#)

Subscribe

[Alerts & RSS feed](#) ▼

Article

## Prognostic and clinicopathologic significance of long non-coding RNA opa-interacting protein 5-antisense RNA 1 in multiple human cancers >

Xiaolei Ren, Jieyu He, Lin Qi, Shuangqing Li, Chenghao Zhang, Zhixi Duan, Wanchun Wang, Chao Tu &amp; Zhihong Li

Pages: 353-361

**Published online:** 03 Jan 2020

1724

Views

11

CrossRef citations

Altmetric

Article

## Histological and functional outcomes in a rat model of hemisected spinal cord with sustained VEGF/NT-3 release from tissue-engineered grafts >

Zi-Xing Xu, Li-Qun Zhang, Yi-Nan Zhou, Xue-Min Chen &amp; Wei-Hong Xu

Pages: 362-376

**Published online:** 03 Jan 2020

1823

Views

10

CrossRef citations

Altmetric

Article

## Protective effect of hyperoside against hydrogen peroxide-induced dysfunction and oxidative stress in osteoblastic MC3T3-E1 cells >

Xin-Chun Qi, Bo Li, Wen-Liang Wu, Hai-Chun Liu &amp; Yun-Peng Jiang

Pages: 377-383

**Published online:** 06 Jan 2020

1705

Views

15

CrossRef citations

Altmetric

Article

## Anti-antioxidant impacts of circZNF609 silence in HaCaT cells through regulating miR-145 >

Rongli Ge &amp; Guanglei Gao

Pages: 384-392

**Published online:** 06 Jan 2020

1604

Views

11

CrossRef citations

Altmetric



# Artificial Cells, Nanomedicine, and Biotechnology

Yingrui Fan, Weiwei Sheng, Yi Meng, Yundi Cao & Rong Li

Pages: 393-407

**Publish with us**

[Submit an article](#) ▼

[About this journal](#) ▼

**Explore**

[Browse all articles & issues](#) ▼

[Latest issue](#)

**Subscribe**

[Alerts & RSS feed](#) ▼

[Views](#) | [CrossRef citations](#) | [Altmetric](#)

Article

## [Preliminary biological evaluation of 123I-labelled anti-CD30-LDM in CD30-positive lymphomas murine models](#) >

Jianhua Gong, Feihu Guo, Weihua Cheng, Hongqiang Fan, Qingfang Miao & Jigang Yang

Pages: 408-414

**Published online:** 08 Jan 2020

1438

7

[Views](#)

[CrossRef citations](#)

[Altmetric](#)

Article

## [RETRACTED ARTICLE: MiR-142-3p targeting NUCKS1 inhibits proliferation and invasion of pancreatic cancer cells](#) >

Kexiang Zhu, Zhengcong Zhang, Hui Zhang, Zhengfeng Wang & Fanghong Wang

Pages: 415-424

**Published online:** 09 Jan 2020

1244

10

[Views](#)

[CrossRef citations](#)

[Altmetric](#)

Article

## [Regenerated silk fibroin \(RSF\) electrostatic spun fibre composite with polypropylene mesh for reconstruction of abdominal wall defects in a rat model](#) >

Dongchao Yang, Zhicheng Song, Jiali Shen, Heng Song, Jianjun Yang, Peihua Zhang & Yan Gu

Pages: 425-434

**Published online:** 09 Jan 2020

2329

7

[Views](#)

[CrossRef citations](#)

[Altmetric](#)

# Artificial Cells, Nanomedicine, and Biotechnology

[GAB3/miR-126-3/TLR6/TLR2 and TLR4/miR-22/TLR6/TLR2 signaling pathways](#)

Zhi-Hai Deng, Gan-Shen Yu, Bin Pan, Zhen-Hua Feng, Qiang Huang, Jian-Zhong Deng, Bo Chen & Shi-Kun Yang

Publish with us

Submit an article ▼

About this journal ▼

Explore

Browse all articles & issues ▼

 Latest issue

Subscribe

Alerts & RSS feed ▼

1559

Views

6

CrossRef citations

Altmetric

## Toxicity assessment of superparamagnetic iron oxide nanoparticles in different tissues >

Roghayeh Vakili-Ghartavol, Amir Abbas Momtazi-Borojeni, Zeynab Vakili-Ghartavol, Hamed Tanimowo Aiyelabegan, Mahmoud Reza Jaafari, Seyed Mahdi Rezayat & Sepideh Arbabi Bidgoli

Pages: 443-451

Published online: 05 Feb 2020

6214

Views

58

CrossRef citations

Altmetric

Article

## *Clostridium difficile* toxin B induces colonic inflammation through the TRIM46/DUSP1/MAPKs and NF- $\kappa$ B signalling pathway >

Ying Li, Su Xu, Qingqing Xu & Yijian Chen

Pages: 452-462

Published online: 10 Jan 2020

2337

Views

12

CrossRef citations

Altmetric

Article

## RETRACTED ARTICLE: Physcion 8-O- $\beta$ -glucopyranoside exerts protective roles in high glucose-induced diabetic retinopathy via regulating lncRNA NORAD/miR-125/STAT3 signalling >

Wencui Wan, Weiwei Wan, Yang Long, Qiuming Li, Xuemin Jin, Guangming Wan, Fengyan Zhang & Yong Lv

Pages: 463-472

Published online: 13 Jan 2020

1370

Views

9

CrossRef citations

Altmetric

Article

## Schisandrin B suppresses liver fibrosis in rats by targeting miR-101-5p through the TGF- $\beta$ signaling pathway >

Wang Cuiqiong, Xu Chao, Fu Xinling & Jiang Yinyan

Pages: 473-478

Published online: 24 Jan 2020

1505

Views

3

CrossRef citations

Altmetric

# Artificial Cells, Nanomedicine, and Biotechnology

Article

[Inhibition of Wnt signalling pathway by XAV939 enhances radiosensitivity in human cervical](#)

Publish with us

Explore

Subscribe

Submit an article ▼

About this journal ▼

Browse all articles &amp; issues ▼

 Latest issue

Alerts &amp; RSS feed ▼

Pages: 479-487

Published online: 24 Jan 2020

2655

Views

10

CrossRef citations

Altmetric

Article

[Tanshinone I induces cell apoptosis by reactive oxygen species-mediated endoplasmic reticulum stress and by suppressing p53/DRAM-mediated autophagy in human hepatocellular carcinoma](#) >

Xu Liu &amp; JiKui Liu

Pages: 488-497

Published online: 04 Feb 2020

2508

Views

13

CrossRef citations

Altmetric

Article

[Long non-coding RNA NKILA weakens TNF- \$\alpha\$ -induced inflammation of MRC-5 cells by miR-21 up-regulation](#) >

Dandan Wang, Jiajie Zhang, Yan Sun, Nan Lv &amp; Jianwei Sun

Pages: 498-505

Published online: 04 Feb 2020

1747

Views

9

CrossRef citations

Altmetric

Article

[Dexmedetomidine protects PC12 cells from oxidative damage through regulation of miR-199a/HIF-1 \$\alpha\$](#)  >

Ling Wu, Yalin Xi &amp; Qinglong Kong

Pages: 506-514

Published online: 05 Feb 2020

1560

Views

7

CrossRef citations

Altmetric

Article

[Antiviral activity of curcumin-nanoemulsion associated with photodynamic therapy in vulvar cell lines transducing different variants of HPV-16](#) >

Caroline Measso do Bonfim, Letícia Figueiredo Monteleoni, Marília de Freitas Calmon, Natália Maria Cândido, Paola Jocelan Scarin Provazzi, Vanesca de Souza Lino, Tatiana Rabachini, Laura Sichero, Luisa Lina Villa, Silvana Maria Quintana, Patrícia

# Artificial Cells, Nanomedicine, and Biotechnology

3060 | 19

Publish with us

Submit an article ▾

About this journal ▾

Explore

Browse all articles &amp; issues ▾

 Latest issue

Subscribe

Alerts &amp; RSS feed ▾

Article

## The effect of $\pi$ -Conjugation on the self-assembly of micelles and controlled cargo release >

Yan Liang, Yalin Sun, Xiaoheng Fu, Yang Lin, Zhu Meng, Yanan Meng, Jiping Niu, Yusi Lai &amp; Yong Sun

Pages: 525-532

**Published online:** 09 Feb 2020

1560

Views

9

CrossRef citations

Altmetric

Article

## Long non-coding RNA DANCR alleviates hypoxia-caused H9c2 cells damage through up regulation of HIF-1 $\alpha$ >

Libin Qiu, Qian Zhao, Lingli Dai, Aoshuang Zhu, Xiaofei Xu, Shanshan Zhao &amp; Jingcheng Chen

Pages: 533-541

**Published online:** 10 Feb 2020[Graphical abstract](#)

1911

Views

8

CrossRef citations

Altmetric

Article

## Folic acid-modified celastrol nanoparticles: synthesis, characterization, anticancer activity in 2D and 3D breast cancer models >

Siukan Law, Albert Wingnang Leung &amp; Chuanshan Xu

Pages: 542-559

**Published online:** 13 Feb 2020

2730

Views

18

CrossRef citations

Altmetric

Article

## The first and low cost copper Schiff base/manganese oxide bio nanocomposite from unwanted plants as a robust industrial catalyst >

Atena Naeimi, Sedighe Abbaspour &amp; Seyedeh Atekeh Torabizadeh

Pages: 560-571

**Published online:** 11 Feb 2020

1074

Views

4

CrossRef citations

Altmetric

# Artificial Cells, Nanomedicine, and Biotechnology

miR-675-5p/β1-Gal axis

Zheng Ren, Xiaochun Liu, Yaoran Si & Desheng Yang

Publish with us

Submit an article ▼

About this journal ▼

Explore

Browse all articles & issues ▼

 Latest issue

Subscribe

Alerts & RSS feed ▼

1914

Views

25

CrossRef citations

Altmetric

Article

**RETRACTED ARTICLE: Knockdown of hsa\_circ\_0058124 inhibits the proliferation of human lung cancer cells by up-regulation of miR-1297** >

Xiaoliang Li, Qianqian Zhang & Zhigang Yang

Pages: 584-593

Published online: 13 Feb 2020

1117

Views

6

CrossRef citations

Altmetric

Article

**Circular RNA cZNF292 silence alleviates OGD/R-induced injury through up-regulation of miR-22 in rat neural stem cells (NSCs)** >

Yaqin Cao, Hui Liu, Jun Zhang & Yubin Dong

Pages: 594-601

Published online: 13 Feb 2020

2087

Views

15

CrossRef citations

Altmetric

Article

**Protocatechuic aldehyde mitigates hydrogen peroxide-triggered PC12 cell damage by down-regulating MEG3** >

Zhiwei Zhong, Xiaoyuan Yao, Min Luo, Mei Li, Lina Dong, Ziyang Zhang & Rui Jiang

Pages: 602-609

Published online: 16 Feb 2020

1774

Views

8

CrossRef citations

Altmetric

# Artificial Cells, Nanomedicine, and Biotechnology

Dan Deng &amp; Hui Liang

Pages: 610-619

Publish with us

Submit an article ▼

About this journal ▼

Explore

Browse all articles &amp; issues ▼

 Latest issue

Subscribe

Alerts &amp; RSS feed ▼

[Views](#) | [CrossRef citations](#) | [Altmetric](#)

Article

## *CD32a* polymorphism rs1801274 affects the risk of Kawasaki disease >

Zhiyong Wang &amp; Pei-Liang Geng

Pages: 620-626

**Published online:** 19 Feb 2020

1644

0

Views

[CrossRef citations](#)[Altmetric](#)

Article

## Stem-like cells of various origins showed therapeutic effect to improve the recovery of spinal cord injury >

Jian Kang, Chenglin Zhang, Zhongzheng Zhi, Yingjie Wang, Jingdong Liu, Furong Wu &amp; Guanghui Xu

Pages: 627-638

**Published online:** 13 Feb 2020

2134

11

Views

[CrossRef citations](#)[Altmetric](#)

Article

## *KANK1* regulates paclitaxel resistance in lung adenocarcinoma A549 cells >

Junyi Pu, Jianfeng Shen, Zihua Zhong, Ma Yanling &amp; Jie Gao

Pages: 639-647

**Published online:** 16 Feb 2020

3039

13

Views

[CrossRef citations](#)[Altmetric](#)

Article

## RETRACTED ARTICLE: Silencing circular RNA-ZNF652 represses proliferation and EMT process of renal carcinoma cells via raising miR-205 >

Ludong Zhang &amp; Ya Guo

Pages: 648-655

**Published online:** 19 Feb 2020

1184

16

Views

[CrossRef citations](#)[Altmetric](#)

# Artificial Cells, Nanomedicine, and Biotechnology

[Pulmonary Emphysema](#) ▶

Zhiming Shen, Wenting Xuan, Huanhuan Wang, Fei Sun, Chengxin Zhang, Qian Gong & Shenglin Ge

Publish with us

[Submit an article](#) ▼

[About this journal](#) ▼

Explore

[Browse all articles & issues](#) ▼

[Latest issue](#)

Subscribe

[Alerts & RSS feed](#) ▼

2030

Views

12

CrossRef citations

Altmetric

Article

**RETRACTED ARTICLE: Long non-coding RNA 91H regulates IGF2 expression by interacting with IGF2BP2 and promotes tumorigenesis in colorectal cancer** ▶

Tianyi Gao, Xiangxiang Liu, Bangshun He, Yuqin Pan & Shukui Wang

Pages: 664-671

**Published online:** 19 Feb 2020

2670

Views

19

CrossRef citations

Altmetric

Article

**Biologically rapid synthesis of silver nanoparticles by *Sphingobium* sp. MAH-11<sup>T</sup> and their antibacterial activity and mechanisms investigation against drug-resistant pathogenic microbes** ▶

Shahina Akter & Md. Amdadul Huq

Pages: 672-682

**Published online:** 19 Feb 2020

2217

Views

38

CrossRef citations

Altmetric

Article

**The expression level and diagnostic value of microRNA-22 in HCC patients** ▶

Zhen Zeng, Jinghui Dong, Yinyin Li, Zheng Dong, Ze Liu, Jiagan Huang, Yonggang Wang, Yunhuan Zhen & Yinying Lu

Pages: 683-686

**Published online:** 23 Feb 2020

1713

Views

8

CrossRef citations

Altmetric

Article

**The protective effect of doxofylline against lipopolysaccharides (LPS)-induced activation of NLRP3 inflammasome is mediated by SIRT1 in human pulmonary bronchial epithelial cells** ▶

Peng Jiao, Weiming Li, Lin Shen, Yan Li, Lili Yu & Zhaohui Liu

Pages: 687-694

**Published online:** 25 Feb 2020

2369

Views

11

CrossRef citations

Altmetric

# Artificial Cells, Nanomedicine, and Biotechnology

Article

Long intergenic non-coding RNA 1939 eliminates proliferation and migration of human

Publish with us

Explore

Subscribe

Submit an article ▼

About this journal ▼

Browse all articles &amp; issues ▼

 Latest issue

Alerts &amp; RSS feed ▼

Pages: 695-702

Published online: 06 Mar 2020

1408

2

Views

CrossRef citations

Altmetric

Correction

Correction &gt;

Pages: 703-704

Published online: 11 Mar 2020

713

0

Views

CrossRef citations

Altmetric

Expression of Concern

Expression of Concern: *Physcion 8-O- $\beta$ -glucopyranoside exerts protective roles in high glucose-induced diabetic retinopathy via regulating lncRNA NORAD/miR-125/STAT3 signalling* >

Page: 705

Published online: 17 Mar 2020

957

2

Views

CrossRef citations

Altmetric

Expression of Concern

Expression of Concern: *Activation of lncRNA lnc-SLC4A1-1 induced by H3K27 acetylation promotes the development of breast cancer via activating CXCL8 and NF- $\kappa$ B pathway* >

Page: 706

Published online: 17 Mar 2020

1268

0

Views

CrossRef citations

Altmetric

Expression of Concern

Expression of Concern: *ASF1A regulates H4Y72 phosphorylation and promotes autophagy in colon cancer cells via a kinase activity* >

Page: 707

Published online: 17 Mar 2020

817

0

Views

CrossRef citations

Altmetric



# Artificial Cells, Nanomedicine, and Biotechnology

*Parkinson's disease via regulating miR-100/ATG10 axis and PI3K/Akt/mTOR pathway activation* >

Publish with us

Submit an article >

About this journal >

Explore

Browse all articles & issues >

 Latest issue

Subscribe

Alerts & RSS feed >

1229

Views

4

CrossRef citations

Altmetric

Expression of Concern

**Expression of Concern: Long noncoding RNA SNHG15 enhances the development of colorectal carcinoma via functioning as a ceRNA through miR-141/SIRT1/Wnt/ $\beta$ -catenin axis** >

Page: 709

**Published online:** 17 Mar 2020

941

Views

1

CrossRef citations

Altmetric

Expression of Concern

**Expression of Concern: Neferine hinders choriocarcinoma cell proliferation, migration and invasion through repression of long noncoding RNA-CHRF** >

Page: 710

**Published online:** 17 Mar 2020

669

Views

0

CrossRef citations

Altmetric

Expression of Concern

**Expression of Concern: Overexpression of lncRNA ANRIL aggravated hydrogen peroxide-disposed injury in PC-12 cells via inhibiting miR-499a/PDCD4 axis-mediated PI3K/AKT/mTOR/p70S6K pathway** >

Page: 711

**Published online:** 17 Mar 2020

960

Views

0

CrossRef citations

Altmetric

Expression of Concern

**Expression of Concern: PHD2 acts as an oncogene through activation of Ras/Raf/MEK/ERK and JAK1/STAT3 pathways in human hepatocellular carcinoma cells** >

Page: 712

**Published online:** 17 Mar 2020

749

Views

1

CrossRef citations

Altmetric

# Artificial Cells, Nanomedicine, and Biotechnology

*unconline 10 via GSK3 to promote the progression of glioma* >

Page: 713

Publish with us

Submit an article ▼

About this journal ▼

Explore

Browse all articles & issues ▼

Latest issue

Subscribe

Alerts & RSS feed ▼

Views | CrossRef citations | Altmetric

Expression of Concern

**Expression of Concern: *Ras-PI3K pathway promotes osteosarcoma progression via regulating VRK1-mediated H2A phosphorylation at threonine 120*** >

Page: 714

Published online: 17 Mar 2020

648

Views

0

CrossRef citations

Altmetric

Expression of Concern

**Expression of Concern: *Scutellaria barbata D. Don (SBD) protects oxygen glucose deprivation/reperfusion-induced injuries of PC12 cells by up-regulating Nrf2*** >

Page: 715

Published online: 17 Mar 2020

656

Views

1

CrossRef citations

Altmetric

Expression of Concern

**Expression of Concern: *Shikonin inhibits proliferation, migration, invasion and promotes apoptosis in NCI-N87 cells via inhibition of PI3K/AKT signal pathway*** >

Page: 716

Published online: 17 Mar 2020

716

Views

0

CrossRef citations

Altmetric

Expression of Concern

**Expression of Concern: *Upregulation of lncRNA HAGLROS enhances the development of nasopharyngeal carcinoma via modulating miR-100/ATG14 axis-mediated PI3K/AKT/mTOR signals*** >

Page: 717

Published online: 17 Mar 2020

867

Views

1

CrossRef citations

Altmetric

# Artificial Cells, Nanomedicine, and Biotechnology

*Crystalline morphology*

Tong Liu, Ning Zhou, Ruihao Xu, Yangang Cao, Yanli Zhang, Zhen Liu, Xiaoke Zheng & Weisheng Feng

Publish with us

Submit an article ▾

About this journal ▾

Explore

Browse all articles & issues ▾

 Latest issue

Subscribe

Alerts & RSS feed ▾

1703

Views

4

CrossRef citations

Altmetric

Article

**RETRACTED ARTICLE: *MiR-616* plays oncogenic role in hepatocellular carcinoma progression through suppressing *PTEN* expression and activating PI3K/AKT pathway** >

Rina Sa, Huali Song, Meihua Wei, Hailong Su, Yao Hong, Lulu Zhou & Yunfei Bai

Pages: 728-734

**Published online:** 01 Apr 2020

976

Views

6

CrossRef citations

Altmetric

Article

**ZnO/CNT@Fe<sub>3</sub>O<sub>4</sub> induces ROS-mediated apoptosis in chronic myeloid leukemia (CML) cells: an emerging prospective for nanoparticles in leukemia treatment** >

Amir-Mohammad Yousefi, Ava Safaroghli-Azar, Zahra Fakhroueian & Davood Bashash

Pages: 735-745

**Published online:** 09 Apr 2020

1588

Views

3

CrossRef citations

Altmetric

Expression of Concern

**Expression of concern: Ras-ERK1/2 signalling promotes the development of osteosarcoma through regulation of H4K12ac through HAT1** >

Page: 746

**Published online:** 14 Apr 2020

701

Views

0

CrossRef citations

Altmetric

Expression of Concern

**Expression of Concern: Upregulation of long non-coding RNA OGFRP1 facilitates endometrial cancer by regulating miR-124-3p/SIRT1 axis and by activating PI3K/AKT/GSK-3 $\beta$  pathway** >

Page: 747

**Published online:** 14 Apr 2020

1083

Views

1

CrossRef citations

Altmetric

# Artificial Cells, Nanomedicine, and Biotechnology

Expression of concern

○ [Expression of concern: Involvement of NORAD/miR-608/STAT3 axis in carcinostasis effects](#)

Publish with us

Submit an article ▼

About this journal ▼

Explore

Browse all articles & issues ▼

 Latest issue

Subscribe

Alerts & RSS feed ▼

798

Views

0

CrossRef citations

Altmetric

Article

○ [RETRACTED ARTICLE: A comparative pulmonary pharmacokinetic study of budesonide using polymeric nanoparticles targeted to the lungs in treatment of asthma](#) ►

Niyaz Ahmad, Rizwan Ahmad, Mortaja Zaki Almakhamel, Khalid Ansari, Mohd Amir, Wasim Ahmad, Abuzer Ali & Farhan Jalees Ahmad

Pages: 749-762

**Published online:** 09 Apr 2020

1579

Views

5

CrossRef citations

Altmetric

Article

○ [RETRACTED ARTICLE: LncRNA \*CASC15\* promotes tumour progression through \*SOX4\*/Wnt/ \$\beta\$ -catenin signalling pathway in hepatocellular carcinoma](#) ►

Chaoyang Wang, Hao Zi, Yang Wang, Binghui Li, Zheng Ge & Xuequn Ren

Pages: 763-769

**Published online:** 14 Apr 2020

1510

Views

13

CrossRef citations

Altmetric

Article

○ [Natural polymeric nanoparticles as a non-invasive probe for mesenchymal stem cell labelling](#) ►

Mojdeh Mohseni, Sima Shojaei, Bitra Mehravi & Elham Mohammadi

Pages: 770-776

**Published online:** 16 Apr 2020

2003

Views

7

CrossRef citations

Altmetric

Article

○ [Intracellular synthesis of gold nanoparticles by \*Gluconacetobacter liquefaciens\* for delivery of peptide CopA3 and ginsenoside and anti-inflammatory effect on lipopolysaccharide-activated macrophages](#) ►

Ying Liu, Haribalan Perumalsamy, Chang Ho Kang, Seung Hyun Kim, Jae-Sam Hwang, Sung-Cheol Koh, Tae-Hoo Yi & Yeon-Ju Kim

Pages: 777-788

# Artificial Cells, Nanomedicine, and Biotechnology

Views | CrossRef citations | Altmetric

Publish with us

Submit an article ▼

About this journal ▼

Explore

Browse all articles & issues ▼

 Latest issue

Subscribe

Alerts & RSS feed ▼

Article

## RETRACTED ARTICLE: Serum levels of *PTEN* mRNA in colorectal cancer: a case-control study >

Yang Yan, Xiaohui Du, Shaoyou Xia, Songyan Li, Da Teng, Shidong Hu, Yufeng Wang & Rong Li

Pages: 789-793

Published online: 22 Apr 2020

908

Views

4

CrossRef citations

Altmetric

Retraction

## Statement of Retraction >

Page: 794

Published online: 22 May 2020

615

Views

0

CrossRef citations

Altmetric

Retraction

## Statement of Retraction >

Page: 795

Published online: 22 May 2020

555

Views

0

CrossRef citations

Altmetric

Retraction

## Statement of Retraction >

Page: 796

Published online: 22 May 2020

598

Views

0

CrossRef citations

Altmetric

Retraction

## Statement of Retraction >

Page: 797

Published online: 22 May 2020

632

Views

1

CrossRef citations

Altmetric

# Artificial Cells, Nanomedicine, and Biotechnology

Page: 798

Published online: 22 May 2020

Publish with us

Submit an article ▼

About this journal ▼

Explore

Browse all articles &amp; issues ▼

 Latest issue

Subscribe

Alerts &amp; RSS feed ▼

Retraction

[Statement of Retraction >](#)

Page: 799

Published online: 22 May 2020

612

Views

0

CrossRef citations

Altmetric

Article

[Pseudomonas aeruginosa synthesized silver nanoparticles inhibit cell proliferation and induce ROS mediated apoptosis in thyroid cancer cell line \(TPC1\) >](#)

Jinmei Yang, Qiang Wang, Chunxiao Wang, Ruiyi Yang, Mukhtar Ahmed, Subramanian Kumaran, Periyannan Velu &amp; Bo Li

Pages: 800-809

Published online: 20 May 2020

2039

Views

13

CrossRef citations

Altmetric

Article

[Enhanced sensitivity and efficiency of detection of Staphylococcus aureus based on modified magnetic nanoparticles by photometric systems >](#)

Ebrahim Naderlou, Mojtaba Salouti, Bahram Amini, Ali Amini, Asghar Narmani, Ahmad Jalilvand, Reza Shahbazi &amp; Saeid Zabihian

Pages: 810-817

Published online: 01 Jun 2020

1267

Views

9

CrossRef citations

Altmetric

Article

[Evaluation of relationship between SPON1 gene and genetic susceptibility of postmenopausal osteoporosis >](#)

Wenlong Ma, Ke Chen, Wenqing Xiao, Hongtao Tang, Shaohui Wang &amp; Kunzheng Wang

Pages: 818-823

Published online: 02 Jun 2020

1272

Views

2

CrossRef citations

Altmetric

# Artificial Cells, Nanomedicine, and Biotechnology

[Inhibition of proliferation and migration and promotion of lysosome-mitochondrial apoptosis](#) >

Publish with us

[Submit an article](#) ▾

[About this journal](#) ▾

Explore

[Browse all articles & issues](#) ▾

 [Latest issue](#)

Subscribe

[Alerts & RSS feed](#) ▾

**Published online:** 27 May 2020

2443

Views

4

CrossRef citations

Altmetric

Article

[The survival benefit of adjuvant radiotherapy for pathological T4N2M0 colon cancer in the Modern Chemotherapy Era: evidence from the SEER database 2004–2015](#) >

Yong Huang, Xi Gu, Kuanxue Ge, Guangshun Fu, Junfeng Chu & Wei Wei

Pages: 834-840

**Published online:** 27 May 2020

2082

Views

3

CrossRef citations

Altmetric

Article

[An emerging technology in lipid research for targeting hydrophilic drugs to the skin in the treatment of hyperpigmentation disorders: kojic acid-solid lipid nanoparticles](#) >

Khadijeh Khezri, Majid Saeedi, Katayoun Morteza-Semnani, Jafar Akbari & Seyyed Sohrab Rostamkalaei

Pages: 841-853

**Published online:** 27 May 2020

3325

Views

16

CrossRef citations

Altmetric

Article

[Everestmab, a novel long-acting GLP-1/anti GLP-1R nanobody fusion protein, exerts potent anti-diabetic effects](#) >

Hongchao Pan, Yunnan Su, Yini Xie, Weiyong Wang, Wanli Qiu, Wei Chen, Wenying Lu, Zhao Lu, Weiwei Wang & Anquan Shang

Pages: 854-866

**Published online:** 29 May 2020

2480

Views

4

CrossRef citations

Altmetric

Article

[The P<sub>50</sub> value detected by the oxygenation-dissociation analyser and blood gas analyser](#) >

Zongtang Chu, Ying Wang, Guoxing You, Quan Wang, Ning Ma, Bingting Li, Lian Zhao & Hong Zhou

Pages: 867-874

**Published online:** 28 May 2020

# Artificial Cells, Nanomedicine, and Biotechnology

Publish with us

Submit an article ▼

About this journal ▼

Explore

Browse all articles & issues ▼

 Latest issue

Subscribe

Alerts & RSS feed ▼

Xiewu Zhang, Hanbiao Xie, Manjun Luo, Daqiang Liang, Weimua Lao, Weijun Ma & Tankun Lin

Pages: 875-884

Published online: 28 May 2020

1601

1

Views

CrossRef citations

Altmetric

Article

## RDM1 plays an oncogenic role in human ovarian carcinoma cells >

Lu Tong, Wenjiao Cao, Jun Sheng, Enhao Zhu, Ying Yu, Tianying Zhong, Yajun Chen & Lihua Wang

Pages: 885-892

Published online: 05 Jun 2020

1144

2

Views

CrossRef citations

Altmetric

Article

## Biosynthesis of antioxidative enzymes and polyphenolics content in calli cultures of *Prunella vulgaris* L. in response to auxins and cytokinins >

Hina Fazal, Bilal Haider Abbasi, Nisar Ahmad, Bushra Noureen, Jahangir Shah, Dan Ma, Liu Chuanliang, Fazal Akbar, Muhammad Nazir Uddin, Haji Khan & Mohammad Ali

Pages: 893-902

Published online: 03 Jun 2020

998

4

Views

CrossRef citations

Altmetric

Article

## Effect of gastric bypass on BMI and lipid metabolism in type 2 diabetes mellitus >

Chen Zhang, Wang Cai, Hongzhi Zhao, Mei Zhu, Jin Cui & Zhe Sun

Pages: 903-911

Published online: 01 Jun 2020

1400

4

Views

CrossRef citations

Altmetric

Article

## Construction of immune-related risk signature for uveal melanoma >

Zhaotian Zhang, Yao Ni, Genghang Chen, Yantao Wei, Manjuan Peng & Shaochong Zhang

Pages: 912-919

Published online: 04 Jun 2020

1869

2



# Artificial Cells, Nanomedicine, and Biotechnology

Article

Publish with us

[Submit an article](#) ▼[About this journal](#) ▼

Explore

[Browse all articles & issues](#) ▼[Latest issue](#)

Subscribe

[Alerts & RSS feed](#) ▼

Lei Qi, Lu Liu, Yue Hu, Jie Li, Jiayi Li, Ningning Cao, Fangxing Zhu, Chaoji Shi &amp; Lei Zhang

Pages: 920-932

**Published online:** 04 Jun 2020

2193

Views

3

CrossRef citations

Altmetric

Article

[Whether miR-4293 rs12220909 variant affects cancer susceptibility: evidence from 11255 subjects](#) ▶

Dan Ji, Mei An &amp; Qiong Fang

Pages: 933-938

**Published online:** 04 Jun 2020

906

Views

1

CrossRef citations

Altmetric

Article

[Anti-hepatoma effect of taccalonolide A through suppression of sonic hedgehog pathway](#) ▶

Hui Tian &amp; Zhenkun He

Pages: 939-947

**Published online:** 04 Jun 2020

1156

Views

4

CrossRef citations

Altmetric

Article

[Diallyl disulphide-loaded spherical gold nanoparticles and acorn-like silver nanoparticles synthesised using onion extract: catalytic activity and cytotoxicity](#) ▶

You Jeong Lee, Song-Hyun Cha, Hyunjo Kim, Sung Eun Choi, Seonho Cho &amp; Youmie Park

Pages: 948-960

**Published online:** 04 Jun 2020

1217

Views

6

CrossRef citations

Altmetric

Article

[LINC02163 promotes colorectal cancer progression via miR-511-3p/AKT3 axis](#) ▶

Junwen Ma, Lihai Zhang, Anquan Shang, Hu Song, Jiege Huo, Mingjian Zhang &amp; Liuqin Jiang

Pages: 961-968

**Published online:** 11 Jun 2020

# Artificial Cells, Nanomedicine, and Biotechnology

Publish with us

Submit an article ▼

About this journal ▼

Explore

Browse all articles & issues ▼

 Latest issue

Subscribe

Alerts & RSS feed ▼

Huiqiang Wu, Jing Wang, Qing Zhao, Yanjie Ding, Bingyi Zhang & Lingli Kong

Pages: 969-976

**Published online:** 08 Jun 2020

1169

8

Views

CrossRef citations

Altmetric

Article

**MicroRNA-155 acts as a diagnostic and prognostic biomarker for oesophageal squamous cell carcinoma** >

Ying-Juan Zheng, Tian-Song Liang, Juan Wang, Jing-Yi Zhao, Su-Nan Zhai, Dao-Ke Yang & Li-Dong Wang

Pages: 977-982

**Published online:** 23 Jun 2020

1089

2

Views

CrossRef citations

Altmetric

Article

**The enhanced treatment efficacy of invasive brain glioma by dual-targeted artemether plus paclitaxel micelles** >

Xiuying Li, Luanxia Shi, Yandong Li, Qinqing Li, Xiujun Duan, Yingli Wang & Qingshan Li

Pages: 983-996

**Published online:** 11 Jun 2020

1261

0

Views

CrossRef citations

Altmetric

Retraction

**Statement of Retraction** >

Page: 997

**Published online:** 21 Oct 2020

487

0

Views

CrossRef citations

Altmetric

# Artificial Cells, Nanomedicine, and Biotechnology

Page: 998

**Published online:** 21 Oct 2020**Publish with us**[Submit an article](#) ▼[About this journal](#) ▼**Explore**[Browse all articles & issues](#) ▼[Latest issue](#)**Subscribe**[Alerts & RSS feed](#) ▼

Article

## Identification of potential key pathways, genes and circulating markers in the development of intracranial aneurysm based on weighted gene co-expression network analysis >

Guojia Du, Dangmurenjiafu Geng, Kai Zhou, Yandong Fan, Riqing Su, Qingjiu Zhou, Bo Liu &amp; Serick Duysenbi

Pages: 999-1007

**Published online:** 26 Jun 2020

1877

Views

1

CrossRef citations

Altmetric

Retraction

## Statement of Retraction >

Page: 1008

**Published online:** 22 Oct 2020

546

Views

0

CrossRef citations

Altmetric

Correction

## Correction >

Page: 1009

**Published online:** 29 Jun 2020

483

Views

0

CrossRef citations

Altmetric

Article

## Localised delivery of quercetin by thermo-sensitive PLGA-PEG-PLGA hydrogels for the treatment of brachial plexus avulsion >

Chao Huang, Chuan Fu, Zhi-Ping Qi, Wen-Lai Guo, Di You, Rui Li &amp; Zhe Zhu

Pages: 1010-1021

**Published online:** 01 Jul 2020

1803

Views

10

CrossRef citations

Altmetric

# Artificial Cells, Nanomedicine, and Biotechnology

for controlled drug delivery >

Beatriz Garcia-Pinel, Alicia Ortega-Rodríguez, Cristina Porrás-Alcalá, Laura Cabeza, Rafael Contreras-Cáceres, Raul Ortiz,

Publish with us

Submit an article ▾

About this journal ▾

Explore

Browse all articles & issues ▾

 Latest issue

Subscribe

Alerts & RSS feed ▾

Graphical abstract

1984

Views

12

CrossRef citations

Altmetric

Article

**Osteoclastic activity was associated with the development of steroid-induced osteonecrosis of femoral head >**

Min-Cong He, Jin Zhang, Xiao-Jun Chen, Ying-Shan Shen, Bin Fang, Yi-Xian Qin, Wei He & Qiu-Shi Wei

Pages: 1036-1046

Published online: 15 Jul 2020

1317

Views

3

CrossRef citations

Altmetric

Article

**LINC00162 participates in the pathogenesis of diabetic nephropathy via modulating the miR-383/HDAC9 signalling pathway >**

WenXing Fan, XiaoLing Wen, JinFeng Zheng, KunHua Wang, HongYu Qiu, Jing Zhang & Feng Su

Pages: 1047-1054

Published online: 17 Jul 2020

1299

Views

9

CrossRef citations

Altmetric

**The negative effects of obesity on heart, especially the electrophysiology of the heart >**

Haishan Chen, Xin Wang, Chongxiang Xiong & Hequn Zou

Pages: 1055-1062

Published online: 22 Jul 2020

2650

Views

4

CrossRef citations

Altmetric

Retraction

**Statement of retraction >**

Page: 1063

Published online: 21 Oct 2020

426

Views

0

CrossRef citations

Altmetric

# Artificial Cells, Nanomedicine, and Biotechnology

Page: 1064

Published online: 21 Oct 2020

Publish with us

Submit an article ▾

About this journal ▾

Explore

Browse all articles &amp; issues ▾

 Latest issue

Subscribe

Alerts &amp; RSS feed ▾

Retraction

[Statement of retraction >](#)

Page: 1065

Published online: 21 Oct 2020

438

Views

0

CrossRef citations

Altmetric

Retraction

[Statement of retraction >](#)

Page: 1066

Published online: 21 Oct 2020

476

Views

0

CrossRef citations

Altmetric

Retraction

[Statement of retraction >](#)

Page: 1067

Published online: 21 Oct 2020

400

Views

0

CrossRef citations

Altmetric

Article

[Zinc oxide nanoparticles synthesised from the \*Vernonia amygdalina\* shows the anti-inflammatory and antinociceptive activities in the mice model >](#)

Hairui Liu, Peipei Kang, Ying Liu, Yifan An, Yanting Hu, Xiyuan Jin, Xin Cao, Yunfei Qi, Thiyagarajan Ramesh &amp; Xiao Wang

Pages: 1068-1078

Published online: 20 Aug 2020

1756

Views

9

CrossRef citations

Altmetric

Article

[Systemic and microvascular comparison of Lactated Ringer's solution, VIR-HBOC, and alpha-alpha crosslinked haemoglobin-based oxygen carrier in a rat 10% toplod model >](#)

Bjorn K. Song, W. Richard Light, Kim D. Vandegriff, Joe Tucker &amp; William H. Nugent

Pages: 1079-1088

# Artificial Cells, Nanomedicine, and Biotechnology

[Publish with us](#)[Submit an article](#) ▼[About this journal](#) ▼[Explore](#)[Browse all articles & issues](#) ▼[Latest issue](#)[Subscribe](#)[Alerts & RSS feed](#) ▼[Articular cartilage](#) ▶

Azizeh Rahmani Del Bakhshayesh, Soraya Babaie, Hamid Tayefi Nasrabadi, Nahideh Asadi, Abolfazl Akbarzadeh & Ali Abedelahi

Pages: 1089-1104

**Published online:** 28 Aug 2020

2141

Views

18

CrossRef citations

Altmetric

Article

[Hepatic targeting of glycyrrhetic acid \*via\* nanomicelles based on stearic acid-modified fenugreek gum](#) ▶

Minghui Zhou, Shuang Li, Sheng Shi, Shaolong He, Yanni Ma & Wenping Wang

Pages: 1105-1113

**Published online:** 03 Sep 2020

895

Views

2

CrossRef citations

Altmetric

Article

[Enzyme/pH-triggered anticancer drug delivery of chondroitin sulfate modified doxorubicin nanocrystal](#) ▶

Yan Liang, Xiaoheng Fu, Chen Du, Haoran Xia, Yusi Lai & Yong Sun

Pages: 1114-1124

**Published online:** 03 Sep 2020

1362

Views

11

CrossRef citations

Altmetric

Article

[Protective effects of isorhynchophylline against silicon-dioxide-induced lung injury in mice](#) ▶

Min Qiu, Zheng Yang, Mengni Bian, Changxiao Liu, Yunshan Zhao & Quanli Liu

Pages: 1125-1134

**Published online:** 04 Sep 2020

971

Views

3

CrossRef citations

Altmetric

Article

[Micronized curcumin fabricated by supercritical CO<sub>2</sub> to improve antibacterial activity against \*Pseudomonas aeruginosa\*](#) ▶

# Artificial Cells, Nanomedicine, and Biotechnology

934	7	
Views	CrossRef citations	Altmetric

Publish with us

Submit an article ▾

About this journal ▾

Explore

Browse all articles &amp; issues ▾

 Latest issue

Subscribe

Alerts &amp; RSS feed ▾

Article

## Near-infra-red fluorescent chitosan oligosaccharide lactate for targeted cancer imaging and photothermal therapy >

Sungsu Lee, Gayoung Jo, Jin Seok Jung, Dae Hyeok Yang &amp; Hoon Hyun

Pages: 1144-1152

Published online: 04 Sep 2020

1213	6	
Views	CrossRef citations	Altmetric



Article

## Green synthesis of copper nanoparticles using *Cissus vitiginea* and its antioxidant and antibacterial activity against urinary tract infection pathogens >

Shuang Wu, Shanmugam Rajeshkumar, Malini Madasamy &amp; Vanaja Mahendran

Pages: 1153-1158

Published online: 14 Sep 2020

7764	34	1
Views	CrossRef citations	Altmetric



Article

## Resveratrol promotes secretion of wound healing related growth factors of mesenchymal stem cells originated from adult and fetal tissues >

Cita R. S. Prakoeswa, Yuyun Rindiastuti, Yohanes Widodo Wirohadidjojo, Evelyn Komaratih, Nurwasis, Aristika Dinaryati, Ni Made Inten Lestari &amp; Fedik A. Rantam

Pages: 1159-1166

Published online: 09 Sep 2020

1906	4	8
Views	CrossRef citations	Altmetric



Article

## Study of tissue engineered vascularised oral mucosa-like structures based on ACVM-0.25% HLC-I scaffold *in vitro* and *in vivo* >

Minyue Zhou, Xiao Chen, Yanling Qiu, He Chen, Yaoqiang Liu, Yali Hou, Minhai Nie &amp; Xuqian Liu

Pages: 1167-1177

Published online: 14 Sep 2020

1015	1	0
Views	CrossRef citations	Altmetric



# Artificial Cells, Nanomedicine, and Biotechnology

pancreatic cancer cells >

Wei Yang, Haitao Xu, Qinghao Liu, Chunxun Liu, Jiahe Hu, Ping Liu, Tianyi Fang, Yuxian Bai, Jiuxin Zhu & Rui Xie

Publish with us

Submit an article ▾

About this journal ▾

Explore

Browse all articles & issues ▾

 Latest issue

Subscribe

Alerts & RSS feed ▾

1698

Views

6

CrossRef citations

Altmetric

## Development of graphene based nanocomposites towards medical and biological applications >

Seyyed Mojtaba Mousavi, Foo Wah Low, Seyyed Alireza Hashemi, Chin Wei Lai, Younes Ghasemi, Sadaf Soroshnia, Amir Savardashtaki, Aziz Babapoor, Nelson Pynadathu Rumjit, Su Mei Goh, Nowshad Amin & Sieh Kiong Tiong

Pages: 1189-1205

Published online: 15 Sep 2020

3108

Views

17

CrossRef citations

Altmetric

Article

## Anticarcinogenic effect of gold nanoparticles synthesized from *Albizia lebbek* on HCT-116 colon cancer cell lines >

Harikrishna Malaikolundhan, Gowsik Mookkan, Gunasekaran Krishnamoorthi, Nirosha Matheswaran, Murad Alsawalha, Vishnu Priya Veeraraghavan, Surapaneni Krishna Mohan & Aiting Di

Pages: 1206-1213

Published online: 04 Oct 2020

3541

Views

10

CrossRef citations

Altmetric

## Radioactive gold nanocluster (198-AuNCs) showed inhibitory effects on cancer cells lines >

Shijin Xuan, Aline Oliveira da Silva de Barros, Rogério Chaffin Nunes, Eduardo Ricci-Junior, Ademir Xavier da Silva, Muhammad Sahid, Luciana Magalhaes Rebelo Alencar, Clenilton Costa dos Santos, Veronica Morandi, Frank Alexis, Surtaj H. Iram & Ralph Santos-Oliveira

Pages: 1214-1221

Published online: 17 Sep 2020

Graphical abstract

1404

Views

9

CrossRef citations

Altmetric

Article

## Efficiency of *Bacillus subtilis* metabolism of sugar alcohols governs its probiotic effect against cariogenic *Streptococcus mutans* >

Danielle Duanis-Assaf, Doron Steinberg & Moshe Shemesh

Pages: 1222-1230

Published online: 21 Sep 2020



# Artificial Cells, Nanomedicine, and Biotechnology

Article

Publish with us

Submit an article ▼

About this journal ▼

Explore

Browse all articles & issues ▼

 Latest issue

Subscribe

Alerts & RSS feed ▼

Gang Wang, Yang Yu, Yu-Zhu Wang, Pei-Hao Yin, Ke Xu & Heng Zhang

Pages: 1231-1249

**Published online:** 26 Sep 2020

2127

Views

6

CrossRef citations

Altmetric



Retraction

**Statement of Retraction** >

Page: 1250

**Published online:** 21 Oct 2020

440

Views

0

CrossRef citations

Altmetric



Retraction

**Statement of Retraction** >

Page: 1251

**Published online:** 22 Oct 2020

436

Views

0

CrossRef citations

Altmetric



Retraction

**Statement of Retraction** >

Page: 1252

**Published online:** 21 Oct 2020

415

Views

0

CrossRef citations

Altmetric



Retraction

**Statement of Retraction** >

Page: 1253

**Published online:** 21 Oct 2020

414

Views

0

CrossRef citations

Altmetric



Retraction

**Statement of Retraction** >



# Artificial Cells, Nanomedicine, and Biotechnology

[Views](#) | [CrossRef citations](#) | [Altmetric](#)

## Publish with us

[Submit an article](#) ▼[About this journal](#) ▼

## Explore

[Browse all articles & issues](#) ▼[Latest issue](#)

## Subscribe

[Alerts & RSS feed](#) ▼

### Retraction

#### Statement of Retraction >

Page: 1255

**Published online:** 21 Oct 2020

420

Views

0

CrossRef citations

Altmetric

### Retraction

#### Statement of Retraction >

Page: 1256

**Published online:** 21 Oct 2020

420

Views

0

CrossRef citations

Altmetric

### Expression of Concern

#### Expression of Concern >

Page: 1257

**Published online:** 21 Oct 2020

410

Views

0

CrossRef citations

Altmetric

### Expression of Concern

#### Expression of Concern >

Page: 1258

**Published online:** 21 Oct 2020

379

Views

0

CrossRef citations

Altmetric

### Article

#### Arabian Primrose leaf extract mediated synthesis of silver nanoparticles: their industrial and biomedical applications >

Shruti Nindawat &amp; Veena Agrawal

Pages: 1259-1271

**Published online:** 05 Oct 2020

940

Views

3

CrossRef citations

Altmetric

# Artificial Cells, Nanomedicine, and Biotechnology

[Understanding mechanisms](#) ▶

Hong Liang Zhao, Jie Zhang, Yu Zhu, Yue Wu, Qing Guang Yan, Xiao Yong Peng, Xin Ming Xiang, Kun Lun Tian, Tao Li & Liang

Publish with us

[Submit an article](#) ▼

[About this journal](#) ▼

Explore

[Browse all articles & issues](#) ▼

[Latest issue](#)

Subscribe

[Alerts & RSS feed](#) ▼

946

Views

3

CrossRef citations

Altmetric

Expression of Concern

[Expression of Concern](#) ▶

Page: 1282

**Published online:** 11 Jan 2021

277

Views

0

CrossRef citations

Altmetric

Expression of Concern

[Expression of Concern](#) ▶

Page: 1283

**Published online:** 11 Jan 2021

275

Views

0

CrossRef citations

Altmetric

Expression of Concern

[Expression of Concern](#) ▶

Page: 1284

**Published online:** 11 Jan 2021

271

Views

0

CrossRef citations

Altmetric

Retraction

[Statement of Retraction](#) ▶

Page: 1285

**Published online:** 11 Jan 2021

382

Views

0

CrossRef citations

Altmetric

Retraction

[Statement of Retraction](#) ▶

Page: 1286

**Published online:** 11 Jan 2021

# Artificial Cells, Nanomedicine, and Biotechnology

[Publish with us](#)[Submit an article](#) ▼[About this journal](#) ▼[Explore](#)[Browse all articles & issues](#) ▼[Latest issue](#)[Subscribe](#)[Alerts & RSS feed](#) ▼

**Published online:** 11 Jan 2021

416

Views

0

CrossRef citations

Altmetric

Retraction

[Statement of Retraction](#) >

Page: 1288

**Published online:** 11 Jan 2021

405

Views

0

CrossRef citations

Altmetric

Retraction

[Statement of Retraction](#) >

Page: 1289

**Published online:** 11 Jan 2021

358

Views

0

CrossRef citations

Altmetric

Retraction

[Statement of Retraction](#) >

Page: 1290

**Published online:** 11 Jan 2021

466

Views

0

CrossRef citations

Altmetric

Retraction

[Statement of Retraction](#) >

Page: 1291

**Published online:** 11 Jan 2021

358

Views

0

CrossRef citations

Altmetric

Retraction

[Statement of Retraction](#) >

Page: 1292

# Artificial Cells, Nanomedicine, and Biotechnology

[Publish with us](#)[Submit an article](#) ▼[About this journal](#) ▼[Explore](#)[Browse all articles & issues](#) ▼[Latest issue](#)[Subscribe](#)[Alerts & RSS feed](#) ▼

Page: 1293

**Published online:** 11 Jan 2021

362

Views

0

CrossRef citations

Altmetric

Retraction

[Statement of Retraction](#) >

Page: 1294

**Published online:** 11 Jan 2021

384

Views

0

CrossRef citations

Altmetric

Expression of Concern

[Expression of Concern](#) >

Page: 1295

**Published online:** 11 Jan 2021

248

Views

0

CrossRef citations

Altmetric

Expression of Concern

[Expression of Concern](#) >

Page: 1296

**Published online:** 11 Jan 2021

251

Views

0

CrossRef citations

Altmetric

Expression of Concern

[Expression of Concern](#) >

Page: 1297

**Published online:** 11 Jan 2021

285

Views

0

CrossRef citations

Altmetric

Expression of Concern

[Expression of Concern](#) >

Page: 1298

# Artificial Cells, Nanomedicine, and Biotechnology

Publish with us

Submit an article ▼

About this journal ▼

Explore

Browse all articles & issues ▼

 Latest issue

Subscribe

Alerts & RSS feed ▼

## Expression of Concern >

Page: 1299

Published online: 11 Jan 2021

267

Views

0

CrossRef citations

Altmetric

Retraction

## Statement of Retraction >

Page: 1300

Published online: 11 Jan 2021

341

Views

0

CrossRef citations

Altmetric

Retraction

## Statement of Retraction >

Page: 1301

Published online: 11 Jan 2021

363

Views

0

CrossRef citations

Altmetric

Correction

## Correction >

Page: 1302

Published online: 11 Jan 2021

245

Views

0

CrossRef citations

Altmetric

Article

## Activation of CXCL12-CXCR4 signalling induces conversion of immortalised embryonic kidney cells into cancer stem-like cells >

Seung-ick Oh, Hyesun Jeong, Hang-soo Park, Kyung-Ah Choi, Insik Hwang, Jiyun Lee, Jeonghee Cho & Sunghoi Hong

Pages: 1303-1313

Published online: 05 Nov 2020

1181

Views

1

CrossRef citations

Altmetric

# Artificial Cells, Nanomedicine, and Biotechnology

Page: 1314

Published online: 11 Jan 2021

Publish with us

[Submit an article](#) ▼[About this journal](#) ▼

Explore

[Browse all articles & issues](#) ▼[Latest issue](#)

Subscribe

[Alerts & RSS feed](#) ▼

Article

## Antimicrobial, antioxidant and anticancer activities of gold nanoparticles green synthesized using *Mangifera indica* seed aqueous extract >

Savan Donga, Gopala Ram Bhadu &amp; Sumitra Chanda

Pages: 1315-1325

Published online: 23 Nov 2020

[Graphical abstract](#)

2098

Views

11

CrossRef citations

Altmetric

Retraction

## Statement of Retraction >

Page: 1326

Published online: 11 Jan 2021

352

Views

0

CrossRef citations

Altmetric

Retraction

## Statement of Retraction >

Page: 1327

Published online: 11 Jan 2021

401

Views

0

CrossRef citations

Altmetric

Retraction

## Statement of Retraction >

Page: 1328

Published online: 11 Jan 2021

371

Views

0

CrossRef citations

Altmetric

Retraction

## Statement of Retraction >

Page: 1329

Published online: 11 Jan 2021

# Artificial Cells, Nanomedicine, and Biotechnology

Publish with us

Submit an article ▼

About this journal ▼

Explore

Browse all articles &amp; issues ▼

 Latest issue

Subscribe

Alerts &amp; RSS feed ▼

Published online: 11 Jan 2021

403

Views

0

CrossRef citations

Altmetric

Article

**A facile one-step preparation of  $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2/\text{Li-BioMOFs}$  resin nanocomposites with *Glycyrrhiza glabra* (licorice) root juice as green capping agent and mechanical properties study** >

Fahimeh Asadi, Hamid Forootanfar &amp; Mehdi Ranjbar

Pages: 1331-1339

Published online: 10 Nov 2020

[Graphical abstract](#)

853

Views

3

CrossRef citations

Altmetric

Article

**Synergistic response of physicochemical reaction parameters on biogenesis of silver nanoparticles and their action against colon cancer and leishmanial cells** >

Bilal Javed, Zia-ur-Rehman Mashwani, Abdullah Sarwer, Naveed Iqbal Raja &amp; Akhtar Nadhman

Pages: 1340-1353

Published online: 26 Nov 2020

[Graphical abstract](#)

1029

Views

12

CrossRef citations

Altmetric

Article

**Biocompatibility, cytotoxicity and antibacterial effects of meropenem-loaded mesoporous silica nanoparticles against carbapenem-resistant *Enterobacteriaceae*** >

Mohammad Yousef Memar, Mina Yekani, Hadi Ghanbari, Shahriar Shahi, Simin Sharifi &amp; Solmaz Maleki Dizaj

Pages: 1354-1361

Published online: 25 Nov 2020

1227

Views

4

CrossRef citations

Altmetric



Home ▶ All Journals ▶ Artificial Cells, Nanomedicine, and Biotechnology ▶ List of Issues ▶ Volume 48, Issue 1

# Artificial Cells, Nanomedicine, and Biotechnology

Triple-negative breast and laryngeal cancer cells >

Asim Halder, Megha Iethwa, Pritha Mukherjee, Subarna Ghosh, Suvadra Das, A. B. M. Helal Uddin, Arup Mukherjee, Urmi

Publish with us

Submit an article ▼

About this journal ▼

Explore

Browse all articles & issues ▼

 Latest issue

Subscribe

Alerts & RSS feed ▼

Graphical abstract

1379

Views

8

CrossRef citations

Altmetric

## Explore articles

Latest

Most read

Most cited

Trending

[Expression of Concern >](#)

Expression of Concern | Published online: 28 Jul 2022

[Expression of Concern >](#)

Expression of Concern | Published online: 27 Jul 2022

[Expression of Concern >](#)

Expression of Concern | Published online: 27 Jul 2022

[Expression of Concern >](#)

Expression of Concern | Published online: 27 Jul 2022

[Home](#) ▶ [All Journals](#) ▶ [Artificial Cells, Nanomedicine, and Biotechnology](#) ▶ [List of Issues](#) ▶ [Volume 48, Issue 1](#)

# Artificial Cells, Nanomedicine, and Biotechnology

AUTHORS

R&D professionals

**Publish with us**

[Submit an article](#) ▼

[About this journal](#) ▼

**Explore**

[Browse all articles & issues](#) ▼

[Latest issue](#)

**Subscribe**

[Alerts & RSS feed](#) ▼

Societies

Opportunities

Reprints and e-prints

Advertising solutions

Accelerated publication

Corporate access solutions

Overview

Open journals

F1000Research

Help and information

Help and contact

Newsroom

All journals

Books

## Keep up to date

Register to receive personalised research and resources by email

 [Sign me up](#)

Copyright © 2022 Informa UK Limited [Privacy policy](#) [Cookies](#) [Terms & conditions](#) [Accessibility](#)



Taylor & Francis Group  
an informa business

Registered in England & Wales No. 3099067  
5 Howick Place | London | SW1P 1WG

# Artificial Cells, Nanomedicine, and Biotechnology

[Publish with us](#)[Submit an article](#) ▼[About this journal](#) ▼[Explore](#)[Browse all articles & issues](#) ▼[Latest issue](#)[Subscribe](#)[Alerts & RSS feed](#) ▼ Taylor & Francis Online[Log in](#)[Register](#)

## Ready to submit?

Start a new manuscript submission or continue a submission in progress

[Go to submission site](#) ↗

## Submission information

[▶ Instructions for authors](#)[▶ Editorial policies](#) ↗

## Editing services

[▶ Editing services site](#) ↗

## About this journal

[▶ Journal metrics](#)[▶ Aims & scope](#)[▶ Journal information](#)[▶ Editorial board](#)[▶ News & call for papers](#)

## Editorial board

### Co-Editor-in-chief

RDK Misra, University of Texas at El Paso, USA

Wojciech Chrzanowski, University of Sydney, Australia

### Reviews Editor

Paul Roach, Loughborough University, UK

### Emeritus Editor

Thomas M. S. Chang - Director, Artificial Cells and Organs Research Centre and Emeritus Professor of Physiology, Medicine and Biomedical Engineering, Faculty of Medicine, McGill University, Montreal, Quebec, Canada

### Associate editors

Ramesh Chandra - University of Delhi, Delhi, India

Dror Fixler - Bar-Ilan University, Ramat Gan, Israel

Rania Hathout, Ain Shams University, Cairo, Egypt

[Home](#) ▶ [All Journals](#) ▶ [Artificial Cells, Nanomedicine, and Biotechnology](#) ▶ [Editorial Board](#)

# Artificial Cells, Nanomedicine, and Biotechnology

Satya Prakash - Biomedical Engineering, McGill University, Montreal, Quebec, Canada

**Publish with us**

[Submit an article](#) ▼

[About this journal](#) ▼

**Explore**

[Browse all articles & issues](#) ▼

 [Latest issue](#)

**Subscribe**

[Alerts & RSS feed](#) ▼

Veena Agrawal - University of Delhi, New Delhi, India

Bilal Ahmed - Yeungnam University, Gyeongsan, Korea (the Republic of)

Muhammad Sajid Hamid Akash - Department of Pharmaceutical Chemistry, Government College University, Faisalabad, Pakistan

Zahra Allahyari - Rochester Institute of Technology, Rochester, NY, USA

Mh Busra Fauzi - Centre for Tissue Engineering and Regenerative Medicine, Faculty of Medicine, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia

Anisoara Cimpean - Faculty of Biology, University of Bucharest, Bucharest, Romania

Daniele Di Mascolo - Fondazione Istituto, Italiano di Tecnologia, Geova, Italy

Leticia Hosta-Rigau - Technical University of Denmark, Kongens Lyngby, Denmark

Doğa Kavaz - Cyprus International University, North Nicosia, Cyprus

Peter E Keipert - Alliance Pharmaceutical Corp, San Diego, CA, USA

John F Kennedy - Chembiotech Laboratories, Bromsgrove, England, UK

Ján Kozempel - Czech Technical University in Prague, Prague, Czech Republic

Sathish Sundar Dhillip Kumar - University of Johannesburg, Johannesburg, South Africa

Jui-Yang Lai - Chang Gung University, Taoyuan City, Taiwan

Vuanghao Lim - Universiti Sains Malaysia, Penang, Malaysia

Pasquale Marrazzo - University of Bologna, Bologna, Italy

Shadab Md - King Abdulaziz University, Jeddah, Saudi Arabia

Arokia Vijaya Anand Mariadoss - Hallym University Dongtan Sacred Heart Hospital, Suwon, Korea (the Republic of)

Nicole Remaliah Sibuyi - University of the Western Cape, Bellville, South Africa

Ghassan Mohammad Sulaiman - University of Technology, Baghdad, Iraq

Wei Tao - Harvard Medical School, Boston, MA, USA

Paul De Vos - University Center Groningen (UMCG), Groningen, The Netherlands

## Social Media Editor

Matthew Hadden - University of Sydney, Australia

**Journal Editorial Office Support:** [IANB-peerreview@journals.tandf.co.uk](mailto:IANB-peerreview@journals.tandf.co.uk)

Sample our   
Medicine, Dentistry, Nursing  
& Allied Health Journals  
>> [Sign in here](#) to start your access  
to the latest two volumes for 14 days

  
**Small GTPases**  
GTPASE PROTEINS: REGULATORS/EFFECTORS AND EMERGING APPROACHES  
**FIND OUT MORE** 

Home ► All Journals ► Artificial Cells, Nanomedicine, and Biotechnology ► Editorial Board

# Artificial Cells, Nanomedicine, and Biotechnology

Publish with us

Submit an article ▼

About this journal ▼

Explore

Browse all articles & issues ▼

 Latest issue

Subscribe

Alerts & RSS feed ▼



## Information for

Authors

R&D professionals

Editors

Librarians

Societies

## Opportunities

Reprints and e-prints

Advertising solutions

Accelerated publication

Corporate access solutions

## Open access

Overview

Open journals

Open Select

Dove Medical Press

F1000Research

## Help and information

Help and contact

Newsroom

All journals

Books

## Keep up to date

Register to receive personalised research and resources by email



Sign me up



Copyright © 2022 Informa UK Limited [Privacy policy](#) [Cookies](#) [Terms & conditions](#) [Accessibility](#)



Taylor & Francis Group  
an informa business

Registered in England & Wales No. 3099067  
5 Howick Place | London | SW1P 1WG

## Resveratrol promotes secretion of wound healing related growth factors of mesenchymal stem cells originated from adult and fetal tissues

Cita R. S. Prakoeswa, Yuyun Rindiastuti, Yohanes Widodo Wirohadidjojo, Evelyn Komaratih, Nurwasis, Aristika Dinaryati, Ni Made Inten Lestari & Fedik A. Rantam

To cite this article: Cita R. S. Prakoeswa, Yuyun Rindiastuti, Yohanes Widodo Wirohadidjojo, Evelyn Komaratih, Nurwasis, Aristika Dinaryati, Ni Made Inten Lestari & Fedik A. Rantam (2020) Resveratrol promotes secretion of wound healing related growth factors of mesenchymal stem cells originated from adult and fetal tissues, *Artificial Cells, Nanomedicine, and Biotechnology*, 48:1, 1159-1166, DOI: [10.1080/21691401.2020.1817057](https://doi.org/10.1080/21691401.2020.1817057)

To link to this article: <https://doi.org/10.1080/21691401.2020.1817057>



© 2020 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group



Published online: 09 Sep 2020.



Submit your article to this journal [↗](#)



Article views: 1906



View related articles [↗](#)



View Crossmark data [↗](#)



Citing articles: 4 View citing articles [↗](#)

## Resveratrol promotes secretion of wound healing related growth factors of mesenchymal stem cells originated from adult and fetal tissues

Cita R. S. Prakoeswa<sup>a</sup>, Yuyun Rindiastuti<sup>b</sup>, Yohanes Widodo Wirohadidjojo<sup>c</sup>, Evelyn Komaratih<sup>b</sup>, Nurwasib<sup>b</sup>, Aristika Dinaryati<sup>d</sup>, Ni Made Inten Lestari<sup>a</sup> and Fedik A. Rantam<sup>d</sup>

<sup>a</sup>Department of Dermatovenerology, Faculty of Medicine Universitas Airlangga/Dr Soetomo, General Academic Hospital, Surabaya, Indonesia;

<sup>b</sup>Department of Ophthalmology, Faculty of Medicine Universitas Airlangga/Dr Soetomo, General Academic Hospital, Surabaya, Indonesia;

<sup>c</sup>Department of Dermatovenerology, Faculty of Medicine Universitas Gadjah Mada/Dr Sardjito, General Academic Hospital, Yogyakarta, Indonesia; <sup>d</sup>Stem Cell Research and Development Center, Universitas Airlangga, Surabaya, Indonesia

### ABSTRACT

Non-healing wounds have demonstrated aberrant regulation of several growth factors, thus using exogenous growth factors and cytokines in the clinical setting may improve the outcomes of non-healing wounds. Mesenchymal stem cells (MSCs) are the source of growth factors that show beneficial effect in promoting impaired wound healing. Certain culture condition should be developed to stimulate growth factor secretion from stem cell. Resveratrol, a small molecule found to increase MSCs therapeutic effectiveness. This study aims to investigate the effect of RV on secretion of wound healing related growth factors. We isolated and characterised MSCs from wharton's jelly (WJ), amniotic membrane (AM), and adipose tissue. We treated MSCs with serum deprived medium (SDM) supplemented with RV at 0.1  $\mu$ M, 0.5  $\mu$ M, 0.8  $\mu$ M concentration. Our study revealed that RV at 0.1  $\mu$ M was more effective to increase cell proliferation rate. Resveratrol at 0.1  $\mu$ M promoted EGF, HGF, PDGF, and TGF- $\beta$ 1 secretion from MSCs. AD-MSCs showed the greatest response to RV stimulation in the term of cell proliferation and growth factors secretion. As conclusion, RV can facilitate cell proliferation and wound healing related growth factors secretion at dosage dependent manner.

### ARTICLE HISTORY

Received 30 October 2019

Revised 6 May 2020

Accepted 24 May 2020

### KEYWORDS

Wound healing; stem cell; resveratrol; secretome



### Introduction

Million people are affected by acute and chronic wounds as a result of surgeries, burns, infections, pressure ulcers, as well as diabetic and venous ulcers. However, chronic wounds possess a significant health burden [1–4]. Wound healing is a complex biological process that involves interaction between cellular components, cytokines, growth factors, and extracellular matrix. It is generally divided into three phase: inflammation, proliferation, and remodelling [5]. Numerous growth factors and their receptors are altered during wound healing phase, including platelet derived growth factor (PDGF), fibroblast growth factor (FGF), epidermal growth factor (EGF), transforming growth factor (TGF), vascular endothelial growth factor (VEGF), hepatocyte growth factor (HGF), and keratinocyte growth factor (KGF) [6–8].

*In vivo* and *in vitro* studies analysing non-healing acute and chronic wounds have demonstrated aberrant regulation of several growth factors suggesting a potential target for therapy. It has led to a robust interest in using exogenous growth factors and cytokines in the clinical setting to improve the outcomes of non-healing wounds [9]. In recent years, many animal studies have demonstrated a promising use of growth factors to promote impaired wound. This led

to the hope that the application of exogenous growth factors may be used clinically to promote wound healing process. PDGF-BB is the only growth factor approved by the US Food and Drug administration (FDA) for clinical use, however, due to its high cost the use of PDGF-BB especially in a developing country is still debatable. Stimulation of wound healing needs crosstalk of many growth factors, hence introduction of single growth factor seems to be inadequate [5,8,10,11]. Regardless of the different growth factors therapeutic approach targeting wound healing enhancement, the search towards source of growth factors is still being explored [6–8].

Mesenchymal stem cells (MSCs) are multipotent cells derived from a variety of tissues including bone marrow, adipose tissues, umbilical cord, and amniotic membrane. Recent studies proved that MSCs stimulated human dermal fibroblast (HDFs) *via* paracrine effects and enhanced cutaneous wound healing. MSCs secrete many cytokines and growth factors which are important in cell growth and maintaining skin tissues [4,12]. Several attempts have been tried to stimulate specific growth factors released by MSCs, such as manipulating culture condition by hypoxic condition, 3D culture system, and small molecule supplementation. Resveratrol (RV, 3,5,49 – hydroxystilbene) is a small molecule, naturally

**CONTACT** Cita R. S. Prakoeswa  [cita-rosita@fk.unair.ac.id](mailto:cita-rosita@fk.unair.ac.id)  Department of Dermatovenerology, Faculty of Medicine Universitas Airlangga/Dr Soetomo, General Academic Hospital, Surabaya 60131, Indonesia

© 2020 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group  
This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.



occurring product found in a number of plants. Numerous studies have shown that RV possesses a wide range of biological effects that could be beneficial for human health. One potential cell target for RV through oral or intravenous injection is the adult stem cells residing in different tissues and organs. Several studies within the last few years have reported the beneficial effects of RV on behaviour of various stem cells. However, limited studies have examined the effect of RV on stem cell behaviour especially in cell secretion products [13,14]. In this study, we hypothesised that RV could induce MSCs to secrete wound healing related growth factors.

## Materials and methods

### Materials

The main reagents included Type IV collagenase (Roche USA), Type II collagenase (Roche USA), alpha modified eagle medium ( $\alpha$ -MEM, Gibco-Life Technologies, USA), dulbecco's modified eagle's medium (DMEM, Gibco-Life Technologies, USA), nonessential amino acid (NEAA, Sigma, USA), Trypsin-EDTA (Gibco – Life Technologies, USA), foetal bovine serum (FBS, Biowest, USA), resveratrol (Sigma, USA), bFGF (Gibco-Life Technologies, USA), 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT; Gibco- Life Technologies, USA). Antibodies for flowcytometry CD 105, CD 90, CD 73, CD 34, CD 133, and CD 45 were purchased from BD bioscience (US). Human PDGF-B, TGF- $\beta$ 1, VEGF-A, EGF, and HGF ELISA kit from Bioassay Technology Laboratory, China.

### Methods

This is an *in vitro* study to investigate the effect of various doses of RV on wharton's jelly MSCs (WJ-MSCs), amniotic membrane MSCs (AM-MSCs), and adipose derived MSCs (AD-MSCs) secretion, mainly for PDGF-B, TGF- $\beta$ 1, EGF, HGF, and VEGF-A levels. All experiments were conformed to institutional ethics review board from dr. Soetomo General Academic Hospital (Registered number: 1293/KEPK/VII/2019). This study was conducted at Stem Cell Research and Development Centre, Universitas Airlangga.

### Cell isolation

#### Wharton's jelly and amniotic membrane MSCs isolation

Wharton's jelly MSCs and AM-MSCs were isolated from single donor of placenta, obtained from healthy full-term baby through caesarian section under aseptic technique. Umbilical cord in 3 cm length and amnion membrane were collected after the mothers have consented. Wharton's jelly MSCs and AM-MSCs were isolated using mixed enzymatic-explant method based on protocol developed by Azendeh et al. [15] with our modification. Briefly, blood vessels were removed to allow only the WJ and AM to come into direct contact with the enzymatic solution. Wharton's jelly and AM were minced into approximately 1 cm<sup>3</sup> pieces and washed with PBS. Each tissue was then placed in sterile tube containing  $\alpha$ -MEM

medium with enzymatic cocktail comprising 0.75 mg/ml Collagenase Type IV and incubated at 37 °C for 30–60 min with gentle agitation. After the incubation period, the tissue pieces were washed with culture media and transferred to a new sterile tube and centrifuged at 300 g for 5 min. Supernatant was discarded and cell pellets resuspended in culture medium composed of  $\alpha$ -MEM, 1% penicillin-streptomycin, 1% amphotericin B, 1% NEAA, 5% FBS, and bFGF 5 ng/mL for WJ-MSCs and DMEM-F12, 1% penicillin-streptomycin, 1% amphotericin B, 1% NEAA, 5% FBS, and bFGF 5 ng/mL for AM-MSCs. Cells and remaining small pieces of tissue were cultured with culture media in incubator at 37 °C and 5% CO<sub>2</sub>. Culture media were changed every 3 days until 90% confluency was reached, then passaged using warm trypsinisation method.

#### Adipose derived MSCs isolation

Adipose derived MSCs were isolated from single donor of adipose tissue, obtained from healthy 27-year-old-woman under aseptic technique. Adipose tissue in 2 × 2 cm of size was collected after assignment of informed consent. Adipose derived MSCs were isolated using enzymatic method based on protocol developed by Palumbo et al. [16] with our modification. Briefly, adipose tissue was minced into approximately 1 cm<sup>3</sup> pieces and washed with PBS. Adipose tissue was then placed in sterile tube containing  $\alpha$ -MEM medium with enzymatic cocktail comprising 0.075% Collagenase Type I and incubated at 37 °C for 30–60 min. After the incubation period, the digested tissues were washed with culture media and transferred to a new sterile tube and centrifuged at 300 g for 5 min. Supernatant was discarded and cell pellets resuspended in culture medium composed of  $\alpha$ -MEM, 1% penicillin-streptomycin, 1% amphotericin B, 1% NEAA, 5% FBS, and bFGF 5 ng/mL then stored in incubator at 37 °C and 5% CO<sub>2</sub>. Culture media were changed every 3 days until 90% confluency was reached, then passaged using warm trypsinisation method.

#### Cell characterization

Flow cytometry was used to assess the surface marker of MSCs, using the standard for MSC as described by the International Society for Cellular Therapy (ISCT). Cells (P2-3) were harvested, pelleted and resuspended in 1% bovine serum albumin (BSA in PBS), and counted. Each population cells were used for flow cytometry. Cells were stained with directly PE (phycoerythrin) conjugated antibodies against CD73, CD90, CD105, and CD45 (BD bioscience, US). Cells were analysed on FACS calibur flow cytometry using FACSDiva Software (BD bioscience, US).

#### Secretome production using resveratrol preconditioning

Amount of 5 × 10<sup>3</sup> cells/well of WJ-MSCs, AM-MSCs, and AD-MSCs at passage 4 were cultured in each 96 multiwell plate with culture media for 24 h to reach 70% confluency. A day later, the cells were treated using media composed of  $\alpha$ -MEM, 1% penicillin-streptomycin, 1% amphotericin B, 1% NEAA, and 2% FBS supplemented with various doses of RV.



We divided into three groups of RV supplementation dose that consist of 0.1  $\mu\text{M}$ , 0.5  $\mu\text{M}$ , and 0.8  $\mu\text{M}$ . For control group, we used culture media in serum deprivation condition (SDM) containing 2% FBS. Cell secretome was collected after 48 h of treatment and filtered using 0.45  $\mu\text{m}$  millipore. The cell secretome then stored at  $-80^{\circ}\text{C}$  until further analysis. All of the experiment groups were conducted in 4 replications.

### Cell viability

3-(4,5-Dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide assay were conducted to determine the effect of RV at various dose on cell viability. After 48 h of resveratrol preconditioning, 10  $\mu\text{l}$  of 0.45 mg/mL tetrazolium solution was added to each well and incubate at  $37^{\circ}\text{C}$  for 4 h. After incubation, 100  $\mu\text{l}$  of solubilisation solution were added to dissolve the formazan crystals. The plate then immediately analysed using microplate reader at absorbance of 570 nm.

### Growth factor measurement

Growth factor measurement was conducted to determine the effect of RV at various doses which in the concentration of PDGF-B, TGF- $\beta$ 1, EGF, VEGF, and HGF. Enzyme-linked immunosorbent assay was performed according to Bioassay Technology Laboratory protocol. Briefly, cell supernatants were collected and centrifuged at 3000 rpm for 20 min. Amount of 40  $\mu\text{l}$  of supernatants were placed into ELISA well plate. Biotinylated antibody and streptavidin HRP were added, then sample were incubated at  $37^{\circ}\text{C}$  for 60 min. Samples were washed 3x with washing buffer, then solution A and B were added and incubated at  $37^{\circ}\text{C}$  for 10 min. Stop solution was added and plate was read immediately using microplate reader at absorbance of 450 nm.

### Statistical analysis

The data of cell viability and growth factor level were presented in mean  $\pm$  standard deviation. Difference of cell viability among groups was analysed with ANOVA and Post-hoc Tukey using SPSS software version 19.0,  $p < .05$  considered to be statistically significant.

## Results

### Cell isolation and characterisation

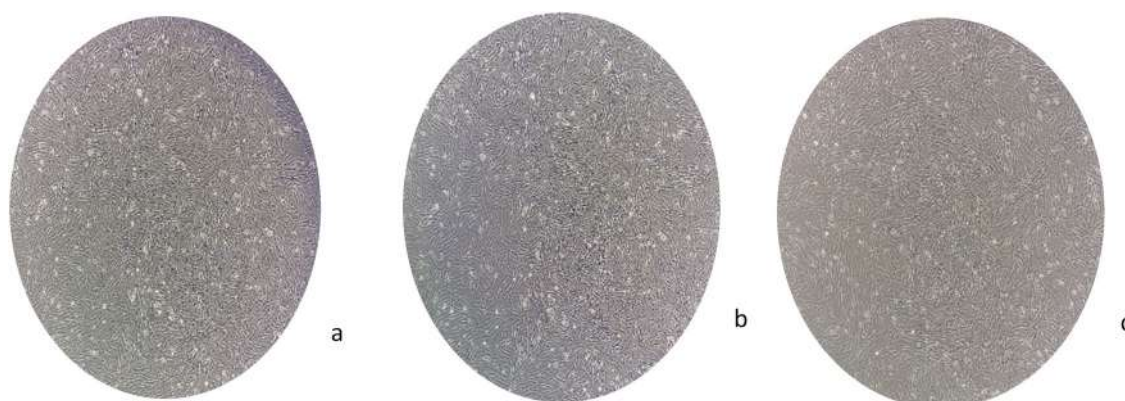
We successfully isolated WJ-MSCs, AM-MSCs, and AD-MSCs which fulfilled The International Society for Cellular Therapy criteria for MSCs such as fibroblast-like morphology appearance (Figure 1), adhere to culture dishes, and positive expression for surface marker of MSCs. Flowcytometry of cell populations at passage 3 indicated positive expression for CD 105, CD 90, and CD 73 FITC antibody but negative for CD 34, and CD 45 antibody as depicted in Figure 2. Identification of CD73 and CD90 within gate R3 showed subset of positive cells in amniotic membrane (87.42% and 92.36%), wharton's jelly (87.41% and 89.2%), adipose tissue (89.46% and 91.2%). Identification of CD105 within gate R5 showed subset of positive cells in amniotic membrane 67.42%, wharton's jelly 59.2%, adipose tissue 61.2%. Identification of CD34 and CD45 within gate R4 showed subset of positive cells in amniotic membrane (15.2% and 8.36%), wharton's jelly (17.1% and 9.2%), adipose tissue (16.16% and 10.2%).

### Resveratrol exerts dosage-dependent effect of MSCs proliferation

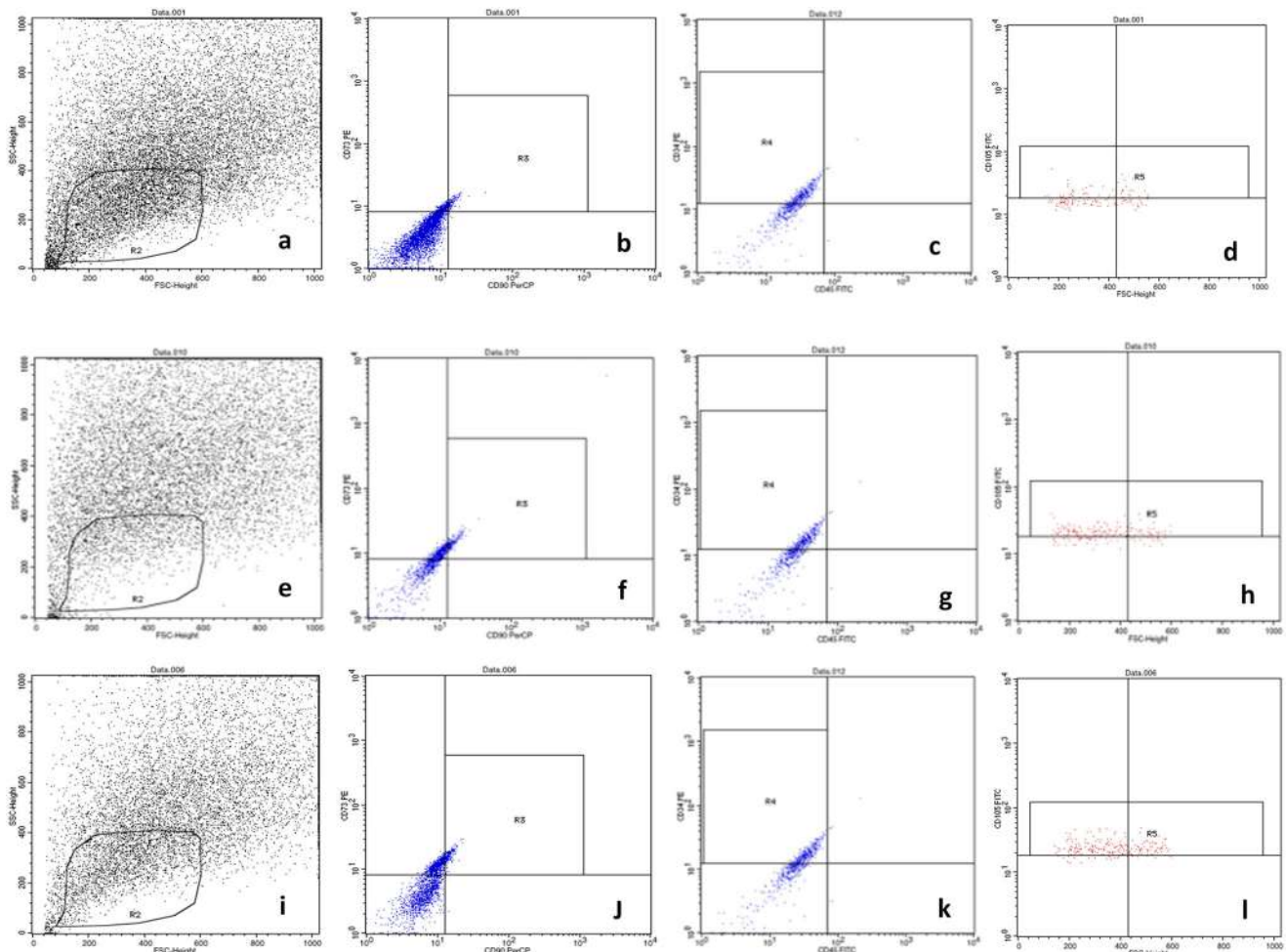
During 48 h culture of WJ-MSCs, AM-MSCs, and AD-MSCs, it was visually noted that cells treated with 0.1  $\mu\text{M}$  RV expand faster than cells treated with serum deprivation media (SDM) and higher concentrations of RV, respectively. Figure 3 shows that while 0.1  $\mu\text{M}$  RV seemed to provide the best growth advantage over SDM treated cells. AD-MSCs showed the highest proliferation rate in response to 0.1  $\mu\text{M}$  RV treatment compared to AM-MSCs and WJ-MSCs. However, higher RV concentrations showed slight growth advantage over SDM treated cells.

### Resveratrol stimulate growth factors secretion from MSCs at dosage dependent manner

To determine the effect of resveratrol on MSCs secretion, we collect the cell supernatant after 48 h of RV treatment and measured the growth factors concentration using direct ELISA. Enzyme linked immunosorbent assay showed that the

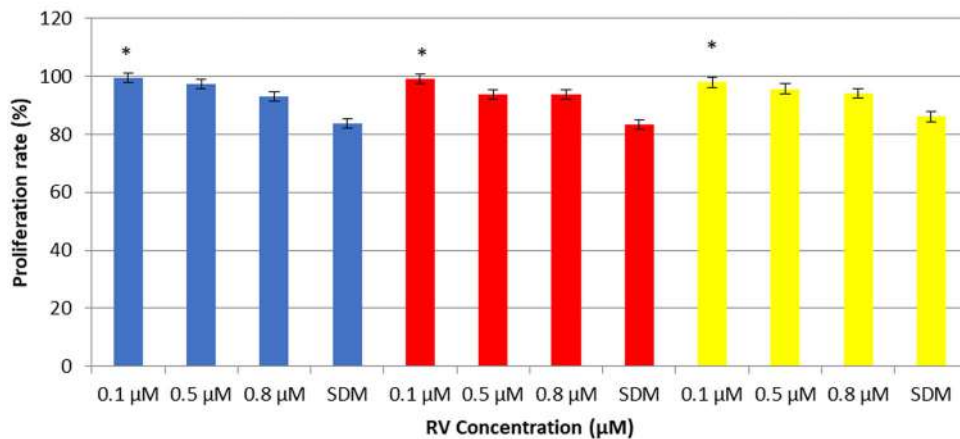


**Figure 1.** Fibroblast like morphology of MSCs derived from (a) wharton's jelly, (b) amniotic membrane, (c) adipose tissue, cells at passage-3 with 90% confluency (Inverted microscope, 100x magnification).



**Figure 2.** Identification of small CD73, CD90, CD105, CD45, CD34 cell population derived from human amniotic membrane (a), wharton’s jelly (e), and adipose tissue (i) that behave as MSCs in culture using flowcytometry. Using a five-antibody/viability marker panel, we identified a subset of small cells that were positive for CD73, CD90, CD105. (a,e,i) cells were initially displayed on SSC density plot (R2), which was subgated onto antigen plot (b,f,j) for identification of CD73 CD90 (gate R3), (c,g,k) subset of small cells were further subgated and negative for CD34 CD45 (R4) cells were further subgated to display cluster of CD105 (gate R5) (d,h,l).

### The effect of RV on proliferation rate of MSC



**Figure 3.** Resveratrol exerts dosage dependent effect on the proliferation rate of MSCs. Cells were plated at equal density and cultured in different concentrations of resveratrol for 48 h and assessed using MTT assay. Blue bar: AD-MSCs, red bar: AM-MSCs, yellow bar: WJ-MSCs, Error bars represent standard deviation (four replications in each treatment condition; SDM: serum deprived media). \*ANOVA, post-hoc Tukey,  $p < .05$  compared to SDM treated cells.

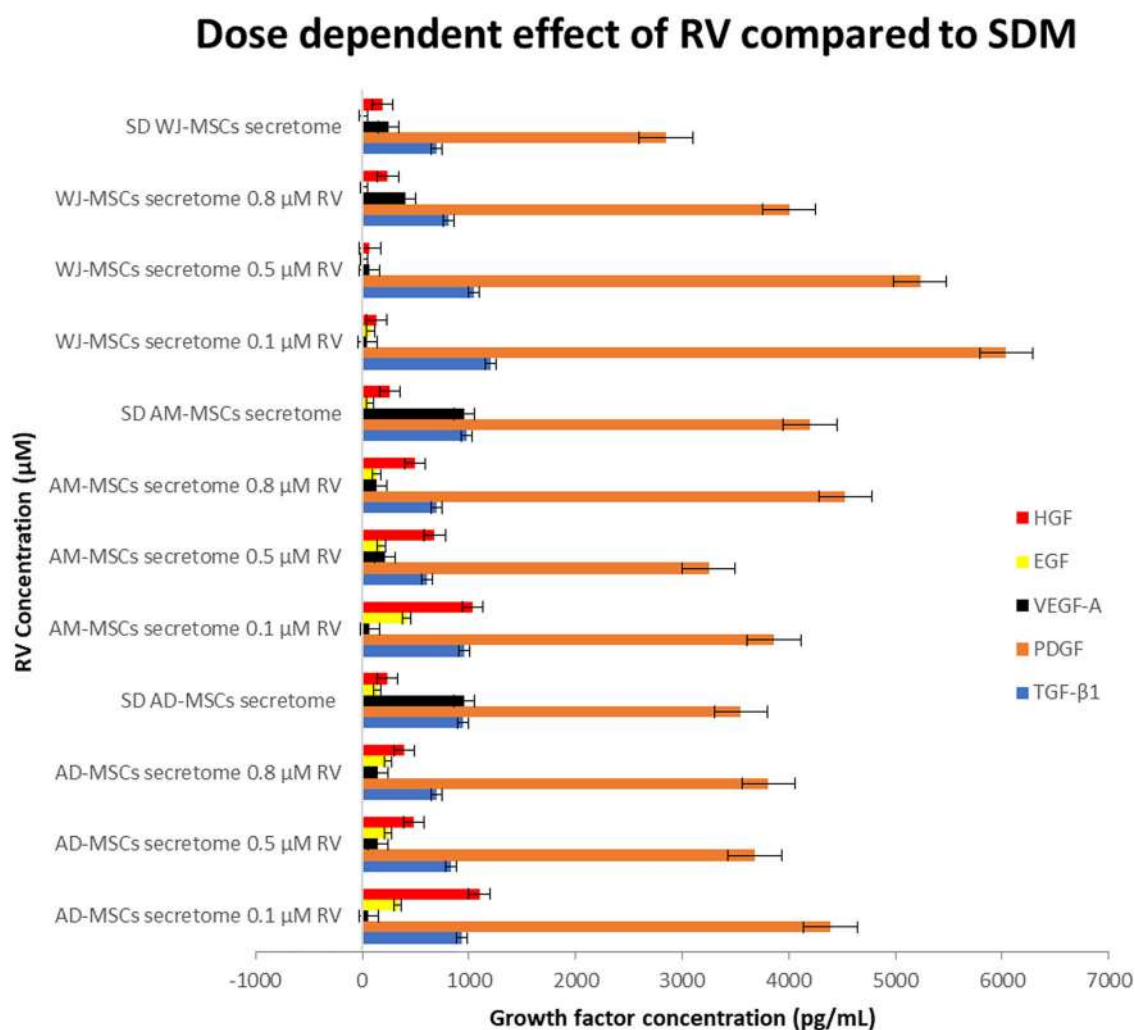
concentration of PDGF-B, TGF-β1, EGF, HGF, and VEGF in cell supernatant are varied among RV treatment (Table 1). Figure 4 reveals stimulation effect of RV on growth factors secretion compared to SDM treated cells.

0.1 μM RV significantly promoted EGF, HGF, PDGF-B, and TGF-β1 from WJ-MSCs ( $p < .01$ ). At 0.1 μM, RV promoted EGF and HGF secretion from AM-MSCs ( $p < .01$ ). The highest level of PDGF and TGF-β1 secretion from AM-MSCs was found at

**Table 1.** Resveratrol induce secretion of wound healing related growth factors at dosage dependent.

GROUP	TGF- $\beta$ level (pg/mL)	PDGF level (pg/mL)	VEGF-A level (pg/mL)	EGF level (pg/mL)	HGF level (pg/mL)
AD-MSC secretome 0.1 $\mu$ M RV	939.81 $\pm$ 47.75	4392.50 $\pm$ 202.11	61.25 $\pm$ 11.08	332.34 $\pm$ 34.94	1098.70 $\pm$ 177.90
AD-MSC secretome 0.5 $\mu$ M RV	836.06 $\pm$ 98.36	3682.50 $\pm$ 103.40	150.0 $\pm$ 20.41	242.25 $\pm$ 38.17	487.02 $\pm$ 123.68
AD-MSC secretome 0.8 $\mu$ M RV	698.31 $\pm$ 103.42	3809.20 $\pm$ 504.65	142.50 $\pm$ 38.62	240.33 $\pm$ 44.10	396.47 $\pm$ 46.67
SD AD-MSC secretome	944.40 $\pm$ 80.49	3550.40 $\pm$ 932.66	954.50 $\pm$ 55.74	141.67 $\pm$ 34.63	232.92 $\pm$ 37.61
AM-MSC secretome 0.1 $\mu$ M	957.44 $\pm$ 69.1	3863.50 $\pm$ 364.77	72.50 $\pm$ 12.58	412.50 $\pm$ 56.78	1037.23 $\pm$ 156.49
AM-MSC secretome 0.5 $\mu$ M	610.56 $\pm$ 100.40	3250.09 $\pm$ 161.76	217.50 $\pm$ 29.86	182.25 $\pm$ 62.04	680.67 $\pm$ 116.89
AM-MSC secretome 0.8 $\mu$ M	698.31 $\pm$ 13.20	4528.50 $\pm$ 421.82	130.0 $\pm$ 25.81	135.0 $\pm$ 26.45	493.0 $\pm$ 76.81
SD AM-MSC secretome	984.25 $\pm$ 12.03	4201.60 $\pm$ 604.18	959.0 $\pm$ 199.54	71.44 $\pm$ 19.21	255.44 $\pm$ 30.60
WJ-MSC secretome 0.1 $\mu$ M RV	1201.70 $\pm$ 240.38	6037.60 $\pm$ 578.96	50.0 $\pm$ 21.21	80.08 $\pm$ 17.36	132.50 $\pm$ 25.0
WJ-MSC secretome 0.5 $\mu$ M RV	1047.90 $\pm$ 212.12	5231.30 $\pm$ 617.17	65.0 $\pm$ 81.64	16.25 $\pm$ 8.53	70.41 $\pm$ 13.95
WJ-MSC secretome 0.8 $\mu$ M RV	806.75 $\pm$ 172.53	4003.80 $\pm$ 470.09	410.0 $\pm$ 106.03	14.75 $\pm$ 8.13	240.50 $\pm$ 57.68
SD WJ-MSC secretome	699.50 $\pm$ 143.84	2847.80 $\pm$ 324.64	247.50 $\pm$ 42.72	9.75 $\pm$ 3.86	188.44 $\pm$ 54.33

SD: serum deprivation.

**Figure 4.** Resveratrol exerts dosage dependent effect on growth factors secretion of MSCs. Cells were plated at equal density and cultured in different concentrations of resveratrol and cell secretome was collected after 48 h and assessed using ELISA. Error bars represent standard deviation (four replications in each treatment condition; SD: serum deprivation).

0.8  $\mu$ M RV and SDM treatment, respectively, however it was insignificant compared to 0.1  $\mu$ M RV treated group (PDGF,  $p = .67$  and TGF- $\beta$ 1,  $p = .984$ ). In AD-MSCs culture, RV at 0.1  $\mu$ M induced significant increment of EGF, HGF, and PDGF ( $p < .01$ ) compared to SDM treated cells. We found that treated AD-MSCs with SDM showed highest level of TGF- $\beta$ 1 yet not significant compared to 0.1  $\mu$ M treatment ( $p = .94$ ). However, the highest level of VEGF secretion from WJ-MSCs,

AD-MSCs, and AM-MSCs was found in SDM treated cell ( $p < .01$ ).

## Discussion

Our study revealed distinct and dynamic actions on self-renewal of MSCs originated from adult and foetal tissues stimulated by different concentrations of RV, as compared to



a previous study. We found that RV at lower dose (0.1  $\mu\text{M}$ ) is more effective to increase cell proliferation rate, while higher concentration (0.5  $\mu\text{M}$  and 0.8  $\mu\text{M}$ ) showed slight effect on cell proliferation. This result is in line with study demonstrating by Peltz et al. [13] which showed that resveratrol is the most beneficial to stem cell development at 0.1  $\mu\text{M}$ . In another study, Komaratih et al. showed that the highest proliferation rate of WJ-MSCs was reached with 0.1  $\mu\text{M}$  RV supplementation [17]. Increased cell proliferation rate would suggest increased representation of S and/or G2/M phase cells in RV treated cells. Peltz et al. demonstrated that at low concentration (0.1  $\mu\text{M}$ ), RV promotes self-renewal of AD-MSCs by reducing cell senescence rate and increasing cell proliferation rate as well as reducing cell population doubling time. However, at high concentrations, RV inhibits self-renewal of AD-MSCs by significantly increasing cell senescence rate and cell population doubling time [13]. Yoon et al. showed that RV (0.1 and 1  $\mu\text{M}$ ) promoted silent information regulator (SIRT1) activation by suppressing SOX2 acetylation which contributing in cell self-renewal, multipotency, and differentiation [18]. On the other hand, the study recently indicated that RV at higher concentration (50  $\mu\text{M}$ ) could stimulate cell proliferation of human embryonic stem cells (ESCs) through cell cycle modulation and enhancement in expression of anti-apoptotic markers [14,19]. Our study revealed that at 0.1  $\mu\text{M}$  concentration, RV exerts the optimal effect in promoting cell proliferation rate in MSCs derived from WJ, AM, and adipose origin. However, the mechanism underlying the biphasic dose response on the regulation of cell proliferation is unclear and would be a great interest for future studies.

Research which was conducted by Kim et al. reported that umbilical cord stem cells conditioned media (UCS-CM) secreted EGF, bFGF, HGF, and PDGF in high amount [12]. In addition, human dermal fibroblasts (HDFs) showed higher proliferation rate and collagen I production when was cultured in USC-CM than ADCS-CM. Other studies have shown that WJ-MSCs can improve the microcirculation and micro-environment significantly through therapeutic paracrine effects in a radiation rat model [12,20]. Sun et al. reported that WJ-MSCs CM promoted wound healing with smaller scar formation in radiation-induced skin wound rat [21]. Natallya et al. demonstrated complete healing in 72.7% subjects with chronic plantar ulcer related to leprosy after topical application of human AM-MSC secretome gel within 2 months period [4]. However, the limited survival of transplanted MSCs reduces the therapeutic effectiveness of MSCs [22]. Hence, strategies must be developed to improve the clinical effectiveness of MSCs. One of the common strategies that improve the therapeutic effects of stem cell transplantation is preconditioned stem cells with small molecules. Small molecule drugs have a protuberant beneficial effects compared to genetic manipulation, as it can be optimised by adjusting their concentration, duration time of exposure, and composition [23]. Resveratrol generally known as a small molecule which promoted MSCs proliferation, maintained differentiation, and delayed MSCs senescence [13,18,19,24]. In this study, we adopted strategy of preconditioning MSCs with RV at various concentrations to promote secretion of wound healing related growth factors as the candidate for cell-free

based therapy instead of cell therapy itself. Our study found that RV at 0.1  $\mu\text{M}$  could promote secretion of EGF, HGF, PDGF, and TGF- $\beta$ 1 from WJ-MSCs, however, those levels of growth factors were lower compared to AM-MSCs and AD-MSCs. We found that 0.1  $\mu\text{M}$  is the most effective dose of RV to stimulate EGF, HGF, PDGF, and TGF- $\beta$ 1 from AM-MSCs and AD-MSCs. Our study revealed that AD-MSCs showed the greatest response to RV stimulation in the term of cell proliferation and growth factor secretion. However, AM-MSCs also showed a good response to RV stimulation.

Various types of growth factors play an essential role in the complex process of wound healing and tissue regeneration [2,5,9]. We found that RV, however, increases secretion of growth factors at dosage-dependent manner and tissue-specific origin of MSCs. However, the pathways that may contribute to this effect have yet to be confirmed in this study. Epidermal growth factor, a 6-kDa molecule was obtained in relative low concentration while MSCs cultured in standard culture condition. We found that RV could increase EGF secretion from MSCs. Epidermal growth factor plays important role in completing wound healing process through increasing the rate of epithelialization and reducing the scar formation by preventing excessive wound contraction. Epidermal growth factor coated wound dressing applied to full-thickness skin wound of rabbit resulted in almost normal histological appearance and faster wound healing [9,25,26]. We found the lowest secretion of VEGF while MSCs was treated with lower dose of RV (0.1  $\mu\text{M}$ ). Vascular endothelial growth factor a homodimeric 34–46 kDa heparin-binding-glycoprotein, seems to be the strongest stimulation of angiogenesis during wound healing process. However, we found that RV could promote HGF secretion from MSCs in high amount of concentration [27]. Hepatocyte growth factor has a main role in regulating cell growth, motility and morphogenesis in cells such as epithelial and endothelial cells. Thus, it is directly related to epithelial repair, granulation tissue formation and neovascularization. Additionally, a synergistic effect between HGF and VEGF over endothelial cells has been demonstrated providing a more intense angiogenic effect at the wound area [8,9,28,29].

Our study showed that 0.1  $\mu\text{M}$  RV was the most effective concentration to promote the secretion of wound healing related growth factors. SIRT1 is thought to be critical players in prolonging life span that consistently demonstrated altered expression in response to RV at 0.1  $\mu\text{M}$ . Downregulation of SIRT1 was found with the treatment of RV at concentration greater than 0.1  $\mu\text{M}$ . The relative changes correlate to higher senescence rate and percentage of S phase cells in response to high concentration resveratrol treatment. Thus, we assumed that in senescence condition and entering of S phase, cells will decrease the secretion of wound healing related growth factors and other developmental growth factors. Taken together, SIRT1 is involved in wound healing processes and its activation provides an approach for acceleration of wound therapy. Although the studies of SIRT1 regulating wound healing related growth factor have not been reported, studies of SIRT1 regulating VEGF and IGF have been reported [28–30].

Our study revealed that RV could enhance PDGF secretion from MSCs. However, the role in promoting growth factors such as EGF, HGF, PDGF, and TGF- $\beta$  is still unclear. Study reported that SIRT1 may be involved in RV enhancing MSCs PDGF secretion [31,32]. PDGF plays a role in each stage of wound healing. PDGF works in orchestra with specific cells to stimulate other growth factors secretion. Levels of PDGF are decreased in chronic wounds. Hence, recombinant human variants of PDGF-BB (Becaplermin) have been successfully applied in diabetic patients and it is the only FDA approved drug for chronic wound treatment [4,9,33,34]. The TGF- $\beta$ 1 is the predominates TGF- $\beta$  in cutaneous wound healing. In this study, we found that RV at 0.1  $\mu$ M enhanced the highest secretion of TGF- $\beta$ 1 from MSCs. However, serum deprivation condition promoted the highest secretion of TGF- $\beta$ 1 among AD-MSCs and AM-MSCs group. Transforming growth factor- $\beta$ 1 (TGF- $\beta$ 1) is a multifunctional cytokine contributed in growth and differentiation of MSC while inhibiting growth of most other cell types. TGF- $\beta$ 1 protects against serum deprivation-induced apoptosis of MSCs. In wound healing, TGF- $\beta$ 1 is important in inflammation, angiogenesis, re-epithelialization, and connective tissue regeneration. This growth factor coordinates the spatio-temporal control of wound healing. In the case of delayed cutaneous ulcer healing, the dysregulation of TGF- $\beta$ 1 activity leads to wound dehiscence, consequently introducing external TGF- $\beta$ 1 is one of the alternatives to promote wound healing [4,9,35–37].

As limitation, our study is a lack of full understanding of RV dynamic action on growth factors regulation attributing to growth promotion. The mechanism underlying the dose response on growth factors secretion is unclear and would be of great interest for future studies. Future studies would be needed to fully elicit the potential effect of RV preconditioned MSC-CM on wound healing acceleration.

## Conclusion

In summary, RV is a potential natural agent for regulating self-renewal and growth factors secretion of various stem cells. Accordingly, RV can facilitate cell proliferation and wound healing related growth factors secretion. This different effect of RV may be explained by various factors like concentration, time and duration of treatment, culture conditions, as well as the stem cell origin. Our results suggested that 0.1  $\mu$ M RV was the most effective concentration to promote secretion of wound healing related growth factors.

## Disclosure statement

We have no conflict of interest in this present study.

## References

- [1] Posnett J, Gottrup F, Lundgren H, et al. The resource impact of wounds on health-care providers in Europe. *J Wound Care*. 2009; 18(4):154–161.
- [2] Demidova-Rice TH, Hamblin MR, Herman IM. Acute and impaired wound healing: Pathophysiology and current methods for drug delivery, part 2: role of growth factors in normal and pathological wound healing: therapeutic potential and methods of f delivery. *Adv Skin Wound Care*. 2012;25(8):349–370.
- [3] Kiritsi D, Nyström A. The role of TGF $\beta$  in wound healing pathologies. *Mech Ageing Dev*. 2018;172:51–58.
- [4] Natallya FR, Herwanto N, Prakoeswa C, et al. Effective healing of leprosy chronic plantar ulcers by application of human amniotic membrane stem cell secretome gel. *Indian J Dermatol*. 2019;64(3): 250.
- [5] Theoret C. Tissue engineering in wound repair: The three “R”s—repair, replace, regenerate. *Vet Surg*. 2009;38(8):905–913.
- [6] Maxson S, Lopez EA, Yoo D, et al. Concise review: role of mesenchymal stem cells in wound repair. *Stem Cells Transl Med*. 2012; 1(2):142–149.
- [7] Hassan WU, Greiser U, Wang W. Role of adipose-derived stem cells in wound healing. *Wound Repair Regen*. 2014;22(3):313–325.
- [8] Barrientos S, Stojadinovic O, Golinko MS, et al. Growth factors and cytokines in wound healing. *Wound Repair Regen*. 2008; 16(5):585–601.
- [9] Yamakawa S, Hayashida K. Advances in surgical applications of growth factors for wound healing. *Burns Trauma*. 2019;7:10–13.
- [10] Borena BM, Martens A, Broeckx SY, et al. Regenerative skin wound healing in mammals: state-of-the-art on growth factor and stem cell based treatments. *Cell Physiol Biochem*. 2015;36(1):1–23.
- [11] Pastar I, Stojadinovic O, Yin NC, et al. Epithelialization in wound healing: a comprehensive review. *Adv Wound Care*. 2014;3(7): 445–464.
- [12] Kim YJ, Seo DH, Lee SH, et al. Conditioned media from human umbilical cord blood-derived mesenchymal stem cells stimulate rejuvenation function in human skin. *Biochem Biophys Rep*. 2018; 16:96–102.
- [13] Peltz L, Gomez J, Marquez M, et al. Resveratrol exerts dosage and duration dependent effect on human mesenchymal stem cell development. *PLoS One*. 2012;7(5):e37162.
- [14] Safaiejad Z, Nabiuni M, Peymani M, et al. Resveratrol promotes human embryonic stem cells self-renewal by targeting SIRT1-ERK signaling pathway. *Eur J Cell Biol*. 2017;96(7):665–672.
- [15] Azandeh S, Orazizadeh M, Hashemitabar M, et al. Mixed enzymatic-explant protocol for isolation of mesenchymal stem cells from Wharton’s jelly and encapsulation in 3D culture system. *JBISE*. 2012;05(10):580–586.
- [16] Palumbo P, Lombardi F, Siragusa G, et al. Methods of isolation, characterization, and expansion of human adipose-derived stem cells (ASCs): an overview. *IJMS*. 2018;19(7):1897.
- [17] Komaratih E, Rindiasuti Y, Wirohadidjojo YW, Dinariyati A, et al. The resveratrol increase of hepatocyte growth factor (HGF) and epidermal growth factor (EGF) levels in wharton’s jelly mesenchymal stem cells (WJ-MSCs) secretome: Toward cell free therapy in dry eye disease (DED). *Biochem Cell Arch*. 2019;19(2):1–9.
- [18] Yoon DS, Choi Y, Jang Y, et al. SIRT1 directly regulates SOX2 to maintain self-renewal and multipotency in bone marrow-derived mesenchymal stem cells. *Stem Cells*. 2014;32(12):3219–3231.
- [19] Wang X, Ma S, Meng N, et al. Resveratrol exerts dosage dependent effects on the self-renewal and neural differentiation of hUC-MSCs. *Mol Cell*. 2016;39(5):418–425.
- [20] Isakson M, de Blacam C, Whelan D, et al. Mesenchymal stem cells and cutaneous wound healing: current evidence and future potential. *Stem Cells Int*. 2015;2015:831095.
- [21] Sun JY, Zhang Y, Song X, et al. The healing effects of conditioned medium derived from mesenchymal stem cells on radiation-induced skin wounds in rats. *Cell Transplant*. 2019;28(1):105–115.
- [22] Shafiq M, Jung Y, Kim SH. Insight on stem cell preconditioning and instructive biomaterials to enhance cell adhesion, retention, and engraftment for tissue repair. *Biomaterials*. 2016;90:85–115.
- [23] Li W, Li K, Wei W, et al. Chemical approaches to stem cell biology and therapeutics. *Cell Stem Cell*. 2013;13(3):270–283.
- [24] Lv YJ, Yang Y, Sui BD, et al. Resveratrol counteracts bone loss via mitofilin-mediated osteogenic improvement of mesenchymal stem cells in senescence-accelerated mice. *Theranostics*. 2018;8(9): 2387–2406.

- [25] Kim YS, Lew DH, Tark KC, et al. Effect of recombinant human epidermal growth factor against cutaneous scar formation in murine full-thickness wound healing. *J Korean Med Sci.* 2010;25(4):589–596.
- [26] Haase I, Evans R, Pofahl R, et al. Regulation of keratinocyte shape, migration and wound epithelialization by IGF-1- and EGF-dependent signalling pathways. *J Cell Sci.* 2003;116(Pt 15):3227–3238.
- [27] Zhang R, Yin L, Zhang B, et al. H. Resveratrol improves human umbilical cord-derived mesenchymal stem cells repair for cisplatin-induced acute kidney injury. *Cell Death Dis.* 2018;9(965):1–13.
- [28] Galiano RD, Tepper OM, Pelo CR, et al. Topical vascular endothelial growth factor accelerates diabetic wound healing through increased angiogenesis and by mobilizing and recruiting bone marrow-derived cells. *Am J Pathol.* 2004;164(6):1935–1947.
- [29] Tammela T, Enholm B, Alitalo K, et al. The biology of vascular endothelial growth factors. *Cardiovasc Res.* 2005;65(3):550–563.
- [30] Zielins ER, Atashroo DA, Maan ZN, et al. Wound healing: an update. *Regen Med.* 2014;9(6):817–830.
- [31] Kunhiraman H, Edatt L, Thekkeveedu S, et al. 2-Deoxy glucose modulates expression and biological activity of VEGF in a SIRT-1 dependent mechanism. *J Cell Biochem.* 2017;118(2):252–262.
- [32] Sun LJ, Yu JW, Shi YG, et al. Hepatitis C virus core protein induces dysfunction of liver sinusoidal endothelial cell by down-regulation of silent information regulator 1. *J Med Virol.* 2018;90(5):926–935.
- [33] Lian Z, Yin X, Li H, et al. Synergistic effect of bone marrow-derived mesenchymal stem cells and platelet-rich plasma in streptozotocin-induced diabetic rats. *Ann Dermatol.* 2014;26(1):1–10.
- [34] Murphy PS, Evans GR. Advances in wound healing: a review of current wound healing products. *Plast Surg Int.* 2012;2012:190436
- [35] Anitua E, Alkhraisat MH, Orive G. Perspectives and challenges in regenerative medicine using plasma rich in growth factors. *J Control Release.* 2012;157(1):29–38.
- [36] Penn JW, Grobbelaar AO, Rolfe KJ. The role of the TGF-beta family in wound healing, burns and scarring: a review. *Int J Burns Trauma.* 2012;2(1):18–28.
- [37] Papanas N, Maltezos E. Growth factors in the treatment of diabetic foot ulcers: new technologies, any promises? *Int J Low Extrem Wounds.* 2007;6(1):37–53.