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Visualizing the latest up-front of chemistry research and education for better future

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Editors • Uyi Sulaeman, Hassan Y. Aboul-Enein, Ahmad Zuhairi Abdullah, Zaheer Ul-Haq Qasmi, Warakorn Limbut, Jas Raj Subba and Mardiyah Kurniasih

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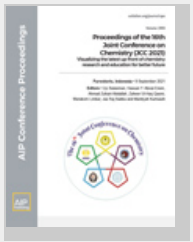
Table of Contents

PROCEEDINGS OF THE 16TH JOINT CONFERENCE ON CHEMISTRY (JCC 2021): Visualizing the latest up-front of chemistry research and education for better future

PREV NEXT



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Proceedings of the 16th Joint Conference on Chemistry (JCC 2021)
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No Access . November 2022

Preface: The 16th Joint Conference on Chemistry 2021 (16th JCC)

AIP Conference Proceedings **2553**, 010001 (2022); https://doi.org/10.1063/12.0012151

No Access . November 2022

Committee: The 16th Joint Conference on Chemistry 2021 (16th JCC)

AIP Conference Proceedings **2553**, 010002 (2022); https://doi.org/10.1063/12.0015105

ARTICLES

No Access . November 2022

The adsorption capacity of clay cetyltrimethylammonium/magnetite against the metal ion Cr(VI)

Choiril Azmiyawati, Ahmad Al Mutashim Billah and Adi Darmawan

AIP Conference Proceedings **2553**, 020001 (2022); https://doi.org/10.1063/5.0103671

SHOW ABSTRACT

No Access . November 2022

Intermolecular interaction and molecular dynamics study of carboxymethyl Chitosan... Vitamin C molecular complex for understanding encapsulation and kinetics-controlled released mechanism

Cholifatul Jannah, Dwi Hudiyanti, Vivitri Dewi Prasasty and Parsaoran Siahaan

AIP Conference Proceedings **2553**, 020002 (2022); https://doi.org/10.1063/5.0103717

SHOW ABSTRACT

No Access . November 2022

Degradation of methylene blue in TiO_2-Fe(VI) system with UV radiation

Dian Windy Dwiasi, Anung Riapanitra and Eggy Izzi Saliya

AIP Conference Proceedings **2553**, 020003 (2022); https://doi.org/10.1063/5.0103697

SHOW ABSTRACT

No Access . November 2022

Encapsulation of hyptolide coated alginate, chitosan, and alginate-chitosan

Meiny Suzery, Bambang Cahyono, Widayat and Lina Apriliana

AIP Conference Proceedings **2553**, 020004 (2022); https://doi.org/10.1063/5.0106801

SHOW ABSTRACT

No Access . November 2022

Synthesis of chitosan for removal of methyl orange and malachite green dyes

Tien Setyaningtyas, Mardiyah Kurniasih, Afrizal Diaz Aztiza Nur Azizi, Kapti Riyani and Dwi Kartika

AIP Conference Proceedings **2553**, 020005 (2022); https://doi.org/10.1063/5.0103999

SHOW ABSTRACT

No Access . November 2022

The effect of formaldehyde addition on the distribution of trimethylamine oxide (TMAO) and trimethylamine (TMA) in marine and freshwater fish organs

Farida Ariyani, Umi Anissah, Hedi Indra Januar, Giri Rohmad Barokah and Ajeng Kurniasari Putri

AIP Conference Proceedings **2553**, 020006 (2022); https://doi.org/10.1063/5.0104100

SHOW ABSTRACT

No Access . November 2022

Synthesis of vanadium oxide material and its photocatalytic activity in the degradation of methylene blue

Anung Riapanitra, Tien Setyaningtyas, Kapti Riyani, Roy Andreas, Agni Lili Ariyanti and Uyi

AIP Conference Proceedings **2553**, 020007 (2022); https://doi.org/10.1063/5.0103707

SHOW ABSTRACT

No Access . November 2022

Ointmen the formulation of bachang mango (*Mangifera foetida* L.) leaves methanol extract and activity test against *Malassezia furfur*

Dian Riana Ningsih, Anung Riapanitra, Purwati, Zusfahair, Gangga Aji Tetuko and Alin Lutpiani

AIP Conference Proceedings **2553**, 020008 (2022); https://doi.org/10.1063/5.0103720

SHOW ABSTRACT

No Access . November 2022

Formulation and release profile for encapsulation of *Centella asiatica* (L.) urban extract in coconut liposomes

Khairul Anam, Silvia Handayani and Dwi Hudiyanti

AIP Conference Proceedings **2553**, 020009 (2022); https://doi.org/10.1063/5.0103925

SHOW ABSTRACT

No Access . November 2022

Recovery ion Cu(II) using precipitation method with NaOH for methylene blue degradation

Linda Suyati, Prasetyowati, Gunawan, Didik Setiyo Widodo, Khabibi and Yayuk Astuti

AIP Conference Proceedings **2553**, 020010 (2022); https://doi.org/10.1063/5.0104476

SHOW ABSTRACT

No Access . November 2022

Antimicrobial activity of N-methyl chitosan and correlation with their degree substitution

Mardiyah Kurniasih, Purwati, Intan Romadhani and Ratna Stia Dewi

AIP Conference Proceedings **2553**, 020011 (2022); https://doi.org/10.1063/5.0103998

SHOW ABSTRACT

No Access . November 2022

Non-invasive neonatal jaundice determination using smartphone camera

Mekar Dwi Anggraeni, Amin Fatoni and Eni Rahmawati

AIP Conference Proceedings **2553**, 020012 (2022); https://doi.org/10.1063/5.0103718

SHOW ABSTRACT

Synthesis of copolymer eugenol-trithiol-divinylbenzene via photoinitiated cross-linking reaction as antibacterial compound

Ngadiwiyana, Dihan Vigy Laksana, Damar Nurwahyu Bima, Ismiyarto, Purbowatiningrum Ria Sarjono and Nor Basid Adiwibawa Prasetya

AIP Conference Proceedings **2553**, 020013 (2022); https://doi.org/10.1063/5.0103667

SHOW ABSTRACT

No Access . November 2022

Potential of extracellular chitinase from *Bacillus subtilis* B 298 as antifungal against *Rhizoctonia solani*

Puji Lestari, Suyata Suyata and Ely Setiawan

AIP Conference Proceedings **2553**, 020014 (2022); https://doi.org/10.1063/5.0103775

SHOW ABSTRACT

No Access . November 2022

Analysis and identification of microbial activity of bioactive component fraction in red and green betels

Rifda Naufalin, Erminawati and Ahmad Hasyim

AIP Conference Proceedings **2553**, 020015 (2022); https://doi.org/10.1063/5.0103951

SHOW ABSTRACT

No Access . November 2022

Antioxidant soap formula based on nyamplung seed oil (*Calophyllum inopphyllum*) with bidara leaves (*Ziziphus mauritiana*) and ketapang fruit (*Terminalia catappa* L) additives

Senny Widyaningsih, Moch Chasani and Novia Ariska Pratiwi

AIP Conference Proceedings **2553**, 020016 (2022); https://doi.org/10.1063/5.0103812

SHOW ABSTRACT

No Access . November 2022

Formulation, characterization and sunscreen potential evaluation of lemongrass *(Cymbopogon citratus)* oil nanoemulsion

Undri Rastuti, Uyi Sulaeman, Senny Widyaningsih, Sity Khalidah Zia and Ryan Aditya Mahendra

AIP Conference Proceedings **2553**, 020017 (2022); https://doi.org/10.1063/5.0105009

SHOW ABSTRACT

No Access . November 2022

Synthesis and photocatalytic properties of Cr-doped $SrTiO_3$ with Ti deficiency for enhanced photocatalytic activity

Uyi Sulaeman, Resha Permana Putra, Kapti Riyani and Ahmad Zuhairi Abdullah

AIP Conference Proceedings **2553**, 020018 (2022); https://doi.org/10.1063/5.0104312

SHOW ABSTRACT

No Access . November 2022

Optimization of solid state fermentation of banana peel for removal of crystal violet dye from aqueous solution

Agustina L. N. Aminin, Ummy Ulvairoh, Nies Suci Mulyani and Gunawan

AIP Conference Proceedings **2553**, 020019 (2022); https://doi.org/10.1063/5.0103729

SHOW ABSTRACT

No Access . November 2022

A green chemistry approach using *Alternanthera brasiliana* extract for urea biosensor

Amin Fatoni, Greda Rido Gusti, Zusfahair, Mekar Dwi Anggraeni and Saluma Samanman

AIP Conference Proceedings **2553**, 020020 (2022); https://doi.org/10.1063/5.0103678

SHOW ABSTRACT

No Access . November 2022

The potency of ethanolic extracts of betel leaves as an antibiofilm against *methicillin-resistant* Staphylococcus aureus

Ari Asnani, Prabadini Ruwielanisa, Hernayanti and Dwi Utami Anjarwati

AIP Conference Proceedings **2553**, 020021 (2022); https://doi.org/10.1063/5.0103681

SHOW ABSTRACT

No Access . November 2022

Eugenol-based molecularly imprinted membrane synthesis for glucose selective transport

Muhammad Cholid Djunaidi, Nesti Dwi Maharani, Pardoyo and Yanuardi Raharjo

AIP Conference Proceedings **2553**, 020022 (2022); https://doi.org/10.1063/5.0104444

SHOW ABSTRACT

No Access . November 2022

Analysis of students' conceptual understanding on the acid-base remedial program with multi-representation teaching material

Endang Susilaningsih, Sri Haryani and Nurkintan Aprilia

AIP Conference Proceedings **2553**, 020023 (2022); https://doi.org/10.1063/5.0103797

SHOW ABSTRACT

No Access . November 2022

The potential of wild spinach (*Amaranthus dubius* Mart) and cockscomb (*Celosia argentea* Var.*Cristata*) seed oil as a source of vegetable squalene

Hartati Soetjipto and November Rianto Aminu

BROWSE VOLUMES

AIP Conference Proceedings **2553**, 020024 (2022); https://doi.org/10.1063/5.0103738

SHOW ABSTRACT

No Access . November 2022

Brine shrimp lethality bioassay of *Zingiber zerumbet* and *Z. cassumunar* rhizomes extracts.

Hartiwi Diastuti, Purwati, Suwandri, Sri Indriani, Restu Pamukasari and Oto Dwi Wibowo

AIP Conference Proceedings **2553**, 020025 (2022); https://doi.org/10.1063/5.0103680

SHOW ABSTRACT

No Access . November 2022

Prediction of bilirubin concentration using neonatal forehead images

Mekar Dwi Anggraeni, Amin Fatoni and Eni Rahmawati

AIP Conference Proceedings **2553**, 020026 (2022); https://doi.org/10.1063/5.0103722

SHOW ABSTRACT

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Basis set validation of sodium dodecyl benzene sulfonate based on infrared spectrum using Ab initio method

Prediction of bilirubin concentration using neonatal forehead images

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Mekar Dwi Anggraeni, Amin Fatoni and Eni Rahmawati

Non-invasive Neonatal Jaundice Determination using Smartphone Camera

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Abstract. Neonatal jaundice is one of the common clinical conditions where the bilirubin levels are above the normal condition, which needs medical attention. It is important to the early determination of neonatal jaundice, especially in a rural area with limitations of medical instruments for bilirubin determination. This research was performed to determine neonatal jaundice using a smartphone camera. The smartphone was used to capture the arm of the neonatal. The arm images were then analyzed using ImageJ software to extract the color intensity of red, green and blue (RGB). The color intensity and the blood bilirubin concentration of neonatal were analyzed to obtain the linear regression. The results showed the blue (B) color intensity had a high correlation ($R^2 = 0.8081$, $y= -4.968x + 165.97$) with blood bilirubin concentration of neonatal observed. This study showed an important aspect of the use of smartphone camera for early detection of neonatal jaundice as an alternative of the visual assessment mainly in remote area when the laboratories analysis is not immediately available.

INTRODUCTION

Neonatal jaundice is commonly found in newborn infants and commonly a reason for hospitalization. In the first week of life, about 60 to 80% of newborn infants develop jaundice, shown in yellow discoloration of the skin and sclera [1]. In Indonesia, almost 48% of newborns showed hyperbilirubinemia [2]. Hyperbilirubinemia is one of the contributors to the high Infant Mortality Rate (IMR) in Indonesia [3]. The IMR in Indonesia is very high at 26.9/1000 live birth and that of the highest IMR in southeast Asia.

Various methods have been reported to determine the blood bilirubin concentration in the newborn infants, for the invasive [4] and non-invasive methods [5]. Bilirubin is neurotoxic to the newborn infants. Hyperbilirubinemia would be caused the deposition of bilirubin in the basal ganglia, resulting in kernicterus [5]. Other effects of hyperbilirubinemia in infants including loss of hearing [6], general movement disorders [7], speech delay with hearing loss [8], bilirubin encephalopathy, moro reflex disorders, opisthotonos, vomiting, and death. Long-term manifestations of hyperbilirubinemia in infants are spasticity, choreoathetosis, and sensorineural deafness [9].

Bilirubin monitoring and phototherapy have been significantly reducing the effect of hyperbilirubinemia in infants [10]. However, in developing country IMR is still high due to the lack of access to medical equipment, especially for the remote areas or rural areas. Hyperbilirubinemia is easily characterized by the yellow color of the skin and sclera. The skin yellow color as an indicator of an increase in bilirubin levels could be observed through physical examination in infants by expert medical care [11]. The physical examination of visual inspection could be inaccurate and it is highly subjective, dependent on experience, and may give inaccurate results [12]. On another side, the laboratory protocol using instruments such as spectrophotometer to determine the blood bilirubin concentration provides accurate results. However, the equipment and reagents are relatively expensive, requires special expertise, and it is not available

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in a remote area. A new method is needed to determine the newborn bilirubin concentration for neonatal jaundice monitoring at a portable, low cost, providing good results. accurate, real-time and easy to use.

Smartphones have been reported to be used as analytical devices, replace conventional visual observation. The methods of the use of smartphone cameras such as to predict the hemoglobin level [13], food safety[14], iron in water [15] and also and glucose[16]. The basic principle of the use of a smartphone camera for analytical device is the digital image capturing of the object, extracting the color and analyzing the color intensity relative to the targeted analytes. The neonatal jaundice prediction using a smartphone could be used to replace the conventional method of a visual examination of skin and sclera [11]. This work reports the use of a smartphone camera to capture the arm of infants with bilirubinemia during hospitalization of neonatal jaundice. The images were then analyzed and related to the blood bilirubin obtained by the hospital protocol to get the equation further used to predict the neonatal jaundice.

METHOD

Study design

Respondent of 31 newborns have been asked for participating the research with criteria of newborn had jaundice and hospitalized. The informed consent has been explained to his/him mothers by the research assistant, and then signed my mother's when agree to participate in this research. The participants have been collected from a local district hospital with the inclusion criteria of newborn showed symptoms of hyperbilirubinemia and need hospitalization. The newborn image was captured in their hospital ward accompanied and with the consent of the newborn's mother. The newborn's blood bilirubin concentration has been analyzed according to the standard method and procedure in the hospital care for neonatal jaundice without any researcher intervention.

Neonatal arm image capturing

Arm images of the participants have been captured using a smartphone camera (Redmi, Camera 13 MP, f/2.0, PDAF) under sufficient lighting without using a camera flash. A standard color chart [17] has been prepared and placed beside the newborn when capturing the images (Fig. 1). Image capture was taken for about 50-60 cm distance, with several repetitions to obtain the best images.

FIGURE 1. Example of neonatal arm image with the standard color chart

Image analysis

Arm images from the smartphone have been analyzed using a laptop (MacBook Air, Apple Inc.) without any treatment or image processing. The images were then extracted to their color intensity of red, green and blue (RGB) using a free software ImageJ software ver. 1.52k (National Institute of Health, USA. http://imagej.nih.gov/ij). Three

different spots in the arms image have been analyzed the color intensity to get the representative image sampling site. The standard color chart was used to correct the possible bad lighting and colored light effect.

Data analysis

Newborn arm image color intensity of RGB was collected and analyzed. The standard color chart spot of the white and yellow boxes was also analyzed. The RGB color intensity of the newborn arm was adjusted when the standard color chart showed a significant difference. The newborn blood bilirubin concentration reported in the medical record has also been collected. Arm image color intensity as a dependent variable was then related to the blood bilirubin concentration (as independent variables) using a simple regression equation (Microsoft Excel). The three RGB color intensities were separately analysis and the color with the highest coefficient of determination has been selected as the best color to predict the bilirubin concentration.

RESULTS DAN DISCUSSION

Respondents characteristics

Respondents who agreed to participate in this research was newborn/neonatal with inform consent signed by mothers. The average of mother's ages were 32 years, with a range of 19 to 41 years and 93.5% of mothers were multipara. None of the mothers had a newborn with hyperbilirubinemia in previous birth. The newborns have a range of neonatal jaundice for 2 days from birth to 26 days with the birth weight in the range of 1526 g to 3900 g and a birth weight average of 2761.4 g. The gestational ages of the newborns were 31 to 41 weeks. The blood bilirubin concentrations were 11 to 25.9 mg/dL with an average of 16.6 mg/dL. The neonatal were 69% cesarean birth and the rest natural birth. These participants' data could be important information for further neonatal jaundice profiling and analysis.

Image Capturing

The newborn arm images were captured by a research assistant with the permission of him/his mother (inform consents have been signed by mother). The research assistant was first explained the aim of this research. There is no compulsion to become a respondent in this study. The arm image has been selected since this body part is easy to capture and almost always exposed even the newborn was dressed. Neonatal jaundice initially causes the skin to become yellow, therefore, neonatal jaundice could be easily observed the yellow color mainly showed in the face, chest, stomach area, arms and legs[18]. The arm images were captured several times to get the best images with the clear arm and sufficient light condition. The captured newborn arm images were then analyzed. A standard color chart was used to correct the images by adding or reducing the color intensity. The white and yellow boxes in the color chart was used to correct the light condition and the effect of colored light may exist. The arm images were corrected when the standard color chart of yellow and white had significantly (more than 3 points) different from other images. The average color intensities of standard white color in the captured images were R = 201.5, G = 237.5 and B = 239. Whereas the average color intensities of the yellow standard color chart were R = 202, G = 200.7 and B = 0.8. The use of a standard color chart was also previously used to correct the digital image processing [17]. Many strategies to correct the digital image analysis were also reported such as software white balance correction [19], the use of white paper [13] and red label-based white balance [20]. The use of a standard color chart in this research was selected for further smartphone software development where all standard color box available for analysis.

Data Analysis

There was a linear relationship of newborn arm image color intensity and blood bilirubin concentration of the participants obtained by standard hospital procedures (spectrophotometric method). The arm images contain red, green and blue color intensities with the blue color intensity showed the highest relationship ($R^2 = 0.8081$) with the blood bilirubin (Fig. 2). On another side, the red color intensity showed the lowest relationship. The standard color chart or yellow box also showed the blue color intensity was almost zero, while the red and green colors showed similar intensity (RGB = 200,200,0).

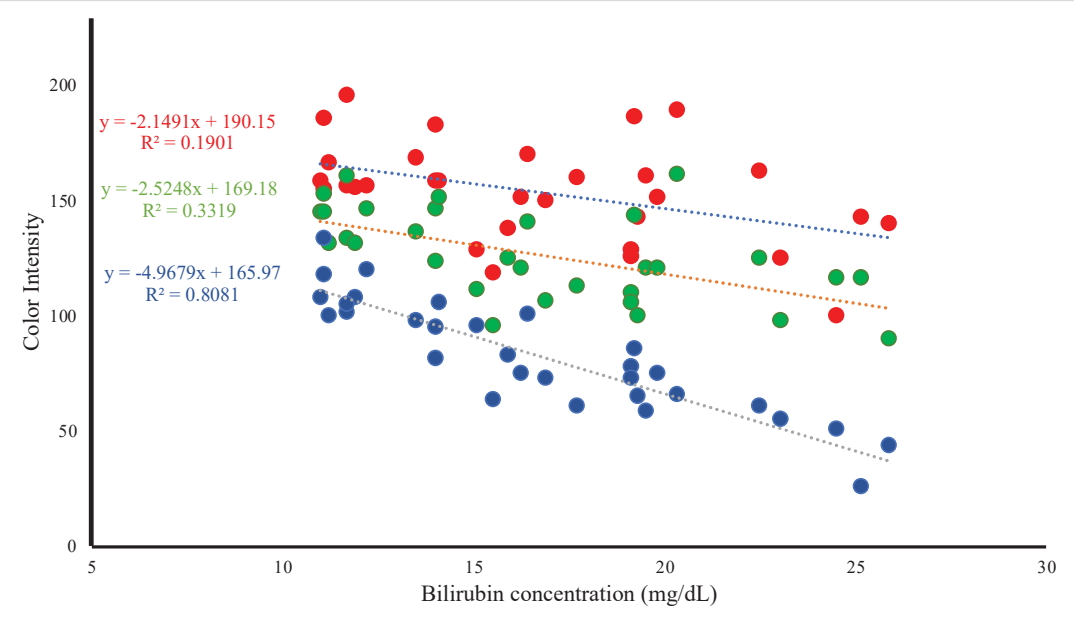

FIGURE 2. The red, green, and blue color intensity of neonatal arm images relations with blood bilirubin concentration. Blue color intensity showed the best relationship compare to red and green color intensity.

Neonatal jaundice related factors

Excess neonatal blood bilirubin (hyperbilirubinemia) is the main cause of neonatal jaundice. Neonatal jaundice is common cause of hospitalization and commonly occurs in the first week of birth [21]. Bilirubin is responsible for the yellow color of neonatal jaundice, which is a normal part of pigment released from the breakdown of red blood cells. Imbalance the metabolism of rapid red blood cells breakdown by immature liver leads to an increase in the blood bilirubin concentration. A newborn immature liver often failed to remove the bilirubin quickly enough resulted in the excess of bilirubin. The conditions that can cause neonatal jaundice could be several factors [22], such as jaundice observed in the first 24h, premature birth [23], significant bruising during birth, blood type, breastfeeding and race [11]. Premature birth or gestational age of 35-36 weeks was the major risk factor, whereas the gestational age of 37-38 was the minor risk factor of neonatal jaundice [11]. The gestational age for more than 40 weeks showed a decreased risk of neonatal jaundice. The participants of this research showed that the average gestational age was 37.8 weeks, with a minimum of 31 weeks and maximum of 41 weeks. Premature newborns also may feed less and have fewer bowel movements, resulting in less bilirubin eliminated through stool [24]. Induced labor was also reported to slightly increase the neonatal jaundice incidence [23]. The result of data analysis in the participants showed the 43.5% were neonatal from the induced labor.

CONCLUSION

The neonatal jaundice prediction method has been developed using arm images of neonatal captured by a smartphone camera. The blue color intensity of the neonatal arm showed a high correlation with the blood bilirubin concentration performed using the standard method in the hospital. The use of a smartphone to capture neonatal arm images and predict neonatal jaundice would be important as an objective preliminary screening of neonatal jaundice compared to the visual assessment, for the area where hospital instrumentation is not available.

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AIP Conference Proceedings

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INFORMATION

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How to publish in this journal

confproc@aip.org

Today, AIP Conference Proceedings contain over 100,000 articles published in 1700+ proceedings and is growing by 100 volumes every year. This substantial body of scientific literature is testament to our 40-year history as a world-class publishing partner, recognized internationally and trusted by conference organizers worldwide. Whether you are planning a small specialist workshop or organizing the largest international conference, contact us, or read these testimonials, to find out why so many organizers publish with AIP Conference Proceedings.

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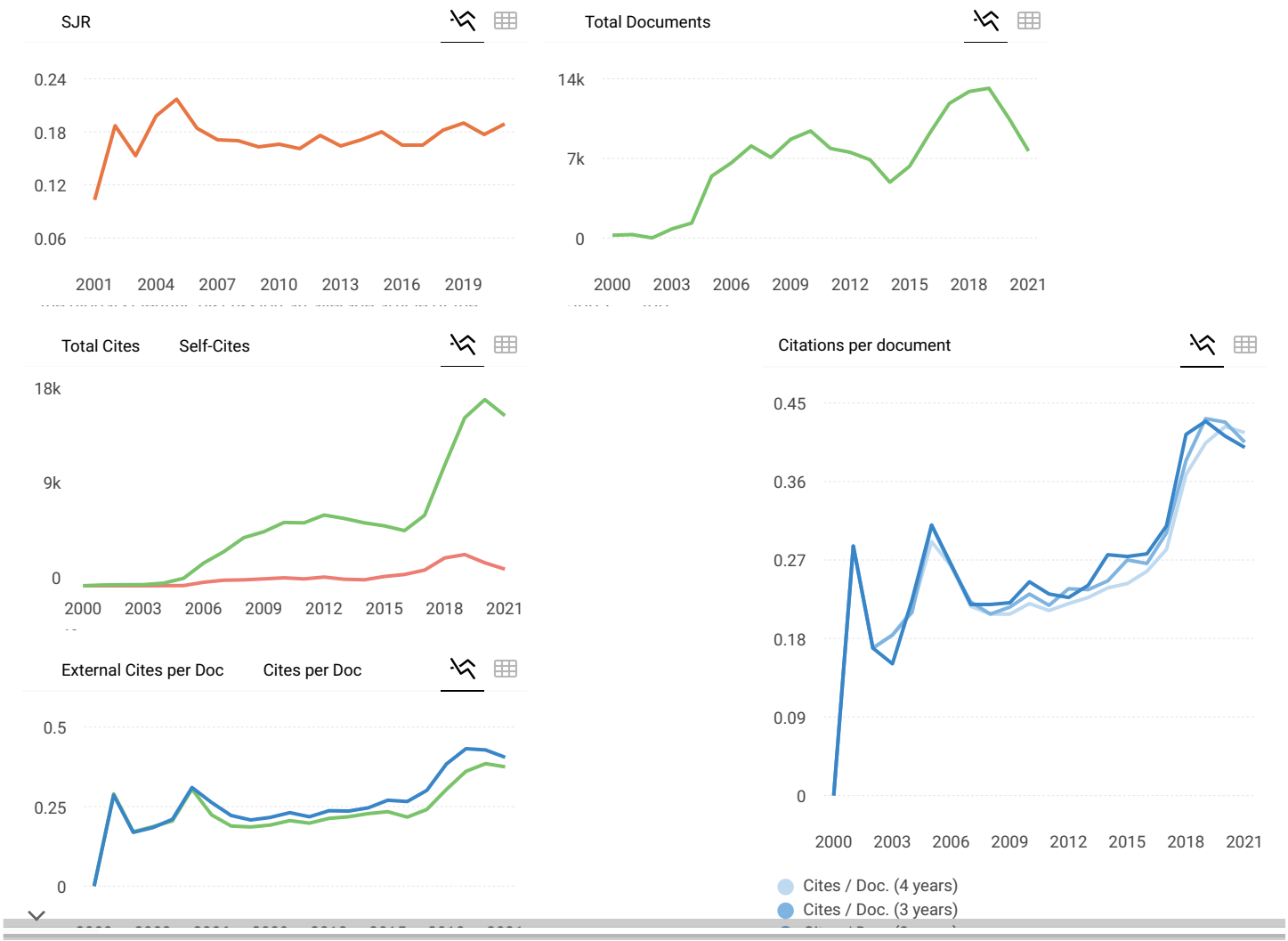

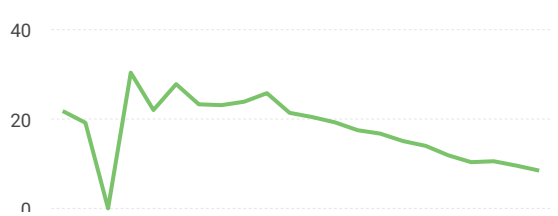

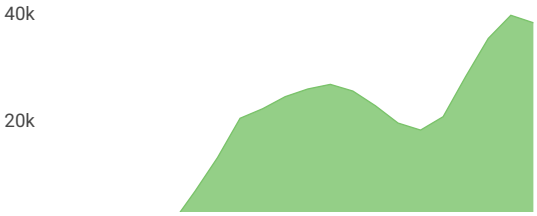

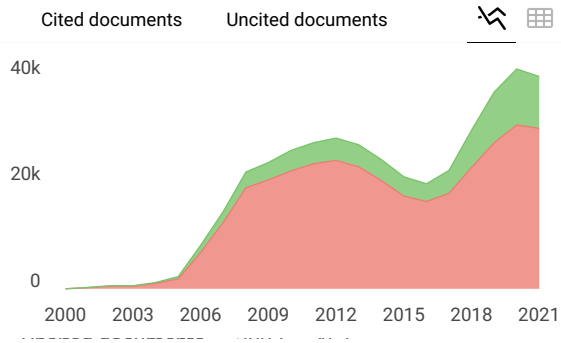

AIP Conference Proceedings

Not yet assigned quartile

SJR 2021
0.19

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B **Bhupender Parashar** 3 months ago

I have my papers published in AIP proceedings. it is showing in Scopus indexing database. BUt it is not showing in Web of Science database. Why is it so?

reply

Dear Bhupender,
Thank you very much for your comment, unfortunately we cannot help you with your request. We suggest you contact the Web of Science team.
Best Regards, SCImago Team

A **Aizat Akmal A.Mohamad Beddelee** 9 months ago

Hi, may I know if this journal is still covered by Scopus Index as the time this comment is written June 2022, the coverage expired already.

Thanks

reply

SCImago Team

Melanie Ortiz 9 months ago

Dear Aizat, thank you very much for your comment. We suggest you consult the Scopus database directly. Keep in mind that the SJR is a static image (the update is made one time per year) of a database (Scopus) which is changing every day.
The Scopus' update list can also be consulted here:
https://www.elsevier.com/solutions/scopus/how-scopus-works/content
Best Regards, SCImago Team

R **RATHEESH KUMAR NM** 11 months ago

AIP Proceedings publish full length papers in conference proceedings from medical science?

reply

SCImago Team

Melanie Ortiz 11 months ago

Dear Ratheesh,
Thank you for contacting us.
We suggest you visit the journal's homepage or contact the journal's editorial staff , so they could inform you more deeply.
Best Regards, SCImago Team

V **Viktor V.Chistyakov** 12 months ago

Dear Scimago!
Why has not assigned quartile for AIP Procs up to now? Were it assigned then what is?
Thank You
Bestregards

SCImago Team

Melanie Ortiz 12 months ago

Dear Viktor,
Thank you for contacting us. Please see comments below.
Best regards, SCImago Team

D **Dr Kumutha D** 2 years ago

Dear Sir,
Greetings!!!!

What is the Q value? Because, in our institution Q1, Q2, Q3 is very much necessary...
Through conference i planned to submit a paper... Please let me know

Thanks

reply

SCImago Team

Melanie Ortiz 2 years ago

Dear Dr Kumutha,
Thank you for contacting us. Please see comments below.
Best regards, SCImago Team

F **Fathi awad** 2 years ago

Hi
I am asking about the Q factor for AIP proceedings.

Thank you very much

reply

SCImago Team

Melanie Ortiz 2 years ago

Dear Fathi,
Thank you for contacting us. Please see comments below.
Best Regards, SCImago Team

G **Ghazwan Jreou** 2 years ago

according to Scopus Q classification list .
with regards.

reply

SCImago Team

Melanie Ortiz 2 years ago

Dear Ghazwan,
Thank you for contacting us. We calculate the SJR data for all the publication's types, but the Quartile's data are only calculated for Journals and Book Series.
Best regards, SCImago Team

A **ASHOK KUMAR K** 2 years ago

As per the information in SJR portal the coverage period for AIP conference proceedings is up to 2020. I want to know whether the period of validity or coverage gets extended or not? If gets extended when can we see those updates in the SJR portal?

reply

SCImago Team

Melanie Ortiz 2 years ago

Dear Ashok,
Thank you very much for your comment.
All the metadata have been provided by Scopus /Elsevier in their last update sent to SCImago, including the Coverage's period data. The SJR for 2019 was released on 11 June 2020. Therefore, the indicators for 2020 will be available in June 2021.
We suggest you consult the Scopus database directly to see the current index status as SJR is a static image of Scopus, which is changing every day.
Best Regards, SCImago Team

K **Kay** 2 years ago

My university is going to organise a conference in social science on 27-28 Oct 2021. We would like to publish our conference papers in your proceeding as our official proceeding. What are the procedures and publication fees?

Regards.

reply

SCImago Team

Melanie Ortiz 2 years ago

Dear Kay

or contact the editorial staff , so they could inform you more deeply.
Best Regards, SCImago Team

R **Ruslan** 2 years ago

I have published articles on AIP, but until now I have not received confirmation for my Scopus ID, please explain. thank you

reply

SCImago Team

Melanie Ortiz 2 years ago

Dear Ruslan,
thank you very much for your comment, unfortunately we cannot help you with your request. We suggest you contact Scopus support:
https://service.elsevier.com/app/answers/detail/a_id/14883/kw/scimago/supporthub/scopus/
Best Regards, SCImago Team

V **Vikas** 3 years ago

currently, the journal is not assigned quartile (Q indexing). When we can expect the assignment.

reply

SCImago Team

Melanie Ortiz 3 years ago

Dear Vikas,
Thank you for contacting us. We calculate the SJR data for all the publication's types, but the Quartile's data are only calculated for Journals and Book Series.
Best regards, SCImago Team

S **Siddik** 3 years ago

This will come under scopus journal list?

reply

SCImago Team

Melanie Ortiz 3 years ago

Dear Siddik,
Thank you very much for your comment

status as SJR is a static image of Scopus, which is changing every day.
Best Regards, SCImago Team

H **Hassan Yassein** 3 years ago

ISSN of this journal different of ISSN in Scopus, although the data of
SJR depends on the scopes

reply

SCImago Team

Melanie Ortiz 3 years ago

Dear Hassan,
Thank you for contacting us.
SJR is a portal with scientometric indicators of journals indexed in Scopus. All the data (Title, ISSN, etc.) have been provided by Scopus /Elsevier and SCImago doesn´t have the authority over this data which are property of Scopus/Elsevier. SCImago has a signed agreement that limits our performance to the generation of scientometric indicators derived from the metadata sent in the last update (April/May 2020).

The next SCImago update will be made throughout June 2020 with the new update sent by Scopus. We suggest you wait for that date in order to see if there are any changes regarding this matter.

Best Regards, SCImago Team

K **Khairil** 3 years ago

Is this proceeding ranked Q4?

reply

A **ali mohammed** 3 years ago

why this journal dont have any rank yet ?
it is dont belong to Q1,2,3,4 ?

reply

SCImago Team

Melanie Ortiz 3 years ago

Dear Ali,
Thank you for contacting us. We calculate the SJR data for all the publication types, but the Quartile data are only calculated for Journal type's publications. Best regards,

A **Akshya Sekar** 3 years ago

Hi mam/sir,
I want to know whether this AIP conference proceeding is indexed in SCI or not?

Thanks

reply

SCImago Team

Melanie Ortiz 3 years ago

Dear Akshya,
Thank you for contacting us. SJR is a portal with scientometric indicators of journals indexed in Elsevier/Scopus. Unfortunately, we cannot help you with your request referring the index status. We suggest you to consult Scopus database (see the current status of the journal) or other databases (like WoS). Best Regards, SCImago Team

K **Khairil** 3 years ago

Your IP (036.071.233.236) is blocked.
Block Reason: This IP was identified as infiltrated and is being used by sci-hub as a proxy.

How to unblock this my IP for acess AIP site?

thanks

reply

SCImago Team

Melanie Ortiz 3 years ago

Dear Khairil,
thank you for contacting us.
Sorry to tell you that SCImago Journal & Country Rank is not a journal. SJR is a portal with scientometric indicators of journals indexed in Elsevier/Scopus.
Unfortunately, we cannot help you with your request, we suggest you to contact the journal's editorial staff by e-mail. Best Regards, SCImago Team

D **Duha Ahmed** 3 years ago

dear Admin
about the AIP Conference Proceeding can you see the Scopus site because the date end to 2019 is there any update about this time or change it to 2020 in the near future and you will see it in the site of Scopus
https://www.scopus.com/sourceid/26916

reply

SCImago Team

Melanie Ortiz 3 years ago

Dear Duha,

Thank you for contacting us.Unfortunately, we cannot see what will happen in the future with this journal. Best Regards, SCImago Team

M **mohammed** 3 years ago

Is the (AIP Conference Proceeding) out of Scopes because I tried to search for it in Scopes and I did not find it
Please answer me

reply

SCImago Team

Melanie Ortiz 3 years ago

Dear Mohammed,

thank you for contacting us. You can find it in Scopus:
https://www.scopus.com/sourceid/26916

Best Regards, SCImago Team

T **Thanh Quang Khai Lam** 3 years ago

Dear Elena Corera!
Can you tell me "Lecture notes in civil engineering" in Q4?
i don't see in Scimago.
Thank you

reply

SCImago Team

Melanie Ortiz 3 years ago

Dear Thanh,
Thank you for contacting us. We calculate the SJR data for all the publication types, but the Quartile data are only calculated for Journal type's publications. Best regards,
SCImago Team

Can i know is this journal Q1,Q2,Q3 or Q4. Thank you.

Regards

reply

SCImago Team

Melanie Ortiz 3 years ago

Dear Teo, thank you very much for your request. You can consult that information in SJR website. Best Regards, SCImago Team

H **Hassan Abdulhadi** 4 years ago

I ASKE ABOUT AIP CONFERENCE PROCEEDINGS WITHIN SCOPUS OR THOMSON REUTERS WITH BEST WISHES

reply

H **Hassan Abdulhadi** 4 years ago

I ASKE ABOUT AIP CONFERENCE PROCEEDINGS WITHIN SCOPUS OR THOMSON REUTERS WITH BEST WISHES

SCImago Team

Elena Corera 4 years ago

Dear Hassan,

thank you for your request, all the journals included in SJR are indexed in Scopus. Elsevier / Scopus is our data provider.

Best Regards,
SCImago Team

T **Tarik** 4 years ago

Dear. Elena
Hi

Please can we concedar AIP conference proceeding as journal .What i mean ,the publication type could be
journal of AIP conference proceedings .

Best regards

SCImago Team

Elena Corera 4 years ago

Dear Tarik,

thank you very much for your comment. Unfortunately, we cannot help you with your request, we suggest you contact journal's editorial staff so they could inform you more deeply. You can find contact information in SJR website https://www.scimagojr.com

Best regards,
SCImago Team

D **Dunia** 5 years ago

dear
did the AIP conference (TMREES 18)have Thomson roeters or scopus or SJR Rank or not?

reply

SCImago Team

Elena Corera 5 years ago

Dear Dunia,

thank you very much for your comment. SCImago Journal & Country Ranks shows all the journal's vailable information in Open Access If you do not locate the journal in the search engine, Scopus / Elsevier has not provided us those data.

Best Regards,
SCImago Tea

B **Budi Adiperdana** 5 years ago

Dear Admin,

Could you please add the Quartile Rank for AIP Conference Proceedings

Best regards,
Budi

reply

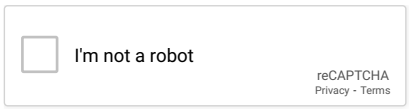
SCImago Team

Elena Corera 5 years ago

Dear Budi, for Conferences and Proceedings the SJR is not calculated. Best Regards,
SCImago Team

Email

(will not be published)



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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.

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