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Research trends in isolation and identification of bacteria from Indonesia with various roles: Review article

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ABSTRACT

Bacteria are agents that can be used widely and are genetically easy to manipulate and reproduce. Many studies related to the isolation and identification of bacterial isolates from Indonesia have been carried out for various purposes. This research is still ongoing and has never been informed about the abundance of data from previous studies. The purpose of this study is to provide an overview of research topic trends related to the isolation and identification of bacterial isolates from Indonesia. The method used in this review is by setting inclusion and exclusion criteria and selecting a random sample of articles for analysis. The results of a review of research trends in isolation and identification of bacterial isolates from Indonesia showed four main topics discussed, namely the topics of food processing, agriculture, health, and bioremediation. Analysis of 41 articles shows that the most common discussion is the exploration of Lactate Origin-producing bacteria, the role of improving food quality. Furthermore, it was identified that the most isolated bacterial isolates came from food and plants, with 14 publications from a total of 41 articles. It can be concluded that exploratory research on Lactic Acid Bacteria for improving the quality of food products is currently the most studied topic by researchers in Indonesia.

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1. Introduction

Indonesia, as the largest tropical archipelago country in the world, has various potentials of natural resources of microbes, fauna, and flora, and as such it is called Megabiodiversity country (Kusmana & Hikmat, 2015). Exploratory studies on plants, animals, and bacteria have been made for various purposes such as mapping, conservation, and exploration on their potentials for raw materials of medicines (Azim, et. al., 2021; Rahardjanto, et. al., 2021; Nuryady, et. al., 2017; Izza & Kurniawan, 2014; Pananjung, et. al., 2014; Jumiyati & Mubarok, 2012). Bacteria are the most abundant microorganisms, are widespread all over the world, and many of them are known to survive in extreme conditions such as salty water lake, hot springs, mountain caldera, deep sea, etc (Budiharjo, et. al., 2017; Mahmudah, et. al., 2016; Firliani, et. al., 2015; Nababan, 2008). Bacteria are widely explored for various purposes such as becoming agents for bioremediation of destroyed environment (Elyza, et. al., 2015; Syahputra, et. al., 2011; Nababan, 2008; Yazid & Arifin, 2006), agents for improving food quality (Bukhori & Sartini, 2020; Hasanah, 2014b; Halim & Zubaidah, 2013; Sari & Nofiani, 2012), agent for producing new medicines, such as fibrinolytics and proteolytics for heart medicines (Pananjung, et. al., 2016; Setiawan, et. al., 2016). Studies regarding bacteria isolation in

Indonesia are mostly done through the stages of morphological identification, biochemical examination, and molecular examination.

Exploratory studies on bacteria by Octaviana, (2012); Oksana, et. al., (2020); Walida et. al., (2019); Nisa, (2018); Setiawati & Mihardja, (2018); Putri, (2013) suggest that phosphate-dissolving bacteria can be isolated from various places such as organic farming soil, ultisol soil, limestone quarry, rhizosphere of coconut tree, tea plant, soybean plant, eruption land, etc. According to Runtuboi, et. al., (2018); Nuritasari, et. al., (2017); Siregar & Huda, (2017); Mahmudah, et. al., (2016); Firliani, et. al., (2015); Muharni, et. al., (2013); Pikoli, et. al., (2000); thermophilic bacteria are mostly isolated from hot springs, volcanic caldera, and oil wells. Thermophilic bacteria can be used to produce thermostable enzymes (which are not easily degraded by heat so that they are more beneficial). Different from study by Viena, et. al., (2021); Dewi, et. al., (2014) mention that exploratory study of plastic-decomposing bacteria by Waluyo, (2018); Lewaru, et. al., (2012), heavy metal decomposing bacteria are highly promising for bioremediation programs. Explorations on lactic acid bacteria have also been extensively done to find the most effective isolate in producing lactic acids which can serve to preserve food, improve food quality, as well as to add probiotics to food, Bukhori & Sartini, (2020); Hasanah,(2014b), (2014a); Halim & Zubaidah, (2013); Sari & Nofiani, (2012). Studies regarding exploration of bacteria will continue to be made since such studies are parts of national strategic studies regarding natural resources exploration. Abundance of data as the results of exploratory studies on bacteria has not been presented in one discourse, so that this review article would be important in presenting adequate information of exploratory studies on bacteria in Indonesia. This review article aims to present the trend in topics of studies related to isolation and identification of bacterial isolates from Indonesia. Furthermore, this article would provide new ideas of studies for Indonesian researchers regarding bacterial exploration with topics which have not been made extensively. .

2. Method

Screening of articles used Publish or Perish (PoP) software, by selecting search engine based on Google Scholar. Keywords to be included in the criteria were isolation, identification, bacteria, Indonesia by limiting to 100 articles published from 2016 to 2021. Results of PoP screening were subsequently analyzed using VOSviewer software to find connections among the keywords of the study, and the trend in study. The results of PoP were also re-screened to be analyzed manually using obligatory criteria from journal sites. When journal titles contained the word molecular, then they were excluded. This resulted in 41 articles that met the requirements.

3. Findings and Discussion

Results from bibliographic visualization using VOSviewer software indicated that there are two clusters in exploratory studies on bacteria in Indonesia. The first cluster consists of topics on isolation and identification, inhibition test on enzymes, and *Cyprinus carpio* species. The second cluster consists of studies on lactic acid bacteria, *Myristica fragrans* species, and *Oreochromis niloticus*. Figure 1 shows trends in exploratory studies on bacteria in various places in Indonesia for various purposes.

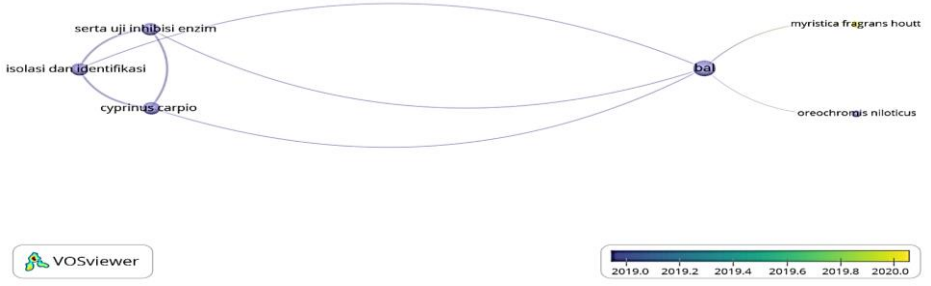

Fig. 1. Results of VOSviewer regarding trends in exploratory studies on bacteria in Indonesia

Lines presented in Figure 1 also indicates correlation between one keyword to the other, and thera are 2 inter-related clusters (Fitria & Dhuhan, 2021; Hudha, et. al., 2020). Results of trend analysis using Vosviewer indicate that the most recent studies which attract and are widely discussed by

Indonesian researchers ore the ones regarding lactic acid bacteria isolated from various plants such as *M. fragrans* (Lawalata, et. al., 2020). This indicates that in the future there will be more exploratory studies in lactic acid bacteria isolated from flora in Indonesia. The increasing interest from researchers to do exploratory studies on lactic acid bacteria is due to the fact that the bacteria can be utilized for wide range of purposes, not only to improve quality of food product, but also to give health benefits for human digestion system (Fig. 2) (Pagi, 2020; Emmawati, et. al., 2015; Halim & Zubaidah, 2013).

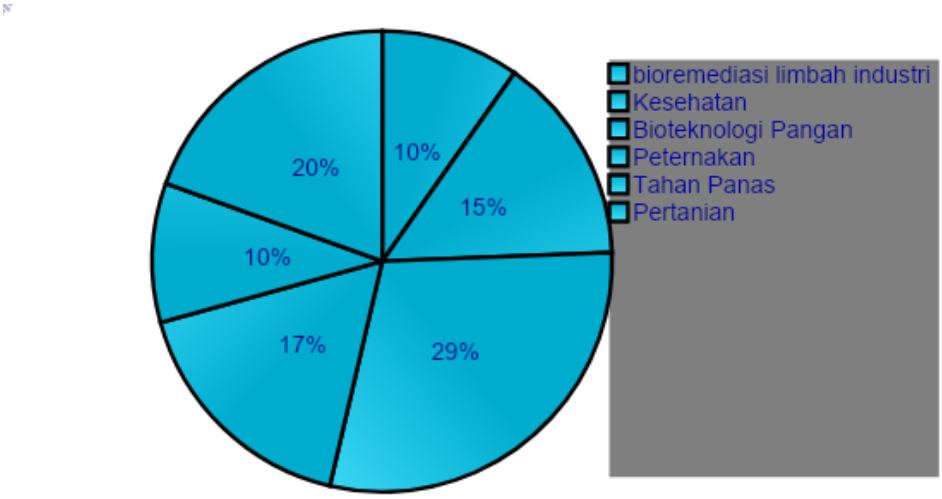

Fig. 2. Results of analysis of exploratory studies on bacteria regarding their roles

Results of analysis of manual screening on 41 articles which met the inclusion criteria indicate that the most executed exploratory studies of bacteria in Indonesia are the ones with the topic of food biotechnology. Among 11 articles, 3 of them discuss about lactic acid bacteria. Besides that, there is also study discussing gelatinase (Bukhori & Sartini, 2020; Prihanto, et. al., 2018). According to Detha (2019), lactic acid bacteria isolated from the milk of Sumba horse are identified as *Lactobacillus brevis*, *L. plantarum*, *L. acidophilus*, *L. salivarius*, *L. delbrueckii* subsp. *delbrueckii* and *Lactococcus lactis* subsp. *lactis*. The next most interesting articles are about isolation and identification of bacteria for agricultural purposes, with 10 articles. Exploratory studies on lactic acid bacteria are not only for the purpose of food biotechnology, but also for agricultural purpose where the bacteria serve as probiotica to control nitrogen compound in fresh water fish farming (Yosmaniar, et. al., 2018). Figure 2 also shows articles on bioremediation at 10% of 41 screened articles. Studies by Hidayat, et. al., (2020); Fidiastuti, et. al., (2020); Irawati, (2020); Indrawan, (2018); discuss about identification of bacteria that are potential to serve as agents of waste bioremediation in a number of polluted areas, showing that there is hope for environmental remediation with the help of microbes. Heat-resistant bacteria are commonly isolated from hot springs in various places. These studies continue to be conducted to explore utilization of thermophilic bacteria as producers of protease and kitinase and sone other enzymes (Runtuboi, et. al., 2018; Nuritasari, et. al., 2017; Siregar & Huda, 2017; Mahmudah, et. al., 2016; Muharni, et. al., 2013). It can be concluded from the diagram of exploratory studies that the most dominant roles of the bacteria is the one regarding food biotechnology, then followed by agriculture, and the least is the one about waste bioremediation and heat resistance (Fig. 3).

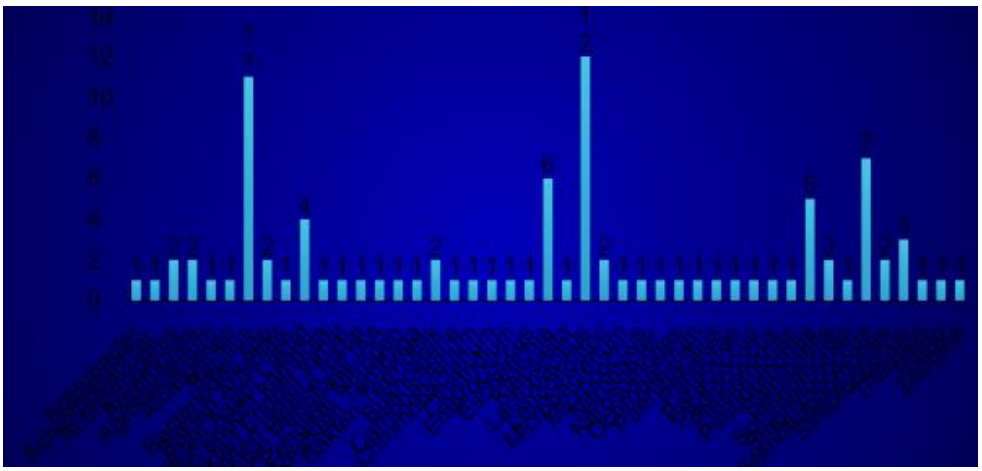

Fig. 3. Analysis of genus and types of isolated bacteria

Analysis from a number of articles reveals that genuses of Lactobacillus dan Bacillus are the most bacterial genuses obtained from isolation and identification activities. These two genuses are mostly found to serve as producers of lactic acids (Bukhori & Sartini, 2020; Lawalata, et. al., 2020; Pagi, 2020; Emmawati, et. al., 2015; Hasanah, 2014b; Halim & Zubaidah, 2013). Some bacterial genuses such as Acetobacter, Agrobacterium, Bacillus, Carnobacterium, Microbacterium and Zooglea are classified as bacteria with dominant role in environmental or biorediation activities (Fidiastuti, et. al., 2020; Indrawan, 2018). Followingly, genuses of Actinomycetes, Clostridium, and Pediococcus are classified as bacteria which are dominant in their role in food processing (Kurnia, et. al., 2020; Detha, 2019; Wulandari & Purwaningsih, 2019; Amaliah, et. al., 2018; Silaban & Simamora, 2018; Susiloningtyas, et. al., 2016;). Studies by Huslina, (2020); Sabbathini dan Pujiyanto, (2017) suggest that bacterial genuses of Nitrobacter, Ochrobacterium, Sphingomonas, Pandorae and Stenotrophomonas are genuses dominant in their role in agriculture. *Escherichia coli* is identified as the most discussed bacteria in the field of health as pathogenic bacteria (Maryanti, et. al., 2019; Rahmani & Handayani, 2016).

Fig. 4. Analysis of origins of bacterial isolates from a.number of studies in Indonesia

Analysis of bacterial isolates based on their types of substrates indicates that the most bacteria isolated in Indonesia originate from foods, drinks, water, and plants. It is shown that, from 41 screened articles, researchers mostly focus on exploration of bacteria to improve food quality (Emmawati, et. al., 2015; Hasanah, 2014b; Halim & Zubaidah, 2013). This correlates to results from the previous studies which indicate that exploration of bacteria in Indonesia commonly refers to screening of candidates and utilization of lactic acid bacteria. Lactic acid bacteria have roles in fermentation and preservation of food (Bukhori & Sartini, 2020; Kurnia, et. al., 2020; Lawalata, et. al., 2020).

4. Conclusion

Studies on exploration and identification of bacteria from Indonesia have been conducted extensively with lactic acid bacteria as the most widely studied. Genuses of Lactobacillus and Bacillus are the most isolated, and the most explored bacterial substrates/environments are foods and drinks. It is concluded that the trend in exploratory studies of bacteria from Indonesia is mostly concerned with lactic acid bacteria with the purposes of improving food quality. It is recommended that the next article reviews use the source of scopus database for PoP for the validity of the publishers and better quality of articles.

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