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Development of an Antibacterial Poster Based on Papaya Leaf Starch (*Carica papaya* L.) Against *Escherichia coli* for the Community

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Abstract: In recent years, the use of natural ingredients as antibacterial agents has gained increasing attention due to the increasing antibiotic resistance. One such potential is papaya leaf extract (*Carica papaya* L.), which has shown antibacterial activity against *Escherichia coli*, a common cause of diarrhea in the community. This study aims to develop an educational poster that communicates the antibacterial benefits of papaya leaf extract against Escherichia coli. This study used the Research and Development (R&D) model as modified by Borg & Gall, which consists of five stages: (1) initial information collection, (2) planning, (3) initial product development, (4) limited field testing, and (5) product revision. Validation was carried out by material, media, and language experts, while readability testing was conducted on individuals aged ≥17 years. Data analysis included qualitative content analysis and quantitative descriptive analysis to evaluate the feasibility and readability of the poster. The results showed that the developed poster obtained a validation score above 80% from all experts, and a highest readability score of 95% from the community, indicating that the poster was very feasible, informative, and easy to understand. The strength of the poster lies in its attractive visual design, communicative language, and concise and focused content. This educational media is expected to increase public awareness of diarrhea prevention using herbal plants. Further research is recommended to explore the long-term impact of the media on behavioral change and assess the antibacterial effectiveness of papaya leaf extract in various formulations.

Keywords: Antibacterial; Educational media; *Escherichia coli*; Papaya leaves; Poster

Introduction

Pathogenic strains of *Escherichia Coli* (E. Coli) are significant contributors to a variety of health disorders, particularly those affecting the human digestive system. These strains can cause severe gastrointestinal illnesses, including diarrhea and other complications (Peng et al., 2024). One of the alternative treatments that is starting to get a lot of attention is the use of natural ingredients, such as papaya leaves (*Carica papaya* L.), which are known to contain bioactive compounds with antibacterial potential. The antibacterial properties of papaya leaf starch juice, which are associated with its flavonoids, saponins, and tannins, have been proven through various studies. These compounds have shown efficacy in inhibiting the growth of pathogenic bacteria, including *Escherichia Coli* (Kurniasari et al., 2022; Habibi et al., 2024). In addition, increasing public awareness of the importance of natural-based medicines further supports the relevance of this research.

However, despite the growing interest in natural medicine, public access to clear and accurate scientific information on the antibacterial potential of papaya leaves is still limited. This poses a challenge in transforming laboratory findings into applicable knowledge at the community level.

The main research questions in this study are: To what extent is papaya leaf extract effective in inhibiting

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the growth of Escherichia coli, and how can this information be effectively communicated to the public?

DEC is a major cause of diarrhea in children and adults. In a study conducted in Sokoto, Nigeria, DEC was found in 21% of children under five years of age, making it the second most common cause of diarrhea after rotavirus. (Ahman et al., 2024). The most common DEC pathotypes include enteropathogenic (EPEC) and enterotoxigenic (ETEC) E. coli, which are associated with severe health impacts in children. This pathotype is responsible for most cases of diarrhea, often causing growth retardation and increased susceptibility to other infections (Salleh et al., 2022; Feletto, 2024). The discovery of antibiotics marked a major milestone in medical history, transforming the treatment of previously fatal infections and enabling life-prolonging medical procedures (De Lacerda et al., 2024; Lawani-Luwaji, 2024). However, the overuse and misuse of these drugs have led to the emergence of antibiotic-resistant bacteria, which pose a significant threat to global health (Hanindyo & Rachman, 2024). This problem is exacerbated by the availability of antibiotics without prescription and their use in agriculture, which accelerates the spread of antimicrobial resistance (AMR) (Hanindyo & Rachman, 2024). Antimicrobial resistance (AMR) is a significant public health challenge, as it makes infections increasingly difficult to treat and can lead to serious complications. This phenomenon occurs when microorganisms such as bacteria, viruses, fungi, and parasites evolve to resist the effects of drugs that were once effective in treating infections. The misuse and overuse of antimicrobials in health care, agriculture, and other sectors have accelerated the emergence and spread of resistant strains, posing a global threat that requires urgent action. The implications of AMR are profound, affecting not only individual health outcomes but also broader health care systems and economic stability. (Mehboob, 2022; Ribeiro Junior, 2025).

Research on the antibacterial properties of papaya leaves (Carica papaya L.) has shown promising potential in combating bacterial infections. Papaya leaves contain various bioactive compounds such as flavonoids, tannins, and alkaloids, which contribute to their antibacterial activity. These compounds are effective against a variety of bacteria, including Staphylococcus epidermis, Salmonella typhi, and Pseudomonas aeruginosa (Pujowati et al., 2024; Rosales & Ruiz, 2025). The integration of papaya leaf extract with other agents, such as silver nanoparticles, further enhances its antibacterial efficacy. This study highlights the potential of papaya leaves as a natural alternative to conventional antibiotics, especially in developing countries where bacterial infections are prevalent (Putri et al., 2023). Papaya leaves (Carica papaya L.) are known for their antibacterial properties, attributed to active compounds such as flavonoids, alkaloids, saponins, and tannins. These compounds have been shown to inhibit the growth of various pathogens, including Staphylococcus aureus, Salmonella typhi, and *Escherichia coli* (Sarkono, 2022; Pokharel et al., 2023; Utami et al., 2023). Papaya leaf extract has been shown to significantly inhibit the growth of E. coli, confirming its potential as a natural antimicrobial agent. (Kurniasari et al., 2022; Choudhary et al., 2025).

To address the problem of E. coli infections and increasing antibiotic resistance, this study offers a solution in the form of developing educational media in the form of posters.

This poster is designed to provide information to the community about the antibacterial properties of papaya leaf extract and its potential use in preventing bacterial infections. Another goal is to recognize and preserve indigenous knowledge systems, which can lead to more effective community-based health strategies, as these systems often include valuable insights into natural resource management and the use of traditional medicine (Suwono, 2024). This study aims to explore the antibacterial potential of papaya leaf extract against Escherichia coli and develop educational media in the form of posters to convey this information to the public. In addition, this study also tests the effectiveness of papaya leaves as an alternative natural treatment for bacterial infections, which is expected to reduce dependence on synthetic antibiotics and help overcome antibiotic resistance (Kılıç & Gültekin, 2024). Based on these objectives, the hypothesis tested is that papaya leaf extract has significant antibacterial activity against Escherichia coli, which can be communicated effectively through educational media in the form of posters.

Method

This research was conducted in March 2025 in Terusan Village, Kampung 3, North Musi Rawas Regency. The poster development process was carried out using a modification of the Borg and Gall model, consisting of five stages, namely: Research and data collection through literature studies and field observations, Poster design and content planning, Initial product development in the form of a poster draft, Field trials involving local communities, and Product revision based on input from experts and respondents.

Validation of product eligibility was conducted by three expert validators, namely language experts, material experts, and media experts. In addition, readability tests were also conducted on community groups as target users.

Results and Discussion

The validation results show that all aspects of the assessment are above 80%, which means that the poster is considered very feasible by experts. The highest score comes from the readability test by the community, which is 95%, indicating that the poster is easy to understand, communicative, and relevant. Visual aids clarify complex ideas, making them more accessible. For example, posters can simplify complex health information, allowing patients to quickly understand important concepts (Noor et al., 2023).

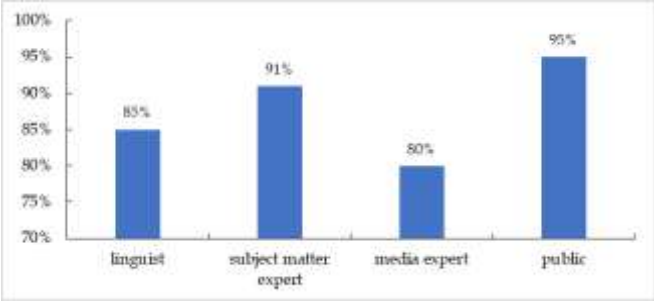

Figure 1. Validation percentage graph

Posters should adhere to the principles of good graphic design to ensure that the message is conveyed effectively (Yulius, 2022). Posters should be culturally relevant to resonate with the target audience. The use of local language and familiar cultural imagery can increase the effectiveness of the message (Safa'ati et al., 2024). Likewise, digital posters leverage interactive and dynamic content to engage viewers, making them a powerful tool for education and communication. These benefits are evident in a variety of contexts, from community information dissemination to educational settings (Burdujan, 2024).

Posters that incorporate culturally resonant symbols and visuals are more likely to attract attention and increase message retention (Ingolo & Ong'onda, 2024). The use of semiotic resources, such as icons and symbols, helps to create a coherent narrative that aligns with the message. Misalignment in these elements can lead to confusion and misinterpretation of the message (Joy, 2023). Effective poster design requires that the imagery is relevant and supports the message being conveyed (Yulius, 2022). The structure of a poster, especially the use of numbers to mark important points, plays a vital role in making the flow of information logical and easy to follow. Posters are a visual medium that can effectively convey complex information in a simplified manner, making them an excellent tool for educational and communicative purposes. The design and organization of a poster are critical to its effectiveness, as they determine how well the information is understood and retained by the audience. The use of numbers and other organizational tools can increase the clarity and accessibility of the information presented (Krymskaya, 2024). The effectiveness of a poster is determined by several criteria, including clarity of message, visual appeal, organized structure, relevance of content, quality of images and text, catchy slogans, and valid references. Each of these elements plays a vital role in ensuring that the poster not only attracts attention but also communicates the intended message effectively (Burnett & Hoffman, 2025).

Figure 2. Final poster product

Posters are very effective in conveying information, and their success depends largely on the quality of the design and the ability to integrate it into the intended context. The effectiveness of a poster depends on the

designer's understanding of the principles of visual communication and the ability to adapt the content to the needs of the audience (Utami, 2024; Mubarat et al., 2023). In addition, the rise of digital technology has expanded the platforms on which posters can be disseminated, enhancing their role as dynamic tools for visual communication. They condense complex information into an easily digestible format, increasing comprehension and engagement. The quality of the design significantly impacts its effectiveness, as well as the presenter's ability to integrate it into an educational context (Utami, 2024). Posters simplify complex data, making it accessible to a diverse audience (Adnan et al., 2022). An effective poster requires clear organization of content, which includes the use of informational headings, summary statements, and clear figures to facilitate easy understanding (Wang et al., 2022). A well-designed poster not only conveys important data but also engages the viewer, encouraging them to explore the subject further, and a neat and organized layout improves readability, allowing the viewer to process the information efficiently (Davies et al., 2024).

Some similar posters are often too dense and difficult for the public to understand. In contrast, a well-prepared poster should capture the interest and imagination of the viewer, which is achieved through brevity, clarity, neatness, and readability. These elements ensure that the poster is not only visually appealing but also scientifically valid (Davies et al., 2024). Although references are not explicitly included in the design, the information conveyed is based on strong research. Source credibility is an important factor in increasing the persuasiveness and trustworthiness of content. It consists of dimensions such as expertise, trustworthiness, and attractiveness, which collectively influence how the audience perceives the information presented (Bogoevska-Gavrilova & Ciunova-Shuleska, 2024).

The Borg and Gall development model, originally a comprehensive framework for educational research and development, has been adapted by researchers into a more efficient five-stage process to address constraints related to effort, time, and cost. This modified model includes the stages of research and data collection, planning, initial product development, field testing (conducting validation), and product revision. This initial stage involves gathering relevant information and understanding the context in which the poster will be used (Pangestu et al., 2022). Planning involves outlining the purpose and design of the poster (Wibowo et al., 2023). The initial product is developed based on insights gained from the research and planning phase (Pangestu et al., 2022). Field testing involves evaluating posters in real-world settings to gather feedback and assess their effectiveness. This stage is critical to identifying problems or areas for improvement. The disaster preparedness poster, for example, was validated by experts and through focus group discussions with students (Pangestu et al., 2022). Based on feedback from the field test, revisions were made to improve the poster. This iterative process ensures that the final product is effective and user-friendly (Wibowo et al., 2023).

While the modified Borg and Gall model provides a structured approach to poster development, it is important to consider the broader educational and information design context. The effectiveness of a poster is determined not only by the process of its development but also by its ability to engage and communicate with its audience (Masruroh et al., 2022). Factors such as design thinking, audience analysis, and content organization play a critical role in the success of a poster (Burnett & Hoffman, 2025). Additionally, the integration of modern risk management and validation techniques can further enhance the development process, ensuring that the final product meets its intended purpose (Lishchyna et al., 2024).

Conclusion

The development of a poster on the antibacterial activity of papaya leaf extract against Escherichia coli has succeeded in producing educational media that is very suitable for use. Based on the results of expert validation and community readability tests, the poster is considered very effective in conveying information in a concise, interesting, and easy-to-understand manner. This poster is expected to be a useful educational tool in increasing public knowledge about the use of local plants as natural antibacterial agents.

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The authors declare no conflict of interest.

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