

Bridging Science and Halal Compliance: DNA Analysis Kits Concept for Effective and Educational Authentication

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ABSTRACT

Global exposure to halal food has increased demand due to its reputation for cleanliness and health benefits, attracting non-Muslims as well. However, traditional methods for verifying halal compliance often fall short. DNA analysis offers a modern solution for accurate halal verification by identifying prohibited substances in food, pharmaceuticals, cosmetics, and other products. This study aims to find the fastest DNA-based technique for detecting forbidden materials and to develop a halal authentication kit. The kit will also serve as an educational tool for students, promoting awareness of halal certification and integrating concepts from biology, chemistry, food science, and religious studies.

Keywords: Halal Authentication; DNA Concept Kit; Education; Knowledge Transfer; Religious Studies pellet

INTRODUCTION

Today, the halal industry is recognized as a substantial global market, valued at approximately USD 580 billion annually (Olya & Al-Ansi, 2018). This expansion is driven by advancements in science and technology within the food processing sector, which have led to an increased variety of ingredients used in food products, including gelatin and genetically modified (GM) foods. The food, cosmetics and pharmaceutical products are essential needs for human beings. With respect to the globalization and industrialization era, these products must meet the community demand and have to fit the required regulations. The advanced technology in the industries has led to the fraud in the product and it may contain nonhalal substances and undeclared ingredients which are allergenic to certain people (Hassan, Ahmad, & Zain, 2018).

As halal dietary requirements gain traction, there has been a notable increase in awareness among Muslim populations in countries like Indonesia, Malaysia, and Pakistan. This heightened consciousness has contributed to the substantial growth of the halal market, which currently accounts for approximately 16% of the global food industry and is projected to rise to 20% of the world's food trade in the near future (Van Der Spiegel et al., 2012). The implications of this growth extend beyond economic statistics; food authenticity has become a pressing concern for consumers, food authorities, and producers alike. The prevalence of misleading labelling and fraudulent practices can undermine consumer

confidence and compromise food safety, making it crucial to establish reliable verification mechanisms to uphold the integrity of halal certification (Barnett et al., 2016).

With the halal market poised for further expansion, the integration of modern technologies in verification processes becomes essential. Employing advanced methods, such as DNA analysis, can help ensure that halal products meet the stringent standards expected by consumers, thereby fostering trust and enhancing the reputation of the halal brand globally. As the halal industry continues to evolve, balancing innovation with tradition will be vital in meeting the demands of an increasingly discerning consumer base. In this context, the halal market is not merely a sector of the economy but a testament to the values and preferences of a growing global population, underscoring the need for transparency, authenticity, and accountability in food production and marketing.

Introducing a halal DNA authentication kit in secondary schools provides students with valuable learning experiences that enhance their understanding of food safety and ethics. This hands-on technology enables them to explore genetic testing and the importance of halal certification, fostering critical thinking and scientific inquiry. Students not only gain knowledge in biology and chemistry but also develop respect for cultural diversity and ethical consumption. By learning to verify halal products, they become informed consumers, ready to make choices aligned with their values, while potentially sparking interest in careers in food science and public health.

MATERIALS AND METHODS

Designing of 3D Design

Three dimensional printing (3D printing) for the masses was a concept introduced by so-called open source 3D printers such as the RepRap project started in 2004 (Pearce et al. 2010, Cano 2011). The creation of a 3D-printed electrophoresis test kit began with digital modeling, leveraging computer-aided design (CAD) software. TinkerCAD was chosen for its user-friendly interface and precise modeling capabilities. The process started with the development of 2D sketches to visualize and outline the initial concept. Once the 2D designs were polished, they were seamlessly converted into a detailed 3D model using TinkerCAD, ensuring both accuracy and printability. This step ensured that the final prototype was both functional and optimized for 3D printing.

Packaging Box Design

For the packaging design, we used both the Canva app and ibisPaint, combining their features to create a fun and engaging look.

RESULTS AND DISCUSSION

Designing of 3D Design

Figure 1 shows the electrophoresis test kit (body component), Figure 2 shows the

electrophoresis test kit (cap component) and Figure 3 shows the full design of the electrophoresis kit.

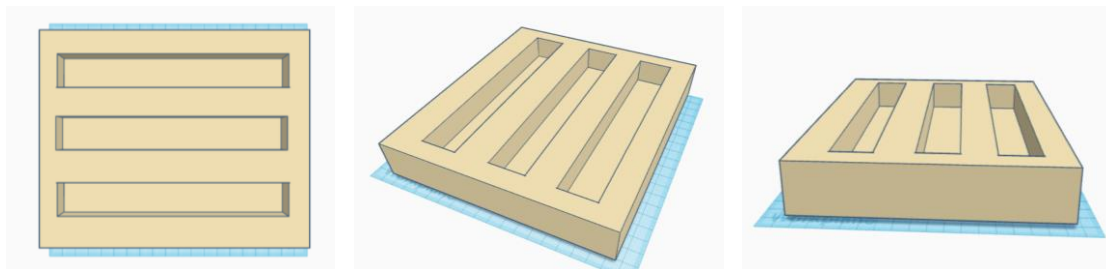


Figure 1. Design of electrophoresis test kit (body component).

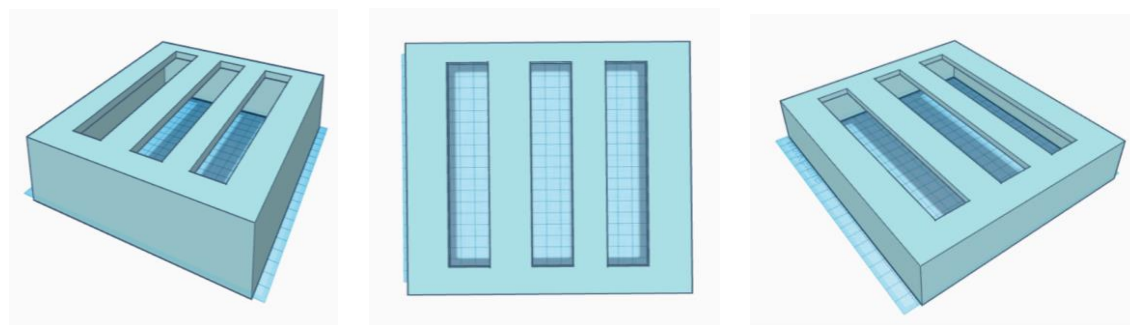


Figure 2. Design of electrophoresis test kit (cap component).

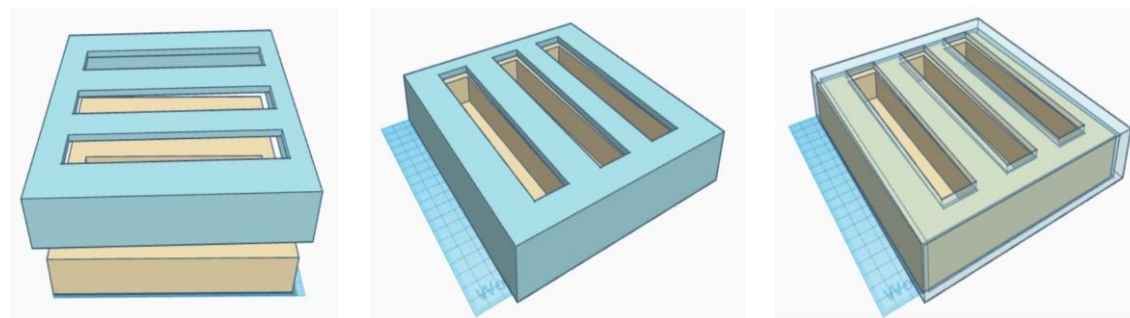


Figure 3. Full design of electrophoresis test kit.

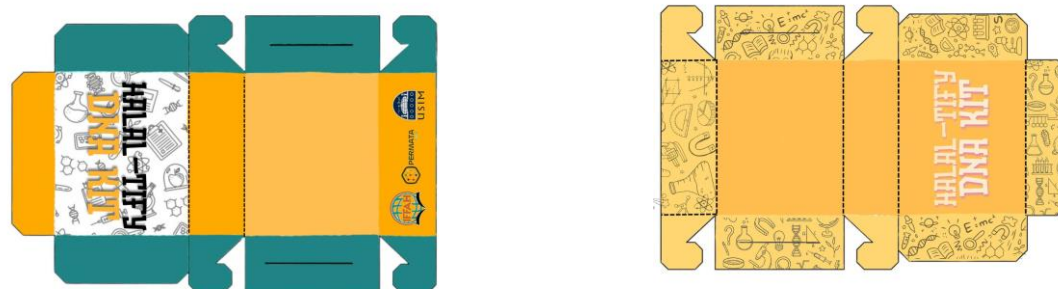


Figure 4. Packaging box design.

Packaging Box Design

The packaging design for the kit now includes vibrant, eye-catching colors along with playful doodle designs, making it even more appealing to kids and teens. Figure 4 shows the draft of our design.

CONCLUSION

We have successfully completed the product design using the Tinkercad app, allowing us to create a functional and user-friendly kit prototype. For the packaging, we utilized both Canva and ibisPaint apps, combining their features to design vibrant, eye-catching packaging that appeals to our target audience of students and young learners. The final packaging includes bright colors and playful doodles, making the kit both engaging and approachable. This combination of tools and creativity has helped us produce a hands-on, educational product that is not only visually appealing but also practical for classroom use.

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