

## Halal strip test for determination of impurities in food: cost effectiveness analysis based on the situation in non-Islamic countries in Southeast Asia

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**Submission:** 7 September 2022

**Revision:** 8 September 2022

**Acceptance:** 14 September 2022

Dear Editor, Muslim population has been growing gradually and is now estimated as 25% of global population [1]. As this community grows, they demand for Halal foods and nonfood commodities. Muslims must consume only Halal foods, which are allowed according to the Islamic rules. Interestingly, recent developments in determination of the adverse effects arisen from non-Halal sources especially in food industries have motivated non-Muslim people to seek for Halal market in the global commerce.

The rule of Halal is usually well maintained in the Islamic countries. However, there are millions of Muslim living in non-Islamic countries, where there is no mandatory rules of Halal foods' certification. For instance, Halal certification is a challenge in Europe and Europeans suffer from lack of Halal food regulation [2]. Unfortunately, Halal is considered as a religious issue and the European governments do not intervene in this regard. To solve this issue in the Europe, Tieman suggested that Halal logos be inserted on the label-

ling of food packages. Once it is implemented, the products meet the requirements of Halal [2]. Other than Halal logo, quality assurance of Halal foods is a critical issue in local markets. Halal food certification should be efficient and available technique at national and international levels to assure the Muslim customers the meal they are consuming is in accordance to their religion [3-4]. Such certification protocol and further surveillance systems result in better marketing and higher market share globally [3]. A primary need is development of authorized laboratories responsible for monitoring of forbidden materials in Halal-certified Foods. Unfortunately, it is usually neglected in non-Islamic countries.

Molecular-based techniques are of common and acceptable methods used for examination of Halal in food industries, but they are expensive and not easily available, and need professional skills. Attempts to develop a simple point-of-care testing has led to immune-chromatographic strip

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test. In this letter, the authors discuss cost-effectiveness of Halal strip test for determination of non-Halal impurities in foods available in non-Islamic countries in Southeast Asia, where most of people are Buddhism.

Fortunately, local Islamic societies are active there and academic scientific centers play pivotal role in development of specific test for Halal foods. One of the locally available Halal strip tests is shown in Figure 1. According to accreditation results, the test has very high sensitivity with 100% specificity in detection of unacceptable meat. In addition, the result is achieved within 10 min.

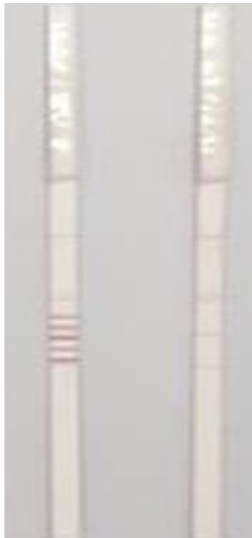


Figure 1- A sample of locally available immunochromatography strip test in Southeast Asia used for evaluation of Halal foods. Left: the positive bands indicate impurities (unacceptable meat); Right: negative (no impurity)

To evaluate cost-effectiveness, we used a local published data about prevalence of forbidden materials in local Halal foods [1]. Molecular-based methods such as real-time polymerase chain reactions (PCR) and gas chromatography (GC) are reference methods for tracing purposes. Cost of examination by one of the reference methods (real-time PCR or GC) and halal strip test is estimated as 136 and 13.6 USD, respectively. It is included to the total cost of experimental analysis per run, that is expense of solvents, disposable materials, chemicals, etc.). A method effectiveness is likelihood of accurate and precise diagnosis. Therefore, cost-effectiveness is calculated according to Eq. 1 as follows:

$$\text{Cost-effectiveness} = \frac{\text{Cost}}{\text{Effectiveness}} \quad \text{Eq. 1}$$

Result of a local survey is presented in Table 1. Accordingly, cost-effectiveness of strip test in diagnosis of meat impurity is much lower than that of real-time PCR or GC, but strip test is not accurate enough in diagnosis of alcohol in the product. Local surveys revealed that undesirable meat is rarely added to the products, but alcoholic contamination is prevalent. Therefore, use of strip test is not helpful in determination of alcohol impurities in place, and regular sampling of foods for their analysis by the reference methods (real-time PCR and GC) is recommended.

Table 1- Cost-effectiveness evaluation of reference analytical methods (real-time PCR and GC) and strip test in determination of impurities in Halal-foods

Impurity	Method	Rate of contamination (%) [1]	Cost (USD)	True diagnosis (%)	Cost-effectiveness (USD)*
Non-Halal meat	PCR and GC	0	136	100	136
	Strip test	0	13.6	100	13.6
Alcohol	PCR and GC	1.3	136	100	136
	Strip test	1.3	13.6	0	Infinity
Overall**	PCR and GC	1.3	136	100	136
	Strip test	1.3	13.6	98.7	13.6

\* High value refers to a high cost required for diagnosis and implies that the method is not appropriate for routine use.

\*\* It refers to both non-Halal meat and alcohol.

Convincing the producers to avoid addition of non-Halal materials to foods is a major concern, because control of Halal food seems unnecessary and luxury action in non-Islamic countries, allowing food producers to release low-qualified products in the market unethically. Thus, designing and development of novel strips able to detect widespread impurities such as alcohol is of importance. Furthermore, it is required to truly distinguish uncommon impurities such as dog meat, other than pork meat that is more common in food adulteration.

Another concern in the new era arises from genetically modified (GM) foods. Indeed, the extracted gene may come from not-allowed sources such as non-Halal animals or the recombinant enzymes used in food industry may be synthesized by non-Halal origins [6-8]. Despite abundance of GM critics in the world, shortage of food supply and global drought have led to increasing demand for GM organisms and recombinant enzymes [9-17]. GM foods are currently sold all over the world [6], and people have different levels of safety concern [7]. Although, GM technology has been introduced in the last decades and science of Halal foods should be updated so that can detect accepted events and traits in GM food products [8-9]. Source of recombinant enzymes and their potential risks are of great importance because they may catalyze unintended reactions in biological systems and may result in production of toxic agents in foods [9]. Source of recombinant enzymes might be of unacceptable origins, in which Halal assurance systems play the main role. In conclusion, development of fast tracing systems such as well-designed strip tests in parallel to the introduction of novel foods is strongly recommended. However, it is expected that rapid tests cannot compete with the molecular-based methods especially in diagnosis of sources at gene level.

**Conflict of interest:** The authors declare that they have no conflict of interest.

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