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Detecting halal meat products using advanced technologies

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Abstract

Meat safety is global issue in which essential requirement for detection of food adulteration of any foods we consume. Although traditional fraud detection methods are accurate and reliable, yet they are time unbearable. Meat Flow Through TM technique is given a recent solution of rapid and exactly detection of meat Halal. Therefore, A total of 90 frozen kofta, oriental sausage and Hawash samples (30 of each) from different grades were randomly collected from different markets in Damietta city, Egypt for evaluation their adulteration with pork. The results revealed that the kits did not detect any adulteration of all kofta and oriental sausage samples with pig species. On the other hand, one Hawash sample was adulterated with pig species. The meat Flow Through™ kits are user-friendly and robust on-site tests that effectively identify low levels (<1%) of meat species adulteration in raw meat products within a timeframe of under 15 minutes. Their implementation can significantly reduce time and costs for factory laboratories while providing assurance regarding the integrity of raw materials and finished products. In conclusion, all precautions of proper sanitation during manufacture, handling and storage of meat products should be adopted to control adulteration and to obtain a maximum limit of safety to consumers.

Keywords: Meat; Adulteration; Kofta; Sausage; Hawawshi

1. Introduction

Adulteration is a serious meat safety and quality issue which becomes the focus of attention for the food industry and consumers in the last few decades [1]. The high price of meat and passiveness of consumer safety warranty further encourage the sellers to substitute components with other replacers in the manufacturing of meat products [2]. The meat products adulteration can take many forms such as complete or partial omission or substitution of valuable constituents with undeclared alternatives to increase product bulk or weight or to make the product appears of better value than it is [3].

The occurrence of food adulteration is a major issue in the food industry, and is causing concerns among costumers and food manufacturers. One of the major authenticity issues of food product involves the alteration of the true labeling of food ingredients whereby high value raw materials are substituted by cheaper materials [4].

Historically, for Muslim consumption meat was not widely associated with adulteration and this could be attributed to the fact that it was sold fresh at easily recognizable joints [5]. Muslim Halal (purification) law requires food and non-food products free from pork and its derivatives. The Halal food can easily make up to 20% of world trade in food products as Muslims are expected to represent 30% of the world's population by the year 2025 [6].

The Halal food market currently accounts for as much as 12% of the global trade in agro-food products [7]. Muslims follow strict dietary laws enshrined in the holy Quran. To obtain halal meat, the animals must be of halal (acceptable) species and slaughtered using the Islamic method (halal slaughter). Additionally, the product must not contain any

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haram ingredients and contamination with haram meat should be avoided during the manufacturing process. Consuming haram materials and utilizing them as food additives or adulterants are prohibited as well. This is made abundantly evident in numerous Quranic verses. For instance, in Surah al-Maidah, Allah states: The following are forbidden to you: carrion, swine blood and flesh, anything over which the name of another deity is invoked, anything strangled, anything killed by beatings or falls from a height, anything killed by horns, anything consumed by wild animals, and anything that has been burned to idols unless you have cleaned it properly and legally while it is still alive [8].

Although the Quran mentions only the flesh but the pig derivatives and by-products are also prohibited as well. This view is supported by al-Qurtubi in al-Jami' li Ahkam al-Qur'an which includes lard as a part of the meat [9]. In addition, Ibn Hazm al-Zahiri that furs and bones which are derived from pig are also haram to be consumed. Nonetheless, tanned pig skins are still acceptable. However, according to Ibn Hayyan and Dawood, the ban was only intended for meat and not for lard or its derivatives.

Some analytical techniques have been developed for food authentication studies because the identification and measurement of adulterants are crucial for safeguarding consumers' health and wealth. Techniques for these applications must be sensitive, quick, economical, specific, and able to examine samples with a variety of morphological traits [10].

Recently, different rapid methods with high sensitivity and specificity have been developed to overcome the limitations of conventional methods for the detection and identification of food adulteration. Therefore, this study was carried out to investigate the use of Meat FlowThroughTM technique to detect and to quantify the presence of pork in some traditional meat products.

2. Materials and Methods

2.1. Sample Collection

A total of 90 frozen kofta, oriental sausage and Hawawshi samples (30 of each) from different grades were randomly collected from different markets in Damietta city, Egypt. The samples were first examined apparently for their expiry date then packed in a plastic bag in an ice-box and transferred without delay to Laboratory of meat hygiene Department of Hygiene and Control, Faculty of Veterinary Medicine, Suez Canal University for evaluation. The samples were kept in a frozen state till the performance of analysis. Samples thawing was completed over night in a refrigerator at 4ºC for 8-10 hrs.

2.2. Detection of Meat Adulteration by Meat Flow Through TM Test

The Raw Meat FlowThroughTM Test (RMFT) is a simple qualitative test offers an ideal testing solution for on-site determination of species by visual inspection with a limit of detection 1%. It is simple and quick to be performed, required no additional equipment and all reagents were pre-dispensed. It is available in the form of packs for five different meat species including cow, horse, pig, poultry and sheep. Specific kits were imported from United Kingdom, Bio-Check Company, the pork specific kits (Catalouge no. R6058).

2.3. Sample extraction

The meat sample scoop was filled with a portion of the sample (0.50g). The cap was removed from the yellow extraction solution tube and the sample was added by slowly applying downward pressure on the handle. Then the tube was recapped. The extraction tube was vigorously shaken for 1 minute. The cap was removed from the yellow extraction solution tube and the separation disc was placed into the tube so as it was level and flush with inside walls. The disc was carefully pushed down into extract using scoop handle to separate liquid from meat paste.

2.4. Sample evaluation

The upper bulb of a clean self-measuring pipette was tightly squeezed. The pipette tip was inserted into the liquid sample extract above the disc and slow pressure was released on the bulb until the solution overfilled the pipette tube into the lower bulb. The cap was removed from the diluent liquid tube and the pipette tip was inserted into it with squeezing the upper bulb to add the extract to the diluent tube. Diluent tube was recapped and gently inverted several times to mix. RMFT unit was removed from the pouch. The cap from the diluent tube containing extract was removed and the diluted extract was carefully added to the well of the RMFT unit. About 5 minutes were waited until diluted extract was completely absorbed in to the RMFT unit. Any particulates and liquid on the test area surface and around

the rim of the RMFT unit well were gently removed by using both ends of a clean cotton bud. The cap was removed from the pink colour reagent tube and the contents were carefully added to the well of the RMFT unit. About 5 minutes were waited until the pink color reagent was completely absorbed into the well of the RMFT unit. The appearance of a clearly visible, pink Test spot on the left of the test area (T) indicates the presence of meat at about 1% or more in the sample being tested. A pink control spot of medium intensity should always appear on the right hand (C) side of the test area; this indicated that the extract was suitable, the test had been performed correctly and all reagents are functional. If a control spot did not appear, the result was invalid and should be repeated.

2.5. Statistical analysis

Data obtained was subjected to statistical analysis using computer program system [11]. Means were compared using least significant difference (LSD). Correlation coefficients between several data were analyzed.

3. Results and Discussion

The ongoing rise in the prices of commercial meat products, coupled with the globalization of the meat trade and the growing trend of processing meat into various value-added products, has led to an increase in instances of adulteration and fraud [5]. Consequently, assessing the quality of meat products and identifying the species of meat have become critical concerns for consumers, vendors, and government agencies [12]. These efforts are essential for protecting public health, supporting consumer lifestyles, ensuring food choices align with religious beliefs, and promoting a fair-trade economy [13]. The increasing number and severity of food poisoning outbreaks worldwide has considerably increased public awareness about food [14].

The Meat FlowThrough™ speciation test utilized in this research represents an innovative solution tailored for implementation in meat processing facilities and smaller food analysis laboratories. This test is characterized by its simplicity and ease of use, requiring no supplementary equipment for execution. It is also notably efficient, typically completing in approximately 12 minutes. The test operates on the principle of enzyme-linked immunosorbent assay (ELISA), employing highly purified antibodies to identify species-specific animal serum protein (albumin), which is present in significant quantities in raw meat. Furthermore, the test demonstrates high sensitivity, having been validated for detecting adulteration in raw meat products at a threshold of around 1%, with this detection limit corroborated by the Laboratory of the Government Chemist (LGC) Reference Materials (Bio-Check, United Kingdom). Additionally, it exhibits exceptional specificity, with no known instances of false positives.

Table 1 Application of Pork Specific Kits of Meat Flow Through™ Test for Detection of Kofta Adulteration with Pork

Kofta	**No.**	**%**
Positive Samples	0	0
Negative Samples	10	100

Raw pork Meat Used as Positive Control | Examined Kofta samples

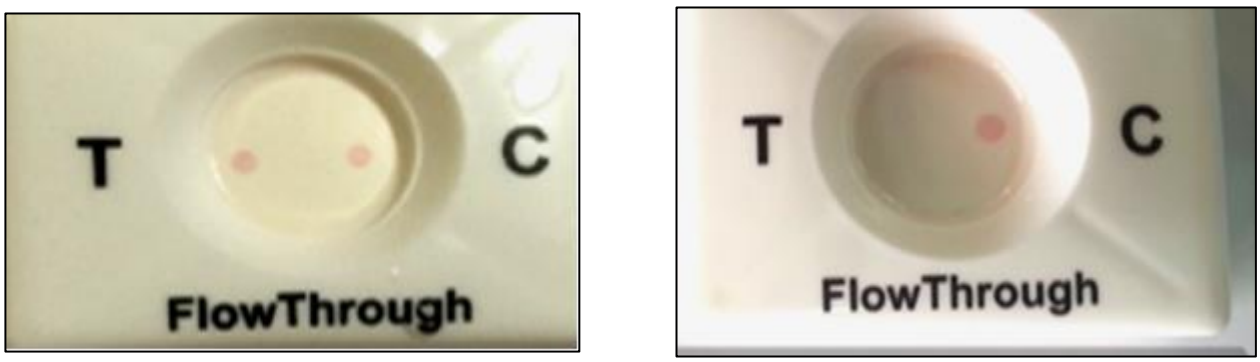
Figure 1 Flow Through ™ Test for Detection of Kofta Adulteration

With respect to the presented results, table 1 and figure 1 showed the application of pork specific kits of Meat Flow Through TM Test for detection of kofta samples adulteration with pig species. The results revealed that the kits did not detect any adulteration of all kofta samples with pig species. The findings indicate that these rapid tests demonstrated both reliability and speed in detecting meat species adulteration within a few minutes across various meat products. Furthermore, their exceptional portability allows for all necessary materials to be conveniently assembled into a single kit.

The results presented in table 2 and figure 2 showed the application of pork specific kits of Meat FlowThroughTM Test for detection of oriental sausage samples adulteration with pig species. The results revealed that the kits did not detect any adulteration of all oriental sausage samples with pig species.

Table 2 Application of Pork Specific Kits of Raw Meat Flow Through TM Test for Detection of Sausage Adulteration with Pork

Sausage	**No.**	**%**
Positive Samples	0	0
Negative Samples	10	100



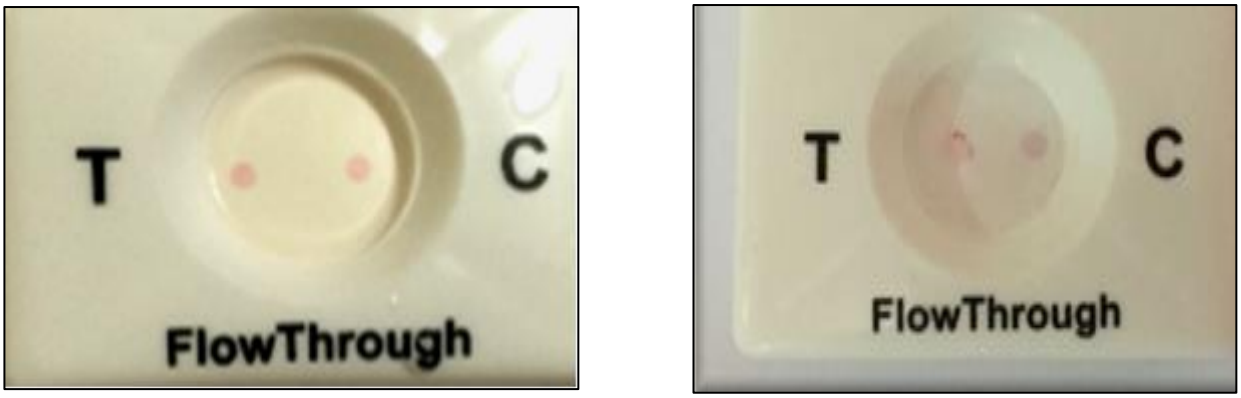
Raw pork Meat Used as Positive Control | Examined Sausage samples

Figure 2 Flow Through TM Test for Detection of Sausage Adulteration

Moreover, the results presented in table 3 and figure 3 showed the application of pork specific kits of Meat FlowThroughTM Test for detection of Hawawshi samples adulteration with pig species. The results revealed that the kits detect adulteration of one Hawawshi sample with pig species.

Table 3 Application of Pork Specific Kits of Meat FlowThrough™ Test for Detection of Hawawshi Adulteration with Pork

Sausage	No.	%
Positive Samples	1	10
Negative Samples	9	90



Raw pork Meat Used as Positive Control

Examined Hawawshi samples

Figure 3 Flow Through™ Test for Detection of Hawawshi Samples Adulteration

In light of the current research, it has been suggested that commercial processed meat products can undergo on-site testing for the detection of adulteration. Only those products that yield positive results from the testing kit will be sent back to the laboratory for confirmatory analysis [15]. This approach can enhance the efficiency of quality control measures for meat products, allowing for rapid routine assessments. Moreover, the improved precision of the employed methods will foster greater confidence in the safety of these products within international trade and will provide credible evidence in cases of suspected adulteration [16]. Furthermore, any inadvertent low-level contamination of one type of meat product with another during processing and handling can be managed and regulated by authorities through regular monitoring procedures at all stages, from primary production and processing to the final points in the supply chain [17].

The meat FlowThrough™ kits are user-friendly and robust on-site tests that effectively identify low levels (<1%) of meat species adulteration in raw meat products within a timeframe of under 15 minutes. Their implementation can significantly reduce time and costs for factory laboratories while providing assurance regarding the integrity of raw materials and finished products. Furthermore, these kits will empower meat inspectors and regulatory agencies to manage and control meat product adulteration more efficiently through prompt and effective decision-making, thereby mitigating the spread of the issue and enhancing efforts for its eventual eradication. Nonetheless, there is a necessity to expand the range of detectable animal species to encompass the majority of animals commonly involved in adulteration.

4. Conclusion

In light of this context, the present study has the potential to enhance the implementation of rigorous quality controls for meat products on a regular basis, thereby ensuring the production of high-quality and safe products within the meat industry, as well as safeguarding public health. Furthermore, it can improve transparency in the local market, which will likely bolster public trust in the meat supply chain, potentially sustaining or even increasing the demand for processed meats. Hygiene plan in slaughterhouses and in cutting and meat preparation companies are crucial. The possibility of contamination of meat products with such serious pathogen remains a public health hazard. Thus all precautions of proper sanitation during manufacture, handling and storage of such meat products should be adopted to control these serious pathogens and to obtain a maximum limit of safety to consumers.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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