Novel probes array-based method for the authenticity of meat and meat products

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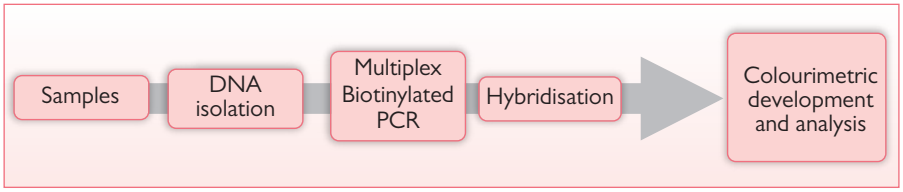

Fig. 1. Meat authenticity workflow.

The issue of meat adulteration is currently a problem for domestic and international trade. The Food Safety Requirements set out under the General Food Regulation 178/2002 deem food unsafe if it is injurious to health or unfit for human consumption with regard to normal conditions of use and information provided to the consumer (The European Parliament and The Council of the European Union, 2002).

More than 10 million beef burgers and other beef products were withdrawn from supermarkets throughout the UK, following the discovery that they contained horsemeat, as well as meat from pigs. In 2013 the discovery of horsemeat in processed beef products sold by a number of UK supermarket chains also resulted in a series of product recalls and threw the spotlight on the food industry's supply chain.

In addition, horse DNA was found in up to 5% of beef product tested across the EU, according to results published by the European Commission (BBC, 2013).

Moreover, The Food Standards Agency (FSA) was set up in 2000 by the then Labour government following numerous public health crises and epidemics including BSE (mad cow disease).

The essential role of the FSA has been to defend and promote the interests of the food and drink companies that comprise the largest manufacturing sector in Britain (Food Standards Agency, 2000).

Therefore, meat authenticity is necessary to prevent wrongful adulteration, to provide assurance for religious requirements, and to provide information about allergens and food product safety. At present a method has been developed using probe array-based techniques for the rapid detection and identification of seven types of meat including cow, pork, chicken, horse, buffalo, sheep and goat. This method relies on the DNA hybridisation between DNA target and specific probes.

Principles of method

Probes array-based method for meat authenticity employs the following principles: the genomic DNA of meat is extracted from specimens by the salting-out method and the target genes (cytochrome b gene) are replicated using multiplex biotinylated PCR amplification technology.

The amplicons are hybridised with specific probes, which will be spotted on the polymer chip in optimum conditions (hybridisation temperature, incubation time and concentration of amplicons).

After hybridisation, stringent washing removes non-target DNA fragments and residual amplicons.

Subsequently, colorimetric development is applied by using biotinylation activity. The result will show as a black spot on the chip depending on which meat is presented in the specimen.

The sequence of probes immobilised at each location, and the identification patterns will then form on the polymer chip depending on which meat is present in the specimen (Fig. 2).

From the results under a validation scheme, probes array-based method showed a highly specific 100% accuracy with 24 meat species tested (cow, buffalo, pig, horse, goat, sheep, chicken, duck, ostrich, crocodile, deer, salmon, white perch, grouper, tilapia, cuttlefish, loligo, octopus, oyster, abalone, mud clam, shrimp, swimming crab and mud crab) and highly sensitive (0.1%w/w of DNA and detection limit is 0.1 ng of DNA).

Moreover, a total of 14 commercial products (sausages, meatballs, soups, pet foods and seasonings) were analysed by probes array-based method, the result showed 100% accuracy for meat identification with the ingredient labelling of each commercial product.

The probes array-based method is the most reliable and accurate method in that it provides fast detection for multi-target of seven species meat authentication.

Hence, the probes array-based method can help track sources, prevent and manage contaminated meat in the food production facility more effectively. ■

References are available from the author on request

Fig. 2. Identification pattern and interpretation of seven species of meats: cow, buffalo, porcine, horse, goat, sheep and chicken.