

On-Site DNA Testing for Species Authenticity in Food and Natural Health Products

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Overview

- Species authenticity remains a critical component of food authenticity and integrity
- DNA testing offers a range of effective solutions for identifying species, but field-testing options are lacking
- Identifying mislabelling of food and natural health products is often time-sensitive
- Real-time PCR can be used on-site for ingredient authentication:
 - Simple kits (90 minutes or less)
 - Hand-held instrumentation
 - Online data management
- Seafood and Natural Health Product (NHP) tests available
- TRU-ID offers custom test creation and product certification

Introduction

Authenticity of food and natural health products remains a risk to businesses and consumers. Yet the complexities of the global supply chain make it increasingly important, and difficult, to ensure the authenticity of products on the market. In many cases, authenticity of ingredients is a matter of species identification. In these cases, DNA testing can often be used to identify species contained in a product and provide a measure of authenticity. However, these tests can be labour-intensive and costly. In addition, samples must often be sent to an appropriately equipped facility and results can be difficult to interpret for non-experts. Real-time PCR provides a potential solution to these issues for authenticating species in food and natural health products.

Methods

Seafood and NHP represent two general categories where product mislabeling has been detected and covered heavily by media, where new regulations for product authenticity are emerging, and where on-site species identification could help combat fraud. To provide an on-site test for DNA authenticity testing, minimal equipment must be used for DNA extraction, and a portable thermocycler is required. In addition, results output should be simple to interpret. These criteria ensure testing can be conducted by non-experts with minimal training, without compromising test efficacy or results. Biomeme offers simplified, equipment-free protocols for DNA extraction as well as a portable real-time PCR instrument suitable for on-site DNA testing. These were tested with real-time PCR assays for various seafood species. A modified DNA extraction protocol was also developed for rapid DNA extraction from plant tissue, which was subsequently used in combination with real-time PCR assays for key commercial species of NHP. All assays were tested on multiple individuals of the target species, and multiple non-target species to ensure specificity. In addition to the Two-Three device, all assays were tested on the LightCycler (Roche) and SmartCycler II (Cepheid) at the University of Guelph to confirm test performance on multiple instruments.

Results



Figure 1. Steps for simplified DNA authenticity. Samples are taken from seafood or NHP using sterile, disposable tweezers or swab, subjected to a 5-10 minute DNA extraction protocol and added to the corresponding species-specific real-time PCR assay. Lyophilized reagents and a hand-held instrument allow field-testing in less than 90 minutes. Results are displayed on the instrument showing presence or absence of the target species, and are automatically uploaded to a secure web portal for additional analysis.

The Biomeme DNA extraction protocol successfully extracted DNA suitable for real-time PCR analysis from all seafood products including canned, smoked and filleted fish. A modified version of the DNA extraction protocol was developed for extraction of plant DNA that was used on leaves, roots and plant powders. Species-specific real-time PCR assays were developed for several species of seafood and natural health products that, along with the DNA extraction protocols, results in a rapid, robust and cost-effective means for on-site DNA testing. These tests are suitable for product screening for species authenticity as a preliminary fraud detection tool to either confirm authenticity, or test for the presence of known adulterants. Future iterations of test kits will include quantification capability. The Biomeme real-time PCR machine allows for simplified data interpretation and exportation of data to an online web portal for further analysis.

Conclusions

On-site testing capacity with commercially available kits and online data management allow retailers, suppliers and regulators to easily conduct species authenticity testing of ingredients including seafood and raw NHP without shipping samples away for analysis. This can help combat food fraud throughout the supply chain. Test results can be used to meet regulatory requirements, as a measure of supply chain risk management and as a brand differentiator in the market. Testing and product certification are available through TRU-ID.

