Horse meat in beef products and adulteration of gadoid fish meat products in the Czech Republic

Veronika Kýrová[1], Vladimír Ostrý[1], Pavla Surmanová[1], Ivana Procházková[1], Irena Řehůřková[1], Jiří Ruprich[1], Marie Jechová[2]

[1]Center for Health, Nutrition and Food
National Institute of Public Health
Brno, Czech Republic
[2]Regional Public Health Authority of the Central Bohemian Region in Prague
Prague, Czech Republic

Abstract

Food fraud of meat species is becoming a widespread problem. Statistics show that food fraud of meat is on the rise. This study focuses on the possible authenticity of horse meat and gadoid fish using the polymerase chain reaction. The presence of horse meat was determined in 7 samples of beef meat products (9.2%). Analysis of samples of sea fish focused on the detection and identification of gadoid fish. A total of 46 samples were declared to be gadoid fish which was confirmed in 43 cases (93.5%). Two samples were identified as hake (*Merluccius* sp.) and one sample was not determined.

Adulteration, beef meat, food safety, fraud, gadoid fish meat, horse meat, PCR

Introduction

The horse meat scandal made headline news across Europe and even further afield, in 2013. The story that horse meat was being passed off as beef exposed the complex nature of our globalised food supply chain. The gathered evidence did not point to a food safety or public health issue, but rather an issue of fraudulent labelling (Walker et al. 2013). Food fraud of other meat species is becoming a widespread problem and, as a result, the meat industry has begun to impose strict criteria in order to introduce effective traceability systems that would help maintain food safety and quality from farm to table (Shackell 2008; Golian and Mašlej 2014). Horse adulterations were solved in 78 cases by the Rapid Alert System for Food and Feed – European Commission – Health and Food Safety RASFF in 2013 – 2016 (RASFF 2016). The current easy accessibility of information encourages consumers to be more attentive to the identification of meat species and the origin of the meat they eat (Kamruzzaman et al. 2012; Golian and Mašlej 2014).

The globalisation and complexity of the seafood trade creates opportunities for fraud. Consumers are routinely given little or no information about the sea fish and seafood they eat. This can occur through transhipping, sea transfers and the falsification of trade documents. Mislabelling can even threaten public health. Sea fish and seafood fraud is also a global problem (Spink and Moyer 2011; Pramod et al. 2014). The Rapid Alert System for Food and Feed – European Commission – Health and Food Safety (RASFF) solved 105 sea fish fraud cases and fraudulent health certificates in 2000 – 2016. The table summarises recent RASFF news from 2015 to the present (Table 1).

Economically motivated adulteration (EMA) of food is the intentional adulteration of food for financial advantage. EMA also has the potential to result in serious public health consequences (Everstine et al. 2013). Authentication methods can be categorised into the areas where fraud is most likely to occur: meat origin, meat substitution, meat processing treatment and non-meat ingredient addition (Ballin 2010). Meat and meat product authenticity investigations based on protein analysis employ electrophoretic, enzymatic, and chromatographic methods, sometimes supported by the mass spectrometry technique.

Address for correspondence:
Ing. Veronika Kýrová, Ph.D.
Center for Health, Nutrition and Food
National Institute of Public Health
Palackého 1946/1, 612 42 Brno, Czech Republic
Phone: +420 515 577 523
E-mail: kyrova@chpr.szu.cz
www.maso-international.cz

Species identification is based on the polymerase chain reaction (PCR), due to their high specificity and sensitivity (Hargin 1996; Montowska and Pospiech 2010; Sentandreu and Sentandreu 2014; Kumar et al. 2015; Orduna et al. 2015).

This study focuses primarily on the authenticity of horse meat and gadoid fish using a DNA-based method.

Table 1. Fish fraud / substitution in RASFF 2015; RASFF classification - news (RASFF 2016)

Date of case	Country	Subject
6.2.2015	Czech Republic	Suspicion of adulteration of Alaska Pollock (*Theragrachalcogramma*) from Poland
29.4.2015	Czech Republic	Suspicion of adulteration (fish meat content was 66%) of frozen tilapia fillets (*Oreochromis niloticus*) from China
6.7.2015	Italy	Substitution of fish species *Epinephelus costae* (GoldblotchGrouper) from Senegal
6.7.2015	Italy	Substitution of fish species *Epinephelus costae* (GoldblotchGrouper) from Senegal
8.7.2015	Czech Republic	Suspicion of adulteration of deep-frozen pangasius fillets (*Pangasiushypophthalmus*) from Vietnam
17.7.2015	Italy	Fraud (*Limanda Aspera* replaced with *Hippoglossoides* spp.) with frozen flounders from China
17.7.2015	Italy	Fraud (*Epinephelus costae* replaced with *Brotula* spp.) with chilled grouper (*Epinephelus costae*) from Senegal
19.8.2015	Slovakia	Adulteration (DNA sequence) of deep-frozen fish fillets labelled as Alaska Pollock substituted with hake from Estonia, via the Czech Republic
17.9.2015	Slovakia	Suspicion of adulteration (frozen hake *Merlucciusgayi* labelled as Argentine hake *Merlucciushubbsi*) of deep-frozen whole gutted Argentine hake from Ecuador, packaged in Slovakia
21.9.2015	Germany	Suspicion of fraud (incorrect species mentioned) in relation to frozen Unagi eel fillets (*Anguilla japonica*) from China

Materials and Methods

A total of 76 samples of beef products (e.g. kebab, beef meat, beef dish) and 46 samples of gadoid fish products (e.g. frozen sea fish fillets, sea fish products, sea fish meals and dishes) were collected from public catering and the retail trade in co-operation with the Regional Public Health Authority of the Central Bohemian Region in the years 2013 – 2015.

The DNA extraction

The samples were grounded in a Grindomix GM 200 electric mill (Retsch, Germany). The DNA was extracted from 25 mg of sample using a commercial UltraClean® Tissue & Cells DNA Isolation kit (Mo Bio Laboratories, Inc., USA) according to the producer's recommendations. The DNA quantity and purity were estimated by measuring the absorbance at 260 nm and 280 nm by means of a Helios Gamma spectrophotometer (Thermo Spectronic, Great Britain). Samples with ratios between 1.8 and 2.0 were used for the PCR.

Confirmation of species by qualitative PCR

Amplification of horse meat was performed using a commercial Ron HORSE Detection Kit – Extended (Bioron GmbH, Germany). Amplification of gadoid fish was carried out with a final volume of 25 µl of reaction mix containing 1x Combi PPP Master Mix (Top Bio, Czech Republic), 0.4 µM of primer set and 1 µl of the DNA.

A thermal cycler programme and gadoid universal primers designed by Aranishi et al. (2005) were used. The PCR products were verified by 2% agarose gel electrophoresis and visualised under UV illumination.

Results and Discussion

Identification of horse meat

The presence of horse meat was determined in 7 samples (9.2%) of beef meat products (6 samples of "beef" kebab and 1 sample of "beef" sirloin). In Mexico, 40 samples of uncooked commercial hamburger and Mexican sausage (chorizo) from local food stores were analysed. An undeclared equine species was detected in 14 samples (35%) (Flores-Munguia et al. 2000). The British Food Standards Agency released the results of 2 501 tests conducted on beef products, of which 29 contained more than 1% horse meat, its threshold for adulteration (Castle 2013). Kane and Hellberg (2016) analysed 48 samples of ground meat products sold on the U.S. commercial market for potential mislabelling. Ten samples were found to be mislabelled. Horse meat, which is illegal to sell on the U.S. commercial market, was detected in two of the samples acquired from on-line specialty meat distributors. These samples were labelled as ground bison and ground lamb meat.

Financial gain lies behind such fraudulent activity given that horse meat is much cheaper than other meats such as beef. Horse meat consumption does not pose any danger to the population if the animal is healthy, if it is slaughtered at a specialised unit, and if storage and marketing conditions are observed (Stanciu 2015).

The use of horse meat has been influenced by the availability of food, needs, tradition and religious resources. Legally, horse meat consumption has been banned in Europe only in Norway, Iceland and Sweden. In Central Asia, horse meat is part of the traditional diet, while some European and African regions consider horse meat a delicacy (Garifulovich et al. 2013, Stanciu 2015).

Identification of gadoid fish meat

Analysis of samples of dishes and products from sea fish focused on the detection and identification of gadoid fish. These samples were either frozen sea fish fillets, sea fish products (cod liver in oil, smoked fish, fish spread and fish fingers) or sea fish meals (fried fish, roasted fish). Typical morphological features were not visible in these cases. A total of 46 samples were declared to be gadoid fish, and this was confirmed in 43 cases (93.5%). Two samples were identified as hake (*Merluccius* sp.), while the species of one sample was not determined.

Hubalkova et al. (2008) tested 81 commercial gadoid fish products by the conventional PCR method. These samples were either fillets or compressed blocks of meat. Of the total of 81 samples, 46 (56.8%) were declared as Alaska Pollock, 15 samples (18.6%) as blue whiting, 1 sample (1.2%) as Atlantic cod, 16 samples (19.7%) as gadoid fish and 3 samples (3.7%) as hake. Gadoid fish was confirmed in 44 samples (54.3%). Hake sp. was confirmed in 20 samples (24.7%), and a mix of gadoid fish and hake sp. was confirmed in 14 cases (17.3%). No gadoid fish or hake sp. was detected in 3 samples (3.7%).

Herrero et al. (2010) investigated 40 products (fresh, frozen, precooked and canned fish) labelled as cod (*Gadus morhua*). In 20% of the products analysed, the name of the species displayed on the label was not in agreement with the species contained as determined by genetic analysis.

The renaming and mislabelling of sea food remain a serious problem. A total of 39 samples (25%) of 156 cod and haddock products, randomly sampled in Dublin, were genetically identified as entirely different species from that indicated on the product labels, and were therefore considered mislabelled under EU regulations. These results indicate that the strict EU policies of seafood labelling have not been adequately implemented and enforced (Miller and Mariani 2010).

Conclusions

The mislabelling of meat, whether intentional or not, has been observed on the Czech market and in Czech catering facilities. The usual reasons of meat adulteration are economic reasons. Food fraud is a food industry issue. These results may be useful for effective control of adulterated consumer meat products and violations of labelling requirements.

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