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TRACEABILITY OF FARM ANIMALS, THEIR MEAT AND MEAT PRODUCTS

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Abstract

Traceability as applied to live animals and animal products, such as meat, has been used for several thousand years for commercial and breeding purposes. During the last decade concerns about the safety and quality of food increased at consumer level which includes the requirement for traceability. Numerous methods are available for the identification of farm animals at individual or population levels. However these methods are usually not standardised, therefore not validated, and this statement can be extended to meat and meat products. Beside the traditionally used methods recently introduced the microchip technique for the individual identification of live animals. Otherwise, identification of meat and meat products after slaughtering arise some problems at the levels of species, genotypes or individuals. Nowadays, among the methods for the identification of farm animal species, the widely used are the molecular methods, based on 12S rRNA, DNA and microsatellite (STR) markers. Other methods, such analysis of myosin light chain or analysis of mutations by sequencing of the melanocortin-1 receptor (*MC1R*) gene in pig and its analogue gene in poultry (*CMC*) also seems to be useful. A novel method, based on the ratio of stable isotopes of nitrogen and carbon ($^{15}N/^{14}N$; $^{13}C/^{12}C$).was also proposed for the identification of populations.
Keywords: traceability, meat, meat products, molecular markers

Gazdasági állatok, azok húsának és hústermékeinek nyomonkövethetősége

Összefoglalás

A gazdasági állatok azonosítását kereskedelmi, majd tenyésztési célból már sok ezer éve alkalmazzák. Az élelmiszerek minősége és biztonsága iránti igény az elmúlt évtizedekben egyre fontosabb kritériummá vált a fogyasztók részéről, amely magában foglalta a nyomon követhetőség iránti növekvő igényt is. Az állatfajok egyedi és populáció szintű azonosítására számos módszer áll rendelkezése. Ugyanakkor ezek a módszerek általában nem standardizáltak és validáltak és ez a megállapítás igaz azok húsára és az azokból készült termékekre is. Az egyedek azonosítására a hagyományos módszerek mellett újabban egyre inkább a elterjedtek a

mikrochip technikák. A vágást követően azonban a hús- és hústermékek azonosítása, akár az egyed, akár a faj vagy fajta szintjén, azonban számos problémát vet fel. Az állatfajok azonosításra alkalmazott módszerek közül napjainkban leginkább a molekuláris módszerek terjedtek el, amelyek a 12S rRNS vagy DNS alapú azonosításon és mikroszatellit (STR), markereken alapulnak. Egyéb módszerek, így például a miozin könnyű lánc elemzésén alapulók, vagy sertésnél a melanocortin-1 receptor (*MC1R*) génben, baromfi fajoknál pedig ennek analógjaiban a *CMC* génekben kimutatott mutációkat is alkalmasnak tűnnek az azonosításra. A populációk azonosításra új módszerként javasolták a nitrogén ($^{15}N/^{14}N$) és a szén ($^{13}C/^{12}C$) stabil izotópjai arányainak mérését is.
Kulcsszavak: nyomonkövethetőség, hús, hústermékek**,** molekuláris markerek

Introduction

Traceability as applied to live animals and animal products, such as meat, has been used for several thousand years for commercial and breeding purposes. The oldest method for individual identification of animals with body markings was written in the Code of Hammurabi at 1800 B.C. Later, in the 13th century, swans of Kings of England were marked with individual indelible branding. From the 18th century in most of the European countries the contaminated or infected meat or hides which were unfit for trade or consumption covered with lime for identification. Slaughtering of different genotypes of beef (e.g. Hungarian grey), because of their different quality should slaughtered on different days in Germany (*Blancou*, 2001).

During the last decades, from the 1980s in the European Community, later in the European Union, concerns new concepts of quality of meat and meat products increased at consumer level. This new concept based on that the former requirement of quality, which was included only health and hygienic aspects (*McKean*, 2001), extended to sensory traits, animal welfare aspects of production, environmental management, special attention to some feed components (e.g. animal origin feeding stuffs or GM plants.) and also meat traceability (*Tomeš et al*. 2009)**.**

Based on these new requirements the European Union established regulations which are obligatory in all Member States, including identification of food producing animals, both flocks or individuals (*1760/2000/EC*, *1825/2000/EC*), and standardised the traceability for food of animal origin (*931/2011/EU*). According to this regulation all food business operators shall ensure that the following information concerning consignments of food of animal origin should be made available documentation on:

(a) An accurate description of the food;
(b) The volume or quantity of the food;
(c) The name and address of the food business operator from which the food has been dispatched – namely identification of the farm;
(d) The name and address of the owner if different from the food business operator from which the food has been dispatched;
(e) The name and address of the food business operator the whom the food is dispatched – identification of the slaughter house / meat processing firm;
(f) The name and address of the owner, if different from the food business operator to whom the food is dispatched;
(g) A reference identify the lot, batch or consignment, as appropriate;
(h) The date of dispatch.

Identification of individual animals

Numerous methods are available for the identification of farm animals at individual or population levels. Until the 1990s, the purposes of farm and animal identification were primarily related to implementation of breeding schemes and health programmes. Recently other aspects have been emphasised, especially in those countries where consumer demand has to led to the need to trace animals and animals products along the food chain (*Madec et al*. 2001). However these methods are usually not standardised, therefore not validated, and this statement can be extended to meat and meat products.

Most of the individual identification methods can be use only up to slaughtering, but those cannot guarantee the identification after is, such as ear tag for rabbits, pigs, sheep or cattle. In poultry species the individual identification is usually not possible (*Fallon*, 2001*)*, even if wing tags were used, therefore for poultry flock identification would be an alternative method, if separate slaughtering is possible.

Beside the traditionally used methods recently introduced the microchip technique for the individual identification of live animals, and also their products after slaughtering. However, wide distribution of this method is questionable because of the cost of microchip and its recover or re-use cannot be guaranteed.

Identification of meat and meat products of different species or genotype

Nowadays, among the methods for the identification of a particular farm animal species, the widely used are the molecular methods. For instance generally acceptable method for the species identification of milk and milk products is based on 12S rRNA, which has high species-specificity (*Zachar et al*. 2011). This method was also proposed to use for the identification of meat and meat products (*Wang et al*. 2010).

The DNA based methods, including tandem repeat sequences or microsatellites, such as short tandem repeats (STR) are suitable and accurate markers (*Butler*, 2001) for the identification of meat and meat products, because of the extreme high rate of polymorphism of STR, therefore high variety of differences can be identified using this method (*Dalvit et al*. 2008).

Another suitable method as biomarker for identification of meat and meat products is based on the identification of individual, species and/or genotype specific proteins with proteomic analysis and peptide mass fingerprinting. Limitation of using this method is that during the muscle to meat transformation process muscle cells undergo rigor mortis, and later, on the time scale of days, muscle fibre degradation occurs due to proteolytic enzyme activity and partly modifies proteins. Among the proteomic analysis method widely use the identification of the peptide sequences of myosin light chain. This method was found as accurate for the detection the presence of chicken meat in a mix with other types of meat, based on chicken specific peptide sequences (*Montowska and Pospiech*, 2013). The inter-species differences in myosin light chain isoforms allow to use this method as suitable for the identification the meat of different farm animal species, such as cattle, pig, chicken, turkey, duck and goose (*Montowksa and Pospiech*, 2012) but less accurate for identification of genotypes in the same species (*Montowska and Pospiech*, 2011).

Identification of myosin light chain isoforms is also typical for species, therefore it was possible to use for differentiation of bovine and river buffalo meat, therefore may be considered as marker to the traceability (*Picariello et al.* 2006):

Analysis of gene mutations of the melanocortin-1 receptor (*MIC1R)* gene, *extension*, with sequence variants and frequency of extension locuses was proposed for the identification of pig species (wild or domesticated) and also pig genotypes in meat and meat products (*Kijas et al. 1998).* Genotypes and alleles frequenciey of the *extension* locus of *MCI1R* gene was determined in eight cattle breeds and marked differences were found (*Rouzaud et al.* 2000). Its analogue gene in poultry (*CMC*), encodes colour of feather, was also suitable for the identification of different poultry genotypes (*Takeuchi et al.* 1997*).*

Based on the high differences in the allele frequencies among species and genotypes this method would be useful for the identification of live animals but also for meat and meat products.

Traceability of poultry and poultry products is possible only on individual flock basis. A perspective method for identification of flocks fed with different diets is to determine the ratio of stable isotopes of nitrogen and carbon ($^{15}N/^{14}N$; $^{13}C/^{12}C$) in feed and also in the animal products from the same flock. Those ratios can be determined accurately, and based on the results the population can be identify, both in the feed and in the animal products, such as meat or keel (*Móri et al*. 2007).

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