Determination of meat adulteration – a review

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INTRODUCTION

There were 10.5 million agricultural holdings in the EU in 2016 but farm numbers have been in steep decline for many years. • Most of the EU's farms are small in nature; two thirds were less than 5 ha in size in 2016. • EU farms used 173 million hectares of land for agricultural production in 2016, which is about 39 % of the EU's total land area. • About 246 000 farms had some organic area in 2016. This number was about one fifth higher than in 2013. • Organic farming covered 12.6 million hectares of agricultural land in 2017. • One quarter (25.1 %) of all the EU's farms were specialist livestock farms in 2016 and just over one half (52.5 %) were specialist crop farms. • Farming remains a predominantly family activity. • About 9.7 million people worked in agriculture in the EU in 2016. • Farmers are typically male and relatively old; 71.5 % of farmers were male in 2016 and only one in ten (10.6 %) were under the age of 40 years old in 2016. • EUR 59.0 billion was invested in agricultural capital in the EU in 2018, which was an estimated EUR 2.3 billion more than in 2017. • There are considerable variations in agricultural land prices and rents between and within Member States [1-3]

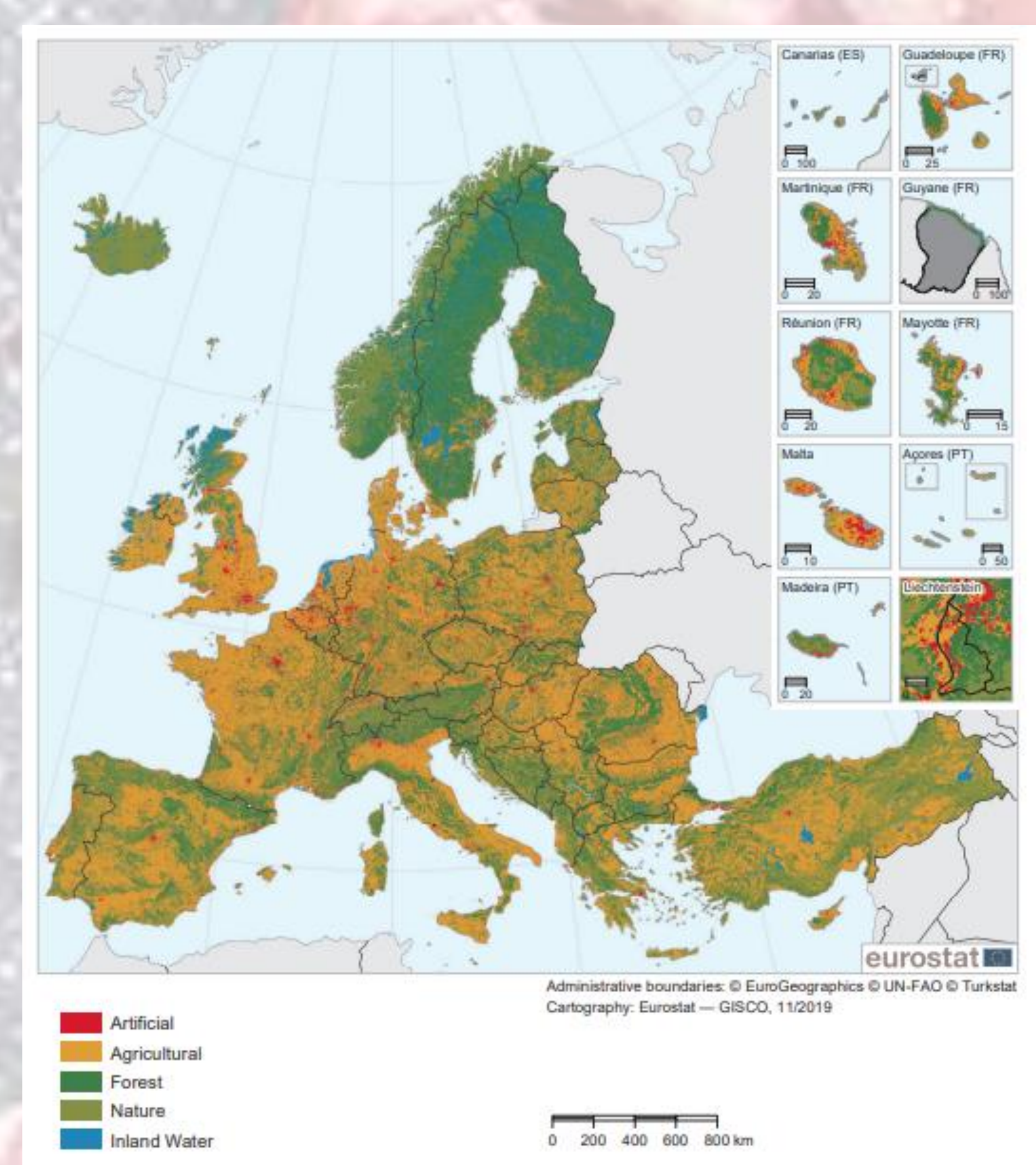

Fig.1 Land cover, EU-28, 2015 []

The EU has a substantial population of livestock: there were 148 million pigs, 87 million bovine animals and 98 million sheep and goats in 2018. The majority of livestock are kept in just a few Member States (see Figure 2). Three quarters of the EU's 2018 bovine population was kept in France (21.2 %), Germany (13.7 %), the United Kingdom (11.0 %), Ireland (7.5 %), Spain (7.4 %), Italy (7.2 %) and Poland (7.1 %). Almost three quarters of the EU's pigs were found in Spain (20.8 %), Germany (17.8 %), France (9.3 %), Denmark (8.5 %), the Netherlands (8.1 %) and Poland (7.4 %). Two thirds of sheep were in the United Kingdom (26.3 %), Spain (18.5 %), Romania (11.9 %) and Greece (9.9 %). Two thirds of the EU's goats were found in Greece, Spain and Romania. [3]

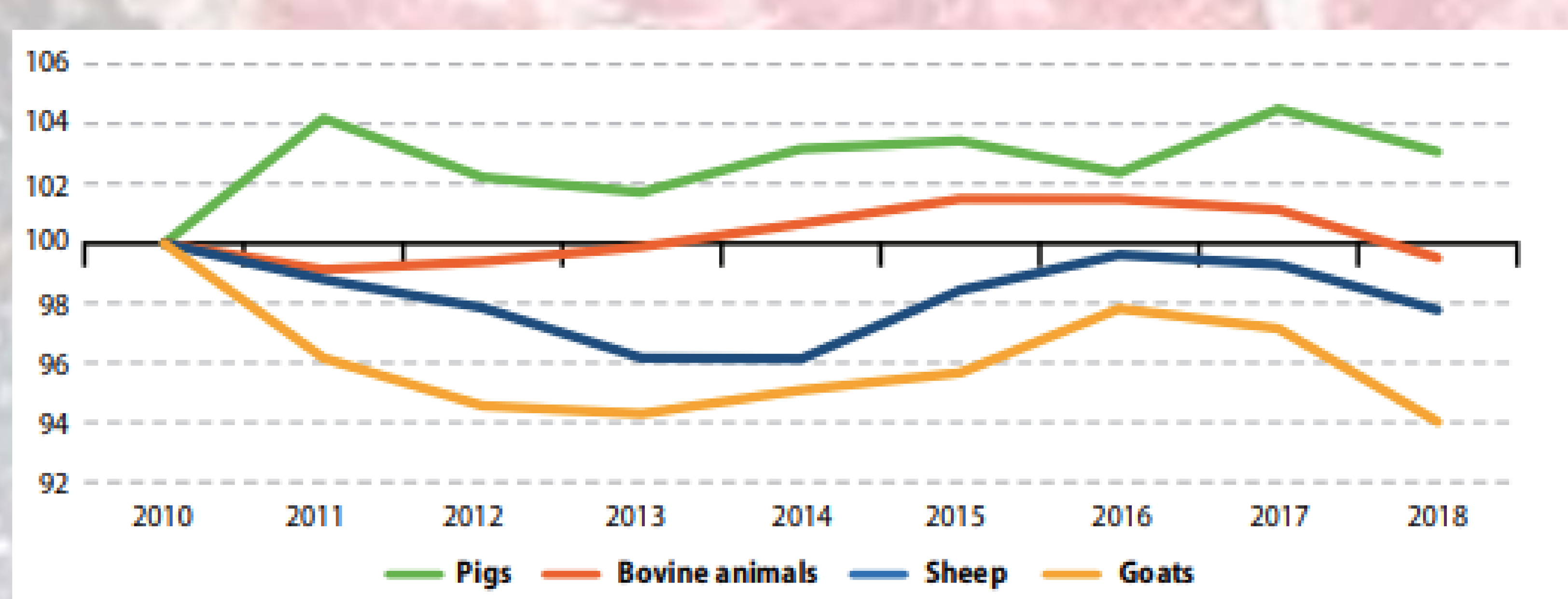

Fig. 2 Livestock population, EU-28, 2010-2018

DETERMINATION OF MEAT ADULTERATION

Adulteration occurs for reasons of economic gain, that is to say diluting a product with an undeclared cheaper ingredient. Adulteration therefore tends to be at significant levels to make an economic impact, typically at concentration levels of several percent.[3] Electrophoresis is the most commonly used technique for meat species determination. Protein bands can be visualized by simple non-specific staining, or by enzymological or immunological methods.

Ding & co, 2000, has developed a near-infrared spectroscopic technique for the detection of beef hamburgers adulterated with 5−25% mutton, pork, skim milk powder, or wheat flour with an accuracy up to 92.7%.[4]

The PCR reaction allows the in vitro enzymatic amplification of a specific region of DNA, located between two known DNA sequences, thus making it possible to multiply a single copy of the fragment of interest in over one million copies in just a few hours. The PCR technique is essential for many molecular analysis procedures: cloning of specific DNA fragments, detection and identification of genes for forensic diagnosis or investigation, analysis of gene expression patterns. In recent years, the PCR reaction has made it possible to initiate research in new areas such as: control of food authenticity, monitoring of GMOs, assessment of microbiological contamination. Ting Ting & co, 2019, has developed a novel reference primer based real-time PCR approach was developed in this study for quantitative determination of goat meat adulterated with pork. By calculating the ratio of Ct (specificity/reference), a good linear correlation (R2 = 0.9929) could be deduced for the goat meat content.

Ropode & co, 2015, has developed a multispectral imaging supported by multivariate data analysis for the detection of minced beef fraudulently substituted with pork and vice versa.

Cristina Alamprese, & co 2013, have investigated the potential of UV–visible (UV–vis), near infrared (NIR) and mid infrared (MIR) spectroscopy, coupled with chemometric techniques, to detect minced beef adulteration with turkey meat.

Alexander Leitner, & co, 2006, have used chromatographic prefractionation on the protein level by perfusion liquid chromatography to isolate peaks of interest from extracts of soybean protein isolate (SPI) and of meat products containing SPI. After enzymatic digestion using trypsin, the collected fractions were analyzed by nanoflow liquid chromatography–tandem mass spectrometry.

Chi-ChungChou & co, 2007, have developed a simple, rapid and reliable method based on high-performance liquid chromatography with electrochemical detection to routinely differentiate among meat products from fifteen food animal species. Samples from cattle, pigs, goats, deer, horses, chickens, ducks, ostriches, salmon, cod, shrimp, crabs, scallops, bullfrogs and alligators each exhibited unique electrochemical profiles.

CONCLUSIONS

In the context of the present global economic situation, due to the COVID-19 pandemic and the impact of climate changes nation authorities and experts are expected a rise in the price of food which will lead to an rise in the adulteration cases occurring. There are different methods for the determination of meat adulteration, especially beef by using other raw materials (like horse meat, pork meat) but there are no methods for the false claims regarding the free pasture/ free range claims, which are strong selling points for the consumers but very hard to control by the authorities.

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