Authent-Net: Food Authenticity Research Network

696371: Horizon 2020 Coordination & Support Action

Deliverable: D1.4

Title: **Food authenticity commodity status reports**

Beneficiaries: All possible users who have an interest in food authenticity

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Status: Final release

Dissemination level		
PU	Public	X
CO	Confidential, only for members of the consortium (including the Commission Services)	

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1. Description of Deliverable

This document represents deliverable D1.4 of work package 1 (WP1), of the H2020 project Authent-Net. The aim of the deliverable was to provide a list of member states (MS) commodity status reports (CSRs) outlining food authenticity state of the art for different commodities. Each CSR provides relevant commodity information regarding food authentication.

The relevant task description, according to the Description of Actions (DoA), is as follows:

T1.4. Develop commodity status reports

Reports, which are summarising an authentication status for a particular commodity on national and regional levels with reference to the lists generated in T1.1 and T1.2, will be produced. The reports will describe motivation and drivers, incident history, material and information flow, detection and validation methods (both analytical and paper-based methodologies) and technologies, databases, good practices and the potential for a technology transfer from one commodity type to another. All reports will use the same template that will be developed in consultation with funding organisations and industry. Within the project oils and fats, meat and seafood status reports will be issued and it is anticipated that other MSs and possibly industry will be interested in commissioning similar reports to develop a comprehensive European food authenticity capability map.

Lead: CSIC; contributors: Matis, IZSPLVA, UNIBO

2. Achievement of Deliverable

The CSRs were populated, based on a template delivered to each partner involved in the CSR delivery (see Milestone 4: Template for the commodity status report). The leader of each commodity shared the CSR within the consortium in order to collect a full account of relevant information on the respective commodity.

At this stage of the project (M14), three CSRs have been collected (Seafish, Beef and Olive oil). In addition to the three CSRs planned in the DoA, two other CSRs are still expected (Honey and Feed).

This document presents the content of the CSRs through screenshots of the contribution provided by the different commodity leaders, as presented at the mid-tem meeting held in Parma in 11-12 May 2017. The CSRs are accessible as annexes to this deliverable. The content will be extracted and converted for the FARNHub tool, accessible from http://farnhub.authent.cra.wallonie.be/ (See WP4 D4.1 and D4.2).

2.1 General information

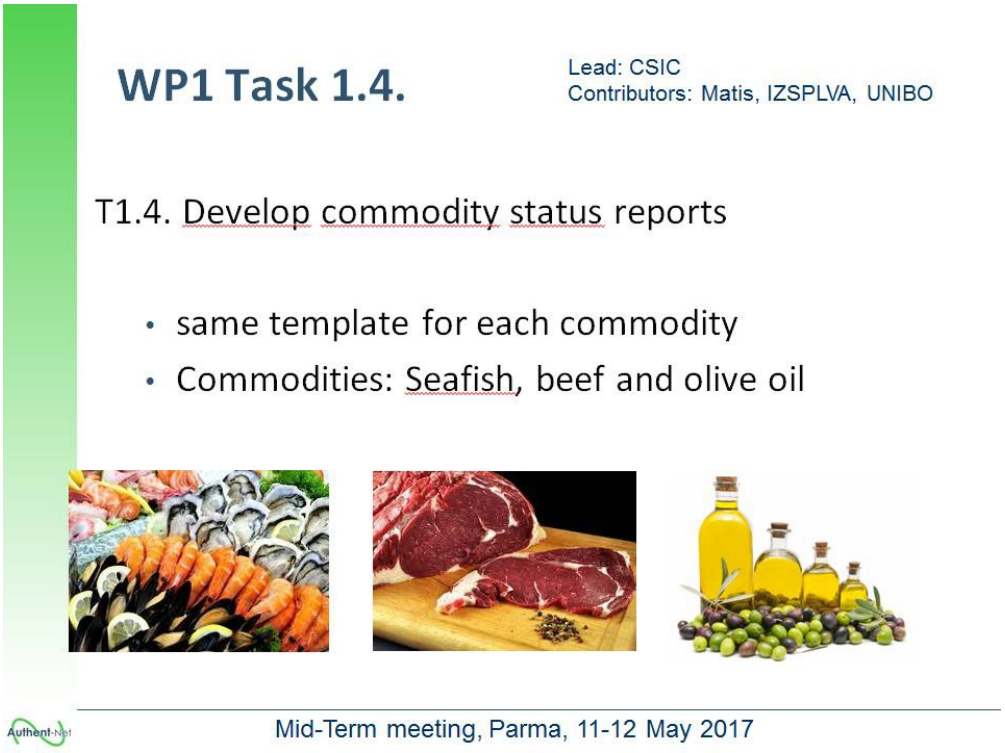


Figure 1: Screenshot of the CSR template: introduction.

2.2 State of the Art of the commodity

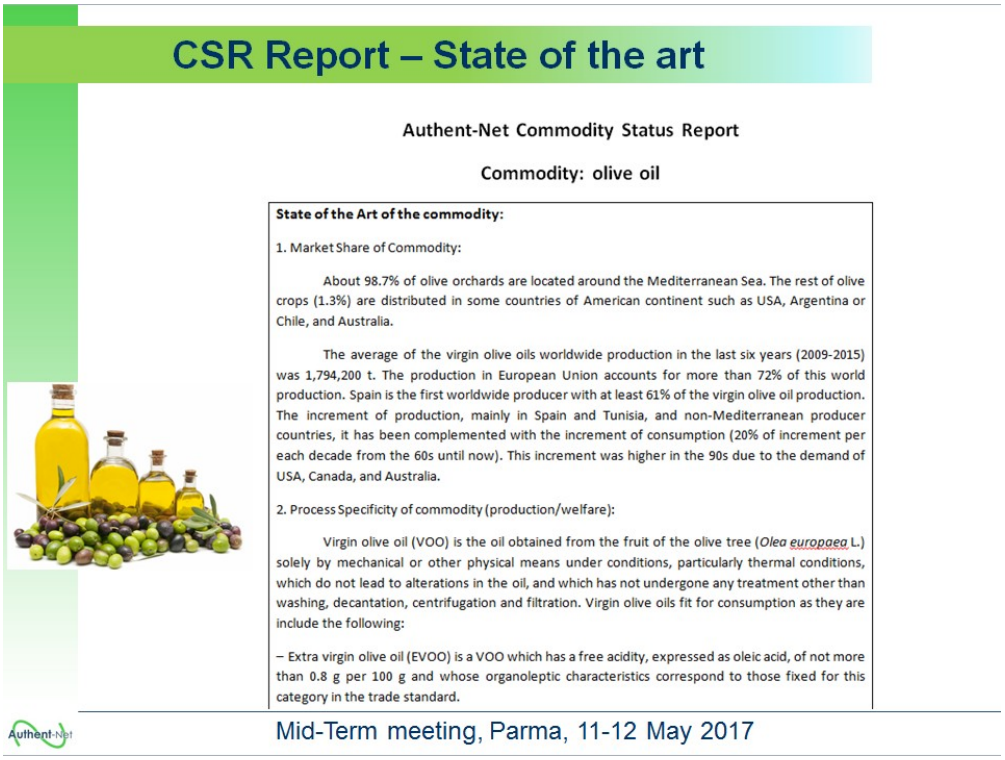


Figure 2: Screenshot of the CSR template: State of the Art (Annex 2: CSR Olive Oil).

2.3 Key known authenticity issues with the commodity

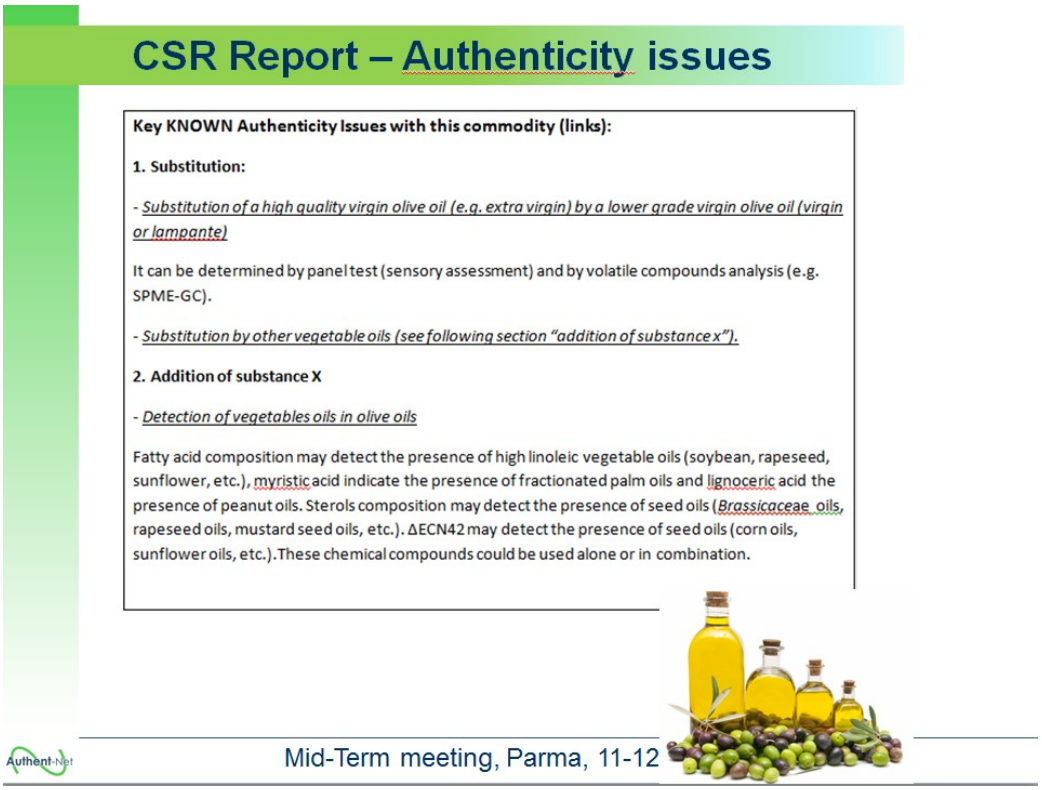


Figure 3: Screenshot of the CSR template: Authenticity issues (Annex 2: CSR Olive Oil).

2.4 Existing relevant information on methods

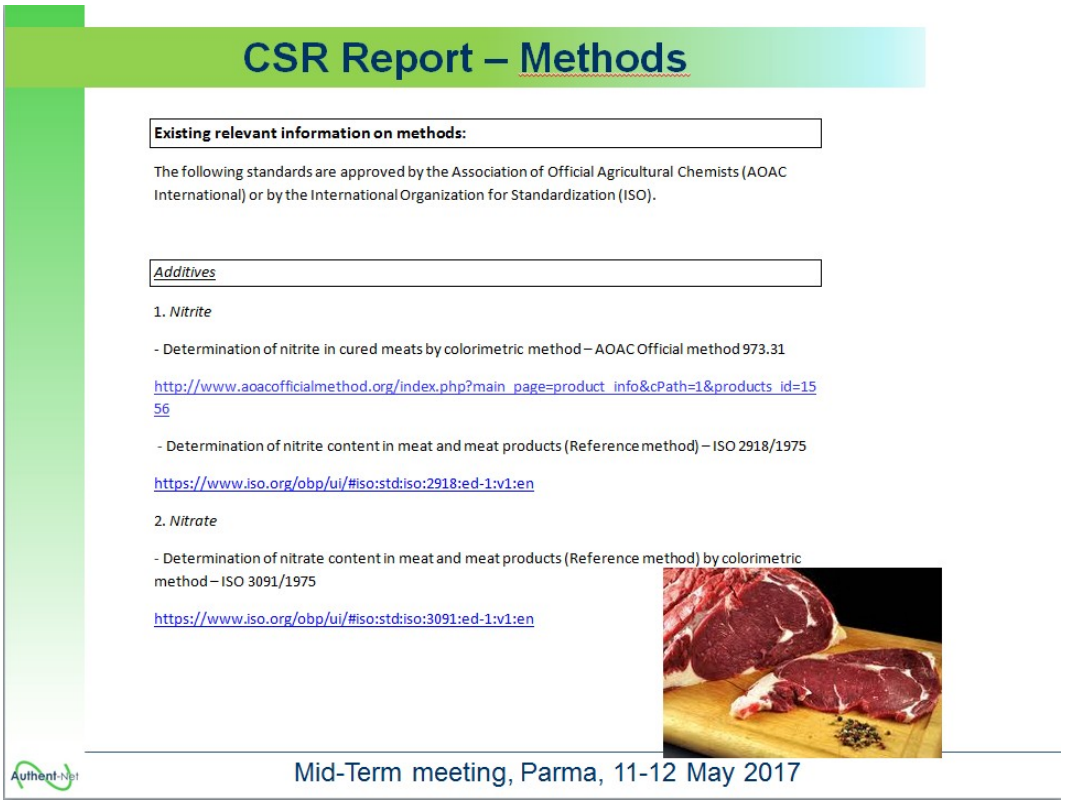


Figure 4: Screenshot of the CSR template: Methods (Annex 1: CSR Beef).

2.5 Official bodies / countries involved in control funding of this commodity

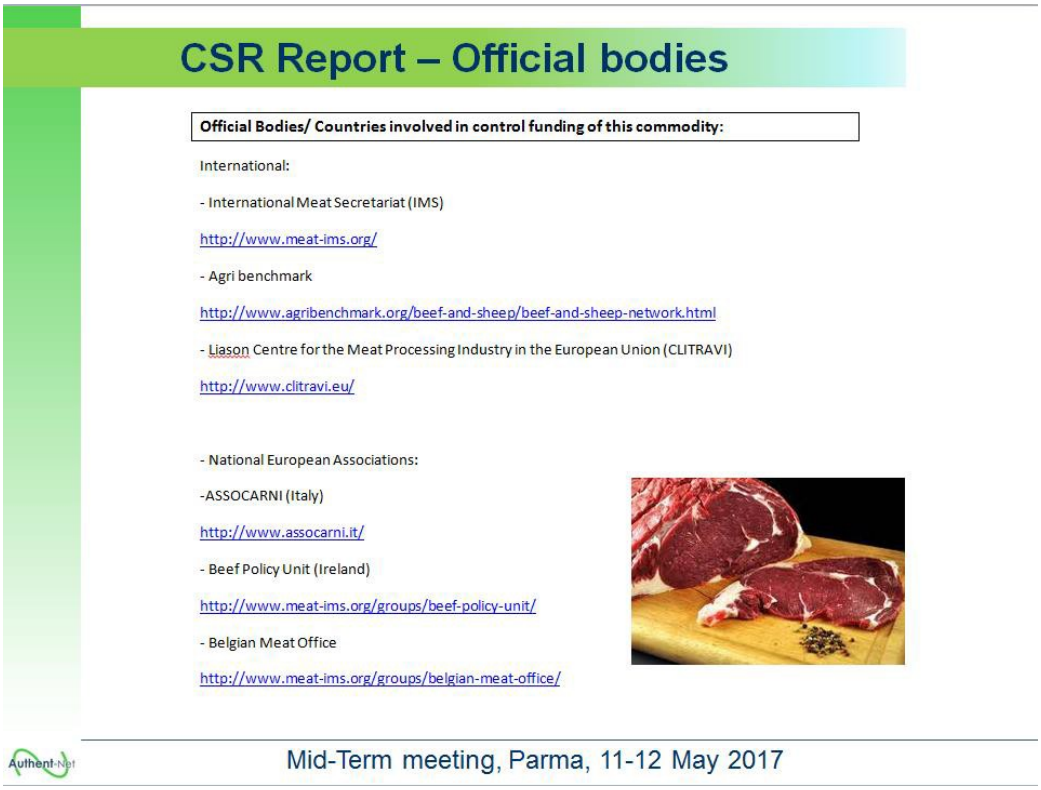


Figure 5: Screenshot of the CSR template: Official bodies (Annex 1: CSR Beef).

2.6 Gaps

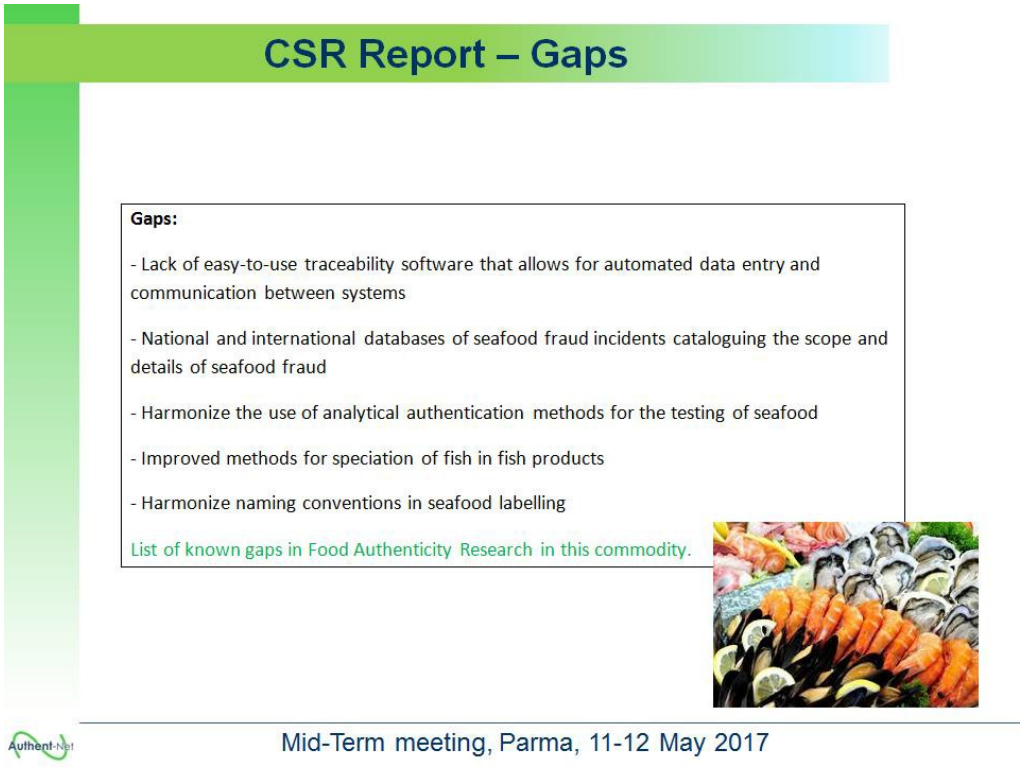


Figure 6: Screenshot of the CSR template: Gaps (Annex 3: CSR Seafood).

3. Annexes

Annex 1: CSR Beef
Annex 2: CSR Olive Oil
Annex 3: CSR Seafood

Annex 1

Authent-Net Commodity Status Report

Commodity: Beef

State of the Art of the commodity:

1. Market Share of Commodity:

In the last years, the world bovine meat production has been modestly increasing: in 2016 it is expected to reach 68.4 million tonnes, while in 2015 it was 67.9 million tonnes. The United States are the major bovine meat producing country in the world, with 11328000 tonnes (10815000 in 2015) that is the highest production in the last three years. The second producer is Brazil, with 9620000 tonnes (9425000 in 2015) which is encouraged in herd expansion thanks to the international trade, despite of a reduction in domestic demand. The European Union is the third beef producer (7876000 tonnes in 2016 and 7719000 in 2015), followed by China, India and Argentina.

In Europe, beef production increased by 3.4% year on year in the first half of 2015, thanks to milk cow slaughtering due to low milk prices and changes in milk producing system. The European countries where this growth was greater were: Hungary, Bulgaria, the Czech Republic, Estonia, Lithuania and Romania, because of the increase in the number of slaughtered heads and in carcass weight. However EU 15 countries (Belgium, Denmark, Germany, Ireland, Greece, Spain, France, Italy, Luxembourg, the Netherlands, Austria, Portugal, Finland, Sweden and the United Kingdom) maintained higher absolute changes in slaughtered beef volume than EU 13 countries (the Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia ,Slovakia, Bulgaria, Romania and Croatia), especially thanks to Italy, Spain, Austria, Belgium and Portugal, despite of a smaller increase in slaughtering percentage. On the other hand, Ireland, the Netherlands and the United Kingdom reduced the number of slaughtered animals to increase dairy herds. The growth in EU-13 countries slaughtering is referred to bulls and bullocks and confirms the trend to a rise of importance in beef production in certain EU-13 countries, despite of a shift from beef to dairy in other EU-15 countries. Therefore, the rise of production forecasted in 2016 compared to 2015 (2%) is mainly due to the culling of dairy cows, heavier average slaughter weights and retention of male dairy calves for meat production.

2. Process Specificity of commodity (production/welfare):

It is possible to distinguish between fresh and processed meat. Fresh meat is defined as meat without treatments different from chilling and freezing, while processed meat is a very broad category of many different types of products, all defined by having undergone at least one further processing or preparation step such as, i.e. grinding, adding an ingredient or cooking, which changes the appearance, texture or taste. The main classes of processed meat are described below:

- minced meat – boneless meat reduced in fragments which contains less than 1% salt;

- mechanically separated meat – obtained by removing meat from bones using mechanical devices that bring to the loss or modification of muscle-fibrous meat texture;

- meat preparations – fresh meat (including fragments), containing flavourings, additives or subjected to treatments that do not modify the muscle-fibrous texture;

- meat products – processed products derived from processed meat or further processing of other meat products subjected to treatments that modify the muscle-fibrous texture. There are many meat products produced in different countries, but it is possible to categorize them in six groups, considering the processing technology used:

1. fresh processed meat products – products that are composed of muscle mixed fragments with different amounts of animal fat. They are salted and small quantities of non meat ingredients are added to improve taste and binding. All ingredients are added fresh and some of these products are filled in casings. They are cooked or fried immediately prior to consumption (e.g. hamburgers).

2. cured meat products – products that are submitted to a curing process and they are treated with small amounts of nitrite. These products are divided in two groups:

- *cured raw meat*: products that undergo a process of curing, fermentation and ripening in controlled conditions without any heat treatment (e.g. raw cured beef);

- *cured cooked meat:* products that undergo a curing process and then they are submitted to heat treatment (e.g. cooked beef).

3. raw-cooked meat products – products composed of muscle meat, fat and non meat ingredients which are reduced in fragments, mixed and portioned before being submitted to heat treatment (e.g. meat loaf);

4. precooked – cooked meat products – products made of muscle trimmings, fatty tissues, head meat, animal skin, blood, liver and other edible parts mixed, which undergo two different heating processes: precooking of raw materials and cooking of the finished product mix (e.g. corned beef);

5. raw fermented sausages – uncooked meat products obtained by a mixture of lean and fatty tissues combined with salts, nitrite, sugars, spices and other non meat ingredients filled into casings. They are submitted to a fermentation process (drying and ripening) to obtain the typical flavour and they are consumed raw (e.g. salami).

6. dried meat products – lean meat that undergo a process of drying in natural or artificial conditions to prolong its shelf-life (e.g. dried meat strips or flat pieces).

3. Trade of Commodity:

In 2016 the world trade in bovine meat is expected to rise 1.3% compared to 2015 and to reach 9.3 million tonnes. Brazil is becoming the first exporting country for this commodity (1.8 million tonnes), by superseding India, that was the leader in world beef exports in 2014 and 2015. This trend is due to herd expansion, reduced domestic consumption and currency devaluation. India is forecast to maintain the second place with 1.7 million tonnes of bovine meat exported, despite of the competition from countries of South America. The third exporter is Australia, despite of a fall in output that has reduced exports by 10.5% compared to 2015.

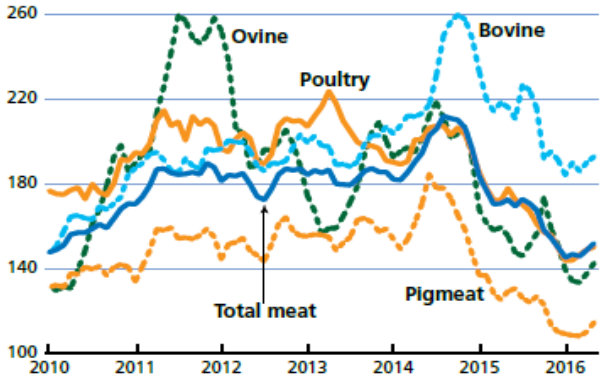
The United States are the forth beef trader with 1.1 million tonnes, rising by 6% from 2015 to 2016, after 3 years without growth in output.

Europe export quotes are expected to little increase compared to 2015, with 292000 tonnes; in 2015 Turkey and Lebanon were the main importers of European live animals.

Considering imports, in 2016 the expansion of demand from Asia (China, Malaysia, Iran, Korea), that would be mainly met by exports from South America, India and the United States accompanied by the recovery in imports from the Russian Federation, are expected to be the main drivers of growth in beef trade. China is becoming the first importer with 1.4 million tonnes. On the other hand, the United States have strongly reduced their purchases but remaining the second world importing country with 1.2 million tonnes. Moreover, imports by Vietnam, Japan and Egypt may modestly decrease, while those from Europe and Canada are remaining steady. In 2015 there was a minor shift in EU suppliers from Brazil and New Zealand to Argentina and the USA.

In 2016 world meat prices are reducing compared to 2014 and 2015, while food consumption is remaining steady.

International prices (FAO meat price index*: 2002-2004 = 100). FAO food outlook, June 2016.



*The FAO price indices are calculated using the Laspeyres formula; the weights used are based on the average export value of each commodity for the 2002-2004 period.

In Europe beef consumption was 10.7 kg/capita in 2015 and it is expected to stay at this level in 2016.

Bovine meat statistics (thousand tonnes, carcass weight equivalent: carcass weight after bleeding, skin, bowel, limbs, head, tail, kidney, fat, breast and external genitalia removal). FAO Food Outlook, June 2016

	Production		Imports		Exports		Utilization	
	2015 *estim.*	2016 *f'cast*	2015 *estim.*	2016 *f'cast*	2015 *estim.*	2016 *f'cast*	2015 *estim.*	2016 *f'cast*
ASIA	**17 990**	**18 118**	**4 592**	**4 780**	**1 945**	**1 966**	**20 681**	**20 928**
China	6 766	6 801	1 207	1 351	38	49	7 954	8 093
India	2 678	2 700	-	-	1 678	1 685	1 000	1 015
Indonesia	601	608	70	65	1	1	670	672
Iran, Islamic Republic of	254	254	98	131	4	4	348	381
Japan	481	475	703	688	2	2	1 164	1 170
Korea, Republic of	323	308	366	390	8	8	720	686
Malaysia	31	31	224	258	15	16	240	273
Pakistan	1 725	1 775	4	4	33	33	1 697	1 747
Philippines	295	300	145	150	4	4	436	446
AFRICA	**6 230**	**6 225**	**742**	**728**	**128**	**88**	**6 844**	**6 865**
Algeria	140	140	82	83	-	-	222	223
Angola	105	104	94	90	-	-	199	194
Egypt	859	870	360	350	9	10	1 210	1 210
South Africa	870	862	25	24	92	50	803	836
CENTRAL AMERICA	**2 555**	**2 571**	**366**	**367**	**325**	**359**	**2 595**	**2 579**
Mexico	1 850	1 865	195	193	151	187	1 894	1 871
SOUTH AMERICA	**15 576**	**15 722**	**329**	**320**	**2 545**	**2 758**	**13 365**	**13 284**
Argentina	2 713	2 653	-	-	201	231	2 512	2 422
Brazil	9 425	9 620	53	50	1 626	1 776	7 853	7 894
Chile	211	200	217	210	11	13	417	397
Colombia	845	820	5	5	13	19	837	806
Uruguay	546	551	4	4	336	369	213	186
Venezuela	557	582	30	30	-	-	592	612
NORTH AMERICA	**11 873**	**12 400**	**1 681**	**1 523**	**1 440**	**1 501**	**12 131**	**12 423**
Canada	1 058	1 072	282	283	356	352	986	1 003
United States of America	10 815	11 328	1 396	1 237	1 084	1 149	11 142	11 417
EUROPE	**10 375**	**10 406**	**928**	**947**	**475**	**515**	**10 828**	**10 837**
European Union	7 719	7 876	322	327	289	292	7 752	7 911
Russian Federation	1 604	1 551	510	524	43	54	2 071	2 022
Ukraine	380	310	2	2	27	28	355	284
OCEANIA	**3 260**	**2 930**	**63**	**63**	**2 273**	**2 067**	**1 052**	**955**
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New Zealand	690	660	16	16	582	553	124	123
WORLD	**67 859**	**68 372**	**8 700**	**8 728**	**9 131**	**9 253**	**67 496**	**67 871**
Developing countries	41 754	42 045	5 263	5 445	4 943	5 170	42 141	42 306
Developed countries	26 105	26 327	3 437	3 283	4 189	4 083	25 355	25 566
LIFDCs	7 981	7 998	128	128	1 804	1 810	6 305	6 315
LDCs	3 519	3 513	166	163	4	4	3 682	3 671

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Key KNOWN Authenticity Issues with this commodity (links):

List of known beef authenticity issues by topic

1. Substitution

Species substitution

In 2013 mislabelled meat products containing horse meat were discovered in many European countries (Ireland, UK, France, Norway, Austria, Switzerland, Sweden and Germany), inducing member states to increase surveillance on these topics. As a matter of fact a common fraud is to mix superior quality meat with cheaper one in ground meat or meat products without declaring it on label or declaring false percentages. Considering analytical tools, species identification is mainly achieved using different methods:

- histological techniques to differentiate species considering muscular parameters (fiber length, diameter, density and pattern of the muscular fibers);

- chemical analysis considering the fact that the amount of certain substances varies among species (glycogen, fat);

- genetic methods using nuclear or mitochondrial DNA:
    - End point PCR;
    - Multiplex PCR;
    - Nested PCR;
    - Real time PCR;
    - RFLP (Restriction Fragment Length polymorphism) PCR;
    - RAPD (Random Amplification of Polymorphic DNA) PCR;
    - AFLP (Amplified Fragment Length Polymorphism);
    - Sequencing Barcoding – FINS (Forensically Informative Nucleotide Sequencing);
    - DNA Hybridization.

- Protein analysis:
    - Poly Acrylamide Gel Electrophoresis (PAGE);
    - Sodium Dodecyl Sulphate PAGE (SDS-PAGE);
    - Counter Immunoelectrophoresis (CIE);
    - Isoelectric Focusing (IEF);
    - Liquid Chromatography.

- Immunological methods:
    - Precipitation Test – Overnight Rapid Beef Identification Test (ORBIT), Multispecies Identification Field Test (MULTI-SIFT);
    - ELISA;
    - Immunoblotting.

NEWS AND CASES RELATED TO SPECIES SUBSTITUTION

- Conspiracy to sell horse meat instead of beef - criminal investigation
http://www.independent.co.uk/news/uk/crime/horsemeat-three-men-charged-conspiring-beef-selling-magistrates-court-police-a7211611.html

- £15,000 fine for lacing lamb mince with cheap beef
http://www.messengernewspapers.co.uk/news/14421045.Skimping_Halal_butchers_slapped_with__15_000_fine_for_lacing_lamb_mince_with_cheap_beef/?ref=twtrec

- Supermarket supplying takeaways and restaurants has been fined £20,000 after environmental health officers discovered lamb mince on sale containing 80% beef
http://www.mirror.co.uk/news/uk-news/supermarket-supplying-takeaways-restaurants-famous-6353818

- US researchers uncover mislabelled meat in two studies
http://www.foodqualitynews.com/R-D/Reasons-behind-mislabelled-meat-findings-vary-researchers

- Adulterated meat products identified in products sold by a large supermarket chain in Russia
https://www.securingindustry.com/food-and-beverage/new-adulterated-meat-scandal-surfaces-in-russia/s104/a2442/#.WMaJEm_hDcs

Protein substitution

Animal proteins could be replaced with vegetable cheaper ones, such as soy, that can be identified thanks to different techniques:

- ELISA;
- Histochemical analysis;
- Immunohistochemical techniques;
- Immunofluorescence;
- HPLC;
- PCR.

Cheaper animal proteins could substitute more expensive animal proteins.

H - caldesmon ELISA can be used to differentiate tissues (it is present in smooth muscles and absent in cardiac and skeletal muscles) and detect this kind of frauds.

Melamine and urea could be also used to add nitrogen to products instead of real meat proteins. Analytical methods normally used to measure total nitrogen content (Kjeldhal and Dumas) are not able to discriminate between nitrogen atoms derived from proteins or chemical compounds, thus chromatographic techniques are employed (liquid or gas chromatography coupled to mass spectrometry).

Fat substitution

The substitution of animal fat with cheaper vegetable one might occur. However, vegetable fat contains phytosterols that are absent in animal fat and can be detected by using different chromatographic methods, such as:

- HPLC;
- GC-MS;
- (APPI) LC-MS/MS

Tissue substitution

The substitution of muscle with collagen or offal may occur. Referring to collagen it is important to consider that it contains hydroxyproline in a larger amount (about 8%) than other proteins. Therefore, it is possible to distinguish between meat parts containing different percentages of hydroxyproline by:

- spectroscopic method;
- chromatographic techniques (LC/MS-MS).

Regarding offal, it can be discriminated from skeletal muscle tissue by:

- mid-infrared spectroscopy;
- ELISA detecting h-caldesmon (it is present only in smooth muscles but absent in cardiac and skeletal ones).

Breed substitution

Different methods can be used to differentiate some cattle breeds:

- genetic analysis.
  - Microsatellite DNA markers, used to identify the Italian cattle breeds Chianina, Marchigiana, Romagnola and Piemontese (Dalvit et al, 2008);
  - SNP, used to detect the cattle breeds Holstein and Japanese Black (Sasazaki et al, 2004).
- NIRS, used to study Friesan and Hereford breeds (Alomar et al, 2003).

Sex substitution

It is possible to determine the sex origin of meat by detecting sex-specific hormones by different analytical tools, such as:

- GC-MS;
- HPLC/MS-MS;
- ELISA;

Moreover, it is possible to employ molecular techniques for sex specific identification of raw meat:

- End point PCR to distinguish the DNA regions that differ between males and females (zinc fingers genes, sex determining region of the y chromosomal gene, tooth enamel amelogenin gene);

- Real time PCR to distinguish the DNA regions that differ between males and females (sex-determining region of y chromosomal gene, X chromosomal proteolipid protein gene, tooth enamel amelogenin gene).

2. Addition of substance X

Additives

Many additives could be fraudulently added to meat. Among these, colouring agents, aromas and preservatives can be detected using HPLC and GC, while fibrinopeptides A and B deriving from trombin addition - are identified using LC-MS/MS.

NEWS AND CASES RELATED TO ADDITIVES

- Ho Chi Minh authorities confiscated a large amount of pork soaked in loads of chemicals to look like beef in a butcher shop in Saigon
http://www.thanhniennews.com/society/yet-another-food-safety-scare-as-fake-beef-discovered-at-saigon-butcher-shop-59006.html

- Chinese firm investigated over food fraud
http://www.globalmeatnews.com/Safety-Legislation/Chinese-firm-investigated-over-meat-doctoring

Water

Water could be added to meat in order to increase its weight; thus extraneous water in meat can be determined by measuring water and protein content, using standardized methods and by determining the water/protein ratio.

3. Process/production/welfare deception

Meat preparation (high temperature cooking process)

It is possible to verify if a product has been treated at high temperatures by detecting chemical compounds produced during its cooking, such as acrylamide, produced above 120°C and that can be identified and quantified, as example, by HPLC (Eerola et al, 2007; Paleologos et Kontominas, 2007) and LC-MS/MS (Granby et Fagt, 2004).

Fresh versus thawed meat

The analytical tools used to distinguish between fresh and thawed meat can be classified in 7 categories:

- sensory methods;
- enzymatic methods (spectrophotometric and colour test methods to measure Beta-hydroxyacyl-CoA-dehydrogenase – HADH);
- optic microscopy (histology);
- electron microscopy;
- Comet Assay;
- Infrared Spectroscopy;
- Nuclear Magnetic Resonance.

Slaughtering methods

Council Regulation (EC)n. 1099/2009 on the "Protection of animals at the time of killing" requires, as a general rule, that "animals shall be spared any avoidable pain, distress or suffering during their killing and related operations". However, it allows slaughter without stunning for particular methods prescribed by Jewish rite (kosher meat) and Muslim rite (halal meat) if it takes place in a slaughterhouse. Therefore, there must be a correct labelling system to avoid that meat obtained through Jewish or Islamic ritual slaughter may be purchased by unwilling consumers who prefer not to eat this meat, while vice versa meat deriving from stunned animals could be sold to Muslim or Jewish consumers.

NEWS AND CASES RELATED TO SLAUGHTERING METHODS

- Beef exporters plead guilty to halal fraud
http://www.omaha.com/news/crime/beef-exporters-plead-guilty-to-halal-fraud/article_f84f81d2-d21b-50f2-a82d-7c42f64ee23c.html

Geographic origin

Different methods can be used to determine the geographic origin of meat and they are divided into two groups:
- chemical analysis, such as inductively coupled plasma mass spectrometry of trace elements and stable isotopes ratios (oxygen, carbon and nitrogen isotopic ratios), based on the principle that the content of these substances in animals depends on feed intake, drinking water, pollution and soil composition, that are typical of the geographic areas in which the animal lives;
- genetic analysis, such as SNP, used to identify breeds that are typical of specific countries.

Organic versus conventional meat

A strategy to differentiate between animals bred using organic or conventional farming systems could be the analysis of isotopic composition, through stable ratio mass spectrometry as it was utilized in Irish beef (Schmidt et al, 2005). The differences detected in carbon, nitrogen and sulphur isotopic composition are partly due to feed intake and to the higher content of 15N contained in fertilizers applied to the soil where conventional animals are fed.

Feed intake

It is possible to determine the feed intake by different chemical methods, which can detect in animal blood and fat the metabolised forms of typical feed constituents. The most common procedures are:

- carotenoids content (higher in pasture than in concentrate and hay) in heifer's fat, detected by HPLC;
- fatty acids composition in meat, detected by GC (higher ratio of polyunsaturated fatty acids than saturated ones and of n-3 polyunsaturated fatty acids than n-6 ones, in grass-fed animals than in concentrate fed animals);
- vitamin and terpen contents in meat.

List of meat authenticity issues by priority

- Prioritisation established according to European Food Fraud Network Reports

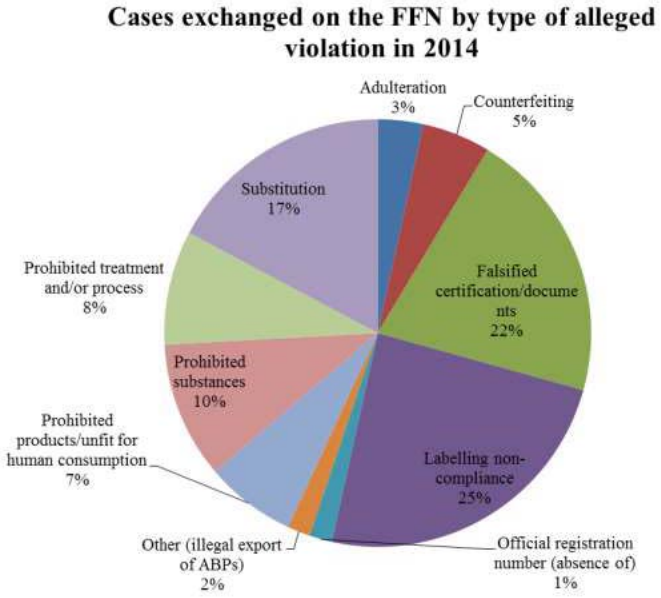
The EU Food Fraud Network (FFN), activated after the horse meat crisis in 2013, is a tool to facilitate the exchange of information on potential food fraud cases. This service is provided by 28 national authorities designed by each Member State for cross-border cooperation.

In 2014, 60 cases were notified by the network, mainly involving meat products and mostly related to:

- Labelling irregularities (durability dates, addition of water, ingredients);

- falsified certification and/ or documents;

- substitution (replacement of higher value species with lower value ones).



https://ec.europa.eu/food/sites/food/files/safety/docs/official-controls_food-fraud_network-activity-report_2014.pdf

- Prioritisation established according to consumer organizations' studies

From April 2014 to August 2015 seven European consumer organizations (Altroconsumo, Consumentenbond, DECO, dTest, OCU, Test-Achats, Which?) analysed a big range of meat- based foods in order to evaluate the presence of frauds. The results showed that the most common irregularities were:

- Mislabelling (for example using similar names to those of legal defined products without respecting the same quality standards; selling products with the same trade name but different characteristics due to confusing definitions by national laws; unclear and misleading food labelling);

- Missing QUID (Quantitative Ingredient Declaration) or discrepancies between what is declared and the actual meat content;

- Undeclared water addition;

- Use of additives (for example the addition of additives in some traditional meat preparations, permitted by EU Regulations, can be unlawfully extended to similar foods that do not meet the same definitions; the utilization of marinades can be unlawfully used to transfer additives to meat by the "carry over principle"; an illegal use of sulphites can take place in fresh meat);

- Undeclared mechanically separated meat;

- Meat species substitution (for example the addition of undeclared species to the declared ones or products only containing other species without the presence of the declared one).

http://www.beuc.eu/publications/Close-up_on_the_meat_we_eat_Consumers_want_honest_labels.pdf

Existing relevant information on methods:

The following standards are approved by the Association of Official Agricultural Chemists (AOAC International) or by the International Organization for Standardization (ISO).

Additives

1. *Nitrite*

- Determination of nitrite in cured meats by colorimetric method – AOAC Official method 973.31
http://www.aoacofficialmethod.org/index.php?main_page=product_info&cPath=1&products_id=1556

- Determination of nitrite content in meat and meat products (Reference method) – ISO 2918/1975
https://www.iso.org/obp/ui/#iso:std:iso:2918:ed-1:v1:en

2. *Nitrate*

- Determination of nitrate content in meat and meat products (Reference method) by colorimetric method – ISO 3091/1975
https://www.iso.org/obp/ui/#iso:std:iso:3091:ed-1:v1:en

- Determination of nitrates and nitrites in meat by spectroscopic method – AOAC 935.48
http://www.eoma.aoac.org/methods/info.asp?ID=16587

3. *Ascorbic acid*

- Determination of total vitamin C in food – semiautomatic fluorimetric method – AOAC official method 984.26
http://www.aoacofficialmethod.org/index.php?main_page=product_info&cPath=1&products_id=345

4. *Phosphorus and polyphosphates*

- Determination of total phosphorus content in meat and meat products (Reference method) – ISO 2294/1974
https://www.iso.org/obp/ui/#iso:std:iso:2294:ed-1:v1:en

- Determination of total phosphorous content in meat and meat products by spectrometric method – ISO 13730/1996
http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=22789

- Determination of linear condensed phosphates in meat and meat products by thin layer chromatographic separation – ISO 5553:1980
https://www.iso.org/obp/ui/#iso:std:iso:5553:ed-1:v1:en

- Determination of total phosphorus content by titrametric, gravimetric method – AOAC 969.31
http://www.eoma.aoac.org/methods/info.asp?ID=16332

- Determination of phosphorus in meat and meat products by spectroscopic method – AOAC 991.27
http://www.eoma.aoac.org/methods/info.asp?ID=16417

5. *Colouring agents*

- Detection of synthetic, water-soluble colouring agents in meat and meat products by a thin layer chromatographic method – ISO 13496/2000

https://www.iso.org/obp/ui/#iso:std:iso:13496:ed-1:v1:en

6. *Sulphur dioxide*

- Detection of sulphurous acid (free) in meat by titrimetric method – AOAC 892.02
http://www.eoma.aoac.org/methods/info.asp?ID=9328

7. *Preservatives*

- Detection of preservatives (sorbates, ascorbates, benzoates, sulphites) in ground meat by spectroscopic method – AOAC 980.17
http://www.eoma.aoac.org/methods/info.asp?ID=9464

Meat components

1. *Fat*

- Determination of total fat content in meat and meat products – ISO 1443/1973
https://www.iso.org/obp/ui/#iso:std:iso:1443:ed-1:v1:en

- Determination of fat (crude) or ether extract in meat by gravimetric method – AOAC 960.39
http://www.eoma.aoac.org/methods/info.asp?ID=16128

- Determination of fat (crude) in meat and meat products – AOAC 991.36
http://www.eoma.aoac.org/methods/info.asp?ID=16281
2. *Water*

- Determination of moisture content in meat and meat products (Reference method) – ISO 1442/1997
https://www.iso.org/obp/ui/#iso:std:iso:1442:ed-2:v1:en

- Determination of moisture in meat and meat products by air drying – AOAC 950.46
http://www.eoma.aoac.org/methods/info.asp?ID=15720

- Determination of moisture and fat by microwave and Nuclear Magnetic Resonance analysis – AOAC 2008.06
http://www.eoma.aoac.org/methods/info.asp?ID=49193

3. *Protein*

- Determination of nitrogen content (Reference method) – ISO 937/1978
https://www.iso.org/obp/ui/#iso:std:iso:937:ed-1:v1:en

- Determination of nitrogen in meat by Kjeldahl method – AOAC 928.08
http://www.eoma.aoac.org/methods/info.asp?ID=16468

- Determination of crude protein in meat and meat protein by combustion method -AOAC 992.15
http://www.eoma.aoac.org/methods/info.asp?ID=16519

- Determination of crude protein by digestion method – AOAC 981.10
http://www.eoma.aoac.org/methods/info.asp?ID=16570

- Determination of protein in raw and processed meat by authomated dye binding method – AOAC 2011.04
http://www.eoma.aoac.org/methods/info.asp?ID=49499

- Determination of soyben flour in meat/cured meat by microscopy – AOAC 913.01
http://www.eoma.aoac.org/methods/info.asp?ID=16740

- Determination of soy proteins in raw and heat processed meat by Enzyme Linked Immunosorbent Assay – AOAC 988.10
http://www.eoma.aoac.org/methods/info.asp?ID=16859

4. *Hydroxyproline*

- Determination of hydroxyproline content in meat and meat products – ISO 3496/1994
https://www.iso.org/obp/ui/#iso:std:iso:3496:ed-2:v1:en

- Determination of hydroxyproline in meat and meat products by colorimetric method – AOAC 990.26
http://www.eoma.aoac.org/methods/info.asp?ID=16706

Species identification

- Multiplex PCR – ISO/NP 20148 under development
http://www.iso.org/iso/catalogue_detail.htm?csnumber=67154

- Identification of beef and poultry adulteration of meat products by ORBIT (overnight rapid bovine identification test) and PROFIT (poultry rapid overnight field identification test) kits – AOAC 987.06
http://www.eoma.aoac.org/methods/info.asp?ID=16876

Official Bodies/ Countries involved in control funding of this commodity:

International:

- International Meat Secretariat (IMS)
http://www.meat-ims.org/
- Agri benchmark
http://www.agribenchmark.org/beef-and-sheep/beef-and-sheep-network.html
- Liason Centre for the Meat Processing Industry in the European Union (CLITRAVI)
http://www.clitravi.eu/

National European Associations:

- ASSOCARNI (Italy)
http://www.assocarni.it/
- Beef Policy Unit (Ireland)
http://www.meat-ims.org/groups/beef-policy-unit/
- Belgian Meat Office
http://www.meat-ims.org/groups/belgian-meat-office/
- Centre d'Information des Viandes (CIV) (France)
http://www.meat-ims.org/groups/centre-dinformation-des-viandes-civ/
- Confecarne (Spain)
http://www.meat-ims.org/groups/confecarne/
- Dutch Meat Association (COV) (Netherlands)
http://www.cov.nl/
- Fédération des Industries et des Commerçants en gros de la viande (France)
http://www.fnicgv.com/Default.aspx?lid=1&rid=76&rvid=1140
- INTERBEV- Interprofession bétail et viande (France)
http://www.interbev.fr/interbev/missions/
- Meat Industry Ireland (Irerland)
http://www.meat-ims.org/groups/meat-industry-ireland-138591444/
- The Livestock and Meat Commission of Northern Ireland (LMC) (Northern Ireland)
https://www.lmcni.com/
- The Norwegian Egg and Meat Marketing Board (Norway)
http://www.matprat.no/
- UNICEB - unione importatori esportatori industriali commissionari grossisti ingrassatori macellatori spedizionieri carni bestiame prodotti derivati (Italy)
http://www.meat-ims.org/groups/uniceb/
- VDF – German Meat Association (Germany)
http://www.v-d-f.de/

Gaps:

It is necessary to ameliorate analytical tools to detect meat frauds following three strategies:

1. to improve standardization of analytical validated procedures not included in existing standards (determination of additives, use of molecular techniques to determine species substitutions);

2. to revise standardized methods, such as the EU reference method to determine hydroxyproline content in meat (it is a simple spectrophotometric technique, while other more advanced ones (e.g.LC-MS/MS) are available but not recognized as reference techniques);

3. to develop and validate innovative analytical approaches to propose solutions for different issues directly linked to frauds such as:

- distinguishing different meat cuts (a possible solution could be the evaluation of collagen content that varies among different meat cuts, considering that visual inspection is useful only to differentiate primary beef cuts);

- characterizing different animal breeds, using larger data set to build effective models (NIR techniques);

- determining the animal feed intake , since the actual analysis based on carotenoid content in fat and blood are influenced by other factors such as breed, gender, lactation and rumen environment;

- establishing the geographic origin of meat, since the simple identification of breed could not be effective due to the fact that individual breeds can be raised in different countries despite of their origin;

- determining the slaughter age of animals;

- quantifying vegetable fat as adulterant in meat, not only revealing its presence by phytosterols detection;

- detecting animal fat from different not declared species used ;

- developing methods to reveal fresh- thawed products applicable to ground meat and temperatures higher than -12°C (the HADH method is not applicable to ground meat because the grinding process causes alterations similar to those induced by freezing and it is able to detect frozen-thawed meat only if the freezing temperature has been -12°C or below).

References:

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- Authentication of meat and meat products, Ballin N.Z. (2010) Meat Science ,86 ,577-587

- Categories of meat products (FAO) http://www.fao.org/docrep/010/ai407e/ai407e09.htm

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- Comparison of new immunofluorescence method for detection of soy protein in meat products with immunohistochemical, histochemical and ELISA methods, Petràsovà M. et al (2014) Acta Vet. Brno, 83:S65-S69.

- European Commission, Short term Outlook for EU arable crops, dairy and meat markets in 2015 and 2016

- European Regulation 853/2004 attachment 1

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Annex 2

Authent-Net Commodity Status Report

Commodity: olive oil

State of the Art of the commodity:

1. Market Share of Commodity:

About 98.7% of olive orchards are located around the Mediterranean Sea. The rest of olive crops (1.3%) are distributed in some countries of American continent such as USA, Argentina or Chile, and Australia.

The average of the virgin olive oils worldwide production in the last six years (2009-2015) was 1,794,200 t. The production in European Union accounts for more than 72% of this world production. Spain is the first worldwide producer with at least 61% of the virgin olive oil production. The increment of production, mainly in Spain and Tunisia, and non-Mediterranean producer countries, it has been complemented with the increment of consumption (20% of increment per each decade from the 60s until now). This increment was higher in the 90s due to the demand of USA, Canada, and Australia.

2. Process Specificity of commodity (production/welfare):

Virgin olive oil (VOO) is the oil obtained from the fruit of the olive tree (*Olea europaea* L.) solely by mechanical or other physical means under conditions, particularly thermal conditions, which do not lead to alterations in the oil, and which has not undergone any treatment other than washing, decantation, centrifugation and filtration. Virgin olive oils fit for consumption are the following:

– Extra virgin olive oil (EVOO) is a VOO which has a free acidity, expressed as oleic acid, of not more than 0.8 g per 100 g and whose organoleptic characteristics correspond to those fixed for this category in the trade standard.

– Virgin olive oil is a VOO which has a free acidity, expressed as oleic acid, of not more than 2 g per 100 g and whose organoleptic characteristics correspond to those fixed for this category in the trade standard.

– Ordinary virgin olive oil is a VOO which has a free acidity, expressed as oleic acid, of not more than 3.3 g per 100 g and whose organoleptic characteristics correspond to those fixed for this category in the trade standard.

– Virgin olive oil not fit for consumption as it is, known as lampante virgin olive oil, is a VOO which has a free acidity, expressed as oleic acid, of more than 3.3 g per 100 g or whose organoleptic characteristics correspond to those fixed for this category in the trade standard. It is intended for refining or for technical purposes.

It is important to consider the classification according to European Union, in which ordinary category does not exist. In this case, the limits of free acidity are the following:

Extra virgin olive oil: ≤0.8 g per 100g.

Virgin olive oil: ≤2 g per 100g.

Lampante virgin olive oil: >2 g per 100g.

3. Trade of Commodity:

About 78% of worldwide consumption corresponds to producer countries, being Italy the first consumer country (38.5%) followed by Spain (28.4%). However, the higher increment of consumption of virgin olive oils is observed in non-producer countries. Thus, European producer countries have become importer/exporters of virgin olive oil. Further information can be obtained from Handbook on Olive Oil: Analysis and Properties (Aparicio, R., Harwood, J., Eds., 2° Edition, Springer, New York, 2013) and on the website of International Olive Council (http://www.internationaloliveoil.org).

In the non-Mediterranean zones, the imports of USA, Australia, Japan, Canada or Brazil have to be highlighted, being USA the first import country from European countries principally.

Although Southern Europe, North Africa, and the Middle East produces over 98% of the world's olive oil, recently several new producer countries outside the Mediterranean region (USA and Australia) have begun to produce olive oil for their domestic and export markets. Australia produces about 18,000 t of olive oil from 110 processing plants. Production is primarily from medium-density orchards and the cultivars Barnea, Frantoio or Picual. Expansion is limited due to the scarcity and high cost of irrigation water. Average production costs for orchard are approximately $4,500/ha or $1.92/kg of oil. In the case of USA, California produces the 99% of olive oil, producing approximately 4,000 t of oil, which represents only 2% of total USA consumption. Production has doubled in the last 2 years and will continue to increase significantly as new orchards come into full bearing. Over 70 % of the production is from the cultivar Arbequina, followed in descending order by Arbosana, Koroneiki, Frantoio, and Leccino. Production costs for the orchard are range from $3,311 to $6,020/ha, or $1.65 to $3.00/kg oil.

Key KNOWN Authenticity Issues with this commodity:

The possible authenticity issues described in olive oil can be classified into three types; (i) mixture of different categories of olive oil, (ii) mixture with other vegetable oils, (iii) problems related to mislabelling, such as virgin olive oil labelled as extra virgin olive oil, or oil labelled with an origin that does not match with its real provenance. Although olive oil authenticity is a complex topic, the main issues and subissues can be summarizes as follows:

Issue: Adulteration

Subissue:

- Addition of cheaper oil to olive oils (Detection of refined hazelnut oils in ROOs).
- Addition of refined oils to VOOs (Detection of seed oils in VOOs).
- Addition of low to high oil categories (Detection of deodorised VOOs in VOOs).

Issue: Geographical origin
Subissue:
- Inexact label (Detection of VOO from several origins).
- Traceability (Characterisation of PDOs).

Issue: Agricultural systems
Subissue: Organic vs. conventional (Addition of conventional to organic VOOs).

Issue: Cultivar.
Subissue: Varietal VOOs (e.j. Authentication of monovarietal VOOs).

To guarantee the quality and safety of olive oil and to control its authenticity, this product has been at the forefront of the implementation of multiple standard methods. Thus, olive oil has become one of the most strictly regulated food products.

Since it is a product highly regulated, in all the works related to olive oil authenticity it is relevant to consider the regulatory bodies and associations for olive oil, which present an extensive collection of analytical methods to characterize olive oils and olive-pomace oils and to avoid possible frauds. These organizations are, among others, International Olive Council (IOC), European Commission (EC), Codex Alimentarius Commission, CODEX STAN, German Society for Fat Science (DGF), Association of Official Analytical Chemistry (AOAC), American Oils Chemists' Society (AOCS), International Union of Pure and Applied Chemistry (IUPAC), and Federation of Oil Seeds and Fats Association (FOSFA). Olive oil is subjected to worldwide trade, and international regulation is provided by trade standards published and updated by these institutions. Particularly important is to consider the trade standards of IOC and EC.

There is a considerable interest in optimizing current methods and developing new ones, because it is important to keep the pace with changing technologies and sophisticated adulterations. Great part of research is focused on these activities.

The improvement of the standard methods requires time and an important and continuous funding on innovation and research activities. Since some of the current adulterations described today are more sophisticated than in the past, the strategy of some current research studies is to combine standard methods and emerging technologies, including fingerprinting approaches into a single comprehensive analytical strategy. The analytical techniques are sometimes based on spectroscopic techniques (near-infrared-NIR spectroscopy, Fourier transform mid-infrared spectroscopy-FTIR spectroscopy, etc.).

A list of authenticity issues is presented below. The importance is established in each one of them from a general point of view (e.g. frequency, difficulty in its detection), although there is not official data from an international perspective about their incidences.

1. Substitution:

- *Substitution of a high quality virgin olive oil (e.g. extra virgin) by a lower grade virgin olive oil (virgin or lampante)*

It can be determined by panel test (sensory assessment) and by volatile compounds analysis (e.g. SPME-GC). Free acidity, peroxide value and other physico-chemical parameter also help in controlling quality. They are mentioned below.

Importance: Medium-Low

- *Substitution by other vegetable oils (see following section "addition of substance x").*

2. Addition of substance X

- *Detection of vegetables oils in olive oils*

Fatty acid composition may detect the presence of high linoleic vegetable oils (soybean, rapeseed, sunflower, etc.), myristic acid indicate the presence of fractionated palm oils and lignoceric acid the presence of peanut oils. Sterols composition may detect the presence of seed oils (*Brassicace*ae oils, rapeseed oils, mustard seed oils, etc.). ΔECN42 may detect the presence of seed oils (corn oils, sunflower oils, etc.). These analytical parameters could be used alone or in combination.

Importance: Low

- *Detection of pomace oil in olive oils*

The determination of erythrodiol+uvaol (E+U) may indicate the presence of pomace oil. The presence of waxes may also indicate the presence of pomace oil when the concentration of E+U is within (2%-4.5%).

Importance: Medium-Low

- *Detection of crude and/or refined corn oil in olive oil*

Detection of crude and/or refined corn oil in olive oil (mixture of refined olive oil and virgin olive oil) and/or refined olive oil by quantification of sterols (apparent β-sitosterol -beta-sitosterol + delta-5-avenasterol + delta-5-23-stigmastadienol + clerosterol + sitostanol + delta 5-24-stigmastadienol-, campesterol, stigmasterol) and determination of ΔECN42.

Importance: Low

- *Detection of refined corn oil in virgin olive oil*

The quantification of stigmastadienes may detect the refined corn in virgin olive oil (stigma-3,5 diene).

Importance: Low

- *Detection of cotton oil in virgin olive oil*

Detection of crude and/or refined cotton oil in olive oil (mixture of refined olive oil and virgin olive oil) and/or refined olive oil by quantification of sterols and determination of ΔECN42.

Importance: Low

- *Detection of refined cotton oil in virgin olive oil*

The quantification of stigmastadienes may detect the refined cotton in virgin olive oil (stigma-3,5-diene).

Importance: Low

- *Detection of palm oil in virgin olive oil*

Detection of crude and/or refined palm oil in olive oil (mixture of refined olive oil and virgin olive oil) and/or refined olive oil by quantification of sterols and fatty acid.

Importance: Medium-Low

- *Detection of refined palm oil in virgin olive oil*

The quantification of stigmastadienes may detect the refined palm in virgin olive oil (stigma-3,5-diene).

Importance: Low

- *Detection of peanut oil in virgin olive oil*

Detection of crude and/or refined peanut oil in olive oil (mixture of refined olive oil and virgin olive oil) and/or refined olive oil by quantification of sterols and fatty acid.

Importance: Low

- *Detection of refined peanut oil in virgin olive oil*

The quantification of stigmastadienes may detect the refined peanut in virgin olive oil (stigma-3,5-diene).

Importance: Low

- *Detection of soybean oil in virgin olive oil*

Detection of crude and/or refined soybean oil in olive oil (mixture of refined olive oil and virgin olive oil) and/or refined olive oil by quantification of sterols and fatty acid.

- *Detection of refined soybean oil in virgin olive oil*

The quantification of stigmastadienes may detect the refined soybean in virgin olive oil (stigma-3,5-diene).

Importance: Low

- *Detection of rapeseed oil in virgin olive oil*

Detection of crude and/or refined rapeseed oil in olive oil (mixture of refined olive oil and virgin olive oil) and/or refined olive oil by quantification of sterols and ΔECN42.

Importance: Low

- *Detection of refined rapeseed oil in virgin olive oil*

The quantification of stigmastadienes may detect refined rapeseed oil in virgin olive oil (stigma-3,5-diene).

Importance: Low

- *Detection of mustardseed oil in virgin olive oil*

Detection of crude and/or refined mustardseed oil in olive oil (mixture of refined olive oil and virgin olive oil) and/or refined olive oil by quantification of sterols.

Importance: Low

- *Detection of refined mustardseed oil in virgin olive oil*

The quantification of stigmastadienes may detect the refined mustardseed oil in virgin olive oil (stigma-3,5-diene).

Importance: Low

- *Detection of hazelnut oil in virgin olive oil*

Detection of crude and/or refined hazelnut oil in olive oil (mixture of refined olive oil and virgin olive oil) and/or refined olive oil by quantification of sterols and Global method (triacylglycerols).

Importance: Medium-Low

- *Detection of refined hazelnut oil in virgin olive oil*

The quantification of stigmastadienes may detect the refined halzenut in virgin olive oil (stigma-3,5-diene).

Importance: Low

- *Detection of safflower oil in virgin olive oil*

Detection of crude and/or refined safflower oil in olive oil (mixture of refined olive oil and virgin olive oil) and/or refined olive oil by quantification of sterols and fatty acid.

Importance: Low

- *Detection of refined safflower oil in virgin olive oil*

The quantification of stigmastadienes may detect the refined safflower in virgin olive oil (stigma-3,5-diene).

Importance: Low

- *Detection of sesame oil in virgin olive oil*

Detection of crude and/or refined sesame oil in olive oil (mixture of refined olive oil and virgin olive oil) and/or refined olive oil by quantification of sterols and fatty acid.

Importance: Low

- *Detection of refined sesame oil in virgin olive oil*

The quantification of stigmastadienes may detect the refined sesame in virgin olive oil (stigma-3,5-diene).

Importance: Low

- *Detection of the presence of any edible oil (crude or refined) in virgin or refined olive oil*

Selected ^{13}C and ^{1}H NRM spectroscopies may detect the adulteration with hazelnut.

Infrared or Raman bands may detect some kinds of adulteration.

Importance: Medium-Low

- *Detection of the presence of any refined edible oil in virgin or refined olive oil*

Spectroscopy by FTIR or FT-Raman may detect *cis/trans* bands to determine the presence of any refined edible oils.

Importance: Low (medium low for refined edible oil in refined olive oil).

- *Detection of the presence of VOOs deodorized at low temperature in EVOOs.*

The determination of ethyl esters may detect the presence of deodorized at low temperature in EVOOs, although it is not effective enough, and there is not an efficient method for detecting this kind of adulteration.

Importance: Medium-low

3. Process/production/welfare deception

- *Determination of the geographical provenance (country, region, PDO) of VOO*

The determination of some compounds present in olive oil may detect the geographical provenance of oils such as:

1. Fatty acids

2. Sterols

3. Hydrocarbons

4. Other minor compounds.

Some strategies include:

- Chemical profiling of the oil (SEXIA project: Aparicio R, Alonso V. Characterization of virgin olive oils by sexia expert system. Progress in Lipid Research. 1994;33(1-2):29-38.).

- EA-IRMS or NMR may determine the provenance of VOOs.

- ICP-MS or ICP-AES may detect the geographical provenance of VOOs.

Importance: Medium

In addition to this authenticity issues, it is important to note that there are standard methods and parameters described by International Olive Council (COI) to determine olive oils **quality** characteristics:

- Free acidity.

The higher the value correspond to the worse the olive quality because the processing of unhealthy olives increases free acidity.

- Organoleptic assessment: median of fruity attribute and median of defect (Panel Test)

- Fatty acid methyl esters and fatty acid ethyl esters.

EVOOs should have no ethyl esters or at trace level. High values characterize lampante olive oils.

- Peroxide value.

After extraction from olives, oil undergoes oxidation depending on several external variables.

- Absorbency in ultraviolet at K_{232} and absorbency in ultraviolet at K_{270}

Oxidation products absorbs at this wavelength. The higher values correspond to the oxidative status.

There are also standards methods described by International Olive Council (COI) to determine olive oil **purity** characteristics.

- 2-glyceryl monopalmitate (%)

A higher value is related to presence of esterified oils whose triacylglycerol are obtained by chemical synthesis.

- Absorbency in ultraviolet at K_{232} and absorbency in ultraviolet at K_{270}

A higher value is related to presence of refined oil.

- Myristic acid (%)

A higher value is related to presence of seed oil, mainly fractionated palm oil.

- Linolenic acid (%)

A higher value is related to presence of seed oils such as soybean oil and low erucic rapeseed oil.

- Eicosecoic acid (%)

- Behenic acid (%)

- Lignoceric acid (%)

A higher value is related to presence of seed oils such as peanut oils.

- ∑C18:1 *trans* isomers (%) and ∑C18:2 + C18:3 *trans* isomers (%)

A higher value is related to presence of refined oils, even if UV absorption is inside the limits.

- Cholesterol (%)

A higher value is related of presence of animal fats or of fractionated palm oil.

- Brassicasterol (%)

A higher value is related to presence of *Brassicaceae* oils even if with “zero” erucic acid content.

- Campesterol (%)

A higher value is related to presence of seed oils.

(Possibly listed in most common to least common type of known fraud with regards to this commodity) – Needs to link to FI terms?

Existing relevant information on methods:

The following standard methods are described by International Olive Council or can be found in scientific research papers:

1. Fatty acids
http://www.internationaloliveoil.org/documents/viewfile/4137-met28eng

2. Sterols
http://www.internationaloliveoil.org/documents/viewfile/4145-met30eng
García-González, D. L., Viera, M., Tena, N., Aparicio, R. (2007). ISSN: 0017-3495

3. ΔECN42
http://www.internationaloliveoil.org/documents/viewfile/3884-testing7

4. Erythrodiol+uvaol
http://www.internationaloliveoil.org/documents/viewfile/4145-met30eng

5. Waxes
http://www.internationaloliveoil.org/documents/viewfile/7717-met-31-alkylester-waxes

6. Stigmastadienes
http://www.internationaloliveoil.org/documents/viewfile/3863-testing2

7. Ethyl esters
http://www.internationaloliveoil.org/documents/viewfile/4137-met28eng

8. Global Method (triacylglycerol composition) used to determine hazelnut oils in olive oil http://www.internationaloliveoil.org/documents/viewfile/4092-metodo-global-english

9. Method of ^{13}C and ^{1}H RMN used to determine edible oils in virgin olive oil http://dx.doi.org/10.1016/j.aca.2012.12.003

10. Method of FTIR or FT-Raman spectroscopy to determine edible oils in virgin olive oil http://dx.doi.org/10.1016/j.foodres.2013.07.039

11. Method FTIR or FT-Raman spectroscopy to determine refined edible oils in virgin olive oil http://pubs.acs.org/doi/abs/10.1021/jf050595n

12. Method sterols and fatty acids to determine geographical provenance of olive oils – http://dx.doi.org/10.1016/j.foodchem.2015.04.139

13. Method sterol, fatty acids and hydrocarbons to determine geographical provenance of olive oils http://dx.doi.org/10.1002/ejlt.200900015

14. Method for determining volatile compounds and phenolic to detect substitution with low grade virgin olive oils
http://dx.doi.org/10.1021/jf101316d

15. Method of EA-IRMS to determine geographical provenance in virgin olive oils http://doi:10.1016/j.foodchem.2008.04.059

16. Method of ICP-MS to determine geographical provenance in virgin olive oils http://dx.doi.org/10.1016/j.foodchem.2011.01.064

17. Free fatty acids used to determine the quality of olive oils - According to ISO 660, "Determination of acid value and acidity".

18. Method for organoleptic assessment used to determine the quality of olive oils http://www.internationaloliveoil.org/documents/viewfile/3685-orga6

20. Peroxide value used to determine the oxidation of olive oils - According to ISO 3960, "Determination of the peroxide value"

21. Method of absorbency in ultraviolet to determine the oxidation of olive oils http://www.internationaloliveoil.org/documents/viewfile/4101-dec-20ecn42-eng

22. Method for determining the content 2-glyceryl monopalmitate to determine esterified oils – http://www.internationaloliveoil.org/documents/viewfile/3325-23-apalmeng

(Many of these would link to WP2 - Knowledgebase in FoodIntegrity)

Official Bodies/Countries involved in controlling this commodity and funding research associated to their authenticity:

eg: Oils and Fats

International:

- International Olive Council, IOC. (http://www.internationaloliveoil.org/)

- European Community (http://ec.europa.eu/agriculture/olive-oil/legislation/index_en.htm).

Other professional associations are directly involved in discussion about authenticity of olive oil, and they sometimes fund some research projects on fraud control.

a.) **Italy**: (list of organisations that are involved in funding authenticity research for this commodity.)

- Associazione italiana industria olearia, ASSITOL (Italian Association of Olive Oil Industry)

- Società Italiana per le Studio delle Sostanze Grasse, SISSG (Italian Society of Olive Oil Study)

- AGER (agrofood and research)

- Ministry of Agricultural, Food and Forestry Policies

b.) **Spain:** (list of organisations that are involved in funding authenticity research for this commodity.)

- Interprofesional del Aceite de Oliva (Interprofessional of Olive Oil).

- Ministerio de Agricultura, Alimentación y Medio Ambiente (Ministry of Agriculture, Food and Environment).

- Asociación Española de la Industria y Comercio Exportador de Aceites de Oliva y Aceites de Orujo, ASOLIVA (Spanish Association of Industry and Exported Trade of Olive Oils and Pomace-Oil)

- Asociación Nacional de Industriales Envasadores y Refinadores de Aceites Comestibles, ANIERAC (Spanish Association of Packing Industrial and Refining of Edible Oils).

c.) **Greece:** (list of organisations that are involved in funding authenticity research for this commodity.)

- Panhellenic Confederation of Unions of Agricultural Cooperatives (PASEGES).

- Greek Association of Industries and Processors of Olive Oil (SEVITEL).

- Hellenic Association of Industries and Packers of Olive Oil (ESVITE).

- National Interprofessional Organization of Olive Oil and Table Olives (EDOEE). The three associations mentioned above are members of this interprofessional association.

Gaps:

It is necessary to reinforce the funding and research organization for a better coordination of the research activities on traceability and fraud control across the food supply chain**.** Specific gaps are:

- Harmonization of the olive oil categories between regulations.

- Reducing the number of trade standards (IOC, EU, Codex Alimentarius, USA and Australia) by their harmonisation and an active collaboration between regulatory bodies.

- Development, validation and pre-normative activities followed by the standardization of a method for the assessment of the organoleptic characteristics. For this purpose, it is necessary to analyse the existing methods, and to promote the design of reference materials to improve sensory assessment and the development of methods based on the determination of flavour compounds. Other challenges are the determination of thresholds and ratios among volatiles and to evaluate the aroma impact of these compounds. Other objective is the development of fMRI methods to measure the hemodynamic response of the brain during the smelling and testing olive oils to understand better the olive oil quality.

- Identification of research needs for robust methods to replace or complement standard methods, in particular to simplify laboratory work and improve efficiency in authenticity control.

- Determination of the blend of extra virgin olive oil (EVOO) or virgin olive oil (VOO) with soft deodorized olive oil with different strategies such as:

1. Collect reliable information on the soft deodorisation process to understand better what are the conditions that are used today and how they affect olive oil composition.

2. Study in a systematic way the changes in oil composition due to soft deodorisation and to identify potential markers of this kind of adulteration.

- Harmonization of methods described to research on altered pigments, mainly chlorophyll and carotenoids, which are sensitive to light exposure, temperature or oil ageing. It is required to understand better the role of pyropheophytins in freshness control. The evaluation of other quality parameters related to freshness is also required.

- Detection of other adulterant oils (vegetable/edible oil or low quality olive oil) blended into edible VOO.

- Development of new techniques (non-targeted approaches) to improve the detection of adulterants in edible VOO. Thus, it is necessary to develop new methods based on near infra-red spectroscopy (NIR), FTIR, NMR, Raman spectroscopy, etc. to determine the standard parameters used for describing the quality and authenticity of olive oil.

- Development of genomic methods to discriminate vegetable oils and quantify the relative addition of seed oils to VOO, and to verify other features (e.g. cultivar).

- Development of “omic” procedures for a better characterization of virgin olive oil, particularly geographical traceability.

- Development of an “olive oil map” to improve the geographical traceability characterized by chromatographic, spectroscopic, and isotopic techniques.

- Improvement of chemometric tools for perfecting the analytical methods.

- To obtain a database to adjust the legal limits of some chemical compounds to the new situation of the world market, in particular in relation to the development of new cultivars, new agricultural practices and new producing countries.

Some of these gaps and challenges are extensively described in:

1. Handbook of Olive Oil. Analysis and Properties, 2nd ed; Aparicio, R., Harwood, J. Eds.; Springer: New York, 2013; pp. 261-309.

2. García-González DL, Aparicio R. Research in olive oil: Challenges for the near future. J Agric Food Chem. 2010;58(24):12569-77.

3. Valli E, Bendini A, Berardinelli A, Ragni R, Riccò B, Grossi M, Gallina Toschi T Rapid and innovative instrumental approaches for quality and authenticity of olive oils, Eur. J. Lipid Sci. Technol. 2016; 118(11), 1601-19.

4. Call on olive oil authenticity: https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/762-sfs-14a-2014.html

5. Scientific workshop on olive oil authentication (Madrid, 10-11 June 2013): http://ec.europa.eu/agriculture/events/olive-oil-workshop-2013_en.htm

6. H2020 EU Project OLEUM - Advanced solutions for assuring the overall authenticity and quality of olive oil – from 09/2016 to 08/2020. Project description: http://cordis.europa.eu/project/rcn/204671_en.html

List of known gaps in Food Authenticity Research in this commodity.

Annex 3

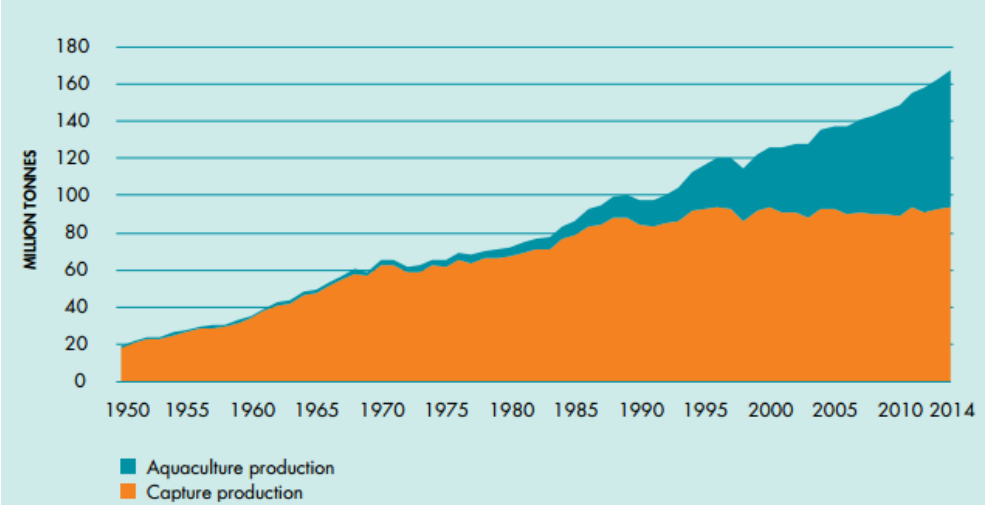
Authent-Net Commodity Status Report

Commodity: seafood

State of the Art of the commodity:

1. Market Share of Commodity:

The total worldwide seafood production considering both fisheries and aquaculture in 2014 was 167.2 million tonnes, and has increased steadily from 145.9 million tonnes in 2009. [1] The growth is mainly driven by increased production in the aquaculture sector, which has increased by 32% over the aforementioned six-year period, with traditional capture fisheries have only increased by 3.5%for the same period. Estimated total production for 2015 is 171 million tonnes, with 93.5 tonnes originating from wild capture fisheries and 77.5 million tonnes from aquaculture; and forecasts for 2016 are predicting total production of 174.1 million tonnes where 92.7 million tonnes come from wild capture and 81.4 million tonnes from aquaculture.[2] Despite a robust growth in aquaculture, traditional fisheries remain the largest sector by volume, on the other hand the aquaculture sector is overtaking capture fisheries as the min producer of seafood for human consumption.



World capture fisheries and aquaculture production

A total of 71% of the world's seafood production originates from Asia, with the greater part being located in Southeast Asia. China is the by far the largest producing country in the world contributing 37%, while other major producers in the region are Indonesia, Japan, Viet Nam and India. Outside of Asia, key producers include the US, Russia, Peru and Norway.

2. Process Specificity of commodity (production/welfare):

The majority of fish products, 87% in 2014, are used for direct human consumption, with the rest mainly going to the production of fishmeal, fish oil and as raw material for feed in the aquaculture sector.

[1] FAO 2016. *The State of World Fisheries and Aquaculture 2016: Contributing to food security and nutrition for all*. Rome. 200 pp.
[2] FAO Food Outlook October 2016

Fish for human consumption is processed and made available in a variety of ways, but is mainly fresh, chilled or frozen, or in some way cured (mainly salted, dried or smoked).

There has been an increasing demand for utilization of rest raw material from fisheries, both for edible and non-edible uses. Rest raw materials include offal, heads, frames and waste cuts and can have high nutritional values. Previously these were either used for silage and fishmeal or simply discarded, but new technologies and increased demand have opened up new markets, thereby decreasing waste from fish production.

3. Trade of Commodity:

Fish is the single-most traded (across borders) food commodity in the world. Around 36% of the total seafood production is destined for export, if counted by live weight, which in 2014 equalled roughly US$148 billion.

According to the latest forecasts, international trade in fish and fishery products will remain steady, in terms of volumes in 2016 (60 million tonnes). Prices of seafood products have been unstable during 2016, which makes it difficult to predict the value of export flows, but the most recent forecasts are expecting the value to increase by over 4% between 2015 and 2016 from $134,1 billion to $140 billion, which will though be well below the 2014 high of $148.3 billion.

WORLD FISH MARKET AT A GLANCE

	2014	2015 *estim.*	2016 *f'cast*	Change: 2016 over 2015
	million tonnes			%
WORLD BALANCE				
Production	**167.2**	**171.0**	**174.1**	**1.8**
Capture fisheries	93.4	93.5	92.7	-0.9
Aquaculture	73.8	77.5	81.4	5.0
Trade value (exports USD billion)	**148.3**	**134.1**	**140.0**	**4.4**
Trade volume (live weight)	**60.0**	**59.9**	**60.0**	**0.2**
Total utilization	**167.2**	**171.0**	**174.1**	**1.8**
Food	146.3	149.4	152.8	2.3
Feed	15.8	16.5	16.2	-1.8
Other uses	5.1	5.1	5.1	0.0
SUPPLY AND DEMAND INDICATORS				
Per caput food consumption:				
Food fish (kg/yr)	20.1	20.3	20.5	1.1
From capture fisheries (kg/year)	10.0	9.8	9.6	-1.8
From aquaculture (kg/year)	10.1	10.5	10.9	3.9

FAO FISH PRICE INDEX (2002-2004=100)	2014	2015	2016 *Jan-Jun*	Change: Jan-Jun 2016 over Jan-Jun 2015 %
	157	142	143	-1.6

Source: FAO Fish Price Index: Norwegian Seafood Council (NSC)
Totals may not add up due to rounding

World fish market at a glance according to FAO food Outlook report from October 2016

Measured in value, major exporting countries include China, Thailand, Norway and Viet Nam, with the latter showing strong growth alongside India. The majority of exports from developed countries is destined towards other developed countries, but an increasing amount has been exported to developing countries over the last few decades as well. This increase is partly due to new consumer patterns in growing economies, but also due to outsourcing of processing to countries with lower production costs. Among exporters, suppliers in Asia are expected to incur strong declines in the value of their exports, especially China, the Philippines and Thailand. Only Vietnam look set to see the value of fish exports rise. The value of fish exports is expected to decrease for most countries in Latin America and the Caribbean, with the exception of Argentina and Brazil, which have regained competitiveness. In Europe, the diversification into new markets, should support a recovery in Norway's fish earnings from the fall incurred in 2015, following the embargo introduced by the Russian Federation.

Japan and the US are the largest single importers of fishery products alongside the EU, with the three responsible for roughly 57% of the total global import. However, the EU has considerable interregional differences. Traditional importers such as Canada, the United States, the EU and Japan are anticipated to face lower fish import bills in 2016. These are also expected to decline in emerging economies such as Brazil, partly reflecting the expected negative impact of the depreciating currency on the country's purchases.

Key KNOWN Authenticity Issues with this commodity (links):

1. Substitution

Species substitution

The ongoing growth in trade and consumption of fish has led to an increase potential for species substitution or mislabelling. This fraudulent practice can have several harmful consequences. For example, conservation and management programs can be negatively affected when endangered species are mislabelled. Alternatively, mislabelling can expose consumers to health risks associated with certain species such as allergens or toxins. However, the incentive for fish species substitution is generally financial, where species of lower quality are mislabelled as a higher-quality species that fetch a higher market price. In any case, incidences of species substitution can lead to consumer mistrust and confusion which in turn can lead to general avoidance of fish products.

Numerus DNA-based techniques have been applied to detect commercial species substitution, including traditional sequencing, FINS (forensically informative nucleotide sequencing), RFLP (restriction length polymorphism), RAPD (random amplified polymorphic DNA), SSCP (single-stranded conformational polymorphism), AFLP (amplified fragment length polymorphism), species specific multiplex PCR and real time PCR. Each of these methods has its advantages and disadvantages and methods are generally select by the quality of the starting material (degree of processing) and the number of species that must be differentiated.
Traceability tools and mass balance calculations are also being applied to detect species substitution fraud. Initial detection via such traceability is then usually confirmed by DNA-based techniques

2. Addition of substance X

Salt
The addition of salt at low concentration affect the water binding ability of muscle proteins, and thus salt has mainly be used to increase weight of fish product (addition of water). Added salt content can be detected using standardised chemical assays.

Benzoic acid
Pelagic fish can be immersed into benzoic acid solution, a preservative, to increase shelf life of marinated products. Addition of benzoic acid can be detected using standardised chemical assays.

Citric acid, ascorbic acid and Erythorbic acid
Citric acid, ascorbic acid and Erythorbic acid can be added to seafood as a preservative and to maintain white colour of whitefish products. This means that they can also be used to "fake" freshness of seafood products. Addition of citric acid, ascorbic acid and Erythorbic acid can be detected using standardised chemical assays.

Carbon monoxide
Carbon monoxide can be added to seafood in order to maintain red colour of tuna meat. Addition of carbon monoxide can be detected using standardised chemical assays.

Injection of vegetable protein
Injection of vegetable protein can be applied to incorporate additional water into the fish muscle, and hence increase weight. Addition of vegetable protein can be detected using standardised chemical assays.

Phosphates
Phosphate can be added to seafood to increase the product weight by incorporating additional water into the fish muscle. It can also be added to inhibit negative quality changes occurring during storage. Phosphates can be detected using standardised chemical assays.

3. Process/production/welfare deception

Frozen sold as fresh
Seafood products that have been frozen and then later thawed are often sold as fresh, without labelling accordingly. Fresh seafood is generally more expensive than frozen, which provides incentives to fraudulently claim that it is fresh. Labelling laws require "previously frozen" products to be labelled as such. Frozen seafood sold as fresh can be detected using NIR and other enzymatic methods.

Geographical origin
Seafood products are often sold with falsified information on geographical origin. Fish coming from unsustainably harvested stocks, illegally caught fish (IUU) and any examples where geographical location can have effect on price is an incentive to falsify information on origin. Falsifying labels of individual producers that have strong market presence or eco-labelling (as well as labelling claiming other favourable attributes) are another manifestation of this problem.

To determine the geographic origin of seafood there are several methods that can be applied:

Genetic methods, such as microsatellite and SNPs, can in some cases distinguish between different geographical stocks of the same species. Otolith microchemical analysis is used to characterize movements, and natal origin of fish. The concentrations of elements and isotopes in otoliths are compared to those in the water in which the fish inhabits in order to identify where it has been. The most effective way for initial detection of this type of fraud is to use traceability and documentation, which are for the most parts a requirement when importing and trading fish within the EU. The application of these traceability data can though be enhanced to facilitate detection of food fraud.

Inconstancies between amounts bought and sold
Illegally caught fish (IUU), species substitution, addition of substances and other such fraudulent acts do usually result in inconsistencies between amount bought and sold. Detection of this is primarily facilitated by strict traceability and documentation requirements within the EU. Catches, landings, trade of raw material, transhipment and more data is required to be documented. The fraud can therefore in most cases be determined by output-/input analysis

Product labelled with ambiguous/vernacular name
Products are in some cases labelled with ambiguous names that consumers do not know and cannot connect with the "common name". Labelling regulations within the EU require producers to use common name and scientific name (Latin name), but this is in some cases being falsified. This kind of fraud can be detected using same methods as for species substitution.

Water injection/overglazing to increase weight
Adding water to the product using injection or excessive glazing is a common way of selling water as more expensive fish tissue. Water and/or brine injection can be determined by analysing the proximate composition of the product, especially water content. Overglazing can be determined by the weight difference before and after thawing of the product. Glazing content can also be determined by direct analyse of the glaze according to the Codex method without thawing the product.

Not disclosed whether farmed or wild caught
EU labelling laws require producers to clearly state whether the seafood is farmed or wild caught. In most cases the wild capture fish is more expensive (this is though not absolute). Analysis of proximate composition and texture can be performed in order to determine whether fish is wild or farmed.

(Possibly listed in most common to least common type of known fraud with regards to this commodity) – Needs to link to FI terms?

Existing relevant information on methods:

The following standards are approved by the Association of Agricultural Chemists (AOAC International), the European Committee for Standardization (CEN) or are currently used as internal validated and accredited methods.

ADDITIVES

Benzoic acid and sorbic acid detected by Gas Chromatographic method – AOAC 983.16
http://www.eoma.aoac.org/methods/info.asp?ID=9379
N-Nitrosamines in Minced Fish–Meat and Surimi–Meat Frankfurters detected by Gas Chromatographic-Thermal Energy Analyzer Method - AOAC 991.28
http://www.eoma.aoac.org/methods/info.asp?ID=16655

WEIGHT

Fish Flesh Content (FFC) in Frozen Coated Fish Products by gravimetric method - AOAC 996.15
http://www.eoma.aoac.org/methods/info.asp?ID=19545
Net contents of frozen seafoods by gravimetric method – AOAC 963.18
http://www.eoma.aoac.org/methods/info.asp?ID=19528

IDENTIFICATION OF FISH SPECIES

Identification of fish species by Starch Gel-Zone Electrophoresis Method – AOAC 962.15
http://www.eoma.aoac.org/methods/info.asp?ID=20089
Identification of fish species by Acrylamide Disc Electrophoresis Method – AOAC 967.14
http://www.eoma.aoac.org/methods/info.asp?ID=20106
Identification of fish species by Thin-Layer Polyacrylamide Gel Isoelectric Focusing Method – AOAC 980.16
http://www.eoma.aoac.org/methods/info.asp?ID=20140
Identification of fish species by Cellulose Acetate Strip Method – AOAC 970.32
http://www.eoma.aoac.org/methods/info.asp?ID=20157

NATIONAL DATABASES FOR GENOMIC AND PROTEOMIC SPECIES IDENTIFICATION

Ittiobase – created by a National Research Laboratory (IZSVE)
http://90.147.123.23/ittiobase/

IDENTIFICATION OF THAWED FISH

Distinction of fresh and thawed fish by a validated histologic method, accredited by the Italian accreditation body (ACCREDIA) that is a member of the European Accreditation (EA)
Microscopical freezing alterations/Histologic analysis of fish muscle – MI 10DG136 rev 2/1 2016
http://www.accredia.it/accredia_labsearch.jsp?ID_LINK=293&area=7&dipartimento=L,S&desc=Laboratori&&&&
http://www.ncbi.nlm.nih.gov/pubmed/22856584

FISH FRESHNESS

Detection of Trimethylamine nitrogen in seafood by colorimetric method – AOAC 971.14
http://www.aoacofficialmethod.org/index.php?main_page=product_info&cPath=1&products_id=976

IDENTIFICATION OF IRRADIATED FISH

Foodstuffs. DNA comet assay for the detection of irradiated foodstuffs. Screening method – EN 13784:2002
http://shop.bsigroup.com/ProductDetail/?pid=000000000030014688

Species substitution

FINS (forensically informative nucleotide sequencing)

Bartlett SE, Davidson WS. 1992. FINS (forensically informative nucleotide sequencing): a procedure for identifying the animal origin of biological specimens. Bio Tech 12(3): 408–11.

RFLP (restriction length polymorphism)

Liu ZJ, Cordes JF. 2004. DNA marker technologies and their applications in aquaculture genetics. Aquaculture 238:1–37.

RAPD (random amplified polymorphic DNA)

Ramella MS, Kroth MA, Tagliari C, Arisi ACM. 2005. Optimization of random amplified polymorphic DNA protocol for molecular identification of Lophius gastrophysus. Cienc Tecnol Aliment Campinas 25(4):733–5.

SSCP (single-stranded conformational polymorphism)

Rehbein H, Kress G, Schmidt T. 1997. Application of PCR-SSCP to species identification of fishery products. J Sci Food Agric 74:35–41.

AFLP (amplified fragment length polymorphism)

Liu ZJ, Cordes JF. 2004. DNA marker technologies and their applications in aquaculture genetics. Aquaculture 238:1–37.

Online resources:

Fish Barcode of Life (FISHBOL) - http://www.fishbol.org/

FishTrace Database - http://www.fishtrace.org

Genetics for Identification of Fish Origin - http://fishgen.jrc.it/welcome.php3

Regulatory Fish Encyclopedia (RFE) - http://www.cfsan.fda.gov/~frf/rfe0.html

Labelfish starndar operating procedures(SOP) - http://labelfish.eu/noticia/labelfish-standard-operating-procedure/

Citric acid

Citric Acid Assay Kit, Cat. No. 10 139 076 035 (enzymatic method)

Carbon monoxide

Anderson, C. R. and W.-H. Wu (2005). "Analysis of Carbon Monoxide in Commercially Treated Tuna (Thunnus spp.) and Mahi-Mahi (Coryphaena hippurus) by Gas Chromatography/Mass Spectrometry." Journal of Agricultural and Food Chemistry 53(18): 7019-7023.

Injection of vegetable protein

Amino acid composition: ISO 13903:2005. “Determination of amino acids content”. Geneva, Switzerland: The International Organization for Standardization.

Water content: ISO 6945:1993. "Determination of moisture and other volatile matter content." Geneva, Switzerland: The International Organization for Standardization.

Phosphate

Nguyen, M. V., J. O. Jonsson, G. Thorkelsson, S. Arason, A. Gudmundsdottir and K. A. Thorarinsdottir (2012). "Quantitative and qualitative changes in added phosphates in cod (Gadus morhua) during salting, storage and rehydration." LWT - Food Science and Technology 47(1): 126-132.

Frozen-thawed fish marketed as fresh fish

Uddin, M., E. Okazaki, S. Turza, Y. Yumiko, M. Tanaka and Y. Fukuda (2005). "Non-destructive Visible/NIR Spectroscopy for Differentiation of Fresh and Frozen-thawed Fish." Journal of food science 70(8): c506-c510.

Rehbein, H. and S. Cakli (2000). "The lysosomal enzyme activities of fresh, cooled, frozen and smoked salmon fish (Onchorhyncus keta and Salmo salar)." Turkish J. Vet Animal Sci 24: 103-108.

Karoui, R., E. Thomas and E. Dufour (2006). "Utilization of a rapid technique based on front-face fluroescence spectroscopy for differentiating between fresh and frozen-thawed fish fillets." Food Research International 39: 349-355

Foucat, L., R. Taylor, R. Labas and J. P. Renou (2001). "Characterization of frozen fish by NMR imaging and histology." Am Lab 33(38-43).

Kitamikado, M., C. Yuan and R. Ueno (1990). "An enzymatic method designed to differentiate between fresh and frozen-thawed fish." J Food Sci 55: 74-76.

Water injection/overglazing to increase weight

Water content: (ISO 6466:1993. "Determination of moisture and other volatile matter content (6496)." Geneva, Switzerland: The International Organization for Standardization.); drip loss (weight loss during thawing); water holding capacity (Eide, O., T. Borresen and T. Strom (1982). "Minced fish production from capelin (Mallotus villosus) A new method for gutting, skinning and removal of fat from small fatty fish species." Journal of Food Science 47: 347-349); weighing of glaze (Codex alimentarius 191-195).

Official Bodies/ Countries involved in control funding of this commodity:

list of organisations that are involved in funding authenticity research for this commodity

International funding:

- European Commission - Research and Innovation (http://ec.europa.eu/research/index.cfm)

Nordic funding:

- Working Group for Fisheries (AG-Fisk) (http://www.norden.org/en/nordic-council-of-ministers/council-of-ministers/nordic-council-of-ministers-for-fisheries-and-aquaculture-agriculture-food-and-forestry-mr-fjls/institutions-co-operative-bodies-working-groups-and-projects/working-group-for-fisheries-ag-fisk).
- NORA - Nordisk Atlantsamarbejde (Nordic Atlantic Cooperation) (http://www.nora.fo/en/frontpageuk/)
- Nordic Innovation (http://www.nordicinnovation.org/en-GB/)

UK funding

- Department for Environment, Food and Rural Affairs (Defra) - https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs
- Food standards agency - https://www.food.gov.uk/
- Marine Scotland - http://www.gov.scot/Topics/marine

Norwegian funding

- Fiskeri- og Havbruksnæringens Forskningsfond, FHF (The Norwegian Seafood Research Fund)
- Norges Forskningsråd (The Research Council of Norway)

Iceland

- RANNIS Rannsóknamiðstöð Íslands (The Icelandic Centre for Research).
- AVS Aukið virði sjávarfangs (R&D Fund of Ministry of Fisheries and Agriculture in Iceland).

France

- DGCCRF / DGDDI: SCL – laboratoire de Marseille LABO13@scl.finances.gouv.fr Official control of inspecting food additives, authenticity, labelling, production mode, nutritional aspects and contaminants level.
- Ministère de l'Agriculture, de l'Agroalimentaire et de la forêt - DGAL : http://agriculture.gouv.fr/mots-cl%C3%A9s/dgal: Monitoring and researching food contaminants, persistent organic pollutants (dioxins, PCBs), heavy metals (lead, cadmium, mercury) and phytosanitary products (chlordecone) etc.
- Ministère des Affaires sociales et de la Santé: ANSES http://social-sante.gouv.fr/ministere/acteurs/agences-et-operateurs/article/anses-agence-nationale-de-securite-sanitaire-de-l-alimentation-de-l monitoring and researching for food safety and risks evaluation, such as histamine levels in fish products, presence of nematodes etc.
- CIRAD: recherche agronomique pour le développement: http://www.cirad.fr/nos-recherches/resultats-de-recherche/%28themes%29/peche-et-aquaculture working on determination of fish origin by DNA analysis of bacteria profile located on fish skin.

Spain

- Ministry of Agriculture, Food and Environment (MAGRAMA): http://www.magrama.gob.es
- Producers' organisations that are involved in traceability and research i.e. AECOC - http://www.aecoc.es/?id=146&plantilla=11&target=Men%FA%3ASectores+de+actividad and ANFACO CECOPESCA - http://www.anfaco.es/es/index.php

Italy

- Ministry of Agriculture, food and forests (MIPAAF) – General Management for Sea Fishery and Aquaculture https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/7486
- National Institutes that collaborate with MIPAAF:
- Institute for Economic Research in Fishery and Aquaculture (IREPA) http://www.irepa.org/
- Council for Agricultural Research and Analysis of Agricultural Economy (CREA) http://www.crea.gov.it/
-National Association of Fish companies (ASSOITTICA) http://www.assoittica.it/

Gaps:

- Lack of easy-to-use traceability software that allows for automated data entry and communication between systems.

- National and international databases of seafood fraud incidents cataloguing the scope and details of seafood fraud.

- Harmonize the use of analytical authentication methods for the testing of seafood (could for example include isotopic ratios database).

- Harmonized databases on chemical contents and nutritional components taking into consideration geographic-, maturity-, seasonal components.

- Improved methods for speciation of fish in fish products (such as surimi and other products where speciation is complicated).

- Lack of official methods to distinguish farmed and caught fish.

- Lack of methods to distinguish fresh from thawed cephalopods and crustaceans.

- Lack of methods to detect H2O2 treatment in seafood products.

- Harmonize naming conventions in seafood labelling.

- validated methods to detect geographic origin.

List of known gaps in Food Authenticity Research in this commodity.