2018 AOCS Annual Meeting & Expo
May 6-9th, Minneapolis, USA

Hot Topic 7
Olive Oil: Innovative Analytical Strategies to Guarantee Quality and Fight Fraud. Focus on the Advancements of the EU H2020 Project OLEUM

Oleum

Better solutions to protect olive oil quality and authenticity

The OLEUM Project: Analytical Solutions Addressing Olive Oil Quality and Authenticity Issues

Start date: 1st September 2016

Now: 21/48 months

Prof. Tullia Gallina Toschi

Department of Agricultural and Food Science – University of Bologna

Scientific Coordinator EU H2020 OLEUM

Minneapolis, 7th May 2018

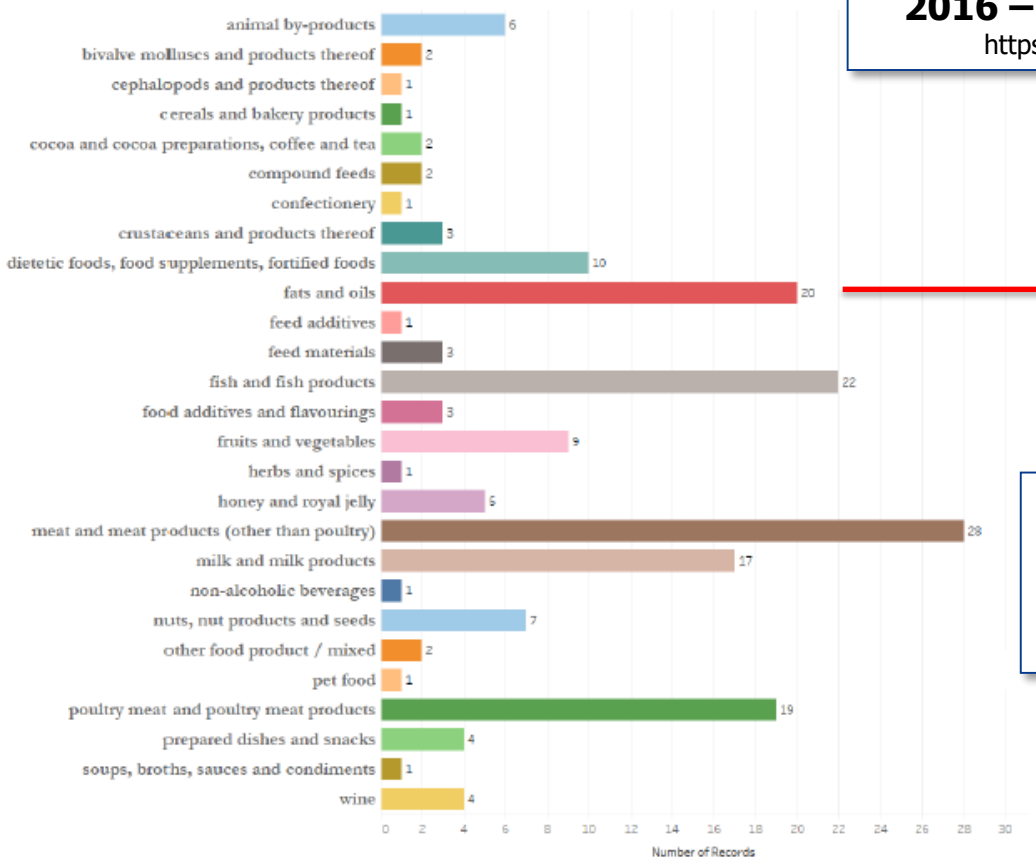
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635690.

Main concepts and assumptions

Olive oil (OO) is in the **top of foods subjected to fraudulent activities**

EU Parliament resolution of 14 January 2014 on food crisis, fraud in the food chain and the control thereof
[Document reference 2013/2091(INI); Johnson, 2014]

Food fraud cases for product categories



2016 – Food Fraud Network Activity Report
https://ec.europa.eu/food/safety/food-fraud/reports_en

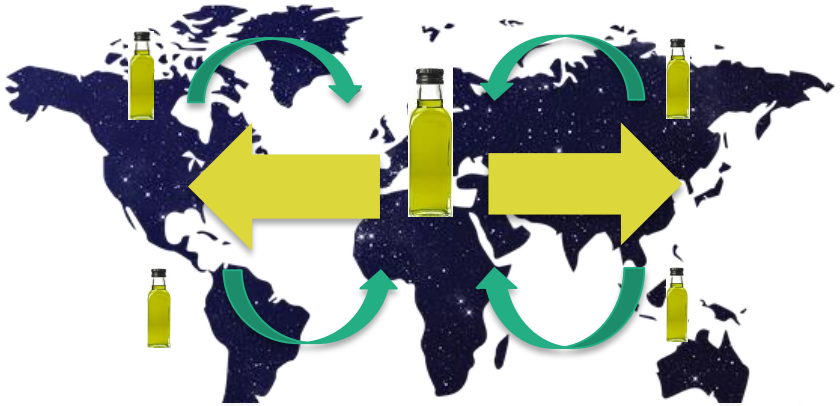
European Commission

Fats and oils

Cases for non compliances

Documents (17)
Mislabeling composition (21)
Unapproved treatment and/or processes (23)

The asymmetry of the olive oil market



- **Europe is the largest producer of OO** (62.4%) and **non-EU countries** are **expanding their domestic production** (IOC stats on OO production – last OO crop 2017-18).

- The International Olive Council **(IOC) member countries account for 92.6% of world OO supply**, but **79.7% of OO demand comes from non-member countries** (e.g. USA, Brazil, Japan, China, Russia, Australia and Canada) (IOC stats on olive oil production and importations– prev. olive oil crop oil 2017-18).

- **Increasing competitiveness**, **expanding markets in non-OO producing countries**, a **lack** of a **centralised databank of validated methods** and a **lack of harmonization** have led to significant weaknesses and vulnerability that can be exploited by counterfeiters.

- **New shared approaches and analytical tools** to check the quality and authenticity of OO are **timely and urgent**, targeting also the **most promising export markets (USA, Brazil, Canada, Australia and Japan)**, **new markets (China, Russia and India)** and **non-producer countries in the EU.**

Gap levels

OLEUM project identified **four main gap levels** that need to be addressed through the **research & development** in the OO sector.

LEGISLATIVE AND REGULATORY

ANALYTICAL

HARMONIZATION AND COORDINATION

CONSUMER AND MARKET CONFIDENCE

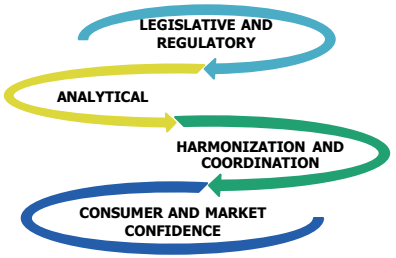
OLEUM zipper role

INPUT

IOC, EC and FDA are involved as **members of the Multi-Stakeholders OLEUM Advisory Board**

OUTPUT

Specific objectives



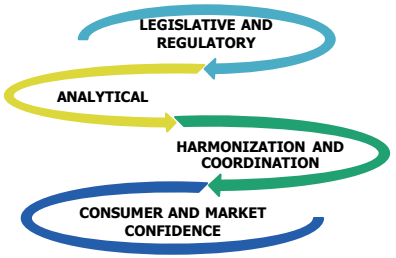
LEGISLATIVE AND REGULATORY

To enable EU and international regulators and policy makers with an array of potential solutions that can contribute to the improvement of **REGULATORY STANDARDS** or **NORMATIVES** (WP2), on the basis of an analysis of **FAILURES** (lack of methods for a specific fraud identification, e.g. deodorization) and/or **INAPPROPRIATENESS** (e.g. Commission Regulation EU No 432/2012 reporting an "OO polyphenols" health claim, but not defining an harmonized methods of quantification).

ANALYTICAL

To revise **EXISTING METHODS**, to verify OO quality and to detect fraud by: identifying the **DRAWBACKS** and improving methods in terms of **performance and efficiency**.
To enhance methodology for **organoleptic assessment** improving reproducibility and developing a quantitative equivalent procedure (**Quantitative Panel Test)**.
To identify **NOVEL ANALYTICAL MARKERS** with the aim of developing and validating **INNOVATIVE ANALYTICAL SOLUTIONS** to:
- Detect **illegal blends** between EVOO and **soft deodorized OO**.
- Reveal **illegal mixtures** between **OO** and **other vegetable oils**.
- Measure the **OO conservation state** in terms of **freshness** and **best before quality** establishment.
- To monitor **compliance with the labelled geographical origin**.

Specific objectives



HARMONIZATION AND COORDINATION

To suggest improvements to **INTERNATIONAL REGULATIONS** and **RECOGNISED PROCEDURES** (EU, IOC, CODEX, ISO) including potential adoption of **new methods** and **reference materials**.

To undertake technology transfer of new methods and procedures to the **WIDER ANALYTICAL COMMUNITY** and assess its **PROFICIENCY** by specific fit-for-purpose actions (e.g. analytical discussions, needs of ring tests).

To compile an **INVENTORY** of **EXISTING** and **EMERGING FRAUDULENT PRACTICES**.

To promote **OPEN-ACCESS KNOWLEDGE GENERATION AND DISSEMINATION** by making **globally available** all the information coming from OLEUM research (e.g. calibration for not targeted methods) and others from reliable sites, to be used for the standardization and make downloadable data and spectra.

CONSUMER AND MARKET CONFIDENCE

To engage the widest range of **STAKEHOLDERS** (opinion leaders/regulators, food and drink industries including SMEs, the media, the scientific community, consumers) in the dissemination, exploitation and knowledge exchange to establish a sustainable source of **reliable information on the methodology for authenticating OO that will be available to the international user community and to the public**.

Oleum

OVERALL OBJECTIVE

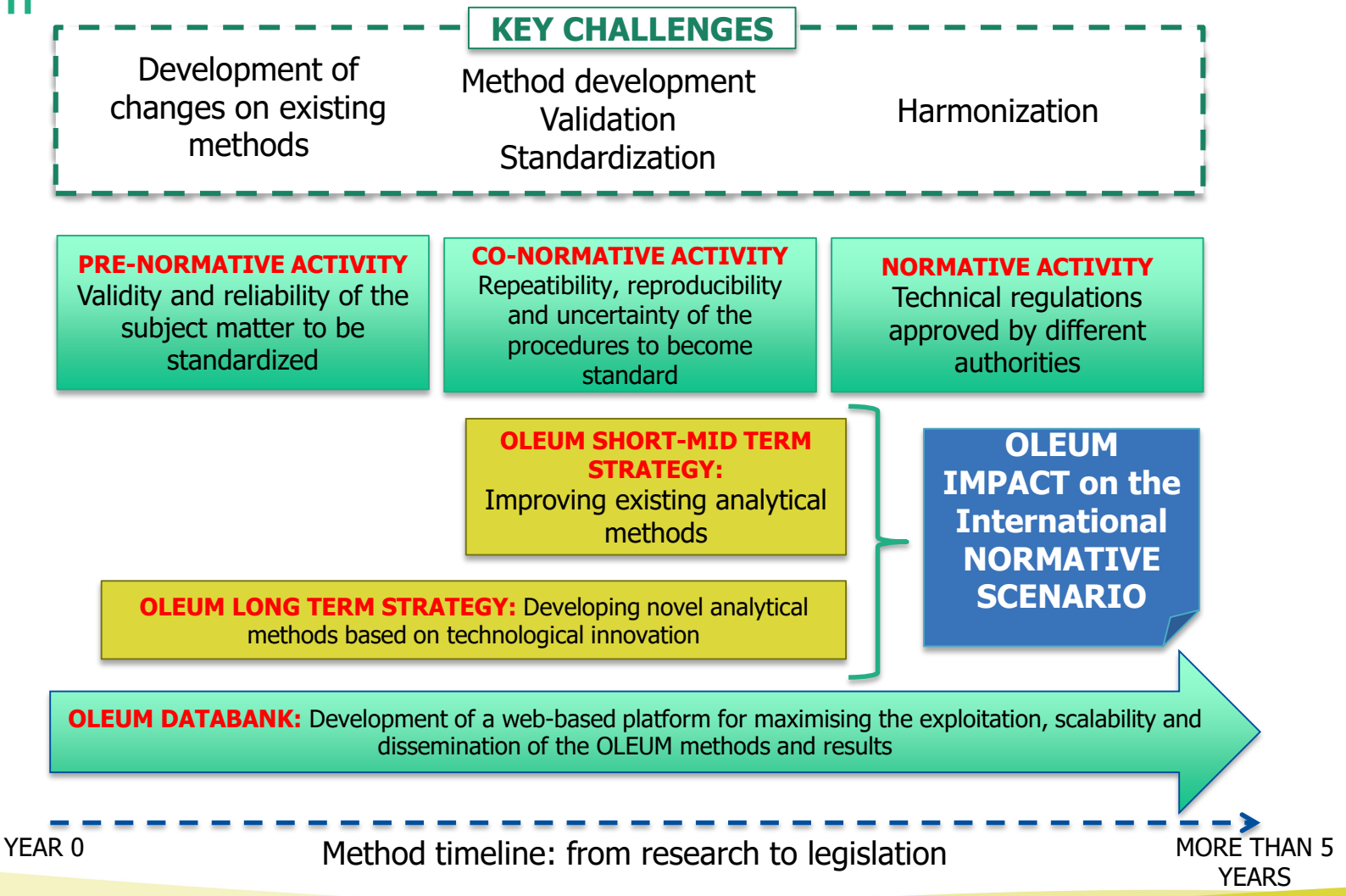
To **better guarantee OO quality** and **authenticity** empowering the **detection** and fostering the **prevention** of OO fraud.

Strategic objectives

- To develop **new/improved methods** for assuring the **quality** and **authenticity** of OOs.
- To develop an **integrated quality assurance infrastructure** for **methods** of analysis (**reference materials**, **downloadable library** of **analytical methods** and **compositions** collected in a **databank**).
- To develop and give a technical support at a **worldwide community of analytical laboratories** involved in the analysis.

Timeline of an OO analytical method *from its inception, validation, standardization (by Standard Developing Organization SDO) and regulation approval and the synergistic OLEUM strategy to maximize the impact on the* ***international normative scenario****.*

Oleum



Strategy and assumption

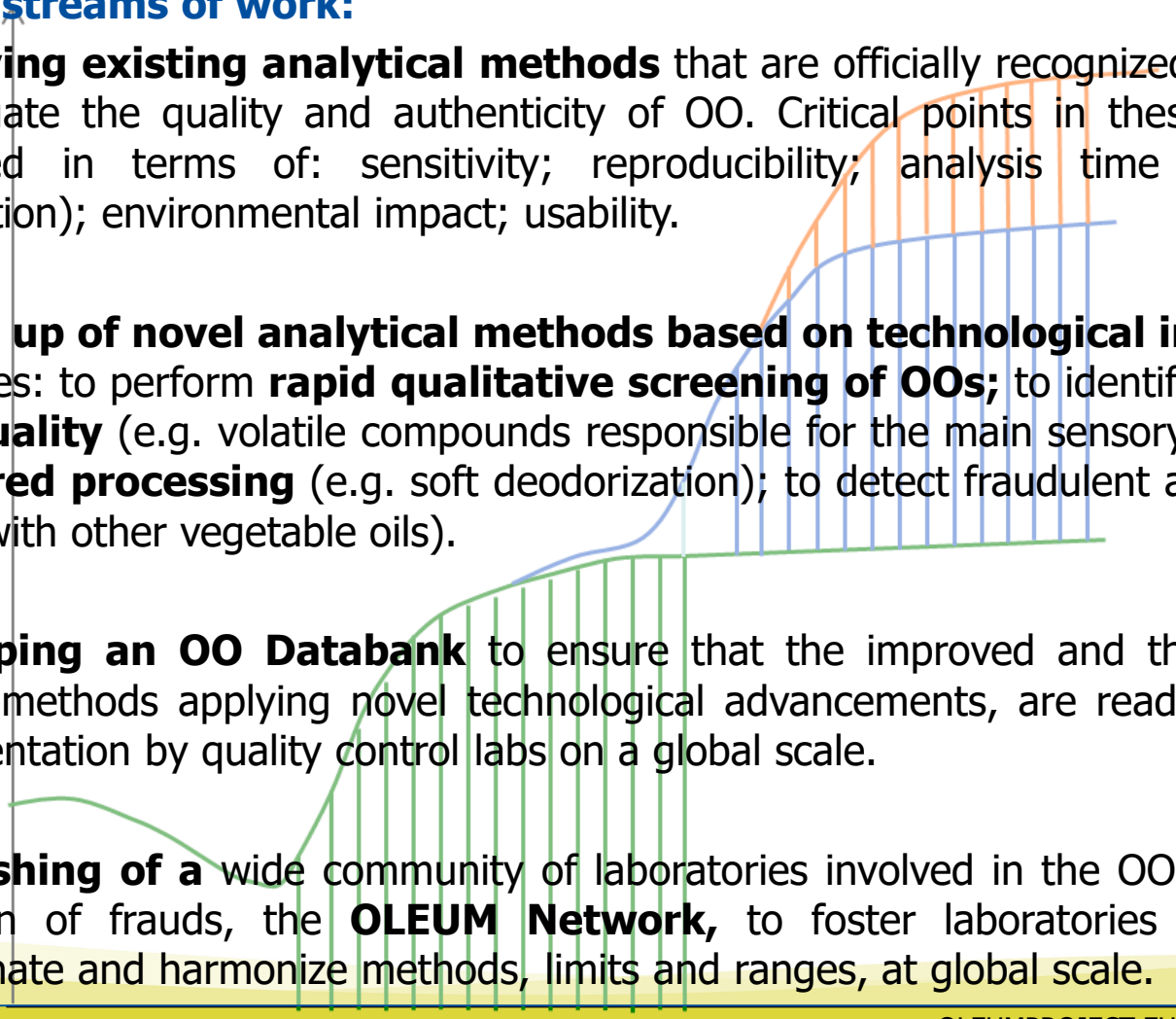
Four main streams of work:

1. **Improving existing analytical methods** that are officially recognized (EU, IOC, CODEX) to evaluate the quality and authenticity of OO. Critical points in these protocols will be evaluated in terms of: sensitivity; reproducibility; analysis time (including sample preparation); environmental impact; usability.

2. **Setting up of novel analytical methods based on technological innovation** with the objectives: to perform **rapid qualitative screening of OOs;** to identify **new markers of poor quality** (e.g. volatile compounds responsible for the main sensory defects); to detect **undesired processing** (e.g. soft deodorization); to detect fraudulent activities (e.g. illegal blends with other vegetable oils).

3. **Developing an OO Databank** to ensure that the improved and the newly developed OLEUM methods applying novel technological advancements, are readily available for the implementation by quality control labs on a global scale.

4. **Establishing of a** wide community of laboratories involved in the OO quality control and detection of frauds, the **OLEUM Network,** to foster laboratories proficiency and to disseminate and harmonize methods, limits and ranges, at global scale.



Strategy and assumption

Improving existing analytical methods that are officially recognized (EU, IOC, CODEX) to evaluate the quality and authenticity of OO.

Envisioned improvement of the existing analytical methods

Scope	Method	*Sensitivity*	*Reproducibility*	*Analysis time*	*Environmental protection*	*Usability*
Quality (commercial categories)	Sensory panel test (EU Reg. 1227/2016)	X	X	X		
Quality (health claim added value)	Biophenols by HPLC (COI T20 Doc. 29/2009 EU Reg. 432/2012)				X	X
Quality-Authenticity (illegal blends with soft deodorized OO)	Fatty acids ethyl esters by GC (EU Reg. 1830/2015)			X	X	X
Authenticity (illegal blends with extraneous vegetable oils)	Global method: TGs by HPLC & FAMEs by GC (COI T20 Doc. 25/2013; EU Reg. 1833/2015)	X	X	X	X	X
Authenticity (illegal blends with extraneous vegetable oils)	Sterols and triterpenic alcohols by TLC / GC (EU Reg. 1833/2015)	X	X	X		

Oleum

Strategy and assumption

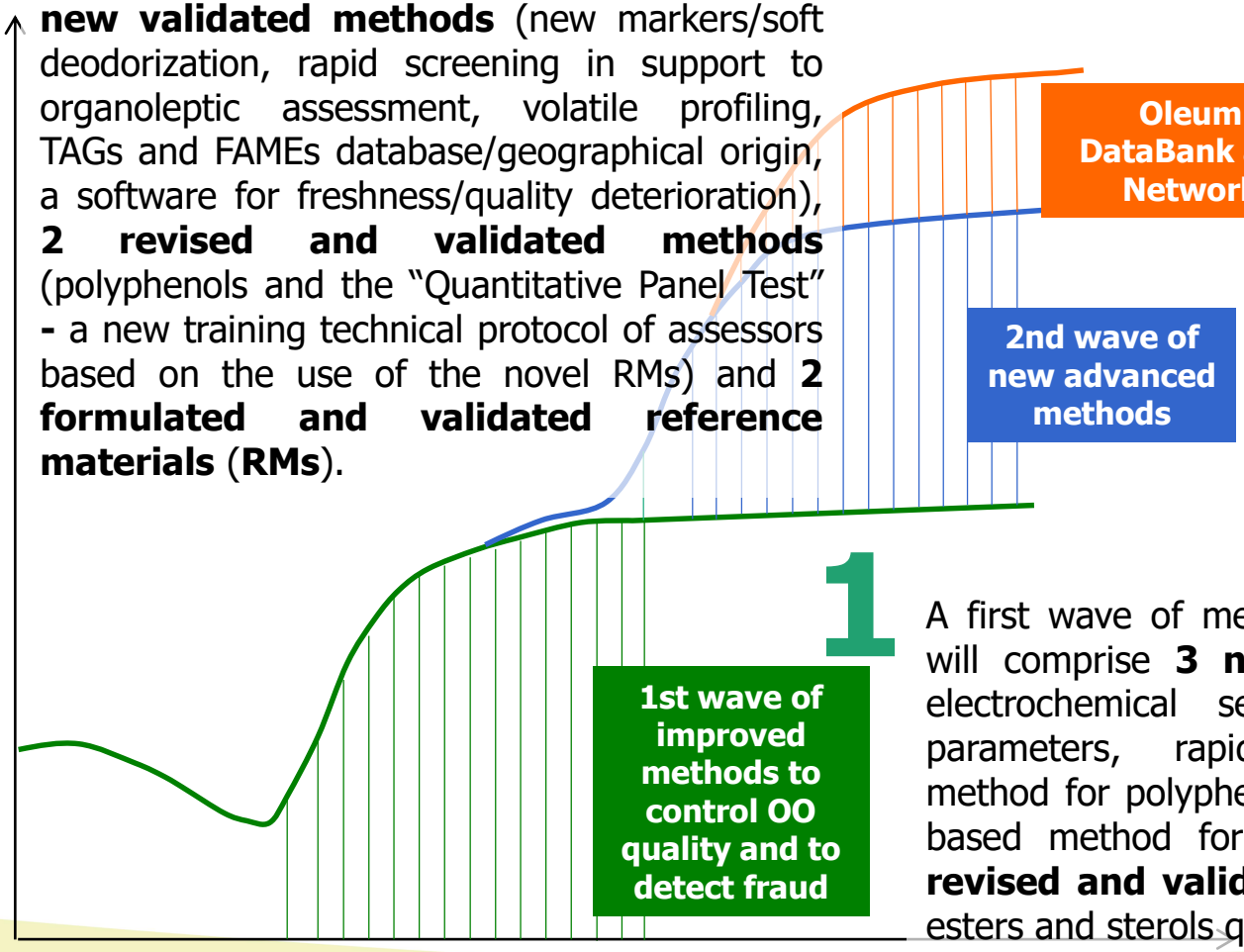
Setting up of novel analytical methods based on **technological innovation.**

Development of new technological advances				
Method	*Quality (new markers)*	*Undesired processing (new markers)*	*Adulteration (new markers)*	*Rapid screening/procedure*
Volatile profiles by SPME-GC-MS NMR, FT-IR, GC-IMS, FGC-e-nose	X	X	X	X
DGs and TGs by FIA-UHRMS	X		X	X
Steryl esters by SPE and LC-MS-MS		X		
Conjugated fatty acids by GC/HPLC-TOF-MS		X		
Fatty acids ethyl esters by TDR, FT-IR		X		X
Next generation sequencing and DNA molecular markers by qRT-PCR, CE (non targeted MiSeq analysis and verification using Nanopore technology)			X	X
Polyphenols, chlorophylls and tocopherols by fluorescence spectroscopy method	X		X	X
Free acidity and peroxide value by electrochemical sensors	X			X
Fingerprint by ^{1}H NMR, FT-IR, mass spectrometry and isotopic analysis	X	X	X	X

Expected results

2

A second wave of methods will generate **5 new validated methods** (new markers/soft deodorization, rapid screening in support to organoleptic assessment, volatile profiling, TAGs and FAMEs database/geographical origin, a software for freshness/quality deterioration), **2 revised and validated methods** (polyphenols and the "Quantitative Panel Test" **-** a new training technical protocol of assessors based on the use of the novel RMs) and **2 formulated and validated reference materials** (**RMs**).



Storage of analytical information

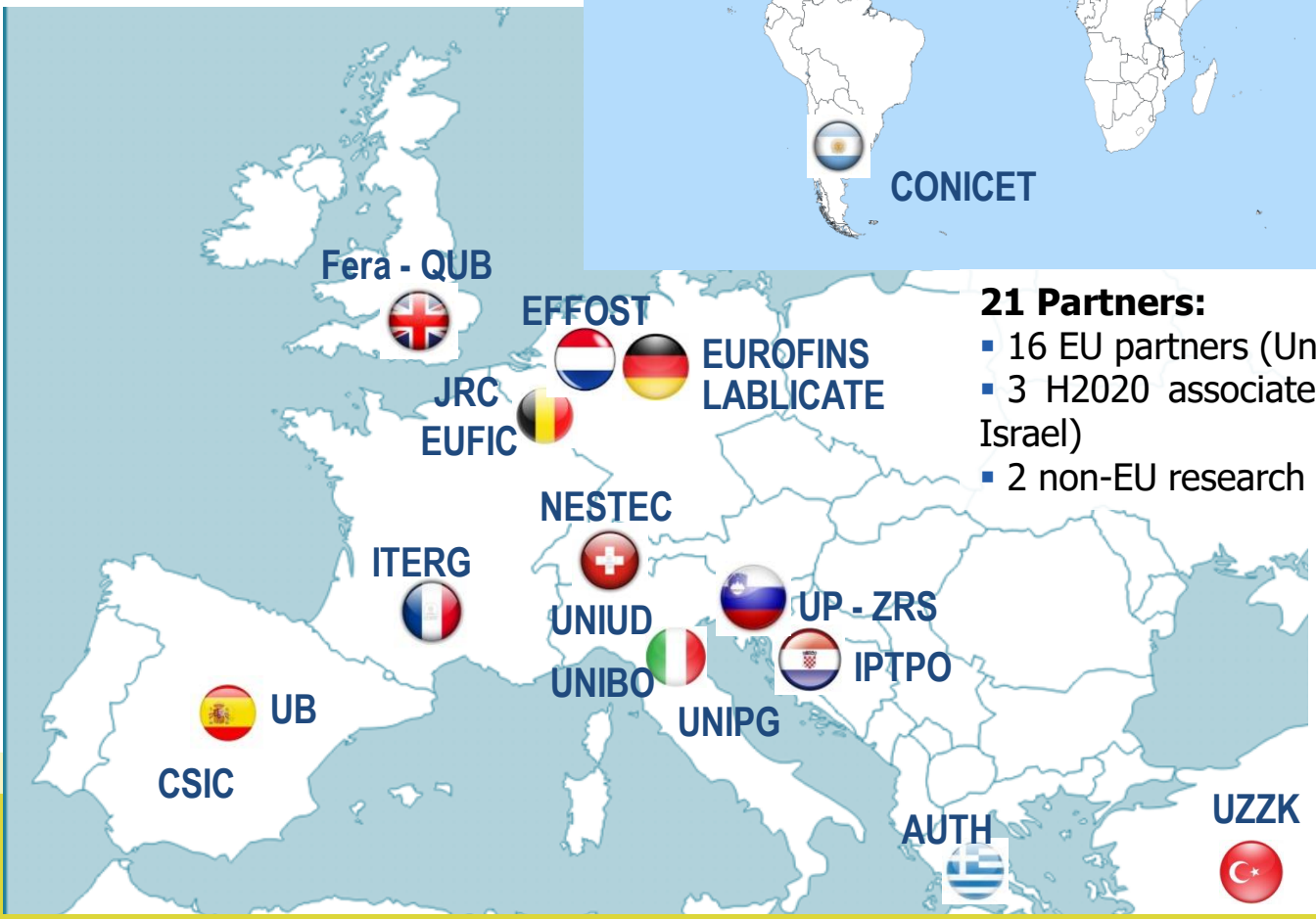
To undertake **technology transfer** and to foster **laboratory proficiency and harmonization on a global scale**

1

A first wave of methods (February-Octobrer 2018) will comprise **3 new validated methods** (e.g. electrochemical sensor technology/basic quality parameters, rapid fluorescence spectroscopic method for polyphenols and genomic/metabolomics based method for illegal blending) and **2 fully revised and validated methods** (fatty acid alkyl esters and sterols quantification).

Tempo

The OLEUM Consortium



21 Partners:

- 16 EU partners (Univ., SME, Associations)
- 3 H2020 associated countries (Switzerland, Turkey, Israel)
- 2 non-EU research centres (Argentina, China)

The OLEUM Consortium

Oleum

2 analytic and service providers SMEs

SMART ASSAYS TECHNOLOGIES LTD

Lablicate

1 large food industry

Nestlé Research

1 private research company

eurofins

3 non-profit organizations

eufic

EFFoST

Uluslar Zeytin ve Zeytinyağı Konseyi UZZK National Olive and Olive Oil Council

14 universities and public research centers

Alma Mater Studiorum A.D. 1088 — Università di Bologna

CSIC — Consejo Superior de Investigaciones Científicas

fera

Aristotle University of Thessaloniki

Università del Litorale Univerza na Primorskem

ZRS — Centro di Ricerche Scientifiche Znanstveno-raziskovalno

Universitas Studiorum Utinensis

CONICET

Queen's University Belfast

European Commission — Joint Research Centre

ITERG — Expertise Corps Gras

Universitat de Barcelona

Studium Generale Civitatis Perusii A.D. MCCCVIII

Institute of Agriculture and Tourism

中轻集团 SINOLIGHT

中国食品发酵工业研究院
CHINA NATIONAL RESEARCH INSTITUTE OF FOOD & FERMENTATION INDUSTRIES

The OLEUM Multi-Stakeholder Advisory Board

- Caroline Jeandin, **European Commission DG Agriculture and Rural Development - Unit G.4 (Arable Crops and Olive Oil)**, Belgium

- Abdellatif Ghedira, Executive Director, **International Olive Council (IOC),** Chemical & Standardization Unit, Spain

- Bruno Di Simone, **Italian Ministry of Agricultural, Food and Forestry Policies**, ICQRF-Laboratorio di Perugia, Italy

- Roland Poms, Secrety General, **MoniQA Association,** Austria

- Breda O'Dwyre, Research Centre Manager of Centre for Entrepreneurship and Enterprise Development (CEED) at the Institute of Technology, **TRADEIT Network**, Ireland

- Fernando José Burgaz Moreno**,** General Director of Food Industry, **Ministry of Agriculture and Fisheries, Food and Environment,** Spain

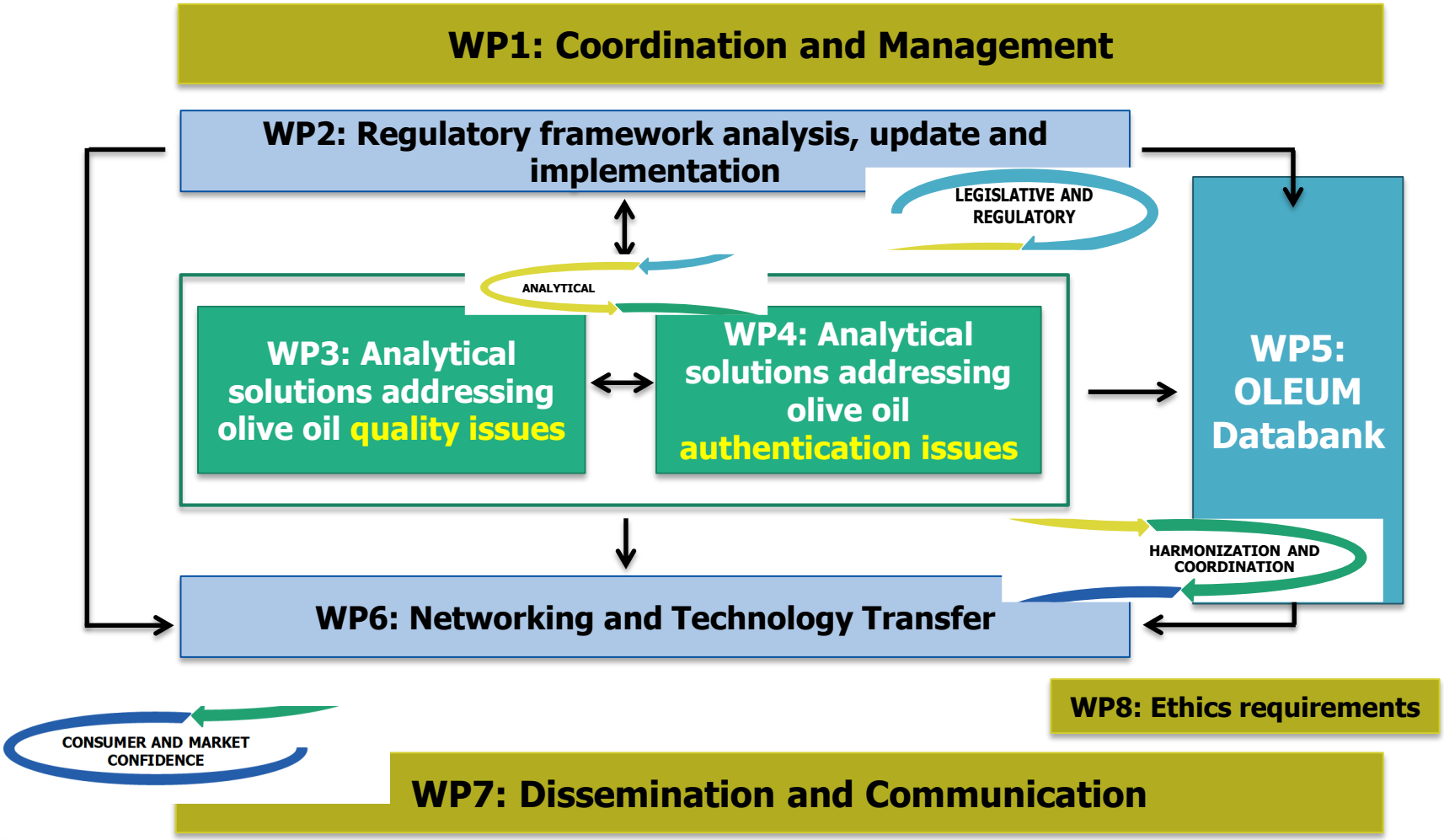
- Richard Cantrill, Chief Science Officer, **American Oil Chemist's Society (AOCS)**, USA

- Dan Flynn, Executive Director, and Selina Wang, Research Director, **UC Davis Olive Center,** USA

- Pierluigi Delmonte, Researcher, **U.S. Food and Drug Administration (USFDA),** USA

- Massimo Vicenzini, President, **Tuscan Food Quality Center,** Italy

PERT Scheme – Work Plan



WP2. Regulatory framework analysis, update and implementation

Oleum

MS12 Selection of available methods and RMs for standardization and harmonization *(Month 42)*

D2.3 Report on the common and emerging frauds *(Month 24)*

D2.2 Review on the dissimilarities among different technical norms, on the lack of methods harmonization (OO quality and authenticity) and on the reported atypical compositions of OOs *(Month 18)*
-DONE-

2020

2019

2018

10:30 a.m. → Olive oil regulatory framework analysis, update and implementation
(Alessandra Bendini, UNIBO, Italy)

D2.4 First report on the cooperative inter-laboratory experiments on the selected methods and RMs and draft of the validated SOPs *(Month 29)*

D2.5 Second report on the cooperative inter-laboratory experiments on the selected methods and RMs and draft of the validated SOPs *(Month 34)*

D2.6 Third report on the cooperative inter-laboratory experiments on the selected methods and RMs and draft of the validated SOPs *(Month 39)*

D2.7 Fourth report on the cooperative inter-laboratory experiments on the selected methods and RMs and draft of the validates SOPs *(Month 44)*

D2.8 Report on the proposal of the validated SOPs and QCMs, togheter with their limits and ranges, to regulatory bodies *(Month 48)*

2016

D2.1 OLEUM position paper on normative failures and inappropriateness *(Month 13)*
-DONE-

Oleum

WP3 Analytical solutions addressing olive oil quality issues

Calibration of sensory Panels

Revision of IOC/T.20/DOC.14/2013

T 3.1 Rapid screening method (set up and in-house validation) and suitable RMs to support the Panel Test - fully validated **Quantitative Panel Test**.

Objectives

T 3.2 Development and in-house validation of a method for **determination of volatile compounds**.

T 3.3 **Freshness** and **best before** assessment.

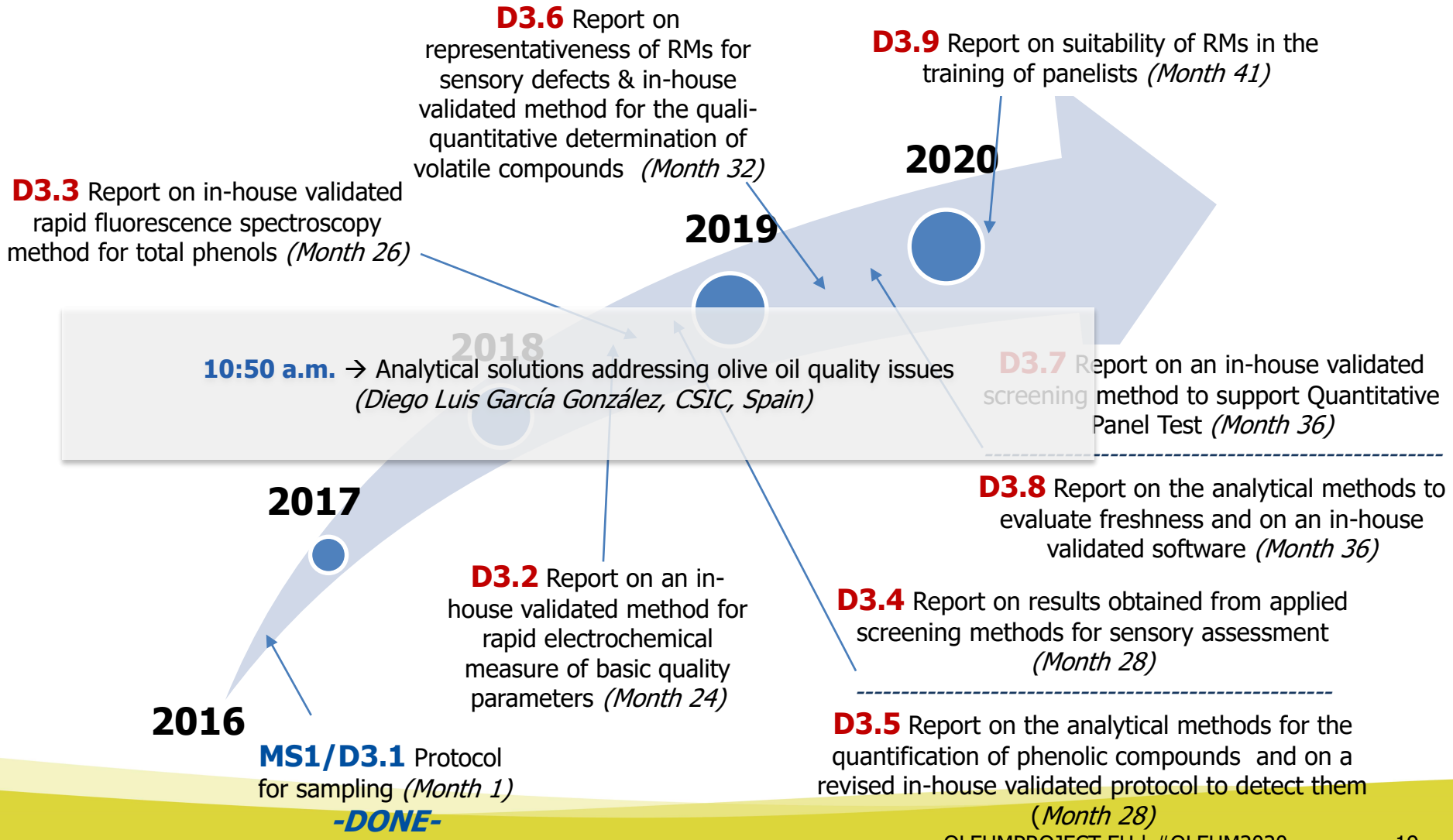
Development and in-house validation of i) a **software** and of ii) a **rapid electrochemical measurement for basic quality parameters**

T 3.4 Hydroxytyrosol and derivatives contents.

Better reliability to guarantee **health claim** (EU Reg. 432/2012).

Development and in-house validation of a method.

WP3. Analytical solutions addressing olive oil quality issues



Oleum

Sample set (EVOO, VOO, LOO)
Reference standards

**In-house validation*

**Fully-validation*

Organoleptic assessment
(6 panels)

Instrumental approaches
(Flash-GC E-nose, SPME-GC-MS, NMR)

High resolution volatile profiling methods
(SPME-GC-FID, GCXGC-MS, TDU-GC-MS, SPME-GC-O)
- on a significant selection of samples -

Classification models

SESSION → Olive Oil, including Sensory Analysis

Tuesday 10:40 a.m. → The profitable relation between sensory and analytics in virgin olive oil quality detection

(Tullia Gallina Toschi, Sara Barbieri, Chiara Cevoli, Ole Winkelmann, Karolina Brkić Bubola, Florence Lacoste, Milena Bučar-Miklavčič, Ummuhan Tibet, Ramón Aparicio-Ruiz, Diego L. García González and Alessandra Bendini)

* **Rapid screening method(s)**
(setting-up and validation)

* Validated method for **volatiles determination**

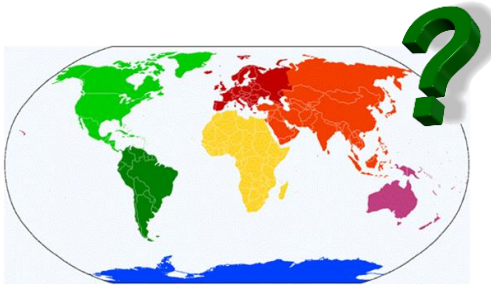
* Formulated and validated **reference materials** (**RMs**)

OBJECTIVE 1:
Reducing the number of samples assessed by the sensory panels

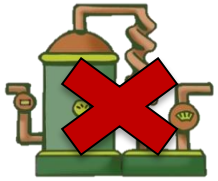
OBJECTIVE 2:
Improving the panel performance (sensitivity, discriminant capacity etc.)

WP4. Analytical solutions addressing olive oil authentication issues

Development of a method to verify the **authenticity of label-declared geographical origin**



T 4.4 Assessment of the **geographical origin** (EU, extra-EU EVOOs)



T 4.1 Set up of a real olive oil "**deodorization scenario**"

Soft-deodorized OOs

Lab scale production

Pilot plant production

Objectives

T 4.2 Detection of **illegal blends with soft-deodorized OOs**

Revision and in-house validation of current EU **FAEE method**

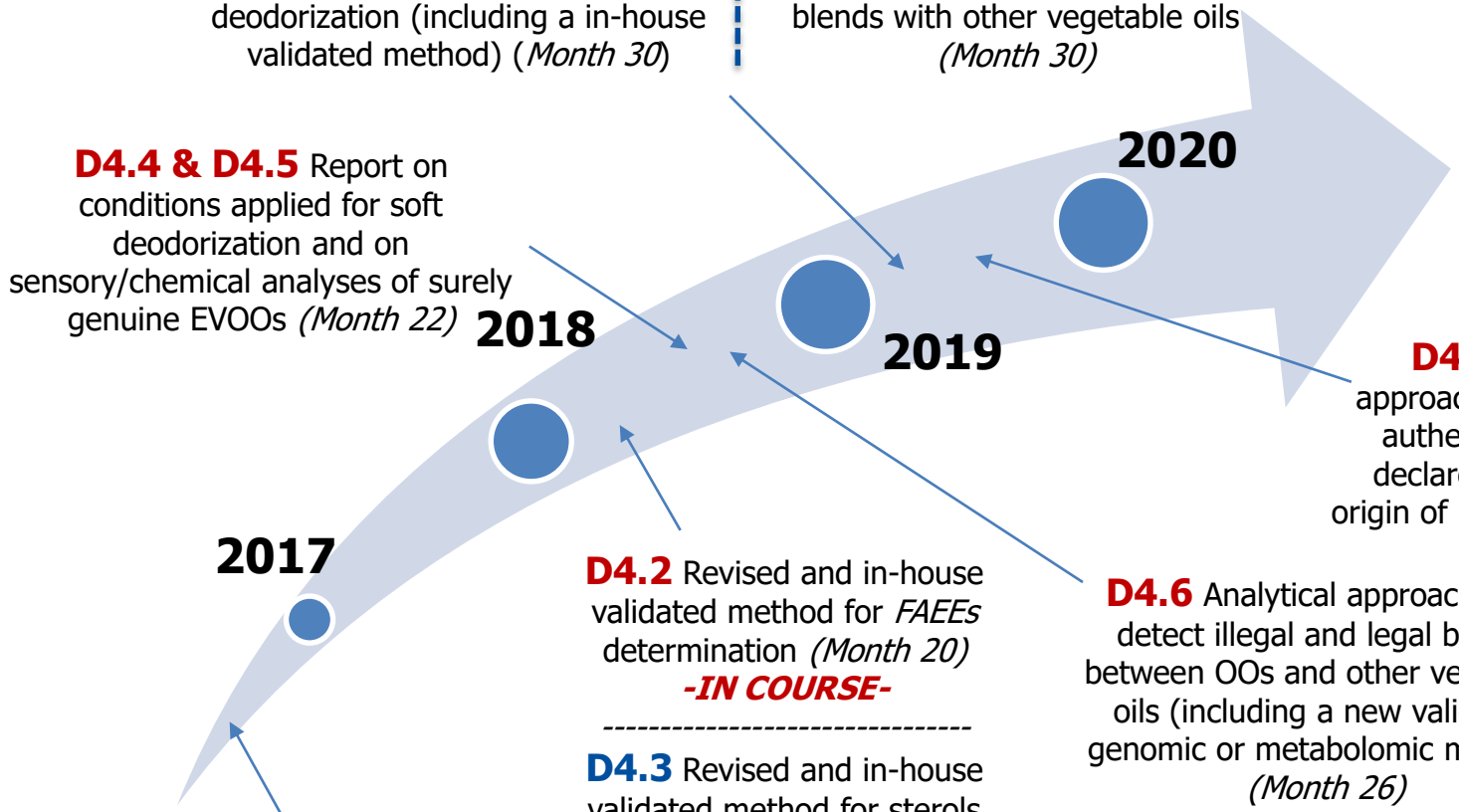
Development and full validation of a new or revised method

T 4.3 Detection of **illegal blends between OOs and other vegetable oils**

Revision and in-house validation of current EU **sterols method**

Development and full validation of a **new genomic or metabolomic method**

WP4. Analytical solutions addressing olive oil authentication issues



D4.1/MS1 Protocol homogeneity and representativeness of the samples *(Month 2)*
-DONE-

D4.2 Revised and in-house validated method for *FAEEs* determination *(Month 20)*
-IN COURSE-

D4.3 Revised and in-house validated method for sterols determination *(Month 18)*
-DONE-

D4.4 & D4.5 Report on conditions applied for soft deodorization and on sensory/chemical analyses of surely genuine EVOOs *(Month 22)*

D4.6 Analytical approaches to detect illegal and legal blends between OOs and other vegetable oils (including a new validated genomic or metabolomic method) *(Month 26)*

D4.7 New and revised analytical approaches to detect soft deodorization (including a in-house validated method) (*Month 30*)

D4.8 Decisional tree for the detection of the percentage of OO in blends with other vegetable oils *(Month 30)*

D4.9 Analytical approaches to verify the authenticity of label-declared geographical origin of EVOOs *(Month 36)*

T4.1 - Soft deodorized OOs production: pilot-plant and blends

Activities of the first year

Conditions applied for the short-path distillation: 140°C, 1L/h and vacuum below 1 mbar (which seems to be the best compromise between discarding of the defect and formation of stigmastadienes).

- Disappearance/strong decrease in the intensity of the **most perceived defect**
- Appearance of a **butter like** sensory note
- Disappearance/decrease in the intensity of **fruity**
- Slight decrease of the **free acidity**
- Slight increase of the **peroxide value**
- No effects on the **UV extinction coefficients**
- No evident decrease of the **FAEEs** content
- Increase of **stigmastadienes** content, but below the EVOO EU legal limit (0.05 mg/kg)
- No formation of ***trans*** **fatty acids**

T4.2 - Detection of illegal processing (deodorization): analytical tools and markers

Analytical determinations performed on all the samples

UNIBO

- FAEEs determination using Time Domain Reflectrometry (TDR)
- Analysis of FAEEs by chromatographic methods (HPLC/GC-FID)

CSIC

- Analysis of the DAG and pyropheophytin by chromatographic methods
- Analysis of FAEEs by chromatographic methods (SPE/GC-FID)
- Analysis of the volatile headspace profile by ion mobility gas chromatography

UB

- Analysis of TAGs profile by direct injection-heated electrospray ionization-ultra high resolution mass spectrometry (HESI-UHRMS)
- Analysis of volatile compounds by SPME-GC/MS

EUROFINS

- FAEEs determination by ^{1}H-NMR

ITERG

- GC-FID for fatty acid profile, LC-refractometry for TAG profile, NIR approach

T4.3- Illegal and legal blends between OOs and other vegetable oils: sampling and analytical tools

Illegal blends

- EVOO + virgin hazelnut (HV_1)
- EVOO + virgin avocado (EVAO_1)
- OO + refined palm olein (RPOO_1)
- OO + refined avocado (RAO_1)
- OO + refined hazelnut (HR_1)
- OO + desterolized HO sunflower (DOSO_1)*

Fera sent vegetable oils, EVOOs and OOs to the partners involved in the analysis. Each partner had to prepare its own blends.

Legal blends

- EVOO + refined NT (conventional) sunflower (RCS_1/NTSO)
- EVOO + refined HO sunflower (ROSO_1)
- OO + refined NT (conventional) sunflower (RCS_1/NTSO)
- OO + refined HO sunflower (ROSO_1)

Fera sent these **legal blends** (60:40, 50:50, 40:60) to the analytical partners, together with the related EVOO/OO and the vegetable oils.

* The desterolized high oleic sunflower oil was produced by ITERG

T4.3 - Illegal and legal blends between OOs and other vegetable oils: sampling and analytical tools

Analytical determinations performed by the partners

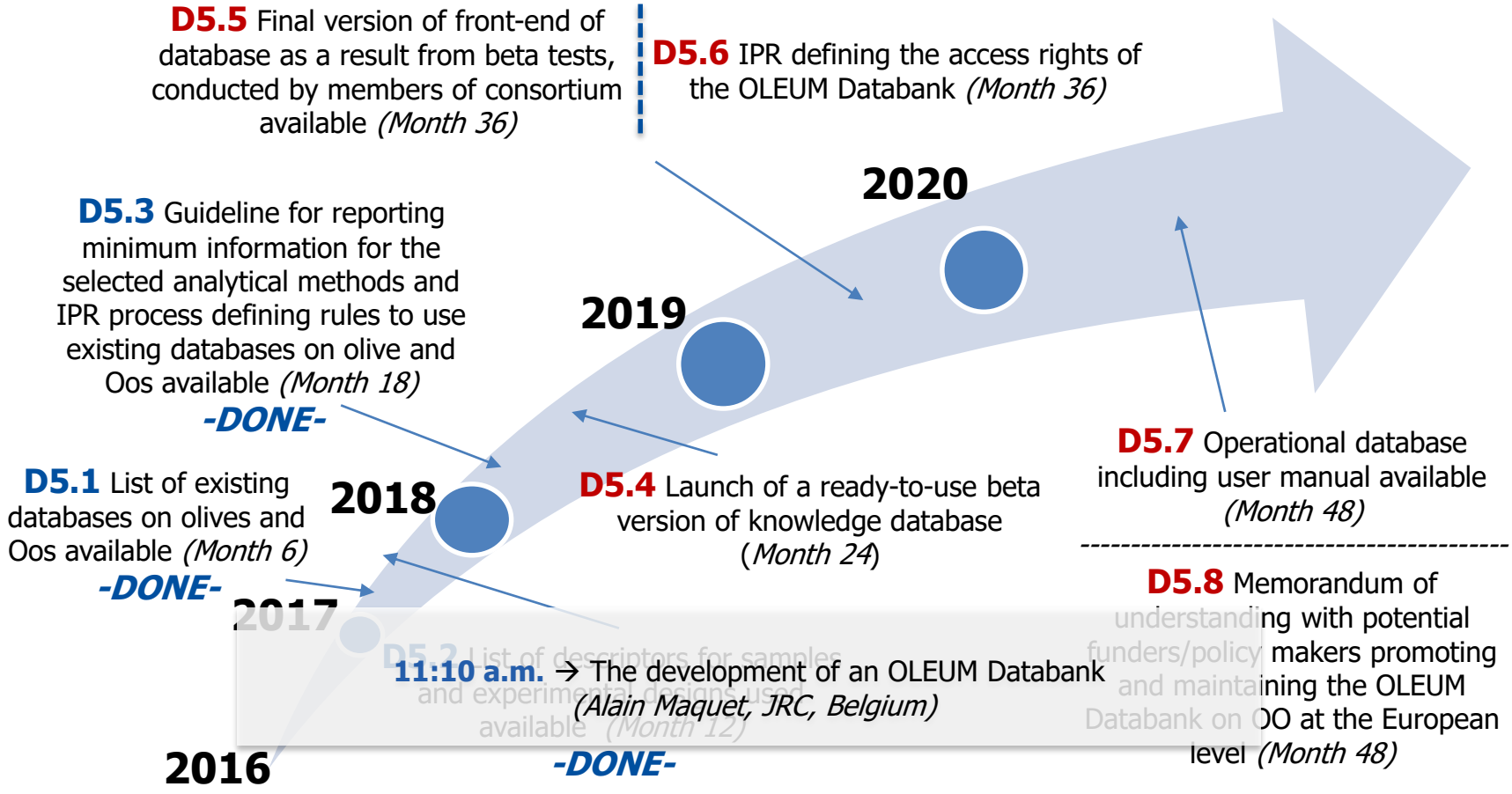
UNIUD	- Determination of TAGs by GC-FID - Analysis of free and esterified sterols (SPE/GC-FID)
EUROFINS	- Analysis of fatty acid profiles by ^{1}H-NMR
CONICET	- ^{1}H-NMR fingerprinting of olive oil to detect the addition of seeds or vegetable oils in illegal and legal blends to olive oils
CSIC	- Analysis of TAG experimental and theoretical composition to check the coherence of composition in illegal blends - Conventional techniques for detecting percentage of vegetable or seed oils in olive oils: TAGs, tocopherols, aliphatic saturated hydrocarbon, sterols - Other advanced and cutting-edge solutions (a genomic targeted approach)
Fera	- Other advanced and cutting-edge solutions (DNA metabarcoding)
UB	- Determination of TAG by direct injection-heated electrospray ionization-ultra high resolution mass spectrometry (HESI-UHRMS) - Analysis of volatile compounds by HS-SPME-GC/MS
Smart Assays	- Analysis of legal and illegal blends of olive oils with vegetable oils using fluorescence spectra scan

T4.4 - Increasing consumer's confidence on the geographical origin of EVOOs: development of analytical tools

Analytical determinations performed by the partners

CNRIFFI	- Isotopic analysis by stable isotope ratios $^{13}C/^{12}C$, $^{18}O/^{16}O$
EUROFINS	- Stable isotope ratios ($^{13}C/^{12}C$, $^{18}O/^{16}O$ and D/H) by IRMS - ^{1}H-NMR fingerprinting of olive oil
CONICET	- ^{1}H-NMR fingerprinting of olive oil
Fera	- Mass spectrometry fingerprinting by LC-TOF-MS
UNIBO	- Flash Gaschromatograpy Electronic Nose (volatile compounds)
UNIUD	- GC-FID and HPLC (TAGs)
NESTEC	- SPME-GC-MS (volatile compounds)
UB	- HS-SPME-GC-MS (sesquiterpene hydrocarbons) - ESI-UHRMS (TAGs)
UNIPG	- UPLC-Q-Exactive Orbitrap MS (TAGs fingerprint)
ITERG	- HPLC-RID (TAGs fingerprint) - GC-FID (FAME)
Smart Assays	- Fluorescence spectroscopy

WP5. OLEUM Databank



WP6. Networking and technology transfer

Enlarge the international body of expertise in the analysis of OOs

Proficiency Testing to identify problems

OBJECTIVES

Develop an **exploitation plan** on the main expected OLEUM research and innovation results

Formal **method validation** (WP2-3-4)

Perform **technology transfer** of new/developed methods to the wider user community

Workshop: problems identified

WP6. Networking and technology transfer

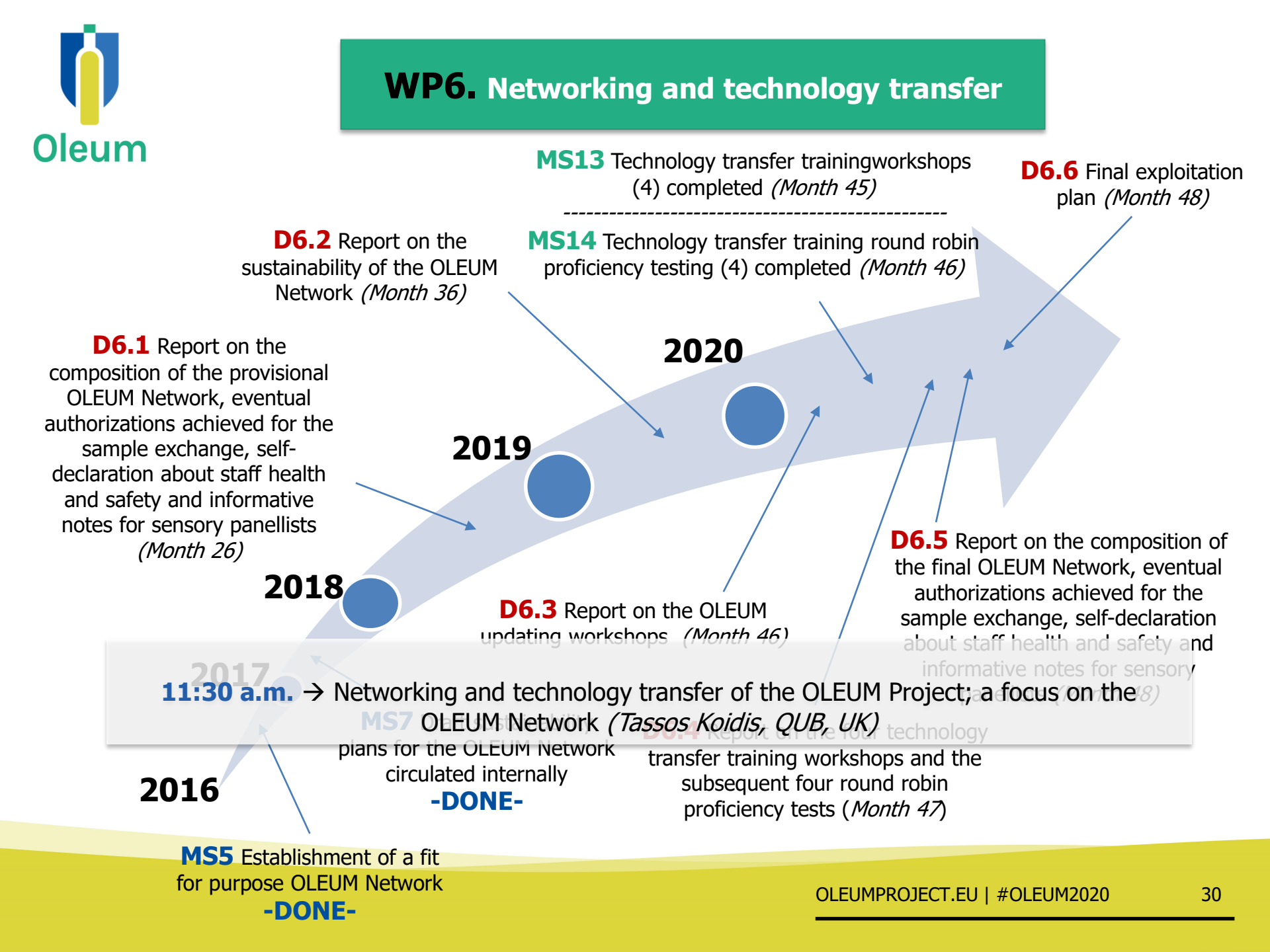
MS13 Technology transfer trainingworkshops (4) completed *(Month 45)*

D6.6 Final exploitation plan *(Month 48)*

D6.2 Report on the sustainability of the OLEUM Network *(Month 36)*

MS14 Technology transfer training round robin proficiency testing (4) completed *(Month 46)*

D6.1 Report on the composition of the provisional OLEUM Network, eventual authorizations achieved for the sample exchange, self-declaration about staff health and safety and informative notes for sensory panellists *(Month 26)*



D6.3 Report on the OLEUM updating workshops *(Month 46)*

D6.5 Report on the composition of the final OLEUM Network, eventual authorizations achieved for the sample exchange, self-declaration about staff health and safety and informative notes for sensory

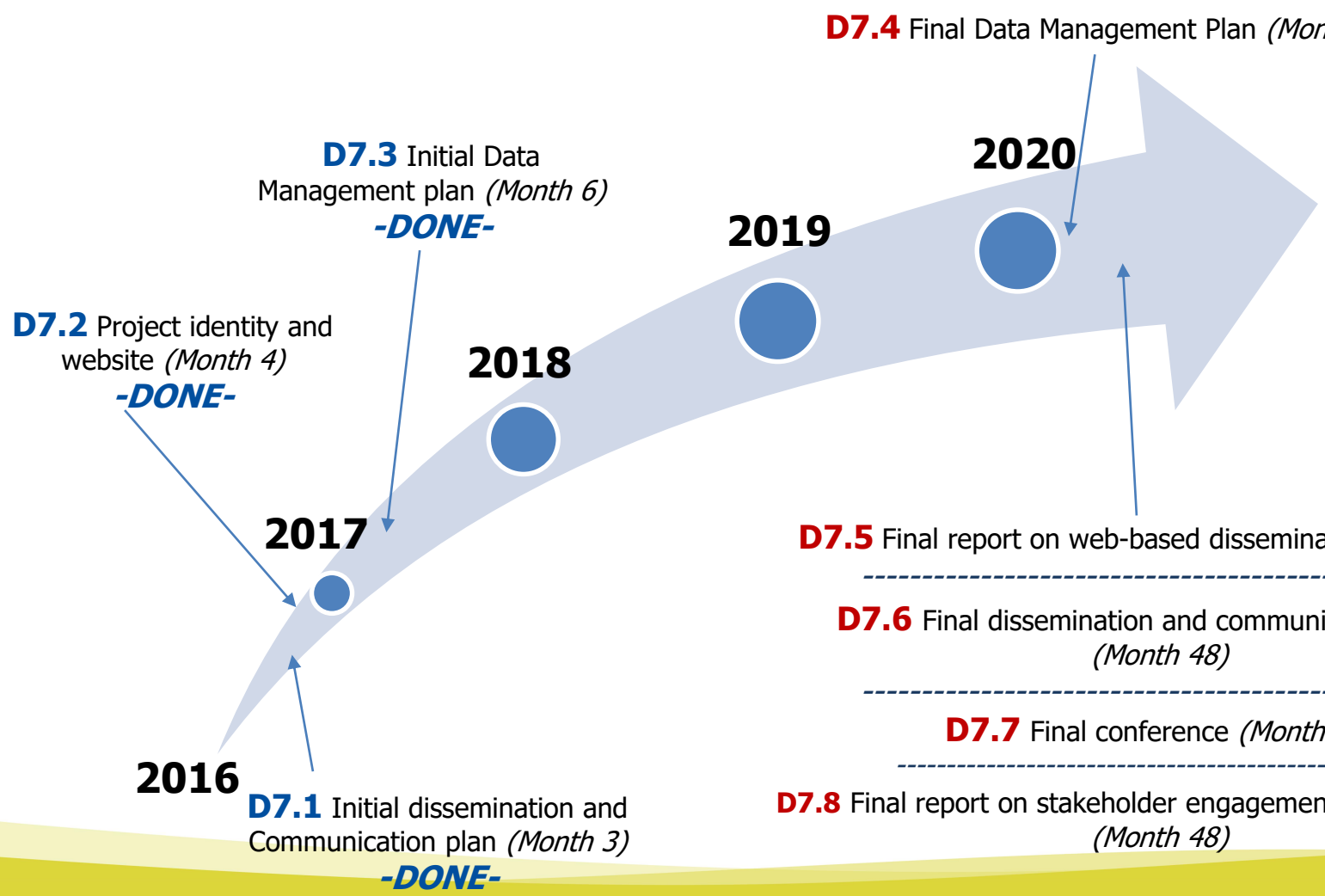
11:30 a.m. → Networking and technology transfer of the OLEUM Project; a focus on the OLEUM Network *(Tassos Koidis, QUB, UK)*

MS7 plans for the OLEUM Network circulated internally **-DONE-**

D6.4 Report on the four technology transfer training workshops and the subsequent four round robin proficiency tests (*Month 47*)

MS5 Establishment of a fit for purpose OLEUM Network **-DONE-**

WP7. Dissemination and communication



WP7. Dissemination and communication

DONE

- **Dissemination & communication plan** outlines all activities (D7.1)
- **Project logo and graphic identity** developed (D7.2)
- Project **website** online at www.oleumproject.eu
- **Social media** presence on Twitter via @Oleum_EU and @SciFoodHealth (ca. 1500 followers)
- **Data management plan** in place
- OLEUM presented at **30 conferences/events**
- **Infographic** for public dissemination about the **production of olive oil** has been realized

Bookmarks and posters

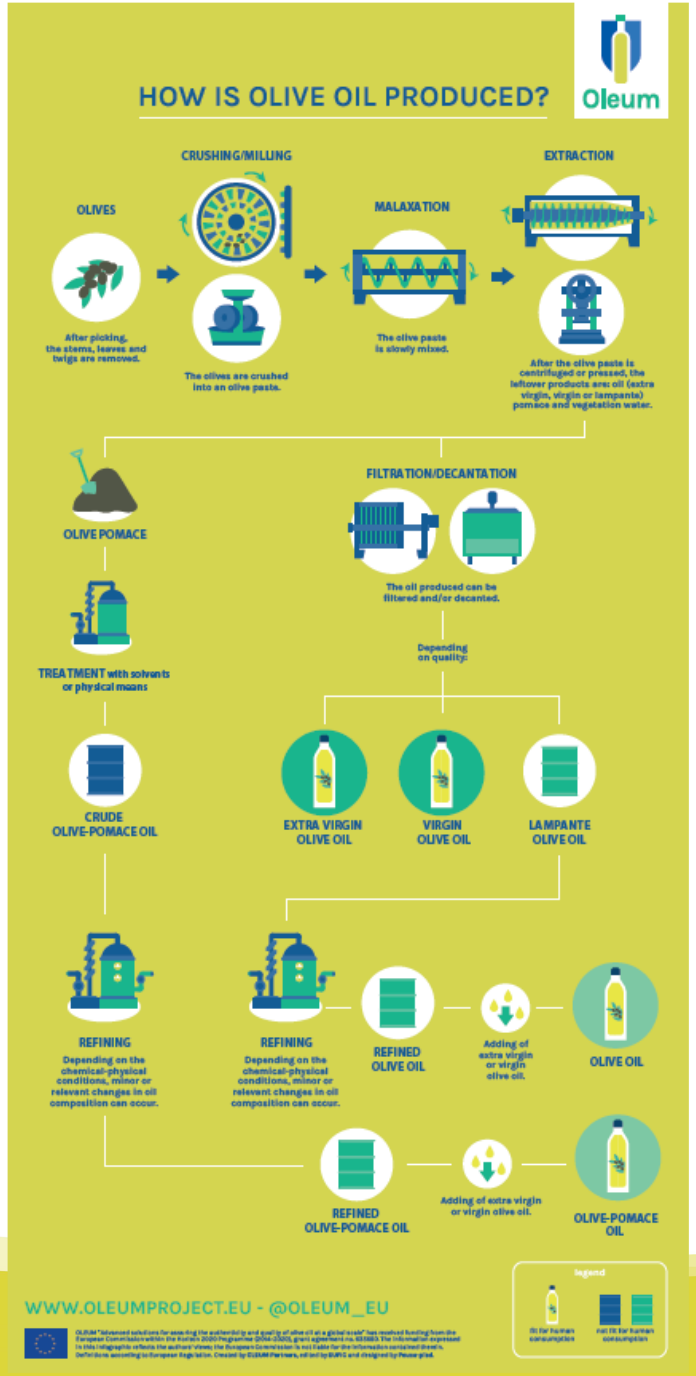
IN COURSE

- Preparation of the **second project newsletter**. To sign up, visit oleumproject.eu
- Update of the **dissemination & communication plan**

NEXT STEPS

- ✓ Realization of **videos and other interactive** materials
- ✓ **Dissemination and communication** activities

Oleum



Infographic for public dissemination about the **production of olive oil**

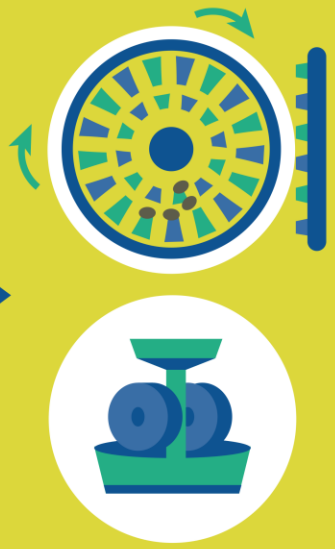
HOW IS OLIVE OIL PRODUCED?

Oleum

OLIVES

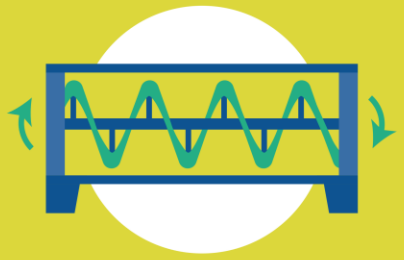
After picking, the stems, leaves and twigs are removed.

CRUSHING/MILLING



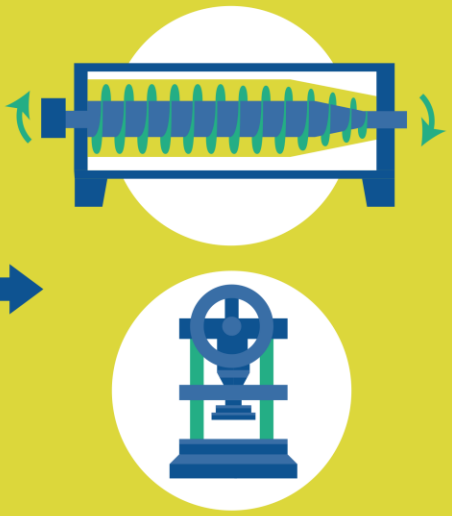
The olives are crushed into an olive paste.

MALAXATION



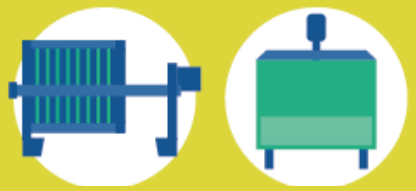
The olive paste is slowly mixed.

EXTRACTION



After the olive paste is centrifuged or pressed, the leftover products are: oil (extra virgin, virgin or lampante) pomace and vegetation water.

FILTRATION/DECANTATION



The oil produced can be filtered and/or decanted.

Depending on quality:

EXTRA VIRGIN OLIVE OIL

VIRGIN OLIVE OIL

LAMPANTE OLIVE OIL

REFINING

Depending on the chemical-physical conditions, minor or relevant changes in oil composition can occur.

REFINED OLIVE OIL

Adding of extra virgin or virgin olive oil.

OLIVE OIL

legend

Fit for human consumption

Not fit for human consumption

Oleum

OLIVE POMACE

TREATMENT with solvents or physical means

CRUDE OLIVE-POMACE OIL

REFINING

Depending on the chemical-physical conditions, minor or relevant changes in oil composition can occur.

REFINED OLIVE-POMACE OIL

Adding of extra virgin or virgin olive oil.

OLIVE-POMACE OIL

legend

Fit for human consumption

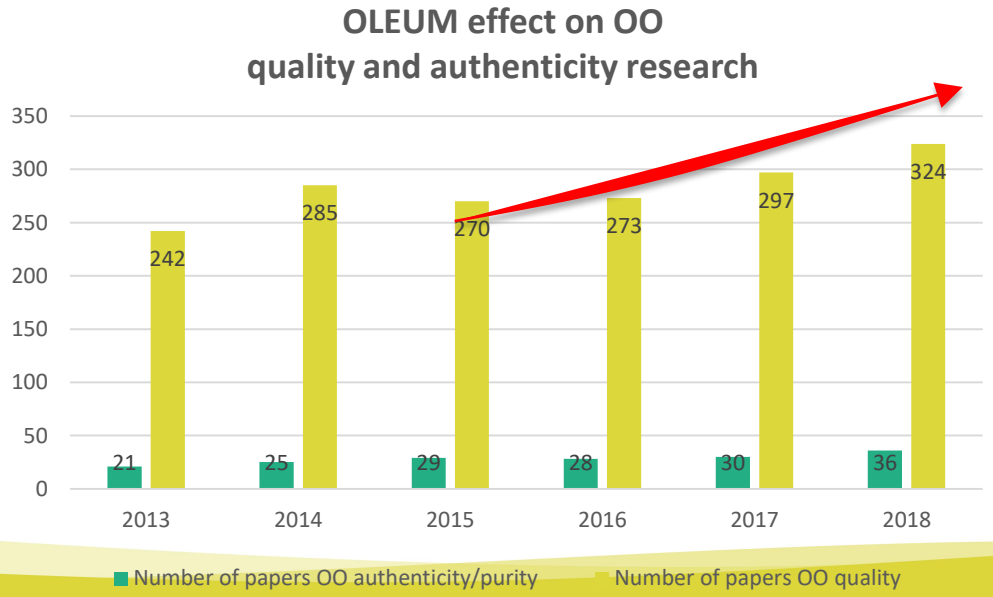
Not fit for human consumption

OLEUM MISSION

- **Promote directly and indirectly collaborative research to speed the control methods path: markers or level of compliance (not targeted) – validation – inclusion in the regulation.**

- **Open the collaboration at non OLEUM partners.**

- **Promote the maximum interaction with instruments' and analytics' producers and sellers.**



Thank you for your attention!

Scientific coordinator

Prof. Tullia Gallina Toschi, PhD

University of Bologna - Department of Agricultural and Food Sciences

tullia.gallinatoschi@unibo.it

Co-coordinator

Dr. Alessandra Bendini, PhD

alessandra.bendini@unibo.it

Project manager

Dr. Andrea Gamberini, PhD

a.gamberini@unibo.it

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635690.