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REGIONE AUTÒNOMA DE SARDIGNA
REGIONE AUTONOMA DELLA SARDEGNA

LIVINGAGRO

Catalogue of innovations

A COLLECTION OF INNOVATIONS FOR THE FIRST B2B EVENT IN JORDAN ON MULTIFUNCTIONAL OLIVE SYSTEMS

WP 2 OUTPUT 2.8 - ACTIVITY 2.8.1

LIVINGAGRO
Cross Border Living Laboratories for Agroforestry

ENI CBC Med Programme 2014 – 2020, first call for standard projects
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Forestas
Agentzia forestale regionale pro s'isvilupu de su territòriu e de s'ambiente de sa Sardigna
Agenzia forestale regionale per lo sviluppo del territorio e dell'ambiente della Sardegna
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Dissemination Level

PU

1 PU = Public document; PP = Partnership document

Project Information

“LIVINGAGRO – Cross Border Living Laboratories for Agroforestry” is a project funded under the ENI CBC Med Programme 2014–2020, first call for standard projects, and refers to thematic objective A.2 “Support to education, research, technological development and innovation,” priority A.2.1 “Technological transfer and commercialization of research results.” Lasting four years (September 2019 - August 2023), LIVINGAGRO involves 6 organizations from 4 different countries (Italy, Greece, Lebanon and Jordan) and addresses the challenge of knowledge and technological transfer in Mediterranean agriculture and forestry systems for achieving and sharing good practices aimed at sustainable production, protecting biodiversity, enhancing transfer of innovation and increasing profitability for territories and main actors as well as stakeholders involved. Using an open innovation-oriented approach for co-creating economic and social values and interactions between supply and demand, eliminating geographical and cultural barriers, two Living Laboratories, focusing on multifunctional olive systems (LL 1) and grazed woodlands (LL 2) are being established. Project partners include: the Regional Forest Agency for Land and Environment of Sardinia (Fo.Re.S.T.A.S.) - Lead Beneficiary, the Italian National Research Council, Department of Biology, Agriculture and Food Science (CNR), and ATM Consulting S.a.s. (ATM), Italy; the National Agricultural Research Center (NARC), Jordan; the Mediterranean Agronomic Institute of Chania (MAICH), Greece; the Lebanese Agricultural Research Institute (LARI), Lebanon.

Introduction

Using the catalogue
We want both senior and less experienced readers to be able to engage with the innovations featured here in order to assess whether these innovations are relevant to the local or global challenges facing them. The catalogue therefore assumes a certain level of understanding of olive growing, olive oil production, and livestock farming, but includes highly technical and scientific terms and notions only where this is essential for a basic understanding of the innovation. This is not a technical manual, but a catalogue intended to provide an overview of some of the innovations that may be useful to those involved with multifunctional olive systems in order to help bring together stakeholders and innovators who may be able to collaborate to solve common problems. Contact information is provided in order to facilitate networking.

About innovations
The European Commission (EC) defines innovation in agriculture and forestry as “‘a new idea that proves successful in practice.’ In other words, the introduction of something new (or renewed, a novel change) which turns into an economic, social or environmental benefit for rural practice.” It may be “technological, non-technological, organisational or social, and based on new or traditional practices. A new idea can be a new product, practice, service, production process or a new way of organising things, etc. Such a new idea turns into an innovation only if it is widely adopted and proves its usefulness in practice.” LIVINGAGRO has gathered a number of innovations in this catalogue which project members believe will prove useful for those who work with multifunctional olive systems.

In 2015, European Commissioner Carlos Moedas established three central policy goals for EU research and innovation: open innovation, open science and open to the world. Open innovation, according to the European Commission, means “opening up the innovation process to people with experience in fields other than academia and science. By including more people in the innovation process, knowledge will circulate more freely.” The LIVINGAGRO team invited numerous stakeholders to share their concerns about needs for innovation related to multifunctional olive systems then attempted to identify innovations related to those concerns, including innovations coming from nonscientists outside academia.

Open science, according to the EC, “focuses on spreading knowledge as soon as it is available using digital and collaborative technology.” Along with LIVINGAGRO’s website, Facebook page, B2B meetings, and other outreach efforts, this catalogue represents an effort to spread knowledge about innovations to the people who need them as soon as possible after project members identify the innovations. Open to the world “means promoting international cooperation in the research community,” and LIVINGAGRO involves direct collaboration among four countries in the Mediterranean region, both in and beyond the European Union: Italy, Greece, Jordan, and Lebanon.

How we created the catalogue
Having identified potentially useful innovations, the partners of LIVINGAGRO suggested a template for innovators to complete. This included assessing the stage of readiness of a potential innovation, as well as which type of challenges it addresses. Taking into consideration the needs expressed by stakeholders, LARI’s research team and technical team reviewed the information provided. Following this review, we went back to the innovators to address questions and fill in gaps, then incorporated the responses into the innovation descriptions.

SECTION 1.

Intercropping and Preparing for Climate Change in Olive Groves

Traditionally, olive groves in Greece have included plants such as legumes, cereals, herbs, vegetables, walnuts, grapevines, and truffles. Such a combination of two crops grown at once on a plot of land is known as intercropping. When it includes trees and an annual crop, it is also a type of agroforestry. The traditional agroforestry practice of intercropping offers many benefits over a monoculture--benefits for the soil, the farm, the broader environment, and (as a result) the farmer. Recommending that olive farmers consider innovating by adapting new, improved versions of traditional agroforestry practices, numerous scientists now provide specific advice to help farmers achieve the greatest possible benefits.

Intercropping increases olive groves’ sustainability by adding to their biodiversity and stabilizing the soil, thus reducing trees’ vulnerability to pests, diseases, and climatic stresses. The greater diversity in plant life enables a larger variety of organisms in the soil, as well as more beneficial insects, pollinators, and birds. With intercropping, the soil benefits from increased porosity, improved drainage, less erosion, and decreased nitrogen and phosphorus leaching, which means fewer valuable minerals lost and less pollution of groundwater and surface water. Fewer pesticides and nitrogen fertilizers are required, and olive trees tend to be healthier, which benefits the planet and the farmer. In addition to saving money on pesticides and fertilizer, farmers may also benefit financially both by producing higher quality olives and by harvesting a second crop. They can either sell this product (as in the case of the recently popular avocados) or use it as a natural soil enricher or an animal feed (as with legumes).

One of the most important crops for the Mediterranean region, the olive tree will be subject to increasingly harsh abiotic stresses due to climate change in the coming years. Abiotic stress comes from environmental conditions that can harm plants and reduce their growth and yield, such as extreme temperatures, soil salinity, and drought. (Biotic stress, on the other hand, is caused by living things such as insects, weeds, bacteria, viruses, or fungi.) Shifting cultivation zones, depletion of organic matter, desertification, degradation of water resources, and other challenges make it imperative to prepare for the future, for example by intercropping and by using trees that can resist the effects of climate change.

Innovation 1: Chickpea intercropping in olive groves

Background
In the regional unit of Fthiotis in Central Greece, agroforestry is a traditional land use system in which farmers used to combine olive production with grazing and arable crops in the same plot. In this way they ensured a steady economic return every year, irrespective of weather conditions or other types of hazards. In recent years, interest in that traditional combination of olive orchards with arable crops revived, so it was tested in a three-year field experiment in Central Greece. Agricultural systems in that area mainly involve field crop production (58%), vegetables (3%), vines (1%), and tree plantations (27%). Typically, farms are small (average size < 3 ha) and managed as private enterprises. Land is usually owned or rented by the farmers. It is estimated that there are almost 7,000,000 trees in the prefecture, which plays a leading role in Greece's edible olive production.

Keywords
olive, silvoarable system, agroforestry system, annual crops, cereal, chickpeas, olive growing, olive groves, olive production.

Methodology
Sow seeds of an annual crop such as chickpeas between tree rows in olive orchards with widely spaced trees (100 trees/ha). 80 kg of seeds are required for each hectare.

Specifications
A local variety of chickpeas that is resistant to fungal infections is preferred (such as Amorgos chickpeas with olives in Fthiotis). A wide variety of species can be used as intercrops between the trees, depending on the region and the compatibility of species to be intercropped. Local experts should be consulted to determine the best species for a given area.

Impact
Chickpeas' low water demand renders them ideal for intercropping with trees of similar water requirements in the Mediterranean and other dry ecosystems. Additionally, they provide nitrogen to the soil, thanks to the symbiotic relationship of their roots with nitrogen-fixing bacteria. This results in a reduced need for nitrogen fertilizers, lower expenditure on such fertilizers, and a reduced risk of nitrogen leaching and subsequent soil and water contamination. The annual crop (chickpeas in this case) can be sold on the market as a high quality product with significant nutritional value, increasing the farmer's income.

Filled gaps
This traditional approach, which was used in the past in silvoarable systems with a variety of species (including nitrogen fixing plants), encourages the preservation of agroforestry systems by their final users, the farmers, by providing financial incentives for their preservation. This is important since these valuable agroforestry ecosystems are closely linked to Greece's natural and cultural heritage. They also provide numerous high-quality, mostly organic products, such as olives, olive oil, and annual crops, thus contributing a great deal to the rural economy. Additionally, intercropping requires that the land be cleared of understory vegetation, and such clearing reduces the risk of forest fires.

Limitation
The intercropping species must be chosen carefully by experts to ensure compatibility with local conditions and lower light availability, as well as eliminating the possibility of pathogen transfer between the plant components.

Next steps/potential extension
To evaluate the possibility that silvoarable systems can provide multiple products while supporting local stakeholders, an experiment was established under the framework of the AGFORWARD project. This practice has also been tested in other countries. The results have been encouraging in all cases. Different seed mixtures could also be tried in different areas to determine which ones work best in each location.

Find out more
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Innovation 2: Effect of soil management and different cover crops on soil characteristics, olive production and olive oil characteristics

Background
The majority of Lebanese olive orchards are considered traditional rain fed and are planted mainly with the local Baladi variety, which is a highly alternate bearing variety. This has a strong negative impact on the ability to reach new olive oil markets, since consistent amounts of high-quality olive oil would need to be provided each year. In Lebanon, many studies have focused on the effect of cultivar, irrigation, harvesting, and processing systems on the quality of olive oil. However, no studies have been conducted on the effect of fertilization, and especially the effect of green fertilization, on soil fertility, tree productivity, olive oil quality, and alternate bearing of the olive tree. Since soil fertility and nutrient requirements may vary among different olive orchards according to the tree age and olive production system, it is necessary to determine how to provide the best fertilization system at the minimum cost. The objective of this experiment is to assess how combining minimum tillage, an overwinter cover crop, and rational fertilization affects the performance of the olive trees—mainly their alternate bearing behaviour--as well as increasing farmers' income through multiple cropping.

Keywords
Olive orchards, olive oil, local olive variety, soil fertility, fertilization, alternate bearing, cover crop.

Methodology

The 2960 m^2 field originally contained 70 trees from the Baladi variety which had been planted in 1996 in 7 columns and 10 rows, with a spacing of 6.5m between rows and columns. Thirty trees chosen for being homogenous were included in the study. To avoid waterlogging during the season of heavy rains, it was necessary to drill a water collector canal at the end of the field just before the start of the experiment in November 2020. Trees were also pruned and sprayed with copper, and the soil was plowed and prepared for the establishment of the five following treatments using a completely randomized design with six replicates (6 trees) per treatment:

- Faba beans *(Vicia faba)*
- Broccoli *(Brassica oleracea var. italica)*
- Barley *(Hordeum vulgare)* with common vetch *(Vicia sativa)*
- Spontaneous vegetation as a negative control
- Fertilizers + herbicides as a positive control

In December, leaf samples were taken (120 leaves/tree) and laboratory analysis was carried out to determine the level of N/P/K/B/Fe/Zn in the leaves. In addition, soil samples from two depths (0-20 cm and 20-40 cm) were taken to measure the pH, texture, calcium carbonate and organic matter, in addition to the ammonium, nitrate, phosphorus and potassium levels. Analyses of leaves and soil samples were repeated at the end of the experiment.

Plant height and yield were measured for the faba plants. For the broccoli, the fresh and dry weight of the biomass were taken. Samples from the vetch and barley treatment as well as the spontaneous vegetation were taken, and weeds were separated and dry weight was measured. Biomass production was taken at the termination of the trial in April.

Specifications

The implementation of this experiment is simple and low-cost. Soil nutrient recycling and moisture and soil temperature were assessed. Fruit samples were collected for olive oil yield and some other chemical, physical and sensory analyses.

Impact

- Reduced alternate bearing behavior in olive trees
- Improved productivity and oil yield and quality
- Increased farmers' income by introducing secondary crops (green faba bean) in the olive orchards

Filled gaps

Farmers can save money on inorganic fertilizers. The use of forage legume (vetch) provided more soil nitrogen through atmospheric fixation as compared to the vetch/barley, barley alone, or the spontaneous weeds.

Limitation

Low or high rainfall in some regions may reduce the germination rate and biomass production.

Next steps / potential extension

Other benefits from the cover crops (forage crop, better water infiltration, protection from soil erosion), better productivity and olive oil quality.

Find out more / contact information

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SECTION 2.

Olive Tree and Olive Oil Authentication

Whether determined through visually observable characteristics (phenotype), genes (genotype), or chemical analysis, olive variety and olive oil grade identification can be useful to nearly everyone who works with olives or olive oil, from producers and millers to researchers and consumers. Consumers and those who serve them, for example, are increasingly interested in learning about the exact type and origin of products, including the types of trees their olive products come from. Seeking high quality and anxious to avoid fraud, many prefer authentic, certified products. Researchers, growers, breeders, and conservationists want to know which olive cultivars are growing in which areas and conditions in order to assess biodiversity, consider how to prepare for climate change, and prepare to preserve genetic resources. Cultivar identification is also fundamental to overcoming confusion concerning varietal names, a common obstacle in current olive research. Innovative ways of identifying olive cultivars are especially useful for all of these reasons, and more.

Innovation 1: DNA-based diagnostic test to authenticate the varietal origin of olive oil

Background

Very rich in health benefits, olive oil has been a major part of the Mediterranean diet for millennia. Thanks to growing awareness of its nutritional value and flavor, as well as the globalization of food markets, olive oil is now widely distributed around the world. Unfortunately, its higher prices compared to vegetable oils make it especially disposed to fraudulent practices. This leads to concern about the quality and origin of olive oil. A variety of factors make it challenging to ascertain an oil's identity, since such variables as the climate, environment, agricultural practices, fruit ripeness, and extraction methods all affect the oil, in addition to the olive variety. We offer a new solution: a DNA-based diagnostic test for olive oil that conclusively identifies the variety of olives used to make premium monovarietal extra virgin olive oil.

Keywords

olive oil authentication, olive oil testing, olive oil analysis, monovarietal olive oil, olive oil authenticity, traceability control, olive oil traceability, monovarietal olive oil validation, SSR-HRM

Methodology

In a laboratory, DNA is extracted from a sample of olive oil and analyzed. A novel analytical technique for olive oil authentication and traceability control is used: high-resolution melting (HRM) DNA analysis with a real-time polymerase chain reaction (PCR). Molecular markers are used to distinguish monovarietal olive oils. This is a closed-tube approach involving a single reaction in the lab, which provides such advantages as speed, low cost, simplicity, sensitivity, and reliability. (See Find Out More below for scientific articles that provide details about this method.) The graph below is an HRM difference plot that shows three different melting profiles, one for each olive variety, allowing them to be conclusively distinguished from each other (Image 1):

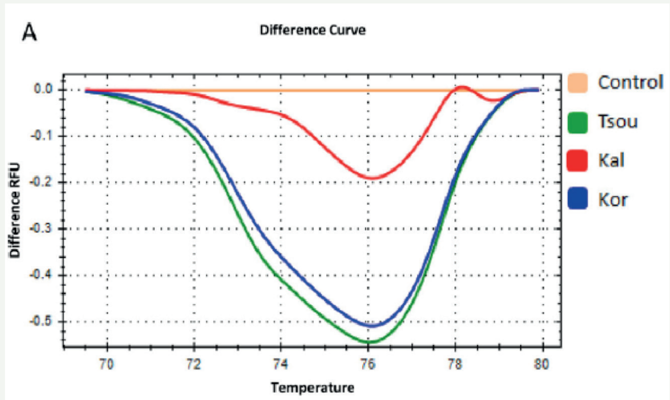

Image 1: a graph illustrating the difference between several olive oil varieties (by Panagiotis Kalaitzis)

Specifications
Specific molecular markers have to be selected and tested to discriminate and authenticate particular olive varieties. Therefore, a database of these markers is required to ensure reliable discrimination and validation. Such a database has been developed at the Mediterranean Agronomic Institute of Chania. Using this database, cultivar-specific diagnostic kits will be prepared to provide the appropriate markers for identification. A kit can be created to identify one olive variety or a number of different varieties.

Impact
There is great concern about the authenticity and traceability of high quality monovarietal extra virgin olive oil (EVOO) on the part of both consumers concerned about the authenticity of their high-priced EVOO and the people working in the olive oil sector who strive to make that EVOO and get it to consumers. Since a major part of authentication efforts concentrates on the identification of the varietal origin of an EVOO, this accurate innovation can be used to provide a certification likely to increase a product's appeal and price.

Filled gaps
DNA-based approaches are more accurate than analytical chemistry methodologies for olive oil varietal authentication due to their sensitivity, specificity, and reliability. DNA-based methods are preferable because they are not affected by the environment or conditions, and they require no statistical analysis. Once a sample is extracted, the test will have very high accuracy regarding the olive variety.

Limitation
DNA-based approaches cannot provide any information about the geographical origin of monovarietal olive oils from similar cultivars. In some cases, it is not possible to extract DNA from a specific olive oil sample, and a fresher sample will be required. Quantitative assessment still remains a challenge.

Next steps/potential extension
A diagnostic test is being developed that can be used in various labs; in the future, any lab will be able to buy a test kit. Work is also progressing toward a kit that will detect adulteration with cheaper vegetable oils. Additional development will continue after an expression of interest from an investor.

Find out more

Elsa Chedid, Myrto Rizou, Panagiotis Kalaitzis (2020) Application of High Resolution Melting combined with DNA-based markers for quantitative analysis of olive oil authenticity and adulteration. Food Chemistry: X, 100082.

Ganopoulos, I., Bazakos, C., Madesis, P., Kalaitzis, P., Tsaftaris, A. (2013) Barcode-DNA High Resolution Melting (Bar-HRM) analysis as a novel close-tubed and accurate tool for olive oil forensic use. J. Sc. Food and Agr. 93(9): 2281-2286.

Kalaitzis, P., Zein, E. (2016) Olive oil authentication, traceability and adulteration detection using DNA-based approaches. Lipid Technology 28 (10-11): 173-176, November 2016, DOI: 10.1002/lite.201600048.

Spaniolas, S., Bazakos, C., Ntourou, T., Bihmidine, S., Georgousakis, A., Kalaitzis, P. (2008) Use of λ DNA as a marker to assess DNA stability in olive oil during storage. Eur. Food Res. Techno. 227: 175-179.

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Innovation 2: The First Use of KASP Technology for Assessment of Genetic Diversity of Ancient Olive Trees in Jordan.

Background
Olive (*Olea europaea* L. subsp. europaea, (2n = 2x= 46) is an important fruit tree in the Mediterranean region that belongs to the Oleaceae family. It is an evergreen fruit tree that was domesticated in the eastern parts of the Mediterranean region more than 6500 years ago. This study was conducted to survey different regions across Jordan for ancient and wild olive trees and included 48 accessions from a local Genebank to assess their genetic diversity based on morphological traits and molecular markers. Morphological traits using leaves, fruits, and endocarps of collected material were characterized following the "Methodology for primary characterization of olive varieties" descriptor. The results of the morphological analysis showed highly significant differences among defined groups using the *chi*-square test. The principal component analysis (PCA) and Heatmap analysis based on morphological data defined three main clusters that included: Romi, Kanabisi trees, and a diverse set of olive trees. For molecular analysis, a set of 24 informative single nucleotide polymorphisms (SNPs) was selected from previous studies and were then used to assess the genetic variation among the identified 248 olive trees using the kompetitive allele-specific PCR (KASP) assay, Similar to phenotypic analysis, the molecular data produced three main clusters and were able to distinguish between the Romi and Kanabisi olive trees with a clear genetic distance between the two groups. So, there was compatibility between the results of phenotypic analysis and molecular analysis using KASP technology. Finally, our findings highlight the importance to conserve and study the agronomic traits of the diverse trees, and used in olive tree breeding programs in the future.

Keywords
Olive (*Olea europaea* L.), kompetitive allele- specific PCR (KASP), single nucleotide polymorphism (SNP), principal component analysis (PCA), and Heatmap analysis.

Methodology
After the extraction of total genomic DNA (gDNA) for each olive tree in this study. A set of 24 SNP markers were selected and analyzed using bioinformatics tools to verify their potential use as differential markers for genotype discrimination of the three groups of olive: ancient trees from different regions in Jordan, wild olive trees, and Genebank olive trees.
The 24 SNP markers were converted into KASP markers and analyzed by LGC genomics-UK. The KASP method offers greater flexibility than other multiplexing methods as it can be used either for many polymorphisms in a few samples or vice versa. KASP genotyping mainly involves two allele-specific forward primers, one common reverse primer, and fluorescence resonance energy transfer (FRET) cassettes which results in the identification of respective alleles having a particular SNP.

Specifications
Specific molecular markers have to be selected and tested to assess the genetic variation among the identified 248 olive trees. A set of SNPs were selected from previous studies, and SNP markers were converted into KASP markers and analyzed by LGC genomics-UK. In addition, the comprehensive phenotypic characterization of olive trees followed "the methodology for primary characterization of olive varieties" descriptor of the International Olive Oil Council (IOOC, 1997).

Impact
The lack of knowledge of the origin and the degree of genetic purity of ancient olive trees, whether are considered clones or not, in addition to a great concern about the loss of such exotic genetic material from their natural habitat due to climate change, urbanization, fragmentation of land ownership, lack of awareness for their historical importance, overgrazing, fire, man-made assault, and replanting in domestic gardens. So, the use of KASP technology in this study proved the compatibility of our findings between morphological analysis and molecular analysis.

Filled gaps
SNP markers and KASP genotyping technology were used successfully for the first time in an olive genetic study and proved to be efficient, reliable, and robust in studying the genetic diversity in olive trees, in addition, the PCA and Heatmap analysis indicated that some morphological traits have higher discriminative power and not affected by the environment and these traits included: (stone weight, fruit shape, stone shape, position of the maximum transverse diameter of stone, position of the maximum transverse diameter of fruit, stone base and location of coloration change of fruit).

Limitation
The number of informative SNPs used was low, where a set of 24 informative SNPs were used to assess the genetic diversity among the identified 248 olive trees using the Kompetitive Allele Specific PCR (KASP) assay that was performed as a service by LGC genomics-UK. Out of the 24 markers, only 22 single nucleotide polymorphism (SNP) markers were successful in genotyping 218 olive trees with 30 trees failing to produce informative genotypic data.

Next steps/potential extension
The study highlights the urgent need to conserve identified unique ancient olive trees. So, a new collection mission is planned to target the diverse set of ancient olive trees identified in this study, we will study the agronomic traits, and conserve these trees through ex-situ conservation by vegetative propagation and planting them in the Genebank of olive in Al_Mushagr/NARC.

Find out more
Under publication

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Innovation 3: Agricultural Blockchain Traceability for Olive Oil

Background
Decapolis is a platform that uses blockchain technology to ensure that food safety and quality directives are met for food producers, agri-businesses, auditors, and regulatory agencies worldwide. The Decapolis platform, Decapolis Food Guard (DFG), ensures the safety and quality of food worldwide. Decapolis helps food producers to provide premium goods for which the end-to-end supply and production chains comply with strict safety and quality control standards.
The olive oil trade is filled with fraud. Many bad actors will take the original oil created at the mill and replace some of the contents of the container with low quality oil. This damages the reputation of the farmer and of the miller. It may lead to safety and health problems because of the unknown origin of the replaced contents.
The olive oil traceability system (DFG) offers a platform to olive oil producers in Jordan in order to validate the provenance of olives, production processes, and handling of olive oil in the supply chain from miller through market fulfillment.
The Decapolis company has implemented a pilot project with Jordan Food and Drug Administration (JFDA) for Olive Oil Millers traceability system and tamper proofing solution. Decapolis has deployed the DFG platform to improve food safety for 100 smallholder farmers in Jordan. The Quality and Tracking Directorate at the Ministry of Agriculture granted permission to the Decapolis Blockchain for monitoring local and imported products.

Keywords
Olive oil, traceability, blockchain, fraud, food safety.

Methodology
The tamper-proofing approach is to create and place a marker on the container that is destroyed when the container is opened – only those containers with intact markers are guaranteed to have original contents from the factory. The spout on the oil container is the only place from which to access the contents of the container. The tamper-proofing marker must be positioned on a filled container in the factory to indicate the spout has been secured. The marker identifying the unique goods in a container is an integral part of the tamper-proofing solution; when the container is opened, the marker is damaged or destroyed and the information about the contents is lost. Markers are not allowed to be easily replicated for usage on containers with contents of unknown origin. A marker can be implemented by means of a well-designed water-absorbent paper label with adhesive needed to secure the label to the container. The label cannot be removed unless the label is damaged. Finished oil is usually placed into 16-liter containers at the olive oil miller. The idea is to secure the container in a way that allows easy detection of tampering. There is a single spout on the container; the only place where oil can be placed into and taken from the container. This spout can be secured in a way that makes it clear that the container has been opened by using a marker that will be altered if the container has been opened. An altered marker indicates that the container contents can’t be guaranteed.
The oil should also be identified on the outside of the container and provide access to detailed information about the source and nature of the contents. A Decapolis traceability chain for a batch of oil production can easily be linked to by means of the identifier.
A QR code placed on each label that secures the spout of a container will have a unique ID embedded. The miller factory worker will apply to a filled container a label with unique QR code. The QR code will be scanned and registered on the Decapolis platform. The code can be registered only once.
When scanning the QR code with a smartphone after registration, the smartphone will bring you to a website. The consumer will be able at this site to login with miller credentials to access the miller production info or be required to enter your phone number to access the consumer info about the contents of the container.

This approach will prevent fraudulent users from gaining access to the info contained in the QR code and prevent replication of the code for containers that were not produced at the Miller's factory.

Specifications

The requirements

1. Gather measurements and production data for all production stages of olive oil from receipt of the fruit to finished goods.
2. The miller decides what information will be captured from their factory and what standards/regulations will be applied for validation.
3. Facilitate safety and quality testing with formal test labs in Jordan.
4. Protect chain of custody of samples to be tested at the Labs.
5. Generate a unique marker associated with a particular batch of Oil production.
6. Place unique marker on each container in a batch to access production traceability data.
7. The marker is easily able to be scanned to recover information about the container and contents.
8. For all millers in the Decapolis program, provide JFDA permissioned access to detailed Millers' traceability data.
9. Ensure that the container is tamper-proof; when closed and secured, the contents are guaranteed to comply with olive oil standards validated at the factory.
10. The marker on the container is not able to be copied for placement on other containers with unknown contents and unknown provenance.
11. A marker provides access to product information by the consumer.
12. A consumer marker is easily able to be scanned by a smartphone without any special application.

Impact

- Provide solution and analysis for the olive sector
- Reduce olive oil fraud in the market
- Increase the profit margin
- Increase the transparency and consumer trust in product information
- Clear data about the sector for the government

Filled gaps

There are pragmatic considerations with the approach outlined above. These relate to the following issues.

1. Labels. Self-adhesive labels are not recommended for usage in the tamper-proofing solution because they are too easy to remove and put back on. Rather, labels with a water-absorbing adhesive material stick to the container much better. When the adhesive dries, the label is affixed strongly to the container to ensure that when attempts are made to remove; the label is torn, indicating that the container could have been opened.

2. Labels creation. The dual-purpose labels for traceability and tamper-proofing can be generated at the miller factory or preprinted. If generated at the factory, then it is required to have a printer that can use the high-quality paper needed from part #1 above. There are also additional cost and maintenance issues with the printer, replacing paper, ink, and printer jams. A solution with the fewest moving pieces is superior.

3. Sampling container contents without invalidating the tamper-proofing solution. There is a need to allow consumers to taste the olive oil before purchase. If there is only one way to access the olive oil by means of breaking the Tamper-proofing seal, then we cannot say that these contents are not altered, if the buyer chooses not to buy. An approach to solving this issue is to put a tap on the container with a one-way valve, which cheaply allows small quantities of oil to be sampled without damaging the seal from above. From discussions with the container producer this is a viable option for a ~low price.

Limitations

Weak regulations and laws for traceability system.

Next Steps\Potential extension

- Enable farmers to use the solution.
- Scale up the solution to other countries.
- Create more cooperative group for farmers.

Find out more

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ENI CBCMED Cooperating across borders in the Mediterranean

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LIVINGAGRO

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