

A hoListic framework in the quality Labelled food supply chain systems' management towards enhanced data Integrity and verAcity, interoperability, traNsparenCy, and tracEability



DELIVERABLE 4.4-

PRACTICE ABSTRACTS

GRANT AGREEMENT NUMBER: 101084188



This project has received funding from the European Union's HE research and innovation programme under grant agreement No 101084188 $\,$



Lead Beneficiary:	UTH
Type of Deliverable:	Report
Dissemination Level:	Public
Submission Date:	30.04.2024
Version:	1.0

Versioning and contribution history

Version	Description	Contributions
0.1	Table of contents	UTH
0.2	First round of contributions	UTH and the Use case partners
0.3	First draft available for internal review	UTH
1.0	Final version submitted	UTH

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List of Abbreviations

Abbreviation	Description
Al	Artificial Intelligence
ALPP	Association of Lika Potato Producers
API	Application Programming Interface
BC	Blockchain
CAC	Codex Alimentarius Commission
CCP	Critical Control Point
DApps	Decentralized Applications
DC	Distribution Centres
EFSA	European Food Safety Authority
EU	European Union
EVOO	Extra Virgin Olive Oil
FSC	Food Supply Chain
FSCM	Food Supply Chain Management
FT-NIR	Fourier Transform Near Infrared Spectroscopy Technology
GC	Gas Chromatography
GFSI	Global Food Safety Initiative
GI	Geographical Indication
GMP	Hazard Analysis And Critical Control Point
GPS	Global Positioning System
HACCP	Hazard Analysis and Critical Control Points
HIS	Hyperspectral Imaging
HRM	High-Resolution Melting
ICT	Information and Communications Technology
IoT	Internet of Things
LC	Liquid Chromatography
MCA	Multiple Corresponding Analysis
MIR	Mid-Infrared
MS	Mass Spectrometry
NIR	Near Infrared Spectroscopy
PDO	Protected Designation Of Origin
PGI	Protected Geographical Indication
PUC	Pilot Use Case
SC	Supply Chain
VACCP	Vulnerability Assessment And Critical Control Points
Vis-NIR	Visible And Near-Infrared Spectroscopy





Executive Summary

The deliverable features seven Practice Abstracts developed in ALLIANCE based on the selected use cases. The purpose of the Practice abstracts is to communicate practical information or recommendations that have been collected within ALLIANCE. These Practice Abstracts should be accessible and should share practical information with a broad range of stakeholders. The information included in the Practice Abstracts addresses all different stakeholders and practitioners such as advisors and advisory organizations, farmers, developers of digital tools and ICT experts and indeed to researchers who can use the learnings from ALLIANCE to embed into their daily practices.





1 Introduction

In ALLIANCE, seven Pilot Use Cases are selected to demonstrate and validate proposed solutions in their respective Food Supply Chains.

- The *first* one is a Blockchain platform aimed at PDO/PGI Extra Virgin Olive Oil Authenticity Validation.
- The second demonstrator is about safeguarding PDO Feta Cheese.
- The *third* pilot is about fighting Fraud and Adulteration and Preserving Authenticity in organic Honey.
- Pilot *four* is about AI-assisted NIR and HIS Rapid Testing for On-Site Verification of Authenticity of PGI Faba Beans.
- Pilot *five* on the other hand is about applying Smart-Contracts to fight Food Fraud in PGI Lika Potatoes. The objective in this pilot is to prevent fraud incidences in the FSCs.
- Pilot *six* deals with combating counterfeit with Rapid Pesticide Identification for Organic Pasta products.
- Pilot *seven* aims to provide Improved means of traceability for the PDO Arilje Raspberries Food Supply Chain through Blockchain.

The deliverable presents the seven Practice Abstracts that are based on the above Pilot Use Cases.





2 Practice Abstract 1 - PDO/PGI Extra Virgin Olive Oil

Olive oil is being considered as the most high-priced source of fat for covering nutritional needs for humans. The high extra virgin olive oil nutritional value and price, alongside low consumer purchasing power, make olive oil more prone to fraudulent acts. This is directly related to the higher value and quality of extra virgin olive oil in different countries (Yan et al., 2020). On a global scale, olive oil complies to different standards and norms, depending on the corresponding affiliation, such as the International Olive Oil Council, Codex Alimentarius, and other EU regulations. These norms aim to facilitate the international trade market, and harmonise the global olive oil quality, in order to reduce olive oil fraud (Conte et al., 2020). According to food fraud reports, released by the Joint Research Centre of the European commission, olive oil is one the most mentioned commodities that has higher risk of fraud. It should be stated that each report includes several types of fraud, such as mislabelling or adulteration of the same product (Casadei et al., 2021). Olive oil fraudulent acts are of wide range, according to the results of anti-fraud inspection in Spain, where olive oil was produced from a non-Protected designation of origin area (PDO), but labelled and marketed as so (Rébufa et al., 2021). Another issue is that other oils are being sold as virgin olive oil, with dye and seed oils or other additives being intentionally mixed (Casadei et al., 2021). Other fraud case examples have been identified, like mixing extra virgin olive oil with vegetable oil, causing the occurrence of stigmastadiene (Conte et al., 2020). There are several methods for olive oil quality and purity evaluation, and each serve a different purpose. Quality assessment focuses on the quality of the fruit, oxidation status, and quality of olive oil (virgin or lower quality). Meanwhile, the purity assessment focuses on the findings or absence of extraneous oils, refined oils, esterified oils, and pomace oil within the olive oil commodity (Conte et al., 2020). These quality measures are essential alongside the global norms, to ensure the reduction of olive oil fraud cases, especially with the emerging global trade market.



Figure 1: PDO/PGI Extra Virgin Olive Oil Use Case

2.1.1 Organizations/stakeholders involved

The key stakeholders that are keener on the adoption of an authentication and traceability system are:

- the producers
- the importers/exporters (e.g. regulatory/authority bodies of foreign countries)
- wholesalers and Olive Oil companies producing private labels from olive oil they purchase.
- the consumers

The stakeholders involved in the value chain of Masoutis retailer are listed as follows:

• Producer: Production of the raw materials.





- Manufacturer: Supply and storage of raw materials, supply and storage of packaging material, manufacturing process, storage of the end product.
- Manufacturer / Distributor: Dispatch of the product to Masoutis' Logistics Center premises under appropriate conditions.
- Masoutis: Product quality inspection, Storage in facilities, compartmentalized in both dry and cold storage.
- Masoutis/ Distributor: Distribution under appropriate conditions to Masoutis stores



Figure 2: Information Flow of the Olive Oil FSC

2.1.2 ALLIANCE Solution

ALLIANCE will leverage the DNA fingerprinting technology to early detect and identify Food Fraud in OO and EVOO. DNA fingerprinting offers an indisputable and accessible source of information that delivers a genetic ID to any natural product, such as the olive varieties comprising an EVOO or detection of substitutions and admixtures with vegetable oils. The ability to obtain the genetic profile of an EVOO via DNA tests makes it almost impossible to admix while in parallel assuring its varietal composition from field-to-store. The DNA authentication and traceability can act as a positive adaptation for both the society and the environment, by adding value to local varieties embracing agrobiodiversity, while supporting local producers by value their produce. Indeed, this aligns with the GREEN DEAL EU F2F (Farm to Fork) framework¹, creating balance between nature-food-biodiversity and consumer wholesomeness. EVOO producers, manufacturers, B2B and retailers demand an accurate solution to protect EVOO quality, health claim and reputation. Therefore, the need for a "holy

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¹ https://ec.europa.eu/food/farm2fork_en



trinity" transparency – traceability – authenticity, verifiable and immutable becomes an absolute necessity.

In ALLIANCE, the BIOCOS EVOO DNA authentication solution will be exploited to discriminate up to 38 varieties inside an Olive Oil. Its main clientele comprises of olive oil companies and recently has expanded to two niche segments (identified during SME Instrument Phase 1; AUTHEVOO²) of the olive oil industry: cosmetics and supplements. The BIOCOS EVOO DNA authentication solution offers on-site inspection and testing with the use of low-cost portable qPCR devices for 5 commercially important Greek Olive varieties (Koroneiki, Tsounati, Manaki, Chalkidikis and Kalamon). In addition, under S3food³, an automated Machine Learning and Artificial Intelligence pipeline will be utilised for the post-processing analytics of DNA profiles from EVOO produced from Koroneiki and Tsunati cultivars, that allows an automated classification of their EVOO in base of the variety and. At present, experiments are performed to include also Manaki, Chalkidikis and Kalamon. The incorporation of a ML/AI post-processing pipeline reduced costs of EVOO DNA authentication tests (~45%), time-to-result (real time; 35%) and minimized errors (no human intervention). Subsequently, the processed DNA data are incorporated into a DNAblockchain system, offering to an EVOO a completed DNA traceability from field to store. BioCoS will expand its DNA traceability based on portable gPCR devices for Italian varieties dedicated to the production of organic PDO/PGI EVOO, with priority to the Moraiolo, Frantoio, Leccino, Dolce Agogia, Rajo e San felice. Other Italian as well as Greek ones will also be included. To achieve this will discover novel biomarkers for the Italian varieties combining sequencing and bioinformatics, and subsequently perform exhaustive DNA authentication tests to calibrate the ML/AI pipeline for the varieties. In the final phase, will set up a Blockchain system (DNAblockchain) to incorporate the DNA profiles as assessed along the different stages of the Olive Oil supply chain (field, milling, storage, bottling and retail) for the Italian producers of PDO/PGI EVOO.

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² <u>https://cordis.europa.eu/project/id/889774</u>

 $^{^{3}\} https://s3food.eu/dna-digitisation-olive-oil-authenticity-and-traceability-from-field-to-bottle/$



3 PRACTICE ABSTRACT 2 - PDO FETA CHEESE

Feta Cheese is a soft white cheese ripened in brine and was adopted as PDO in 2002. For the cheese to bear the name Feta, it has to be produced in continental Greece and on the island of Lesbos, and essentially made by either 100% sheep milk or a mixture of sheep and goat up to a 70-30 ratio. Fraud control measures are taken to prevent the commercialization of white cheese with different ratios than the aforementioned ones, as Feta cheese. Most of the Feta cheese fraud cases are mainly alteration of sheep and goat milk with cow milk, or ratios alteration of sheep and goat milk. Several techniques are used to identify the authenticity of the Feta cheese, such as Matrix-assisted Laser Desorption/Ionization -Time-Of-Flight Mass Spectrometry (Ganopoulos et al., 2013; Kritikou et al., 2022).



Figure 3: PDO Feta Cheese Use Case

3.1.1 Organizations/stakeholders involved

Stakeholders involved in the chain, apart from the Feta production plant, are:

- the milk producers,
- the milk transport company and
- all the certification carriers that have the jurisdiction to check the milk producers and the transports.

The stakeholders involved in the value chain of Masoutis retailer are listed as follows:

- Producer: Production of the raw materials.
- Manufacturer: Supply and storage of raw materials, supply and storage of packaging material, manufacturing process, storage of the end-product.
- Manufacturer / Distributor: Dispatch of the product to Masoutis' Logistics Center premises under appropriate conditions.
- Masoutis: Product quality inspection, Storage in facilities, compartmentalized in both dry and cold storage.
- Masoutis/ Distributor: Distribution under appropriate conditions to Masoutis stores





Figure 4: Information flow of the Feta Cheese FSC

3.1.2 ALLIANCE Solution:

ALLIANCE will leverage the capabilities of Blockchain technology to provide a secure tamperproof shared data laver, thus creating trust, transparency, and accountability between disparate entities in a complex supply chain of Feta Cheese Production. The case study involves the enhancement of the production line of Feta cheese, a famous Greek product of protected designation of origin, that will take place in the premises of OLYMPOS, one of the largest dairy producers in Greece. The transformative potential of Blockchain relying on the Hyperledger Fabric⁴ will secure and tamper-proof the FSC for the feta cheese and it will provide the means for increased data corroboration. In order to assess farmers' decision process, Dynamic Agricultural Household Bio-Economic Simulator (DAHBSIM) model is going to be elaborated. This is a dynamic, scenario-based, bio-economic model that explicitly quantifies interconnections between resources while capturing the effects of population growth, household food needs, changing economic situations, policies, climate change, and other stressors, at the field, farm, and regional levels. Such a model is a powerful tool for decisionmaking in complex issues, such as trade-offs between competing issues (economic, agronomic, and environmental) or deciding between different conservation policies. Thus, different characteristic farm-types will be constructed and assessed, through scenario simulations, via DAHBSIM model to identify the main determinants of farmers' adoption process towards novel practices. In addition, these simulations will permit us to assess the effect of current policy measures or policy changes on farmers' incomes and the adoption process. Special focus will be given on the consumers' norms, trends and initiatives for purchasing and using agricultural products and foodstuff being produced under the aforementioned protocols. For this reason, a tailor-made questionnaire will be developed, based on the Theory of Planned Behaviour (TPB) and the Health Belief Model (HBM), aiming to formulate consumer profiles in every participating country, but also to allocate and measure potential differences among them, having as foundations, economic, educational, cultural and religious aspects.



⁴ https://www.hyperledger.org/use/fabric



4 PRACTICE ABSTRACT 3 - ORGANIC HONEY

Honey is one of the most highly appreciated commodities for its nutritional properties and its high quality. Despite being of high value, honey is one of the top products at risk of fraudulent activities in Europe. A Codex Alimentarius was published to maintain the quality and standards of this valuable commodity against risks of frauds (Arroyo-Manzanares et al., 2019; Lastra-Mejías et al., 2020). The economic importance of honey has made it susceptible to several fraudulent activities, such as mislabelling, adulteration, and substitution. One of the major fraud cases is adulteration using cheap quality syrups (e.g., rice syrup, corn syrup, maple, agave, palm syrup...). It is important to mention that honey adulteration is a serious global issue, and is more complex than it seems, due to the presence of different international standards, as well as the fact that there are not enough studies related to unifloral honey, to reduce adulteration risks. Regardless of the continuous effort to reduce these fraud cases, no real solution has been found yet. Furthermore, another major honey fraud issue is mislabelling. Honey depends on its floral and geographical origin; many fraud cases include mislabelling and misleading information regarding the origin and the floral composition of the commodity. Brar et al., (2023) have noticed a confusion amongst stakeholders regarding the establishment of a methodology for honey authenticity and adulteration, as well as a heterogeneity of worldwide standards that induce a consumer confusion in regards of honey quality.



Figure 5: Organic Honey Use Case

4.1.1 Organizations/stakeholders involved

The two main stakeholders in the Occitanie region were identified and selected:

- ADA Occitanie (Développement de l'Apiculture en Occitanie) is the main organization providing extension services in the regional beekeepers (https://www.adaoccitanie.org/)
- ITSAP Institut de l'abeille Is the main research and development Institution in the French apiculture sector (https://itsap.asso.fr/)

The users that are related to those actors, form the personas that are being involved in the ADA and ITSAP and undertake a particular work/responsibility to accomplish.





Figure 6: Information Flow of the Organic Honey FSC

4.1.2 ALLIANCE Solution:

ALLIANCE will leverage the capabilities of BeeMark⁵ that not only allows tracking of digital data but also enables a holistic supply chain traceability, practises and processes that ensure sustainable harvesting and effective labelling to remove fraud. The BeeMark certification standard is based on practices and processes that ensure bee health, sustainable honey harvesting, product integrity and accurate labelling. It is based on decentralised blockchain technologies to validate sustainable & ethical production of honey at source, trace honey from origin to point of sale and share the product stories across a range of immutable real time digital channels. BeeMark uses AI-enabled sensors to continuously monitor bee health and the wellbeing of production colonies. The development of the BeeMark solution will significantly improve the means to ensure the integrity of Honey supply chains and protect the interests of the consumers. Consequently, the use of Blockchain not only eliminates data manipulation or errors, but also improves time to results and logistics, by delivering increased trust, transparency, and accountability between disparate entities in the complex Honey supply chains. The fully integrated solution will display the following advantages: (1) process automation; (2) real-time tracking and monitoring of production processes; (3) immutable audit trails, full transaction history; (4) proof of certification, identity, provenance and compliance; (5) *improved honey product safety;* Concluding, the overall system it is environmentally friendly, producing trusted and immutable results, enhancing transparency and confidence throughout the honey supply chain.



⁵ https://worldbeeproject.org/2020/12/08/world-bee-mark/



5 PRACTICE ABSTRACT 4 – PGI FABA BEANS

Beans are being part of the second major agricultural family, "Legumes". They are of great economic impact in the food market. Grain legumes, such as fava beans are known to be an important source of protein and are dominant in the human diet as well as in animal feed. Therefore, beans authenticity is essential, as a key element for quality insurance when placed on the market. Various species of beans exist and can be classified on several value levels, based on their origin. This diversity induces mislabelling and the concealment of species, increasing the risk of food fraud in a period where authentication methods are in the need of an improvement to prevent fraudulent acts (Madesis et al., 2012).



Demonstrator #4

Al-assisted NIR and HSI Rapid Testing for On-Site Verification of Authenticity of PGI Faba Beans

Figure 7: PGI Faba Beans

5.1.1 Organizations/stakeholders involved

Four relevant actors in the PGI Asturian Faba Bean value chain have been identified and they are listed below. Namely:

- ASINCAR⁶, as PGI and PDO management expert
- IGPFA⁷, as control body
- Main farmers in IGPFA
- Main packers in IGPFA

The users that are related to those actors, are being involved in the FSC and undertake a particular work/responsibility to accomplish.



⁶ https://www.asincar.com/

⁷ https://faba-asturiana.org/



Figure 8: Information Flow of the Faba beans FSC

5.1.2 ALLIANCE Solution

Considering previous identified gap between ideal analytical tool for the identification of fraud in the PGI faba and that available/used at the moment (mainly advanced analytical techniques and subjective expert-based assessments), in this use case we will study and exploit the potential of using low cost, portable/miniaturized NIR and HSI technologies for the this application, trying to fulfil the requirements any end-user of these tools will expect (fast, non-destructive, easy to use, real-time results and low-cost analytical methods).

ASINCAR has developed multiple works based on the application of NIR and HSI for food applications as food quality, food control, food safety (shelf life and biofilms), as well as food fraud, that is the main topic on the use case. In this line, ASINCAR has developed Proof of Concept algorithms for the identification of adulteration on beef burger adultered with horse meat, the discrimination between fish species as well as the determination of glazing water in frozen fish. ASINCAR will advance and valorise this knowledge during this use case.

Within **ALLIANCE** a complete and qualified NIR and HSI systems (TRL 8) will be demonstrated at real scenario (PGI farmers) for avoiding the fraud of PGI faba when they are mixed with beans from other cheaper origins. Moreover, the PGI is also really interested in advancing the development of a specific fingerprint for each PGI pilot, avoiding also a common fraud practice: selling under a specific PGI license number beans from other producers. Three different main activities are foreseen: (1) Use of a low-cost, and ideally portable, NIR spectrometer for the targeted applications; (2) Similar objective as above but using off-line, and potentially portable, hyperspectral technologies. For both above cases, the development of chemometrics using advanced data analysis techniques as Artificial Intelligence and Machine Learning techniques.





6 PRACTICE ABSTRACT 5 - PGI LIKA POTATOES

Potatoes are in the top 10 most important crops globally, being an essential part of many diets around the world. Under EU regulation, potatoes are required to be labelled by their varietal name, as a consumer protection and quality control measure. In a study focusing on the Spanish market, mislabelling fraud cases were detected, but with a percentage gap between cases that are reported as suspicious fraud acts and cases proven as fraud acts. This difference is mostly due to the supposition of different origin samples, knowing that the sample's collection was done randomly and which some cases of foreign countries origins. In addition, the mislabelling fraud case appears to be a recurrent problem and not a punctual issue (Lopez-Vizcón & Ortega, 2012).



Figure 9: PGI Lika Potatoes Use Case

6.1.1 Organizations/stakeholders involved

The relevant actors in the PGI Lika Potatoes value chain and Migros retailer FSC have been identified and are listed below. These two FSCs, ALLP and Migros will be linked to each other in a later stage of ALLIANCE.

• The Association of Lika Potato Producers (ALPP) at the moment has 7 members, and only one of them is in the system of PGI certification system. Also, there are two producers who are not member of ALPP but they produce and sell potatoes under PGI label.





- Smaller producers are producing and selling directly their potatoes at the doorstep or at local market.
- Verification of PDO/PGI compliance in Croatia is carried out by private certification bodies registered with the Ministry of Agriculture. Biotechnicon Ltd. is the certification body responsible for the process of PGI Lika potatoes certification for both interviewed producers.
- Validity control is also carried out by the Inspec which, which operates within the State Inspectorate.
- Two biggest producers have its own seeds, but they also buy smaller quantities from seed suppliers. Packaging (potato bags and boxes) is purchased partly from domestic suppliers and partly from importers. The main distribution channels are supermarkets (LIDL, INTERSPAR), specialized stores, restaurants and online sales.
- The delivery of potatoes to the distribution centres of retail chains goes from the producer through the distributor or through the transport company.
- Online sales work through online platforms and also through parcel delivery companies that deliver directly to the consumer.

In addition, on the retailer side, Migros is comprised of 2987 stores as of the report date operating in all cities of Turkey. Migros owns, 9 distribution centres, 6 fruits and vegetables production facilities, and 11 wholesale warehouses were independently and externally audited for compliance with IFS Product Safety standards. Migros works with 2,942 active suppliers and 20,000 farmers.



Figure 10: Information Flow PGI Lika Potatoes FSC

6.1.2 ALLIANCE Solution:

ALLIANCE will enhance the traceability of the PGI Lika potatoes that is currently controlled through an opaque traceability documentation system (production site codes, storage site codes) that relies only on an unsafe QR coding system. The new FSC will provide encrypted product information that will be stored on a blockchain. What will be stored on a blockchain database using the **ALLIANCE** solution will be a trusted set of sensor-derived information that can be audited by authorized entities, accessed by the authorized actors across the FSCs (e.g. farmers, retailers) and by the end consumers to get proof of authenticity and full product traceability. In addition, the improved method would serve to more quickly identify and comply with Lika potatoes compared to other similar potatoes from other regions. Possibility of using it at the wholesale place as well as for the activities of the control body to increase the control activity and increase the sales volume.





7 PRACTICE ABSTRACT 6 - ORGANIC PASTA

Pasta represents the national Italian dish, identity, and is an important component on the Mediterranean table. Italy is the largest Pasta producer around the world, taking over more than 25% of the international market. Durum wheat semolina is the main ingredient used for pasta production and is considered as a product of a superior quality. A maximum of 3% of soft wheat can be used in the production of dry pasta, in accordance with the Italian law. Products that are intended to be exported, can exceed the restricted amount if labelled accordingly. However, this 3% causes a quality control issue for manufacturers, requesting at the same time a need for more reliable methods to identify durum wheat from non-durum wheat. Moreover, the low prices of common wheat, in comparison to durum wheat, leads to increased amount of soft wheat by the retailers without declaring it, highlighting that wheat flour adulteration lower the quality of the pasta (Casazza et al., 2012; De Girolamo et al., 2020).



7.1.1 Organizations/stakeholders involved

Several actors in the Organic Pasta value chain have been identified and they are listed below. Namely:

- CCPB is the control body that certifies the organic nature of Alce Nero products. It is also the institution certifying our pasta producer.
- Pastificio Felicetti is the partner that produces the pasta. We are interested in involving the quality manager, the plant manager and the pasta maker.
- Molino De Vita is the partner that grinds durum wheat. His involvement is interesting as he is the one who first receives the grain and therefore defines its acceptance.
- Mediterre.bio is made up of individual farmers and cooperatives from Puglia, Basilicata, Calabria and Emilia, producing mostly organic durum and soft wheat, as well as organic extra virgin olive oil. This cooperative cultivates the wheat for our supply chain.





- Coop. Daunia: Cooperative in the province of Foggia (members of Mediterre.bio), deals only with organic agriculture and mainly durum wheat. They are one of our durum wheat suppliers.
- Coop Terra Maiorum: Cooperative in the province of Bari (also members of Mediterre.bio), deals only with organic agriculture and mainly durum wheat production. They are one of our durum wheat suppliers.
- Independent farmers: farmers who give Alce Nero durum wheat but are not part of any cooperative. It is possible that the number of subjects involved will be reduced.

The stakeholders involved in the value chain of Masoutis retailer are listed as follows:

- Producer: Production of the raw materials.
- Manufacturer: Supply and storage of raw materials, supply and storage of packaging material, manufacturing process, storage of the end product.
- Manufacturer / Distributor: Dispatch of the product to Masoutis' Logistics Center premises under appropriate conditions.
- Masoutis: Product quality inspection, Storage in facilities, compartmentalized in both dry and cold storage.

Masoutis/ Distributor: Distribution under appropriate conditions to Masoutis stores



Figure 12: Information Flow of the Organic Pasta FSC

7.1.2 ALLIANCE Solution

ALLIANCE solution will offer a tool that will be used to collect measurements from a large number of pasta samples, in order to simulate the real scenario of food fraud diffusion in this kind of product. Pasta samples (organic and conventional) will be collected from food retailers; Pesticides and their residues will be identified using a multi-residual analysis and a digital database will be created to store records and monitoring data. Additionally, Alce Nero organic pasta will be used as a control sample. Particularly, multi-residual analysis of pasta samples will be carried out using the QuEChERS (quick, easy, cheap, effective, rugged, and safe) pre-treatment technique, which is trustworthy and accurate method for the extraction of a large number of compounds usually searched in food matrixes. Subsequently, a purification of the

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extracted matrix is performed on each sample in order to make the multiresidual check more accurate. After this purification, pasta samples will be analysed by means of Gas Chromatography (GC) or Liquid Chromatography (LC) paired to mass spectrometry (MS) methods. Each sample spectrum will be compared to many reference standards (one for each potential residue) but also to the one considered as a control sample, free from residues. A database of pasta spectrum profiles will be created, and a selection of most diffused.





8 PRACTICE ABSTRACT 7 - PDO ARILJE RASPBERRIES

Due to the high competition in the market, berries are one of the commodities mostly subjected to adulteration. They are usually at risk of a misidentification or addition of a lower quality species for a higher economical gain. Various chemometric and chromatographic technologies are in use to reduce fraud risk, and ensure authenticity, by the identification of the geographical and botanical origin of the berry species (Krstić et al., 2023). It is important to mention that no direct research studies were found about raspberry fruit fraud cases. However, according to Reuters, in 2017, a major frozen raspberry fraud case was reported under mislabelling. The commodity of Chinese origin was shipped to Chile and labelled as "Chilean-grown organics" and sold to Canadian consumers as mentioned. This food fraud case, according to the Canadian authorities, was connected to a norovirus outbreak in Quebec (Reuters, 2020).



Figure 13: PDO Arilje Raspberries Use Case

8.1.1 Organizations/stakeholders involved

Stakeholder involved in Arilje Raspberries Supply Chain are listed below:

- Farmers that produce raspberries,
- Transporters
- Retailers
- Certificate organisation





External institutions (competent Authority) in order to apply for PDO labels (Serbian level)

The FSC of PDO Arilje Raspberry and FSC of retailer Migros will be linked to each other in a later stage of ALLIANCE. On the retailer side, Migros is comprised of 2987 stores as of the report date operating in all cities of Turkey. Migros owns, 9 distribution centres, 6 fruits and vegetables production facilities, and 11 wholesale warehouses were independently and externally audited for compliance with IFS Product Safety standards. Migros works with 2,942 active suppliers and 20,000 farmers.



Figure 14: Information Flow of the PDO Arilje Raspberried FSC

8.1.2 ALLIANCE Solution

The **ALLIANCE** solution will improve the traceability system and the monitoring of quantities to continuously verify their origin, integrating organisational and capacity development of the producer organisation/s for future management of the system. In order to provide uniform and comprehensive information on PDO Arilje Raspberry, a user-friendly database will be created and updated regularly. This database will be the property of the association Original Srbija, administrated by CBs performing certification of Arilje raspberry GI. Agreec data will be made publicly available for buyers and consumers to increase awareness of the quality guarantee and update generic understanding of raspberry quality related to its origin. The database content will be developed and update with relative data in cooperation with VC stakeholders aiming at the automatization of the food product traceability and at preserving quality assurance. (Information will include various features such as the producers' identity, the area of the orchards, the surface and the quantities of certified raspberry, the status of the certificates, the designation markets, etc.).

Fast, accurate and low-cost techniques will be used for the physio-chemical characterization of the Arilje raspberry and the distinguishment from the raspberries originated from other regions and countries. This characterization will rely on specific food attributes such as color (L*, a*, b*), °Bx (%), pH etc., and they will be used in order to form a representative dataset needed for the multivariate data analysis. Based on the obtained results in correlation with sensory properties, producer organization will create a reliable tool based on Blockchain technology for differentiating Arilje raspberry fruits from those of other origin and quality. Following the needs of Arilje raspberry producers for fast, accurate and cost-effective methods, alternative to classical sensory analysis, rapid descriptive analysis method will be developed in order distinguish raspberries of different quality. The panel consisted of sensory experts will choose







a number of sensory attributes that best describe differences between the samples. Afterwards, relevant stakeholders involved in Arilje raspberry value chain will be educated and trained to apply this method in the field. Currently, buyers (especially international level) know the unique characteristics of the Arilje raspberry and its quality. Therefore, to determine the correct and most appropriate parameters for building differentiation tools, we will rely on qualitative analysis to assess their knowledge and needs. The derived information will be used to create tools and policies to raise the awareness among local consumers, reinforce the marketing of the Arilje berries demonstrating its exceptional quality, and to mitigate the unfair competition with lower quality fruits. The whole process will be highly participatory, with the main focus on producer engagement and producer organisational development.





9 CONCLUSIONS

The deliverable presents the Practice Abstracts for the seven selected Use Cases. An updated deliverable will be prepared and submitted at the end of the project when the pilots' results will be available. The updated Practice Abstracts will be based on lessons learnt.

