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INNOVATIVE TOOLS OF SMART AGRICULTURE TO PROTECT THE SUPPLY CHAIN OF SICILIAN BLOOD ORANGE PGI*

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Abstract

Nowadays, with regard to the final purchase of agri-food products, consumers are very careful to every feature of a foodstuff, such as its “organoleptic” quality or its respect for the environment, which leads to a major consumption of local products and the development of what is called a “Km0 dietary” to reduce CO₂ emissions in the atmosphere and food waste. In order to safeguard the environment and to protect both food excellences and consumers from counterfeiting, voluntary standards and innovative tools can be used: EU quality labels, voluntary standards such as the UNI EN ISO 22005:2007, and innovative tools of agriculture 4.0, i.e. blockchain technology. The aim of the paper is to test the interest in purchasing the Sicilian Blood Orange PGI in the French market, inasmuch considered particularly attractive for citrus fruits. In order to achieve this purpose qualitative and quantitative analysis are conducted to verify if it is convenient, for the Consortium of Protection, to implement protection tools to the orange juice made up of 100% Blood Oranges of Sicily PGI.

Keywords: agriculture 4.0, Blood Orange of Sicily PGI, EU quality labels, Km0 dietary, traceability

1. Introduction

In the field of food production, the concept of quality has been profoundly transformed over time. With the occurrence of the so-called “economic boom”, the industry

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of food transformation and a network of distribution channels have been formed. At this stage, the control took place at the end of the production process (DPR 283, 1962) and production is run with constant quality. Subsequently, international bodies such as the International Standard Organization (abbreviated “ISO”) formulated voluntary standards that companies can employ for quality management throughout the chain of production. The correct usage of these rules is then guaranteed through a system of external certification, by accredited bodies. As the number of products offered on the market grew more and more, consumers started to demand and require products which carry a number of precise qualitative features (i.e. hygienic quality, nutraceutical quality, organoleptic quality, quality of origin, etc.). Due to these changes, new protection tools have been conceived, which are: the “European quality labels”, that offer guarantees on traceability, on the link with the territory and the typicality of a foodstuff; the organic logo of the EU for “BIO” products (EC 834, 2007; EC 889, 2008; EC 271, 2010); and traceability systems in agri-food supply chains through ISO 22005 (2007) certification or through the implementation of blockchain technology.

In view of the above, considering the interest shown by foreign countries for Sicilian products, private firms and public institutions have increasingly activated themselves in order to take advantage of the opportunities that foreign markets and instruments of this kind offer them. Moreover, local typical productions are considered by the European Union itself as a suitable tool for promoting weaker territorial systems, such as the Sicilian one.

At a time of globalization in which it is necessary to keep up with the competitiveness of major international enterprises, the Sicilian agricultural system – characterized mostly by SMEs and, in some respects, a little backlog – has to face complex strategic choices (Cinotti, 2019).

Regarding this, the culture of “zero food miles”, also known as “short supply chain”, is very widespread today: it consists of local products that are sold or given in the vicinity of the place of production. These products are characterized by a “lower” price, which is due to reduced transportation and distribution costs, the absence of commercial intermediaries, but also the low markup of the seller who is often himself the cattleman or farmer. “Km0” foods offer more guarantees of freshness precisely because of the absence, or almost, of transport and passage. In addition, with this choice of consumption, local production is valued and the link with the territory is recovered, meanwhile allowing consumers to learn about typical flavors and gastronomic traditions (Maugeri et al., 2019). The short supply chain aims at establishing a direct relationship between those who consume and those who produce through different modes: for example, individual consumers or organized consumers in the so-called “groups of purchase” directly address to the farmer and/or the cattleman to buy their products; or, the same manufacturers can “open” their company to consumers as well as organizing local markets, the so-called “farmer markets” (Matarazzo and Baglio, 2018).

Italy is also a promoter of European quality labels (PDO, PGI and STG), of which it holds the record for use, especially with regard to the first two categories. In particular, the difference between the PGI certification and the PDO consists on the fact that while for the PGI it is sufficient that one stage of production takes place in the limited geographical area (Gervais, 2008), the PDO applies to productions where all the stages of the production cycle, “from the production of raw material to the finished product”, are localized “within a well-delimited geographical area and is not reproducible outside this area” (Antonelli and Viganò, 2012; Mancini, 2012). Once the name has been registered, any agri-food product that complies with product specification of the PDO/PGI certified product will be able to take advantage of the labelling reserved for it (Law 526, 1999). The result, therefore, is that the relevant producers, united by operating in the territories falling within the established production areas of the Disciplinary and that meet precisely all the requirements mentioned

above, can create or adhere to (if it already exists) a Consortium (Menghini and Fabbri, 2013).

The Consortia of Protection, pursuant to article 2062 of the Civil Code, are voluntary associations recognized by the Ministry that can be constituted “among the subjects included in the system of control of the denomination” in order to carry out supervisory activities “against the associates only” and any other activities aimed at the enhancement, conservation, promotion and protection of the denomination. These carry out a number of institutional tasks assigned by the Ministry and also an important task of safeguarding the denomination from “abuses, acts of unfair competition and counterfeiting”. For this purpose, furthermore, there are nowadays new tools of “Agriculture 4.0” such as, in particular to protect against counterfeits, the “blockchain technology” (Mandarino and Magliuolo, 2019; Menon, 2018).

A blockchain technology is, according to the traditional definition globally accepted, “an open and distributed database capable of recording transactions efficiently, in a verifiable and permanent way”. It consists of a tool that was initially born in the financial field and that allows to obtain different benefits also when applied to the agri-food industry. In fact, being able to “100% track” the supply chain allows to improve the transactions between the different actors operating within it, as well as to enhance the quality of the origin of high value-added products. In turn, the term “food traceability” therefore refers to “the ability to track every food or feed or substance that is used for consumption, and all the processes that they have undergone, through all stages of the supply chain” (Maccaferri, 2019). It is necessary to track food not only for the purpose of being in compliance with the existing mandatory legislation (EC 178, 2002), but also because the availability of data and information increases the efficiency of supply chain processes, producing effects such as better stock management, reduced food waste, new market opportunities and so on.

However, in order to better understand how this result is achieved, it is appropriate to understand how the blockchain performs this tracking (Fig. 1) and why it is the most suitable tool for fulfilling this function (Pantini and Prodi, 2019).

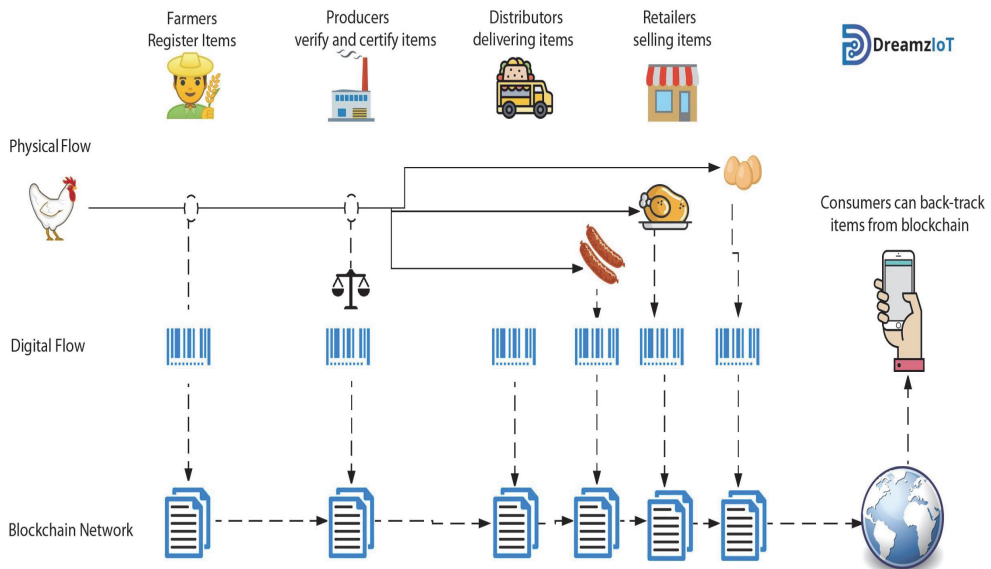


Fig. 1. The physical and digital food supply chain

Other tools, available for pro-active agri-food companies, regard voluntary tools, including ISO 22005 (2007) or EC Directive 112 (2001).

The aim of the paper is to test the level of consumers' knowledge, in France, of the tools mentioned above, their openness towards the Sicilian excellence "Blood Orange of Sicily PGI", their customs and preferences. The choice to investigate the French market is due to the fact that it is deemed to be, among European markets, particularly attractive for citrus fruits. It is also considered the convenience for the Consortium of protection of the Blood Orange of Sicily PGI to start a process of protection of blood orange juice, pursuing a path of customer loyalty differentiating the agri-food products 100% made in Sicily from those of other competitors that offer massed products at low cost, always guaranteeing the consumer an excellent value for money (Munda and Matarazzo, 2020).

In order to achieve this, a questionnaire is created *ad hoc* and administered on a sample of 100 individuals. The study also wants to demonstrate the benefits (from the point of view of both producers and consumers) arising from the implementation of innovative protection tools in Italian agri-food productions, in particular in Sicilian excellences.

2. Case study: Consorzio di Tutela Arancia Rossa di Sicilia IGP

The Consortium for the Protection of the Blood Orange of Sicily PGI was recognized by the European Union in 1996, its official start dates back to 2002 and in July 2015 it was formally recognized by the Ministry for Agricultural, Food and Forestry Policies. Today the major producer organizations (POs) at the regional level, individual producers and the vast majority of packers operating in the fruit and vegetable sector are aggregated to the Consortium. Considerable interest is also shown by companies based outside the territory, which have the obligation to process the product coming from the territories of the PGI that are enclosed in the red area in Fig. 2. In particular, they are: Catania, Adrano, Belpasso, Biancavilla, Caltagirone, Castel di Iudica, Grammichele, Licodia Eubea, Mazzarrone, Militello Val di Catania, Mineo, Misterbianco, Motta S. Anastasia, Palagonia, Paternò, Ramacca, Santa Maria di Licodia, Scordia, Lentini, Francofonte, Carlentini with the hamlet of Pedagaggi, Buccheri, Melilli, Augusta, Priolo, Syracuse, Floridia, Solarino and Sortino, Catenanuova, Centuripe and Regalbuto.

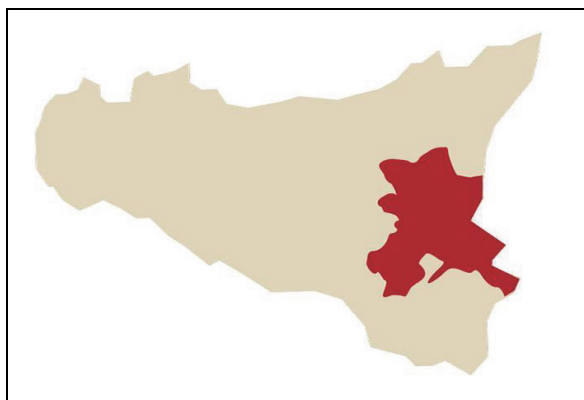


Fig. 2. Sicilian Blood Orange PGI production area

About 550 producers, 60 packaging companies, 12 processing industries and over 30 companies that distribute the compound, elaborated and transformed product are members of

the Consortium. The Consortium for the Protection of Blood Orange of Sicily PGI has been chosen for this study as a Sicilian reality particularly sensitive to issues such as the protection of the environment and the territory, of consumers and, in general, of all its stakeholders.

As a consortium, it undertakes to promote, protect and monitor the production chain in order to obtain an ever-higher positioning of the Sicilian Blood Orange PGI product in the consumer's consumption habits, both nationally and internationally. The Consortium, compared to other protection bodies, has also created the R.O.U.G.E. project, "Red Orange Upgrading Green Economy" in order to implement Smart traceability solutions to the supply chain and thus improve the entire process from cradle to grave.

Nowadays, the products that take advantage of the PGI label of the Sicilian Blood Orange are around 50. The Consortium, indeed, has further enhanced the product by entering into strategic agreements with multinational companies, for example: the partnership with Coca-Cola Italy, in order to obtain a variant of the well-known "Fanta" drink and to create the "Fanta Zero Red Orange PGI". Another example of usage of the Sicilian Blood Orange PGI by big multinational companies is carried out, in the pharmaceutical sector, by the Australian health and wellness company "Swisse", which exploits the nutraceutical properties of the Orange to help digestion process (www.swisse.it/ingredienti/arancia-rossa).

To date, thanks to the operations carried out by the Consortium, it is also possible to find the product Blood Orange of Sicily PGI at some restaurants of the famous Mc Donald's chain in the form of fresh juice.

Besides the fresh market industry sector, the PGI Red Orange of Sicily also satisfies the processing industry sector with its products "Sicilian Red Orange Marmalade PGI BIO" and the bitter called "Amara" of Blood Orange of Sicily PGI.

3. Materials and methods

To achieve the set objectives, a qualitative analysis has been conducted through the administration of a questionnaire via Google Form. The questionnaire consists of 4 sections, which are: "Informations générales", "Vos habitudes d'achats", "A propos des labels" and "Les Oranges Sanguines de Sicile labellisées PGI".

In the first section, questions related to the generality of investigated people are asked, so as to define the sample object of the analysis: 100 individuals, of which 47% men and 53% women, mostly aged (82%) from 20 to 35 years and of which 87% buy foodstuffs from large supermarket chains.

In the second part, purchasing habits are investigated and therefore: how many times foodstuffs are purchased, which variable (between price, quality, geographical origin and brand) determines the final purchase of a certain product, and whether a product possesses - according to the interviewees - particular characteristics linked to its geographical origin.

In the third section, respondents are asked to give a definition of PGI and questions on quality labels are asked in order to investigate their level of knowledge on the topic.

Finally, in the fourth section, their knowledge about the island of Sicily, of the Sicilian Blood Orange PGI and their willingness to pay an extra price for a certified product coming from Sicily and, as such, with inimitable organoleptic characteristics, is tested.

Even if the questionnaire is limited to dealing with the subject of the protected denomination, there are other protection tools that interest the Consortium and they are: the EC Directive 112 (2001), which deals with regulating fruit juices and other similar products intended for to human nutrition, and the ISO 22005 (2007) standard, which concerns the regulation of the traceability system.

The results that these two tools allow to obtain are multiple and coincide with the objectives that the Consortium aims to achieve: supporting food safety, customer satisfaction,

determining the history and origins of the product, facilitating withdrawal or recall, identifying responsibilities, facilitate the verification of specific information regarding the product, communicate information to interested parties, improve the competitiveness of the organization.

The blockchain is therefore the mean that allows the concrete application and realization of these standards, as it guarantees the so-called “heritability” - that is to say each product, in each state change, inherits from the previous state the information deemed significant (manufacturer, supplier, technical and product parameters, interventions carried out and checks) - the compliance with the so-called “principle of consistency” (between the constituent elements of the system, i.e. objectives/extension/control and communication of the information transmitted between the actors operating in the supply chain) and the “economic sustainability”, or rather, cost efficiency (Ferrucci, 2014).

Furthermore, the Consortium relies on the company “CitroGlobe Srl” for the sale of both NFC and concentrated juice. This collaboration ensures that the production takes place at selected co-packers and that the raw materials are carefully analyzed by a technical staff. In addition, it guarantees the respect for all products of HACCP and of “Good Manufacturing Practice” regulations which ensure traceability, identity and authenticity, in accordance with the provisions of national and international regulations for food products.

The control on pesticides and heavy metals is carried out by sending samples to accredited external laboratories. Since its foundation, the purpose of Citroglobe has been to monitor the products of the fruit juice sector that are on the market by periodically performing, as per company rules and regulation, audits and checks on the products manufactured and/or marketed by its members (as part of the Voluntary Control System) in order to verify their observance of the laws and regulations in the food and labeling sector.

CitroGlobe is also a SEDEX member. Sedex is a secure online database as well as a supply chain management tool that can help companies to identify, manage and mitigate ethical risks in the global supply chain.

4. Results and discussion

The growing trend towards the use of protected designation, voluntary regulations such as ISO 22005 (2007) or EC Directive 112 (2001), and other innovative agri-tech tools, i.e. blockchain technology, is determining an important opportunity: the realization of a “sustainable agriculture”, which allows to ensure, over time, a high level of quality, to extinguish the information gap that exists between the producer and the final consumer, to share and assimilate environmental and ethical standards throughout the commercial chain. In 2019 occurred, in fact, a blockchain boom, followed by QR Code, mobile app, data analytics and the Internet of Things (Redazione Food, 2020).

As a result, the Sicilian Consortium of Protection has taken the appropriate action to incorporate some of the aforementioned innovative solutions to its production system, in order to further win over consumers, on the local market (in this regard it should be recalled that even if the case study is aimed at the French market, the protection of the environment implies itself a greater consumption of local products to develop the concepts of “short chain” and “KM0 dietary” in order to reduce the emission of CO₂ in the atmosphere as well as waste) and abroad.

Among the goals that the Consortium has set itself, in fact, falls within the expansion of its trade in other countries, with a particular attention to the French market, inasmuch considered particularly attractive for citrus fruits. For this purpose, a questionnaire has been administered - specifically designed to investigate the uses, knowledge and preferences of French consumers - to a sample of 100 individuals from all over France. Above all, the goal

that has been set is to evaluate the convenience of starting a juice protection process for orange juice made with 100% Sicilian Blood Orange PGI. Specific answers to some questions allowed the Consortium to draw important conclusions; in particular:

- in the section catalogued as “Vos habitudes d’achats”, it is clear that the quality and price of a product are considered the most significant variables in the final choice of consumer purchase; Moreover, 91% of respondents recognize that a product has unique and inimitable characteristics linked to its place of origin;
- in the section entitled “A propos des labels” it has been reported the low level of knowledge, widespread among respondents, regarding labels, focusing on PGI and PDO (as they are particularly common and popular at European level);
- and, finally, in the fourth section “Les Oranges Sanguines de Sicile labellisées IGP” it is reported their willingness to pay an extra-price for the certified Sicilian product. In particular, the relevant data are reported as follows. A 39% of respondents said they were willing to “pay more and choose a food product from Sicily than other food products (including those produced in their country) for their particular organoleptic properties”; the 36% then remain open to this possibility, while only the 25% are unwilling. The 54% of people also stated that they would ask their trusted supplier to import the product, and 13% said they would do so without doubt. Only 33% of individuals would not be willing to make such a request (however, it should be considered in the analysis that among the respondents there are individuals that dislike the citrus fruit, regardless of its origins).

This data show that there is indeed a potential for the Sicilian Orange in this market, which is later confirmed by other studies, such as the study conducted by Ismea, which places France in third place among the world’s citrus importers. But the most important information that is obtained, overall, from the answers to the questionnaire concerns the already mentioned “information gap”, which can be said to consist, in this case, in a metaphorical sea that separates the consumers from the producer. In fact, respondents demonstrated a below-average level of knowledge of quality certifications, including showing a willingness to deal with this misinformation. It can therefore be easily observed that the “foreign” consumer, because of both the physical and the metaphorical sea that separates him from the manufacturer, demands him to provide all the useful tools necessary to build a strong trust relationship, based on the concept of “transparency”.

As a result, it could be thus convenient for the Consortium to concentrate its resources with the aim of obtaining the certification of a juice 100% made up of Sicilian Blood Orange PGI, which would allow to obtain multiple advantages, such as fulfilling these information gaps by specifying the relevant information of the product directly on the label: for example, indicating not only the organoleptic quality of the orange or the positive qualitative difference with respect to other types of oranges (highest content of vitamin C), but also by appearing certain information related to the certifications implemented to the product.

In addition, the poor French citrus production, the fact that the orange is a seasonal fruit (which requires the transformation into juice in order to be preserved and marketed during the year) and the fact that the consumption of orange juice in France is significantly higher than other types of juice, as demonstrated in Fig. 3, further support the result of the study.

For these reasons, in order to achieve its scopes, the Consortium can certainly exploit and enjoy the tools it has recently equipped itself with. In fact, even to cope with the so-called phenomenon of “Digital Transformation”, the Sicilian Blood Orange PGI - already from 2019 - is protected from counterfeiting thanks to blockchain technology, which guarantees the authenticity and integrity of the fruit, in Italy and abroad. It consists of a technological badge that tells the origin and characteristics of the product, facilitates customs

procedures and monitors the conditions and temperature of oranges during transport to ensure everywhere a fruit of excellence.

R.O.U.G.E., “Red Orange Upgrading Green Economy”, is the name of the project which allows the Consortium to implement Smart traceability solutions thanks to an *ad hoc* digital platform, designed and built by Almaviva (Fig. 4). The main advantages of “Rouge” are the improvement of control operations (and therefore the protection of the denomination) together with the fight against counterfeiting, the simplification of bureaucratic procedures and the decrease of paper documentation, the reduction of data imputation errors, the monitoring of the sector by the Administration and the possibility of implementing strategies to promote the product on national and international markets.

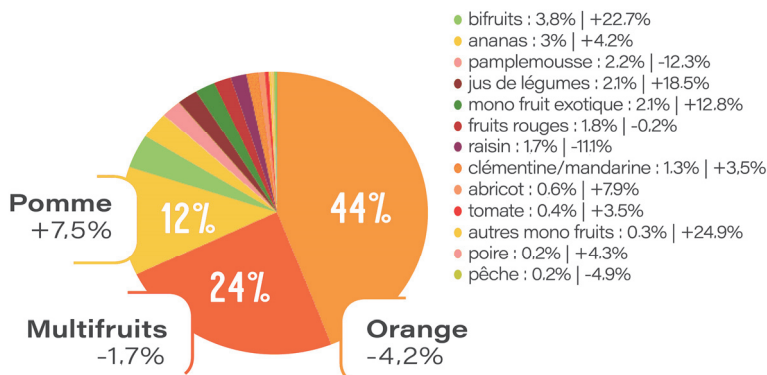


Fig. 3. Trend of fruit juice consumption in France (<https://www.unijus.org/1-514-economie-marche/532-les-chiffres-de-la-filiere.aspx>)



Fig. 4. ROUGE ecosystem & functioning (Consortium of Protection of the Blood Orange of Sicily PGI, 2019)

Through a TAG/NFC badge affixed to the fruit box and sophisticated sensors that check travel conditions, such as humidity and temperature, the App allows to monitor the field of production thanks to a map geolocation system provided by public source, the date of the harvest, the methods of storage and distribution and this allows the consumer to know the whole history of every single package of the citrus through their smartphone.

The project has been recently accepted by the ISO Technical Committee on Blockchain and Distributed Ledger Technologies (ISO/TC 307 WG6) as the first case of usage in the UE agri-food sector. The technical report on ISO/TC307 WG6 use cases is expected to be published at the end of this year.

6. Concluding remarks

The national agri-food and agro-industrial sector is operating under strong competition, as a result of a progressive saturation of international markets.

Sicilian agricultural products, unable to compete on price in the face of competition from the bordering countries of Africa, the eastern countries or South America that produce at a much lower cost, have no other way but to bet on quality and identity.

Consumers, who are increasingly demanding quality and safety, are pushing towards a diversification of food products based on qualitative and guarantee characteristics they offer, sometimes requiring producers to adopt production systems with traceable goods throughout the production chain.

The Consortium of Protection of Sicilian Blood Orange PGI – intended as a cohesive group of entrepreneurs who commercialize under the collective brand “Blood Orange of Sicily PGI”, who are heading towards agriculture 4.0 and who also open up to the international market - is an example of proactivity from the point of view of the green economy, in terms of low environmental impact, quality and product safety , especially in the south of Italy.

The Orange, with its cultivar Tarocco, Moro and Sanguinello is the image, the symbol, that represents Sicily all around the world and, for this reason, the Consortium has a great ethical responsibility that, to date, through a smart and green approach, is externalized in an exceptional way by its stakeholders.

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