Food Blockchain

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Abstract: The article aims to highlight the main elements that must be taken into account in the case of food traceability, from producer to final consumer, by using blockchain technology or in other words how this technology borrowed from the field of cryptocurrencies can revolutionize food chain management Throughout the chain from production, storage, transport, to the final consumer, the complexity of food management and tracking is difficult to carry out. What makes blockchain technology stand out, is the solution to consumer confidence in the product they are buying. It is required that the seller at the end of the chain assume the quality level of the product, for which the buyer pays. In this sense, there are several international retailers that have developed this technology for their own products, with the aim of reducing food fraud.

Keywords: food traceability, food chain management, blockchain technology, food fraud.

JEL Classification: D18; I14; L66; P36

1. Introduction

We, the consumers, take information that will be transparent about the food consumed, mainly from the product label, from the media, from the internet, but is all this enough for a correct information and ensuring food safety?

With a high potential for impact on food security, the use of blockchain technology can provide the data we need, the transparency, the trust, the effective information, thus the product no longer being a potential threat. The final consumer should be sovereign, there being no need for "*middlemen, in their function of controlling information and possibly exerting undue market power, or third-party institutions safeguarding rules, are no longer needed. Traceability would practically be given as an intrinsic feature of this technology*" (Kniepert & Fintineru, 2018).

If we were to refer to the EU's policy on food traceability, we would find that it is based on many quality standards, and, "in order to ensure food safety, it is necessary to consider all aspects of the food production chain as a continuous process, including primary production and feed production and ending with the sale or supply of food to consumers, as *each element can have a potential impact on food safety"*(Order (CE) no. 178/2002 of the European Parliament and Council– article 12).

Some of the information that guarantees the safety of the product is not compelling for the final consumer, since it does not provide the fundamental information they need, so the process is inefficient

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from this point of view. If it is also considered the "*organic character of production or geographic indications, the respective certification could be added to traditional products, supported by the respective EU legislation and international trade agreements*" (Kniepert & Fintineru, 2018), the information on the food traceability of the product is totally unnecessary.

The inclusion of fundamental information of interest to the final consumer about the delivered product is the basis for real-time chain observation and control.

2. Blockchain Technology

When purchasing a food item, the first aspect checked is the shelf life, we are less interested in the content of the nutrition label and almost not at all in how it was produced, if the recipe and production stages were followed, if the ingredients used have a safe or organic origin, how it has been stored, transported, or handled until it got in the stores. It is necessary to investigate a history in order to determine the possible damages that the foodstuff has suffered, or to determine the level of confidence of the producer and last but not least, of the seller.

"*Blockchain technology has been created as a solution to the mistrust issue*" (Toth, 2020). The first steps in the development of technology were taken in 1991, when Stuart Haber and W. Scott Stornetta first spoke about a cryptographically secure blockchain.

Since 2008, following the financial crisis, the concept, which is in fact a distributed database, was developed, "*aiming to propose a solution to change the way monetary transactions are carried out through various financial institutions*" (Toth, 2020).

"*A blockchain is a growing list of records (or data) called blocks that are linked and secured using cryptography…*" (https://ro.wikipedia.org/wiki/Blockchain). At present, securing financial exchanges requires a middleman that provides trust to the transactions. Instead, a "*blockchain allows consumers and suppliers to connect directly, eliminating the need for a third party"*, (Fersht & JohnSpink, 2019). Through the cryptographic system, the data is secured, the system providing a digital register of transactions that can be viewed within the network.

"*Blockchain has the following key characteristics:*

1. Decentralization. It can be classified into three forms: architectural, political and logical decentralization.

2. Persistency. All records in the whole network cannot be tampered and any falsification can be detected easily.

3. Anonymity. A user could generate many addresses to avoid identity exposure. It preserves the privacy on the transactions.

4. Auditability. It improves the traceability and the transparency of the data stored in the blockchain (Chen, Bing, Manli & Chen, 2018).

Technology has the potential to make any organization an owner of information exchanged between participants, it can collect and transmit various information, ensuring coordination between the parties, given the fact that they are not known and can not determine how credible they are.

2.1. Blockchain Technology and the Food Industry

The existence of an imbalance between economic agents and consumers makes the impact of the technical-scientific revolution to offer food products about which the producers know everything, while the consumers do not have the means of control or information regarding their quality. Consumers are at risk of purchasing counterfeit foodstuffs, or worse, a risk of infection with a pathogen.

Some manufacturers set aside the rules of ethics when it comes to reducing costs and increasing food production, leading to uncertainty about food safety. Food safety scandals have continued and continue to happen, and the „double standard" cases in Eastern Europe are better known than ever.

As a measure to prevent counterfeiting in the food field, "*food traceability has been highlighted as an important measure to get rid of the impact to the industry*" (Lin, Shih, Liu & Jie, 2017).

If we consider food traceability, it "*means the possibility of identifying and tracking, during all specific stages, the movement of food"* (CODEX Alimentarius. 2006) (production/processing, reception and distribution), as well as the traceability of raw materials for its manufacture (Feed, animal for food production, substance to be incorporated into the food). We find the same definition in the ISO Standard 22000:2018 which "*defines the steps an organization must take to demonstrate its ability to control food safety hazards and ensure that food is safe for consumption*" (ISO 22000:2018, Romanian standard *SR EN ISO 22000:2019). "The standard applies to any organization in the food chain from feed producers and primary producers, to food producers, processors, transport and storage operators, from retail stores to restaurants or street kiosks. Feeding organizations, wildlife gatherers, hunters, fishermen, farmers, ingredient producers, service organizations, catering services, cleaning and disinfection services, transport, storage and distribution services, suppliers of equipment, cleaning and disinfection products, packaging materials and other food contact materials are not excluded either*." (SR EN ISO 22000:2019).

Referring to the first blockchain feature, respectively decentralization, the network participants are all equal, adhere to the same protocols (agreed consensus on content, cryptographic system and digital signatures to ensure data integrity), the system recording chronologically all valid data agreed by network members , the process being irreversible (data cannot be modified). Consequently, the third party certifying by standards, the control of food safety hazards and ensuring that food is safe for consumption is eliminated.

For a traditional centralized traceability system, all data must cover all stages of the chain from production, transport, storage, handling, marketing, and be able to make the connection between them. "*Moreover, essential information documenting compliance with relevant standards must be passed along the chain as products move from one stage to another*" (Schuppers & Voinițchi, 2017) (see figure 1).

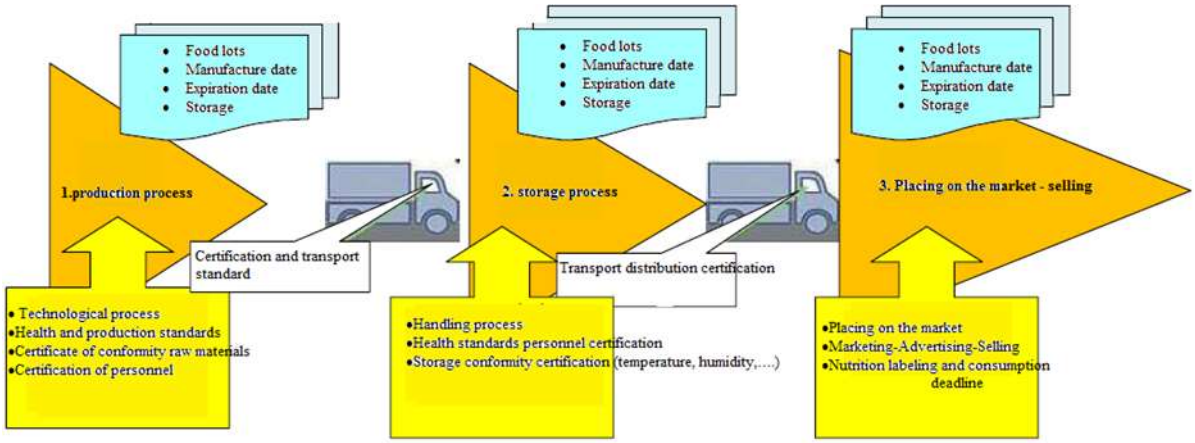

Figure 1. Traditional Centralized Traceability System

A traditional traceability system used today is "*inefficient, expensive, non-transparent and fraudulent and abusive*" (Sloane Brakeville & BhargavPerepa, 2016), and in addition we find „*the existence of a third party system that provides trust, or another intermediary in the system"*. (Lin, Shih, Liu & Jie, 2017). A feature is the fact that all participants keep their own data, sometimes with discrepancies, sometimes inefficiently managed.

For a blockchain traceability system, which is a distributed database shared between nodes of a computer network, the distinct stages of the chain from production, transportation, storage, handling, marketing, and the third party that ensures trust disappear. The information is transmitted together in groups, known as blocks, which store information electronically in digital format, each block in the chain carrying a list of data and transactions from the previous block but also a reference (hash). For this reason it is called "distributed ledger technology" (DLT)

"The blocks have certain storage capacities and, when filled, they are closed and linked to the previously filled block, forming a data chain known as a blockchain. All new information following the newly added block is compiled into a newly formed block, which will then be added to the chain once completed." (Hayes, 2021).

The purpose of the blockchain is to allow digital information to be recorded and distributed, but not edited. In this way, a blockchain is a basis for data logs or transaction logs that cannot be modified, deleted or destroyed.

Such an example can be seen in the following figure:

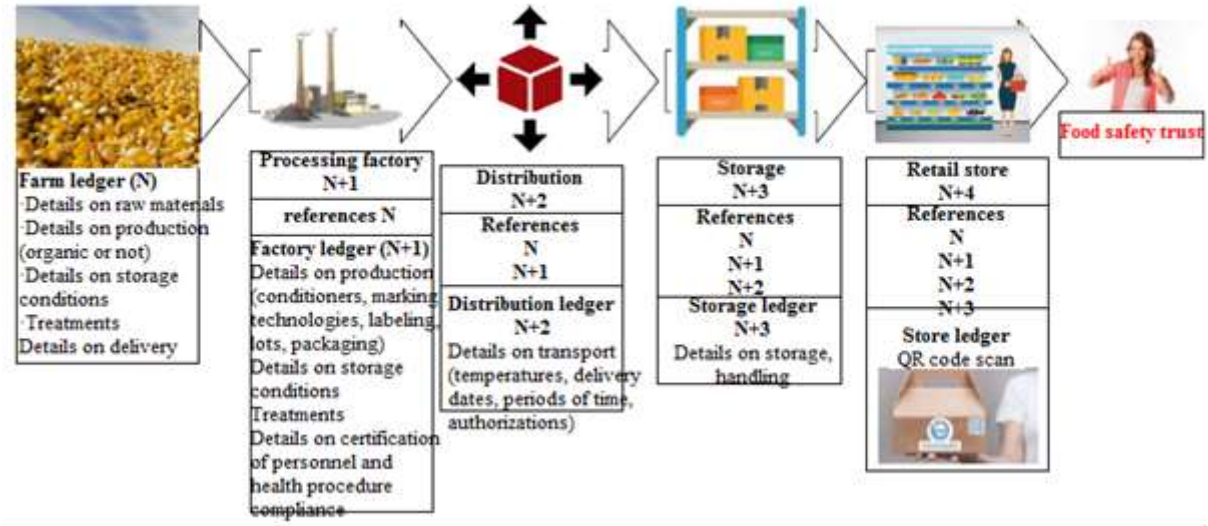

Figure 2. Food Blockchain Traceability System

Traceability and quality control in the way food is manufactured, stored, transported and marketed could increase the responsibility of all actors involved in this network.

Use in the food sector allows each organization in the production, distribution, supply, and sales chain to provide the information for which it is responsible for each batch of products on store shelves. Thus, consumers are offered the opportunity to be informed correctly and transparently, the information being accessible in real time.

3. Examples of Blockchain Technology Used in the Food Industry

One of the first attempts to use blockchain technology in the food industry was initiated by the US Food Standards Agency (FSA), which „*initiated the application of the blockchain in two areas. The first area refers to the implementation of the technology in the case of slaughtering beef and pork, the purpose being to provide reliable data on the origin of pork exported to China* (newfoodmagazine 2020), and the second refers to the import of wine from Australia, the data provided on the blockchain about wine being used by companies and various regulators.

The overseas Walmart retailer uses blockchain technology in its supermarkets within the internal organizational framework, as a way to quickly understand the problems that have arisen in its supply chain with lettuce. Traceability can lead back to the farm, being perceived as the latest generation solution in food safety.

IBM has created the IBM Food Trust for the transparency of food supply chains. "*In this way, the company certifies in real time the data on food safety, it ensures the observance of the appropriate handling protocols and the freshness of the food, helping to reduce the waste…*" (Sam Daley 2019)

Ripe IO is a company set up in 2017, with the purpose of being the first complete "*Food blockchain*". The company has been using "*the blockchain technology from one end to the other*" (Sam Daley 2019) in order to increase transparency in the food supply chain by tracking, securely aggregating data, checking product quality, automating agricultural processes, distributing food tracking in real time, and consumers receiving verified information on food traceability.

Greenfence, a service company set up in 2013, operates a remote audit and certification platform for the food industry, and it provides simple and scalable cutting edge blockchain solutions that empower all stakeholders "*to build their own supply chains on the world's first self-serve blockchain"* (https://pr.linkedin.com/company/greenfence).

Through company software rented to users, the farms, locations, distributors, equipment or other information that is of interest throughout the chain, from farm to consumer, is identified and certified to ensure that quality standards are met step by step.

A collaboration between Carrefour and IBM Food Trust at European level brings to the forefront the implementation of a standard of food traceability within the company, throughout the chain, from production, processing, packaging and distribution. "*Through this network of collaboration established between producers and distributors, the beneficiaries - consumers receive information about product safety, especially information about:*

traceability of the origin and quality of the product;
the nutritional properties of the products and the potential presence of any allergens or questionable substances;
traceability shared throughout the supply chain in the event of a product being withdrawn, which could lead to a health problem, non-compliance with specifications or poor labeling" ... (carrefour_press_release 2018).

Carrefour uses blockchain technology for Auvergne chickens through the Carrefour Quality Sector at European level since March 2018 (Filière Qualité Carrefour -FQC), being the first in this field.

Since 2019, the Carrefour Quality Chain has been expanded to include a range of products such as Cauralina tomatoes, Loué farm-raised eggs, AOC (Appellation d'Origine Controlee) cheese, Rocamadour, fresh Gillot milk, Norwegian salmon and Christmas chicken.

For the first time in the Romanian food sector, consumers have the opportunity to discover information, directly from the farm, about the origin and quality of the products they consume, within the products present on Carrefour shelves, for eggs, Carrefour Quality Chain from Rojişte Farm from Dolj County.

Carrefour Quality Chain (FCC) is a program through which the company partners directly with local and international manufacturers to provide consumers with healthy, tasty, varied, accessible to all, and especially environmentally friendly products.

4. Conclusions

Blockchain technology implemented in the food sector is a solution to the problem of mistrust between actors entering the chain of traceability, maybe in the near future a successful solution to eradicate the double food standard.,,There are at least two essential problems in the food industry that blockchain has been presumed to solve.

First, the trust issue: the public demand for transparency is growing within the market. Essentially, customers are becoming more health-conscious and want to know as much as possible about the food they get…

Food companies implement traceability because they see that the consumers require transparency and credibility. Blockchain's immutability helps them to prove that the information the different supply chain companies provide is uncorrupted...(Stephen O'Neal 2019)

"One of the primary drivers for food providers to consider blockchain technology is the ability of the technology to collect data from various sources and create a single view of the transaction This plays an important role in the ability to track the food product back to its origin driving more efficiency when a food safety issue arises" (https://www.cryptonewspoint.com/post 2020).

Its usefulness in the food sector is given by the management of the system which is basically nothing more than a series of producers, processors, distributors, traders who must comply with standards and end consumers who must receive information about the products they buy, much more than the nutrition label provides, but the bottom line is the trust that the product purchased is what it is supposed to be… *"Although not 100% resistant to counterfeiting, the technology behind the blockchain is extremely secure and suitable for food system management"* (Mehmet, 2020).

If we look at the system as a series of data that we need to trust, we are of course wondering who enters the data into the system, whether that data can be shared between chain members, how controlled this sharing is, or in other words, its limitations in terms of who can see the information, how much they can see and what they can do with it.

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