Food freshness in Portugal:
Southern European narratives of meanings and technologies

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Abstract: All year round availability of fresh foods is an almost ubiquitous quality criterion in contemporary agro-food systems. Yet, the normalization of freshness in everyday life is a recent phenomenon. Regular access to fresh food became a necessity (and not a luxury as before) for many consumers in the 20th and 21st centuries. In order to secure the globalization and circulation of fresh foods major transformations in production, distribution, storage, transport and home consumption were institutionally orchestrated. This article shows the varieties and trajectories of food freshness in contemporary Portugal by framing it under the emergence of international cooling technologies.

Key-words: freshness, cooling systems, refrigeration, Portugal, consumption, food, quality.
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Introduction

In contemporary societies food freshness is almost a ubiquitous quality food criteria. It configures practices of producers, retailers and consumers across the food chain. Examining food freshness is useful to unpack a set of dichotomies that are pervasive in everyday practices of the various intervening actors that produce, select, control and market food quality: unspoilt/spoilt; healthy/unhealthy; safe/unsafe; local/global; good/bad; tasty/tasteless; wholesome/wholesomeless; cold/hot; clean/dirty. Freshness is often associated with the first term of the pair. Yet, the arrival of modern technologies for preserving freshness (e.g. refrigeration, irradiation, shrink-wrap) and the reconfiguration of quality food meanings have greatly disturbed such simple dichotomies, giving rise to a more refined and critical conceptualization. For example, Kenyan green beans flown in to the UK in the last 24 hours can be fresher than the ones on sale in a farm shop, which were harvested a week ago. The categories of ‘local’ and ‘global’ can no longer be employed blindly when determining food freshness. In this sense, new time and space configurations contribute to warp the meanings of freshness in significant and novel ways. Therefore, the hybrid and ambiguous meanings of freshness allow for eschewing simple binary conceptualizations and open up the possibility for starting unpacking the shifts and trajectories of the history of freshness. The work
by Susanne Freidberg, Fresh - a Perishable History\(^1\) and also a recent article that appeared in this journal\(^2\) has hitherto offered a substantial contribution to unveil the history of freshness. However, it focuses substantially on the 19\(^{th}\)/20\(^{th}\) centuries’ North American context (albeit occasionally mentioning other geographies of freshness, namely in Asia, Northern and Central Europe and Africa). In this paper our focus is on a southern European country – Portugal – falling on the same period but unveiling different geographies and climates of freshness combining both Mediterranean and Atlantic influences.

In this paper, we seek to present an overview of the processes and techniques of producing and keeping food fresh by looking at the geographical, technical, scientific and social implications of both slowing spoilage and preserving freshness. Freidberg distinguishes between ‘slow spoilage’ and ‘preserving freshness’, the former is associated with a period before the advent of ice manufacture and mechanical refrigeration (before the 19th century) while the latter is associated with the period after this advent (mid-to-late 19th century).\(^3\)

By following the idea of producing isothermal conditions and how they are embedded in nature, we explore four aspects: firstly, how do people in their daily lives develop artefacts in different landscapes using disparate natural resources and materials that replicate the same function of thermal insulation; secondly how the amalgamation of these technical solutions developed in different landscapes present a common principle of producing isothermal conditions; thirdly, how science allows its diffusion by stabilizing this principle into a concept widely

\(^1\) Susanne FREIDBERG, Fresh - A Perishable History, (London, 2009).
\(^3\) Ibid., p. 259.
applied in the architecture of fresh (e.g. cellars, storeroom, pantry, warehouses); fourthly, how standardized and co-evolving technologies of food preservation multiply the meanings of freshness (extending the seasons; health; hygiene; energy inefficiency; convenience; ecological sustainability). We will pursue this by describing the 19th century and the 20th centuries’ technologies and architectures. In this vein, we focus less on the well-researched history of meals of the elite and more on the everyday life of the populations.

Food freshness and preservation: Nature, materials and building skills

This section focuses on food freshness before the invention of artificial cold chains and refrigeration systems. The timeframe is confined to the 19th century (although, occasionally, other historical periods will be mentioned to justify a specific argument) and it is geographically constricted to the Portuguese European continental territory. We stress, in particular, the relevance of food preservation and its recurrent use when access to sources of production became more distant and urbanization called for strategies of food supply at a distance.

As described by McMahon regarding food diets in New England (Maine), a process of ‘deseasonalization’ started by mid-18th century. According to the author the idea of access to foods ‘all year round’ was already in place, much before refrigeration, freezing and canning processes were developed to simplify food preparation. Manuals and guides on the best methods to store fruit and vegetables circulated in early 19th century. These empirical methods were the precursors of the modern

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5 Ibid., p. 142.
methods of preservation (e.g. canning, refrigeration, dehydration, chemical preservatives, along with later developments as irradiation, modified atmosphere packaging or biotechnology and nanotechnology applications to food). In this paper, our focus is not on long-term food preservation processes that alter the inner properties of food (e.g. texture, taste, and appearance), existent in contemporary as in other historical periods. Examples of such long term food preservation processes are: the use of spices (herbs), salt, olive oil or other vegetable oils, butter, garlic or other vegetables; smoking processes like the ones applied to meat or fish; the use of vinegar and olive oil in the confection of pickles, chutneys and similar processed condiments. The preparation of baked goods (e.g. biscuits, long storage cakes, and alike) is also outside the scope of our analysis.

Therefore, the present analysis is included, by default, in the history of technology literature as it explores the use of materials crafted, modelled and jointed together to create sufficient or even optimal thermal insulation conditions to extend the shelf life of food, and keeping it as fresh as possible. In this vein, a cultural and technological history of freshness will cover three main aspects: technology and materials wherein the geography, the climate and geomorphology played a crucial role; space and ownership of property as determinant to produce and preserve food freshness; an architecture of freshness which could not exist without knowledge, skills and know-how of building design.

By looking at the physical properties of materials embedded in Nature and the development of technology and building skills, the history of food preservation and storage of perishables becomes strongly articulated to a social history of space ownership and its social uses.
In order to explain some of the systems used throughout time for keeping and producing cold storage it is important to look at building materials (e.g. stone, clay or sand used to cover the floor in the wooden fishermen huts to preserve better the house⁶), and portable natural resources (e.g. leather, straw or cork). All of them were used to produce conditions of insulation in order to control thermal and humidity conditions. These processes were used in very large spaces (big farms), in shepherd’s and fishermen communities. Such processes would be copied at a small scale and built in as permanent structures, gradually from the 19th century onwards, and extending to every household (not being solely confined to the Aristocracy, urban dwellings or farmers warehouses).

The natural participants of freshness: weather, geography and materials

The historiography of food history and of technology has demonstrated that there were very skilful ways of preserving fresh food by making use of insulating materials to keep goods in edible conditions, long before the invention of the fridge.⁷

Natural conditions for maintaining and producing freshness vary according to climate, altitude, geomorphology, the longitude and latitude coordinates. That is, different climates across the plurality of worldwide landscapes produce a wide

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range of different conditions for keeping foods fresh. Accordingly, in nature there are varied materials that can be used to produce insulation and protect food from rotting. Such insulating devices for food preservation have been made of wood, cork, rocks, clay and sand. There are also historical records of food preserved by wrapping it in straw.8

Portugal is a good case study to explore freshness given its contrasting climates and landscapes on a single territory.9 This country is a crossroad of Mediterranean, Atlantic and continental climates, concentrating on a small area (92 212 Km²), a myriad of landscapes. It congregates a very diverse relief from highlands to valleys and floodplains, together with continental, coastal, wet and dry landscapes. In this irregular typology of landscapes and climates, weather can be quite unpredictable. At the south of river Tagus, a mix of Mediterranean and continental Atlantic climatic patterns affects this region. At the north, some regions (e.g. valley of Douro’s river) can be also influenced by a Mediterranean type climate.10

Thus, irregular and heterogeneous weather combined with an irregular relief and asymmetric hydrological, forest, slopes and floodplains distributions offer a wide diversity of natural environments. Considering its natural characteristics, Portugal is an excellent place to grasp local communities uses of natural materials for food preservation.

How does Nature produce and keep cold conditions? We start with this question to try to understand poor rural communities’ access to fresh food. Possibly, we can find amongst the mountaineers some of the best techniques and strategies for this purpose.\(^{11}\)

At first glance, the link between shadow, thickness, air circulation and the dynamic logistics for food preservation may be difficult to make.\(^{12}\) Yet, excluding ice, oil and salt, those elements were important to secure safe storage of meat, cookies, fruit and grain. These products were kept in natural shelters used by shepherds or in storage compartments (e.g. cellars, mills, presses, pantries, storerooms).

Shadow from dells or trees provide protection from the burning sun in the summer, both to human and non-human animals. As to food preservation, the lack of light and heat contributes to delay organic decomposition.

Refuges made of stone or cavern shelters kept stable thermal conditions, providing a warmer or cooler environment that appeases the unbalance of extreme temperatures.\(^{13}\) Knowing that the temperature 10 to 20 meters below the soil’s surface is cooler; seller and basements bellow the houses would copy these same natural conditions. It is known that since the Roman times, pits or holes dug on the floor or sand in the margins of riverbeds served to keep food fresh.\(^{14}\) The mountain range of Serra da Estrela (the Portuguese highest mountain range in the territory),

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\(^{11}\) Lourenço Justiniano da Fonseca e COSTA, *Apontamentos de uma Visita à Serra da Estrela no Mês de Agosto de 1875*, (Lisboa, 1875).


was a case in point, where shepherds would use megalithic monuments for sheltering.\(^1\)

Thus, the conditions to keep food fresh can be observed from Nature performance. Copying nature at a smaller scale would be the conceptual framework used by local communities to reproduce isothermal natural conditions. These conditions were the absence of light or shadow, temperature control achieved by using thick materials, and finally, humidity control obtained through air circulation. In the course of time, shadow, thickness of external walls, holes for air circulation found in Nature and used for protecting food from rotting, were reproduced in cellars, barns and houses.

In order to achieve temperature control, materials for sheltering had to comply with a specific criterion: thickness. If not respected, permeability to heat and cold would threaten food preservation. Furthermore, these materials offered clear advantages to timber constructions: a fire could be lit inside a cave without causing destruction. Hence, materials found in Nature such as mud, clay, rocks, sand and other goods of low economic value in agriculture-based economies became crucial for food preservation.

Later on, with the modernization and globalization of markets in the 19\(^{th}\) century, economic goods traded at a long distance and in time (e.g. wine, oil, fruit, hay, flowers, marmalades, dry fish, seafood), demanded specific storage logistics. Thus, with long global trade and provision of all year round foods the architecture of the warehouse emerged. Constructions of this kind required building materials. Some of them could be obtained or produced at a low cost. These were the cases of brick,

\(^{1}\) Francisco Martins SARMENTO, *Expedição Científica à Serra da Estrela 1881*, (Lisboa, 1883).
limestone, timber and glass for their raw materials (e.g. clay and sand) could be freely collected in Nature. It is important to stress those activities such as flagstone, clay, or sand extraction although classified as products of regulation in the state property in 1852-3, their extraction was poorly controlled or inexistent by the central Portuguese fiscal system up to the 20th century. In the commons their extraction was left either to free access or to municipalities’ control. Very few private activities were developed at a large scale in this area until the 20th century.

Thus, rocks and stone could be easily collected from the commons in the Portuguese 1800s highlands to build shepherds’ shelters and huts. This was the case in Terras do Soajo in the northwest mountains of Soajo or in Terra Quente, in the Provinces of Beira Alta and of Trás-os-Montes, in the inland area of the river Douro. Moreover, in the interior, rivers, lakes, ponds along with their natural resources, were left without regulation from 1832 to the late 19th century (1892). At local level, in some specific inland areas, they played a very important role of social control.

In their ethnographic and anthropological seminal work – *Construções Primitivas em Portugal* (Primitive Constructions in Portugal), Ernesto Veiga de Oliveira, Fernando Galhano and Benjamim Pereira, have identified a typology of housing and sheltering constructions for all over the country, including the Archipelagos of

19 António José NOBRE, *Cabanhas, Casulos e Palumbares na Terra de Miranda*, (Lisboa, 2004).
Madeira and Azores. Those structures, of an unrefined architecture, were made of unhewn materials deemed of poor economic value in the 1950s.

In this work the authors presented an inventory of materials and processes of construction of shelters, sheds and huts across the country that served both as permanent housing or temporary protection against extreme weather conditions.\(^{21}\) Some of those sheds used by shepherds, farmers, peasants or rural keepers were precarious constructions, sometimes even shacky. They could be found widely distributed across the Portuguese territory near the shoreline (from Oporto to Leiria), in the summits of Viseu’s mountain range, or in the fields of Alentejo for pigs breeding.\(^{22}\)

The descriptions made by the authors on the materials used in these shelters give evidence that such constructions were fit to create isothermal conditions for slowing spoilage for a few days. If we consider that inside the caves thermal values are regular, in these conditions fresh food could be kept (e.g. vegetables, milk, cheese or even meat). This was practised in the last quarter of 1800s.\(^{23}\)

Another way of delaying food spoilage was through palisades of shrubs as they can maintain a stable temperature and level of humidity, especially when there is open-air circulation. Regular circulation of air is desirable either to prevent excess or lack of humidity.

Adding to those forms of creating isothermal conditions, Portuguese shepherds travelling in the mountains and plains would also use movable tents made of


\(^{22}\) Ibidem, pp. 125-145.

straw. By following millennial practices of transhumance, much like the nomad tribes of the Indian populations in the USA, shepherds would built portable structures made of wood, sticks and straw, sometimes covered with goat or caw skin. Still today, in a Portuguese hilly village called Sendim located in the province of Beira Alta, local shepherds have recollection of seeing their ancestors with these tents transported by ox or caws. In inland mountains of Serra da Estrela, milk and cheese were some of the products kept in these tents, both in the summer or winter, given their good insulating properties from external weather conditions (e.g. cold, rain, heat and humidity).

However, a degree of humidity was needed to avoid drying food. As it had been stated in a source of 1875 on the same mountain (in the region of Gouveia), meat was kept for a week inside stone built shelters and in rocky crevices. Meat provisions supplied each week could be fresh or salted. However, it is likely that communities living on cattle breeding (sheep and goat), milky products, and dry fruits (chestnuts – *Castanea sativa*), had access to fresh food. And they seemed to be able to keep perishables for a week without getting dry or rot.

If we move south, to the savannah of Alentejo where the cork oak tree (*Quercus suber*) was abundant, cork would be an insulating material widely used in containers of small dimensions (Figure 1).

Shepherds on swineherds’ transhumance from inland Alentejo to the markets in coastal areas, especially used this material. From the personal archive of Raul Miguel Rosado Fernandes, it was possible to confirm that, in the early 1900s, swineherds with 1000 to 4000 pigs were annually steered to the coastal area (fairly 150km away from the starting point of departure). As shepherd Brites specified, in these transhumance journeys, food would be carried in cork containers.

Thus, competences and technical skills to build structures that keep temperature and humidity stable were acquired empirically almost in every regions of the country. Despite using different resources to keep food fresh the properties of insulation based on non-conducting materials (such as cork, stones, and straw) were widely used by the general population from farmers to shepherds, fishermen or shells collectors.

Álvaro Garrido and Inês Amorim, amongst others, have produced a substantial amount of work regarding fishing activities and the salt industry. Keeping fish fresh for a week was difficult to achieve under the aforementioned preservation processes used for meat, fruit or vegetables. Fish demanded chillier temperatures. Therefore the use of ice would be the solution to delay spoilage.

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29 Agendas de bolso pessoais de António Fernandes sobre a gestão agrícola das herdades (1904-1906), Arquivo pessoal de Raul Miguel Rosado Fernandes.
30 Personal communication by shepherd BRITES (of 76 years old) in Reguengos de Monsarás, Herdade da Cerejeirinha, by 14-05-2012).
A southern environment: ice and its exceptional character

Previously to the invention of the fridge, ice was a rare and expensive good. Throughout the Modern Ages, in a southern European country, permeable to Mediterranean climates, ice was a luxury item mostly used to chill drinks at the kings or aristocratic tables and also for medical purposes\(^{33}\). Snow (ice) was transported by oxes from the inland mountains until the Tagus River and then it would be carried in boats directly to the court, to Lisbon\(^{34}\).

In the eighteenth and nineteenth centuries the technology of cold was applied in the ice factories of the mountain ranges of Serra da Estrela (150 kilometres from Lisbon) and of Serra de Montejunto. The latter was a small mountain elevated at a distance of 50 km from Lisbon, it being the biggest supplier of ice to the royal house and aristocratic families in the capital\(^{35}\).

Ice production required appropriate technology and materials. Ice would be produced in big round or square holes dug on the ground, its walls covered in stone, and closed at the top with a big piece of wood. Ice would be transported to Lisbon in donkeys or by boats, inside wood containers wrapped up in thick covers of straw and cloth (possibly made of wool or linen)\(^{36}\). In the fast vessels, ice was stored in boxes probably covered with dry straw and cloths as well. Temperature was therefore kept stable by materials that had no properties of conductibility.

\(^{33}\) Susanne FREIDBERG, *Fresh ...*, p.20.
\(^{34}\) Isabel M. R. Mendes Drumond BRAGA, “O Consumo da Neve...”, p. 28.
\(^{36}\) Ibid.
Although the technology of cold production had been adopted in the few examples of ice factories, ice was a rare and expensive product. But as electricity was not available to produce ice at a universal scale till the end of the 19th century, what were the alternatives to produce the essential conditions to keep freshness?

There were other systems for keeping fresh food, which did not require ice. The same principles used to preserve freshness (in wholes and wells from 10 to 20 meters below the surface enclosed in stone walls) could be obtained with thickness and air corridors. This can be observed in cellars or barns widespread in the provinces of Beira Baixa, Ribatejo and Alentejo or caves for wine storage. Therefore, a substantial amount of space inside the house was needed to keep fresh food before the advent of the fridge. This leads to a discussion on the social uses of space articulated to the geographies of freshness.

Geographies of freshness: the social uses of space

Throughout the 15th and 18th centuries urban areas were not concentrated conglomerates of services. The “city” was a place with buildings where churches, justice, military and tax services were concentrated as symbols of seigniorial power. Handcraft activities, markets, industry and food production coexisted. Animals for human consumption would cross the streets before reaching the slaughterhouse. Near to the shoreline, fish would be sold alive, freshly captured from the sea, in daily markets of coastal villages. In cities like Lisbon, convents and

monasteries would have their own vegetable plots and orchards inside their walls. Thus, for centuries, freshness was easily accessible given close production-consumption links.

Fresh food was eventually accessible not only by the social elite of the capital but also by the lower classes, especially when these had their own vegetable and kitchen gardens in the city. Some social groups would have access to fresh foods through their own vegetable gardens and poultry production (e.g. chickens)\textsuperscript{38}. Thus, fresh food, although scarce, was available even for the lower classes\textsuperscript{39}.

This situation changed dramatically in the industrial cities of the 1800s. An extensive historiography on health, medical, material and administrative history has demonstrated that due to the explosion of the industrial cities the relations between housing, people, hygiene and food altered substantially\textsuperscript{40}. These new configurations took place in industrial and commercial cities served by trains and harbours, where people started to live in “human hives” in the industrial neighbourhoods or urban “islands”, for example, in Oporto and in the outskirts of Lisbon\textsuperscript{41}.

Social access to all sorts of fresh food started being problematic with this huge urban development. The majority of wageless peasants and urban lower classes would not have access to property of their own\textsuperscript{42}. The few, who could afford living in a house or a shed of their own, would likely not waste a room for storage. As it

\textsuperscript{39} Raquel Soeiro de Brito, \textit{Palheiros de Mira} ..., pp. 75-84.
\textsuperscript{40} Fátima Loureiro de MATOS, Teresa Barata SALGUEIRO, “Habitar nas Cidades Portuguesas” in Carlos Alberto MEDEIROS (Dir), \textit{Geografia de Portugal...}, vol IV, pp.306-342, pp. 323-325.
was vital to save energy and heat, the family often gathered around the open hearth in the home's main room\textsuperscript{13}. Thus, owning a room for storing food became a sign of wealth and social status. The architecture of fresh would require space as much as technology. By consulting housing plans and blueprints of the nineteenth century one can examine how space for storerooms was allocated in different houses, which varied according to social background\textsuperscript{44}.

It was in the context of population concentration and poor hygiene conditions that food storage became paramount. In the cities, more than in the countryside, space for storage (e.g. warehouses) was needed to supply the urban population with food provisions; thus, space would be required for more quantity of food stored. In the overpopulated “islands” of industrial cities, houses with storerooms did not follow the sudden increase of population density in house occupation. Therefore instead of more room available to store fresh food, space, in lower classes housing became valuable for accommodating people. Before the diffusion of the fridge in the 20\textsuperscript{th} century, only wealthy families could afford houses with enough space for storage. Once the artificial cold chain was consolidated, the technological shift of food preservation methods (replacing natural with artificial cold) was revolutionary in changing consumers’ relations with space and the architecture of preserving fresh food. It also contributed to a new configuration of meanings about freshness and diets as it changed consumers and producers expectations to all year round food, out of season and away from the sources of production.

\textsuperscript{43} Ruth Schwartz COWAN, More Work for Mother. The Ironies of Household Technology from the Open Hearth to the Microwave, (United States of America, 1985).
\textsuperscript{44} Fernando GALHANO, Casas de Pátio Fechado do Concelho de Paredes, (Coimbra, 1956); Ernesto Veiga de OLIVEIRA, Fernando GALHANO, Casas da Maia, (Porto, 1956); Idem, Casas de Esposende, (Porto, 1956); Idem, Casas da Zona Central do Litoral Português, (Porto, 1961); Idem, Palheiros do Litoral Portugués, (Lisboa, 1964); Idem, Arquitectura Tradicional Portuguesa, (Lisboa, 1992).
The advent of artificial cold storage in 20\textsuperscript{th} century Europe and Portugal

In the 18\textsuperscript{th} century, transportation of snow was carried out in many ways from the source of production in ice factories sited in Portugal or Spain, namely in Catalonia and Madrid. It was also extracted in the uplands in the Alps and moved to the lower lands by horses, donkeys, and caws. Once in the lowlands, river and maritime vessels moved it globally. It was certainly the case with North America and Scandinavian countries (Norway and Denmark), it being exported to Australia, South America, South Africa and India via fast vessels\textsuperscript{45}.

In the US, there were negative public perceptions towards cold storage for domestic use (e.g. the icebox). It was viewed as deceiving freshness and a health hazard due to potential pollution of natural ice sourced from contaminated waters\textsuperscript{46}. In another country with a strong food culture – France – fears of using ice or buying iced products were related to raising suspicion of the intentions of retailers and traders in selling foods that were not fresh. Expectations of freshness were already well regarded by consumers in late 19\textsuperscript{th} century France.

Some of these concerns have gradually superseded by the introduction of artificial cold, which “paved the way for the transition to an efficient mass production” of food\textsuperscript{47}, revolutionizing the organization and scale of production, storage, distribution, and ultimately, consumption. After the first experiments with artificial cold (e.g. compressed air; evaporation of liquefied ammonia) in the 1830’s, major developments in refrigeration and freezing systems took place in the

\textsuperscript{46} Hans Jürgen TEUTEBERG, “History of Cooling …”., p. 54; Susanne FREIDBERG, Fresh ..., pp. 23-31.
\textsuperscript{47} Ibid., p. 57.
second half of the 19th century with long distance and fast cold transportation. It was about this time that the first refrigerators appeared in the market, often presented in theme fairs. James Harrison developed an ether-compression-machine that made him establish an ice factory and set up in 1851 an Australian brewery with a refrigeration system. In 1859, F. Carré opened a similar brewery in Marseille. In 1874, T.S. Mort opened the first meat-freezing factory near Sidney (the New South Wales Fresh Food and Ice Company), and a slaughterhouse near its premises the following year. Both entrepreneurs tried to ship frozen Australian meat to Europe, but with no success. After some failed experiments conducted in Europe under the supervision of the engineer Charles Tellier, the first successful shipment of frozen meat was carried out between Buenos Aires and Le Havre in 1877 with the cold-storage steamer ‘Paraguay’.

Charles Tellier, a French engineer of late 19th century, is considered the ‘father of cold’. He has spent most of his life trying to put in place his dream of supplying the French population with cheap meat. He thought that one way to do it was to find a way to freeze it. The idea was to import food from places where it was cheaper to produce it and then transport it in a refrigerated vessel to France, so that it was sold at a cheaper price. He invented an ammonia-fuelled refrigeration system that was installed in the steamer called Le Frigorifique. In 20th September of 1876 the boat set off from Rouen towards South America (Buenos Aires) with frozen meat, but after a few days in the sea, it was caught by a storm and had to dock in Lisbon.

for repairs. The importance of this event, one of the first boats to transport frozen meat, was met in Lisbon with great furore. Charles Tellier met “with ambassadors and the king of Portugal”49, exhibiting the relevance of the new refrigeration technology for the Portuguese elite.

(Figures 2 and 3 about here)

This was certainly an important event in the history of artificial refrigeration systems. On a worldwide scale, a ‘cold chain’ quickly emerged for industrial and commercial use countervailing nature cycles of seasonality. However, refrigerators for domestic use were slower to pick up, given the fact that there were technical design problems in the cold storage technology to be properly transferred to domestic households; moreover, electricity or water systems were not distributed on a wider scale, especially in rural areas. After World War I, advertising campaigns, government agencies, fridge manufacturers, home economists and the recent discoveries around the world of vitamins helped to popularize images of freshness and persuade users for the benefits of cold storage50. Together with progresses in transport systems, the diffusion of electricity and water infrastructure, and other socio-temporal changes the fridge (and the freezer) became a normalized and convenient device in everyday life after World War II, especially in Western middle class kitchens. If this is true for several countries in Europe and the US, what can we say about the Portuguese appropriation of

49 Susanne FREIDBERG, *Fresh ...*, p. 61
50 Susanne FREIDBERG, “Freshness From Afar...”, p. 268.
industrial and domestic refrigeration systems to extend the shelf life of food? We must first examine the advent of cold industries in Portugal.

*The advent of cold industries: frozen meat and codfish*

In Portugal, the take off of the cold industry started with a push from two key players: the State that invested in food storage and distribution policies, and the Industry that needed regular power supply for its activities⁵¹.

In the inter-war period Portuguese rulers were concerned with the problem of scarce food production. From the 1910s until 1930s they faced the problem of epidemics (e.g. Pneumonic fever), which would widespread given low hygiene practices of food handling in overcrowded cities⁵². Starvation, unequal distribution of provisions across the country and health care were issues requiring massive public intervention.

Historians have suggested that during the New State Regime (1933-1974) rulers followed protective policies towards food production (cereals, fruit and wine), with a greater emphasis on cereals under the aegis of the “wheat campaign” (1929-1960)⁵³. Despite the growth of cereal production in the 1930s, were there a significant shortfall in food production in Portugal, this country could not resort to

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⁵³ Dulce FREIRE, *Producir e Beber...*
foreign aid for cereal imports given that Spain was in Civil War from 1936-39. Moreover, other traditional suppliers in Europe were involved in the World War II in the first half of the 1940s. Therefore investment in extractive food industries (e.g. fisheries, fruit, tomatoes) was strategic in public economic policies of food security\(^{54}\). In this vein, developing modern storage and refrigeration systems gradually permeated the political and scientific discourses throughout the 1940s and the 1950s.

To illustrate, in 1940, politicians and intellectuals stressed the importance of artificial cold as a strategy to solve part of the food shortage problem. In the Portuguese World Congress of 1940, the former representative of the International Association of Refrigeration, José Matos Braamcamp\(^{55}\), paraded this technology as a significant breakthrough to overcome the risk of food spoilage in storage.

In early 1900s other nations were already developing cooling systems that allowed Portugal to import frozen meat, at a small scale, since 1912\(^{56}\). However, this product was not well received among customers (especially amongst lower social classes to whom this product was targeted) given the poor preservation conditions

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\(^{55}\) José Matos Braamcamp was an engineer with an interest on cooling systems. As it was often the case during this period of development of modern infrastructures in cities like Lisbon, there was an exchange and transfer of technical knowledge and technology between Portugal and other foreign countries (see Ana Cardoso de MATOS and Maria Paula DIOGO, “Bringing it All Back Home: Portuguese Engineers and Their Travels of Learning (1850-1900)”, In *HOST – Journal of History of Science and Technology*, Vol. 1, pp. 155-182, 2007. [http://johost.eu/vol1_summer_2007/vol1_am.htm](http://johost.eu/vol1_summer_2007/vol1_am.htm). Braamcamp was one of such engineers who visited industrial site plants, fairs or conferences where ground-breaking technology on cooling systems was being presented and discussed. It was on one of such occasions that he met Charles Tellier at the 1\(^{st}\) International Congress of Refrigeration that took place in Paris in 1908. This congress was the embryo of the International Association of Refrigeration founded the following year in 1909. In 1920 it was restructured and renamed to the International Institute of Refrigeration still on-going.

\(^{56}\) The first frozen meat import was carried out by the company *Lisbon Frozen Meat, Cº. Lda.* that was founded in early 1912. Luís Navarro BRAZÃO, *O Frio na Conservação dos Produtos Alimentares de Origem Animal (suas Vantagens económico-sanitárias)*, (Lisboa, 1951).
in the fridges that were not prepared to produce cold below -5º C. In tandem, butchers and game sellers developed a campaign against frozen meat unsettling consumers’ trust in this product. Frozen meat of national origin (e.g. pork, beef, poultry and game) was stored in small quantities.

Although the take off of the cold industry applied to food preservation starts with the meat sector, this industry grows with other products that abounded in the country, namely sea fish, fruit and legumes. From the 1930s onwards sea fish and fruit were deemed as excellent goods to be frozen with chemists backing their unchanged nutritional properties. However, as industrial freezers were costly some engineers proposed their regional centralization, instead of being sited in large conurbations like Lisbon and Oporto. In this vein, small and large scale refrigerator warehouses to store frozen fish mushroomed in a variety of ports such as Peniche (1934), Almada, Olhão and Oporto (1939), Lisbon (1942), Aveiro (1948), and Figueira da Foz (1959). These became infrastructure icons materially reflecting the industrial and commercial economic policies of the authoritarian regime.

Moreover, these material infrastructures served to solve the problem of codfish supply to the nation. Greater reliance on cod imports and the monopoly of its internal distribution triggered a scarcity of this good in the 1st Republic period (1910-1926). In order to solve this issue, it was founded in 1934 the Cod Trade Regulatory Commission (Comissão Reguladora do Comércio de Bacalhau). This

57 Luís Navarro BRAZÃO, O Frio na Conservação..., p. 18; Jorge Perez FERNANDES, A Conservação das Carnes pelo Frio - Dissertação Inaugural, (Lisboa, 1911).
Commission had a significant role in organizing the storage, distribution, trade and marketing of codfish. In 1939 they launched in Oporto the first large refrigerator warehouse for codfish. Three years later, in 1942, it was overtaken by what was then considered the largest refrigerator warehouse built in the country. This one was located in Lisbon (Alcântara) and was composed of 49 cold-storage chambers and a capacity of storing 8 tons of salted dried codfish. This warehouse stored not only codfish but also fruit and potatoes.

The warehouse was considered an iconic technical and architectural building made of cutting edge technology imported from Germany during World War II, and revealing New State (Estado Novo)’s strategic investment in building a “cold chain” for the “Good of the Nation”. Thus, the authoritarian regime was also being consolidated through the development of artificial cold technologies and its representative materialities expressed in architecture and buildings. A few years later, in 1950, two frozen meat chambers and two refrigerator tunnels were built in the cellars of this warehouse, under the aegis of the National Board of Livestock Products (Junta Nacional de Produtos Pecuários). Later on, in 1954, the Lisbon Council decided to built the most modern refrigerated slaughterhouse of the country in the outskirts of the city (Odivelas). This one supplanted the first slaughterhouse with industrial refrigeration built in the country, located in Oporto, and built in 1932. Interestingly, the building of a cold chain in Portugal has also

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60 This Commission launched several codfish campaigns (e.g. one in 1938-1939, another in 1942-1943) to encourage consumers to buy this product. It was signaled to consumers the origin of codfish (either national or imported) so that the people would be enticed to support national production. See Deolinda FOLGADO, “A Caixa do Frio Artificial. A Conformação de um Lugar na Lisboa dos Anos 40”. In Deolinda FOLGADO et al, Museu do Oriente: de armazém frigorífico a espaço Museológico, (Lisboa, 2008), pp. 46-57.
62 Luís Navarro BRAZÃO, O Frio…, p.20.
63 Ibid., p. 21.
revealed a rivalry for technological protagonism between the two largest cities of the country: Oporto and Lisbon.

Importantly, these new ventures on refrigerated food supply systems would depend crucially on having access to a regular and consolidated energy power source, namely electricity. As we can observe, before the development of a national electrical grid, both public and private uses of cold for food preservation co-evolved with the closeness of electricity power plants. Electricity could be provided either by the State or by private power sources (e.g. thermoelectric and hydroelectric power plants)\textsuperscript{64}. Therefore the development of the electrical network in Portugal is one of the most suggestive indicators of the confidence placed on the adoption of both refrigerated-based industrial and domestic technologies to preserve freshness. The electrical power distribution was crucial to not only contributing to the development of industrial cold systems but also to the massification of domestic food technologies (e.g. fridge, freezer), especially after World War II.

\textit{The electrification of Portuguese households in the 20\textsuperscript{th} century}

There is a growing literature on the history of energy systems in 20\textsuperscript{th} century Portugal (electricity, gas), albeit more research is needed on its relation with the cold industry and domestic technologies. However, studies conducted by Mário

Mariano, Nuno Luís Madureira Diego Bussola, Sofia Teives among a few others are pioneering and have greatly contributed to understanding the implementation of energy infrastructures and the role of such provisioning systems to configure the consumption of domestic technologies for preserving freshness (e.g. the fridge-freezer). According to these studies the introduction of electricity as a source of energy for household consumption was a slow process that only picked up speed after World War II, and mainly in cities. Energy substitution of coal by electricity and gas sources was not as quick as in other European countries. At first, electricity was used for public lighting and only later found more multiple uses, it being the supply of electric domestic appliances one of the triggers of electricity consumption and the expansion of the network.

According to Teives in 1935 access to electricity was as follows: 16.7% of the Portuguese families lived in a house supplied by this source. This leaves more than 80% of the population using kerosene, firewood, olive oil, candles or acetylene as a way to lighten their houses. Electricity is then a privilege of urban populations, but at this time, Lisbon had 60% of its population with access to electricity whilst Oporto had 69%. The differences of access express different energy policy models in the two cities. At the time, the two biggest cities in the country had two different models of energy supply. Oporto, benefiting from favourable electricity policies (at

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68 Sofia TEIVES, Consumos ..., p. 103.
the level of the municipality) could offer its users cheaper consumption rates. Moreover, gas supply in Oporto was fading away and being replaced by electricity. Thus, this city can be considered the precursor of electricity domestic consumption in Portugal. Whilst in Lisbon, both electricity and gas sources of energy were supplied to feed domestic kitchens. The remaining cities of the country presented levels of access to electricity below 50%. From the 1950s onwards electricity distribution was dependent on the proximity of sources of energy production, namely hydropower plants.

Regarding gas, if at the end of the 19th century, it was used for street and domestic lighting, after World War II, it was mainly used for cooking and heating. This gradual shift was due, in partly, to the marketing activity of Companhias Reunidas de Gás e Electricidade [(CRGE) Electricity and Gas Joined Companies]]\(^70\) in promoting the “adoption of gas stoves by establishing a showroom/warehouse and creating a system of purchase by instalments”\(^71\) since the end of the 19th century. Those efforts continued in full force especially after the 1930s with a set of strategies to make consumers use both electricity and gas sources in Lisbon, that included: credit sales, promotional films, press advertisements, radio ads, free appliances given as competitions’ prizes, the circulation of a magazine – *O Amigo do Lar* (The Home’s Friend) advertising and explaining the benefits of several domestic technologies and gadgets (namely the fridge), and also free cookery classes for housewives and kitchen servants to learn how to cook with a gas stove.

\(^{69}\) Sofia TEIVES and Diego BUSSOLA, “O Consumo...”, pp. 115-140.

\(^{70}\) This company resulted from the merger between the Companhia Lisbonense de Iluminação a Gás (1848) and the Companhia Gás de Lisboa (1887). The CRGE was founded on the 10th June 1891 to produce both electricity and gas, and worked until 1975. The Lisbon City Council awarded a concession to this company to produce and distribute energy to the city. See Ana Cardoso de MATOS, Gas industry and urban modernisation: Lisbon in the 19th and 20th centuries. In *Transportes, Servicios y Telecomunicaciones*, December, nº 16, pp. 62-80, 2009.

\(^{71}\) Idem, Ana Cardoso de MATOS, “Gas industry...” p. 75.
or use electricity supplied fridges. After the 1940s the use of gas for cooking and heating had become widespread, and in "1974 over 60% of the population of Lisbon had gas in their homes"\textsuperscript{72}.

Given the dawdling dissemination of electricity systems in Portugal the next table shows the slow penetration of the fridge in domestic households of the city of Lisbon, compared to other capital cities in Europe and to the US.

(Table 1 about here)

Despite the insignificant acquisition levels of the fridge by domestic households in Lisbon, as we have seen as early as 1930s housewives could see fridges advertised in the magazine of propaganda for domestic technologies – \textit{O Amigo do Lar} (the Home's Friend) – that ran between 1932 and 1938. This magazine was set up by CRGE to encourage the take up of new customers to feed the energy provisioning system (electricity and gas). One example is an advert launched in the first number of the magazine advertising the famous Frigidaire by Electrolux (Amigo do Lar, 25/12/1932). In 1939, a different magazine (EVA) was advertising another Electrolux fridge (Figure 4).

(Figure 4 about here)

\textsuperscript{72} Idem Ana Cardoso de MATOS, Gas industry..., p. 78.
This refrigerator was released in the US in 1930, and looked like a small cupboard to be installed in city flats. In the Portuguese ad it is promoted the lack of vibration and noise of this particular model. A child, who is sleeping near the fridge without waking up, graphically demonstrates this advantage. Interesting also are the instructions given to users on the versatility of energy supply. For the country house it can work with oil; for the city it can work with gas or electricity. The ad seems also to imply what target population it aims. By mentioning the house in the country, we can hint at it was possibly targeting social groups that could afford two properties: a house in the countryside, and another one in the city. This also shows the two different speeds in the electrification process of the country, wherein rural areas were lagging behind urban areas. In 1940, 78% of the population lived in rural areas of which only 8,5% had access to electricity\textsuperscript{73}. At this time electrical appliances in rural areas were inexistent. The open hearth in the kitchen (the most important room in the house) was the main equipment for heating and cooking. For lighting, rural families would use the oil lamp, fed often by kerosene, and seldom by olive oil. Firewood was used for cooking, heating and also lighting. For this reason, rural families were still using traditional practices for slowing food spoilage such as the ones depicted before the advent of industrial cooling systems.

After World War II it is put in place a new energy tariff regime by central government in order to encourage the take up by consumers of electrical appliances\textsuperscript{74}. This was part of the government plan to try to lower energy prices for industrial purposes, so that the country could develop its industrial sector faster under the New State development plans (II Plano de Fomento). Apart from a

\textsuperscript{73} Sofia TEIVES and Diego BUSSOLA, “O Consumo...”, p. 125.

\textsuperscript{74} Diego BUSSOLA, A "Modernização...”, p. 32.
change in the tariff regime, electrical appliances were being sold at small instalments, so that not only the richer populations could afford buying those but also the increasing section of middle classes. Combined goods publicity was a common marketing strategy, and often a food product was combined with the fridge to encourage its purchase. This has certainly encouraged take up by consumers. In 1950, 10 years after the introduction of these policies, 78.4% of families living in the city of Oporto were covered by an electricity supply. The most popular electrical appliance was the electrical iron (39%), and the fridge would get much marginal percentages (3.4%). However, clearly improving from previous values (in 1936 only 0.86% of Lisbon residents had a fridge)\textsuperscript{75}. The marketing of fridges from US companies in Portugal in the 40s and 50s, such as the models by General Motors, was often attached to ideas of modernisation and efficiency of the household (ideas that were spread in other countries, namely in North America, during 1920s and 1930s around rationalization and domestic economy). In this sense, freshness was equalled to ideas of modernisation and efficiency.

(Figure 5 about here)

In Figure 5, the caption reads: “The electrical refrigerator is a necessity in the life of this family, preserving fresh and tasty food. This refrigerator has an internal light to increase efficiency”. Thus, the fridge gains centrality in the family household, bringing values such as freshness, taste, efficiency and also ideas of the modern American lifestyle to the Portuguese context.

\textsuperscript{75} Sofia TEIVES and Diego BUSSOLA, “O Consumo...”, p. 124-125.
By the 1960s, electricity reaches 88.5% of urban dwellings, but in rural areas covers only 27.4% of the population\(^7\). In many rural areas the modernization of household with domestic appliances will only arrive in the 1980s (with the consolidation of the democratic regime, the accession of Portugal to the European Economic Community and the rising comfort standards of the population). It is in the 80s that the acquisition of electrical appliances on a substantial scale is consolidated. Items like the fridge or the television become necessities and not luxuries as in previous decades\(^7\). Nowadays, the combined fridge-freezer has become a normal item in the Portuguese household with close to 100% coverage. Thus, until very late the use of different food preservation techniques was uneven across the territory, wherein one can observe a gradual and slow diffusion of cooling technologies in urban areas coexisting with the use of traditional techniques for food preservation in rural spaces, especially in inland regions with scattered population. Indeed, in these areas, after the accomplishment of the national electrical grid the freezer almost replaced the containers for food preservation in salt with the same purpose of prolonged food storage (wintertime). While in the cities the single freezer unit has become less normalized in everyday life; the combo fridge-freezer was more successful. This is also explained by the food retail geographies that emerged in the country throughout the 20\(^{th}\) century. The widespread of big retailers across the country is a fairly recent phenomenon, and shoreline areas had privileged access to big supermarket chains, it being less necessary to store food in big containers for long periods of time. In inland rural areas, access to food from big supermarket chains was only


possible from the 1990s onwards\textsuperscript{78}, thus, rural families would needed big freezers to store food for longer periods of time. This tendency has not disappeared completely even with the widespread of supermarket chains, because nowadays the majority of the population is concentrated in the shoreline.

\textit{The fridge-freezer and the multiple meanings of freshness}

In the course of the twentieth century, with the help of the cold chain, food freshness has gained a number of meanings and values: from preserving food and extending the shelf life, through efficiency and modernisation, taste, energy inefficiency, health and nutrition.

With the electrification and industrial development of cooling technologies access to fresh food is extended to a significant part of the population. For some time preserving freshness through the freezer corresponded to the preservation of the nutritional qualities, food hygiene, bacterial contamination control and body health. With the advent of the convenience and processed food industry, frozen meals were not always associated with the best nutritional and balanced meals. Frozen processed meals of poor nutritional value and low price contributed, in partly, to tarnish the former positive aspects associated with preserving freshness through cooling systems.

Between the 1930s and the 1980s, it was visible in the fridge-freezer marketing campaigns the association of this device with "more health". In tandem to health being flagged up, the use of polluting gases would be inadvertently invoked, such

\textsuperscript{78} Herculano CACHINHO, \textit{O Comércio Retalhista Português}, (Lisboa, 2002).
as in a General Electric fridge where it is announced that the equipment is “Cooled by freon-12, the best refrigerant known (odourless, incombustible, inert and non-poisonous)”\textsuperscript{79}. Nowadays freon-12 is part of a group of gases that contributes to ozone layer depletion, and is forbidden in the manufacture of cooling appliances.

At the time, ecological sustainability did not arise as a decisive aspect in industrial cooling production. Moreover, the state of scientific knowledge on these matters would be incipient regarding unveiling the harmful effects of substances on human and environmental health. The credibility on these technological systems relies upon an unquestionable trust in science, in a country where an educated population was a minority until the 1980s/1990s. A large part of the population was illiterate and would not think about challenging the veracity of propaganda leaflets by commercial companies, wherein the quality of those devices were certified by scientific knowledge. Consumers themselves believed that science could not be put into question.

Developments in science produced, in the last decades, some conclusions that are diametrically opposed to the discourses visible in these cooling technologies advertising campaigns. The current stages of knowledge of chemistry, biology or environmental science have significantly influenced public environmental awareness and mobilization, which invited further reconfigurations of the meanings attributed to food freshness. In the 1980s, the controversy surrounding the use of CFCs in refrigerators and the concerns on energy consumption of cooling systems have set up new shifting meanings on freshness. The demand for all year round fresh food and its high dependence on cooling systems opens up a new

\textsuperscript{79} Menos Despesas...Mais Saúde.GE. O Frigorífico Para Toda a Vida. 4 pp.
challenge: how to supply fresh food in a sustainable way? How to ensure low carbon cooling systems? In the 1990s, an energy efficient labelling system was set up with the purpose of grading domestic technologies according to energy efficiency classes: from A+++ (more energy efficient) to D (less energy efficient). This was one way to offer information to consumers on energy impacts when buying a cooling technology device.

Some sociological studies have traced evolving meanings associated with the uses of the freezer. One of those meanings conveys the freezer as a time-shifting device, as it helps to sustain the organization of everyday life. In tandem with the diffusion of the fridge a market of convenience food co-evolved. This established co-aliances with other technologies (such as the microwave) and locked in the uses of the freezer (and its associated cultural conventions on food freshness) in particular sociotechnical infrastructures (the weekly supermarket shopping undertaken by car in the outskirts of the city).

**Conclusions**

From the modern ages to our days, access to fresh food suffered several changes. Before the industrial revolution of the 19th century, access to fresh food required at least one of three conditions: the proximity to the places of production (e.g. fruit,
vegetables, meat or fish); the capacity for slowing food spoilage; and the ability to produce cooling conditions.

Before the use of electricity the techniques to achieve insulation were: the outer covering with non-conducting materials; the absence of light; and the control of air circulation. In the case of “Primitive Constructions”81 the competences to preserve freshness had been acquired in the course of centuries by local communities using containers of non-conductive materials. The insulating materials were varied and differently distributed across multiple landscapes, from the mountain to the floodplains or inland wetlands (e.g. the containers or structures made of wood, cork or sandstone were sealed with plants that grow in moist environments, such as reeds, ferns and grass like sedges that become naturally waterproof).

Equivalent principles of insulation would be applied in more sophisticated architectures of housing and storage in the countryside as well as in industrial and non-industrial cities. Private and commercial big warehouses would require space. Therefore, cooling systems entailed access to property. However, the latter was not easily accessed by every member of the population, neither in the rural world nor in urban areas. Space to spare was a luxury that the poor could not afford to have, especially in crowded cities. The construction of spaces to preserve food from spoilage would then lead to different architectures of freshness according to economic wealth and social status. Social differentiation was also revealed through access to fresh or non-fresh food. Electricity, housing construction, cooling and insulating technologies completely altered this paradigm. Social status could no

81 Ernesto Veiga de OLIVEIRA and Fernando GALHANO et al., Construções Primitivas...
longer be identified through the size of storage in households as it had happened in the second half of 1800.

Throughout the 19th century the gap between production and consumption of fresh food (e.g. meat, fish, fruit and vegetables) became larger as the concentration of the population increased in cities. Electricity production was key to sustain the normalization of fresh food supply both in urban as in rural areas. The big revolution of access to fresh food would come with the invention of the electric fridge and the advent of artificial cooling. Whereas at the beginning of the 20th century the introduction of electricity created social inequalities of access to fresh food, at the end of the century the wide diffusion of the electrical network across urban and rural areas contributed to dilute such differences. The acquisition of electrical appliances such as the refrigerator became popular among all the population, especially after the 1980s. The ability to keep fresh food in refrigerators had to wait for the completion of national electricity supply network, only achieved in the 1980s.

It is important to highlight that during Salazar’s dictatorship the take off of the cooling industry and electricity were both endorsed by the State and the private sector. From the 1930s, the risks of food shortage and famine felt in Spain during the Civil War (1936-1939), and later, the food rationing measures taken during World War II, have encouraged the Portuguese deputies to sponsor cooling technologies as unavoidable policies to prevent starvation and grant regular food supply to all the population (food security).

After the revolution in 1974 electricity production and supply became a state monopoly. It allowed the population to have widespread access to the already
available domestic technologies in the market. Access was still geographically and socially differentiated. The urban populations would benefit from easier access to these appliances and to a regular supply of energy without disruption.

To sum up, we have showed, on one hand, how raw materials, craft technologies, architectures, and cooling systems have produced positive meanings of preserving freshness (avoiding spoilage, beating the seasons, keeping food hygiene and security, good nutritional properties, convenience). On the other hand, we have also revealed how shifting these meanings can be with the progress of food technology, science and markets. For instance, cooling technologies allowed for the diffusion of foods of poor nutritional value (excess of saturated fats, sugar and salt), which are associated with the onset of several health related problems (e.g. obesity, cardiovascular diseases, Diabetes type II). Plus, whereas in the 1950s the freezer was galvanized as a rescuer of the housewife from drudgery and a factor for the maintenance of family harmony, in the 1980s the discovery of CFCs as contributors to the ozone layer depletion made the fridge an ecological hazard. Therefore, technologies of food preservation co-evolved with multiple meanings of freshness.