

Cities and milk consumption in Europe, 1890-1936: the emergence of a new market in Spain

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KEYWORDS: urbanization, milk consumption, food supply, Europe.

JEL CODES: N30, N50, N90, N70.

One of the main features of the European nutritional transition involved the wide-spread increase in milk consumption, a singular process as it involved the emergence of new consumption preferences. This transformation will be examined here using Spain as a case study. Even up until the 1890s milk was not considered a valuable dietary component in Spain, and was normally consumed only by those who were on liquid diets for medical reasons. By the 1930s, however, milk was regarded as a basic foodstuff, especially for children. Our main hypothesis is that cities played a central role in this change in preferences. Large population centres provided an avenue to spread new knowledge of nutrition and food hygiene, while cities allowed social economies of scale that made it easier to implement new public hygiene measures and to publicize or distribute new products. We also show that the spreading of milk consumption in cities progressed slowly in Spain, because until well into the twentieth century supply could only rely on short-range distribution networks.

Las ciudades y el consumo de leche en Europa, 1890-1936: la aparición de un nuevo mercado en España

PALABRAS CLAVE: urbanización, consumo de leche, abastecimiento de alimentos, Europa.

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***L**a difusión del consumo de leche fue una de las principales características de la transición nutricional europea. Este proceso fue además muy singular, porque exigió la formación de nuevas preferencias de consumo. En este artículo examinaremos esta cuestión tomando como referencia España. En este caso, todavía en los años 1890 la leche era un alimento muy poco valorado por la sociedad y normalmente solo la consumían aquellos colectivos que precisaban ingerir dietas líquidas. En los años 1930, en cambio, la leche era considerada un alimento de primera necesidad, especialmente para los menores de edad. Nuestra principal hipótesis es que las ciudades ocuparon un lugar destacado en este proceso, porque fue en estos núcleos de población donde antes se difundieron los nuevos conocimientos en nutrición e higiene de los alimentos, y donde las economías sociales de escala hacían más fácil impulsar nuevas políticas de higiene pública y la difusión de nuevos productos. También mostraremos que la difusión del consumo de leche avanzó muy lentamente en España, porque el abastecimiento debió ser de proximidad hasta muy entrado el siglo XX.*

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1. INTRODUCTION

The diffusion of milk consumption in Europe has been the subject of numerous studies on agrarian history and nutrition. These studies put forward two hypotheses. First, that the diffusion of milk consumption was the characteristic feature of the European nutritional transition, between the mid-19th century and the 1930s. Secondly, that this process of diffusion was very singular within this general framework because, in contrast with other changes in the diet, it demanded the emergence of new consumption preferences.

The sharp increase in milk consumption was not exclusive to Central and Northern Europe, where environmental conditions were highly favourable for stock-breeding¹. This increase is also attested, albeit later, in regions that specialised in the production of cereals and other vegetal crops². In addition, these processes were not only driven by economic factors. Traditional studies consider that the demand for milk and other animal products was elastic with regard to income, and that consumption grew when this variable also increased and technical advances allowed supply to react swiftly to new demand³. Concerning milk, however, this explanation is inadequate because the process was also affected by two other factors: a) the new knowledge provided by microbiology on the nutritional qualities of milk and the ways to prevent its contamination; and b) the initiatives put forward in this context by different groups and institutions in order to spread that the consumption of milk was both necessary and safe⁴.

In the 1870's, milk was still a poorly valued foodstuff, because the nutritional value of foodstuffs was chiefly assessed in terms of calories, proteins and fats, and milk was poor in these nutrients. Also, milk was prone to contamination by harmful microorganisms, and consuming contaminated milk could result in grave illnesses. For both reasons, milk consumption was considered necessary only for those people who were on liquid diets and consumption only reached significant levels in those European regions where it was abundantly available as a by-product of other agrarian activities (meat, butter or cheese production). By the 1930s, however, liquid milk was considered a basic foodstuff, and its consumption and milk-consuming groups had already grown substantially in most of

1. ATKINS (1980, 2007); KNIBBE (1993); KJÆRNES (1995); BIELEMAN (2005); ORLAND (2005).

2. HERNÁNDEZ ADELL and PUJOL (2016).

3. See for instance ABEL (1980) and GRIGG (1992), and the persistence of the traditional arguments in numerous economic and agrarian history handbooks.

4. KJÆRNES (1995); KAMMINGA and CUNNINGHAM (1995); MURCOTT (1999); SMITH and PHILLIPS (2000); ORLAND (2004, 2007); ATKINS (2005).

Europe⁵. Following this idea, different authors have also examined other aspects, which make the singularity of those processes even clearer. These other aspects include the new debates that they brought about the quality and hygiene of foodstuffs and, at the same time, the resulting controversies between sanitary specialists, public bodies and dairy companies on the formation of new milk markets⁶.

In this article we shall argue that cities played a crucial role in the diffusion of milk consumption because new knowledge about nutrition and food hygiene spread more quickly in large population centres and because the implementation of new public hygiene policies and the diffusion of new products was also easier in large cities. In order to explore this hypothesis, we shall focus on Spain. In this regard, the Spanish case is relevant because milk consumption was very low in most regions in the 1890s and, later, consumption only increased significantly in stock-breeding areas in the north and in a few large cities. Moreover, this took place in a context in which milk spoiled easily and in which cities were far away from the main production centres.

The text will be divided into three sections. The first section stresses the sharp increase in milk consumption in large cities between 1865 and 1936, based on: a) new estimates on apparent consumption in 12 countries and 63 cities in Western Europe (including 9 Spanish cities) from national and local statistics⁷; and b) more precise estimates on milk consumption among different social groups, based on family budget surveys and public-health reports (*topografías médico-sanitarias*). On the basis of this information, the second and third sections focus on the Spanish case and analyse those initiatives that contributed the most to generate a new demand for milk and the emergence of distribution networks to meet it. With these goals, we shall present new evidence on public health regulations; milk consumption in schools, hospitals and charitable institutions; innovation and diffusion initiatives led by doctors, pharmacists and dairy companies; and the activity of urban dairies and dairy firms. In the conclusion, we summarise our main contributions. In order to make the text more easily accessible, sources and estimations are presented in the appendices.

5. ORLAND (2004, 2005, 2007); ATKINS (2005, 2007); HARTOG (2007); NICOLAU, PUJOL and HERNÁNDEZ ADELL (2010).

6. STANZIANI (2007); SCHOLLIERS and VAN DEN EECKHOUT (2011); ATKINS (2017). See also the work of Bruegel, Hierholzer and Guy, on food safety, the regulation of markets and public hygiene policies in BRUEGEL (2012).

7. These estimates refer to milk in all forms, and do not consider product losses in the production chain. Different milk forms will only be mentioned when relevant.

2. MILK CONSUMPTION IN EUROPE AND THE LEADING ROLE OF CITIES

The leading role played by milk in the European nutritional transition has been stressed in numerous studies (Appendix 1 and Figure 1). Except in those regions where milk consumption was already high (*e.g.* Switzerland, Norway and Sweden), milk consumption in most European countries soared in the decades following the 1860s. Between 1865 and the peak in consumption, before 1950, milk consumption per capita grew by 45% in France (1930), between 145% and 170% in Netherlands (1950) and Denmark (1949), and over 200% in Great Britain (1950). In Spain, milk consumption increased by nearly 180% (1930). Concerning this case, however, some words of caution are necessary: in Spain, average consumption levels in the 19th century were very low, and remained so in comparison with those of other countries in the 1930s.

The low level of milk consumption in Spain in the 19th century is reflected in national statistics (20-23 l/p/y between 1865 and 1900), but also in other sources. For instance: in the stock-breeding provincial reports issued by the engineers of the National Agronomic Service (*Servicio Agronómico Nacional*) in 1891, in the nearly 200 healthcare reports issued by municipal doctors during the 19th century, and in different family budget estimates. In most of these sources, milk consumption is seldom mentioned and rarely quantified. In those cases where it was estimated, in addition, consumption hardly reached 20 l/p/y⁸. The situation improved in the first third of the 20th century, but less than in Central and Northern Europe and only in some provinces and among certain social groups. In the 1930s, average consumption was between 100 and 130 l/p/y in Great Britain, France, Netherlands and Denmark, but was only between 50 and 60 l in Spain⁹. At the same time, in Spain, milk consumption was above 100 l/p/y, and even 200 l/p/y, in stock-keeping areas in the north, but other than this, it only reached 40 l in a few provinces¹⁰. These differences, in fact, did not disappear until the second half of the 20th century. Between 1950 and 1980, milk consumption decreased in Northern and Central Europe (Figure 1) while it increased in Spain, and both trends finally converged in the 1990s around 100 l/p/y. This process of convergence can also be observed within Spain. In the 1980s, milk consumption in all provinces was above 100 l/p/y, and in some cases 150 l¹¹.

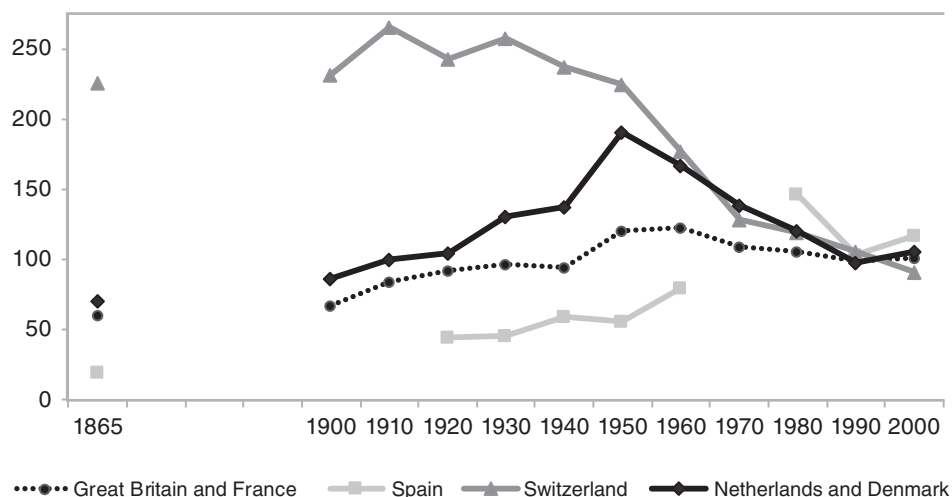
8. NICOLAU, PUJOL and HERNÁNDEZ ADELL (2010: 122); PUJOL and CUSSÓ (2014: 14).

9. Consumption was also nearly 100 l in Germany, and was well above this amount in Norway, Sweden, Austria and Switzerland.

10. DIRECCIÓN GENERAL DE AGRICULTURA (1934); HERNÁNDEZ ADELL, MUÑOZ and PUJOL (2017).

11. HERNÁNDEZ ADELL, MUÑOZ and PUJOL (2017).

FIGURE 1
Consumption of liquid milk in Europe, 1865-2001* (l/p/y)



*Aggregated estimates for Great Britain and France, and Netherlands and Denmark, are the weighted arithmetic mean on the basis of population.

Sources: Appendix 1 and Maddison (2003).

Plentiful data also suggest that in the early stages of these processes, the role of cities was very important (Appendix 2). Between the mid-19th century and the 1930s, milk consumption in London increased from approximately 35 l/p/y to 140 l, and in Berlin from 77 to 120 l. Furthermore, milk consumption in London, Berlin, Brussels, Copenhagen, Oslo and Bern in the 1930s was clearly higher than the respective national averages, and in Prague, Vienna, Stockholm and Paris, the city's and the national averages were very similar. It is also significant that in all of these cases milk consumption was near, or greater than, 100 l.

Obviously, this does not mean that milk consumption was always higher in major population centres. As we shall likewise illustrate with the Spanish case, milk consumption in towns or cities located in stock-keeping areas could be considerably higher. Milk consumption in Paris, for instance, was much lower than in Mulhouse (220 l), Strasburg (160 l) and Metz (150 l), and that of Berlin (120 l), was much lower than in Stuttgart, Munich and Mulheim Ruhr (*c.* 200 l), and also Frankfurt, Cologne or Hamburg (*c.* 150 or 160 l) (Appendix 2).

The speedy spread of milk consumption in the cities of this part of Europe is also attested by family budget inquiries (Table 1). In Belgium, milk consumption among waged

urban workers was estimated at nearly 48 l/p/y around 1890 and at nearly 148 l in the 1930s –that is, 70 l above the national average on the eve of World War II. In Germany, according to the same source, milk consumption among the same social group increased by 60 l between 1910 and 1930, and was a good deal higher than the national average. In Norway and Sweden, where consumption was traditionally high, milk consumption among urban workers was on level with, or remained only slightly below, the national average. Only in Austria did it remain clearly below the national level in the 1930s, although it was still very high (*c.* 160 l/p/y). In Great Britain, milk consumption among this group also increased rapidly from 1890 onwards, and it is likely that it also eventually overtook the national average. In this regard, it is important to highlight that the estimates presented in Table 1 do not include the consumption of condensed milk, and that the imports of this product into the United Kingdom increased substantially from the late 19th century onwards. In 1890, these imports were estimated at 15,000 tonnes and nearly 135,000 tons around 1930¹².

TABLE 1
Consumption of liquid milk among urban workers in Europe, 1890-1930 (l/p/y)

Country	1890	1910	1920	1930	1930 National average
Belgium	48	85	114	148	79
Sweden		265	272	233	290
Great Britain*	41	52	69		89
Germany		120		182	107
Norway (Oslo)		190		192	190
Austria (Vienna)				157	200

*Qualified workers.

Sources: Gazeley and Newell (2010: 28-9); League of Nations (1936: 34; 1937: 134-39, 271, 289); Rew (1892: 266).

In the case of Spain, the leading role played by cities is even clearer (Table 2). If we exclude milk consumption in the stock-keeping provinces, which were sparsely populated, high levels of milk consumption in the 1930s was limited to Madrid, Barcelona and Valencia. Milk consumption in these cities was greater than the average consumption in the remaining provinces (31 l/p/y) by as much as 30 l. Moreover, milk consumption in these three cities (60-75 l) was almost three-times that in the rest of their respective provinces (25-28 l). In other provinces of the centre and south, where milk consumption was still

12. PIRTLE (1926: 234); IIA (1940-41: 778). According to Atkins (1977), most of this type of milk was consumed by the working classes, and its consumption in London was between 9 and 18 l/p/y as early as 1910.

low, the difference between consumption in the capital and the rural areas were likewise very pronounced. In Seville and Zaragoza, milk consumption in the capital was between 36 and 40 l/p/y, and between 14 and 16 l in the rest of the province. In some of these cases, it is even possible that urban demand was satisfied at the expense of the consumption of the rural areas. Only in stock-breeding regions in the Cantabrian and Atlantic cornice and in the north of Catalonia was the situation reversed. In the provinces of Biscay, Guipuzcoa and Gerona, where production was high, milk consumption in the capitals (Bilbao, San Sebastián and Gerona) was far below that in the countryside.

TABLE 2
Milk consumption in capitals and in the rest of their respective provinces (l/p/y)

	1865		1925		1933	
	Capital	Rest of province*	Capital	Rest of province*	Capital	Rest of province*
Cities in stock-keeping provinces						
Bilbao			112.0	155.3	113.0	158.4
San Sebastián			150.0	210.7		
Gerona					83.0	157.8
Cities in non stock-keeping provinces						
Barcelona	3.7	0.1	64.3	25.9	72.0	24.7
Madrid	6.8	0.5	65.3	26.0	68.0	27.7
Valencia	5.4	1.1	56.0	20.63	63.0	27.8
Zaragoza					40.0	15.9
Seville					36.0	14.2
National average		20		45		56
without stock-keeping provinces		10		21		31

*Estimate based on provincial supply earmarked for direct consumption, milk consumption in the capital, and population censuses.

Sources: Appendices 2 and 3; *Boletín de cotizaciones* (1929); Calatayud and Medina (2017).

Finally, recent research also allows the conclusion that milk consumption in Spain increased more rapidly than that of other animal products, and that this occurred even in periods when milk prices increased (Table 3). On a national scale, for instance, milk consumption grew by nearly 145% between 1900 and 1933, while the consumption of meat and fish, which had also been low in the 19th century, increased by nearly 115% and 80% respectively. This marked increase in milk consumption can be observed even more clearly in cities. In Barcelona, milk consumption increased by nearly 500% between 1900 and 1933, while that of cheese grew by 185%, that of eggs by 80% and that of fish by 60%. Meat consumption, on the other hand, increased until 1914, but later fell below 1900 levels. This sort of specific study is still lacking for Madrid and Valencia, but it seems hard to believe that the consumption of other foodstuffs in these cities could have grown more than that of milk: between 100% and 250%, in the first third of the 20th century (Appendix

2). Finally, also concerning Barcelona, recent research also suggests that milk consumption increased in a sustained manner until 1930, even though its price allowing for inflation increased more than that of other foodstuffs from the 1920s onwards, and remained above early-20th century prices¹³.

TABLE 3
Animal product consumption in Spain and Barcelona, 1900-33

	Milk l/p/y	Meat kg/p/y	Fish u/p/y	Cheese	Eggs
Spain					
1900	23	13	14		
1933	56	28	25		
Barcelona					
1900	12	33	18	0.6	99
1914	57	38	19	0.6	135
1933	72	27	29	1.7	177

Sources: Appendices 2 and 3; Nicolau and Pujol (2005); Pujol and Cussó (2014: 12, 17).

In short, our estimates and other research show that the spread of milk consumption in Europe from the mid-19th century onwards was a very singular process which cannot be explained, as we stated in the Introduction, only by the increase in income levels brought about by economic growth¹⁴. Although this factor could explain the increasing consumption of other animal products (meat, cheese, eggs, fish) during this period, other variables were also at play concerning milk. Even if the income of households increased, this alone does not explain the intense increase in milk consumption that we have been describing here, or the fact that the consumption in Spain increased so much more than that of other foodstuffs. Similarly, higher income levels cannot explain why, in Barcelona, in the 1920s and 1930s, the consumption of meat decreased while that of milk increased, despite the fact that milk prices grew more than meat prices.

As other authors have suggested, in order to better explain the diffusion of milk consumption, therefore, we must take into consideration¹⁵ the emergence of new con-

13. Based on an index 100 in 1913, milk prices, allowing for inflation, decreased from 104 between 1898-1900 to 95 between 1914-19, and increased later to an average of 110 between 1921-30. The 1913 levels, in fact, were not reached again until 1932-34 (PUJOL, NICOLAU & HERNÁNDEZ ADELL, 2007: 318).

14. ABEL (1980); GRIGG (1992).

15. ATKINS (2000a, 2000b); HARTOG (2007); MURCOTT (1999: 320-27).

sumption preferences when the advances in microbiology afforded a more advanced knowledge about the properties of the product, especially with regard to two aspects: a) the bacteria that contaminated the product and the ways to mitigate their action (pasteurization, cooling); and b) the high nutritional content of the product in valuable micronutrients, especially calcium (known since 1808), vitamin A (1914) and D (1918). It was also discovered that vitamin D facilitated the absorption of calcium in teeth and bones, and that, consequently, milk consumption favoured bone development during childhood¹⁶. If these advances in nutrition are taken into consideration the prominent role played by cities in the spread of milk consumption also becomes easier to understand. In cities, the implementation of public hygiene policies and the popularisation of new products were easier, and the sanitary sector, the industry and the commercial sector were more developed. The following section examines the initiatives set out by these entities and the public bodies in order to promote the consumption of milk as both safe and necessary. The last section will examine changes undergone by distribution networks in order to be able to respond to this new demand.

3. NEW DEMAND FOR MILK

To disseminate among the population the idea that milk consumption was safe and necessary was especially important, because consumer choices are heavily dependent on the expected benefits of the purchased products¹⁷. The number of these initiatives and the importance assigned to them by different authors is, therefore, unsurprising¹⁸. As a result of these initiatives, the perceived benefits of consuming milk, which were still low in the late 19th century, had soared by 1930, especially for children¹⁹. At the same time, product hygiene also improved as a result of widespread pasteurisation and the implementation of stricter sanitary controls, which stimulated demand even more²⁰.

16. HOLSINGER, RAJKOWSKI and STABEL (1997: 441-42); CARPENTER (2003: 3023); HARTOG (2007: 131-32).

17. LANCASTER (1966).

18. KJÆRNES (1995); ATKINS (2000b); ORLAND (2004, 2007).

19. In Germany, for instance, consumption in the 1930s, was estimated between 197 and 222 l/y among children under ten, and between 100 and 127 l among the rest of the population (CASADO, 1931: 50-1).

20. Great Britain was a special case. ATKINS (2000a) estimates that in England and Wales milk caused half a million children to die from tuberculosis between 1850 and 1950 and, although he also specifies that most of these deaths occurred in the 19th century, it is reasonable to think that product hygiene did not improve sufficiently in later years. Probably because of this condensed milk consumption was high. See note 12 and associated text.

In Spain, the central government did not take active part in the spread of milk consumption until a very late date²¹, but local initiatives were very important. This circumstance is clearly appreciated if we consider the initiatives set out by municipal governments, often in close co-operation with the healthcare sector and milk companies, with the goal of improving product hygiene. This was, also, especially urgent in Spain because in many regions milk was contaminated easily, and this negatively affected the way the product was regarded. Milk consumption was dangerous and milk consumers were even viewed with suspicion. According to a prestigious geographer, in the municipality of Olot, in a stock-keeping district near the Pyrenees, nobody drank any milk in the 19th century unless it was on doctor's orders, and it was common for people to make enquiries prior to marriage in order to know whether their future spouses had ever drunk milk, as this could reveal a grave illness. Also according to this author, in Mataró, a town on the Mediterranean coast, near Barcelona, milk was regarded as *something fatal*, and *in households where there were young girls, if the doctor prescribed one of them to drink milk, the family did everything in their power for the neighbours not to know*²².

It is, therefore, important to highlight three of the initiatives set forth in order to foster milk consumption in Spain: the enactment of new regulations concerning milk hygiene and fraud prosecution; the creation of new agencies to oversee the sector; and the dissemination of new technologies to prolong the product's life.

In Barcelona, for instance, the council issued numerous regulations from the second half of the 19th century onwards (Table 4), especially concerning distribution networks. Until the late 19th century, when milk consumption was still very low, milk mostly came from two sources: there was the milk from cows and goats that were kept in the city itself, and that of cows and goats that were brought in daily to be milked in set public locations at appointed times. With the increase in consumption, however, the health and logistic problems associated with these practices increased (*e.g.* the spread of diseases such as tuberculosis and brucellosis, or the problems associated with animal feeding practices, the removal of excrement, or the transference of young animals to rural areas), and the council prohibited peddling animals in the early 20th century, and soon later proceeded to limit the activity of urban dairies. For this reason, the council increased sanitary controls in these facilities from approximately 1910 onwards, and in 1925 the commercialisation of raw goat's milk was forbidden. Soon afterwards urban dairies were compelled to abandon the most populous districts (Casco Antiguo and Barceloneta). In more sparsely populated districts, urban dairies were tolerated as long as they were not sold to

21. COLLANTES (2015b).

22. VILA (1979: 120-21).

TABLE 4

Main regulations on milk production and commercialisation. Barcelona, 1865-1930

Year	Scope	Norm	Main targets
1865	Barcelona	Regulation for the inspection of dairy animals (cows, jennies, goats)	Setting the basis for the Royal Order of 1867.
1867	National	Regulation of cow-, jenny-, goat- and sheep-keeping facilities (Royal Order of 8 August, 1867).	Ordered animal-keeping establishments in towns and cities of over 4,000 inhabitants to have a municipal license. Established minimum hygiene conditions for these facilities. Encouraged (but did not compel) local councils to locate these facilities outside the towns and cities.
1908	National	Royal Order 22/12/1908.	Entrusted municipalities with supervising the hygiene of milk for sale: inspection of stables and livestock and milk-sample analyses.
1910	Barcelona	Council decision 25/09/1910.	Repeated previous orders and made pasteurisation compulsory in certain cases.
1918	Barcelona	Council decision 25/09/1918.	Gave three months for animal-keeping facilities to move outside the city.
1925	National	Local Sanitary Regulations.	Defined the areas of action of local councils and the national authorities with regard to urban stables and insalubrious industries.
1925	Barcelona	Sanitary policy regulations concerning milk.	Authorised the sale of raw milk only after the cows had been tuberculin-tested and contamination was below 10,000 bacteria per cm ³ . Made pasteurisation compulsory in any other circumstances. Forbade the commercialisation of raw goat's milk. Established new sanitary regulations for dairies, stables, containers and transports.
1926	Barcelona (province)	Reminder of the norms that regulated the commercialisation of milk.	Compiled previous orders on milk peddling and adulteration of the product, with specification of fines and other sanctions.
1927	Barcelona	Regulation of sanitary policies concerning the milk supply of the city of Barcelona.	Clarified a number of technical points in the 1925 regulation.
1930	Barcelona	Norms for the relocation and establishment of dairies.	Established new norms concerning the relocation of cows and the creation of new dairies. Divided the city into zones according to the intensity of milk production.
1930	Barcelona	Regulations of the sanitary police.	Established new norms for the sanitary control of livestock.
1931	Barcelona	Regulation for the local veterinary sanitary services.	Organised inspections and the veterinary control of dairies, slaughterhouses and other animal-related establishments.

Sources: Arxiu Municipal Administratiu de Barcelona (AMAB), Governació, serie D, exp. 1246bis, 1910, 1918; Ajuntament de Barcelona (1865, 1925, 1927, 1930, 1931); Ayuntamiento de Madrid (1890); Junta Provincial de Abastos (1926); *Real decreto de 9 de febrero...* (1925).

non-first-degree relatives (spouses and offspring), and only in those districts that were farther away from the centre (Sant Martí and Sant Andreu) was their activity allowed to remain free of extra regulations²³. Following these measures, urban milk production in the 1920s stagnated at around 25 million litres per year, and the importation of milk from other regions increased from under 12 million litres in 1917, to nearly 50 million litres in 1934 (Appendix 3). In Madrid, the process followed a similar trajectory. The council greatly restricted the activity of urban dairies, and this led to a radical change in supply systems. After World War I, urban production stagnated at approximately 21 million litres, and the importation of milk from other regions increased from nearly 15 million litres in 1917 to 42 million in 1930 (Appendix 3).

At the same time as urban production stagnated and the arrival of milk from other regions increased, councils also improved sanitary product controls and promoted pasteurisation²⁴. Public health officials in Barcelona and Madrid claimed that, as a consequence of these measures, milk hygiene had improved substantially in urban dairies by 1935, and that a large proportion of the milk coming from other regions was pasteurised. According to their estimates, at that time 39 million litres were being pasteurised annually in Barcelona, and 17 million in Madrid –that is, 50% and 25%, respectively, of all the milk commercialised. Specifically, the firm Letona S. A. (1925), which commercialised nearly 22,000 l per day in the 1930s, built a collection and pasteurisation centre 40 km from Barcelona in 1925, and another one, 120 km from the city, in the 1930s. In 1935, Granja Soldevila S. A. (1928) created a new plant with a daily capacity of 19,000 l of milk, 72 km from the city. These and other firms not only pasteurised their own milk, but that commercialised by other producers which did not have the resources to create their own pasteurising facilities. Two more such centres were built in the city during this period. One of these was created by the council in 1930, and the second was opened shortly after by the Alliance of Milk Distributors of Barcelona (Alianza de Receptores de Leche de Barcelona), which integrated milk importers. In these centres, milk was analysed and, if the product did not meet the local regulations, it was pasteurized or rejected. In Madrid, Granja Poch and Cooperativa SAM (Sindicatos Agrícolas Montañeses) opened similar centres in Cantabria, approximately 450 km to the north of Madrid.

Two important measures that contributed to better control milk hygiene and to promote pasteurisation were: the enactment of new regulations concerning the bacteriological composition of milk (Table 5), and the creation of new laboratories to take advan-

23. AJUNTAMENT DE BARCELONA (1930).

24. For Barcelona, GENERALITAT DE CATALUNYA (1937: 12-3, 40-9, 78); MAS (1935: 22-3, 28-31); REPARAÇ (1928: 280). For Madrid, AGENJO (1936: 146-48); SANZ EGAÑA (1935: 348, 352).

tage of the latest advances in microbiology (*e.g.* using microscopes and new analytical techniques). The earliest of these laboratories to be founded were the Laboratorio Municipal de Microbiología de Barcelona (1886), the Laboratorio Central (Instituto Nacional) de Bacteriología e Higiene de Madrid (1894) and the Laboratorio Bacteriológico Municipal de Valencia (1894)²⁵.

TABLE 5

Milk ratings according to bacteriological content and frequency of inspections

Rating	Frequency of inspections	Maximum bacteria per cm ³		Pasteurisation
		Production-end	Retail-end	
A	Bimonthly	200,000	10,000	If between 10,000 and 200,000 bacteria per cm ³
B	Monthly	200,000 to 1,000,000	50,000	Compulsory
C	Monthly, detection of deficiencies in the facilities	Over 1,000,000	50,000	Compulsory (or boiled for a minimum of 5 minutes)

Source: Ajuntament de Barcelona (1925,1927: 595-96).

TABLE 6

Number of fresh milk samples analysed in Barcelona and Madrid, 1901-35

	Madrid				Barcelona			
	Fit	Unfit	Total	% Unfit	Fit	Unfit	Total	% Unfit
1901-10 ⁽¹⁾	135	269	404	66.5	62	73	135	54.1
1911-20 ⁽²⁾	50	237	287	82.6	197	103	300	34.4
1921-30 ⁽³⁾	168	404	572	70.7				
1931-35 ⁽⁴⁾	1,880	5,535	7,415	74.6	10,883	1,607	12,490	12.9

Notes: (1) Madrid: average between 1901 and 1910; Barcelona: figures for 1902. (2) Madrid: average of 1915, 1919 and 1920; Barcelona: average between 1911 and 1913. (3) Madrid: average between 1925 and 1927. (4) Madrid: figures for 1932; Barcelona: average between 1932 and 1935.

Sources: Negociado de Estadística, Padrón y Elecciones (1902-19); *Boletín del Laboratorio Municipal de Higiene de Madrid* (1901-35); Ajuntament de Barcelona (1921-35); García Revenga (1932).

These laboratories became especially active after World War I (Table 6). Between 1915 and the 1930s, the number of analysed milk samples went from nearly 300 to 7,500 in Madrid, and from around 300 to more than 12,000 in Barcelona. Table 6 also indicates, however, that the quality of the product did not improve to the same degree in both cities. In Barcelona, the percentage of samples unfit for human consumption dropped from nearly 55% to less than 15%. In Madrid, on the other hand, the percentage of unfit samples was always high. This does not mean that milk in Madrid was dangerous. Accord-

25. ETXANIZ and JUARISTI (1998: 269-70); RODRÍGUEZ OCAÑA and MARTÍNEZ NAVARRO (2008: 63).

ing to the laboratory reports, the differences were fundamentally due to the fraudulent practice, which was especially common in Madrid, of adding water to the milk²⁶.

Other activities that must have had a great impact on the emergence of new consumption preferences were those which aimed to promote healthier eating habits among the young. One of these activities was the distribution of milk at schools. Another, the creation of Gotas de Leche (Milk Depots). About the first issue, a significant example can be found in two well-known schools in Barcelona (Escola de Bosc, 200 pupils) and Madrid (San Ildefonso, 90 pupils) in 1911. That is, when milk consumption was still low. In these schools, between 20 and 25 cl of milk per child per day was distributed during school term. This practice must have been followed in other schools as well, although perhaps more sporadically or limited to pupils in need. At the Colegio de la Paz and the Asilo de Nuestra Señora de las Mercedes, for girls, in Madrid, the average milk consumption in 1911 was nearly 10 cl per pupil per day. In the Hospicio y Colegio de Desamparados, for boys, also in Madrid, it was below 3 cl²⁷.

Gotas de Leche and other similar charitable institutions were created by councils, influential families and doctors, with the purpose of providing breast milk substitutes for newborn babies in sterilised bottles. These institutions appeared first in large cities and later in smaller towns²⁸. Of the thirty-nine created between 1890 and 1920, thirty-five were located in provincial capitals. Between 1920 and 1934, twelve more opened in large population centres and seventeen in other towns. As a result, by 1934 almost all provinces had one Gota de Leche, especially in the main cities, and in Madrid and Barcelona there were three. The first was created in Barcelona (1890), and soon after, between 1903 and 1910, new ones opened in Madrid (1904), Valencia (1910) and other four cities. Between 1918 and 1923, 32,156 children were assisted in Madrid, with a total volume of 1.7 million litres of milk, and 7,215 children were assisted in Valencia, with 148,000 litres of milk. In Zaragoza and Seville, the number of children assisted was 7,659 (123,000 l) and 3,982 (80,000 l) respectively. Another two institutions that also contributed to popularise milk consumption were the Instituto Municipal de Puericultura de Madrid and La Casa de Maternidad de Barcelona. The former provided 7.3 million litres to 45,513 babies between 1914 and 1933, and the latter 1.2 million litres to 27,115 babies between 1921 and 1935²⁹.

26. CARUANA (1902: 94-7).

27. MINISTERIO DE GOBERNACIÓN (1915: 216-26); CARRO (1917: 14-5); CUSSÓ and GARRABOU (2004: 504).

28. MUÑOZ PRADAS (2016); RODRÍGUEZ OCAÑA, ORTIZ GÓMEZ and GARCÍA-DUARTE ROS (1985).

29. *Anuario Estadístico de España* (1918: 596; 1919: 466; 1920: 400; 1921-22: 398; 1922-23: 432;

Sanitary specialists did not limit themselves to assessing public institutions and to taking an active part in the organisation and the direction of the new supervisory bodies, laboratories and charitable institutions. Doctors and pharmacists also played an important role in the dissemination of milk consumption in two additional ways: by endorsing new diets in different publications and hospitals³⁰; and by promoting technological product innovations in close co-operation with the dairy industry. The importance of these activities did not go unnoticed. The author of the *Topografía médica de Calaf* (central Catalonia), indicated in 1903 that milk consumption was starting to become more common, *largely owing to the advice proffered by the good doctors of the town*. In 1923, the director of the Catalanian Technical Agricultural Service (Servicios Técnicos de Agricultura), concluded a report about nutrition in Barcelona by saying that the high level of milk and egg consumption in the city could be due to the medical advice given to patients, which was also adopted by healthy individuals on their own accord³¹.

There is plentiful evidence for the new diets promoted by these specialists in hospitals. Around 1911, the average daily consumption in hospitals for children with tuberculosis in Santander and Oza (La Coruña) was 60 cl. Also, at that time, the average intake in three healthcare institutions in Madrid (Manicomio of Santa Isabel, a mental hospital; Hospital de San Juan de Dios and the Casa de Maternidad y Asilo para los Hijos de las Cigarreras, for children), was nearly 20 cl per person per day. In two other hospitals also from this city (Hospital de la Princesa and Instituto Oftalmológico, for adults), consumption could reach 150 cl, when a milk-rich diet was prescribed. There are many more examples of the growing presence of milk in hospital diets. If we include patients and staff, average daily consumption in the Hospital Clínico de Barcelona was 58.6 cl per person between 1911 and 1913. In the Hospital de Sant Jaume, in Olot (Gerona), consumption increased from 2.2 cl/p/d in 1885 to nearly 54 cl in 1936. In the Hospital Provincial de Valencia, consumption increased from 9.3 cl in 1905 to nearly 30 cl in 1915³².

1923-24: 518; 1932-33: 685); NEGOCIADO DE ESTADÍSTICA, PADRÓN Y ELECCIONES (1902-19); AJUNTAMENT DE BARCELONA (1921-35).

30. For instance, over 350 articles were published about milk between 1881 and 1936 in the medical journal *Revista de Medicina y Cirugía Prácticas*. In a popular book published in 1932, Dr. CARRASCO (1934: 78), advised women to drink 25 cl of milk every day.

31. LLORENS I GALLART (1903: 81); RAVENTÓS (1923: 30-1).

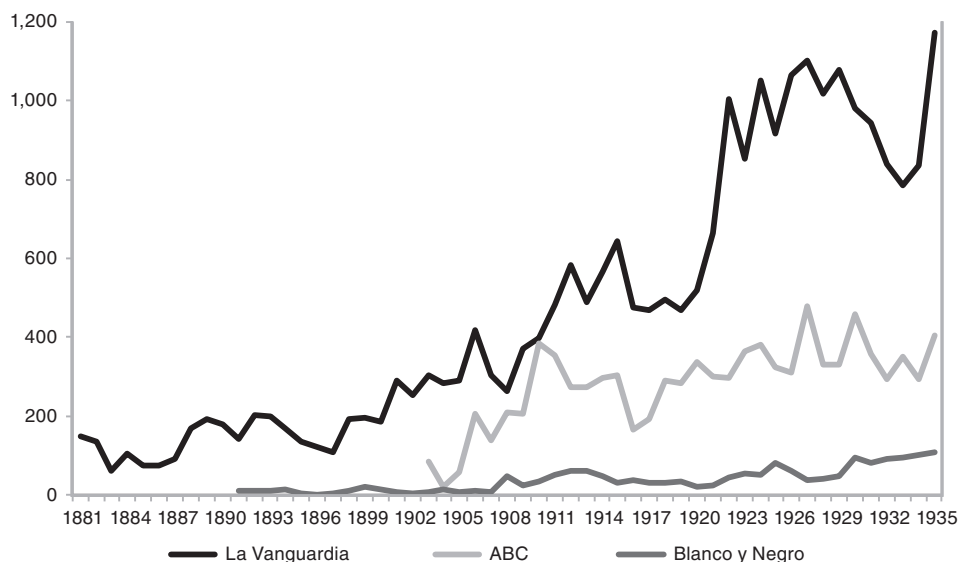
32. MINISTERIO DE GOBERNACIÓN (1915: 6-7, 9, 14, 21, 26, 32, 212-13, 241-42, 273, 413-14, 427); NEGOCIADO DE ESTADÍSTICA, PADRÓN Y ELECCIONES (1902-1920); Arxiu Comarcal de la Garrotxa (ACGAX), Hospital de Sant Jaume d'Olot, Administración General, 1936, boxes 19-31, 230; Archivo General y Fotográfico de la Diputación de Valencia (ADPV), Hospital General, Presupuestos, vol. 2.3.

The co-operation between doctors, pharmacists and the industrial sector has already been pointed out in previous studies³³. In Barcelona, these initiatives proliferated after World War I, and introduced new types of milk, which were widely publicised. For instance new types of formula milk made with pasteurised and homogenised milk (Lacta, Nutricia, Kes), new types of condensed milk (Sila, La Sirena, El niño, Montseny), and even special products for ill children (Vitamlac and Hepatilac). Vitamlac was a vitamin-rich type of milk formula, and Hepatilac was a product prepared with skimmed milk and no sucrose for children with hepatic and intestinal problems. It was also common for doctors and pharmacists to advertise the new products. In a leaflet from 1914, for instance, Industrias Lecheras S. A. promoted the condensed milk Montseny by publishing the names of 99 medical doctors who supported its quality and hygiene. Also of note is the fact that the National Medical Doctors' Conference (Congreso Nacional de Médicos), celebrated in Madrid in 1919, gave the condensed milk Sila (Productos Sila, S. A.) an award for its quality.

In conclusion, from the late 19th century onwards, the initiatives launched in Spain to promote milk consumption were also numerous and diverse, especially in cities. It is likely that the impact of these initiatives was uneven and that, as was the case in other European countries, their implementation was the cause of numerous debates and controversies. It is also likely that their effects were at first of little significance, and that they become more relevant as the 20th century wore on. What we want to stress now, however, is that these initiatives, overall, led to the emergence of a new institutional and cultural framework, within which milk eventually became accepted as a basic food. An indicator of this new framework is provided in Figure 2. The figure shows the number of times that milk was mentioned in three major periodical publications: the newspapers *La Vanguardia* (Barcelona, 1881-1936) and *ABC* (Madrid, 1903-36), and the weekly magazine *Blanco y Negro* (Madrid, 1891-1936). If all three cases are considered, we may conclude that milk was still receiving little attention in Spain in the late 19th century, and that this circumstance changed significantly later. In *La Vanguardia*, mentions increased from an annual average of 123 between 1881 and 1890, to nearly 1,000 between 1926 and 1935; in *ABC*, the increase was from 54 between 1903 and 1905, to 361; and in *Blanco y Negro*, from 10 between 1891 and 1900, to 76.

33. NICOLAU, PUJOL and HERNÁNDEZ ADELL (2010); CASTEJÓN and PERDIGUERO (2011); section 14.5 in the database www.proyectonisal.org. See also FERRER (1898) and Archivo General de la Administración (AGA), Ministerio de Gobernación, Especialidades farmacéuticas, Sustitutivos de la lactancia, 1926-36, boxes (8) 8 44/17.472, (8) 8 44/17.473, (8) 8 44/17.474.

FIGURE 2

Annual frequency of the word *milk* in three major periodical publications

Sources: <http://www.lavanguardia.com/hemeroteca/>; <http://hemeroteca.abc.es/>

4. THE URBAN SUPPLY OF MILK

In order to meet the new demand for milk, however, supply needed to increase and this proved to be a serious challenge in Spain. In contrast with Central and Northern European countries, in Spain the main production areas were 300 km or more away from the most densely populated areas, and transport infrastructures in most of the territory (roads and railroads) were inadequate for long-distance milk distribution until well into the 20th century. This was not achieved until lorry-transport became widespread and new centres for the reception, pasteurisation and cooling of milk were created³⁴. Until then, the new and increased demand could not be met, except in those cities which could be supplied from nearby areas. As demand increased, however, these regions approached their productive limits, and consumption stagnated. In Barcelona, Madrid and Valencia, for instance, consumption increased rapidly at first, reaching between 56 and 65 l/p/y in 1925, but it barely grew at all after this date. Between 1925 and the 1930s, consumption in Madrid increased by as little as 3 l/p/y, and between 7 and 8 in Barcelona and Valencia (Appendix 2).

34. COLLANTES (2015a); HERNÁNDEZ ADELL and PUJOL (2016). The problem with supply networks has also been highlighted by GALLEGO (2016).

The differences in the supply of Barcelona, Madrid and Valencia, on the one hand, and Berlin, London and Paris, on the other, are very clear. In the latter cities (Table 7), supply was still largely local in the early 19th century, but conditions changed rapidly thereafter and railway transport was clearly predominant by the 1870s. In this decade, train-borne milk accounted for 60% of all milk consumed in Berlin, 73% in Paris and 44% in London. Shortly before World War I, these percentages were even higher. Around 1910, train-borne milk accounted for 80% of the milk consumed in Berlin and nearly 100% in London. Different studies have also shown that supply areas were increasingly far away from the consumption centres. In Berlin, milk from an area within 60 km of the city dropped from 60% of the total consumed in the city in 1893 to 29% in 1927. Conversely, milk from areas located 90 km or more from the city increased from 5% of the total in 1893 to nearly 50% in 1927³⁵. A similar trend can be detected in Paris. In 1937, only 4% of milk came from areas which were within a 50 km radius of the city, while 71% came from locations which were 150 km distant or more³⁶.

TABLE 7
Urban supply indicators in Berlin (B), London (L) and Paris (P), 1840-1910

	Total supply			Urban dairies			Nearby areas			Train-borne		
	Millions of litres			%			%			%		
	B	L ⁽¹⁾	P	B	L	P	B	L	P	B	L ⁽⁴⁾	P
1850		71.3	109.3		80.1	8.0		15.1	38.0		4.8	54.0
1870	61.4 ⁽²⁾	94.0	111.7	11.2	41.0	16.0	29.1	15.3	11.0	59.7	43.7	73.0
1890	137.2 ⁽³⁾	209.1		15.0	14.5		30.0	0.5		55.0	85.0	
1900	255.1 ⁽⁴⁾	250.9	280.0	18.0	6.3		10.0	0.2		72.0	93.5	
1910	416.1	420.3	410.0	18.0	2.8		3.0	0.1		79.0	97.1	

Notes: (1) Includes liquid milk from evaporated milk (1.4% in 1870; 3.4% in 1880; 8.7% in 1890; 18% in 1900; 15.5% in 1910); (2) 1875; (3) 1893; (4) 1903.

Sources: Atkins (1977, 2005a: 25); Brandt (1929: 56); Dubuc (1938: 258); Llovet (1934: 15); Meyer (1907: 299-300); Nebert (1930: 28, 58).

In Spain, in contrast, urban supply also improved, but in the 1930s it still only involved short-range transport (Table 8). In Barcelona and Madrid, urban dairies produced 70 and 55%, respectively, of all the milk commercialised in the opening decade of the 20th century, and nearly 35% in the 1930s. At this time, however, approximately 75% of all the milk brought to these cities came from locations within 60 km of the urban centres. Valencia was somewhat different and probably is representative of a pattern typical of the other cities on the eastern coast –less populated and surrounded by large vegetables gar-

35. BRANDT (1929: 14); CASADO DE LA FUENTE (1931: 19).

36. DUBUC (1938: 261-62).

dens (*huertas*). In Valencia, 25% of all milk commercialised in 1895 came from urban dairies, and the remaining 75% came from dairies that were so close to the city that could also be considered urban. In the following years, urban growth absorbed many of these *huertas*, and many of these dairies were turned into creameries that commercialised the milk produced in nearby regions.

TABLE 8

Urban supply indicators in Barcelona (B), Madrid (M) and Valencia (V), 1865-1930

	Total supply			Urban dairies			Up to 60 km			Over 60 km		
	Millions of litres			%			%			%		
	B	M	V	B	M	V	B	M	V	B	M	V
1865	0.8	1.9	0.8	100	100							
1900	6.8 ⁽¹⁾	18.0 ⁽¹⁾	5.1 ⁽¹⁾	72.1	46.6	24.38 ⁽²⁾	27.9	44.5	75.62 ⁽²⁾			8.9
1910	37.7	35.0	12.4	68.4	56.0		31.6	31.4				12.6
1920	52.6	55.6	19.3	52.2	37.7		38.8	32.6		9.0		29.7
1930	73.0 ⁽³⁾	64.7	26.3 ⁽³⁾	36.5	36.0		50.5	47.0		13.0		17.0

Notes: (1) 1902 for Barcelona and Madrid, and 1906 for Valencia; (2) Percentages for 1894; (3) 1932 for Barcelona and 1933 for Valencia.

Sources: Appendix 4; Calatayud and Medina (2017).

In short, milk-distribution networks also expanded in Spain in the first third of the 20th century, but this expansion only improved supply in a few cities and, even then, only to a limited extent. Specifically, this expansion only took place in Barcelona, Madrid and Valencia, and while nearby regions could increase their production.

5. CONCLUSION

This article has addressed the Spanish case and has proposed new evidence on two aspects of the European nutritional transition: the significant diffusion of milk consumption between the mid-19th century and the 1930s, and the important role played by cities in this process. These have been attested in different European capitals, but have been noted especially in Barcelona, Madrid and Valencia. In Spain, outside milk producing regions, consumption only increased significantly in these three cities, and did so to a much larger extent than many other foodstuffs. We have also seen that these circumstances can be largely explained because these diffusion processes involved the promotion of new consumption preferences, and initiatives set forth for this purpose took place in the cities sooner, and more intensively, than elsewhere. The sanitary sector, the industry and the commercial sector were more developed in these urban concentrations, and councils worked under better conditions to implement new public hygiene measures.

Within this general framework, our study has also led us to conclude that the spread of milk consumption was particularly complex in Spain. First, because in the 19th century drinking milk was a very rare habit, and was often associated with health problems. Secondly, because environmental conditions in most of the country and the available distribution networks impeded the commercialisation of milk from the main production areas until the dissemination of truck transport and the creation of new centres for the collection, pasteurisation and refrigeration of milk. When this happened, consumption centres no longer had to be supplied by nearby regions, and the new demand for milk could be met more satisfactorily. Until then, outside major production areas, consumption could only increase in a few cities, and only as far as the production of nearby areas could be increased.

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APPENDIX

APPENDIX 1

Consumption of milk in Europe, 1865-2000 (l/p/y)

	Denmark	Norway	Sweden	Germany	Austria	Belgium	France	Netherlands	Switzerland	Spain	Italy	UK*
1865	67 ⁽¹⁾						71	73	226 ⁽²⁾	20		46
1900	98 ⁽³⁾	169	183 ⁽⁴⁾				81	81	231	23		68-53
1910	116 ⁽⁵⁾	174					92	93	265		31 ⁽⁶⁾	104-77
1920	104 ⁽⁷⁾	182					103	105	243	45	30 ⁽⁸⁾	83
1930	130	188	292	107	200	77	104	131	258	56	35 ⁽⁹⁾	100-89
1940	128 ⁽¹⁰⁾			120 ⁽¹¹⁾		74 ⁽¹¹⁾	83 ⁽¹⁰⁾	142	237		36 ⁽¹²⁾	
												104 ⁽¹⁰⁾
1950	161 ⁽¹³⁾	163					84 ⁽¹⁴⁾	204	225	56 ⁽¹⁵⁾	47 ⁽¹⁴⁾	153
1960	181 ⁽¹⁶⁾	195					102	162 ⁽¹⁷⁾	178		63 ⁽¹⁸⁾	142
1970	147	174	157	85	144	88	74	135	128	83		141
1980	132	178	167	70	128	75	77	116	120	100	78	133
1990	121	159	136	71	94	70	77	90	106	101	79	121
2000	129	120	118	87	90	86	91	99	90	120	85	111

Notes: *Only Great Britain from 1865 to 1930. (1) 1881; (2) 1866; (3) 1903; (4) 1895; (5) 1909; (6) 1913; (7) 1921; (8) 1918; (9) 1928; (10) 1939; (11) 1937; (12) 1938; (13) 1949; (14) 1951; (15) 1954; (16) 1959; (17) 1962; (18) 1961. Complete yearly data from 1865 to 2000 at www.proyectonisal.org

Sources: from 1966 to 2001 (IDF, 1982, 1989, 1999, 2002). Until 1966: Denmark (Hernández Adell & Pujol, 2016; *SAD*, 1948: 123, 1950: 138, 1955: 152, 1960: 173; Jensen, 2014); Norway (Kajærnes, 1995: 104; Jensen, 2014); Sweden (Guinchard, 1914: 172; League of Nations, 1936: 34; Jensen, 2014); Germany (Casado de la Fuente, 1931; League of Nations, 1937: 289; IIA, 1940-41: 126-29); Austria (League of Nations, 1937: 289); Belgium (League of Nations, 1937: 289; IIA, 1940-41: 126-29); France (Hernández Adell & Pujol, 2016; Toutain, 1975: 1951); Netherlands (Hernández Adell & Pujol, 2016; Knibbe, 1993: 264-65; 1962-65: *SYN*, 1965-66: 139, 147-48, 338); Switzerland (Hernández Adell & Pujol, 2016; 1866-1911: *ASS*, 1930: 153; 1916-29: *ASS*, 1930: 153; 1932-44: *ASS*, 1950: 118); Spain (1865-1930: AGGR, 1925; Hernández Adell & Pujol, 2016; Junta Consultiva Agronómica, 1892; Junta General de Estadística, 1868; Ministerio de Agricultura, 1934; 1955: average of 1954 and 1955: Ministerio de Agricultura, 1954, 1955, 1957); Italy (*ASI*, 1935: 164; 1944-48: 199, 201-3, 421, 425; 1955: 152, 254, 365-67, 490; 1965: 188, 190, 401-3); United Kingdom (1861, 1900, 1930: Taylor, 1974: 153; 1880, 1885, 1890: Rew, 1892: 266, 271-72; 1910: Shanahan, 1920: 206; 1925: Flux, 1930: 555; 1939: Lamartine Yates, 1960: 47; 1945-64: *AAS*, 1955: 179, 1960: 176, 1965: 182).

APPENDIX 2

Milk consumption in European cities, 1900-30 (l/p/y)

	1900	1910	1920	1930		1900	1910	1920	1930
Germany				107	France	81	92	103	104
Berlin	100 ⁽¹⁾	111	80 ⁽³⁾	120 ⁽⁴⁾	Lyon			62 ⁽³⁾	73
Bremen	125 ⁽¹⁾			137 ⁽⁴⁾	Marseille				44
Breslau	97 ⁽¹⁾	127	95 ⁽³⁾	115 ⁽⁴⁾	Metz			146 ⁽³⁾	
Colonia	102 ⁽¹⁾		82 ⁽³⁾	159 ⁽⁴⁾	Montpellier			36 ⁽³⁾	
Dresden	105 ⁽¹⁾		56 ⁽³⁾	117 ⁽⁴⁾	Mulhouse			219 ⁽³⁾	
Frankfurt	160 ⁽¹⁾	157	88 ⁽³⁾	144 ⁽⁴⁾	Nantes			73 ⁽³⁾	
Gera	87 ⁽¹⁾	40 ⁽²⁾		107 ⁽⁴⁾	Nice			95 ⁽³⁾	
Hamburg	137 ⁽¹⁾	133	73 ⁽³⁾	145 ⁽⁴⁾	Paris	91 ⁽¹³⁾	110	120 ⁽³⁾	91 ⁽¹¹⁾
Magdeburg	80 ⁽¹⁾			96 ⁽⁴⁾	Rouen			44 ⁽³⁾	
Munich	131 ⁽¹⁾	161 ⁽²⁾	112 ⁽³⁾	193 ⁽⁴⁾	Toulouse				69
Mühlheim R.	81 ⁽¹⁾			191 ⁽⁴⁾	United Kingdom	53	77	83	89
Stuttgart	157 ⁽¹⁾	183 ⁽²⁾	115 ⁽³⁾	198 ⁽⁴⁾	London	56 ⁽¹⁴⁾	86 ⁽¹⁴⁾		139
Austria				200	Manchester	110 ⁽¹⁵⁾		91 ⁽⁵⁾	
Vienna		164 ⁽¹⁾	189 ⁽³⁾	186	Rural Areas	67 ⁽¹⁵⁾			
Belgium				79	Bristol			85 ⁽⁵⁾	
Brussels			97 ⁽⁵⁾		Plymouth			85 ⁽⁵⁾	
Czechoslovakia				146	Preston			83 ⁽⁵⁾	
Prague			138 ⁽⁵⁾	137	Liverpool			73 ⁽⁵⁾	
Denmark	98	116	104	130	Newcastle			68 ⁽⁵⁾	
Copenhagen				256	Sheffield			64 ⁽⁵⁾	
Spain	20		45	56	Leeds			60 ⁽⁵⁾	
Barcelona	12 ⁽¹⁾	57 ⁽⁶⁾	64 ⁽⁷⁾	72 ⁽⁸⁾	Hull			46 ⁽⁵⁾	
Bilbao		89 ⁽⁹⁾	112	113 ⁽¹⁰⁾	Italy		29	33	33
Figueras				80 ⁽¹¹⁾	Genoa	48	68		
Gerona				83 ⁽⁸⁾	Milan			52	65
Madrid	33 ⁽¹⁾	46 ⁽⁶⁾	65 ⁽⁷⁾	68	Naples	17			
San Sebastián		150			Rome				37
Seville				36	Norway	169	174	182	188
Valencia	18 ⁽¹²⁾	41 ⁽⁶⁾	56 ⁽⁷⁾	63	Oslo				197
Zaragoza				40	Netherlands	81	93	105	131
France	81	92	103	104	Amsterdam			145 ⁽⁵⁾	146
Annecy			98 ⁽³⁾		Sweden	183			292
Bordeaux			58 ⁽³⁾	61	Stockholm				256
Clermont			55 ⁽³⁾		Switzerland	231	265	243	258
Chambery			95 ⁽³⁾		Bern				274
Strasbourg			150 ⁽³⁾	161	Lucerne				328
Grenoble			95 ⁽³⁾		Zurich			233 ⁽³⁾	230
Lille			80 ⁽³⁾						

Notes: (1) 1902; (2) 1913-14; (3) 1923-24; (4) 1927-28; (5) 1924-25; (6) c. 1917; (7) c. 1925; (8) 1933; (9) 1914-16; (10) 1929-32; (11) 1936; (12) 1906; (13) 1896; (14) averages between 54 and 58 l, and 72 and 102 l respectively; (15) c. 1890.

Sources: Germany (Clevish, 1925: 362; Nebert, 1930: 58; Lesniczak, 2003: 65, 66, 86, 87; Orland, 2005: 222); France (Bulharowski, 1929: 7; Dubuc, 1938: 258; Tapernoux, 1935: 485); Austria and Switzerland (Bulharowski, 1929: 7; Casado de la Fuente, 1931: 11, 77; Clevish, 1925: 366); United Kingdom (Atkins, 1977; Barnes, 1958: 195; Llovet, 1934: 15; Rew, 1892: 266); Italy (Comune di Milano, c. 1931: 7; Llovet, 1934: 15; Pirtle, 1926: 389, 394); Barcelona and Madrid (Appendix 3); Bilbao: *Boletín Mensual Adicional de Estadística Sanitaria de Bilbao* (1914, 1916, 1929, 1932); Figueras (Arxiu Històric Comarcal de Figueras, 1937, "Informe sobre la municipalització de la producció i subministrament de llet a Figueras", box 596); Gerona (Ajuntament de Girona, 1934); San Sebastián (Saiz, 1919: 101); Seville and Zaragoza (Soroa, 1931: 12); Valencia (Calatayud & Medina, 2017); other countries (Bulharowski, 1929: 7; Clevish, 1925: 366).

APPENDIX 3
Milk supply in Barcelona and Madrid
Barcelona

Year	Pop.	Cow's milk			Goat's milk collected			Imported	Total	Annual consumption
		collected in the city			in the city			(cow and goat)		
		Thousands	Cows	l/cow/y	Million litres	Goats	l/goat/y	Million litres	Million litres	Million litres
1865	216	534	1,250 ⁽¹⁾	0.67	483 ⁽¹⁾	280	0.13		0.80	3.7
1900	550	1,404	3,200 ⁽²⁾	4.49	1,050	400	0.42	1.91	6.83	12.4
1917	663	7,000	3,500 ⁽³⁾	24.50			1.28	11.90 ⁽⁴⁾	37.68	56.8
1925	818	7,000	3,594	25.16	8,113	280	2.27	25.16 ⁽⁵⁾	52.59	64.3
1932	1,015	7,527	3,394	25.55			1.09	46.35	73.00	72.0
1934	1,037	7,487	3,900	29.20	4,236	258	1.09	48.18	78.47	75.7

Notes: (1) estimated 7 l/d/cow for 180 days and 2 l/d/goat for 140 days (Junta Consultiva Agronómica, 1892, vol. 1: 295); (2) estimated 12 l/d/cow for 270 days (Junta Consultiva Agronómica, 1892, vol. 1: 295); (3) estimated 13 l/d/cow for 270 days; (4) we estimate that Barcelona was supplied with the milk of 3,400 cows that were kept near the city (Ministerio de Fomento, 1921, vol. 2: 205); (5) authors' own estimate based on provincial production figures (AGGR, 1925).

Sources: AEB (1902: 526); Arxiu Nacional de Catalunya, Fun GR, Box 1072, UC 7604; Negociado de Estadística, Padrón y Elecciones (1925: 96-7); Generalitat de Catalunya (1937: 5, 57-65); Junta Consultiva Agronómica (1892, vol. 1: 295); Junta General de Estadística (1868: 24-5); Mas (1933: 20-1; 1935: 27-31); Ministerio de Fomento (1921, vol. 2: 183-85, 205); Reparac (1928: 280); Vila (1979: 121-22).

Madrid

Year	Pop.	Cow's milk			Goat's milk collected			Imported	Total	Annual consumption
		collected in the city			in the city			(cow and goat)		
		Thousands	Cows	l/cow/y	Million litres	Goats	l/goat/y	Thousands	Cows	l/cow/y
1865	285	1,360	1,250 ⁽¹⁾	1.70	1,359	180 ⁽¹⁾	0.24		1.94	6.8
1900	540	2,400	3,200 ⁽²⁾	7.68	1,740	400	0.69	9,600	17.97	33.3
1917	751	5,600	3,500 ⁽³⁾	19.60				15,400	35.00	46.6
1925/27	852	6,000	3,500	21.00				34,651	55.65	65.3
1930	953	6,545	3,500 ⁽³⁾	22.90	1,825	200	0.36	41,498	64.77	68.0

Notes: (1) estimated 7 l/d/cow for 180 days and 1 l/d/goat for 180 days (Junta Consultiva Agronómica, 1892, vol. 3: 450, 461); (2) estimated 15 l/d/cow for 210 (Junta Consultiva Agronómica, 1892, vol. 3: 461); (3) 1925-27.

Sources: AGGR (1925); *Boletín de cotizaciones* (1929); Doaso (1931: 26-8); García Izcarra (1927: 959); Junta Consultiva Agronómica (1892, vol. 3: 461); Junta General de Estadística (1868); Luís (1903: 42-3); *BOAM* (1902, 1903).