Journal of Cleaner Production 52 (2013) 253–262

Contents lists available at SciVerse ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Environmental Life Cycle Assessment of a Galician cheese: San Simon da Costa

Sara González-García [a,*], Almudena Hospido [b], María Teresa Moreira [b], Gumersindo Feijoo [b], Luis Arroja [a]

[a] CESAM, Department of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal
[b] Department of Chemical Engineering, Institute of Technology, University of Santiago de Compostela, 15782 Santiago de Compostela, Spain

ARTICLE INFO

Article history:
Received 4 October 2012
Received in revised form
26 February 2013
Accepted 1 March 2013
Available online 21 March 2013

Keywords:
Dairy sector
Environmental analysis
Food
LCA
Life cycle inventory (LCI)
Milk
Whey

ABSTRACT

Cheese production has always been the standard way of preserving milk. This is the second most consumed dairy product in Spain (ca. 6.2 kg per year and person), with more than 100 different cheeses available in the market. However, only 26 types are labelled with a Protected Designation of Origin (PDO), a symbol of quality recognition. In this study, an environmental Life Cycle Assessment (LCA) was performed to identify and quantify the environmental impacts (cradle-to-grave perspective) derived from the manufacture of one of the most popular and traditional PDO Galician cheeses: San Simon da Costa cheese. The most critical steps throughout the chain were identified. As expected, milk production at the dairy farm is the main environmental hot-spot in all categories assessed, with contributions ranging from 63% to 89%. Both feed production (mainly fodder) and on-farm emissions derived from enteric fermentation and manure management were the highest contributing farming activities.

Cheese making activities should also be considered, with emphasis on impacts associated with the smoking process, the heating system and wastewater treatment. The studied dairy factory has not implemented a system for whey recovery due to its small-scale production. Thus, whey waste mixed with the wastewater effluent is sent to the municipal wastewater treatment plant. Therefore, the valorisation of whey into whey powder was considered as an alternative for improvement. Using this process modification, it is possible to achieve reductions in the environmental profile of the PDO San Simon cheese of up to 15% in categories such as eutrophication. In addition, attention must be paid to the environmental loads of whey powder production arising from electricity and heating requirements.

1. Introduction

The food and beverages sector is the largest manufacturing sector in Europe in terms of revenue and employment (Food Drink Europe, 2011), with significant environmental side effects (Garnett, 2009; Iribarren et al., 2011; Fantin et al., 2012). In this context, the dairy sector must receive special attention for several reasons: i) within the European food and beverages sector, the dairy division holds the top position in terms of innovative markets (Ramírez et al., 2006; Berlin and Sonesson, 2008; Euromilk, 2012); ii) milk and dairy products are important ingredients in the human diet (Bachmann, 2001; Muñoz et al., 2010); and iii) the high demand of dairy products has fostered changes in production practices towards the production of organic milk in order to reduce the environmental impact in terms of eutrophying and toxicity emissions as well as energy use (de Boer, 2003; Thomassen et al., 2008; de Vries and de Boer, 2010) and the application of the best management practices (BIDF, 2009; del Prado et al., 2010).

The dairy sector involves the production of several products, manufactured in very different production lines, but always originating from the same raw material: raw milk. Within dairy products, nowadays cheese is experiencing an increasing demand and is the most consumed dairy product after drinking milk (Rohner–Thielen, 2008). Moreover, over 36% of the total whole milk produced in Europe in 2010 was processed into cheese, while only 12.4% was used for drinking milk (European Commission, 2012).

According to the Eurostat statistics (2011), Spain occupies the seventh position in Europe in terms of production volume of dairy products (ca. 5.8 million tonnes in 2011). Spanish dairy farms are mainly located in ten regions, accounting for 92% of the total Spanish cows. One of these regions is Galicia (NW Spain), leader in the

* Corresponding author. Tel.: +351 234370349.
E-mail addresses: sara.gez.garcia@gmail.com, sara.gonzalez@usc.es (S. González-García).

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http://dx.doi.org/10.1016/j.jclepro.2013.03.006

production of raw milk: 37.7% of the Spanish production and ca. 2 million tonnes per year (FEGA, 2012; Xunta de Galicia, 2012). Agricultural activity in Galicia is depicted by a wide diversity of land use, production models, farm sizes and geographical dispersion (Álvarez-López et al., 2008). However, the modernization activities developed in the farms in recent years highlight the role of the Galician dairy sector in a framework of quality and innovation (Xunta de Galicia, 2012).

Regarding the consumption of cheese in Spain, it represents 3.1% of the total food expenses per family and the average annual consumption per capita is ca. 6.2 kg (Martín Cerdeño, 2008). There are currently 26 Protected Designation of Origin (PDO) in Spain regulated by the Spanish Ministry of Agriculture, according to climatic, geographical and cultural variations. Among them, cow milk is the raw material used for the elaboration of twelve different cheeses (Cerespain, 2012) and Galicia is the leader in the manufacture of cow milk cheeses. Therefore, this study focusses on the production of one single Galician cheese derived from cow milk and labelled with a PDO: San Simon da Costa cheese. The quantification of the environmental effects derived from its manufacture is the main goal of this study since this type of cheese is produced following a traditional recipe, although with an exhaustive state of the art sanitary control. To do so, the Life Cycle Assessment (LCA) methodology (ISO 14040, 2006) was considered in this study.

To date, this environmental methodology has just been applied for the evaluation of the environmental performance of different milk production systems at farms and dairy mills (such as Castanheira et al., 2010; Iribarren et al., 2011; Hospido et al., 2003; Bartl et al., 2011; Fantin et al., 2012). In addition, the production of other dairy products such as semi-hard cheese (Berlin, 2002; González-García et al., Submitted for publication; van Middelaar et al., 2011), mozzarella cheese (Nielsen and Høier, 2009), milk powder (Ramírez et al., 2006) or butter and blend products (Flysjö, 2011) have also been assessed using LCA. An example of an available database where the dairy sector has been assessed in detail is the Danish LCA Food database (Nielsen et al., 2003). However, there is no environmental information about the production of Spanish cheese and, therefore, this paper, focused on the production of San Simon cheese, can be of interest not only in the Spanish context, but also for the European dairy sector since to the best of our knowledge, it presents for the first time a detailed report of the life cycle inventory and environmental assessment of a cheese production in Spain.

2. Materials and methods

2.1. Goal definition

The goal of this study was to identify and quantify the environmental impacts derived from the manufacture of one of the most popular and traditional Galician cheeses: San Simon da Costa cheese (Regulation (EC) No 1229/2008, 2008). Moreover, this study aims not only at quantifying the environmental profile but also at identifying the most critical steps in the production line of a dairy mill considered representative of the San Simon da Costa cheese sector.

2.2. Functional unit

The functional unit considered was 1 kg of cheese packaged and ready to be consumed, which corresponds to the average weight of the large format, i.e. the most common option available in Spanish markets. The selection of this unit is in agreement with other cheese studies (Berlin, 2002; Nielsen and Høier, 2009). The moisture and fat content of this type of cheese is around 42% and 45%, respectively (As Fontelas, 2012).

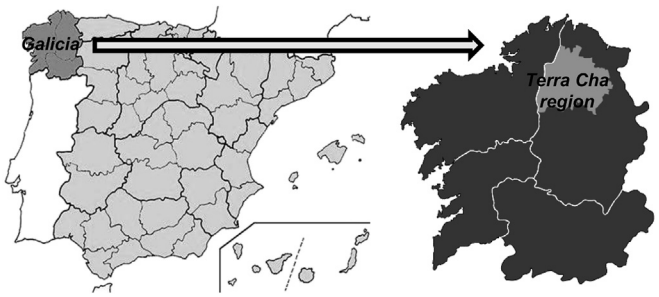

Fig. 1. Geographical location of the San Simon da Costa protected designation of origin cheeses production area – Terra Cha (Lugo, Galicia).

2.3. Geographical scope and remarks

San Simon da Costa PDO cheeses are produced in the *Terra Cha* region (Fig. 1), which has a long tradition of cheese making. The local dairy herds are mainly composed of Galician Blonde, Brown Swiss and Friesian breeds, which provide the high quality raw material for the San Simon da Costa cheese, since only milk produced in this area can be used for its production.

Commonly, there are two cheese formats. The large format - matured for at least 45 days – weighing 0.8–1.5 kg (13–18 cm in height) and the small one – matured for at least 30 days – weighing 0.4–0.8 kg (10–13 cm in height). In both formats, the cheese shape is characteristic with the upper part being pointed (Fig. 2). The rind is smoked, rigid (1–3 mm thickness) and presents an ochre-yellow colour. The body is of fine texture, fatty and with a characteristic flavour and aroma. This type of cheese can be included within the group of semi-hard cheeses.

2.4. Description of the system under study

The production of San Simon da Costa cheese follows a traditional recipe, where two elements provide the cheese with its particular flavour and aroma. Firstly, the basic raw material is the milk produced by the cows bred in the local area under the highest standards of hygiene and quality and, secondly, the smoking process using Galician birch wood exclusively.

Fig. 2. Image of the Galician semi-hard cheese under assessment.