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The environmental impact of mastitis: a case study of dairy herds

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Abstract

Mastitis is defined as an inflammatory reaction of udder tissue to bacterial, chemical, thermal or mechanical injury, which causes heavy financial losses and milk wastage throughout the world. Until now, studies have focused on the economic aspects from which perspective mastitis can generally be considered as the most serious disease in dairy cows; however, costs are not the only negative consequence resulting from the infection. The environmental impact is also significant; milk is discarded, which means lower efficiency and hence a greater environmental impact per produced liter of milk. Less milk is produced, which leads to an increased need for calf feed, and meat production is also affected.

The main aim of this paper was to quantify the environmental impact of mastitis incidence. A standard scenario (representative of present-day reality in Galicia, Spain) and an improved scenario (in which mastitis incidence rate is reduced by diverse actions) have been defined and compared using Life Cycle Assessment (LCA) methodology.

Among the impact categories studied, acidification, eutrophication and global warming were found to be the most significant environmental impacts. In all these categories, it was revealed that a decrease in mastitis incidence has a positive influence as the environmental impact is reduced. Even if the quantitative results cannot show a considerable decrease in the environmental burden, the impact cannot be regarded as negligible when the total consumption or total production of a region is considered. For example, the outcome of the proposed improvement measures for Spain's greenhouse gas emissions can be quantified as 0.06% of total emissions and 0.56% of emissions by the agricultural sector.

Keywords: Life Cycle Assessment; Milk; Mastitis; Dairy cow; Animal health

1. Introduction

Mastitis (*mast*—breast; *itis*—inflammation) is defined as an inflammatory reaction of udder tissue to bacterial, chemical, thermal or mechanical injury. It is generally categorized into contagious mastitis caused by bacteria, mainly *Staphylococcus aureus* and *Streptococcus agalactie* that live on the skin of the teat and inside the udder and are transmitted from one cow to another during milking, and environmental mastitis caused by organisms such as *Escherichia coli, Streptococcus uberis* or *Kleb-*

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siella, which do not normally live on the skin or in the udder but which enter the teat canal when the cow comes into contact with a contaminated environment (McGill University, 2003).

There are several approaches to classify mastitis. Classification according to the degree of infection results in the following categories (McGill University, 2003):

- clinical mastitis (CM), characterized by the presence of gross signs of inflammation (different stages are peracute mastitis, acute mastitis and subacute mastitis);
- subclinical mastitis (sCM), characterized by a change in milk composition but no signs of gross inflammation or milk abnormalities; and
- chronic mastitis (ChM), which is an inflammatory process that has lasted for months and may continue from one lactation to another.

In economic terms, mastitis can generally be considered the most serious disease of dairy cows. However, mastitis is not only an economic matter but also affects the environmental performance of milk products. Besides involving two types of milk losses (low-quality milk that has to be discarded because it is unfit for human consumption and milk that is never produced due to reduction in the productive yield), each mastitis case influences a number of flows at the dairy farm that are involved in the environmental performance of milk production.

According to the European Commission report (2000), Spain occupies sixth position in annual milk production. In the year 2000, the Galician region contributed 28.97% to the total Spanish production of 6937 thousand tons (MAPA, 2002). Medium-sized farms, with herds of 40–60 cows, are most common in milk production. Around 17% of the total working population in Galicia works on dairy farms. Moreover, milk accounts for almost one-third of the total agrarian production, i.e., the sum of the whole production minus own consumption of the agrarian sector measured in monetary units (López, 2000).

Since the early 1990s, the Galician Autonomous Government has carried out a dairy cow management program, including about 1500 farms (Barbeyto, 1993, 1996, 1997). Although the majority of the farms included have fewer than 15 cows, their influence on the actual productive framework is almost irrelevant, and, in addition, these farms will most likely be the first to suffer the consequences of recession as they will not be able to compete with larger farms. The Holstein Friesian is the most common breed in Galicia. This class is characterized by an average number of lactations of 3.85 ± 1.93 and a productive yield of 7334 ± 2321 kg per lactation (Pérez-Cabal and Alenda, 2002).

The Life Cycle Assessment (LCA) methodology has proved to be a valuable tool for documenting and analyzing environmental considerations of product and service systems that need to be part of decision-making towards sustainability (UNEP-DTIE, 2003). Consoli (1993) defines an LCA as "... a process to evaluate the environmental burdens associated with a product, process, or activity by identifying and quantifying energy and materials used and wastes released into the environment; to assess the impact of the energy and materials used and released into the environment; and to identify and evaluate opportunities to affect environmental improvements."

The first LCA studies of food products were performed in the early 1990s. Since then, LCAs have been used to address questions about food processing relating to the identification of the subsystems that contribute most to the total environmental impact named "hot spots" or relating to a comparison of products and processes with the same function (Mattsson and Sonesson, 2003).

The aim of this paper was to quantify the environmental impact of mastitis in dairy farming. We did this by using Galician dairy herds as a model of dairy production and by comparing, using LCA methodology, today's system with a hypothetical and improved system.

2. Material and methods

The International Organization for Standardization (ISO) has set up the technical framework for LCA methodology (ISO, 2000), and this includes four phases:

- goal and scope definition, in which the intended application as well as the extent of the study has to be clearly exposed;