

Chemical residues in milk and dairy products: proactive management to achieve ‘within specification’ levels

Bernadette O’Brien and David Gleeson

Teagasc, Animal & Grassland Research and Innovation Centre, Moorepark, Fermoy, Co. Cork

Summary

- When detergents containing chlorine are used for cleaning milking equipment and food processing plants, they can result in residues such as Trichloromethane (TCM) and Chlorates in milk and dairy products.
- These residues must be reduced and controlled to product specifications that are acceptable at market level.
- Current and new strategies for control are being deployed.
- If using alternative chlorine-free detergent products, it must be ensured that cleaning is effective and alternative residues do not arise.

Introduction

Dairy foods are nutritious and are an essential part of sustainable diets. However, milk on its journey from cow to human consumer is exposed to various sources of residues linked to modern production practices and processing procedures. Some of those residues are potentially harmful if present at significant levels in product, others impact product quality as perceived by consumers and regulators.

Sources and significance of residues

Chlorine and chlorine-based detergents are the most common chemicals used to assist in cleaning milking equipment and food processing plants, as well as for water disinfection. However, there is increasing concern with regard to the development of TCM in butter and Chlorates in milk powder, i.e. residues derived from chlorine-based disinfectants. The target level for TCM in butter is <0.03 mg/kg, which is equivalent to <0.0015 mg/kg in milk. With regard to Chlorates, the EU Commission has proposed imposing a Maximum Residue Limit (MRL) of 0.01 mg/kg of food. It is already established that many foods, including dairy products may exceed this proposed MRL. There is particular concern in the Irish dairy industry regarding achieving this MRL as a significant portion of the milk and dairy ingredients produced here go towards whole- and skim-milk powders and a new category referred to as Specialised Nutritional Powders (SNP). SNP include infant milk formula and sports nutrition foods with a combined export value of >€1.1b to the Irish economy. The markets for these products are particularly aware of and sensitive to chemical contaminants including Chlorates, as they may be destined for particularly vulnerable consumers. In fact, ~50% of the dairy SNP were exported to China in 2018, with further significant growth expected (www.Bordbia.ie). The market in China is very aware of potential Chlorate contamination in SNP products and, if market value is to be maintained and increased, confirmation that products are within specification for Chlorate will be essential. So these potential residues need to be addressed at both farm and processing level.

Mitigation strategies to address TCM and Chlorate residues

The development of mitigation strategies to control TCM and Chlorate levels in dairy foods will have a significant impact on the capacity of the dairy sector to compete on the domestic and international markets and thus, impact on economic wellbeing and

development. Mitigation strategies to reduce and control TCM and Chlorates in dairy foods are broadly similar. Current information includes recommendations on short storage periods for cleaning products containing chlorine, using registered products with chlorine levels of <3.5%, correct volumes of detergent-sterilizer and adequate rinse water levels (14 l/milking unit), rinsing the milking plant immediately after completion of the wash cycle, not re-using detergent-sterilizer solution more than once, not adding chlorine to rinse water, not dipping clusters in chlorine, not reusing rinse water, using Peracetic acid instead of chlorine, and avoiding teat disinfectants that contain chlorine dioxide/chloride. Current research is examining the impact of removing chlorine-based detergents and using alternative cleaning protocols on the microbiological quality of milk and subsequent food products and ingredients. Additional planned work in relation to Chlorates includes:

- Establishing baseline data on Chlorates in dairy foods.
- Examining the potential for Chlorate to accumulate in foods from farm through to factory.
- Examining the efficacy of chlorine-free detergents.
- Investigating any potential new contaminants arising from the use of new alternate detergent formulations.
- Measuring the impact of different water disinfection technologies on Chlorate levels in water.

This challenge is being addressed at a group stakeholder level. Teagasc coordinates the Milk & Dairy Products Quality Working Forum, which incorporates the TCM and Chlorate Working Groups, chaired by Ornuá and Teagasc, respectively. The Forum also includes representatives from the dairy companies, and Teagasc Research and Advisory personnel, in addition to other key stakeholders, such as the Department of Agriculture Food and the Marine (DAFM), Food Safety Authority of Ireland (FSAI), Irish Dairy Industry Association (IDIA) and Irish Milk Quality Cooperative Society (IMQCS).

Conclusions

Awareness and proactive management of the risk for TCM and Chlorate residues along the production chain, by quality specialists is a pre-requisite for the sustainable production of high quality and safe dairy products. While these residues can pose risks to dairy products, care must be exercised when changing to alternative chlorine-free cleaning products; firstly, that these products allow effective cleaning and do not lead to high microbial levels in the plant, and secondly, that they do not pose alternative residue risks.

