HorizonScan Occasional Articles

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Chlorate Contamination in Food and Drink

Introduction

Chlorate is a contaminant in chlorine-based disinfectants, which can enter the food chain through many routes. It also has a historical use as an herbicide.

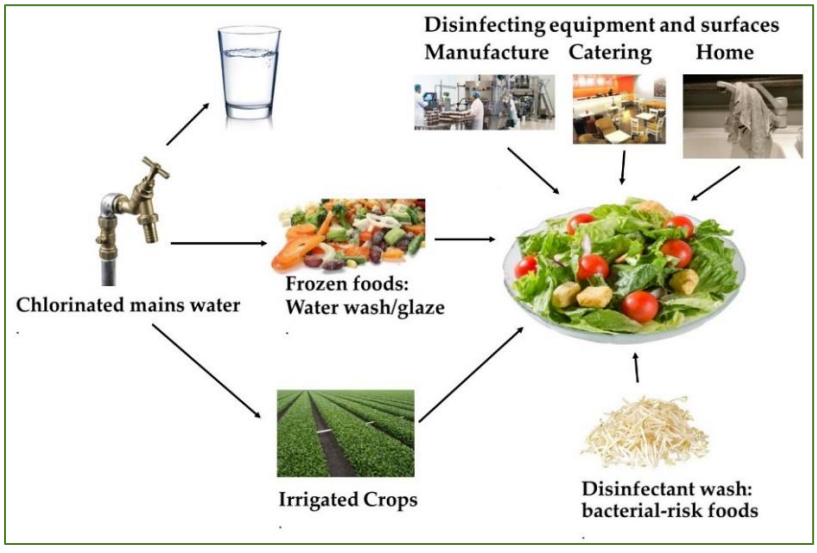
Chlorate is an unusual food contaminant insofar that it has an EU regulatory limit that is consciously not enforced. In the UK, industry and regulators both accept that illegal residues are not only inevitable in many scenarios but, in some instances, may be the desirable balance of competing food safety concerns. There is no desire in most EU Member States to enforce the current law. Data from HorizonScan, however, suggests that this enforcement approach is not consistent across Europe. Businesses operating internationally need to be aware of the attitude of different national authorities.

This paper summarises the issues, the likely way forward, and action that food businesses can take to demonstrate due diligence with respect to general food safety principles.

Sources of Chlorate in Food and Drink

The ultimate origin of chlorate is a breakdown contaminant in hypochlorite disinfectants. Hypochlorite is intrinsically unstable, and the rate of its self-decomposition to form chlorate is dependent upon a complex mix of factors including temperature, storage time and metal ion concentration.

Figure 1: Examples of Chlorate Dietary Exposure Sources



Chlorine-based disinfection is ubiquitous from farm-to-fork (Figure 1), leading to numerous routes for chlorate to enter the diet. Exposure is highly dependent upon local infrastructure and cultural factors, such as the extent and method of mains water chlorination, or the National popularity of foods that require rigorous disinfection protocols to control bacterial risks, such as ready-to-eat pots of cut fresh fruit. There is a generation of UK householders that religiously disinfect their dishcloths in diluted bleach.

Some of the processes currently required for microbiological control in the food manufacturing industry will inevitably leave chlorate residues in food. For example, after the 2011 German *E. coli* O104:H4 outbreak was linked to beansprouts, many UK brand-owners made it mandatory for all sprouting seeds in their supply chains to be washed in relatively strong hypochlorite solution. Such foods now contain some of the highest chlorate residues. In the US, unlike the EU, chlorine-disinfected food also includes fresh meat.

Are Current Exposure Levels a Health Risk?

If exposure is significantly high then chlorate can have a toxic effect on the thyroid, inhibiting iodine uptake. Calculating whether current exposure levels are significant at a population level is difficult. As well as the high variation in individuals' chlorate exposure, the calculation is compounded by the need to account for exposure to perchlorate. Perchlorate is a different substance (an environmental contaminant from fireworks and munitions, and another potential hypochlorite degradation product) that often contaminates drinking water at low levels, has the same toxic effect on the thyroid, but is more potent than chlorate.

In their most recent assessment[1], the European Food Safety Authority concluded that chronic exposure to chlorate at current levels are a specific concern for children who have an existing iodine deficiency. If it were assumed that current EU regulatory controls were relaxed, and that all food contained chlorate at 0.7 mg/kg (the WHO guideline limit for drinking water), then both acute and chronic exposure would be a concern for all consumer groups.

The EU Regulatory Conundrum – Pesticides Regulation 396/2005

The reason that much of today's food is legally non-compliant is that chlorate has a Maximum Residue Limit (MRL) of 0.01 mg/kg, set under European Council Regulation 396/2005, although this is not being enforced before new detailed commodity specific MRLs are agreed. This regulation is designed to police the correct use ("Good Agricultural Practice") of pesticides. The MRL is the maximum residue that should be expected in a food if a pesticide is used correctly, according to its license. If a pesticide has no use, then a default "shouldn't-be-present" MRL of 0.01 mg/kg applies. Prior to 2008 chlorate had an approved use as an herbicide, with appropriate MRLs set. When these approved uses were withdrawn, the MRL defaulted to 0.01 mg/kg.

The regulatory conundrum arises because, once a substance is listed as a pesticide, there is no regulatory mechanism to remove it. It must either have an active MRL or a default MRL. There is no legal mechanism to acknowledge that a substance can have other routes into food than as a pesticide residue, or to regulate an ex-pesticide using an "As-Low-As-Reasonably-Achievable" approach or Code of Practice approach in the same way as contaminants such as acrylamide. There is no legal mechanism to balance microbiological risk control against the toxicological risk of chlorate residues in food.

[1] EFSA Journal 2015;13(6):4135

Legislative Next Steps

Over the past year the European Commission have been consulting on how best to change the chlorate MRL legislation to an enforceable law that best protects consumers. Most responses from UK stakeholders favoured code-of-practice approach, tailored to each industry sector, and based on a balance between microbiological and chemical risk management. This would effectively mean a change to the EU pesticides legislative framework.

The current Commission proposal[2] is to retain the framework, but to set a matrix of MRLs for chlorate in different foods. Rather than being based on GAP, these would be based on typical distribution of residue concentrations found in that food type. These MRLs would not differentiate between different distribution patterns in different Member States (*e.g*. due to different mains-water chlorination processes), or different chlorate distribution patterns between prepared vs unprepared food (*e.g.* whole apples vs pots of cut apple slices). The distribution calculations underpinning the proposed MRLs are based upon surveillance data that has been provided to EFSA by both industry and regulators over the past 4 years.

The proposed MRL matrix is contentious. It is due to be discussed at a meeting of the EC Standing Committee on Plants, Animals, Food and Feed on 26 September 2019.

Enforcement Action and Industry Self-Regulation

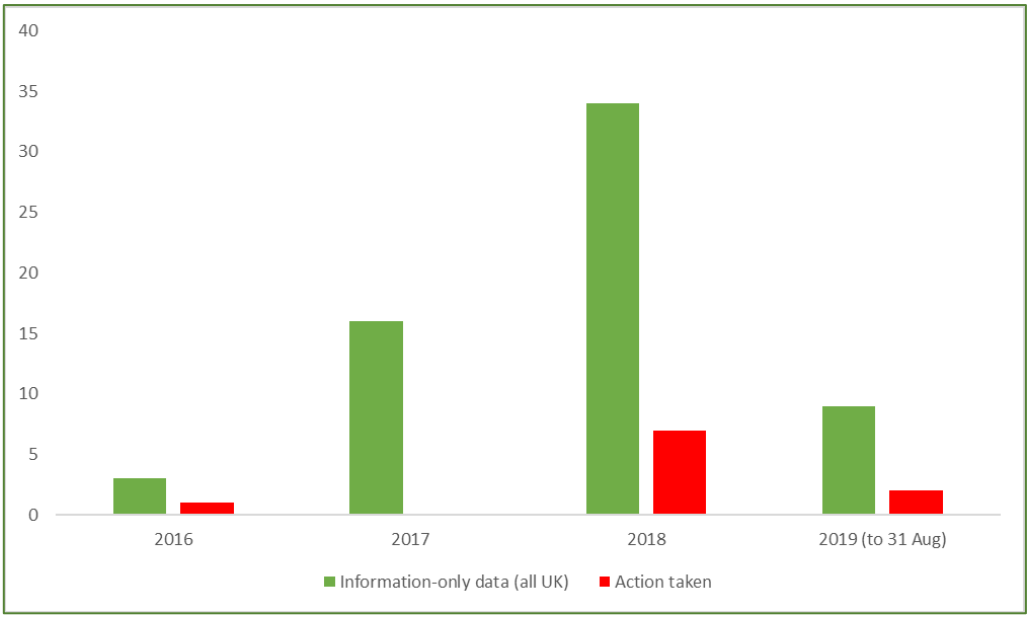
A few industry sectors, notably Infant Formula Milk, have expended huge resources in removing sources of chlorate and on batch-release testing to ensure that chlorate residues in final product are below 0.01 mg/kg. Most are awaiting the outcome of the European Commission legal review before taking any action.

Data from HorizonScan, at first sight, suggests that chlorate-related incidents increased in 2017 and 2018 as the issue gained prominence. All were within the EU: chlorate contamination is not on the food-safety radar in the rest of the world. The majority of incidents, however, are information-only notifications from the UK national pesticide residues surveillance scheme (**Figure 2**). There are published in PRiF Annual Reports[3] with an accompanying statement that they are not considered to arise from pesticide use, each residue has been satisfactorily risk-assessed, no enforcement action will be taken, and that they are published purely to add to the public information on typical distributions of chlorate levels in food.

This enforcement approach is not mirrored in every EU Member State, although none are going as far as enforcing the current MRL of 0.01 mg/kg. An example in June 2019 was a 3 mg/kg residue in cut fruit. This would not have prompted any action in the UK, but in Germany it resulted in product withdrawal and a RASFF notification[4]. Over the past 3 years, action has been taken by authorities in Austria, Bosnia Herzegovina, the Czech Republic, Germany and Hungary.

[2] SANTE 10684/2015 Draft
[3] https://www.gov.uk/government/groups/expert-committee-on-pesticide-residues-in-food-prif
[4] https://webgate.ec.europa.eu/rasff-window/portal/index.cfm?event=notificationDetail&NOTIF_REFERENCE=2019.2108

Figure 2: Chlorate HorizonScan Incidents, 2016-19



What Can a Responsible Food Company Do?

It is important for companies to understand their own cleaning and disinfecting protocols, and how microbiological effectiveness is balanced against chemical residues. This means gathering objective evidence; for example, including measurement of chemical residues, as well as log-count reductions, as part of their cleaning verification programme. Protocols should be designed to leave the minimum chemical residues commensurate with microbiological safety.

There is also an urgent need for such objective evidence to inform policy decisions. Regulators are keen for industry not to implement knee-jerk reactions to reduce chemical residues at the risk of compromising microbiological safety but have no evidence on which to base best-practice guidance. The UK Food Standards Agency has an active request for companies to share any data on the impact of changing chlorine-based cleaning regimes on disinfection effectiveness.

In terms of minimising avoidable chlorate contamination, there is excellent industry advice available from the GFSI[5]. This advice has been fed into the EC regulatory consultation. Companies trading in Germany, though, may have to take a less pragmatic approach and ensure that chlorate residues are below the new proposed MRLs.

[5] Chemicals in Food Hygiene VOLUME 1 The optimal usage of cleaning agents, sanitisers and disinfectants to minimise the risk of traces in foods, available via https://www.chilledfood.org/fbig/