Salmonella risk profile of UK-produced hen shell eggs: Hazard identification

Non-typhoidal *Salmonella* enterica (henceforth referred to as *Salmonella*) is widespread in domestic and wild animals and can readily pass through the food chain (World Health Organisation, 2022). Human cases of *Salmonella* are generally contracted through the consumption of contaminated food, primarily foods of animal origin (mainly eggs, meat, poultry, and milk), although other foods, including green vegetables, have been implicated with cases (World Health Organisation, 2022). Prevention of *Salmonella* requires control of the bacteria through the food chain, through animal feed, vaccination, processing, and manufacturing measures.

Salmonella is one of the leading causes of foodborne disease in the UK, with an estimated 31,601 foodborne cases in 2018, taking into account underreporting (Holland and Mahmoudzadeh, 2020). In 2019 there were 8,398 laboratory confirmed cases of *Salmonella* in the UK, primarily caused by S. Enteritidis and S. Typhimurium (UK Health Security Agency, 2021). This is also reflected in EU data (Table 1).
Across the EU for the year 2020, *Salmonella* was the causative agent in 694 foodborne outbreaks with 3,686 cases of illness (European Food Safety Authority and European Centre for Disease Prevention and Control, 2021). Salmonella was a common source of foodborne outbreaks across the UK between 2015-2020 at 27% (68/251) of total foodborne outbreaks. Eggs were implicated in 26% (18/68) of these foodborne outbreaks, making them the most common food vehicle associated with *Salmonella* outbreaks across the 5-year period (DEFRA, 2021).

Table 1: Top five serovars of Salmonella that cause human disease in the EU in 2020 and their primary animal sources. Data adapted from European Food Safety Authority and European Centre for Disease Prevention and Control (2021)

Serovar	Primary source
S. Enteritidis	Broilers, layers and eggs
S. Typhimurium	Broiler and pig
Monophasic S. Typimurium	Pig and broiler
S. Infantis	Broiler sources
S. Derby	Pig

The top food vehicle associated with outbreaks of Salmonella in the EU in 2020 were eggs and egg products, which were associated with 44% (37) of outbreaks (European Food Safety Authority and European Centre for Disease Prevention and Control, 2021). Of these, 25 outbreaks were associated with S. Enteritidis contamination of eggs.

The external surface of raw shell eggs may become contaminated with *Salmonella* via i) contamination with faeces after laying ii) during the laying process where the reproductive tract is contaminated. *Salmonella* may additionally migrate through the shell surface into the interior of the egg. S. Enteritidis is considered the primary serotype for cases associated with eggs and may be more able to transfer into the interior of eggs (Ricke, 2017).

Salmonella in eggs is controlled through various strategies, but primarily through the prevention of Salmonella infection of layer hens, as once hens are infected, the subsequent infection of eggs is

too complex a system to control (Pande et al., 2016). Prevention of infection in layer flocks is done through a variety of interventions, including environmental control strategies and vaccination of hens (Ricke, 2017). There are a number of schemes in the UK that cover the eggs production chain, using food safety controls that prevent contamination of eggs with Salmonella to reduce the risk to consumers. This includes the British Lion Scheme (British Lion Eggs, 2022) and the Laid in Britain Scheme (Laid in Britain, 2022). These schemes require increased levels of controls compared to legislative requirements, including vaccination of hens against Salmonella, increased testing of eggs and the egg production chain and regular audits of the production system. Labelling of these eggs, for instance with the British Lion Stamp, helps inform vulnerable consumers that these are part of specific food safety schemes.

An ACMSF report (ACMSF, 2016) concluded that eggs produced under the Lion Code scheme and demonstrably equivalent schemes (later broadened to include Laid in Britain) would pose a ‘very low’ risk with a ‘low’ degree of uncertainty to UK consumers. In 2017, the FSA deemed raw or less-than-thoroughly cooked eggs and egg products as safe to consume by certain vulnerable groups due to the additional control measures put in place by these schemes. Other UK hen shell eggs that are not under one of these schemes pose a ‘low’ risk to public health.