Fifteen years after the launch of the Lion Code of Practice, and 25 years after the salmonella crisis, the UK egg industry's success in overcoming salmonella has been recognised by a range of food safety experts.

There has been a continued fall in human salmonella since the launch of the Lion Code in 1998 and the latest results of the UK National Control Programme show that the level of salmonella in UK layer flocks has fallen to just 0.07%, and continues to be the lowest among the EU's major egg producing countries.

The latest version of the Lion Code – the only UK egg-specific assurance scheme that meets the stringent requirements of the EN 45011 international accreditation standard - was launched at the end of 2013 with 700 auditable criteria, including further improvements in food safety standards and auditing requirements across the entire egg production chain.

Around 90% of UK eggs are now produced under the Lion Quality scheme.
Independent experts have praised the UK egg industry on the effective elimination of salmonella in UK eggs.

Lesley Larkin, Defra Veterinary Advisor (Zoonoses and Imports), said: “The UK industry is to be commended on its excellent record of Salmonella control… There have been no recent reported salmonellosis outbreaks linked to UK produced eggs.”

Professor Sarah J. O’Brien, University of Liverpool, said in an article published in Clinical Infectious Diseases: “If success in public health is defined by illnesses averted, then the story of Salmonella Enteritidis PT4 in the United Kingdom, which has come down and stayed down, is good news.”

And Edwina Currie, speaking 25 years after her comments triggered the salmonella in eggs crisis, said: “The producers concerned have made an enormous amount of effort to ensure that their laying flocks are clean, that they’re vaccinated, and they have a testing regime which I think is second to none. You can have your soft-boiled egg today, in Britain, provided it’s got a little Lion on. It’s safe.”

Data published in 2013 by the European Food Safety Authority (EFSA) confirmed the status of UK egg production as among the safest in the world, with levels of salmonella of public health significance in egg-laying flocks of just 0.07%.

Previous reports from the Food Standards Agency (FSA) and the Health Protection Agency (HPA), published in 2004, praised the British egg industry for the huge decline in salmonella associated with eggs, contrasting with an FSA survey of imported eggs on sale in the UK, published in 2006, which found egg shell and/or contents contamination in one in 30 boxes of six eggs sampled. HPA tests on imported eggs in 2004 found nearly 7% tested positive for salmonella. In the same HPA investigation, salmonella was not recovered from any British Lion eggs.

The wide-ranging Lion Code of Practice covers the entire production chain, incorporating around 1,100 laying farms and 60 packing stations. The latest version, published in 2013, incorporates a range of food safety controls. Many are in excess of the National Control Programme, including:

- All Lion hens and eggs guaranteed British
- Hens vaccinated against Salmonella Enteritidis and Salmonella Typhimurium
- Registration and a unique ‘passport’ system, ensuring complete traceability of hens, eggs and feed
- Increased hygiene controls and salmonella testing of all flocks in the production chain, including turnaround swabbing of breeding, pullet rearing and laying flocks; and packing centre hygiene swabbing

Eggs are graded at the packing station for quality and size.

Only Class A eggs are sold fresh for human consumption. These eggs have a normal, clean, intact shell; an air cell not exceeding 6mm in depth; a clear, translucent, gelatinous egg white, free of foreign substances; and a stationary yolk which is visible under candling as a shadow only and which is free from foreign substances. The egg should be free of all foreign odours. Washing or other cleaning of Class A eggs is not permitted.

Class B eggs are those which do not meet the standards for Class A eggs. Class B eggs cannot be sold by retailers nor used by caterers. Class B eggs must only be sent for processing by premises approved by local authorities to manufacture egg products or may be sold to non-food manufacturers.

All Class A eggs have to be marked with a code showing the type of farming system, country of origin and production unit.

In addition, Lion Quality eggs have a best-before date on the shell and carry the Lion logo.

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There are approximately 2,400 known serotypes of salmonella but the most important type in human infection worldwide is Salmonella Enteritidis (SE). During the late 1980s there was a sharp increase in the occurrence of SE worldwide. Investigations implicated poultry as a source and poultry meat and shell eggs as food vehicles.

SE is invasive in poultry and can cause clinical disease resulting in death in young chicks and pericarditis and perihepatitis can sometimes be seen in carcasses examined at slaughter; although this bacterium is currently only very rarely isolated from UK poultry, and levels of infection in hens and people are declining across Europe.

The public health importance of SE is related to the fact that the organism can be isolated from the contents of intact shell eggs and it has been demonstrated that reproductive tissue can be infected.

Production of infected eggs by hens carrying the organism is sporadic - experimental work by the Public Health Laboratory Service (PHLS) in 1989 showed that only around 1% of all the eggs from a known infected flock contained salmonella, with less than 3% of the eggs of individual infected hens found to be contaminated.

In addition, the number of bacteria in each infected egg at lay was very low, at around 10 cells.

Investigations of naturally contaminated eggs also showed that all those examined when fresh contained fewer than 20 organisms. This is unlikely to be a sufficient dose to cause an infection in most humans. However, naturally contaminated eggs with large populations of SE in their contents have been reported, albeit very rarely.

The chances of an individual becoming infected from a single egg are very small indeed if the egg is correctly handled, and the risk has been markedly reduced by the Lion Code salmonella vaccination policy.

The principal site of contamination in egg contents appears to be either the outside of the yolk membrane or the albumen surrounding it. The yolk membrane becomes more permeable during storage and growth of SE, associated with invasion of yolk contents, can occur when eggs are stored at 20°C for more than three weeks.

Growth of salmonella can be prevented or minimised by low temperature storage, particularly in the kitchen, where temperature fluctuations can accelerate changes to yolk membrane permeability.

The advantages of low temperature storage are three fold: salmonella, if present, is unable to multiply; the yolk membrane remains essentially unchanged for long periods of storage; and any salmonellas present may be rendered more heat-sensitive by prior exposure to low temperature.

Eggs should therefore be kept at a constant temperature below 20°C to prevent deterioration in yolk membrane permeability and minimise growth of any micro-organisms that may be present.

Caterers should store eggs in a refrigerator. If this is not possible they should be stored in the coolest storage area available and orders kept to a minimum volume and regularly delivered.

To avoid the risk of higher temperatures and of temperature fluctuations in a typical domestic kitchen, consumers should place eggs in the refrigerator as soon as possible after purchase.

Eggs should be stored separately from other foods, preferably in the egg box. Eggs should be brought to room temperature before cooking.

At room temperature homogenised egg provides an ideal medium for the growth of micro-organisms and it is therefore essential to avoid any risk of cross-contamination from other foods.

Cooked egg dishes should be eaten as soon as possible after cooking and, if not for immediate use, should be stored in the refrigerator.

Hands should always be washed before and after handling shell eggs. Cracked or dirty eggs should not be used.

Following the salmonella and eggs scare in 1988, the Department of Health recommended that recipes for uncooked dishes involving the use of raw eggs should be avoided, and that lightly cooked eggs should not be served to vulnerable groups - ie infants, pregnant women, elderly and debilitated people. However, the British Egg Industry Council advises that for pregnant and breastfeeding women, and infants who have tolerated eggs on first exposure, the microbiological safety record of British Lion eggs suggests that they can now be consumed normally, ie without the need to cook fully.

In the catering industry, pasteurised egg products can be substituted for raw eggs.
Egg products are obtained from eggs once the shell and outer membrane have been removed. These are made from whole egg, yolk or albumen.

Regulations covering manufacture of Egg Products were first introduced in 1993 and are now found in EU Hygiene Legislation. They require that:

- Egg products must be processed on premises which have been approved by the Environmental Health Department of the local authority who will also be responsible for the supervision of approved establishments and the general enforcement of the Regulations.
- The use of centrifuging and crushing to obtain egg products for human consumption is banned.
- Bakers and caterers are required to use Class A hen shell eggs.
- Cracked eggs - eggs with a damaged shell where the membranes are intact, and the egg contents are not exposed to the external environment - may be used for production of egg products for human consumption subject to extra precautions being taken during processing.
- Broken eggs - in which damage extends from the shell to the membrane, exposing the internal liquid contents - are banned for human consumption.

In addition, the Code has stringent food safety and hygiene practices covering processing procedures, quality control, freezing/delifrosting procedures, pasteurising temperatures and packing instructions. The Code of Practice is policed by independent auditors.

The following measures are currently applied to eggs produced in the UK:

**Salmonella National Control Programme legislation**
- The Zoonoses Order 1989 requires all isolations of Salmonella from specified species of animals, birds, carcasses, products or surroundings of an animal or bird to be reported to Defra (ref SI 1989/285).
- The Control of Salmonella in Poultry Order 2007 sets out specific sampling requirements for Salmonella in breeding and laying flocks required by the National Control Programmes for Salmonella, (ref SI 2007/3574). This Order implements the requirements of European legislation in Regulation (EC) No 2160/2003 on the control of Salmonella and other specified food-borne zoonotic agents.
- The legislation also allows for various actions to be taken when specified Salmonella serotypes are found in breeding and laying flocks, including for restrictions to be imposed on the eggs from that flock and requiring the cleansing and disinfection of breeder houses when certain invasive Salmonella serotypes - Salmonella Enteritidis (SE), Salmonella Typhimurium (ST) and monophasic Salmonella Typhimurium strains - have been isolated. There is also compulsory slaughter if SE or ST are found in breeder flocks.

**Egg Marketing Legislation**
- The Egg and Chick Regulations (2009) England (SI 2009/2163) and equivalent in Wales, Scotland and Northern Ireland, covers production through to final sale, laying down stamping, labelling and permitted marketing of eggs. This legislation makes it mandatory to show a “best before” date for eggs on packs and for instructions to be printed on packs telling consumers to keep eggs refrigerated (chilled) after purchase. The EU regulatory provisions which apply to the marketing of eggs for consumption are contained in Council Regulation (EC) No. 1308/2013 and Commission Regulation (EC) No. 589/2008. These regulations cover the quality and weight grading, marking, packaging, storage, transport and labelling for retail sale.
- The Ungraded Eggs (Hygiene) Regulations 1990 banning the retail sale by egg producers of cracked eggs (ref SI 1990/1323).

**Food Labelling Legislation**
- The Food Labelling Regulations 1996 (as amended) (SI 1996/1499) lay down general labelling required on all foods, including eggs. This legislation implements the requirements of Directive 2000/13/EC covering the name of food, date marking and some net quantity issues. Labelling specifically related to eggs is included in the Egg and Chick Regulations (2009) above.

**Food Hygiene Legislation**
- In general, the legislation covers production and handling of all foods along the whole food chain and includes specific requirements to minimise risks to the hygienic production of high quality eggs.