Public health and safety of eggs and egg products in Australia

Explanatory summary of the risk assessment

FOOD STANDARDS
Australia New Zealand
Te Mana Kounga Kai – Ahitereiria me Aotearoa

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Foreword

This explanatory summary provides a concise plain-English summary of the background, approach and main findings of the *Risk Assessment of Eggs and Egg Products* undertaken by Food Standards Australia New Zealand (FSANZ).

In order to gain an in-depth understanding of the scientific evaluation, it is recommended that you read the full document which is available on the FSANZ website (see Useful Links at the end of this document).

Summary of main findings

Food Standards Australia New Zealand (FSANZ) has conducted a scientific assessment of the risks to public health and safety that may arise from the consumption of eggs and egg products in Australia. The assessment considered chemical and microbiological hazards and the main findings are:

- Risks associated with chemical hazards in eggs and egg products are low.
- *Salmonella* is the principal microorganism of human health concern associated with eggs and egg products.
- The frequency of *Salmonella*-contaminated eggs in Australia is very low. Despite this, there is a potential risk of illness from consumption of raw or lightly-cooked eggs, or the consumption of uncooked foods containing raw egg.
- Contamination of eggs with *Salmonella* mainly occurs at the time of, or soon after the egg is laid.
- Consumption of eggs that have cracks or are visually dirty (soiled) leads to an increased risk of human illness from *Salmonella*.
- Cooking of eggs significantly reduces the risk to human health from *Salmonella*.

1. Introduction

Australian consumers enjoy a high level of food safety. However, as many as one-in-four Australians may contract foodborne illness – that is, food poisoning – from something they have eaten each year. To address the problem, the governments of Australia have decided to examine the risks to human health along entire food chains, and to put in place management systems to control identified hazards.

Australian consumers enjoy a high level of food safety

FSANZ is the government agency responsible for conducting scientific assessments and managing risks to public health and safety for food products. We are currently developing through-chain food safety regulations (a food standard) for eggs and egg products to supplement existing measures in the Australia New Zealand Food Standards Code.

2. Scope of the scientific assessment

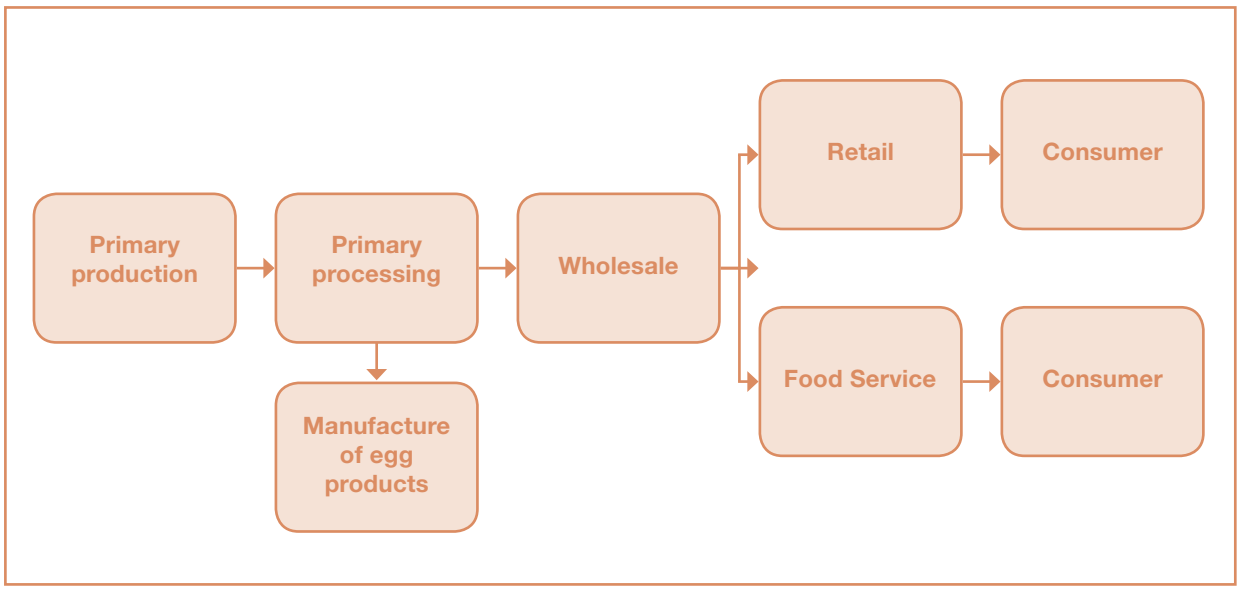
We have undertaken a scientific evaluation of the public health and safety risks posed by microbiological and chemical hazards associated with the consumption of eggs and egg products in Australia. In doing this, we adhered to the principles and guidelines of the Codex Alimentarius Commission – the international agency that advises national food regulators on best practice for assessing and managing risk.

We have attempted to determine the extent of the food safety risks associated with the consumption of eggs and egg products and to identify the specific stages along the egg supply chain - from laying flocks through to consumption - that may have the greatest impact on public health and safety.

In our assessment we considered all farmed avian (bird) species used for the production of eggs for human consumption, including chicken, duck and quail. We did not consider emu and ostrich eggs in our evaluation.

3. Egg supply chain

Figure 1. Eggs and egg product supply chain



The on-farm rearing of hens and the production of eggs is called 'primary production' (Figure 1). For commercial egg production in Australia, hens can be housed in cage, barn or free range systems. These systems are described as follows:

Husbandry	Description
Cage	Birds are continuously housed in cages within a shed.
Barn	Birds are free to roam in a shed which may have more than one level. The floor may be based on litter and/or other material such as slats or wire mesh.
Free Range	Birds are housed in sheds and have access to outdoor range.

From: Model Code of Practice for the Welfare of Animals – Domestic Poultry (2001)

After eggs are collected, they generally undergo sorting, washing, candling (crack detection), grading, and packing. These tasks are collectively referred to as 'primary processing'.

Eggs that are cracked, mis-formed or rejected for other aesthetic reasons are often used in the manufacture of egg products (e.g. pasteurised liquid egg) and can be described as 'further processing'. These products are largely used by the food service, hospitality and manufacturing industries.

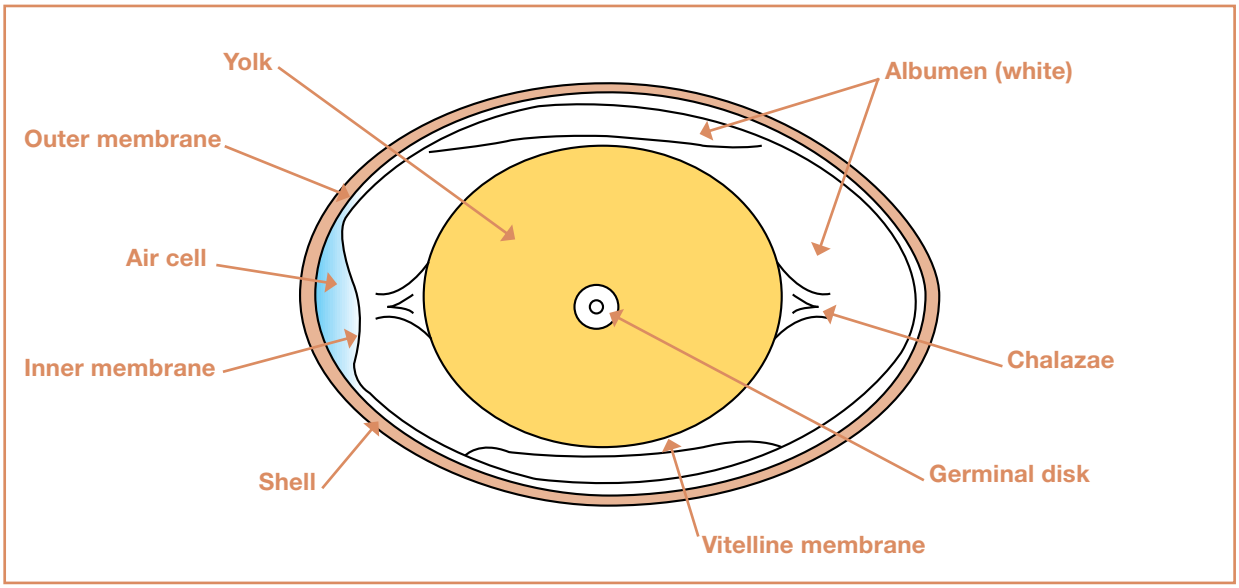
The series of activities leading to the preparation of eggs before consumption includes handling, storage and cooking.

Eggs' natural defences

The egg contains a number of physical barriers - the shell, cuticle and membranes - that help prevent microorganisms and other material from gaining access to its contents (Figure 2). In addition, the albumen (egg white) contains substances that limit the growth of microorganisms. For microorganisms to travel to the yolk and multiply, they must traverse these physical barriers and tolerate the hostile conditions of the albumen.

But the egg shell has small pores for exchange of gases and water vapour needed for the growth of a developing chick. These may also present a potential route for transmission of microorganisms and other materials into the egg contents

Figure 2. Internal egg structure



4. Scientific assessment approach

During the scientific assessment, we reviewed a wide range of information, including:

- domestic and international scientific literature
- government surveys
- industry data
- epidemiological data
- the Australian National Nutrition Survey

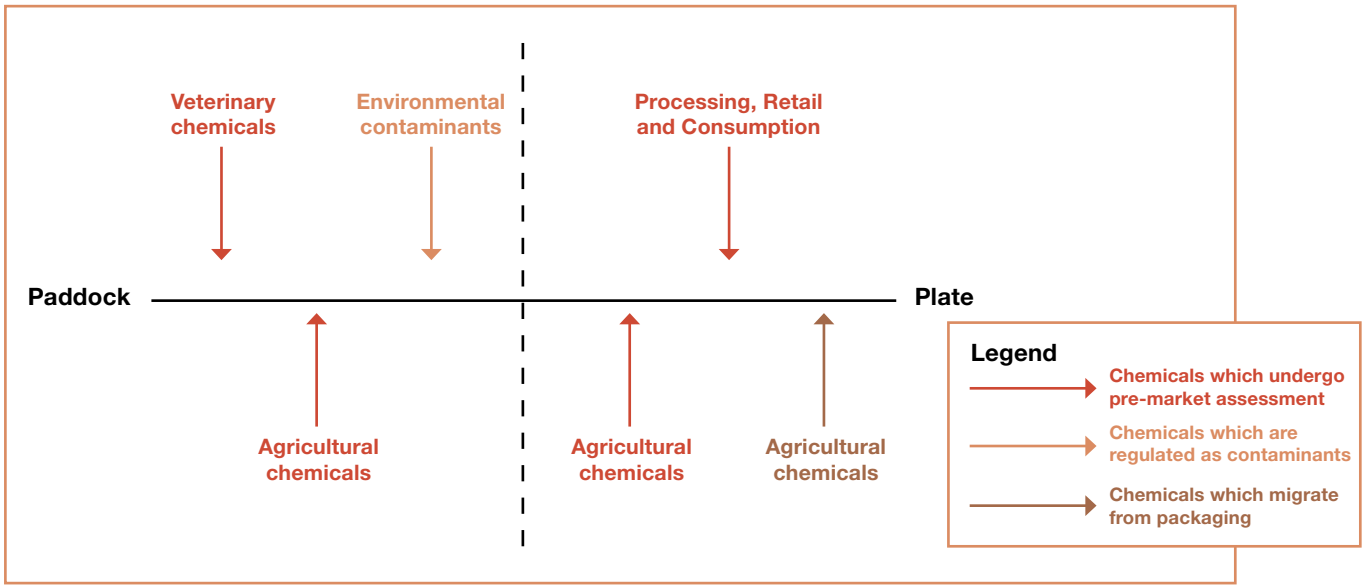
Our assessment builds on information developed for the Australian Egg Corporation Limited (AECL) including a published quantitative risk assessment of *Salmonella* spp. in Australian eggs and egg products (see Useful Links).

Chemical hazards

As part of the assessment of eggs and egg products, we looked into the potential risks that may occur as a result of the use, or presence of various chemicals at different points in the egg supply chain. Chemical contamination may be introduced via feed, water and veterinary treatment during the primary production stages and via food additives, cleaning chemicals and chemicals that migrate from packaging materials during the manufacture and sale of egg products.

Figure 3 shows a paddock-to-plate flowchart identifying stages in the egg and egg product supply chain where chemical contamination may occur.

Figure 3. Potential chemical inputs in egg production



Microbiological hazards

Our microbiological assessment considered points along the egg production and supply chain where *Salmonella* may become associated with the egg and/or its levels change due to growth or inactivation e.g. death of bacteria due to cooking.

5. Scientific assessment results

Chemical hazards

Although various chemical hazards can be introduced into eggs and egg products, we found little evidence to suggest that chemicals pose a threat to public health and safety in Australia. The results also indicated that the current regulatory measures in the Food Standards Code adequately protect consumers from the impact of chemical hazards.

Microbiological hazards

While a wide range of microorganisms may become associated with layer hens and eggs, only a small proportion of these have the potential to cause human illness.

Salmonella stands out as the most commonly reported microbiological agent responsible for foodborne illness where eggs have been implicated as the cause.

Salmonella is the principal pathogen of concern associated with eggs and egg products

Our review of reported outbreaks associated with eggs in Australia indicated that most cases could be attributed to the consumption of uncooked or lightly-cooked foods containing contaminated raw egg, for example sauces and desserts. A common risk factor in these outbreaks was the use of visually dirty (soiled) eggs.

Other factors that may have contributed to outbreaks included cross-contamination during food preparation (i.e. transfer of *Salmonella* from the surface of the egg to other surfaces and/or foods) and storage of the food containing raw egg at temperatures that would permit growth of *Salmonella* (greater than 7°C).

The use of cracked eggs may increase the likelihood of foodborne disease as there is increased potential for microorganisms such as *Salmonella* to gain access to the egg contents.

The integrity of the membranes and albumen inside the egg is affected by time and temperature. Once the integrity has been compromised, *Salmonella* (if present in the egg contents) can gain access to the yolk, where it can grow if temperatures are greater than 7°C.

Where do the main risks occur along the supply chain?

(a) Primary production

Numerous factors during primary production have the potential to introduce *Salmonella* into a laying flock including feed, water, pests (e.g. rodents and insects), the environment, personnel, new laying stock (day-old chicks or replacement pullets) and equipment.

The three main pathways by which eggs become contaminated with *Salmonella* are:

(1) faecal contamination of the egg as it exits the bird;

The vent of the bird is the common opening for waste material and eggs, and as a result contamination of the surface of egg with faeces can take place as it is laid.

(2) contamination of the egg from the environment.

The egg surface can also become contaminated by contact with faeces or faecally contaminated material found in the immediate environment where the egg is laid. Birds infected with *Salmonella* can shed large numbers of this bacterium in their faeces, and these organisms may persist in the environment.

(3) vertical transmission where the contents of the egg become contaminated as it is formed inside the bird.

The types of *Salmonella* commonly able to contaminate eggs by vertical transmission are not present in Australian laying flocks.

(b) Primary processing

Following collection, shell eggs are transferred either automatically or by hand to re-usable trays to continue along the supply chain to be sorted, washed, candled (crack detection), graded and packaged. This can occur either on the farm where the eggs are produced or at a centralised grading facility.

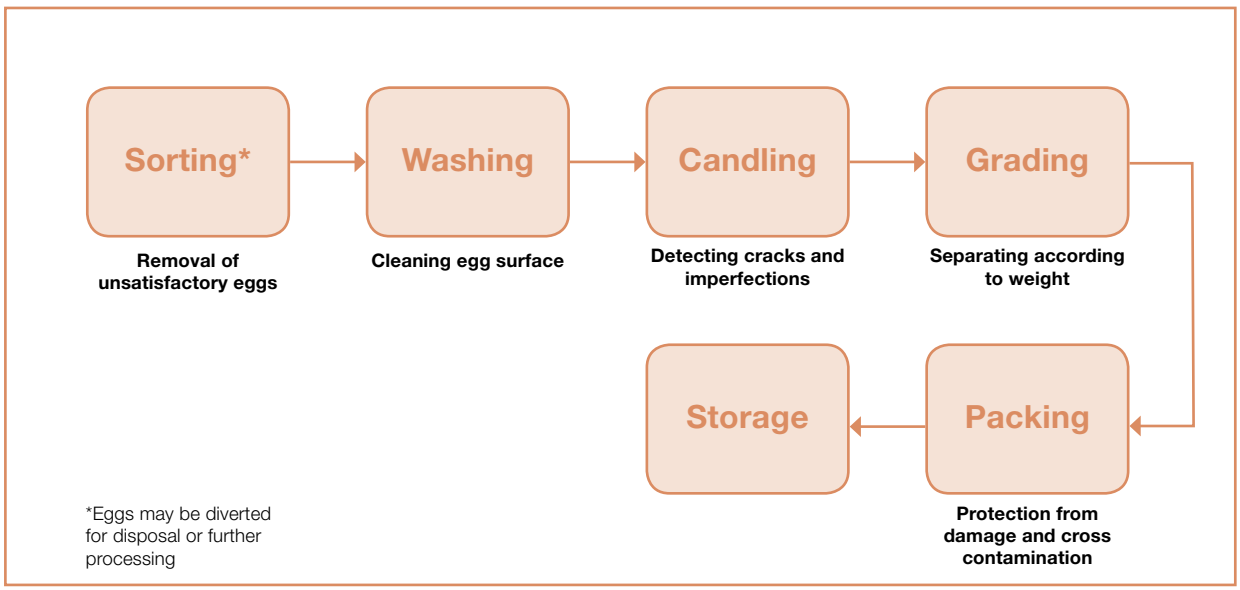
The main reason for carrying out these procedures is to maintain consistent quality and size of eggs. A second, but equally important reason is to minimise cracked and/or dirty eggs being packaged and made available for retail sale.

Eggs are sometimes washed to remove extraneous material, which may include faeces, from the egg surface. In the commercial setting, this usually involves passing the egg through a series of sprays containing detergents and/or sanitising agents, followed by rinsing, drying and oiling.

We found that, if performed correctly, commercial egg washing results in a reduction in the level of microorganisms on the egg surface. Factors that are critical to the effectiveness of egg washing include the correct use of detergents and sanitising agents and use of appropriate wash water temperatures.

Alternatively, if performed incorrectly, washing can increase the potential for transmission of *Salmonella* from the shell surface into the egg contents. For example, if the temperature of the wash water is lower than that of the egg, a pressure differential can be created allowing microorganisms that may be present on the shell surface to be drawn into the egg contents.

Figure 4. Major steps of primary processing for shell eggs



(c) Manufacture of egg products

Contents of an egg can be collected whole, or separated into its component parts of albumen and yolk.

Whole liquid egg can be collected by crushing the egg and removing the shell particles by centrifugation and/or filtration. In this process, the egg contents have contact with the external surface of the shell, increasing the potential for cross-contamination – especially if the shell is contaminated with faeces.

Due to the possible presence of *Salmonella* in raw liquid egg, these products are heat treated (pasteurised) prior to being packaged and stored at temperatures that prevent the growth of *Salmonella*.

(d) Handling and preparation

Although the frequency of eggs contaminated with *Salmonella* is very low, there remains a risk of foodborne illness if contaminated eggs are consumed raw or lightly cooked (e.g. runny eggs) – this would be the same when uncooked foods containing raw egg (e.g. egg nog, home-made ice cream, mayonnaise) are consumed.

Similarly, sauces, desserts and other foods prepared and consumed outside of the home (e.g. restaurants) may contain egg or egg products which have not received sufficient heat treatment to inactivate *Salmonella* if it was present.

The use of dirty or cracked eggs, and the practice of storing eggs at temperatures that permit the growth of *Salmonella* and/or using eggs which have passed their best-before date, may pose an increased risk of foodborne illness. Unhygienic practices used by food handlers during preparation of food containing egg have also been reported as contributing factors to the risk of foodborne illness.

6. Conclusion

The purpose of the risk assessment was to determine the chemical and microbiological risks associated with the consumption of eggs and egg products in Australia and identify where in the supply chain the hazards are introduced and what factors impact on their levels.

Chemical risks in eggs and egg products are either absent or low and of little public health and safety risk.

Salmonella is the principal microorganism of human health concern associated with eggs and egg products. While the frequency of *Salmonella*-contaminated eggs in Australia is very low, there is a potential risk of illness from consumption of raw or lightly-cooked eggs, or consumption of uncooked foods containing raw egg.

Of the foods containing eggs that were associated with outbreaks of foodborne illness, uncooked or lightly cooked sauces and desserts containing raw eggs were frequently reported. Consumption of well-cooked eggs (or cooked foods containing egg) presents little risk of foodborne illness since any *Salmonella* that may be present would be destroyed.

Soiled or visually dirty eggs were found to be a common risk factor in outbreaks. Contributing factors identified included cross-contamination during food preparation and allowing foods containing raw egg to be held at temperatures that would permit the growth of *Salmonella* (temperature abuse).

In the primary production stage of the supply chain, *Salmonella* can be introduced into laying flocks by many sources such as feed, water, the laying environment and personnel.

Major factors that impact on the potential transfer of *Salmonella* into the egg contents include the presence and amount of faecal material on the egg surface, and the condition of the shell (e.g. cracks) and cuticle. The temperature along the whole supply chain affects the rate at which the protective membranes within the egg degrade, as well as impacts on the potential for growth of *Salmonella* in those eggs that are contaminated.

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Useful Links

FSANZ website including link to the full Risk Assessment of Eggs and Egg Products

http://www.foodstandards.gov.au/thecode/primaryproductionprocessingstandards/eggstandard/index.cfm

AECL Quantitative Risk Assessment of *Salmonella* spp. in Australian Eggs and Egg Products

http://www.aecl.org/images/File/Research%20Reports/SAR42A%20Final%20Report%20Food%20Safety%20Salmonella.pdf