ACM/490

ADVISORY COMMITTEE ON THE MICROBIOLOGICAL SAFETY OF FOOD

In-shell egg pasteurisation

1. J Sainsbury plc announced on 1 August 2000 that it had produced the UK's first in-shell pasteurised eggs. The prototype eggs were said to have been through a heat treatment which kills bacteria without cooking the eggs. Sainsbury's reported that they were embarking on customer trials with the aim of bringing the eggs to the market next year. The company claim that, once on sale, the eggs, which will be clearly labelled, will allow pregnant women, children and the elderly to eat raw or lightly cooked eggs without worrying about any possible food safety implications.

2. The Chief Medical Officer's current advice to the public is that it would be prudent to avoid eating raw eggs or uncooked foods made from them and that, in addition, vulnerable people such as the elderly, the sick, babies and pregnant women should consume only eggs which have been cooked until the white and yolk are solid.

3. The attached paper providing information about their in-shell pasteurisation process has been provided for the information of Members by Sainsbury's and will be introduced by their Chief Microbiologist Alec Kyriakides.

4. The Food Standards Agency would be grateful for the Committee's views on the effectiveness of the process from a microbiological food safety standpoint.

Secretariat
September 2000

IN-SHELL PASTEURISED EGGS

PAPER BY ALEC KYRIAKIDES OF SAINSBURY'S SUPERMARKETS

1. Background:

Eggs, contaminated with *Salmonella* on the surface of the shell or in the egg contents have been implicated in numerous outbreaks of salmonellosis over the last decade. UK government advice to the public since 1988 has been to avoid the consumption of raw eggs or uncooked foods containing raw eggs. Vulnerable groups such as pregnant women, the elderly and babies are additionally advised to consume only eggs where the yolk and white have been cooked until they are solid (Anon. 1988 & Anon. 1998).

The reported incidence of *Salmonella* in British eggs in 1991 was calculated to be 1 in 650 (de Louvois, 1993) which is similar to that found in a DoH survey of eggs in 1998. The introduction of improved hygiene practices together with the vaccination of laying flocks against *Salmonella* by the British Egg Industry through the Lion Code of Practice is believed to have resulted in a further reduction in the incidence of *Salmonella* in eggs, although this still has to be independently verified.

It is nevertheless true that these improvements in egg production have coincided with a dramatic reduction in confirmed cases of salmonellosis over recent years, where levels in England and Wales caused by *S.* Enteritidis have decreased from twenty-three thousand in 1997 to just over ten thousand in 1999 (Anon. 2000).

Sainsbury's intends to introduce a range of eggs, pasteurised in their shells that will be suitable for consumption as a ready-to-eat food.

2. Process:

The process, which is currently in its trial form, involves placing eggs in an oven and applying heated, humidified air to slowly elevate the egg temperature to a level sufficient to achieve a defined lethality in *Salmonella* whilst causing minimal effects on the egg contents.

The process does not involve immersing the eggs in water, nor does it use any chemical additive or any unconventional heat source.

Eggs pasteurised in their shell will be new to the UK market but they have been sold in the USA for several years. The US process, however, involves the use of hot water immersion that would be prohibited in the UK according to the Egg Marketing Standards Regulation. The basic principles of the thermal destruction of *Salmonella* in eggs by gentle heating have been researched for many years and several publications exist on the topic that demonstrate its feasibility. The challenge to this process relates not to the

heat source, but instead to the precision in time and temperature control necessary to achieve the correct lethality without adversely affecting the egg.

3. Validation:

3.i. Method:

Thermal destruction studies have been performed at an independent laboratory using two cocktails of *Salmonella*; cocktail 1 consisted of a mixture of *S*. Typhimurium DT104 and *S*. Enteritidis PT4 (previously shown to exhibit enhanced heat resistance) and cocktail 2 consisted of a mixture of *S*. Virchow, *S*. Infantis, *S*. Agona, *S*. Montevideo, *S*. Hadar, *S*. Heidelberg and *S*. Enteritidis (different to cocktail 1).

Eggs were inoculated using stationary phase cultures to achieve c.10^6 colony forming units per gram (CFU/g). The inoculum was made up in either albumen or yolk, as appropriate, prior to inoculation. Inoculation was conducted by needle injection into the yolk or albumen of separate eggs sourced from the same flock.

Process lethality was determined over a range of times at a fixed temperature and thermocouple readings, taken using a probe inserted into the yolk, were used to track the applied process.

All testing was conducted in triplicate and enumeration was conducted on a non selective resuscitation agar which, after a suitable period, was overlayed with selective agar.

3.ii. Results:

3.ii.a. Cocktail 1 (*S*. Typhimurium DT104 and *S*. Enteritidis PT4)
The mean reduction in the albumen using the chosen time / temperature combination was >4.85 $\log_{10}$CFU with a range from >4.82 to >4.91.

The mean reduction in the yolk was 4.45 $\log_{10}$CFU with a range from 4.22-4.65.

3.ii.b. Cocktail 2 (*S*. Virchow, *S*. Infantis, *S*. Agona, *S*. Montevideo, *S*. Hadar, *S*. Heidelberg and *S*. Enteritidis)
The mean reduction in the albumen was >4.78 $\log_{10}$CFU with a range from >4.68 to >4.84.

The mean reduction of cocktail 2 in the yolk was 4.54 $\log_{10}$CFU with a range from 4.3 to 4.78.

4. Risks:

4.i Eggs

Using the data described above on the process lethality and making the following assumptions, the risk of a contaminated egg, pasteurised in its shell reaching the market can be estimated.

4.i.a. Assumption:
Contamination rate: 1 in 650 eggs (de Louvois, 1993) contaminated with *Salmonella*
Contamination level: 1 cell
Position: Centre of the yolk
Minimum Process lethality: 4.22 $\log_{10}$CFU

(Note: The incidence of *Salmonella* in eggs is likely to be lower than this as in-shell pasteurised eggs will be sourced from Grade A eggs layed by vaccinated flocks and processed within 72 hours of lay. In addition, contamination is more likely to occur in the albumen).

4.i.b. Probability
The probability of one contaminated egg reaching the market is c.1 in 10 million or c.1 in 10^7eggs.

5. Egg Properties:

5.i. Measured
Independent analysis of 30 pasteurised and standard eggs from the same flock indicated no difference in cuticle as measured by electron microscopy or in egg weight. The Haugh unit was slightly higher in the pasteurised eggs, as was the Roche measurement of egg yolk colour.

The egg white is slightly opaque.

5.ii. Recipes
The eggs are intended for use by those who wish to consume them in raw egg dishes and perform well in raw egg mousse, mayonnaise but meringue is more difficult to whip.

The eggs will also be suitable for use by vulnerable groups such as pregnant women, the elderly and babies, who will all be able to go back to consuming soft boiled eggs and fried eggs with runny yolks. Soft boiled and fried eggs are no different when made from pasteurised eggs than standard eggs.

No difference is apparent in the taste or smell of the egg and the in-shell pasteurised egg is currently undergoing extensive consumer trials using an independent company to assess product quality against standard eggs (blind trials).

6. Stability and Storage

Studies are currently underway to determine the microbial stability of the in-shell pasteurised egg in comparison to standard eggs. Challenge tests are being conducted with *Listeria monocytogenes, Bacillus cereus, Salmonella* Enteritidis and *Clostridium botulinum* to determine the relative growth potential during storage. If these studies indicate any loss in stability then the eggs will be stored under refrigeration with clear instruction to keep refrigerated. However, it must be stressed that little if any work has been published on the growth of some of these pathogens in standard eggs in their shells and therefore the relative differences in growth is most relevant.

7. Production

The eggs will be produced from Grade A eggs derived from vaccinated flocks and post production practices will be compliant with standards in place in the manufacture of ready-to-eat foods.

8. Legislation

The in-shell pasteurised eggs do not comply with the EC Egg Marketing Standards Regulations due principally to the slight opacity in the albumen and due to the application of a heat process. The eggs could therefore not be marketed as Grade A eggs.

The eggs also do not comply with the Egg Products Regulations for pasteurised eggs as they only allow for eggs processed out of their shell.

Sainsbury's are currently asking MAFF to seek changes to the Egg Marketing Standards Regulations in order to allow these safer eggs to be called Grade A eggs.

9. Packaging and Labelling

The outcome of the discussions above will dictate the labelling requirements for the eggs. The intention is to clearly label that the egg has been pasteurised in its shell and that it would be suitable for consumption in raw egg dishes. Guidance will be given on appropriate storage and handling of the eggs to ensure that poor practices after purchase do not compromise the additional safety delivered through in-shell pasteurisation. The packaging will be tamper evident

References:

Anon (1988) *Salmonella* and eggs. Department of Health, UK, London. November 21.

Anon (1998e) Expert advice repeated on *Salmonella* and raw eggs. Department of Health, London, UK, April 9.

de Louvois, J. (1993) *Salmonella* contamination of eggs: a potential source of human salmonellosis. *PHLS Microbiology Digest*, **10** (3), 158-162.

Anon (2000) PHLS *Salmonella* Fact Sheet (updated 22 March 2000). www.phls.co.uk