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Report

Affect of Water Level when Pasteurising Human Milk And Special Diets

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Introduction

The pasteurisation of human milk in milk banks is performed using a water bath. Traditionally the water level in the bath allowed the bottle to be entirely submerged to allow the process temperature to be attained both in the milk and headspace of the bottle. The disadvantage of this process is the reliance of a good watertight seal of the cap and bottle to prevent water from the bath entering the bottle. An alternative design has now entered the market that uses a water level just above the level of milk in the bottle. The aim of this paper is to measure the time/temperature relationship between these two methods and determine if they both allow reliable pasteurisation of milk and internal bottle surfaces.

Equipment

Water container – Cannon Avent electric baby bottle steriliser with a temperature controller inline with the heater, able to regulate the water temperature to 63 °C +1/-0 °C and fitted with a stirrer. Illustrated in Figure 1.
Bottles - Sterifeed 130ml plastic bottle fitted with a plastic entry port.
Temperature datalogger – Chessell 4100G 6 point logger with a set scale 0 – 100 °C Using 0.2mm Cu/Con thermocouple wire,
Milk – UHT low fat cows milk.

Protocol

1. The water bath was switched on and allowed to settle to 63 °C with the stirrer in operation.

2. Thermocouple wires were fitted to the test bottle as listed and one wire free to dip into the water bath water.

3. The data logger was checked for calibration by placing the all thermocouple wire in the water together with certificated mercury in glass thermometer. After equilibration of 10 minutes readings were taken of all the probes and the thermometer. The results are listed in Table 4.

4. The test bottle was filled with milk to the 130ml line and the cap carefully fitted to provide a good seal.

5. The test bottle was placed into the water bath with the water level to the shoulder for tests 1 and 2. For test 3 the water level was raised until the cap of the test bottle was covered.

6. The time was noted when the milk reached 63 °C and 30 minutes was then allowed before the test ended.

7. On completion of the 30 minutes at 63 °C the test bottle was removed from the heated bath to cool.

Results

Table 1. Test 1: Water level to top of milk level

Channel	Probe site	Temperature in °C when milk at 63 °C	Temperature at end of pasteurisation °C
1	Inside cap	54.4	54.0
2	Head space	53.6	53.5
3	Water bath	65.4	63.3
5	Shoulder inside bottle	51.7	50.8
6	Threaded area inside bottle	54.0	54.3

Temperature of milk at start: 23.4 °C

Table 2. Test 2: Water level to top of milk level

Channel	Probe site	Temperature when milk at 63 °C	Temperature at end of pasteurisation °C
1	Inside cap	54.5	56.5
2	Head space	55.8	59.2
3	Water bath	64.3	64.6
5	Shoulder inside bottle	54.5	57.8
6	Threaded area inside bottle	54.5	56.6

Temperature of milk at start: 25.4 °C

Table 3. Test 3: Water level above top of bottle

Channel	Probe site	Time delay of probe reaching 63 °C
1	Inside cap	6 min 20 sec
2	Head space	5 min 28 sec
3	Water bath	7 min 28 sec
5	Shoulder inside bottle	First probe to 63 °C
6	Threaded area inside bottle	5 min 08 sec

Temperature of milk at start: 17.3 °C

Table 4 Calibration check on thermocouple probes

Temperature of water bath measured using certificated mercury in glass thermometer: 63.3 °C
Temperature reading of probes-

Probe	Temperature	error
1	63.2 °C	- 0.1°C
2	63.1°C	- 0.2 °C
3	62.9 °C	- 0.4 °C
4	63.4 °C	+ 0.1°C
5	63.0 °C	- 0.3 °C
6	63.5 °C	+ 0.2 °C

Comments

Test 1. Gave a differential of 8.6 °C to 12.2 °C between the milk temperature and areas around the bottle headspace and walls. Pasteurisation would not be attained in these areas thus allowing bacterial survival resulting in contamination of the pasteurised milk during storage.

Test 2. Gave a differential of 5.2 °C to 8.5 °C which also would cause a failure of pasteurisation. In addition at the end of 30 minutes exposure time at 63 °C the probes in and on the surface of the bottle headspace did not rise above 59.2 °C. Therefore at no time during pasteurisation did any of the headspace probes come within 3.8 °C of the required minimum temperature during tests 1and 2.

Test 3. Illustrated that when the bottle was heated with a depth of water that covered the cap the slowest probe to reach 63 °C was in the milk. All the probes in the headspace area were heated to temperature at least 5 minutes longer than the 30 minutes pasteurisation time.

The tests prove that it is essential to cover the milk bottles with heated water to ensure that all surfaces coming in contact with the milk are pasteurised to the required standard. Failure to heat all internal bottle surfaces will result in the survival of contaminating organisms in the bottle headspace. After pasteurisation these organisms will re-contaminate the milk and pose a potential hazard to baby consuming the product.

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