

## DETECTION OF INHIBITORY SUBSTANCES IN MILK

### ***Bacillus stearothermophilus* Disc Assay (BsDA), Charm Tablet Method (Raw Commingled Cow Milk, Raw Commingled Goat Milk, and NCIMS Accepted Pasteurized Cow Milk Products) IMS# 9-B2**

[Unless otherwise stated all tolerances are  $\pm 5\%$ ]

#### GENERAL REQUIREMENTS

1. **Laboratory Requirements (see Cultural Procedure (CP), items 33 & 34), except** \_\_\_\_\_
  - a. For Appendix N testing, see Appendix N General Requirements (App. N GR), items 14 & 15 \_\_\_\_\_

#### SAMPLES

2. **See CP, item 33, except** \_\_\_\_\_

- a. For Appendix N testing, see App. N GR items 9 \_\_\_\_\_

#### APPARATUS & MATERIALS

3. **See CP items 1-23, except** \_\_\_\_\_

- a. For Appendix N testing, see App. N GR items 1-8 \_\_\_\_\_

4. **Equipment** \_\_\_\_\_

- a. Incubator thermostatically controlled at  $64 \pm 2^\circ\text{C}$  \_\_\_\_\_
  - b. Heating block, water bath or other acceptable method to heat to at least  $82 \pm 2^\circ\text{C}$ , for confirmation \_\_\_\_\_
  - c. Pipettor - 90  $\mu\text{L}$  and 500  $\mu\text{L}$  (optionally 50  $\mu\text{L}$ ) and disposable tips (see App. N GR item 7 or CP item 6) \_\_\_\_\_
  - d. Forceps, Fine Points, Stainless Steel \_\_\_\_\_
  - e. Vernier, Dial or Digital Calipers, metal (readable to 0.1 mm) \_\_\_\_\_
  - f. Stirring hot plate/stirring bar (optional) \_\_\_\_\_
  - g. 100 mL Class A graduate cylinder \_\_\_\_\_
  - h. 250 mL Erlenmeyer flasks \_\_\_\_\_

- i. 13 x 100 mm test tubes for beta-lactam confirmation \_\_\_\_\_
- j. Timer \_\_\_\_\_

**MATERIALS**

**5. See CP, items 24-32** \_\_\_\_\_

- a. Filter Paper Discs, Blank, Unimpregnated, Non-sterile \_\_\_\_\_  
 Brand: \_\_\_\_\_ Lot #: \_\_\_\_\_  
 1. High absorbability, diameter 12.7±0.1 mm \_\_\_\_\_
- b. Charm PM Indicator Agar \_\_\_\_\_  
 1. **Do Not Autoclave** - (see plate preparation, item 19 below) \_\_\_\_\_
- c. Charm Spore Tablets \_\_\_\_\_  
 1. Bacillus stearothermophilus (Geobacillus stearothermophilus) tablets containing 100,000,000 (±10 million) spores per tablet \_\_\_\_\_  
 Lot #: \_\_\_\_\_ Exp. Date: \_\_\_\_\_
- d. Plastic Petri dish (15 x 100 mm, bottom plate inner diameter 86.1 - 87.0mm) \_\_\_\_\_

**REAGENTS**

**6. Reagents** \_\_\_\_\_

- a. Charm 5.0 ppb Penicillin G Standard Positive Control \_\_\_\_\_  
 Lot #: \_\_\_\_\_ Exp. Date: \_\_\_\_\_  
 1. Store according to label directions \_\_\_\_\_
- 2. Rehydrate according to label instructions \_\_\_\_\_
- 3. Test for suitability each time prepared, add to one (1) disc, must produce zone 16-20 mm; maintain records \_\_\_\_\_  
 Avg. Zone Size: \_\_\_\_\_
- 4. Use rehydrated standard within 48 hours if refrigerated \_\_\_\_\_  
 Lab Prep. Date: \_\_\_\_\_

5. Or, aliquot within 24 hours and freeze at -15°C or colder in non-frost-free freezer or in an insulated foam container in a frost-free freezer, use within 2 months (Once thawed, maintain according to manufacturer's instructions)

Lab Prep. Date: \_\_\_\_\_ Lab Exp. Date: \_\_\_\_\_

b. Negative Control

1. Charm Zero Control Standard

Lot #: \_\_\_\_\_ Exp. Date: \_\_\_\_\_

- a. Reconstitute according to label instructions
- b. Use rehydrated negative control within 72 hours if refrigerated

Lab Prep. Date: \_\_\_\_\_ Lab Exp. Date: \_\_\_\_\_

- c. Or, aliquot within 24 hours and freeze at -15°C or colder in non-frost-free freezer or in an insulated foam container in a frost-free freezer, use within 2 months (Once thawed, maintain according to manufacturer's instructions)

Lab Prep. Date: \_\_\_\_\_ Lab Exp. Date: \_\_\_\_\_

2. Inhibitor Free Raw Milk

Sample ID: \_\_\_\_\_ Date Tested: \_\_\_\_\_

- a. Use within 72 hours if refrigerated

Lab Prep. Date: \_\_\_\_\_ Lab Exp. Date: \_\_\_\_\_

- b. Or, aliquot within 24 hours and freeze at -15°C or colder in non-frost-free freezer or in an insulated foam container in a frost-free freezer, use within 2 months. Once thawed, use within 24 hours

Lab Prep. Date: \_\_\_\_\_ Lab Exp. Date: \_\_\_\_\_

3. Test for suitability, add to one (1) disc, produces no zone; maintain records

Zone Size: \_\_\_\_\_

c. Charm Beta-lactamase tablet or liquid concentrate (not required if beta-lactamase is not used for confirmation) \_\_\_\_\_

1. Stored at -15°C or below \_\_\_\_\_

2. Do not use beyond expiration date \_\_\_\_\_

Lot #: \_\_\_\_\_ Exp. Date: \_\_\_\_\_

3. Reconstitute freeze dried concentrate as per manufacturer instructions \_\_\_\_\_

a. Liquid concentrate stored at -15°C or below in a non-frost-free freezer or in an insulated foam container in a frost-free freezer; use within 2 weeks \_\_\_\_\_

4. Test each lot for suitability, add beta-lactamase to 5.0 ppb positive control (item 6.a) and add to one (1) disc, beta-lactamase neutralizes zone produced by positive control; maintain records \_\_\_\_\_

Zone Size: \_\_\_\_\_

### ASSAY PLATE

#### 7. Preparation of Plate \_\_\_\_\_

a. Prepare agar according to label, 3.2 g/95 mL H<sub>2</sub>O, bring agar to a boil \_\_\_\_\_

b. Promptly cool to 64±2°C (Temperature Control [TC] used) \_\_\_\_\_

1. Optionally, temperature may be determined by inserting a dedicated thermometer (not used for any other purpose) directly into test agar \_\_\_\_\_

c. Add 1 spore (white) tablet to 5 mL deionized water in 13 x 100 mm test tube \_\_\_\_\_

d. Shake test tube 25 times through 1 foot arc in 7 sec, or vortex for 10 sec; let settle 1 min \_\_\_\_\_

e. Repeat item d above \_\_\_\_\_

f. Decant spore mixture into agar tempered to 64±2°C leaving residue on bottom of tube (avoid pouring mixture down side of flask) \_\_\_\_\_

g. Mix agar well for 1.5 min avoiding incorporation of air bubbles, optionally use stirring bar on magnetic stir plate \_\_\_\_\_

h. Constantly mix remaining agar during preparation of plates \_\_\_\_\_

- i. Pipet 6 mL inoculated agar into Petri dish (item 5.d) \_\_\_\_\_
  - 1. Or, appropriate amount of agar into other size  $[(Dcm)^2 6/8.65^2 = V]$ ; Dcm = inner diameter of plate in centimeters; V = volume (mL) of agar to add in dishes; maintain records \_\_\_\_\_
  - j. Plates have flat bottoms and do not buckle after addition of agar; plates observed before and after preparation for suitability \_\_\_\_\_
  - k. Swirl plate gently on level surface to evenly distribute agar \_\_\_\_\_
  - l. Allow agar to solidify on a level surface for 15 min with lid ajar \_\_\_\_\_
  - m. Use within 5 days, if stored at 0-4.5°C in airtight container \_\_\_\_\_
- Lab Prep. Date: \_\_\_\_\_ Lab Exp. Date: \_\_\_\_\_

**TECHNIQUE**

**8. Performance Check (see App N. GR item 10.a)** \_\_\_\_\_

- a. Positive and negative controls give appropriate zones prior to any sample analysis (refers to new lot numbers) \_\_\_\_\_
- b. Take corrective actions for out of range zones \_\_\_\_\_
- c. Maintain records \_\_\_\_\_

**9. Laboratory Procedure, Screening** \_\_\_\_\_

- a. Label bottom of plates prior to adding discs, use template as a guide to assure discs will be placed at least 10 mm from the Petri dish wall and other discs \_\_\_\_\_
- b. Each test plate may contain a maximum of 5 test sample discs plus a positive control and negative control disc (7 discs total as per template, for larger plates more discs may be placed, maintain comparable spacing) \_\_\_\_\_
- c. Sample agitation \_\_\_\_\_
  - 1. Mix raw milk sample(s)/control(s) (approx.  $\frac{3}{4}$  full), subsample(s) of retail milk containers or control(s) by shaking 25 times in 7 sec with a 1 ft movement or vortex for 10 sec at maximum setting; use within 3 min (samples/controls must be in appropriate container to allow the use of vortexing) \_\_\_\_\_
  - 2. Mix retail samples by inverting containers top to bottom then bottom to top (a complete half circle or 180 degrees) without pausing, 25 times; use within 3 in \_\_\_\_\_

- d. Add 90 µL of mixed sample/control to each disc \_\_\_\_\_
  - 1. Using pipettor (item 4.c) with new tip for each sample/control, draw up 90 µL avoiding foam and bubbles \_\_\_\_\_
  - 2. Remove tip from liquid \_\_\_\_\_
  - 3. Using clean, dry forceps, remove a disc from container and place the disc (using a template as a guide) on the agar surface of the inhibitor plate \_\_\_\_\_
  - 4. Press the disc **gently** with the forceps to insure good contact and then fill disc immediately \_\_\_\_\_
  - 5. With pipettor in vertical position and tip about 5 mm above the center of the disc, depress the plunger to the first stop in such a way to get a rapid drop-wise release of the sample \_\_\_\_\_
    - a. If pipettor has two (2) stops, depress plunger to second stop \_\_\_\_\_
  - 6. Sample not applied too slowly or quickly (streamed) \_\_\_\_\_
  - 7. Allow a second or two for the milk to absorb into the disc \_\_\_\_\_
  - 8. **Gently** touch off the tip on an area of the disc away from where the sample was deposited \_\_\_\_\_
  - 9. Repeat the above until all samples have been done \_\_\_\_\_
- e. Place a positive control disc containing 5.0 ppb Penicillin G and a negative control disc on each test plate using above procedure \_\_\_\_\_
  - 1. Vary the location of positive control discs in a series of test plates; i.e. center or outside of the plate \_\_\_\_\_
- f. Invert plate(s) and incubate at 64±2°C until well defined zones of inhibition are obtained around the 5.0 ppb positive control(s), the remainder of the plate(s) should be yellow with an incubation time of approximately 2.5 to 3 hours \_\_\_\_\_
- g. Remove plates from incubator and allow to cool on a level surface for 2 minutes (do not remove lid before plates are cooled) \_\_\_\_\_
- h. Examine positive control zone. A valid test requires a positive control zone of 16-20 mm. If zone size is < 16 or > 20 mm the test **must** be repeated \_\_\_\_\_
- i. Examine plate for zones of inhibition surrounding the test discs, zones of >12.7 mm indicates presence of inhibitory substances \_\_\_\_\_

- j. Measure zones of inhibition by using calipers \_\_\_\_\_
  - 1. Use the inside diameter points (smaller points) \_\_\_\_\_
  - 2. Anchor one point in the bottom of the plate at the edge of the zone and expand calipers until the other point rests on the other edge \_\_\_\_\_
  - 3. Read calipers and report zone size to the nearest 0.1 mm \_\_\_\_\_
- k. Zones of  $\leq 12.7$  mm are read as no zone \_\_\_\_\_
- l. Zones  $> 12.7$  mm must be promptly confirmed to report as positive for inhibitor or beta-lactam residue \_\_\_\_\_

**10. Confirmation of PMO Section 6 Samples or Verification of Appendix N Initial Positive Tanker Samples (see App. N GR item 11); Confirmation of Presumptive Positive Tanker Samples (see App. N GR item 12); and if applicable, Traceback of Producer(s) on a Confirmed Positive Tanker (see App. N GR item 13). PROMPTLY retest the SAME sample in DUPLICATE along with a positive and negative control as described below (10.a.1-8)** \_\_\_\_\_

- a. Inhibitor confirmation/verification and optional beta-lactamase confirmation \_\_\_\_\_
  - 1. Confirmation (without beta-lactamase) \_\_\_\_\_
    - a. Heat a 0.5 mL (500  $\mu$ L) portion of each suspect sample to  $82 \pm 2^\circ\text{C}$  for 2 minutes (TC required) \_\_\_\_\_
    - b. Cool promptly in ice bath to room temperature \_\_\_\_\_
    - c. Label bottom of plates prior to adding discs \_\_\_\_\_
    - d. Vortex for 10 seconds; use within 3 minutes \_\_\_\_\_
    - e. Add 90  $\mu$ L of heated samples to a disc on plate as in item 9.d \_\_\_\_\_
  - 2. Confirmation using beta-lactamase **(optional by State Regulatory Agency)** \_\_\_\_\_
    - a. Add one beta-lactamase (red) tablet to each of the heated samples and mix samples as in item 9.c.1 \_\_\_\_\_
    - b. Let particulates settle for 1 min then add 90  $\mu$ L to a disc on plate (Avoid clogging pipet tip with particulates by pipetting from top of samples) \_\_\_\_\_
    - c. Or, alternatively add 50  $\mu$ L of beta-lactamase liquid concentrate (item 6.c), mix samples, wait 1 min then add 90  $\mu$ L to a disc on plate \_\_\_\_\_

- 3. Proceed as in items 9.d-l \_\_\_\_\_
  - b. Results of Presumptive Positive, Confirmation, and optional beta-lactamase test \_\_\_\_\_
    - 1. Inhibitor present \_\_\_\_\_
      - a. Zones  $\geq 16$ mm of the heat treated (10.a.1) sample is **Positive for inhibitor** \_\_\_\_\_
    - 2. Beta-lactam present (optional beta-lactamase test) \_\_\_\_\_
      - a. A zone around the disc containing the heat treated milk sample (10.a.1) but no zone around the disc containing beta-lactamase (10.a.2), treated milk sample, sample is **Positive for beta-lactam** \_\_\_\_\_
      - b. Zones around the heat treated sample (10.a.1) of equal size, or  $< 4$  mm greater, than beta-lactamase treated sample (10.a.2) is **Positive for inhibitor** \_\_\_\_\_
      - c. Zones around both the heat treated milk sample disc (10.a.1) **and** the beta-lactamase treated milk sample disc (10.a.2), **and** the zone around the heat treated milk sample disc is at least 4 mm larger than the zone around the beta-lactamase treated milk disc (10.a.1) [ex. beta-lactamase = 14 mm, untreated = 18 mm], sample is **Positive for beta-lactam and non-beta-lactam inhibitor** \_\_\_\_\_
  - c. **Confirmation of Appendix N samples, see App. N GR from items 12-13, perform confirmation as in item 10 above (use of beta-lactamase required) and interpret as in items 10.b above** \_\_\_\_\_
  - d. **Verification of Initial Positive Tanker (see App. N GR item 11) or Producer (see item App. N GR item 13.c-g). Duplicate samples tested using beta-lactamase specific test kit; conduct test as in respective FORM FDA/NCIMS 2400 for the test kit; if beta-lactam not detected in either sample duplicate, verify sample using the Charm BsDA test kit as described in item 10 above** \_\_\_\_\_
- 11. Recording and Reporting (for Appendix N also see App. N GR item 14)** \_\_\_\_\_
- a. Record numeric values for all measurable zone sizes for samples **and** controls (screen and confirmation), if no zone is observed record as **No Zone (NZ)** \_\_\_\_\_
  - b. Report presence of inhibitor only from heated milk samples \_\_\_\_\_
  - c. Report sample as **Positive for inhibitor** (if heat only used 10.a.1) or where demonstrated in beta-lactamase test (10.a.2), and zone size  $\geq 16$  mm (10.b.1 or 10.b.2.b), **report to State Regulatory Agency** \_\_\_\_\_

- d. Report as **Positive for beta-lactam** where demonstrated in beta-lactamase test (10.a.2) and when zone size  $\geq 16$  mm (10.b.2.a); **report to State Regulatory Agency** \_\_\_\_\_
- e. If both beta-lactam and non-beta-lactam inhibitors are demonstrated in beta-lactamase test (10.a.2) and zone size  $\geq 16$  mm (10.b.2.c), report test as **Positive for beta-lactam and inhibitor; report to State Regulatory Agency** \_\_\_\_\_
- f. Report numeric values for **all** measurable zone sizes for samples **and** controls \_\_\_\_\_
- g. Report when zone size  $> 12.7$  and  $< 16$  mm as positive but Below Actionable Level \_\_\_\_\_
- h. Report absence of inhibitor (no zone) as **Not Found** \_\_\_\_\_
- i. If any inhibitor is present, i.e., zone  $> 12.7$  mm, bacteria counts cannot be reported \_\_\_\_\_