Preparation of CowM2 Assay Reagents and Standards for qPCR analysis

1. INTRODUCTION

1.1. This quantitative Polymerase Chain Reaction (qPCR) assay targets a non-ribosomal gene in an unknown group of bacteria. It is used to detect bovine (cattle) fecal contamination. A gBlock® fragment containing a 130 bp CowM2 qPCR target sequence is used as a standard in the CowM2 assay, which generates a standard curve for determination and performance characteristics of the qPCR assay.

1.2. Extraction control and third well spike: The extraction control contains an added known concentration of gBlock DNA that is extracted and analyzed along with environmental samples. The third well spike also contains a known concentration of gBlock DNA and is added as a third replicate well to each environmental sample during reaction plate setup. Both extraction control and third well spikes are used as positive controls for the CowM2 target sequence and qPCR assay.

2. EQUIPMENT AND SUPPLIES

2.1. Gloves, latex or nitriles

2.2. Tube racks

2.3. Centrifuge tubes, 0.5mL, 1.5 mL, and 2.0 mL

2.4. Brady FreezerBondz II Laboratory Labels (Cat#19-140-586)

2.5. Micropipettes with sterile PCR grade filter tips

2.5.1. Calibrate and use per SOP PCR-2.4.

2.6. CBS Optimizer PCR Workstation #1 (S/N 007631)

2.7. CBS Optimizer PCR Workstation #2 (S/N 007632)

2.8. Fisher mini vortexer

2.9. Fisher minicentrifuge

2.10. Eppendorf centrifuge model 5418 (S/N 5418AG715992)

2.11. Qubit 2.0 Fluorometer (S/N 1301008411)

2.11.1. Calibrate and use per SOP PCR-2.0

2.12. PCR#9, Thermo Refrigerator Isotemp (S/N TR1562211012), maintained at 4ºC ± 2ºC, Room B246A

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2.13. PCR#2, Thermo freezer (S/N 0121174101121218), maintained at -20ºC ± 10ºC, Room B246A

2.14. PCR#4, Thermo freezer (S/N 0121174201121218), maintained at -20ºC ± 10ºC, Room B246B

2.15. PCR#8, Thermo Revco Freezer (S/N 1127018801220603), maintained at -80ºC ± 10ºC, Room B246

2.16. Incubating mini shaker (S/N 150747)

2.17. Autoclave (S/N 0317618851)

3. REAGENTS AND CHEMICALS

3.1. Deionized (DI) water

3.2. Molecular Biology grade water. Corning Molecular Biology Grade Water tested to USP Sterile Water (Cat.#MT46000CV).

3.3. Bleach solution, 10% (v/v)

3.4. Ethanol 80% (v/v)

3.5. TE buffer

4. COWM2 PRIMER/ PROBE STOCK

4.1. Always purchase primer/ probes together as a set. Primers are ordered dry, salt free, and at a 1 µmol scale. The probe is dry, HPLC purified and at a 1 µmol scale. The probe has the 5' 6-FAM dye and 3' Zen-Iowa Black FQ quencher from Integrated DNA Technologies (IDT). Keep stored at -20°C.

4.1.1. Forward Primer CowM2For: 5'- CGGCCAAATACTCCTGATCGT - 3'

4.1.2. Reverse Primer CowM2Rev: 5'- GCTTGTTGCGTTCCTTGAGATAAT - 3'

4.1.3. Probe CowM2Probe: 5'- /56-FAM/ AGGCACCTA /ZEN/TGTCCTTTACCT CATCAACTACAGACA/3IABkFQ/ – 3'

4.2. Each order includes an Oligonucleotide Data Sheet. Record received date on this sheet and review the sequences on the sheet for correctness. Scan the data sheet into the following folder: \\Fldep1\dear\Labs\Lab5\Biology\MolecularBiology\Certificates of Analysis\Oligo Data Sheet

4.3. Record each preparation in Laboratory Information Management System (LIMS) Standard Preparation Tracker module (**Laboratory/Technical/Standard Preparation Tracker**).

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4.3.1. In LIMS select **Laboratory/Technical/Standard Preparation Tracker** from the menu. Choose **BIO-PCR** from the "Group" drop down list.

4.3.2. Select **Purchased/New Reagent/Material** from the menu. If a similar reagent exists, select **Purchased/Duplicate Reagent/Material** from the menu and choose the reagent to duplicate from the list.

4.3.3. In the "Purchased Material" pop-up window, enter the following information:

4.3.3.1. For Forward Primer CowM2For: Identity: = CowM2For; Description = CowM2 Assay Forward Primer; Entered by: = Analyst Name; Type: = Powder; Grade: = blank; Purity: = Salt-free; Received: = Date of receipt; Expires: = 1 year from receive date; Manufacturer: = Integrated DNA Technologies (IDT); Lot # = Barcode ID from data sheet; Storage Location: = B246A; Storage Temperature: = Freezer at <-10 degC; Container Size: = weight in mg; Units: = mg;

4.3.3.2. For Reverse Primer CowM2Rev: Identity = CowM2Rev; Description = CowM2 Assay Reverse Primer; Entered by = Analyst Name; Type = Powder; Grade = blank; Purity = Salt-free; Received: = Date of receipt; Expires: = 1 year from receive date; Manufacturer = Integrated DNA Technologies (IDT); Lot # = Barcode ID from data sheet; Storage Location = B246A; Storage Temperature = Freezer at <-10 degC; Container Size = weight in mg; Units = mg;

4.3.3.3. For Probe CowM2Probe: Identity = CowM2Probe; Description = CowM2 Assay Probe; Entered by = Analyst Name; Type = Powder; Grade = HPLC Grade; Purity = HPLC; Received: = Date of receipt; Expires: = 1 year from receive date; Manufacturer = Integrated DNA Technologies (IDT); Lot # = Barcode ID from data sheet; Storage Location = B246A; Storage Temperature = Freezer at <-10 degC; Container Size = weight in mg; Units = mg;

4.3.3.4. Select "Yes" for the "Has Certificate of Analysis" drop-down list.

4.3.4. If a component is not already in the components list, click **Add**, and "Identity" name will self-populate in the "Components" table.

4.3.5. Double click the component and add the concentration of the reagent. Use the concentration in nmol from the data sheet. The **Add** or **Remove** buttons can be used to add or remove components.

4.3.6. Click **OK** to save the entry and receive a serial number. Open the LabelMark6 software and create labels (see SOP PCR-5.0 for details). Print labels with the reagent name, serial number, and expiration date and affix labels to the side of each tube. The top label should include the reagent name. Place labels on all aliquoted tubes. Place the label on the Oligonucleotide Data Sheet before scanning it (from Step 4.2).

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4.3.7. The concentration of primer/probes provided will vary with each order. This is listed in the "nmol" column of the data sheet. The data sheet will list how much TE buffer is needed to reconstitute the primer/probe to a 100 µM concentration in the "Add X µL for 100 µM" column. Use this amount for a 100 µM concentration. For a 500 µM concentration, divide this number by 5.

4.4. All primer/ probe mixing and pipetting must be completed in PCR Workstation #1 (DNA free) using sterile, DNA free supplies. Use only aerosol barrier tips for micropipettes. Before opening the dry oligonucleotide tube, pulse centrifuge to make sure all the oligos are at the bottom of the tube. Oligos are shipped by the manufacturer as dried content and appear as either a translucent film or a white powder.

4.5. For each primer, pipette appropriate amount of TE buffer into the tube containing the dried primer. The forward and reverse primers are resuspended at 500 µM concentration. Dissolve by tapping the tube. Allow the solution to equilibrate for 5 minutes. Mix again and pulse centrifuge to coalesce droplets. Aliquot 10 µL volumes into green 0.5 mL centrifuge tubes. Affix labeled stickers to the top and side of each tube.

4.6. For the probe, pipette appropriate amount of TE buffer into the tube containing the dried probe to make a 100 µM concentration. Dissolve by tapping the tube. Allow the solution to equilibrate for 5 minutes. Mix again and pulse centrifuge to coalesce droplets. Aliquot 6 µL volumes into green 0.5 mL centrifuge tubes. Affix labeled stickers to the top and side of each tube.

4.7. Group in sets of forward primer, reverse primer, and probe in a freezer box and store at -20°C.

4.8. Record each primer/probe preparation in Laboratory Information Management System (LIMS) Standard Preparation Tracker module (**Laboratory/Technical/Standard Preparation Tracker**).

4.8.1. In LIMS select **Laboratory/Technical/Standard Preparation Tracker** from the menu. Choose **BIO-PCR** from the "Group" drop down list.

4.8.2. Select **Prepared/New Reagent** from the menu. If a similar reagent exists, select **Prepared/Duplicate Reagent** from the menu and choose the reagent to duplicate from the list.

4.8.3. In the "Prepared Reagent" pop-up window, enter the following information:

4.8.3.1. For CowM2 Forward Primer: Identity: = CowM2For; Type: = Working Reagent; Entered by: = Analyst Name; Holding Time: = 365 Days; Prepared = Date/Time of preparation and Analyst; SOP: = PCR-3.7; See Also: = leave blank; Location: = B246A; Description = CowM2 Assay Forward Primer 500 µM concentration; Storage Temperature = Freezer at <-10 degC; Additional Information: = TE Buffer S#; Solvent Used: =

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AE Buffer; Final Volume: = final total volume of preparation in µL; Units: = µL;

4.8.3.2. For CowM2 Reverse Primer: Identity = CowM2Rev; Type: = Working Reagent; Entered by: = Analyst Name; Holding Time: = 365 Days; Prepared = Date/Time of preparation and Analyst; SOP: = PCR-3.7; See Also: = leave blank; Location: = B246A; Description = CowM2 Assay Reverse Primer 500 µM concentration; Storage Temperature = Freezer at <-10 degC; Additional Information: = TE Buffer S#; Solvent Used: = AE Buffer; Final Volume: = final total volume of preparation in µL; Units: = µL;

4.8.3.3. For CowM2 Probe: Identity = CowM2Probe; Type: = Working Reagent; Entered by: = Analyst Name; Holding Time: = 365 Days; Prepared = Date/Time of preparation and Analyst; SOP: = PCR-3.7; See Also: = leave blank; Location: = B246A; Description = CowM2 Assay Probe 100 µM concentration; Storage Temperature = Freezer at <-10 degC; Additional Information: = TE Buffer S#; Solvent Used: = AE Buffer; Final Volume: = final total volume of preparation in µL; Units: = µL;

4.8.4. Click **Add**. Choose the **Purchased Materials** radio button in the "Select Source:" section. In the "Enter Serial #" pop up window, choose the primer/probe that was used to make the preparation being entered from the list, or enter its serial number in the text box. In the "Enter Amount & Units for.." pop up window, enter weight of the primer/probe added in µg and choose "µg" from the "Added Units:" drop down list. Click **OK**.

4.8.5. Click **OK** to save the entry and receive a serial number. Open the LabelMark6 software and create labels. Print labels with the reagent name (CowM2For, CowM2Rev, or CowM2Probe), serial number, and expiration date and affix labels to the side and top of each tube. The top label should include the primer name and serial number. Place labels on all aliquoted tubes before storage at -20°C.

5. GBLOCK STANDARD

5.1. A gBlock® gene fragment is ordered from IDT and is used as a standard for the CowM2 assay. The target sequence for the CowM2 assay is a 130 bp fragment (bold sequences show location of primer binding):

5' –
ATCGCTCACACCGAATCG**CGGCCAAATACTCCTGATCGT**ACTCGAGATAGG
CACCTATGTCCTTTACCTCATCAACTACAGACAAA**ATTATCTCAAGGAACGC**
AACAAGCATCGCCTCTAATGGAAAATG – 3'

5.2. This sequence is combined with the target sequence for the HumM2 assay to generate a standard that can be used for both assays. This gBlock fragment is named C2H2 gBlock and is a 449 bp fragment:

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5’ –
ATCGCTCACACCGAATCGCGGCCAAATACTCCTGATCGTACTCGAGATAGGC
ACCTATGTCCTTTACCTCATCAACTACAGACAAAATTATCTCAAGGAACGCAA
CAAGCATCGCCTCTAATGGAAAATGCGTCAGGTTTGTTTCGGTATTGAGTATC
GAAAATCTCACGGATTAACTCTTGTGTACGCTCTCGAGGACCAGCTAATGCAT
ATAAATAAGTTACGTGATGAGACCGGCGCACGGGTGAGTAACACGTATCCAA
CCTGCCGTCTACTCTTGGCCAGCCTTCTGAAAGGAAGATTAATCCAGGATGG
GATCATGAGTTCACATGTCCGCATGATTAAAGGTATTTTCCGGTAGACGATGG
GGATGCGTTCCATTAGCTCGAGATAGTAGGCGGGGTAACGGCCCACCTAGTC
AACGATGGATAGGGGTTCTGAGAGGAAGG – 3’

5.3. There are no modifications or purifications needed, and 250 ng of the gBlock arrives dried and appears either as a translucent film or a white powder in a centrifuge tube. Record the gBlock in LIMS Standard Preparation Tracker module (Laboratory/Technical/Standard Preparation Tracker).

5.3.1. In LIMS select **Laboratory/Technical/Standard Preparation Tracker** from the menu. Choose **BIO-PCR** from the “Group” drop down list.

5.3.2. Select **Purchased/New Standard** from the menu. If a similar standard exists then select **Purchased/Duplicate Standard** from the menu and choose the standard to duplicate from the list.

5.3.3. In the “Purchased Standard” pop up window enter the following information:

5.3.3.1. <u>For C2H2 gBlock</u>: Identity: = C2H2 gBlock; Description: = gBlock standard for CowM2 and HumM2 assays; Entered by: = Analyst Name; Received: = Date received; Expires: = 365 days; Type: = purchased powder; Has certificate of Analysis: = YES; Manufacturer: = Integrated DNA Technologies (IDT); Lot #: = (list number on tube); Storage Location: = B246; Storage Temperature: = Freezer <10 degC; Additional information: = Use with SOP = PCR-3.7.

5.4. To resuspend, centrifuge the tube briefly then add TE to reach a final concentration of 10 ng/µL. For 250 ng, add 25 µL TE. Vortex briefly, then incubate at 50°C for 20 minutes in benchtop incubator. Briefly vortex and centrifuge.

6. STOCK DNA AND WORKING STANDARDS

6.1. Dilute the resuspended gBlock in TE buffer to measure on Qubit. Gently mix each dilution and pulse centrifuge to coalesce droplets.

6.1.1. Mix 10 µL of resuspended CowM2 gBlock with 90 µL of TE buffer to make a 1:10 dilution.

6.1.2. Mix 50 µL of the 1:10 dilution with 450 µL of TE buffer to make a 1:100 dilution.

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6.2. Analyze the 1:10 and 1:100 dilutions in triplicate on the Qubit fluorometer per SOP PCR-2.0 to determine the concentration. Use 10 µL as the sample volume. The 1:10 dilution should be 10X greater than the 1:100 dilution. If this is not the case, use a more concentrated or dilute sample as needed.

6.3. Determine the concentration of stock C2H2 gBlock in ng/mL.

6.3.1. For each dilution, multiply the stock concentration (from Qubit data file) measured on the Qubit by the dilution factor. Use the average of these as the concentration of the stock C2H2 gBlock.

6.3.2. Compare this value to the expected concentration of 10 ng/µL. If calculated value differs greatly, recheck measurements.

6.4. Determine the concentration of the stock DNA in TSC/5 µL using the following equation with the conversion factor of 1 ng of C2H2 double-stranded gBlock = 2.06 X 10^9 target sequence copies of C2H2.

$$\frac{TSC\ C2H2}{5\ uL} = (Stock\ Conc.\ in\ ng/mL)\left(\frac{1\ mL}{1000\ uL}\right)\left(\frac{2.06\ \times\ 10^9\ TSC}{1\ ng}\right) \times 5$$

6.4.1. If developing a new gBlock, please refer to SOP PCR-5.4 Section 2.3.3. to determine the number of copies per nanogram

6.5. Determine the concentrations of the dilutions in TSC/5 µL units and continue the serial dilution down to a concentration of 10^7 in 1000 µL volumes. This will be used as the working standard.

6.6. Using green 0.5 mL tubes, aliquot the 10^7 dilution in 50 µL volume for the standards and 16 µL volume for the extraction control spikes. Print labels and affix them on the top and sides of the tubes. The side label should include the serial number, name (_.__ E7 C2H2 STD or _.__ E7 C2H2 SPK), and expiration date. Top label should include E7 C2H2 SPK or E7 C2H2 STD. Store the 10^7 tubes at -80°C.

6.6.1. The 10^7 standards will be diluted further to 10^6, 10^5, 10^4, and 10^3 when setting up the reaction plate to make a standard curve for the CowM2 assay, and as a third well spike at a concentration of 10^5.

6.7 Record the stock DNA and dilutions in LIMS Standard Preparation Tracker module (**Laboratory/Technical/Standard Preparation Tracker**).

6.7.1 In LIMS select **Laboratory/Technical/Standard Preparation Tracker** from the menu. Choose **BIO-PCR** from the "Group" drop down list.

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6.7.2 Select **Prepared/New Standard** from the menu. If a similar standard exists then select **Prepared/Duplicate Standard** from the menu and choose the standard to duplicate from the list.

6.7.3 In the "Standard Solution" pop up window enter the following information:

6.7.3.1 For Stock C2H2 gBlock DNA: Identity: = x.xxEx C2H2 gBlock (use measured concentration in TSC/5µL); Type: = Stock Standard; Holding Time: = 365 days; Entered by: = Analyst Name; Location: = B246; Prepared = Date/time of preparation and analyst; SOP: = PCR-3.7; See Also: = leave blank; Description: = C2H2 gBlock reconstituted at 10 ng/uL in TE buffer; Additional Information = TE Buffer S#; Storage Temperature: = Freezer at <-10 degC; Solvent Used: = AE Buffer; Final Volume: = 50.00; Units: = µL;

Note: The stock DNA will be used to make working standards and the original tube will be stored at -80°C.

6.7.3.2 For working C2H2 gBlock Standard: Identity: = x.xxE7 C2H2 gBlock (use measured concentration in TSC/5µL); Type: = Working Standard; Holding Time = 365 days; Entered by: = Analyst Name; Location: = B246; Prepared = Date/time of preparation and analyst; SOP: = PCR-3.7; See Also: = leave blank; Description: = resuspended gBlock used for standards for C2H2 assay; Additional Information = TE Buffer S#; Storage Temperature: = Freezer at <-10 degC; Solvent Used: = AE Buffer; Final Volume: = 1000.00 ; Units: = µL;

6.7.3.3 Click **Add**. In the "Enter Serial #" pop up window, choose the standard that was used to make the standard being entered from the list, or enter its serial number in the text box. For C2H2 gBlock stock DNA, the standard is in the **Purchased Materials** "Select Source:" list. For the other working standards, choose **Existing Standards** for the source list. In the "Enter Amount & Units from.." pop up window, enter the amount of standard added in µL and "Final Conc. Units:" should be entered as "ng/mL". Click **OK**.

6.7.3.4 Click **OK** in the "Standard Solution" pop up window to save the entry and receive a serial number. Open the LabelMark6 software and create labels. Print labels and affix them on the top and sides of the tubes. The side label should include the serial number, name (_.__ E7 C2H2 STD or _.__ E7 C2H2 SPK), and expiration date. The top label should include E7 C2H2 SPK or E7 C2H2 STD. Place labels on all aliquoted tubes before storage at -80°C.

7. COWM2 ASSAY STANDARD CURVES AND THIRD WELL SPIKE

7.1. The CowM2 standard curve consists of running concentration series 10^7, 10^6, 10^5, 10^4, and 10^3 TSC/5 µL, and the third well spike is run at a concentration of 10^5 TSC/5 µL.

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7.2. CowM2 standards and the third well spike will be diluted before each run from 10^7 concentration. To make the 10^6 standard, dilute by mixing 10 µL of the 10^7 dilution with 90 µL of TE buffer. 10^5, 10^4, and 10^3 will be made similarly by serially diluting.

7.3. Record the third well spike standard in LIMS Standard Preparation Tracker module (**Laboratory/Technical/Standard Preparation Tracker**) as a working standard per Step 6.7.3.2, except add SPIKE to the end of the Identity name.

7.4. When new standards are needed, dilute the original gBlock stock and measure as described in Section 6.1. Reorder as needed.

8. COWM2 EXTRACTION CONTROL

8.1. The extraction control (EC) has a concentration of 10^7 TSC/5 µL of C2H2 gBlock.

8.2. Use the 10^8 C2H2 gBlock stock standard to make the 10^7 EC dilution by mixing 50 µL of the 10^8 dilution with 450 µL of TE buffer.

8.3. Aliquot the EC spike into green 0.5 mL tubes in 16 µL volumes and keep frozen at -80°C in B246. Place labeled dots with the concentration (E7) on the tops of all tubes.

8.4. Record the extraction control spike in LIMS Standard Preparation Tracker module (**Laboratory/Technical/Standard Preparation Tracker**) as a working standard per Step 6.7.3.2, except add SPIKE to the end of the Identity name.

9. QUALITY CONTROL

9.1. Maintain control charts of CowM2 extraction controls. If recoveries show a decreasing trend, DNA standards may be deteriorating and need to be remade.

9.2. When new standard curve sets are made, analyze alongside an older set for comparison. New standards should perform similarly to older standards. If older standards are not available, compare to the control chart information.

10. REFERENCES

10.1. DEP Laboratory Quality Manual

10.2. Health and Safety Plan

10.3. DEP SOP PCR-2.0 *Calibration, Use and Maintenance of Qubit 2.0 Fluorometer*

10.4. DEP SOP PCR-2.4 *Calibration and Use of Mechanical Pipettes using PCS® Pipette Calibration System*

10.5. DEP SOP PCR-5.4 *Determining Optimal Running Conditions for qPCR Markers*

Appendix of Significant Changes

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12/15/2020 Updated the gBlock information to the combined C2H2 gBlock.

12/06/2022 Updated to new fridge and freezer information in Equipment and Supplies.

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