

POLYNUCLEOTIDES FOR AMPLIFICATION AND DETECTION OF HUMAN BETA ACTIN

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Application No. 16/700,824, filed December 2, 2019, the disclosure of which is incorporated by reference herein in its entirety.

SEQUENCE LISTING

[0002] The instant application contains a Sequence Listing which has been submitted electronically in ASCII format and is hereby incorporated by reference in its entirety. Said ASCII copy, created on December 1, 2020, is named TSM-047WO_SL.txt and is 42,596 bytes in size.

FIELD OF THE INVENTION

[0003] The present invention relates to the fields of molecular biology and nucleic acid chemistry. The invention provides methods and reagents for detecting mammalian, specifically human, gene for *beta actin* and also relates to the fields of medical diagnostics and prognostics. In particular, the invention relates to polynucleotides and methods for amplifying and detecting *beta actin*, hereinafter referred to as “ β -actin”.

BACKGROUND

[0004] Housekeeping genes are required for the maintenance of basal cellular functions essential for the existence of a cell, regardless of its specific role in the tissue or organism. Thus, such genes are expected to be expressed in all cells of an organism under normal and patho-physiological conditions, irrespective of tissue type, developmental stage, cell cycle state, or external signal. Since these genes represent the minimal set of genes necessary for sustaining life, they can provide value to researchers and professionals conducting experimental studies and molecular testing by frequently using them as a control. Controls are assessed in parallel with target analytes of interest to establish a factor of confidence in the final results obtained. When the expected presence of the control is determined, one or more aspects of the experiment or assay are confirmed to be properly functioning. However,

when the expected presence of the control is absent, the final results in question do not meet performance standards and indicate an error.

[0005] In one specific example, nucleic acid amplification tests (NAATs) for molecular diagnostic testing require the use of one or more controls to be tested and detected in parallel with one or more target analytes of interest. The embodiments disclosed herein provide primers and probes relate to the detection of the housekeeping gene encoding β -actin using loop-mediated isothermal amplification.

SUMMARY OF THE INVENTION

[0006] The present invention encompasses, in some embodiments, a composition comprising a set of polynucleotides selected from the group consisting of Set-1 through Set-29. In some embodiments, the composition further comprises a probe. In some embodiments, the probe comprises a label. In some embodiments, the probe is a labeled polynucleotide. In a preferred implementation, the label is a fluorophore, which preferably is covalently attached to a terminus of the polynucleotide. In a particularly preferred embodiment, the probe or polynucleotide is a molecular beacon comprising a fluorophore, a quencher, and a polynucleotide. In one embodiment, the fluorophore is FAM and the quencher is BHQ1. In an alternate implementation, the fluorophore is ATTO 565 or Alexa 594 and the quencher is BHQ1 or BHQ2.

[0007] In some implementations, composition comprises a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 6-33 of SEQ ID NO: 135, nucleotides 6-30 of SEQ ID NO: 136, nucleotides 7-27 of SEQ ID NO: 137, nucleotides 7-26 of SEQ ID NO: 138, nucleotides 1-26 of SEQ ID NO: 139, nucleotides 7-26 of SEQ ID NO: 140, nucleotides 7-30 of SEQ ID NO: 141, nucleotides 6-30 of SEQ ID NO: 142, nucleotides 8-32 of SEQ ID NO: 143, nucleotides 8-30 of SEQ ID NO: 144, nucleotides 6-31 of SEQ ID NO: 145, nucleotides 8-30 of SEQ ID NO: 146, 8-22 of SEQ ID NO: 147, nucleotides 8-24 of SEQ ID NO: 148, nucleotides 7-27 of SEQ ID NO: 149, nucleotides 8-21 of SEQ ID NO: 150, nucleotides 8-32 of SEQ ID NO: 151, nucleotides 1-24 of SEQ ID NO: 152, nucleotides 4-24 of SEQ ID NO: 153, nucleotides 1-23 of SEQ ID NO: 154, nucleotides 8-26 of SEQ ID NO: 155, nucleotides 7-29 of SEQ ID NO: 156, nucleotides 8-28 of SEQ ID NO: 157, nucleotides 8-29 of SEQ ID NO: 158, nucleotides 7-25 of SEQ ID NO: 159, nucleotides 8-22 of SEQ ID NO: 160, nucleotides 6-22 of SEQ ID NO: 161, nucleotides 3-22

of SEQ ID NO: 162, nucleotides 8-28 of SEQ ID NO: 163, nucleotides 3-28 of SEQ ID NO: 164, nucleotides 5-25 of SEQ ID NO: 165, nucleotides 5-26 of SEQ ID NO: 166, nucleotides 5-20 of SEQ ID NO: 167, nucleotides 4-22 of SEQ ID NO: 168, nucleotides 7-22 of SEQ ID NO: 169, nucleotides 3-22 of SEQ ID NO: 170, nucleotides 7-28 of SEQ ID NO: 171, nucleotides 6-27 of SEQ ID NO: 172, nucleotides 7-29 of SEQ ID NO: 173, nucleotides 5-27 of SEQ ID NO: 174, nucleotides 7-29 of SEQ ID NO: 175, nucleotides 6-28 of SEQ ID NO: 176, nucleotides 4-23 of SEQ ID NO: 177, nucleotides 4-34 of SEQ ID NO: 178, nucleotides 3-27 of SEQ ID NO: 179, nucleotides 2-27 of SEQ ID NO: 180, nucleotides 5-33 of SEQ ID NO: 181, nucleotides 3-30 of SEQ ID NO: 182, nucleotides 9-34 of SEQ ID NO: 183, and nucleotides 8-28 of SEQ ID NO: 184. In further implementations, the labeled polynucleotide can comprise a sequence elected from the group consisting of SEQ ID NO: 135 through SEQ ID NO: 184. In certain implementations, the sequence of the labeled polynucleotide is selected from the group consisting of SEQ ID NO: 135 through SEQ ID NO: 184.

[0008] In some embodiments, the set of polynucleotides is selected from the group consisting of Sets 9-12, Set-17, and Sets 22-29, and the composition comprises a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 8-22 of SEQ ID NO: 147, nucleotides 8-24 of SEQ ID NO: 148, nucleotides 7-27 of SEQ ID NO: 149, nucleotides 8-21 of SEQ ID NO: 150, nucleotides 8-26 of SEQ ID NO: 155, nucleotides 7-29 of SEQ ID NO: 156, nucleotides 5-25 of SEQ ID NO: 165, nucleotides 5-26 of SEQ ID NO: 166, nucleotides 5-20 of SEQ ID NO: 167, nucleotides 4-22 of SEQ ID NO: 168, nucleotides 7-22 of SEQ ID NO: 169, nucleotides 7-28 of SEQ ID NO: 171, nucleotides 6-27 of SEQ ID NO: 172, nucleotides 7-29 of SEQ ID NO: 173, nucleotides 5-27 of SEQ ID NO: 174, nucleotides 7-29 of SEQ ID NO: 175, nucleotides 6-28 of SEQ ID NO: 176, nucleotides 9-34 of SEQ ID NO: 183, and nucleotides 8-28 of SEQ ID NO: 184. In some implementations, the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 147, SEQ ID NO: 148, SEQ ID NO: 149, SEQ ID NO: 150, SEQ ID NO: 155, SEQ ID NO: 156, SEQ ID NO: 165, SEQ ID NO: 166, SEQ ID NO: 167, SEQ ID NO: 168, SEQ ID NO: 169, SEQ ID NO: 171, SEQ ID NO: 172, SEQ ID NO: 173, SEQ ID NO: 174, SEQ ID NO: 175, SEQ ID NO: 176, SEQ ID NO: 183, and SEQ ID NO: 184. In some implementations, the sequence of the labeled polynucleotide is SEQ ID NO: 147, SEQ ID NO: 148, SEQ ID NO: 149, SEQ ID NO: 150, SEQ ID NO: 155, SEQ ID NO: 156, SEQ ID NO: 165, SEQ ID NO: 166, SEQ ID NO: 167, SEQ ID NO: 168, SEQ ID NO: 169, SEQ ID NO: 171, SEQ ID NO: 172, SEQ ID NO: 173, SEQ ID NO: 174, SEQ ID NO: 175, SEQ

ID NO: 176, SEQ ID NO: 183, and SEQ ID NO: 184. In a preferred implementation, the sequence of the labeled polynucleotide is SEQ ID NO: 184, and the set of polynucleotides is Set-29.

[0009] In yet another embodiment, the set of polynucleotides is selected from the group consisting of Sets 9-11, Set-17, and Sets 23-29, and the composition comprises a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 1-24 of SEQ ID NO: 152, nucleotides 4-24 of SEQ ID NO: 153, and nucleotides 1-23 of SEQ ID NO: 154. More particularly, the labeled polynucleotide can comprise a sequence selected from the group consisting of SEQ ID NO: 152, SEQ ID NO: 153, and SEQ ID NO: 154. In certain implementations, the sequence of the labeled polynucleotide is selected from the group SEQ ID NO: 152, SEQ ID NO: 153, and SEQ ID NO: 154.

[0010] In one implementation, the set of polynucleotides is selected from the group consisting of Set-4, Sets 9-12, Set-17, and Sets 22-26, and the composition comprises a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 8-30 of SEQ ID NO: 144, nucleotides 6-31 of SEQ ID NO: 145, and nucleotides 8-30 of SEQ ID NO: 146. In certain implementations, the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 144, SEQ ID NO: 145, and SEQ ID NO: 146. In some embodiments, the sequence of the labeled polynucleotide is selected from the group SEQ ID NO: 144, SEQ ID NO: 145, and SEQ ID NO: 146.

[0011] In another implementation, the set of polynucleotides is selected from the group consisting of Set-5, Set-12, Set-17, and Sets 22-25, and the composition comprises a labeled polynucleotide comprising nucleotides 3-22 of SEQ ID NO: 170. In some implementations, the labeled polynucleotide comprises SEQ ID NO: 170. In other embodiments, the sequence of the labeled polynucleotide is SEQ ID NO: 170.

[0012] In one embodiment, the set of polynucleotides is selected from the group consisting of Sets 6-8, Set-15, and Set-16, and the composition comprises a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 2-27 of SEQ ID NO: 180 and nucleotides 3-30 of SEQ ID NO: 182. In some implementations, the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 180 and SEQ ID NO: 182. In other embodiments the sequence of the labeled polynucleotide is SEQ ID NO: 180 or SEQ ID NO: 182.

[0013] In yet another embodiment, the set of polynucleotides is selected from the group consisting of Sets 6-11, Set-28, and Set-29, and the composition comprises a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 4-34 of SEQ ID NO: 178 and nucleotides 5-33 of SEQ ID NO: 181. In some embodiments, the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 178 and SEQ ID NO: 181. In other embodiments, the sequence of the labeled polynucleotide is SEQ ID NO: 178 or SEQ ID NO: 181.

[0014] In certain implementations, the set of polynucleotides is selected from the group consisting of Sets 6-9 and Set-11, and the composition comprises a labeled polynucleotide comprising nucleotides 3-27 of SEQ ID NO: 179. In other implementations, the labeled polynucleotide comprises SEQ ID NO: 179. In yet another implementation, the sequence of the labeled polynucleotide is SEQ ID NO: 179.

[0015] In one embodiment, the set of polynucleotides is selected from the group consisting of Sets 6-9, Set-11, and Set-28, and the composition comprises a labeled polynucleotide comprising nucleotides 4-23 of SEQ ID NO: 177. In some embodiments, the labeled polynucleotide comprises SEQ ID NO: 177. In other embodiments, the sequence of the labeled polynucleotide is SEQ ID NO: 177.

[0016] In one implementation, the set of polynucleotides is selected from the group consisting of Sets 13-15, and the composition comprises a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 7-25 of SEQ ID NO: 159 and nucleotides 8-22 of SEQ ID NO: 160. In another implementation, the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 159 and SEQ ID NO: 160. In other implementations, the sequence of the labeled polynucleotide is SEQ ID NO: 159 or SEQ ID NO: 160.

[0017] In one embodiment, the set of polynucleotides is selected from the group consisting of Sets 13-16, and the composition comprises a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 8-28 of SEQ ID NO: 157, nucleotides 8-29 of SEQ ID NO: 158, nucleotides 6-22 of SEQ ID NO: 161, and nucleotides 3-22 of SEQ ID NO: 162. In such an embodiment, the labeled polynucleotide can comprise a sequence selected from the group consisting of SEQ ID NO: 157, SEQ ID NO: 158, SEQ ID NO: 161, and SEQ ID NO: 162. In yet another embodiment, the sequence of the labeled

polynucleotide is selected from the group consisting of SEQ ID NO: 157, SEQ ID NO: 158, SEQ ID NO: 161, and SEQ ID NO: 162.

[0018] In another implementation, the set of polynucleotides is Set-3, and the composition comprises a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 7-27 of SEQ ID NO: 137, nucleotides 7-26 of SEQ ID NO: 138, nucleotides 1-26 of SEQ ID NO: 139, nucleotides 7-26 of SEQ ID NO: 140, nucleotides 7-30 of SEQ ID NO: 141, nucleotides 6-30 of SEQ ID NO: 142, nucleotides 8-32 of SEQ ID NO: 151, and nucleotides 4-24 of SEQ ID NO: 153. In certain implementations, the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 137, SEQ ID NO: 138, SEQ ID NO: 139, SEQ ID NO: 140, SEQ ID NO: 141, SEQ ID NO: 142, SEQ ID NO: 151, and SEQ ID NO: 153. In a further implementation, the sequence of the labeled polynucleotide is selected from the group consisting of SEQ ID NO: 137, SEQ ID NO: 138, SEQ ID NO: 139, SEQ ID NO: 140, SEQ ID NO: 141, SEQ ID NO: 142, SEQ ID NO: 151, and SEQ ID NO: 153.

[0019] In some embodiments, the set of polynucleotides is selected from the group consisting Set-1, Set-2, and Sets 18-20, and the composition comprises a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 8-28 of SEQ ID NO: 163 and nucleotides 3-28 of SEQ ID NO: 164. In some implementations, the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 163 and SEQ ID NO: 164. In other embodiments, the sequence of the labeled polynucleotide is SEQ ID NO: 163 or SEQ ID NO: 164.

[0020] In yet another implementation, the set of polynucleotides is selected from the group consisting of Set-1, Set-2 and Sets 18-21, and the composition comprises a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 6-33 of SEQ ID NO: 135 and nucleotides 6-30 of SEQ ID NO: 136. In some embodiments, the labeled polynucleotide comprises a sequence from the group consisting of SEQ ID NO: 135 and SEQ ID NO: 136. In other embodiments, the sequence of the labeled polynucleotide is SEQ ID NO: 135 or SEQ ID NO: 136.

[0021] Another aspect of the invention provides molecular beacons comprising a fluorophore, a quencher, and a polynucleotide, wherein the polynucleotide comprises a sequence selected from the group consisting of nucleotides 6-33 of SEQ ID NO: 135, nucleotides 6-30 of SEQ ID NO: 136, nucleotides 7-27 of SEQ ID NO: 137, nucleotides 7-26

of SEQ ID NO: 138, nucleotides 1-26 of SEQ ID NO: 139, nucleotides 7-26 of SEQ ID NO: 140, nucleotides 7-30 of SEQ ID NO: 141, nucleotides 6-30 of SEQ ID NO: 142, nucleotides 8-32 of SEQ ID NO: 143, nucleotides 8-30 of SEQ ID NO: 144, nucleotides 6-31 of SEQ ID NO: 145, nucleotides 8-30 of SEQ ID NO: 146, 8-22 of SEQ ID NO: 147, nucleotides 8-24 of SEQ ID NO: 148, nucleotides 7-27 of SEQ ID NO: 149, nucleotides 8-21 of SEQ ID NO: 150, nucleotides 8-32 of SEQ ID NO: 151, nucleotides 1-24 of SEQ ID NO: 152, nucleotides 4-24 of SEQ ID NO: 153, nucleotides 1-23 of SEQ ID NO: 154, nucleotides 8-26 of SEQ ID NO: 155, nucleotides 7-29 of SEQ ID NO: 156, nucleotides 8-28 of SEQ ID NO: 157, nucleotides 8-29 of SEQ ID NO: 158, nucleotides 7-25 of SEQ ID NO: 159, nucleotides 8-22 of SEQ ID NO: 160, nucleotides 6-22 of SEQ ID NO: 161, nucleotides 3-22 of SEQ ID NO: 162, nucleotides 8-28 of SEQ ID NO: 163, nucleotides 3-28 of SEQ ID NO: 164, nucleotides 5-25 of SEQ ID NO: 165, nucleotides 5-26 of SEQ ID NO: 166, nucleotides 5-20 of SEQ ID NO: 167, nucleotides 4-22 of SEQ ID NO: 168, nucleotides 7-22 of SEQ ID NO: 169, nucleotides 3-22 of SEQ ID NO: 170, nucleotides 7-28 of SEQ ID NO: 171, nucleotides 6-27 of SEQ ID NO: 172, nucleotides 7-29 of SEQ ID NO: 173, nucleotides 5-27 of SEQ ID NO: 174, nucleotides 7-29 of SEQ ID NO: 175, nucleotides 6-28 of SEQ ID NO: 176, nucleotides 4-23 of SEQ ID NO: 177, nucleotides 4-34 of SEQ ID NO: 178, nucleotides 3-27 of SEQ ID NO: 179, nucleotides 2-27 of SEQ ID NO: 180, nucleotides 5-33 of SEQ ID NO: 181, nucleotides 3-30 of SEQ ID NO: 182, nucleotides 9-34 of SEQ ID NO: 183, and nucleotides 8-28 of SEQ ID NO: 184.

[0022] Yet another aspect of the invention provides method of detecting β -actin in a test sample, the method comprising (a) extracting nucleic acid from the test sample, (b) amplifying a target sequence by reacting the nucleic acid extracted in step (a) with a reaction mixture comprising a strand displacement DNA polymerase and a sequence specific primer set, wherein said sequence-specific primer set is selected from the group consisting of Set-1 through Set-29, and (c) detecting the presence or absence of an amplified product of step (b); wherein the presence of said amplification product is indicative of the presence of β -actin in the test sample. In one embodiment, the amplification in step (b) of the target sequence is performed between about 60°C and about 67°C for less than 30 minutes. Preferably, the amplification step is performed for less than fifteen minutes. In some implementations, the reaction mixture further comprises a reverse transcriptase.

[0023] In certain embodiments, detecting the presence or absence of the amplification product comprises hybridizing the amplified product with a probe comprising a polynucleotide attached to a label. In a preferred implementation, the label is a fluorophore, which is preferably attached to a terminus of the polynucleotide. In a particularly preferred embodiment, the probe or polynucleotide is a molecular beacon comprising a fluorophore, a quencher, and a polynucleotide. In one embodiment, the fluorophore is FAM and the quencher is BHQ1. In an alternate implementation, the fluorophore is ATTO 565 or Alexa 594 and the quencher is BHQ1 or BHQ2.

[0024] Yet another aspect of the invention provides kits comprising the compositions comprising a set of polynucleotides selected from the group consisting Set-1 through Set-29. In some embodiments, the kit further comprises a strand displacement polymerase and, optionally, a reverse transcriptase. In certain embodiments, the kit comprises a molecular beacon comprising a fluorophore, a quencher, and a polynucleotide, wherein the polynucleotide comprises a sequence selected from the group consisting of nucleotides 6-33 of SEQ ID NO: 135, nucleotides 6-30 of SEQ ID NO: 136, nucleotides 7-27 of SEQ ID NO: 137, nucleotides 7-26 of SEQ ID NO: 138, nucleotides 1-26 of SEQ ID NO: 139, nucleotides 7-26 of SEQ ID NO: 140, nucleotides 7-30 of SEQ ID NO: 141, nucleotides 6-30 of SEQ ID NO: 142, nucleotides 8-32 of SEQ ID NO: 143, nucleotides 8-30 of SEQ ID NO: 144, nucleotides 6-31 of SEQ ID NO: 145, nucleotides 8-30 of SEQ ID NO: 146, 8-22 of SEQ ID NO: 147, nucleotides 8-24 of SEQ ID NO: 148, nucleotides 7-27 of SEQ ID NO: 149, nucleotides 8-21 of SEQ ID NO: 150, nucleotides 8-32 of SEQ ID NO: 151, nucleotides 1-24 of SEQ ID NO: 152, nucleotides 4-24 of SEQ ID NO: 153, nucleotides 1-23 of SEQ ID NO: 154, nucleotides 8-26 of SEQ ID NO: 155, nucleotides 7-29 of SEQ ID NO: 156, nucleotides 8-28 of SEQ ID NO: 157, nucleotides 8-29 of SEQ ID NO: 158, nucleotides 7-25 of SEQ ID NO: 159, nucleotides 8-22 of SEQ ID NO: 160, nucleotides 6-22 of SEQ ID NO: 161, nucleotides 3-22 of SEQ ID NO: 162, nucleotides 8-28 of SEQ ID NO: 163, nucleotides 3-28 of SEQ ID NO: 164, nucleotides 5-25 of SEQ ID NO: 165, nucleotides 5-26 of SEQ ID NO: 166, nucleotides 5-20 of SEQ ID NO: 167, nucleotides 4-22 of SEQ ID NO: 168, nucleotides 7-22 of SEQ ID NO: 169, nucleotides 3-22 of SEQ ID NO: 170, nucleotides 7-28 of SEQ ID NO: 171, nucleotides 6-27 of SEQ ID NO: 172, nucleotides 7-29 of SEQ ID NO: 173, nucleotides 5-27 of SEQ ID NO: 174, nucleotides 7-29 of SEQ ID NO: 175, nucleotides 6-28 of SEQ ID NO: 176, nucleotides 4-23 of SEQ ID NO: 177, nucleotides 4-34 of SEQ ID NO: 178, nucleotides 3-27 of SEQ ID NO: 179, nucleotides 2-27 of SEQ ID NO: 180, nucleotides

5-33 of SEQ ID NO: 181, nucleotides 3-30 of SEQ ID NO: 182, nucleotides 9-34 of SEQ ID NO: 183, and nucleotides 8-28 of SEQ ID NO: 184. The polynucleotide sequence of the molecular beacon can comprise a sequence selected from the group consisting of SEQ ID NO: 135 through SEQ ID NO: 184. In some embodiments, the polynucleotide sequence of the molecular beacon consists of a sequence selected from the group consisting of SEQ ID NO: 135 through SEQ ID NO: 184. In one embodiment, the polynucleotide sequence of the molecular beacon consists of SEQ ID NO: 184 and the set of polynucleotides is Set-29.

[0025] Another aspect of the invention provides methods of detecting β -actin in a test sample, the method comprising (a) extracting nucleic acid from the test sample, (b) amplifying a target sequence by reacting nucleic acid extracted in step (a) for less than ten minutes with a reaction mixture comprising a strand displacement DNA polymerase and a sequence specific LAMP primer set, and (c) detecting the presence or absence of an amplified product of step (b); wherein the presence of said amplification product is indicative of the presence of β -actin in the test sample. In some implementations, the amplifying step comprises reacting the nucleic acid extracted in step (a) with a reaction mixture comprising a strand displacement DNA polymerase and a sequence-specific primer set, wherein said sequence-specific primer set is selected from the group consisting of Set-1 through Set-29. In such implementations, detecting the presence or absence of the amplification product can comprise hybridizing the amplified product with a molecular beacon comprising a polynucleotide sequence selected from the group consisting of SEQ ID NO: 135 through SEQ ID NO: 184. In such implementations, detecting the presence or absence of the amplification product comprises hybridizing the amplified product with a molecular beacon comprising a polynucleotide sequence selected from the group consisting of SEQ ID NO: 147, SEQ ID NO: 148, SEQ ID NO: 149, SEQ ID NO: 150, SEQ ID NO: 155, SEQ ID NO: 156, SEQ ID NO: 165, SEQ ID NO: 166, SEQ ID NO: 167, SEQ ID NO: 168, SEQ ID NO: 169, SEQ ID NO: 171, SEQ ID NO: 172, SEQ ID NO: 173, SEQ ID NO: 174, SEQ ID NO: 175, SEQ ID NO: 176, SEQ ID NO: 183, and SEQ ID NO: 184.

DETAILED DESCRIPTION

[0026] The present invention encompasses, in some embodiments, a composition comprising a set of polynucleotides for priming a nucleic acid amplification reaction and methods of using such. In some embodiments, the composition further comprises a probe.

[0027] As used herein, “nucleic acid” includes both DNA and RNA, including DNA and RNA containing non-standard nucleotides. A “nucleic acid” contains at least one polynucleotide (a “nucleic acid strand”). A “nucleic acid” may be single-stranded or double-stranded. The term “nucleic acid” refers to nucleotides and nucleosides which make up, for example, deoxyribonucleic acid (DNA) macromolecules and ribonucleic acid (RNA) macromolecules. The most common nucleic acids are deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). It should be further understood that the present invention can be used for biological sequences containing artificial nucleotides such as peptide nucleic acid (PNA), morpholino, locked nucleic acid (LNA), glycol nucleic acid (GNA) and threose nucleic acid (TNA), among others. Preferably, the artificial nucleotides are locked nucleic acid molecules, including [alpha]-L-LNAs. LNAs comprise ribonucleic acid analogues wherein the ribose ring is “locked” by a methylene bridge between the 2'-oxygen and the 4'-carbon—i.e., oligonucleotides, containing at least one LNA monomer, that is, one 2'-O,4'-C-methylene-β-D-ribofuranosyl nucleotide. LNA bases form standard Watson-Crick base pairs but the locked configuration increases the rate and stability of the basepairing reaction (Jepsen et al., *Oligonucleotides*, 14, 130-146 (2004)).

[0028] As used herein, a “polynucleotide” refers to a polymeric chain containing two or more nucleotides, which contain deoxyribonucleotides, ribonucleotides, and/or their analog, such as those containing modified backbones (e.g. peptide nucleic acids (PNAs) or phosphorothioates) or modified bases. “Polynucleotides” includes primers, oligonucleotides, nucleic acid strands, etc. A polynucleotide may contain standard or non-standard nucleotides. Thus the term includes mRNA, tRNA, rRNA, ribozymes, DNA, cDNA, recombinant nucleic acids, branched nucleic acids, plasmids, vectors, probes, primers, etc. Typically, a polynucleotide contains a 5' phosphate at one terminus (“5' terminus”) and a 3' hydroxyl group at the other terminus (“3' terminus”) of the chain. The most 5' nucleotide of a polynucleotide may be referred to herein as the “5' terminal nucleotide” of the polynucleotide. The most 3' nucleotide of a polynucleotide may be referred to herein as the “3' terminal nucleotide” of the polynucleotide. Where nucleic acid of the invention takes the form of RNA, it may or may not have a 5' cap.

[0029] LAMP is a nucleic acid amplification method that relies on auto-cycle strand-displacement DNA synthesis performed by Bst DNA polymerase, or other strand displacement polymerases. The amplified products are stem-loop structures with several

repeated sequences of the target, and have multiple loops. The principal merit of this method is that denaturation of the DNA template is not required, and thus the LAMP reaction can be conducted under isothermal conditions (ranging from 60 to 67°C). LAMP requires only one enzyme and four types of primers that recognize six distinct hybridization sites in the target sequence. The reaction can be accelerated by the addition of two additional primers. The method produces a large amount of amplified product, resulting in easier detection, such as detection by visual judgment of the turbidity or fluorescence of the reaction mixture.

[0030] In brief, the reaction is initiated by annealing and extension of a pair of ‘loop-forming’ primers (forward and backward inner primers, FIP and BIP, respectively), followed by annealing and extension of a pair of flanking primers (F3 and B3). Extension of these primers results in strand-displacement of the loop-forming elements, which fold up to form terminal hairpin-loop structures. Once these key structures have appeared, the amplification process becomes self-sustaining, and proceeds at constant temperature in a continuous and exponential manner (rather than a cyclic manner, like PCR) until all of the nucleotides (dATP, dTTP, dCTP & dGTP) in the reaction mixture have been incorporated into the amplified DNA. Optionally, an additional pair of primers can be included to accelerate the reaction. These primers, termed Loop primers, hybridize to non-inner primer bound terminal loops of the inner primer dumbbell shaped products.

[0031] The term “primer” as used herein refers to an oligonucleotide, which is capable of acting as a point of initiation of synthesis when placed under conditions in which synthesis of primer extension product which is complementary to a nucleic acid strand (template) is induced, i.e., in the presence of nucleotides and an agent for polymerization, such as DNA polymerase, and at a suitable temperature and pH.

[0032] Applications for LAMP have been further extended to include detection of RNA molecules by addition of Reverse Transcriptase enzyme (RT). By including RNA detection, the types of targets for which LAMP can be applied are also expanded and add the ability to additionally target RNA based viruses, important regulatory non-coding RNA (sRNA, miRNA), and RNA molecules that have been associated with particular disease or physiological states. The ability to detect RNA also has the potential to increase assay sensitivity, for instance in choosing highly expressed, stable, and/or abundant messenger RNA (mRNA) or ribosomal RNA (rRNA) targets. This preliminary phase of amplification involves the reverse transcription of RNA molecules to complementary DNA (cDNA). The

cDNA then serves as template for the strand displacing DNA polymerase. Use of a thermostable RT enzyme (i.e., NEB RTx) enables the reaction to be completed at a single temperature and in a one step, single mix reaction.

[0033] A “target sequence,” as used herein, means a nucleic acid sequence of *Neisseria gonorrhoeae*, or complement thereof, that is amplified, detected, or both amplified and detected using one or more of the polynucleotides herein provided. Additionally, while the term target sequence sometimes refers to a double stranded nucleic acid sequence, those skilled in the art will recognize that the target sequence can also be single stranded, e.g., RNA. A target sequence may be selected that is more or less specific for a particular organism. For example, the target sequence may be specific to an entire genus, to more than one genus, to a species or subspecies, serogroup, auxotype, serotype, strain, isolate or other subset of organisms.

[0034] The speed, specificity and sensitivity of the primers/probe compositions and method described herein result from several aspects. Exemplary primers for use in the compositions and methods according to the present invention include those provided in Table 1.

Table 1: Primer Sequences

Sequence ID	Sequence (5' to 3')
SEQ ID NO: 1	GAGCTACGAGCTGCCTGA
SEQ ID NO: 2	TCTGCATCCTGTGCGCAA
SEQ ID NO: 3	CCAGGAAGGAAGGCTGGAAGAGTCGGCCAGGTCATCACCAT
SEQ ID NO: 4	CTGTGGCATCCACGAACTACCTTCTGTGTTGGCGTACAGGTCT
SEQ ID NO: 5	CGGAACCGCTCATTGCCA
SEQ ID NO: 6	TCATGAAGTGTGACGTGGACATC
SEQ ID NO: 7	AAGAGATGGCCACGGCTG
SEQ ID NO: 8	ATGAAGTGTGACGTGGACATG
SEQ ID NO: 9	GCGGAACCGCTCATTGCCAAGCTCCTCCCTGGAGAAGA
SEQ ID NO: 10	ACTCTTCCAGCCTTCCTTCCTGGATGGAGTTGAAGGTAGTTTCGTG
SEQ ID NO: 11	GTGATGACCTGGCCGTCAG
SEQ ID NO: 12	GCATGGAGTCCTGTGGCATC
SEQ ID NO: 13	CAGGATGCAGAAGGAGAT
SEQ ID NO: 14	GTGTAACGCACTAAGTCAT
SEQ ID NO: 15	CCACACGGAGTACTTGCGCCAGCACAAATGAAGATCAA
SEQ ID NO: 16	CCAGCAGATGTGGATCAGCCTAGAAGCATTTGCGGTG
SEQ ID NO: 17	CTCAGGAGGAGCAATGATC

SEQ ID NO: 18	GACGAGT
SEQ ID NO: 19	ACCCAGATCATGTTTGAGA
SEQ ID NO: 20	ATCTCTTGCTCGAAGTCC
SEQ ID NO: 21	CATCACGATGCCAGTGGTACCATGTACGTTGCTATCCAG
SEQ ID NO: 22	CATGAAGATCCTCACCGAGCCTCCTTAATGTCACGCAC
SEQ ID NO: 23	CAGAGGCGTACAGGGATA
SEQ ID NO: 24	CTACAGCTTACCACCAC
SEQ ID NO: 25	ATCCACGAACTACCTTCA
SEQ ID NO: 26	GATCCACACGGAGTACTT
SEQ ID NO: 27	CCAGACAGCACTGTGTTGGCCATCATGAAGTGTGACG
SEQ ID NO: 28	ACAGGATGCAGAAGGAGATCACAGGAGGAGCAATGATCT
SEQ ID NO: 29	CAGGTCTTTGCGGATGTC
SEQ ID NO: 30	CACCCAGCACAATGAAGAT
SEQ ID NO: 31	GTGATGGTGGGCATGG
SEQ ID NO: 32	TGGGTCATCTTCTCGC
SEQ ID NO: 33	GTGACGATGCCGTGCTCTCAGAAGGATTCCTATGTGG
SEQ ID NO: 34	AACTGGGACGACATGGAGACACACGCAGCTCATTG
SEQ ID NO: 35	GGTGAGGATGCCTCTC
SEQ ID NO: 36	TCTGGCACCACACCTT
SEQ ID NO: 37	CTTCCCCTCCATCGTG
SEQ ID NO: 38	CACACGCAGCTCATTG
SEQ ID NO: 39	TGAGGATGCCTCTCTTGCTCGTGATGGTGGGCAT
SEQ ID NO: 40	CCATCGAGCACGGCATCGAAGGTGTGGTGCCA
SEQ ID NO: 41	CACATAGGAATCCTTCTGACC
SEQ ID NO: 42	CTGGGACGACATGGAGA
SEQ ID NO: 43	CGTGATGGTGGGCAT
SEQ ID NO: 44	GGGTACTTCAGGGTGAGGATCAGAAGGATTCCTATGTGG
SEQ ID NO: 45	GAGCACGGCATCGTCACGAAGGTGTGGTGCCA
SEQ ID NO: 46	TGCCTCTCTTGCTCTGG
SEQ ID NO: 47	GAGAGGCATCCTCACC
SEQ ID NO: 48	GTAGATGGGCACAGTGT
SEQ ID NO: 49	CCACACGCAGCTCATTGTAATCGAGCACGGCATC
SEQ ID NO: 50	TGCTATCCAGGCTGTGCTAAGTCCATCACGATGCC
SEQ ID NO: 51	AAGGTGTGGTGCCAGA
SEQ ID NO: 52	CTCTGGCCGTACCACT
SEQ ID NO: 53	ATCGAGCACGGCATC
SEQ ID NO: 54	CCACACGCAGCTCATTGTGGGACGACATGGAGAAA
SEQ ID NO: 55	TCAGAAGGATTCCTATGTGG
SEQ ID NO: 56	TCTCCATGTCGTCCCAGTTGAGAGGCATCCTCACC
SEQ ID NO: 57	TGACGATGCCGTGCT

SEQ ID NO: 58	ACCGCGAGAAGATGAC
SEQ ID NO: 59	GACGCAGGATGGCAT
SEQ ID NO: 60	CCAGAGGCGTACAGGGATTCATGTTTGAGACCTTCAAC
SEQ ID NO: 61	CGTACCACTGGCATCGTGGTAGATGGGCACAGTGT
SEQ ID NO: 62	CACAGCCTGGATAGCAAC
SEQ ID NO: 63	ATGGACTCCGGTGACG
SEQ ID NO: 64	TCGCCTTTGCCGATC
SEQ ID NO: 65	GGAATCCTTCTGACCCAT
SEQ ID NO: 66	CATGCCGAGCCGTTGCGCCAGCTCACCATG
SEQ ID NO: 67	TTGCGGGGCGACGATCATCACGCCCTGGTG
SEQ ID NO: 68	GCGCGGCGATATCATC
SEQ ID NO: 69	GTCTTCCCCCTCCATCGT
SEQ ID NO: 70	CGAGCACAGAGCCTC
SEQ ID NO: 71	CGAGCGCGGCGATATCGCCTTTGCCGATCCG
SEQ ID NO: 72	CATCCATGGTGAGCTGG
SEQ ID NO: 73	GATGCCGTGCTCGAT
SEQ ID NO: 74	CCGGCCTTGACATGCCGCCAGCTCACCATG
SEQ ID NO: 75	CGTGATGGTGGGCATGGGGTGAGGATGCCTCTC
SEQ ID NO: 76	TGTCGACGACGAGCG
SEQ ID NO: 77	GTCAGAAGGATTCTATGTGG
SEQ ID NO: 78	CGCCAGCTCACCATG
SEQ ID NO: 79	CATCACGCCCTGGTGCTCGTCGTCGACAACG
SEQ ID NO: 80	GGTCAGAAGGATTCTATGTGGGGTGAGGATGCCTCTC
SEQ ID NO: 81	CCGGCCTTGACATG
SEQ ID NO: 82	CGAGGCCCGAGAGCAA
SEQ ID NO: 83	ATGAGCTGCGTGTGGCTCCC
SEQ ID NO: 84	GGGCATACCCTCGTAGATGGG
SEQ ID NO: 85	AGCACAGCCTGGATAGCAACGTACACCAAGGCCAACCGCGAGAAG
SEQ ID NO: 86	ATCCCTGTACGCCTCTGGCCGTACCAGTGTGGGTGACCCCGTCA
SEQ ID NO: 87	TGGCTGGGGTGTTGAAGGTCTCA
SEQ ID NO: 88	CACTGGCATCGTGATGGACTCCG
SEQ ID NO: 89	CTGGACTTCGAGCAAGAGATGGC
SEQ ID NO: 90	TGTTGGCGTACAGGTCTTTGCG
SEQ ID NO: 91	AAGAGTGCCTCAGGGCAGCGGAAGGAGAAGAGCTACGAGCTGCCT
SEQ ID NO: 92	CCAGCCTTCCTTCTGGGCATGGACCACGTCACTTCATGATGGAGTT
SEQ ID NO: 93	GCTCATTGCCAATGGTGATGACCTG
SEQ ID NO: 94	CCTGTGGCATCCACGAACTACCTT
SEQ ID NO: 95	ACGGCTGCTTCCAGCTCCTC
SEQ ID NO: 96	GACAGCACTGTGTTGGCGTACA
SEQ ID NO: 97	AAGAGTGCCTCAGGGCAGCGGAAGCTACGAGCTGCCTGACGG

SEQ ID NO: 98	AGCCTTCCTTCTGGGCATGGAGTCCCACGTCACACTTCATGATGGAGT
SEQ ID NO: 99	TGTGGCATCCACGAACTACCTTCA
SEQ ID NO: 100	GCGGATGTCCACGTCACACTTC
SEQ ID NO: 101	CCAATGGTGATGACCTGGCCGTCAGACGGCTGCTTCCAGCTCCTC
SEQ ID NO: 102	ATGAGCGGTTCCGCTGCCCTGATCGTGGATGCCACAGGACTCC
SEQ ID NO: 103	GCAGCTCGTAGCTCTTCTCCAGG
SEQ ID NO: 104	GCACTCTTCCAGCCTTCCTTCCTG
SEQ ID NO: 105	ATGAGCGGTTCCGCTGCCCTGAGATGCCACAGGACTCCATGCC
SEQ ID NO: 106	CCAGAGGCGTACAGGGATCCAGATCATGTTTGAGACC
SEQ ID NO: 107	CCAACCGCGAGAAGAT
SEQ ID NO: 108	AGAGGCGTACAGGGATAGCACCCAGATCATGTTTGAGA
SEQ ID NO: 109	ATAGCAACGTACATGGCTG
SEQ ID NO: 110	AGAGGCGTACAGGGATAGCGACCCAGATCATGTTTGAG
SEQ ID NO: 111	CCAACCGCGAGAAGA
SEQ ID NO: 112	GAGGCGTACAGGGATAGCATGACCCAGATCATGTTTGA
SEQ ID NO: 113	TTCTACAATGAGCTGCGTGT
SEQ ID NO: 114	CGGAGTCCATCACGATGC
SEQ ID NO: 115	AAGGTCTCAAACATGATCTGGGTCACGTGCTGCTGACCGAG
SEQ ID NO: 116	CCAGCCATGTACGTTGCTATCCAAGTGGTACGCCAGAGG
SEQ ID NO: 117	TCGCGGTTGGCCTTGG
SEQ ID NO: 118	GGCTGTGCTATCCCTGTACG
SEQ ID NO: 119	AATCTGGCACCACACCTTC
SEQ ID NO: 120	AGGCGTACAGGGATAGCA
SEQ ID NO: 121	TTGGCCTTGGGGTTCAGGGGAGCTGCGTGTGGCTC
SEQ ID NO: 122	GCGAGAAGATGACCCAGATCATGTGCCTGGATAGCAACGTACAT
SEQ ID NO: 123	GCCTCGGTGAGCAGCA
SEQ ID NO: 124	AGACCTTCAACACCCCAGC
SEQ ID NO: 125	GCACGGCATCGTCACC
SEQ ID NO: 126	GCCTGGATAGCAACGTACAT
SEQ ID NO: 127	AGCCACACGAGCTCATTTGTAAGTGGGACGACATGGAGA
SEQ ID NO: 128	TGAACCCCAAGGCCAACCGCTGGGGTGTGAAGGTCTC
SEQ ID NO: 129	AGAAGGTGTGGTGCCAGATT
SEQ ID NO: 130	CGAGAAGATGACCCAGATCATGT
SEQ ID NO: 131	ACGGCATCGTCACCAAC
SEQ ID NO: 132	TGCTCCTCGGGAGCCACAGACATGGAGAAAATCTGGCAC
SEQ ID NO: 133	TGAACCCCAAGGCCAACCGTGGGGTGTGAAGGTCTCA
SEQ ID NO: 134	GCAGCTCATTGTAGAAGGTGTG

[0035] Detection of the LAMP amplified products can be achieved via a variety of methods. In a preferred embodiment, detection of product is conducted by adding a

fluorescently-labeled probe to the primer mix. The term used herein “probe” refers to a single-stranded nucleic acid molecule comprising a portion or portions that are complementary, or substantially complementary, to a target sequence. In certain implementations, the fluorescently-labeled probe is a molecular beacon.

[0036] As used herein, “molecular beacon” refers to a single stranded hairpin-shaped oligonucleotide probe designed to report the presence of specific nucleic acids in a solution. A molecular beacon consists of four components; a stem, hairpin loop, end labelled fluorophore and opposite end-labelled quencher (Tyagi et al., (1998) *Nature Biotechnology* 16:49-53). When the hairpin-like beacon is not bound to a target, the fluorophore and quencher lie close together and fluorescence is suppressed. In the presence of a complementary target nucleotide sequence, the stem of the beacon opens to hybridize to the target. This separates the fluorophore and quencher, allowing the fluorophore to fluoresce. Alternatively, molecular beacons also include fluorophores that emit in the proximity of an end-labelled donor. “Wavelength-shifting Molecular Beacons” incorporate an additional harvester fluorophore enabling the fluorophore to emit more strongly. Current reviews of molecular beacons include Wang et al., 2009, *Angew Chem Int Ed Engl*, 48(5):856-870; Cissell et al., 2009, *Anal Bioanal Chem* 393(1):125-35; Li et al., 2008, *Biochem Biophys Res Comm* 373(4):457-61; and Cady, 2009, *Methods Mol Biol* 554:367-79.

[0037] In one implementation, the molecular beacon comprises a fluorophore, a quencher, and a polynucleotide, wherein the polynucleotide comprises a sequence selected from the group consisting of nucleotides 6-33 of SEQ ID NO: 135, nucleotides 6-30 of SEQ ID NO: 136, nucleotides 7-27 of SEQ ID NO: 137, nucleotides 7-26 of SEQ ID NO: 138, nucleotides 1-26 of SEQ ID NO: 139, nucleotides 7-26 of SEQ ID NO: 140, nucleotides 7-30 of SEQ ID NO: 141, nucleotides 6-30 of SEQ ID NO: 142, nucleotides 8-32 of SEQ ID NO: 143, nucleotides 8-30 of SEQ ID NO: 144, nucleotides 6-31 of SEQ ID NO: 145, nucleotides 8-30 of SEQ ID NO: 146, 8-22 of SEQ ID NO: 147, nucleotides 8-24 of SEQ ID NO: 148, nucleotides 7-27 of SEQ ID NO: 149, nucleotides 8-21 of SEQ ID NO: 150, nucleotides 8-32 of SEQ ID NO: 151, nucleotides 1-24 of SEQ ID NO: 152, nucleotides 4-24 of SEQ ID NO: 153, nucleotides 1-23 of SEQ ID NO: 154, nucleotides 8-26 of SEQ ID NO: 155, nucleotides 7-29 of SEQ ID NO: 156, nucleotides 8-28 of SEQ ID NO: 157, nucleotides 8-29 of SEQ ID NO: 158, nucleotides 7-25 of SEQ ID NO: 159, nucleotides 8-22 of SEQ ID NO: 160, nucleotides 6-22 of SEQ ID NO: 161, nucleotides 3-22 of SEQ ID NO: 162, nucleotides 8-28

of SEQ ID NO: 163, nucleotides 3-28 of SEQ ID NO: 164, nucleotides 5-25 of SEQ ID NO: 165, nucleotides 5-26 of SEQ ID NO: 166, nucleotides 5-20 of SEQ ID NO: 167, nucleotides 4-22 of SEQ ID NO: 168, nucleotides 7-22 of SEQ ID NO: 169, nucleotides 3-22 of SEQ ID NO: 170, nucleotides 7-28 of SEQ ID NO: 171, nucleotides 6-27 of SEQ ID NO: 172, nucleotides 7-29 of SEQ ID NO: 173, nucleotides 5-27 of SEQ ID NO: 174, nucleotides 7-29 of SEQ ID NO: 175, nucleotides 6-28 of SEQ ID NO: 176, nucleotides 4-23 of SEQ ID NO: 177, nucleotides 4-34 of SEQ ID NO: 178, nucleotides 3-27 of SEQ ID NO: 179, nucleotides 2-27 of SEQ ID NO: 180, nucleotides 5-33 of SEQ ID NO: 181, nucleotides 3-30 of SEQ ID NO: 182, nucleotides 9-34 of SEQ ID NO: 183, and nucleotides 8-28 of SEQ ID NO: 184. In one embodiment, the polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 135 through SEQ ID NO: 184. In another embodiment, the polynucleotide consists of a sequence selected from the group consisting of SEQ ID NO: 135 through SEQ ID NO: 184.

[0038] The molecular beacon is preferably used in a composition also comprising a set of sequence-specific LAMP primers. In one implementation, the molecular beacon comprises a sequence selected from the group consisting of nucleotides 6-33 of SEQ ID NO: 135, nucleotides 6-30 of SEQ ID NO: 136, nucleotides 7-27 of SEQ ID NO: 137, nucleotides 7-26 of SEQ ID NO: 138, nucleotides 1-26 of SEQ ID NO: 139, nucleotides 7-26 of SEQ ID NO: 140, nucleotides 7-30 of SEQ ID NO: 141, nucleotides 6-30 of SEQ ID NO: 142, nucleotides 8-32 of SEQ ID NO: 143, nucleotides 8-30 of SEQ ID NO: 144, nucleotides 6-31 of SEQ ID NO: 145, nucleotides 8-30 of SEQ ID NO: 146, 8-22 of SEQ ID NO: 147, nucleotides 8-24 of SEQ ID NO: 148, nucleotides 7-27 of SEQ ID NO: 149, nucleotides 8-21 of SEQ ID NO: 150, nucleotides 8-32 of SEQ ID NO: 151, nucleotides 1-24 of SEQ ID NO: 152, nucleotides 4-24 of SEQ ID NO: 153, nucleotides 1-23 of SEQ ID NO: 154, nucleotides 8-26 of SEQ ID NO: 155, nucleotides 7-29 of SEQ ID NO: 156, nucleotides 8-28 of SEQ ID NO: 157, nucleotides 8-29 of SEQ ID NO: 158, nucleotides 7-25 of SEQ ID NO: 159, nucleotides 8-22 of SEQ ID NO: 160, nucleotides 6-22 of SEQ ID NO: 161, nucleotides 3-22 of SEQ ID NO: 162, nucleotides 8-28 of SEQ ID NO: 163, nucleotides 3-28 of SEQ ID NO: 164, nucleotides 5-25 of SEQ ID NO: 165, nucleotides 5-26 of SEQ ID NO: 166, nucleotides 5-20 of SEQ ID NO: 167, nucleotides 4-22 of SEQ ID NO: 168, nucleotides 7-22 of SEQ ID NO: 169, nucleotides 3-22 of SEQ ID NO: 170, nucleotides 7-28 of SEQ ID NO: 171, nucleotides 6-27 of SEQ ID NO: 172, nucleotides 7-29 of SEQ ID NO: 173, nucleotides 5-27 of SEQ ID NO: 174, nucleotides 7-29 of SEQ ID NO: 175, nucleotides 6-28 of SEQ ID NO: 176, nucleotides

4-23 of SEQ ID NO: 177, nucleotides 4-34 of SEQ ID NO: 178, nucleotides 3-27 of SEQ ID NO: 179, nucleotides 2-27 of SEQ ID NO: 180, nucleotides 5-33 of SEQ ID NO: 181, nucleotides 3-30 of SEQ ID NO: 182, nucleotides 9-34 of SEQ ID NO: 183, and nucleotides 8-28 of SEQ ID NO: 184. In such an implementation, the molecular beacon can comprise a sequence selected from the group consisting of SEQ ID NO: 135 through SEQ ID NO: 184. More preferably, polynucleotide sequence of the molecular beacon consists of a sequence selected from the group consisting of SEQ ID NO: 135 through SEQ ID NO: 184. In a particularly preferred implementation, the polynucleotide sequence of the molecular beacon is SEQ ID NO: 184.

[0039] When included in a composition comprising a set of polynucleotides selected from the group consisting of Sets-9-12, Set-17, and Sets-22-29, the molecular beacon preferably comprises a sequence selected from the group consisting of nucleotides 8-22 of SEQ ID NO: 147, nucleotides 8-24 of SEQ ID NO: 148, nucleotides 7-27 of SEQ ID NO: 149, nucleotides 8-21 of SEQ ID NO: 150, nucleotides 8-26 of SEQ ID NO: 155, nucleotides 7-29 of SEQ ID NO: 156, nucleotides 5-25 of SEQ ID NO: 165, nucleotides 5-26 of SEQ ID NO: 166, nucleotides 5-20 of SEQ ID NO: 167, nucleotides 4-22 of SEQ ID NO: 168, nucleotides 7-22 of SEQ ID NO: 169, nucleotides 7-28 of SEQ ID NO: 171, nucleotides 6-27 of SEQ ID NO: 172, nucleotides 7-29 of SEQ ID NO: 173, nucleotides 5-27 of SEQ ID NO: 174, nucleotides 7-29 of SEQ ID NO: 175, nucleotides 6-28 of SEQ ID NO: 176, nucleotides 9-46 of SEQ ID NO: 183, and nucleotides 8-40 of SEQ ID NO: 184. More particularly, the molecular beacon can comprise a sequence selected from the group consisting of SEQ ID NO: 147, SEQ ID NO: 148, SEQ ID NO: 149, SEQ ID NO: 150, SEQ ID NO: 155, SEQ ID NO: 156, SEQ ID NO: 165, SEQ ID NO: 166, SEQ ID NO: 167, SEQ ID NO: 168, SEQ ID NO: 169, SEQ ID NO: 171, SEQ ID NO: 172, SEQ ID NO: 173, SEQ ID NO: 174, SEQ ID NO: 175, SEQ ID NO: 176, SEQ ID NO: 183, and SEQ ID NO: 184. In certain implementations, the sequence of the molecular beacon is selected from the group consisting of SEQ ID NO: 147, SEQ ID NO: 148, SEQ ID NO: 149, SEQ ID NO: 150, SEQ ID NO: 155, SEQ ID NO: 156, SEQ ID NO: 165, SEQ ID NO: 166, SEQ ID NO: 167, SEQ ID NO: 168, SEQ ID NO: 169, SEQ ID NO: 171, SEQ ID NO: 172, SEQ ID NO: 173, SEQ ID NO: 174, SEQ ID NO: 175, SEQ ID NO: 176, SEQ ID NO: 183, and SEQ ID NO: 184.

[0040] When included in a composition comprising a set of polynucleotides selected from the group consisting of Sets 9-11, Set-17, and Sets 23-29, the molecular beacon preferably

comprises a sequence selected from the group consisting of nucleotides 1-24 of SEQ ID NO: 152, nucleotides 4-24 of SEQ ID NO: 153, and nucleotides 1-23 of SEQ ID NO: 154. In certain implementations, the molecular beacon can comprise a sequence selected from the group consisting of SEQ ID NO: 152, SEQ ID NO: 153, and SEQ ID NO: 154. In some embodiments, the sequence of the molecular beacon is selected from the group consisting of SEQ ID NO: 152, SEQ ID NO: 153, and SEQ ID NO: 154.

[0041] When used in combination with a set of polynucleotides selected from the group consisting of Set-4, Sets 9-12, Set-17, and Sets 22-26, the molecular beacon preferably comprises a sequence selected from the group consisting of 8-30 of SEQ ID NO: 144, nucleotides 6-31 of SEQ ID NO: 145, and nucleotides 8-30 of SEQ ID NO: 146. In some embodiments, the molecular beacon can comprise a sequence selected from the group consisting of SEQ ID NO: 144, SEQ ID NO: 145, and SEQ ID NO: 146. In other embodiments, the sequence of the molecular beacon is selected from the group consisting of SEQ ID NO: 144, SEQ ID NO: 145, and SEQ ID NO: 146.

[0042] When included in a composition comprising a set of polynucleotides selected from the group consisting of Set-5, Set-12, Set-17, and Sets 22-25, the molecular beacon preferably comprises nucleotides 3-22 of SEQ ID NO: 170. In some implementations, the molecular beacon comprises SEQ ID NO: 170. In other embodiments, the sequence of the molecular beacon is SEQ ID NO: 170.

[0043] When used in combination with a set of polynucleotides selected from the group consisting of Sets 6-8, Set-15, and Set-16, the molecular beacon preferably comprises a sequence selected from the group consisting of nucleotides 2-27 of SEQ ID NO: 180 and nucleotides 3-30 of SEQ ID NO: 182. In such an embodiment, the molecular beacon can comprise a sequence selected from the group consisting of SEQ ID NO: 180 and SEQ ID NO: 182. In another embodiment, the sequence of the molecular beacon is SEQ ID NO: 180 or SEQ ID NO: 182.

[0044] When included in a composition comprising a set of polynucleotides selected from the group consisting of Sets 6-11, Set-28, and Set-29, the molecular beacon preferably comprises a sequence selected from the group consisting of nucleotides 4-34 of SEQ ID NO: 178 and nucleotides 5-33 of SEQ ID NO: 181. In some embodiments, the molecular beacon can comprise a sequence selected from the group consisting of SEQ ID NO: 178 and SEQ ID

NO: 181. In other embodiments, the sequence of the molecular beacon is SEQ ID NO: 178 or SEQ ID NO: 181.

[0045] When used in combination with a set of polynucleotides selected from the group consisting of Sets 6-9 and Set-11, the molecular beacon preferably comprises nucleotides 3-27 of SEQ ID NO: 179. In some implementations, the molecular beacon comprises SEQ ID NO: 179. In other embodiments, the sequence of the molecular beacon is SEQ ID NO: 179.

[0046] When included in a composition comprising a set of polynucleotides selected from the group consisting of Sets 6-9, Set-11, and Set-28, the molecular beacon preferably comprises nucleotides 4-23 of SEQ ID NO: 177. In some embodiments, the molecular beacon comprises SEQ ID NO: 177. In other embodiments, the sequence of the molecular beacon is SEQ ID NO: 177.

[0047] When used in combination with a set of polynucleotides selected from the group consisting of Sets 13-15, the molecular beacon preferably comprises a sequence selected from the group consisting of nucleotides 7-25 of SEQ ID NO: 159 and nucleotides 8-22 of SEQ ID NO: 160. In such an embodiment, the molecular beacon can comprise a sequence selected from the group consisting of SEQ ID NO: 159 and SEQ ID NO: 160. In other embodiments, the sequence of the molecular beacon is SEQ ID NO: 159 or SEQ ID NO: 160.

[0048] When included in a composition comprising a set of polynucleotides selected from the group consisting of Sets 13-16, the molecular beacon preferably comprises a sequence selected from the group consisting of nucleotides 8-28 of SEQ ID NO: 157, nucleotides 8-29 of SEQ ID NO: 158, nucleotides 6-22 of SEQ ID NO: 161, and nucleotides 3-22 of SEQ ID NO: 162. More particularly, the molecular beacon can comprise a sequence selected from the group consisting of SEQ ID NO: 157, SEQ ID NO: 158, SEQ ID NO: 161, and SEQ ID NO: 162. In certain implementations, the sequence of the molecular beacon is selected from the group consisting of SEQ ID NO: 157, SEQ ID NO: 158, SEQ ID NO: 161, and SEQ ID NO: 162.

[0049] When used in combination with a set of polynucleotides consisting of Set-3, the molecular beacon preferably comprises a sequence selected from the group consisting nucleotides 7-27 of SEQ ID NO: 137, nucleotides 7-26 of SEQ ID NO: 138, nucleotides 1-26 of SEQ ID NO: 139, nucleotides 7-26 of SEQ ID NO: 140, nucleotides 7-30 of SEQ ID NO: 141, nucleotides 6-30 of SEQ ID NO: 142, nucleotides 8-32 of SEQ ID NO: 151, and nucleotides 4-24 of SEQ ID NO: 153. In certain implementations, the molecular beacon can

comprise a sequence selected from the group consisting of SEQ ID NO: 137, SEQ ID NO: 138, SEQ ID NO: 139, SEQ ID NO: 140, SEQ ID NO: 141, SEQ ID NO: 142, SEQ ID NO: 151, and SEQ ID NO: 153. In some embodiments, the sequence of the molecular beacon is selected from the group consisting of SEQ ID NO: 137, SEQ ID NO: 138, SEQ ID NO: 139, SEQ ID NO: 140, SEQ ID NO: 141, SEQ ID NO: 142, SEQ ID NO: 151, and SEQ ID NO: 153.

[0050] When included in a composition comprising a set of polynucleotides selected from the group consisting of Set-1, Set-2, and Sets 18-20, the molecular beacon preferably comprises a sequence selected from the group consisting of nucleotides 8-28 of SEQ ID NO: 163 and nucleotides 3-28 of SEQ ID NO: 164. In certain implementations, the molecular beacon can comprise a sequence selected from the group consisting of SEQ ID NO: 163 and SEQ ID NO: 164. In some embodiments, the sequence of the molecular beacon is SEQ ID NO: 163 or SEQ ID NO: 164.

[0051] When included in a composition comprising a set of polynucleotides selected from the group consisting of Set-1, Set-2 and Sets 18-21, the molecular beacon preferably comprises a sequence selected from the group consisting of nucleotides 6-33 of SEQ ID NO: 135 and nucleotides 6-30 of SEQ ID NO: 136. In some implementations, the molecular beacon can comprise a sequence selected from the group consisting of SEQ ID NO: 135 and SEQ ID NO: 136. In other embodiments, the sequence of the molecular beacon is SEQ ID NO: 135 or SEQ ID NO: 136. The polynucleotides having the sequences described above can include one or more non-natural nucleosides or linkages, such as peptide nucleic acid (PNA), morpholino, locked nucleic acid (LNA), glycol nucleic acid (GNA) and threose nucleic acid (TNA), among others. In some embodiments, the polynucleotide of the molecular beacon comprises one to six locked nucleic acids. In a preferred embodiment, the polynucleotide of the molecular beacon comprises three or four locked nucleic acids.

[0052] The term “label” as used herein means a molecule or moiety having a property or characteristic which is capable of detection and, optionally, of quantitation. A label can be directly detectable, as with, for example (and without limitation), radioisotopes, fluorophores, chemiluminophores, enzymes, colloidal particles, fluorescent microparticles and the like; or a label may be indirectly detectable, as with, for example, specific binding members. It will be understood that directly detectable labels may require additional components such as, for example, substrates, triggering reagents, quenching moieties, light, and the like to enable

detection and/or quantitation of the label. When indirectly detectable labels are used, they are typically used in combination with a “conjugate”. A conjugate is typically a specific binding member that has been attached or coupled to a directly detectable label. Coupling chemistries for synthesizing a conjugate are well known in the art and can include, for example, any chemical means and/or physical means that does not destroy the specific binding property of the specific binding member or the detectable property of the label. As used herein, “specific binding member” means a member of a binding pair, i.e., two different molecules where one of the molecules through, for example, chemical or physical means specifically binds to the other molecule. In addition to antigen and antibody specific binding pairs, other specific binding pairs include, but are not intended to be limited to, avidin and biotin; haptens and antibodies specific for haptens; complementary nucleotide sequences; enzyme cofactors or substrates and enzymes; and the like.

[0053] The molecular beacon can be composed of nucleic acid only such as DNA or RNA, or it can be composed of a peptide nucleic acid (PNA) conjugate. The fluorophore can be any fluorescent organic dye or a single quantum dot. The quenching moiety desirably quenches the luminescence of the fluorophore. Any suitable quenching moiety that quenches the luminescence of the fluorophore can be used. A fluorophore can be any fluorescent marker/dye known in the art. Examples of suitable fluorescent markers include, but are not limited to, Fam, Hex, Tet, Joe, Rox, Tamra, Max, Edans, Cy dyes such as Cy5, Fluorescein, Coumarin, Eosine, Rhodamine, Bodipy, Alexa, Cascade Blue, Yakima Yellow, Lucifer Yellow, Texas Red, and the family of ATTO dyes. A quencher can be any quencher known in the art. Examples of quenchers include, but are not limited to, Dabcyl, Dark Quencher, Eclipse Dark Quencher, ElleQuencher, Tamra, BHQ and QSY (all of them are Trade-Marks). The skilled person would know which combinations of dye/quencher are suitable when designing a probe. In an exemplary embodiment, fluorescein (FAM) is used in conjunction with Blackhole Quencher™ (BHQ™)(Novato, Calif.). Binding of the molecular beacon to amplified product can then be directly, visually assessed. Alternatively, the fluorescence level can be measured by spectroscopy in order to improve sensitivity.

[0054] A variety of commercial suppliers produce standard and custom molecular beacons, including Abingdon Health (UK; www.abingdonhealth.com), Attostar (US, MN; www.attostar.com), Biolegio (NLD; www.biolegio.com), Biomers.net (DEU; www.biomers.net), Biosearch Technologies (US, CA; www.biosearchtech.com), Eurogentec

(BEL; www.eurogentec.com), Gene Link (US, NY; www.genelink.com) Integrated DNA Technologies (US, IA; www.idtdna.com), Isogen Life Science (NLD; www.isogen-lifescience.com), Midland Certified Reagent (US, TX; www.oligos.com), Eurofins (DEU; www.eurofinsgenomics.eu), Sigma-Aldrich (US, TX; www.sigmaaldrich.com), Thermo Scientific (US, MA; www.thermoscientific.com), TIB MOLBIOL (DEU; www.tib-molbiol.de), TriLink Bio Technologies (US, CA; www.trilinkbiotech.com). A variety of kits, which utilize molecular beacons are also commercially available, such as the Sentinel™ Molecular Beacon Allelic Discrimination Kits from Stratagene (La Jolla, Calif.) and various kits from Eurogentec SA (Belgium, eurogentec.com) and Isogen Bioscience BV (The Netherlands, isogen.com).

[0055] The oligonucleotide probes and primers of the invention are optionally prepared using essentially any technique known in the art. In certain embodiments, for example, the oligonucleotide probes and primers described herein are synthesized chemically using essentially any nucleic acid synthesis method, including, e.g., according to the solid phase phosphoramidite triester method described by Beaucage and Caruthers (1981), *Tetrahedron Letts.* 22(20):1859-1862, which is incorporated by reference, or another synthesis technique known in the art, e.g., using an automated synthesizer, as described in Needham-VanDevanter et al. (1984) *Nucleic Acids Res.* 12:6159-6168, which is incorporated by reference. A wide variety of equipment is commercially available for automated oligonucleotide synthesis. Multi-nucleotide synthesis approaches (e.g., tri-nucleotide synthesis, etc.) are also optionally utilized. Moreover, the primer nucleic acids described herein optionally include various modifications. To further illustrate, primers are also optionally modified to improve the specificity of amplification reactions as described in, e.g., U.S. Pat. No. 6,001,611, issued Dec. 14, 1999, which is incorporated by reference. Primers and probes can also be synthesized with various other modifications as described herein or as otherwise known in the art.

[0056] In addition, essentially any nucleic acid (and virtually any labeled nucleic acid, whether standard or non-standard) can be custom or standard ordered from any of a variety of commercial sources, such as Integrated DNA Technologies, the Midland Certified Reagent Company, Eurofins, Biosearch Technologies, Sigma Aldrich and many others.

[0057] The term “test sample” as used herein, means a sample taken from an organism or biological fluid that is suspected of containing or potentially contains a target sequence. The

test sample can be taken from any biological source, such as for example, tissue, blood, saliva, sputa, mucus, sweat, urine, urethral swabs, cervical swabs, vaginal swabs, urogenital or anal swabs, conjunctival swabs, ocular lens fluid, cerebral spinal fluid, milk, ascites fluid, synovial fluid, peritoneal fluid, amniotic fluid, fermentation broths, cell cultures, chemical reaction mixtures and the like. The test sample can be used (i) directly as obtained from the source or (ii) following a pre-treatment to modify the character of the sample. Thus, the test sample can be pre-treated prior to use by, for example, preparing plasma or serum from blood, disrupting cells or viral particles, preparing liquids from solid materials, diluting viscous fluids, filtering liquids, distilling liquids, concentrating liquids, inactivating interfering components, adding reagents, purifying nucleic acids, and the like.

[0058] Advantageously, the invention enables reliable rapid detection of β -actin in a clinical sample, such as a urine sample.

[0059] To further illustrate, prior to analyzing the target nucleic acids described herein, those nucleic acids may be purified or isolated from samples that typically include complex mixtures of different components. Cells in collected samples are typically lysed to release the cell contents, including target nucleic acids. For example, a test sample suspected of containing a sexually transmitted infection (STI), including, but not limited to, Chlamydia trachomatis (CT), Neisseria gonorrhea (NG) and Trichomonas vaginalis (TV), can be lysed by contacting cells with various enzymes, chemicals, and/or lysed by other approaches known in the art, which degrade, e.g., bacterial cell walls. In some embodiments, nucleic acids are analyzed directly in the cell lysate. In other embodiments, nucleic acids are further purified or extracted from cell lysates prior to detection. Essentially any nucleic acid extraction methods can be used to purify nucleic acids in the samples utilized in the methods of the present invention. Exemplary techniques that can be used to purifying nucleic acids include, e.g., affinity chromatography, hybridization to probes immobilized on solid supports, liquid-liquid extraction (e.g., phenol-chloroform extraction, etc.), precipitation (e.g., using ethanol, etc.), extraction with filter paper, extraction with micelle-forming reagents (e.g., cetyl-trimethyl-ammonium-bromide, etc.), binding to immobilized intercalating dyes (e.g., ethidium bromide, acridine, etc.), adsorption to silica gel or diatomic earths, adsorption to magnetic glass particles or organo silane particles under chaotropic conditions, and/or the like. Sample processing is also described in, e.g., U.S. Pat. Nos. 5,155,018, 6,383,393, and 5,234,809, which are each incorporated by reference.

[0060] A test sample may optionally have been treated and/or purified according to any technique known by the skilled person, to improve the amplification efficiency and/or qualitative accuracy and/or quantitative accuracy. The sample may thus exclusively, or essentially, consist of nucleic acid(s), whether obtained by purification, isolation, or by chemical synthesis. Means are available to the skilled person, who would like to isolate or purify nucleic acids, such as DNA, from a test sample, for example to isolate or purify DNA from cervical scrapes (e.g., QIAamp-DNA Mini-Kit; Qiagen, Hilden, Germany).

Equivalents and Scope

[0061] Those skilled in the art will recognize, or be able to ascertain using no more than routine experimentation, many equivalents to the specific embodiments in accordance with the invention described herein. The scope of the present invention is not intended to be limited to the above Description, but rather is as set forth in the appended claims.

[0062] In the claims, articles such as “a,” “an,” and “the” may mean one or more than one unless indicated to the contrary or otherwise evident from the context. Claims or descriptions that include “or” between one or more members of a group are considered satisfied if one, more than one, or all of the group members are present in, employed in, or otherwise relevant to a given product or process unless indicated to the contrary or otherwise evident from the context. The invention includes embodiments in which exactly one member of the group is present in, employed in, or otherwise relevant to a given product or process. The invention includes embodiments in which more than one, or all of the group members are present in, employed in, or otherwise relevant to a given product or process.

[0063] It is also noted that the term “comprising” is intended to be open and permits but does not require the inclusion of additional elements or steps. When the term “comprising” is used herein, the term “consisting of” is thus also encompassed and disclosed.

[0064] Where ranges are given, endpoints are included. Furthermore, it is to be understood that unless otherwise indicated or otherwise evident from the context and understanding of one of ordinary skill in the art, values that are expressed as ranges can assume any specific value or subrange within the stated ranges in different embodiments of the invention, to the tenth of the unit of the lower limit of the range, unless the context clearly dictates otherwise.

[0065] All cited sources, for example, references, publications, databases, database entries, and art cited herein, are incorporated into this application by reference, even if not expressly stated in the citation. In case of conflicting statements of a cited source and the instant application, the statement in the instant application shall control.

[0066] Section and table headings are not intended to be limiting.

EXAMPLES

[0067] The following examples are put forth so as to provide those of ordinary skill in the art with a complete disclosure and description of how to make and use the present invention, and are not intended to limit the scope of what the inventors regard as their invention nor are they intended to represent that the experiments below are all or the only experiments performed. Efforts have been made to ensure accuracy with respect to numbers used (e.g. amounts, temperature, etc.) but some experimental errors and deviations should be accounted for. Unless indicated otherwise, parts are parts by weight, molecular weight is weight average molecular weight, temperature is in degrees Centigrade, and pressure is at or near atmospheric.

Example 1: Target Selection and Primer Probe Design

[0068] Primer/probe based detection assays were designed to utilize isothermal loop mediated amplification (LAMP) targeting RNA through the addition of a Reverse transcriptase (RT-LAMP) to the reaction. A molecular beacon probe with 5' fluorophore/3' quencher modifications (6-Carboxyfluorescein and Black Hole Quencher 1 was included to provide target-specific fluorescent detection. β -actin RT-LAMP primer sets (Table 1 and Table 2) were designed using a combination of software programs including Premier Biosoft's LAMP Designer, Beacon Designer, an in-house script and manual designs. Designed primer sets and beacons were further analyzed for specificity using BLAST against the human genome and the NCBI nucleotide database. Various primer sets and probes were designed and screened for reaction speed.

[0069] The inventive primer sets are summarized in Table 2, which include, at a minimum, a forward inner primer (FIP) and backward inner primer (BIP). Additionally, the primer sets typically also include at least two additional primers selected from the forward

outer primer (F3), backward outer primer (B3), forward loop primer (LF) and backward loop primer (LB).

Table 2: LAMP Primer Sets

Set	F3	B3	FIP	BIP	LF	LB
Set-1	SEQ ID NO: 1	SEQ ID NO: 2	SEQ ID NO: 3	SEQ ID NO: 4	SEQ ID NO: 5	SEQ ID NO: 6
Set-2	SEQ ID NO: 7	SEQ ID NO: 8	SEQ ID NO: 9	SEQ ID NO: 10	SEQ ID NO: 11	SEQ ID NO: 12
Set-3	SEQ ID NO: 13	SEQ ID NO: 14	SEQ ID NO: 15	SEQ ID NO: 16	SEQ ID NO: 17	SEQ ID NO: 18
Set-4	SEQ ID NO: 19	SEQ ID NO: 20	SEQ ID NO: 21	SEQ ID NO: 22	SEQ ID NO: 23	SEQ ID NO: 24
Set-5	SEQ ID NO: 25	SEQ ID NO: 26	SEQ ID NO: 27	SEQ ID NO: 28	SEQ ID NO: 29	SEQ ID NO: 30
Set-6	SEQ ID NO: 31	SEQ ID NO: 32	SEQ ID NO: 33	SEQ ID NO: 34	SEQ ID NO: 35	SEQ ID NO: 36
Set-7	SEQ ID NO: 37	SEQ ID NO: 38	SEQ ID NO: 39	SEQ ID NO: 40	SEQ ID NO: 41	SEQ ID NO: 42
Set-8	SEQ ID NO: 43	SEQ ID NO: 38	SEQ ID NO: 44	SEQ ID NO: 45	SEQ ID NO: 46	SEQ ID NO: 42
Set-9	SEQ ID NO: 47	SEQ ID NO: 48	SEQ ID NO: 49	SEQ ID NO: 50	SEQ ID NO: 51	SEQ ID NO: 52
Set-10	SEQ ID NO: 53	SEQ ID NO: 48	SEQ ID NO: 54	SEQ ID NO: 50	SEQ ID NO: 51	SEQ ID NO: 52
Set-11	SEQ ID NO: 55	SEQ ID NO: 48	SEQ ID NO: 56	SEQ ID NO: 50	SEQ ID NO: 57	SEQ ID NO: 52
Set-12	SEQ ID NO: 58	SEQ ID NO: 59	SEQ ID NO: 60	SEQ ID NO: 61	SEQ ID NO: 62	SEQ ID NO: 63
Set-13	SEQ ID NO: 64	SEQ ID NO: 65	SEQ ID NO: 66	SEQ ID NO: 67	SEQ ID NO: 68	SEQ ID NO: 69
Set-14	SEQ ID NO: 70	SEQ ID NO: 65	SEQ ID NO: 71	SEQ ID NO: 67	SEQ ID NO: 72	SEQ ID NO: 69
Set-15	SEQ ID NO: 70	SEQ ID NO: 73	SEQ ID NO: 74	SEQ ID NO: 75	SEQ ID NO: 76	SEQ ID NO: 77
Set-16	SEQ ID NO: 78	SEQ ID NO: 73	SEQ ID NO: 79	SEQ ID NO: 80	SEQ ID NO: 81	SEQ ID NO: 82
Set-17	SEQ ID NO: 83	SEQ ID NO: 84	SEQ ID NO: 85	SEQ ID NO: 86	SEQ ID NO: 87	SEQ ID NO: 88
Set-18	SEQ ID NO: 89	SEQ ID NO: 90	SEQ ID NO: 91	SEQ ID NO: 92	SEQ ID NO: 93	SEQ ID NO: 94
Set-19	SEQ ID NO: 95	SEQ ID NO: 96	SEQ ID NO: 97	SEQ ID NO: 98	SEQ ID NO: 93	SEQ ID NO: 99
Set-20	SEQ ID NO: 89	SEQ ID NO: 100	SEQ ID NO: 101	SEQ ID NO: 102	SEQ ID NO: 103	SEQ ID NO: 104
Set-21	SEQ ID NO: 89	SEQ ID NO: 100	SEQ ID NO: 101	SEQ ID NO: 105	SEQ ID NO: 103	SEQ ID NO: 104
Set-22	SEQ ID NO: 58	SEQ ID NO: 59	SEQ ID NO: 106	SEQ ID NO: 61	SEQ ID NO: 62	SEQ ID NO: 63
Set-23	SEQ ID NO: 107	SEQ ID NO: 59	SEQ ID NO: 108	SEQ ID NO: 61	SEQ ID NO: 109	SEQ ID NO: 63
Set-24	SEQ ID NO: 107	SEQ ID NO: 59	SEQ ID NO: 110	SEQ ID NO: 61	SEQ ID NO: 109	SEQ ID NO: 63
Set-25	SEQ ID NO: 111	SEQ ID NO: 59	SEQ ID NO: 112	SEQ ID NO: 61	SEQ ID NO: 109	SEQ ID NO: 63
Set-26	SEQ ID NO: 113	SEQ ID NO: 114	SEQ ID NO: 115	SEQ ID NO: 116	SEQ ID NO: 117	SEQ ID NO: 118
Set-27	SEQ ID NO: 119	SEQ ID NO: 120	SEQ ID NO: 121	SEQ ID NO: 122	SEQ ID NO: 123	SEQ ID NO: 124
Set-28	SEQ ID NO: 125	SEQ ID NO: 126	SEQ ID NO: 127	SEQ ID NO: 128	SEQ ID NO: 129	SEQ ID NO: 130
Set-29	SEQ ID NO: 131	SEQ ID NO: 126	SEQ ID NO: 132	SEQ ID NO: 133	SEQ ID NO: 134	SEQ ID NO: 130

[0070] Typically, 3 to 5 μ L of nucleic acid extracted from a human urine sample or from buffer spiked with in-house in vitro transcribed HsActB RNA or negative controls (NTC = nuclease free water or Tris buffer, no template control) served as template for RTLAMP

reactions. 10-25 μ l total volume reactions were prepared on ice as mixes containing formulations including 1x amplification buffer comprising 10-40 mM Tris-HCl, 0-0.5% Tween 20, 0-300 mM Trehalose, 5-70 mM KCl, 4-41 mM MgSO₄, 10-20 mM (NH₄)₂SO₄, 0-2mM TCEP and 1.6-2mM each dCTP, dGTP, dATP and dTTP. NEB Bst2 polymerase (NEB CN# M0537L) and RTx Warmstart reverse transcriptase (NEB CN# M0380S) enzymes. Primers (2 μ M inner primers, 0.2 μ M outer primers, and 0.8 μ M Loop primers) were added to individual reactions or directly to master mixes as required per experimental design. Molecular beacons (0.2 μ M) or 200 nM Yo-Pro-1, Yo-Pro-3 or To-Pro dye was also added to the master mix, as indicated in the examples below. Amplification reactions were prepared with the standard 6-primer. Master mixes were distributed to individual sample templates, vortexed and centrifuged briefly and each reaction loaded into individual wells of a 96 or 384 well plate (Roche CN# 4729692001 or BioRad CN#sI9605). Reactions were carried out at temperatures ranging from 60-67°C and fluorescence monitored on either a Roche LightCycler 96 Real-Time PCR instrument or a BioRad CFX96 real time cycler. Target amplification was monitored via intercalating dye or molecular beacon probe binding to target resulting in release of molecular beacon fluorescence intramolecular quenching.

Example 2: LAMP with Dye Detection

[0071] A negative urine matrix that naturally contains endogenous human B-actin was extracted using standard extraction methods and the sample was amplified using LAMP primers (as described in Table 2). YoPro™ dye or a compatible wavelength version within the same dye set family (Life Technologies; green fluorescent carbocyanine nucleic acid stain) was used for the detection of the amplified product. The master mix was prepared as described in Example 1. Results are summarized in Table 3, in which the Time to Positive (Tp) was calculated using an in house developed algorithm.

Table 3: Time to Positive Dye Detection

Primer Set	Urine	NTC
Set-1	7.95	16.3
Set-2	5.41	negative
Set-3	7.95	19.6
Set-4	7.81	negative
Set-5	negative	negative
Set-6	4.51	negative
Set-7	7.25	negative

Set-8	4.43	negative
Set-9	13.04	negative
Set-10	11.9	negative
Set-11	13.32	negative
Set-12	5.42	negative
Set-13	9.79	negative
Set-14	11.9	negative
Set-15	11.91	negative
Set-16	15.87	negative
Set-17	negative	negative
Set-18	8.8	negative
Set-19	negative	negative
Set-20	negative	negative
Set-21	11.86	negative
Set-22	6.54	27.88
Set-23	6.47	24.16
Set-24	6.435	28.82
Set-25	5.28	25.63
Set-26	13.31	negative
Set-27	negative	negative
Set-28	7.25	negative
Set-29	6.05	negative

Example 3: Molecular Beacon Detection

[0072] To provide an additional level of direct sequence based detection of amplified product (as opposed to indirect dye detection), molecular beacons (MB1-50) targeting unique nucleotides within the β -actin amplicon of primer sets with promising Tp's combined with sensitivity, were designed (SEQ ID NOs: 135-184) and utilized for detection of amplification from nucleic acid extracted from live bacteria (Table 4). The molecular beacon probe was designed with 5' fluorophore/3' quencher modifications (6-Carboxyfluorescein (FAM)) and Black Hole Quencher 1 (BHQ1) included to provide target-specific fluorescent detection. Molecular Beacons MB49 and MB50 (SEQ ID NOs: 183 & 184) include LNA nucleotides as indicated by "[+X]", where X indicates the identity of the nucleobase.

Table 4: Probe Sequences

ID	Fluor	Quench	Sequence (5' to 3')	Sequence ID
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MB1	FAM	BHQ1	CGCGT GCACTCTTCCAGCCTTCCTTCTGGGCACGCG	SEQ ID NO: 135
MB2	FAM	BHQ1	CGCGT GGCATGGAGTCCTGTGGCATCCACGCG	SEQ ID NO: 136
MB3	FAM	BHQ1	CGCGAT CGATCGGCGGCTCCATCCTGGATCGCG	SEQ ID NO: 137
MB4	FAM	BHQ1	CGACCA GGATCGGCGGCTCCATCCTGCTGGTCG	SEQ ID NO: 138
MB5	FAM	BHQ1	CCGTGTGGATCGGCGGCTCCATCCTGCACACGG	SEQ ID NO: 139
MB6	FAM	BHQ1	CCGAT GGATCGGCGGCTCCATCCTGCCATCGG	SEQ ID NO: 140
MB7	FAM	BHQ1	CGCGAT CAGATGTGGATCAGCAAGCAGGAGGATCGCG	SEQ ID NO: 141
MB8	FAM	BHQ1	CGTAC GCAAGATGTGGATCAGCAAGCAGGAGGCGTACG	SEQ ID NO: 142
MB9	FAM	BHQ1	CGGCCTA AGATGTGGATCAGCAAGCAGGAGTAGGCCG	SEQ ID NO: 143
MB10	FAM	BHQ1	CGCGATC TACCACTGGCATCGTGATGGACTGATCGCG	SEQ ID NO: 144
MB11	FAM	BHQ1	CCGCT CGTACCACTGGCATCGTGATGGACTCGAGCGG	SEQ ID NO: 145
MB12	FAM	BHQ1	CCGCGGAT TACCACTGGCATCGTGATGGACTTCCGCGG	SEQ ID NO: 146
MB13	FAM	BHQ1	CGTCCAG CCAGATCATGTTTGACTGGACG	SEQ ID NO: 147
MB14	FAM	BHQ1	CGTCCAG AGATCATGTTTGAGACCCTGGACG	SEQ ID NO: 148
MB15	FAM	BHQ1	CGAGGT CCCAGATCATGTTTGAGACCCTCG	SEQ ID NO: 149
MB16	FAM	BHQ1	CGCTGAG TCATGTTTGAGACCCTCAGCG	SEQ ID NO: 150
MB17	FAM	BHQ1	CGCGATC GTCACCTTCCAGCAGATGTGGATCGCG	SEQ ID NO: 151
MB18	FAM	BHQ1	CCGCGAGAAGATGACCCAGATCATCTCGCGG	SEQ ID NO: 152
MB19	FAM	BHQ1	CCT CGAGAAGATGACCCAGATCATCTCGAGG	SEQ ID NO: 153
MB20	FAM	BHQ1	CCGCGAGAAGATGACCCAGATCACTCGCGG	SEQ ID NO: 154
MB21	FAM	BHQ1	CGCGATC GACCCAGATCATGTTTGAGGATCGCG	SEQ ID NO: 155
MB22	FAM	BHQ1	CGTCGGT GACCCAGATCATGTTTGAGACCGACG	SEQ ID NO: 156
MB23	FAM	BHQ1	CGCGATC ACATGCCGGAGCCGTTGTGCGATCGCG	SEQ ID NO: 157
MB24	FAM	BHQ1	CCGATGG ACATGCCGGAGCCGTTGTGCGACCATCGG	SEQ ID NO: 158
MB25	FAM	BHQ1	CGCGATC CGCCAGCTCACCATGGATCGCG	SEQ ID NO: 159
MB26	FAM	BHQ1	CAGGTCT CGCCAGCTCACCATGAGACCTG	SEQ ID NO: 160
MB27	FAM	BHQ1	CGCGATC TTCCCTCCATCGTGATCGCG	SEQ ID NO: 161
MB28	FAM	BHQ1	CACCGT CTTCCCTCCATCGTGACGGTG	SEQ ID NO: 162
MB29	FAM	BHQ1	CGCGATC CTGTGGCATCCACGAACTAGATCGCG	SEQ ID NO: 163
MB30	FAM	BHQ1	CCGGAGT CCTGTGGCATCCACGAACTAACTCCGG	SEQ ID NO: 164
MB31	FAM	BHQ1	CCGCGA AGATGACCCAGATCATGTTTCGCGG	SEQ ID NO: 165
MB32	FAM	BHQ1	CCGCGA AGATGACCCAGATCATGTTTCGCGG	SEQ ID NO: 166
MB33	FAM	BHQ1	CGGCGAT GACCCAGATCATGATCGCCG	SEQ ID NO: 167
MB34	FAM	BHQ1	CGCGA AGATGACCCAGATCATGCTTCGCG	SEQ ID NO: 168
MB35	FAM	BHQ1	CAAGCC GATGACCCAGATCATGCGGCTTG	SEQ ID NO: 169
MB36	FAM	BHQ1	CCGATGGACTCCGGTGACGGGGCCATCGG	SEQ ID NO: 170
MB37	FAM	BHQ1	CGTCGGT GACCCAGATCATGTTTGAGACACCGACG	SEQ ID NO: 171
MB38	FAM	BHQ1	CGGCC TGACCCAGATCATGTTTGAGACAGGCCG	SEQ ID NO: 172
MB39	FAM	BHQ1	CGGCGG TGACCCAGATCATGTTTGAGACCGCCG	SEQ ID NO: 173
MB40	FAM	BHQ1	CGGCGAT GACCCAGATCATGTTTGAGATCGCCG	SEQ ID NO: 174

MB41	FAM	BHQ1	CAGCGGTGACCCAGATCATGTTTGAGACCGCTG	SEQ ID NO: 175
MB42	FAM	BHQ1	CGCGGTGACCCAGATCATGTTTGAGACCCACCGCG	SEQ ID NO: 176
MB43	FAM	BHQ1	CGGCACCAACTGGGACGACATGGGGTGCCG	SEQ ID NO: 177
MB44	FAM	BHQ1	CGGCACCAACTGGGACGACATGGAGAAAATCTGGTGCCG	SEQ ID NO: 178
MB45	FAM	BHQ1	CGACCCCATCGAGCACGGCATCGTCACGGGGTCG	SEQ ID NO: 179
MB46	FAM	BHQ1	CCATGGGTCAGAAGGATTCTATGTGGCCCATGG	SEQ ID NO: 180
MB47	FAM	BHQ1	CGGCCGACATGGAGAAAATCTGGCACCACACCTCGGCCG	SEQ ID NO: 181
MB48	FAM	BHQ1	CCGGGTCAGAAGGATTCTATGTGGGCGACCCGG	SEQ ID NO: 182
MB49	FAM	BHQ1	CACGGGTCGACC [+C] AGA [+T] CA [+T] GTT [+T] GAGACCCGTG	SEQ ID NO: 183
MB50	FAM	BHQ1	CACGCGTGACC [+C] AGA [+T] CA [+T] GTT [+T] GAGACGCGTG	SEQ ID NO: 184

[0073] 10-25 μ L total volume reactions were evaluated utilizing eluate from a negative urine matrix that contains naturally occurring endogenous human β -actin as template input according to the methods described in Examples 1 and 2. While use of a Molecular Beacon for detection resulted in a slight increase in reaction T_p , the ability to directly detect amplification products based on sequence, and thereby distinguish closely related species, provides a reasonable tradeoff.

Table 5: Time to Positive (Probe Detection)

Primers	Beacon	T_p w/ beacon	T_p for NTC
Set-1	SEQ ID NO: 136	10.03	--
Set-2	SEQ ID NO: 135	10.42	--
Set-3	SEQ ID NO: 137	15.16	--
Set-3	SEQ ID NO: 138	14.70	--
Set-3	SEQ ID NO: 139	12.79	--
Set-3	SEQ ID NO: 140	10.91	--
Set-3	SEQ ID NO: 141	12.57	--
Set-3	SEQ ID NO: 142	13.38	--
Set-3	SEQ ID NO: 143	13.95	--
Set-3	SEQ ID NO: 151	11.13	--
Set-6	SEQ ID NO: 181	8.78	--
Set-6	SEQ ID NO: 182	8.90	--
Set-8	SEQ ID NO: 177	7.94	--
Set-8	SEQ ID NO: 178	7.68	--
Set-8	SEQ ID NO: 179	7.12	--
Set-8	SEQ ID NO: 180	8.47	--
Set-12	SEQ ID NO: 144	10.59	--
Set-12	SEQ ID NO: 145	8.34	--

Set-12	SEQ ID NO: 146	9.80	--
Set-12	SEQ ID NO: 147	13.00	--
Set-12	SEQ ID NO: 148	11.80	--
Set-12	SEQ ID NO: 149	11.16	--
Set-12	SEQ ID NO: 150	11.51	--
Set-13	SEQ ID NO: 157	11.25	50.07
Set-13	SEQ ID NO: 158	11.86	--
Set-13	SEQ ID NO: 159	16.05	--
Set-13	SEQ ID NO: 160	18.66	--
Set-13	SEQ ID NO: 161	17.28	27.26
Set-13	SEQ ID NO: 162	14.92	--
Set-18	SEQ ID NO: 163	10.62	42.32
Set-18	SEQ ID NO: 164	11.27	--
Set-22	SEQ ID NO: 144	10.45	36.48
Set-22	SEQ ID NO: 145	8.75	40.97
Set-22	SEQ ID NO: 146	9.81	--
Set-22	SEQ ID NO: 148	11.74	42.13
Set-22	SEQ ID NO: 152	11.78	--
Set-22	SEQ ID NO: 153	13.77	14.72
Set-22	SEQ ID NO: 154	13.68	47.92
Set-22	SEQ ID NO: 155	12.14	45.17
Set-22	SEQ ID NO: 156	12.19	--
Set-22	SEQ ID NO: 170	9.45	
Set-25	SEQ ID NO: 144	11.55	42.02
Set-25	SEQ ID NO: 145	9.77	41.11
Set-25	SEQ ID NO: 146	10.34	--
Set-25	SEQ ID NO: 148	12.82	24.08
Set-25	SEQ ID NO: 152	12.18	--
Set-25	SEQ ID NO: 153	14.80	16.33
Set-25	SEQ ID NO: 154	14.39	--
Set-25	SEQ ID NO: 155	13.64	--
Set-25	SEQ ID NO: 156	8.99	--
Set-29	SEQ ID NO: 145	14.77	--
Set-29	SEQ ID NO: 152	10.48	17.81
Set-29	SEQ ID NO: 153	10.69	--
Set-29	SEQ ID NO: 154	10.02	--
Set-29	SEQ ID NO: 155	12.99	--
Set-29	SEQ ID NO: 156	7.69	--
Set-29	SEQ ID NO: 165	12.98	20.93
Set-29	SEQ ID NO: 166	9.76	--

Set-29	SEQ ID NO: 167	13.98	--
Set-29	SEQ ID NO: 168	14.26	--
Set-29	SEQ ID NO: 169	13.72	--
Set-29	SEQ ID NO: 171	8.63	25.44
Set-29	SEQ ID NO: 172	8.41	--
Set-29	SEQ ID NO: 173	7.37	--
Set-29	SEQ ID NO: 174	7.68	25.79
Set-29	SEQ ID NO: 175	7.80	--
Set-29	SEQ ID NO: 176	8.31	--
Set-29	SEQ ID NO: 183	9.89	--
Set-29	SEQ ID NO: 184	9.17	--

[0074] Although the foregoing invention has been described in some detail by way of illustration and example for purposes of clarity of understanding, it is readily apparent to those of ordinary skill in the art in light of the teachings of this invention that certain changes and modifications can be made thereto without departing from the spirit or scope of the appended claims. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to be limiting, since the scope of the present invention will be limited only by the appended claims.

[0075] Accordingly, the preceding merely illustrates the principles of the invention. It will be appreciated that those skilled in the art will be able to devise various arrangements which, although not explicitly described or shown herein, embody the principles of the invention and are included within its spirit and scope. Furthermore, all examples and conditional language recited herein are principally intended to aid the reader in understanding the principles of the invention and the concepts contributed by the inventors to furthering the art, and are to be construed as being without limitation to such specifically recited examples and conditions. Moreover, all statements herein reciting principles, aspects, and embodiments of the invention as well as specific examples thereof, are intended to encompass both structural and functional equivalents thereof. Additionally, it is intended that such equivalents include both currently known equivalents and equivalents developed in the future, i.e., any elements developed that perform the same function, regardless of structure. The scope of the present invention, therefore, is not intended to be limited to the exemplary embodiments shown and described herein. Rather, the scope and spirit of present invention is embodied by the appended claims.

CLAIMS

1. A composition comprising a set of polynucleotides selected from the group consisting of Set-1 through Set-29.
2. The composition of claim 1, further comprising a probe.
3. The composition of claim 2, wherein the probe comprises a label.
4. The composition of claim 3, wherein the probe is a labeled polynucleotide.
5. The composition of claim 4, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of nucleotides 6-33 of SEQ ID NO: 135, nucleotides 6-30 of SEQ ID NO: 136, nucleotides 7-27 of SEQ ID NO: 137, nucleotides 7-26 of SEQ ID NO: 138, nucleotides 1-26 of SEQ ID NO: 139, nucleotides 7-26 of SEQ ID NO: 140, nucleotides 7-30 of SEQ ID NO: 141, nucleotides 6-30 of SEQ ID NO: 142, nucleotides 8-32 of SEQ ID NO: 143, nucleotides 8-30 of SEQ ID NO: 144, nucleotides 6-31 of SEQ ID NO: 145, nucleotides 8-30 of SEQ ID NO: 146, 8-22 of SEQ ID NO: 147, nucleotides 8-24 of SEQ ID NO: 148, nucleotides 7-27 of SEQ ID NO: 149, nucleotides 8-21 of SEQ ID NO: 150, nucleotides 8-32 of SEQ ID NO: 151, nucleotides 1-24 of SEQ ID NO: 152, nucleotides 4-24 of SEQ ID NO: 153, nucleotides 1-23 of SEQ ID NO: 154, nucleotides 8-26 of SEQ ID NO: 155, nucleotides 7-29 of SEQ ID NO: 156, nucleotides 8-28 of SEQ ID NO: 157, nucleotides 8-29 of SEQ ID NO: 158, nucleotides 7-25 of SEQ ID NO: 159, nucleotides 8-22 of SEQ ID NO: 160, nucleotides 6-22 of SEQ ID NO: 161, nucleotides 3-22 of SEQ ID NO: 162, nucleotides 8-28 of SEQ ID NO: 163, nucleotides 3-28 of SEQ ID NO: 164, nucleotides 5-25 of SEQ ID NO: 165, nucleotides 5-26 of SEQ ID NO: 166, nucleotides 5-20 of SEQ ID NO: 167, nucleotides 4-22 of SEQ ID NO: 168, nucleotides 7-22 of SEQ ID NO: 169, nucleotides 3-22 of SEQ ID NO: 170, nucleotides 7-28 of SEQ ID NO: 171, nucleotides 6-27 of SEQ ID NO: 172, nucleotides 7-29 of SEQ ID NO: 173, nucleotides 5-27 of SEQ ID NO: 174, nucleotides 7-29 of SEQ ID NO: 175, nucleotides 6-28 of SEQ ID NO: 176, nucleotides 4-23 of SEQ ID NO: 177, nucleotides 4-34 of SEQ ID NO: 178, nucleotides 3-27 of SEQ ID NO: 179, nucleotides 2-27 of SEQ ID NO: 180, nucleotides 5-33 of SEQ ID NO: 181, nucleotides 3-30 of SEQ ID NO: 182, nucleotides 9-34 of SEQ ID NO: 183, and nucleotides 8-28 of SEQ ID NO: 184.
6. The composition of claim 4, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 135 through SEQ ID NO: 184.
7. The composition of claim 4, wherein the label is a fluorophore.

- 8.** The composition of claim 7, wherein the fluorophore is covalently attached to a terminus of the polynucleotide.
- 9.** The composition of claim 1, further comprising a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 8-22 of SEQ ID NO: 147, nucleotides 8-24 of SEQ ID NO: 148, nucleotides 7-27 of SEQ ID NO: 149, nucleotides 8-21 of SEQ ID NO: 150, nucleotides 8-26 of SEQ ID NO: 155, nucleotides 7-29 of SEQ ID NO: 156, nucleotides 5-25 of SEQ ID NO: 165, nucleotides 5-26 of SEQ ID NO: 166, nucleotides 5-20 of SEQ ID NO: 167, nucleotides 4-22 of SEQ ID NO: 168, nucleotides 7-22 of SEQ ID NO: 169, nucleotides 7-28 of SEQ ID NO: 171, nucleotides 6-27 of SEQ ID NO: 172, nucleotides 7-29 of SEQ ID NO: 173, nucleotides 5-27 of SEQ ID NO: 174, nucleotides 7-29 of SEQ ID NO: 175, nucleotides 6-28 of SEQ ID NO: 176, nucleotides 9-34 of SEQ ID NO: 183, and nucleotides 8-28 of SEQ ID NO: 184, and wherein the set of polynucleotides is selected from the group consisting of Sets 9-12, Set-17, and Sets 22-29.
- 10.** The composition of claim 9, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 147, SEQ ID NO: 148, SEQ ID NO: 149, SEQ ID NO: 150, SEQ ID NO: 155, SEQ ID NO: 156, SEQ ID NO: 165, SEQ ID NO: 166, SEQ ID NO: 167, SEQ ID NO: 168, SEQ ID NO: 169, SEQ ID NO: 171, SEQ ID NO: 172, SEQ ID NO: 173, SEQ ID NO: 174, SEQ ID NO: 175, SEQ ID NO: 176, SEQ ID NO: 183, and SEQ ID NO: 184.
- 11.** The composition of claim 10, wherein the sequence of the labeled polynucleotides is SEQ ID NO: 184, and the set of polynucleotides is Set-29.
- 12.** The composition of claim 1, further comprising a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 1-24 of SEQ ID NO: 152, nucleotides 4-24 of SEQ ID NO: 153, and nucleotides 1-23 of SEQ ID NO: 154, and wherein the set of polynucleotides is selected from the group consisting of Sets 9-11, Set-17, and Sets 23-29.
- 13.** The composition of claim 12, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 152, SEQ ID NO: 153, and SEQ ID NO: 154.
- 14.** The composition of claim 1, further comprising a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 8-30 of SEQ ID NO: 144, nucleotides 6-31 of SEQ ID NO: 145, and nucleotides 8-30 of SEQ ID NO: 146, and wherein the set of polynucleotides is selected from the group consisting of Set-4, Sets 9-12, Set-17, and Sets 22-26.

- 15.** The composition of claim 14, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 144, SEQ ID NO: 145, and SEQ ID NO: 146.
- 16.** The composition of claim 1, further comprising a labeled polynucleotide comprising nucleotides 3-22 of SEQ ID NO: 170, and wherein the set of polynucleotides is selected from the group consisting of Set-5, Set-12, Set-17, and Sets 22-25.
- 17.** The composition of claim 16, wherein the labeled polynucleotide comprises SEQ ID NO: 170.
- 18.** The composition of claim 1, further comprising a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 2-27 of SEQ ID NO: 180 and nucleotides 3-30 of SEQ ID NO: 182, and wherein the set of polynucleotides is selected from the group consisting of Sets 6-8, Set-15, and Set-16.
- 19.** The composition of claim 18, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 180 and SEQ ID NO: 182.
- 20.** The composition of claim 1, further comprising a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 4-34 of SEQ ID NO: 178 and nucleotides 5-33 of SEQ ID NO: 181, and wherein the set of polynucleotides is selected from the group consisting of Sets 6-11 and Sets 28-29.
- 21.** The composition of claim 20, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 178 and SEQ ID NO: 181.
- 22.** The composition of claim 1, further comprising a labeled polynucleotide comprising nucleotides 3-27 of SEQ ID NO: 179, and wherein the set of polynucleotides is selected from the group consisting of Sets 6-9 and Set-11.
- 23.** The composition of claim 22, wherein the labeled polynucleotide comprises SEQ ID NO: 179.
- 24.** The composition of claim 1, further comprising a labeled polynucleotide comprising nucleotides 4-23 of SEQ ID NO: 177, and wherein the set of polynucleotides is selected from the group consisting of Sets 6-9, Set-11, and Set-28.
- 25.** The composition of claim 24, wherein the labeled polynucleotide comprises SEQ ID NO: 177.

- 26.** The composition of claim 1, further comprising a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 7-25 of SEQ ID NO: 159 and nucleotides 8-22 of SEQ ID NO: 160, and wherein the set of polynucleotides is selected from the group consisting of Sets 13-15.
- 27.** The composition of claim 26, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 159 and SEQ ID NO: 160.
- 28.** The composition of claim 1, further comprising a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 8-28 of SEQ ID NO: 157, nucleotides 8-29 of SEQ ID NO: 158, nucleotides 6-22 of SEQ ID NO: 161, and nucleotides 3-22 of SEQ ID NO: 162, and wherein the set of polynucleotides is selected from the group consisting of Sets 13-16.
- 29.** The composition of claim 28, wherein the labeled polynucleotide comprises a sequence from the group consisting of SEQ ID NO: 157, SEQ ID NO: 158, SEQ ID NO: 161, and SEQ ID NO: 162.
- 30.** The composition of claim 1, further comprising a labeled polynucleotide comprising a sequence selected from the group of nucleotides 7-27 of SEQ ID NO: 137, nucleotides 7-26 of SEQ ID NO: 138, nucleotides 1-26 of SEQ ID NO: 139, nucleotides 7-26 of SEQ ID NO: 140, nucleotides 7-30 of SEQ ID NO: 141, nucleotides 6-30 of SEQ ID NO: 142, nucleotides 8-32 of SEQ ID NO: 151, and nucleotides 4-24 of SEQ ID NO: 153, and wherein the set of polynucleotides is Set-3.
- 31.** The composition of claim 30, wherein the labeled polynucleotide comprises a sequence from the group consisting of SEQ ID NO: 137, SEQ ID NO: 138, SEQ ID NO: 139, SEQ ID NO: 140, SEQ ID NO: 141, SEQ ID NO: 142, SEQ ID NO: 151, and SEQ ID NO: 153.
- 32.** The composition of claim 1, further comprising a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 8-28 of SEQ ID NO: 163 and nucleotides 3-28 of SEQ ID NO: 164, and wherein the set of polynucleotides is selected from the group consisting of Set-1, Set-2, and Sets 18-20.
- 33.** The composition of claim 32, wherein the labeled polynucleotide comprises a sequence from the group consisting of SEQ ID NO: 163 and SEQ ID NO: 164.
- 34.** The composition of claim 1, further comprising a labeled polynucleotide comprising a sequence selected from the group consisting of nucleotides 6-33 of SEQ ID NO: 135 and

nucleotides 6-30 of SEQ ID NO: 136, and wherein the set of polynucleotides is selected from the group consisting of Set-1, Set-2 and Sets 18-21.

35. The composition of claim 34, wherein the labeled polynucleotide comprises a sequence from the group consisting of SEQ ID NO: 135 and SEQ ID NO: 136.

36. The composition of claim 2, wherein the probe is a molecular beacon comprising a fluorophore, a quencher, and a polynucleotide.

37. The composition of claim 36, wherein the molecular beacon comprises a sequence selected from the group consisting of nucleotides 6-33 of SEQ ID NO: 135, nucleotides 6-30 of SEQ ID NO: 136, nucleotides 7-27 of SEQ ID NO: 137, nucleotides 7-26 of SEQ ID NO: 138, nucleotides 1-26 of SEQ ID NO: 139, nucleotides 7-26 of SEQ ID NO: 140, nucleotides 7-30 of SEQ ID NO: 141, nucleotides 6-30 of SEQ ID NO: 142, nucleotides 8-32 of SEQ ID NO: 143, nucleotides 8-30 of SEQ ID NO: 144, nucleotides 6-31 of SEQ ID NO: 145, nucleotides 8-30 of SEQ ID NO: 146, 8-22 of SEQ ID NO: 147, nucleotides 8-24 of SEQ ID NO: 148, nucleotides 7-27 of SEQ ID NO: 149, nucleotides 8-21 of SEQ ID NO: 150, nucleotides 8-32 of SEQ ID NO: 151, nucleotides 1-24 of SEQ ID NO: 152, nucleotides 4-24 of SEQ ID NO: 153, nucleotides 1-23 of SEQ ID NO: 154, nucleotides 8-26 of SEQ ID NO: 155, nucleotides 7-29 of SEQ ID NO: 156, nucleotides 8-28 of SEQ ID NO: 157, nucleotides 8-29 of SEQ ID NO: 158, nucleotides 7-25 of SEQ ID NO: 159, nucleotides 8-22 of SEQ ID NO: 160, nucleotides 6-22 of SEQ ID NO: 161, nucleotides 3-22 of SEQ ID NO: 162, nucleotides 8-28 of SEQ ID NO: 163, nucleotides 3-28 of SEQ ID NO: 164, nucleotides 5-25 of SEQ ID NO: 165, nucleotides 5-26 of SEQ ID NO: 166, nucleotides 5-20 of SEQ ID NO: 167, nucleotides 4-22 of SEQ ID NO: 168, nucleotides 7-22 of SEQ ID NO: 169, nucleotides 3-22 of SEQ ID NO: 170, nucleotides 7-28 of SEQ ID NO: 171, nucleotides 6-27 of SEQ ID NO: 172, nucleotides 7-29 of SEQ ID NO: 173, nucleotides 5-27 of SEQ ID NO: 174, nucleotides 7-29 of SEQ ID NO: 175, nucleotides 6-28 of SEQ ID NO: 176, nucleotides 4-23 of SEQ ID NO: 177, nucleotides 4-34 of SEQ ID NO: 178, nucleotides 3-27 of SEQ ID NO: 179, nucleotides 2-27 of SEQ ID NO: 180, nucleotides 5-33 of SEQ ID NO: 181, nucleotides 3-30 of SEQ ID NO: 182, nucleotides 9-34 of SEQ ID NO: 183, and nucleotides 8-28 of SEQ ID NO: 184.

38. The composition of claim 37, wherein the molecular beacon comprises a sequence selected from the group consisting of SEQ ID NO: 135 through SEQ ID NO: 184.

39. The composition of claim 38, wherein the polynucleotide sequence consists of SEQ ID NO: 184.

- 40.** A molecular beacon comprising a fluorophore, a quencher, and a polynucleotide, wherein the polynucleotide comprises a sequence selected from the group consisting of nucleotides 6-33 of SEQ ID NO: 135, nucleotides 6-30 of SEQ ID NO: 136, nucleotides 7-27 of SEQ ID NO: 137, nucleotides 7-26 of SEQ ID NO: 138, nucleotides 1-26 of SEQ ID NO: 139, nucleotides 7-26 of SEQ ID NO: 140, nucleotides 7-30 of SEQ ID NO: 141, nucleotides 6-30 of SEQ ID NO: 142, nucleotides 8-32 of SEQ ID NO: 143, nucleotides 8-30 of SEQ ID NO: 144, nucleotides 6-31 of SEQ ID NO: 145, nucleotides 8-30 of SEQ ID NO: 146, 8-22 of SEQ ID NO: 147, nucleotides 8-24 of SEQ ID NO: 148, nucleotides 7-27 of SEQ ID NO: 149, nucleotides 8-21 of SEQ ID NO: 150, nucleotides 8-32 of SEQ ID NO: 151, nucleotides 1-24 of SEQ ID NO: 152, nucleotides 4-24 of SEQ ID NO: 153, nucleotides 1-23 of SEQ ID NO: 154, nucleotides 8-26 of SEQ ID NO: 155, nucleotides 7-29 of SEQ ID NO: 156, nucleotides 8-28 of SEQ ID NO: 157, nucleotides 8-29 of SEQ ID NO: 158, nucleotides 7-25 of SEQ ID NO: 159, nucleotides 8-22 of SEQ ID NO: 160, nucleotides 6-22 of SEQ ID NO: 161, nucleotides 3-22 of SEQ ID NO: 162, nucleotides 8-28 of SEQ ID NO: 163, nucleotides 3-28 of SEQ ID NO: 164, nucleotides 5-25 of SEQ ID NO: 165, nucleotides 5-26 of SEQ ID NO: 166, nucleotides 5-20 of SEQ ID NO: 167, nucleotides 4-22 of SEQ ID NO: 168, nucleotides 7-22 of SEQ ID NO: 169, nucleotides 3-22 of SEQ ID NO: 170, nucleotides 7-28 of SEQ ID NO: 171, nucleotides 6-27 of SEQ ID NO: 172, nucleotides 7-29 of SEQ ID NO: 173, nucleotides 5-27 of SEQ ID NO: 174, nucleotides 7-29 of SEQ ID NO: 175, nucleotides 6-28 of SEQ ID NO: 176, nucleotides 4-23 of SEQ ID NO: 177, nucleotides 4-34 of SEQ ID NO: 178, nucleotides 3-27 of SEQ ID NO: 179, nucleotides 2-27 of SEQ ID NO: 180, nucleotides 5-33 of SEQ ID NO: 181, nucleotides 3-30 of SEQ ID NO: 182, nucleotides 9-34 of SEQ ID NO: 183, and nucleotides 8-28 of SEQ ID NO: 184.
- 41.** The molecular beacon of claim 40, wherein the polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 135 through SEQ ID NO: 184.
- 42.** The molecular beacon of claim 41, wherein the polynucleotide consists a sequence selected from the group consisting of SEQ ID NO: 135 through SEQ ID NO: 184.
- 43.** The molecular beacon of claim 40, wherein the fluorophore is FAM and the quencher is BHQ1.
- 44.** The molecular beacon of claim 40, wherein the fluorophore is ATTO 565 or Alexa 594 and the quencher is BHQ1 or BHQ2.
- 45.** A method of detecting β -actin in a test sample, the method comprising:

- (a) extracting nucleic acid from the test sample;
- (b) amplifying a target sequence by reacting the nucleic acid extracted in step (a) with a reaction mixture comprising a strand displacement DNA polymerase and a sequence specific primer set, wherein said sequence-specific primer set is selected from the group consisting of Set-1 through Set-29; and
- (c) detecting the presence or absence of an amplified product of step (b); wherein the presence of said amplification product is indicative of the presence of β -actin in the test sample.

46. The method of claim 45, wherein the amplification in step (b) of the target sequence is performed between about 60°C and about 67°C for less than 30 minutes.

47. The method of claim 46, wherein the amplification step is performed for less than fifteen minutes.

48. The method of claim 47, wherein the amplification step is performed for less than twelve minutes.

49. The method of claim 48, wherein the amplification step is performed for less than nine minutes.

50. The method of claim 45, wherein the reaction mixture further comprises a reverse transcriptase.

51. The method of claim 45, wherein detecting the presence or absence of the amplification product comprises hybridizing the amplified product with a probe comprising a polynucleotide attached to a label.

52. The method of claim 51, wherein the label is a fluorophore.

53. The method of claim 52, wherein the fluorophore is covalently attached to a terminus of the polynucleotide.

54. The method of claim 51, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of nucleotides 6-33 of SEQ ID NO: 135, nucleotides 6-30 of SEQ ID NO: 136, nucleotides 7-27 of SEQ ID NO: 137, nucleotides 7-26 of SEQ ID NO: 138, nucleotides 1-26 of SEQ ID NO: 139, nucleotides 7-26 of SEQ ID NO: 140, nucleotides 7-30 of SEQ ID NO: 141, nucleotides 6-30 of SEQ ID NO: 142, nucleotides 8-32 of SEQ ID NO: 143, nucleotides 8-30 of SEQ ID NO: 144, nucleotides 6-31 of SEQ ID NO: 145, nucleotides 8-30 of

SEQ ID NO: 146, 8-22 of SEQ ID NO: 147, nucleotides 8-24 of SEQ ID NO: 148, nucleotides 7-27 of SEQ ID NO: 149, nucleotides 8-21 of SEQ ID NO: 150, nucleotides 8-32 of SEQ ID NO: 151, nucleotides 1-24 of SEQ ID NO: 152, nucleotides 4-24 of SEQ ID NO: 153, nucleotides 1-23 of SEQ ID NO: 154, nucleotides 8-26 of SEQ ID NO: 155, nucleotides 7-29 of SEQ ID NO: 156, nucleotides 8-28 of SEQ ID NO: 157, nucleotides 8-29 of SEQ ID NO: 158, nucleotides 7-25 of SEQ ID NO: 159, nucleotides 8-22 of SEQ ID NO: 160, nucleotides 6-22 of SEQ ID NO: 161, nucleotides 3-22 of SEQ ID NO: 162, nucleotides 8-28 of SEQ ID NO: 163, nucleotides 3-28 of SEQ ID NO: 164, nucleotides 5-25 of SEQ ID NO: 165, nucleotides 5-26 of SEQ ID NO: 166, nucleotides 5-20 of SEQ ID NO: 167, nucleotides 4-22 of SEQ ID NO: 168, nucleotides 7-22 of SEQ ID NO: 169, nucleotides 3-22 of SEQ ID NO: 170, nucleotides 7-28 of SEQ ID NO: 171, nucleotides 6-27 of SEQ ID NO: 172, nucleotides 7-29 of SEQ ID NO: 173, nucleotides 5-27 of SEQ ID NO: 174, nucleotides 7-29 of SEQ ID NO: 175, nucleotides 6-28 of SEQ ID NO: 176, nucleotides 4-23 of SEQ ID NO: 177, nucleotides 4-34 of SEQ ID NO: 178, nucleotides 3-27 of SEQ ID NO: 179, nucleotides 2-27 of SEQ ID NO: 180, nucleotides 5-33 of SEQ ID NO: 181, nucleotides 3-30 of SEQ ID NO: 182, nucleotides 9-34 of SEQ ID NO: 183, and nucleotides 8-28 of SEQ ID NO: 184.

55. The method of claim 54, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 135 through SEQ ID NO: 184.

56. The method of claim 51, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of nucleotides 8-22 of SEQ ID NO: 147, nucleotides 8-24 of SEQ ID NO: 148, nucleotides 7-27 of SEQ ID NO: 149, nucleotides 8-21 of SEQ ID NO: 150, nucleotides 8-26 of SEQ ID NO: 155, nucleotides 7-29 of SEQ ID NO: 156, nucleotides 5-25 of SEQ ID NO: 165, nucleotides 5-26 of SEQ ID NO: 166, nucleotides 5-20 of SEQ ID NO: 167, nucleotides 4-22 of SEQ ID NO: 168, nucleotides 7-22 of SEQ ID NO: 169, nucleotides 7-28 of SEQ ID NO: 171, nucleotides 6-27 of SEQ ID NO: 172, nucleotides 7-29 of SEQ ID NO: 173, nucleotides 5-27 of SEQ ID NO: 174, nucleotides 7-29 of SEQ ID NO: 175, nucleotides 6-28 of SEQ ID NO: 176, nucleotides 9-34 of SEQ ID NO: 183, and nucleotides 8-28 of SEQ ID NO: 184, and wherein the sequence specific primer set is selected from the group consisting of Sets 9-12, Set-17, and Sets 22-29.

57. The method of claim 56, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 147, SEQ ID NO: 148, SEQ ID NO: 149, SEQ ID NO: 150, SEQ ID NO: 155, SEQ ID NO: 156, SEQ ID NO: 165, SEQ ID NO: 166, SEQ

ID NO: 167, SEQ ID NO: 168, SEQ ID NO: 169, SEQ ID NO: 171, SEQ ID NO: 172, SEQ ID NO: 173, SEQ ID NO: 174, SEQ ID NO: 175, SEQ ID NO: 176, SEQ ID NO: 183, SEQ ID NO: 184.

58. The method of claim 57, wherein the sequence of the labeled polynucleotide is SEQ ID NO: 184, and the sequence-specific primer set is Set-29.

59. The method of claim 51, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of nucleotides 1-24 of SEQ ID NO: 152, nucleotides 4-24 of SEQ ID NO: 153, nucleotides 1-23 of SEQ ID NO: 154, and wherein the sequence-specific primer set is selected from the group consisting of Sets 9-11, Set-17, and Sets 23-29.

60. The method of claim 59, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 152, SEQ ID NO: 153, and SEQ ID NO: 154.

61. The method of claim 51, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of nucleotides 8-30 of SEQ ID NO: 144, nucleotides 6-31 of SEQ ID NO: 145, and nucleotides 8-30 of SEQ ID NO: 146, and wherein the sequence-specific primer set is selected from the group consisting of Set-4, Sets 9-12, Set-17, and Sets 22-26.

62. The method of claim 61, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 144, SEQ ID NO: 145, and SEQ ID NO: 146.

63. The method of claim 51, wherein the labeled polynucleotide comprises nucleotides 3-22 of SEQ ID NO: 170, and wherein the sequence-specific primer set is selected from the group consisting of Set-5, Set-12, Set-17, and Sets 22-25.

64. The method of claim 63, wherein the labeled polynucleotide comprises SEQ ID NO: 170.

65. The method of claim 51, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of nucleotides 2-27 of SEQ ID NO: 180 and nucleotides 3-30 of SEQ ID NO: 182, and wherein the sequence-specific set is selected from the group consisting of Sets 6-8, Set-15, and Set-16.

66. The method of claim 65, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 180 and SEQ ID NO: 182.

67. The method of claim 51, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of nucleotides 4-34 of SEQ ID NO: 178 and nucleotides 5-33

of SEQ ID NO: 181, and wherein the sequence-specific primer set is selected from the group consisting of Sets 6-11 and Sets 28-29.

68. The method of claim 67, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 178 and SEQ ID NO: 181.

69. The method of claim 51, wherein the labeled polynucleotide comprises nucleotides 3-27 of SEQ ID NO: 179, and wherein the sequence-specific primer set is selected from the group consisting of Sets 6-9 and Set-11.

70. The method of claim 69, wherein the labeled polynucleotide comprises SEQ ID NO: 179.

71. The method of claim 51, wherein the labeled polynucleotide comprises nucleotides 4-23 of SEQ ID NO: 177, and wherein the sequence-specific primer set is selected from the group consisting of Sets 6-9, Set-11, and Set-28.

72. The method of claim 71, wherein the labeled polynucleotide comprises SEQ ID NO: 177.

73. The method of claim 51, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of nucleotides 7-25 of SEQ ID NO: 159 and nucleotides 8-22 of SEQ ID NO: 160, and wherein the sequence-specific primer set is selected from the group consisting of Sets 13-15.

74. The method of claim 73, wherein the labeled polynucleotide comprises a sequence from the group consisting of SEQ ID NO: 159 and SEQ ID NO: 160.

75. The method of claim 51, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of nucleotides 8-28 of SEQ ID NO: 157, nucleotides 8-29 of SEQ ID NO: 158, nucleotides 6-22 of SEQ ID NO: 161, and nucleotides 3-22 of SEQ ID NO: 162, and wherein the sequence-specific primer set is selected from the group consisting of Sets 13-16.

76. The method of claim 75, wherein the labeled polynucleotide comprises a sequence from the group consisting of SEQ ID NO: 157, SEQ ID NO: 158, SEQ ID NO: 161, and SEQ ID NO: 162.

77. The method of claim 51, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of nucleotides 7-27 of SEQ ID NO: 137, nucleotides 7-26 of SEQ ID NO: 138, nucleotides 1-26 of SEQ ID NO: 139, nucleotides 7-26 of SEQ ID NO: 140, nucleotides 7-30 of SEQ ID NO: 141, nucleotides 6-30 of SEQ ID NO: 142, nucleotides 8-32 of

SEQ ID NO: 151, and nucleotides 4-24 of SEQ ID NO: 153, and wherein the sequence-specific primer set is Set-3.

78. The method of claim 77, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 137, SEQ ID NO: 138, SEQ ID NO: 139, SEQ ID NO: 140, SEQ ID NO: 141, SEQ ID NO: 142, SEQ ID NO: 151, and SEQ ID NO: 153.

79. The method of claim 51, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of nucleotides 8-28 of SEQ ID NO: 163 and nucleotides 3-28 of SEQ ID NO: 164, and wherein the sequence-specific primer set is selected from the group consisting of Set-1, Set-2, and Sets 18-20.

80. The method of claim 79, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 163 and SEQ ID NO: 164.

81. The method of claim 51, wherein the labeled polynucleotide comprises a sequence selected from the group consisting of nucleotides 6-33 of SEQ ID NO: 135 and nucleotides 6-30 of SEQ ID NO: 136, and wherein the sequence-specific primer set is selected from the group consisting of Sets 1-2 and Sets 18-21.

82. The method of claim 81, wherein the labeled polynucleotide comprises a sequence from the group consisting of SEQ ID NO: 135 and SEQ ID NO: 136.

83. A kit comprising a composition according to claim 1.

84. The kit of claim 83, further comprising a strand displacement polymerase.

85. The kit of claim 84, further comprising a molecular beacon comprising a fluorophore, a quencher, and a polynucleotide, wherein the polynucleotide comprises a sequence selected from the group consisting of nucleotides 6-33 of SEQ ID NO: 135, nucleotides 6-30 of SEQ ID NO: 136, nucleotides 7-27 of SEQ ID NO: 137, nucleotides 7-26 of SEQ ID NO: 138, nucleotides 1-26 of SEQ ID NO: 139, nucleotides 7-26 of SEQ ID NO: 140, nucleotides 7-30 of SEQ ID NO: 141, nucleotides 6-30 of SEQ ID NO: 142, nucleotides 8-32 of SEQ ID NO: 143, nucleotides 8-30 of SEQ ID NO: 144, nucleotides 6-31 of SEQ ID NO: 145, nucleotides 8-30 of SEQ ID NO: 146, 8-22 of SEQ ID NO: 147, nucleotides 8-24 of SEQ ID NO: 148, nucleotides 7-27 of SEQ ID NO: 149, nucleotides 8-21 of SEQ ID NO: 150, nucleotides 8-32 of SEQ ID NO: 151, nucleotides 1-24 of SEQ ID NO: 152, nucleotides 4-24 of SEQ ID NO: 153, nucleotides 1-23 of SEQ ID NO: 154, nucleotides 8-26 of SEQ ID NO: 155, nucleotides 7-29 of SEQ ID NO: 156, nucleotides 8-28 of SEQ ID NO: 157, nucleotides 8-29 of SEQ ID NO: 158, nucleotides 7-25 of

SEQ ID NO: 159, nucleotides 8-22 of SEQ ID NO: 160, nucleotides 6-22 of SEQ ID NO: 161, nucleotides 3-22 of SEQ ID NO: 162, nucleotides 8-28 of SEQ ID NO: 163, nucleotides 3-28 of SEQ ID NO: 164, nucleotides 5-25 of SEQ ID NO: 165, nucleotides 5-26 of SEQ ID NO: 166, nucleotides 5-20 of SEQ ID NO: 167, nucleotides 4-22 of SEQ ID NO: 168, nucleotides 7-22 of SEQ ID NO: 169, nucleotides 3-22 of SEQ ID NO: 170, nucleotides 7-28 of SEQ ID NO: 171, nucleotides 6-27 of SEQ ID NO: 172, nucleotides 7-29 of SEQ ID NO: 173, nucleotides 5-27 of SEQ ID NO: 174, nucleotides 7-29 of SEQ ID NO: 175, nucleotides 6-28 of SEQ ID NO: 176, nucleotides 4-23 of SEQ ID NO: 177, nucleotides 4-34 of SEQ ID NO: 178, nucleotides 3-27 of SEQ ID NO: 179, nucleotides 2-27 of SEQ ID NO: 180, nucleotides 5-33 of SEQ ID NO: 181, nucleotides 3-30 of SEQ ID NO: 182, nucleotides 9-34 of SEQ ID NO: 183, and nucleotides 8-28 of SEQ ID NO: 184.

86. The kit of claim 85, wherein the polynucleotide comprises a sequence selected from the group consisting of SEQ ID NO: 135 through SEQ ID NO: 184.

87. The kit of claim 86, wherein the polynucleotide consists of a sequence selected from the group consisting of SEQ ID NO: 135 through SEQ ID NO: 184.

88. The kit of claim 87, wherein the polynucleotide consists of SEQ ID NO: 184 and the set of polynucleotides is Set-29.

89. A method of detecting β -actin in a test sample, the method comprising:

- (a) extracting nucleic acid from the test sample;
- (b) amplifying a target sequence by reacting nucleic acid extracted in step (a) for less than ten minutes with a reaction mixture comprising a strand displacement DNA polymerase and a sequence specific LAMP primer set; and
- (c) detecting the presence or absence of an amplified product of step (b); wherein the presence of said amplification product is indicative of the presence of β -actin in the test sample.

90. The method of claim 89, wherein the amplifying step comprises reacting the nucleic acid extracted in step (a) with a reaction mixture comprising a strand displacement DNA polymerase and a sequence-specific primer set, wherein said sequence-specific primer set is selected from the group consisting of Set-1 through Set-29.

91. The method of claim 90, wherein detecting the presence or absence of the amplification product comprises hybridizing the amplified product with a molecular beacon comprising a polynucleotide sequence selected from the group consisting of SEQ ID NO: 135 through SEQ ID NO: 184.

92. The method of claim 90, wherein detecting the presence or absence of the amplification product comprises hybridizing the amplified product with a molecular beacon comprising a polynucleotide sequence selected from the group consisting of SEQ ID NO: 147, SEQ ID NO: 148, SEQ ID NO: 149, SEQ ID NO: 150, SEQ ID NO: 155, SEQ ID NO: 156, SEQ ID NO: 165, SEQ ID NO: 166, SEQ ID NO: 167, SEQ ID NO: 168, SEQ ID NO: 169, SEQ ID NO: 171, SEQ ID NO: 172, SEQ ID NO: 173, SEQ ID NO: 174, SEQ ID NO: 175, SEQ ID NO: 176, SEQ ID NO: 183, and SEQ ID NO: 184.