

developing improved DNA extraction compositions and methods that are particularly suitable for extracting DNA from urine samples.

SUMMARY

[006] The present disclosure provides compositions for storing a urine sample obtained from a subject. In one aspect, the present disclosure refers to a composition for storing a urine sample obtained from a subject, wherein the composition comprises a pH buffer, a chelating agent, and a surfactant. In some examples, the compositions comprise, comprise essentially of, or consist of a pH buffer, a chelating agent, and a surfactant.

[007] In some examples, the pH buffer is configured to adjust a pH of the composition to within a preselected range. In some examples, the pH buffer comprises acetic acid and a salt of acetic acid. In some examples, the preselected range of pH is about 5.0 to 6.5. In some examples, the pH of the composition is about 6.0.

[008] In some examples, the salt of acetic acid is sodium acetate. In some examples, the sodium acetate has a concentration of about 0.5 to 1.0 mol/L, for example, about 0.5-0.7 mol/L, or about 0.6-0.7 mol/L.

[009] In some examples, the chelating agent is an aminopolycarboxylic acid. In some examples, chelating agent is ethylenediaminetetraacetic acid (EDTA). In some examples, the EDTA has a concentration of about 10 to 20 mmol/L, for example, about 15-20 mmol/L, about 16-20 mmol/L or about 16-18 mmol/L.

[010] In some examples, the surfactant is an anionic surfactant. In some examples, the anionic surfactant is a salt of dodecyl hydrogen sulfate. In some examples, the salt is a sodium salt, and the anionic surfactant is sodium docecyl sulfate (SDS). In some examples, the SDS has a concentration of about 5% to 10% (m/v), for example, about 5%-8%, about 5%-7%, about 6%-8%, or about 6%-7%.

[011] In some examples, the composition does not contain a preservative, a cell fixative, or a formaldehyde quencher.

[012] The present disclosure also provides a processed urine sample. In another aspect, the present disclosure refers to a processed urine sample for storage, wherein the processed urine sample comprises a urine sample collected from a subject, a pH buffer, a chelating agent, and a surfactant. The urine sample can be used for DNA extraction right away, or after being stored. In some examples, the processed urine sample comprises a urine sample collected from a subject, a pH buffer, a chelating agent, and a surfactant. In some examples, the pH buffer is configured to adjust a pH of the composition to within a preselected range. In some examples, the pH buffer comprises acetic acid and a salt of acetic acid. In some examples, the salt of acetic acid is sodium acetate.

[013] In some examples, the preselected range of pH is about 5.0 to 6.5. In some examples, the pH of the composition is about 6.0. In some examples, the sodium acetate in the processed urine sample has a concentration of about 0.05 to 0.1 mol/L, for example, about 0.05-0.07 mol/L, or about 0.06-0.07 mol/L. In some examples, the chelating agent is an aminopolycarboxylic acid. In some examples, the chelating agent is ethylenediaminetetraacetic acid (EDTA). In some examples, the EDTA has a concentration of about 1 to 2.5 mmol/L, for example, about 1.5-2 mmol/L, about 1.6-2 mmol/L or about 1.6-1.8 mmol/L. In some examples, the surfactant is an anionic surfactant. In some examples, the anionic surfactant is a salt of dodecyl hydrogen sulfate. In some examples, the salt is a sodium salt, and the anionic surfactant is sodium dodecyl sulfate (SDS). In some examples, the SDS has a concentration of about 0.5% to 1.5% (m/v), for example, about 0.5%-0.8%, about 0.5%-0.7%, about 0.6%-0.8%, or about 0.6%-0.7%. In some examples, the processed urine sample does not contain a preservative, a cell fixative, or a formaldehyde quencher.

[014] The present disclosure further provides methods for producing a processed urine sample for storage. In another aspect, the present disclosure refers to a method for producing a processed urine sample for storage, comprising mixing a urine sample collected from a subject with a pH buffer, a chelating agent, and a surfactant, or with a composition as disclosed herein. In some examples, the methods comprise mixing a urine sample collected from a subject with a pH buffer, a chelating agent, and a surfactant, or with a composition of the present disclosure as described herein.

[015] The present disclosure further provides methods for storing a urine sample collected from a subject. In another aspect, the present disclosure refers to a method for storing a urine sample collected from a subject, comprising mixing the urine sample collected from the subject with a pH buffer, a chelating agent, and a surfactant to produce a urine sample ready for storage. In some examples, the methods comprise mixing the urine sample collected from the subject with a pH buffer, a chelating agent, and a surfactant, or with a composition of the present disclosure as described herein to produce a urine sample ready for storage. In some examples, the pH buffer, the chelating agent, and the surfactant are provided in a mixture before they are mixed with the urine sample collected from the subject, such as a composition of the present disclosure as described herein. In some examples, the urine sample collected from the subject contains cells of the subject and at least one viral pathogen, and both the cells and the viral pathogen are lysed after the urine sample is ready for storage. In some examples, the viral pathogen is a Human papillomavirus (HPV). In some examples, comprising storing the urine sample ready for storage at a predetermined temperature, such as 4°C, -20°C, -80°C, or at room temperature. In some examples, DNA content in the urine sample is stable after a 15-day to 30-day storage time. In some examples, DNA content in the urine sample is stable after a 1-week to 2-week storage time.

[016] The present disclosure further provides methods for detecting the presence or absence of one or more analytes in a urine sample collected from a subject. In another aspect, the present disclosure

refers to a method for detecting the presence or absence of one or more analytes in a urine sample collected from a subject, wherein the method comprises using a processed urine sample as disclosed herein. In some examples, the methods comprise using a processed urine sample as described herein. In some examples, the analyte is a virus or any DNA molecule derive from the virus. In some examples, the virus is a HPV. In some examples, the detection of the analyte comprises detecting DNA of the virus.

[017] The present disclosure further provides a collection of compositions and kits for extracting DNA from a urine sample of a subject. In some examples, the compositions or kits comprise, comprise essentially of, or consist of a lysis solution, magnetic nanoparticles, a protease, a first washing buffer, a second washing buffer, an elution buffer, or any combination thereof.

[018] In some examples, the lysis solution comprises guanidinium isothiocyanate, Triton X 100, Tris-HCl, EDTA, isopropanol, or any combination thereof. In some examples, the guanidinium isothiocyanate has a concentration of about 2 to 6 M. In some examples, the Triton X 100 has a concentration of about 1 to 5%. In some examples, the Tris-HCl has a concentration of about 20 to 50 mM, wherein the lysis solution has a pH of about 6.5. In some examples, the EDTA has a concentration of about 10 to 50 mM. In some examples, isopropanol is added after all other components are mixed together. In some examples, the isopropanol has a dosage of about 50% to 200% (v/v).

[019] In some examples, the guanidinium isothiocyanate has a concentration of about 2 to 6 M, the Triton X-100 has a concentration of about 1 to 5%, the Tris-HCl has a concentration of about 20 to 50 mM, the lysis solution has a pH of about 6.5, the EDTA has a concentration of about 10 to 50 mM, or any combination thereof. In some examples, the lysis solution comprises guanidinium isothiocyanate, Triton X-100, Tris-HCl, and EDTA. In some examples, the lysis solution further comprises isopropanol. In some examples, the isopropanol has a dosage of about 50% to 200% (v/v) of the lysis solution.

[020] In some examples, the guanidinium isothiocyanate has a concentration of about 1 to 2 M, the Triton X-100 has a concentration of about 1 to 2%, the Tris-HCl has a concentration of about 5 to 10 mM, the lysis solution has a pH of about 6-7, the EDTA has a concentration of about 3 to 5 mM, the isopropanol has a volume of about 50% to 80% of the lysis solution, or any combination thereof. In some examples, the guanidinium isothiocyanate has a concentration of about 1.67 M, the Triton X-100 has a concentration of about 1.33%, the Tris-HCl has a concentration of about 8.33 mM, the lysis solution has a pH of about 6.5, the EDTA has a concentration of about 3.33 mM, the isopropanol has a volume of about 66.7% of the lysis solution, or any combination thereof.

[021] In some examples, the magnetic nanoparticles have an inner core layer and an outer shell layer. In some examples, the inner core layer is composed of core-shell type magnetic nanoparticles,

wherein the outer shell layer is composed of SiO₂. In some examples, the magnetic nanoparticles have a diameter of about 100 to 1000 nm, and a concentration of about 50 mg/ml. In some examples, the magnetic nanoparticles have a volume of about 10-20 μ L, for example, about 20 μ L.

[022] In some examples, the first washing buffer comprises guanidinium isothiocyanate, Tris-HCl, NaCl, and ethanol. In some examples, the guanidinium isothiocyanate has a concentration of about 50 mM. In some examples, the Tris-HCl has a concentration of about 20 to 50 mM. In some examples, the first washing buffer has a pH of about 5.0. In some examples, the NaCl has a concentration of about 50 to 200 mM. In some examples, the ethanol has concentration of about 40% to 60% (v/v).

[023] In some examples, the second washing buffer comprises Tris-HCl and ethanol. In some examples, the Tri-HCl in the second washing buffer has a concentration of about 10 to 50 mM., and the second washing buffer has a pH of about 6.0. In some examples, the ethanol has concentration of about 70% to 80% (v/v).

[024] In some examples, the elution buffer is a Tris-EDTA buffer having a pH of about 8.0.

[025] In some examples, the protease is protease K. In some examples, the protease K has a concentration of about 10 to 20 mg/ml. In some examples, the protease K has a dosage of about 2.5 to 25 μ g, for example, about 25 μ g.

[026] The present disclosure further provides methods for extracting DNA from a urine sample of a subject, comprises using a kit or a collection of compositions for DNA extraction as described herein.

[027] The present disclosure further provides methods for extracting DNA from a urine sample of a subject. In some examples, the methods comprise, comprise essentially of, or consist of : (1) contacting the urine sample with magnetic nanoparticles and a protease to produce a pre-treated urine sample; (2) lysing the pre-treated urine sample obtained in step (1) in a lysis solution to produce a lysed urine sample; (3) washing the magnetic nanoparticles containing DNA from urine samples obtained in step (2) with a first washing buffer; (4) washing the magnetic nanoparticles containing DNA from urine samples obtained in step (3) with a second washing buffer; (5) washing off DNA from the magnetic nanoparticles collected in step (4) with a elution buffer to obtain the extracted DNA. In some examples, the lysis solution, the magnetic nanoparticles, the first washing buffer, the second washing buffer, the elution buffer, the protease are those described in the present disclosure herein.

[028] In some examples, step (1) in the methods for DNA extraction comprises (a) contacting the urine sample with the magnetic nanoparticles to form a mixture; (b) centrifuging the mixture or utilizing magnetic separation device to form a precipitate and a supernatant; (c) contacting the precipitate with the protease to form a reaction system; and (d) heating the reaction system under suitable conditions for a predetermined time.

[029] In some examples, steps (3), (4), and/or (5) in the methods for DNA extraction comprise using a magnetic frame or an automatic nucleic acid extraction instrument.

[030] The present disclosure provides methods for detecting the presence or absence of an analyte in a urine sample collected from a subject. In another aspect, the present disclosure refers to a method for detecting the presence or absence of an analyte in a urine sample collected from a subject, wherein the method comprises: (1) using a processed urine sample of any one of claims 16 to 30; and (2) extracting DNA from the processed urine sample, comprising: (a) contacting the urine sample with magnetic nanoparticles and a protease to produce a pre-treated urine sample; (b) lysing the pre-treated urine sample obtained in step (a) in a lysis solution to produce a lysed urine sample; (c) washing the magnetic nanoparticles obtained in step (b) with a first washing buffer; (d) washing the magnetic nanoparticles obtained in step (c) with a second washing buffer; (e) collecting magnetic nanoparticles in the urine sample obtained in step (d); and (f) washing off DNA from the collected magnetic nanoparticles obtained in step (e) with an elution buffer to obtain extract DNA. In some examples, the methods comprises using DNA extracted from the urine sample using a kit or a collection of composition as described herein. In some examples, the analyte is a virus, such as a HPV. In some examples, the detection of the analyte comprises detecting DNA of the virus.

[031] The present disclosure provides methods for detecting the presence or absence of an analyte in a urine sample collected from a subject. In some examples, the methods comprise using a processed urine sample as described herein. In some examples, the methods further comprise extracting DNA from the processed urine sample. In some examples, the step of extracting DNA from a sample comprises (a) contacting the urine sample with magnetic nanoparticles and a protease to produce a pre-treated urine sample; (b) lysing the pre-treated urine sample obtained in step (a) in a lysis solution to produce a lysed urine sample; (c) washing the magnetic nanoparticles containing DNA from urine samples obtained in step (b) with a first washing buffer; (d) washing the magnetic nanoparticles containing DNA from urine samples obtained in step (c) with a second washing buffer; (e) washing off DNA from the magnetic nanoparticles collected in step (d) with a elution buffer to obtain the extracted DNA. In some examples, the lysis solution, the magnetic nanoparticles, the first washing buffer, the second washing buffer, the elution buffer, the protease are those described in the present disclosure herein.

[032] In some examples, the methods for detecting the presence or absence of an analyte in a urine sample of a subject further comprises treating the subject based on the presence or absence of the analyte in the urine sample.

[033] The present disclosure further provides methods for extracting DNA from a urine sample of a subject. In some examples, the methods comprise using a kit as described herein. In some examples, the methods comprise: (1) contacting the urine sample with magnetic nanoparticles and a protease to

produce a pre-treated urine sample; (2) lysing the pre-treated urine sample obtained in step (1) in a lysis solution to produce a lysed urine sample; (3) washing the magnetic nanoparticles obtained in step (2) with a first washing buffer; (4) washing the magnetic nanoparticles obtained in step (3) with a second washing buffer; (5) collecting magnetic nanoparticles in the urine sample obtained in step (4); and (6) washing off DNA from the collected magnetic nanoparticles obtained in step (5) with an elution buffer to obtain extracted DNA.

[034] In some examples, the lysis solution comprises guanidinium isothiocyanate, Triton X-100, Tris-HCl, EDTA and isopropanol. In some examples, the guanidinium isothiocyanate has a concentration of about 1 to 2 M. In some examples, the Triton X 100 has a concentration of about 1 to 2%. In some examples, the Tris-HCl has a concentration of about 5 to 10 mM. In some examples, the lysis solution has a pH of about 6-7. In some examples, the EDTA has a concentration of about 3 to 5 mM. In some examples, the isopropanol has a volume of about 50% to 80% (v/v) of the lysis solution.

[035] In some examples, the magnetic nanoparticles have an inner core layer and an outer shell layer, wherein the inner core layer is composed of core-shell type magnetic nanoparticles, wherein the outer shell layer is composed of SiO₂, and the magnetic nanoparticles have a diameter of about 100 to 1000 nm, and a concentration of about 50 mg/ml.

[036] In some examples, the first washing buffer comprises guanidinium isothiocyanate, Tris-HCl, NaCl, and ethanol. In some examples, the guanidinium isothiocyanate has a concentration of about 50 to 100 mM. In some examples, the Tris-HCl has a concentration of about 20 to 50 mM. In some examples, the first washing buffer has a pH of about 5.0. In some examples, the NaCl has a concentration of about 50 to 200 mM. In some examples, the ethanol has concentration of about 40% to 60% (v/v).

[037] In some examples, the second washing buffer comprises Tris-HCl and ethanol. In some examples, the Tri-HCl in the second washing buffer has a concentration of about 10 to 50 mM. In some examples, the second washing buffer has a pH of about 6.0. In some examples, the ethanol has a concentration of about 70% to 80% (v/v).

[038] In some examples, the elution buffer is a Tris-EDTA buffer having a pH of about 8.0. In some examples,

[039] In some examples, the protease is protease K, wherein the protease K has a concentration of about 10 to 20 mg/ml.

[040] In some examples, the step (1) of the methods for extracting DNA from a urine sample (“contacting the urine sample with magnetic nanoparticles and a protease to produce a pre-treated urine sample”) comprises: (a) contacting the urine sample with the magnetic nanoparticles to form a mixture; (b) centrifuging the mixture or utilizing magnetic separation device to form a precipitate and

a supernatant; (c) contacting the precipitate with the protease to form a reaction system; and (d) heating the reaction system under suitable conditions for a predetermined time.

[041] In some examples, the steps of washing and/or collecting magnetic nanoparticles in the methods for extracting DNA from a urine sample of a subject comprise using a magnetic frame or an automatic nucleic acid extraction instrument.

[042] The present disclosure further provides methods for detecting the presence or absence of an analyte in a urine sample collected from a subject. In some examples, the methods comprise using DNA extracted from the urine sample using a kit as described herein. In some examples, the analyte is a virus. In some examples, the virus is an HPV. In some examples, the detection of the analyte comprises detecting DNA of the virus.

[043] The present disclosure further provides methods for detecting the presence or absence of an analyte in a urine sample collected from a subject. In some examples, the methods comprise: (1) using a processed urine sample of any one of claims 16 to 30; and (2) extracting DNA from the processed urine sample, which comprises: (a) contacting the urine sample with magnetic nanoparticles and a protease to produce a pre-treated urine sample; (b) lysing the pre-treated urine sample obtained in step (a) in a lysis solution to produce a lysed urine sample; (c) washing the magnetic nanoparticles obtained in step (b) with a first washing buffer; (d) washing the magnetic nanoparticles obtained in step (c) with a second washing buffer; (e) collecting magnetic nanoparticles in the urine sample obtained in step (d); and (f) washing off DNA from the collected magnetic nanoparticles obtained in step (e) with an elution buffer to obtain extract DNA.

[044] In some examples, the lysis solution comprises guanidinium isothiocyanate, Triton X-100, Tris-HCl, EDTA, and isopropanol. In some examples, the guanidinium isothiocyanate has a concentration of about 1 to 2 M. In some examples, the Triton X 100 has a concentration of about 1 to 2%. In some examples, the Tris-HCl has a concentration of about 5 to 10 mM. In some examples, the lysis solution has a pH of about 6-7. In some examples, the EDTA has a concentration of about 3 to 5 mM. In some examples, the isopropanol has a volume of about 50% to 80% (v/v) of the lysis solution.

BRIEF DESCRIPTION OF THE FIGURES

[045] **Figure 1** depicts fluorescence quantitative PCR amplification curve of β -actin gene in urine samples with or without being processed by a storage reagent of the present disclosure.

[046] **Figure 2** depicts change of β -actin internal standard in urine samples processed by urine storage reagent at 4 °C during 0-4 weeks after the urine samples were mixed with the urine storage reagent.

[047] **Figure 3** depicts change of β -actin internal standard in urine samples processed by urine storage reagent at room temperature during 0-4 weeks after the urine samples were mixed with the urine storage reagent.

[048] **Figure 4** depicts change of HPV gene in urine samples processed by urine storage reagent at 4 °C during 0-4 weeks after the urine samples were mixed with the urine storage reagent.

[049] **Figure 5** depicts change of HPV gene in urine samples processed by urine storage reagent at room temperature during 0-4 weeks after the urine samples were mixed with the urine storage reagent.

[050] **Figures 6A to Figure 6D** depict amplification curves of β -actin gene or HPV gene in DNA extracted from urine samples using different methods/kits. Figures 6A and 6B compare reagents and methods of the present disclosure to Quick-DNA Urine Kit (ZYMO RESEARCH, D3061). Figures 6C and 6D compare reagents and methods of the present disclosure to the magnetic bead urinary genomic DNA extraction kit (Enriching biotechnology, UDE-5005), and FineMag large-volume magnetic bead - DNA extraction kit for plasma free DNA (Genefine Biotech, FM107).

CLAIMS

1. A composition for storing a urine sample obtained from a subject, wherein the composition comprises a pH buffer, a chelating agent, and a surfactant.
2. The composition of claim 1, wherein the pH buffer is configured to adjust a pH of the composition to within a preselected range.
3. The composition of claim 1, wherein the pH buffer comprises acetic acid and a salt of acetic acid.
4. The composition of claim 3, wherein the salt of acetic acid is sodium acetate.
5. The composition of claim 2, wherein the preselected range of pH is about 5.0 to 6.5.
6. The composition of claim 5, wherein the pH of the composition is about 6.0.
7. The composition of claim 4, wherein the sodium acetate has a concentration of about 0.5 to 1.0 mol/L.
8. The composition of claim 1, wherein the chelating agent is an aminopolycarboxylic acid.
9. The composition of claim 8, wherein the chelating agent is ethylenediaminetetraacetic acid (EDTA).
10. The composition of claim 8, wherein the EDTA has a concentration of about 10 to 25 mmol/L.
11. The composition of claim 1, wherein the surfactant is an anionic surfactant.
12. The composition of claim 11, wherein the anionic surfactant is a salt of dodecyl hydrogen sulfate.

13. The composition of claim 11, wherein the salt is a sodium salt, and the anionic surfactant is sodium dodecyl sulfate (SDS).
14. The composition of claim 1, wherein the SDS has a concentration of about 5% to 10% (m/v).
15. The composition of claim 1, wherein the composition does not contain a preservative, a cell fixative, or a formaldehyde quencher.
16. A processed urine sample for storage, wherein the processed urine sample comprises a urine sample collected from a subject, a pH buffer, a chelating agent, and a surfactant.
17. The processed urine sample for storage of claim 16, wherein the pH buffer is configured to adjust a pH of the composition to within a preselected range.
18. The processed urine sample for storage of claim 16, wherein the pH buffer comprises acetic acid and a salt of acetic acid.
19. The processed urine sample for storage of claim 18, wherein the salt of acetic acid is sodium acetate.
20. The processed urine sample for storage of claim 17, wherein the preselected range of pH is about 5.0 to 6.5.
21. The processed urine sample for storage of claim 20, wherein the pH of the composition is about 6.0.
22. The processed urine sample for storage of claim 19, wherein the sodium acetate in the processed urine sample has a concentration of about 0.05 to 0.1 mol/L.
23. The processed urine sample for storage of claim 1, wherein the chelating agent is an aminopolycarboxylic acid.

24. The processed urine sample for storage of claim 23, wherein the chelating agent is ethylenediaminetetraacetic acid (EDTA).
25. The processed urine sample for storage of claim 24, wherein the EDTA has a concentration of about 1 to 2.5 mmol/L.
26. The processed urine sample for storage of claim 16, wherein the surfactant is an anionic surfactant.
27. The processed urine sample for storage of claim 26, wherein the anionic surfactant is a salt of dodecyl hydrogen sulfate.
28. The processed urine sample for storage of claim 26, wherein the salt is a sodium salt, and the anionic surfactant is sodium docecyl sulfate (SDS).
29. The processed urine sample for storage of claim 16, wherein the SDS has a concentration of about 0.5% to 1.5% (m/v).
30. The processed urine sample of claim 16, wherein the processed urine sample does not contain a preservative, a cell fixative, or a formaldehyde quencher.
31. A method for producing a processed urine sample for storage, comprising mixing a urine sample collected from a subject with a pH buffer, a chelating agent, and a surfactant, or with a composition of any one of claims 1 to 15.
32. The method of claim 31, wherein the pH buffer comprises acetic acid and a sodium acetate.
33. The method of claim 32, wherein the sodium acetate in the processed urine sample has a concentration of about 0.05 to 0.1 mol/L.
34. The method of claim 31, wherein the chelating agent is EDTA.

35. The method of claim 34, wherein the EDTA in the processed urine sample has a concentration of about 1 to 2.5 mmol/L.
36. The method of claim 31, wherein the surfactant is SDS.
37. The method of claim 36, wherein the SDS in the processed urine sample has a concentration of about 0.5% to 1.5% (m/v).
38. A method for storing a urine sample collected from a subject, comprising mixing the urine sample collected from the subject with a pH buffer, a chelating agent, and a surfactant to produce a urine sample ready for storage.
39. The method of claim 38, wherein the pH buffer, the chelating agent, and the surfactant are provided in a mixture before they are mixed with the urine sample collected from the subject.
40. The method of claim 39, wherein the pH buffer is configured to adjust a pH of the composition to within a preselected range.
41. The method of claim 38, wherein the pH buffer comprises acetic acid and a salt of acetic acid.
42. The method of claim 41, wherein the salt of acetic acid is sodium acetate.
43. The method of claim 40, wherein the preselected range of pH is about 5.0 to 6.5.
44. The method of claim 43, wherein the pH of the composition is about 6.0.
45. The method of claim 42, wherein the sodium acetate in the urine sample ready for storage has a concentration of about 0.05 to 0.1 mol/L.
46. The method of claim 38, wherein the chelating agent is an aminopolycarboxylic acid.
47. The method of claim 46, wherein the chelating agent is ethylenediaminetetraacetic acid (EDTA).

48. The method of claim 47, wherein the EDTA in the urine sample ready for storage has a concentration of about 1 to 2.5 mmol/L.

49. The method of claim 38, wherein the surfactant is an anionic surfactant.

50. The method of claim 49, wherein the anionic surfactant is a salt of dodecyl hydrogen sulfate.

51. The method of claim 50, wherein the salt is a sodium salt, and the anionic surfactant is sodium docecyl sulfate (SDS).

52. The method of claim 51, wherein the SDS in the urine sample ready for storage has a concentration of about 0.5% to 1.5% (m/v).

53. The method of claim 38, wherein the urine sample ready for storage does not contain a preservative, a cell fixative, or a formaldehyde quencher.

54. The method of claim 38, wherein the urine sample collected from the subject contains cells of the subject and at least one viral pathogen, and both the cells and the viral pathogen are lysed after the urine sample is ready for storage.

55. The method of claim 54, wherein the viral pathogen is a Human papillomavirus (HPV).

56. The method of claim 38, comprising storing the urine sample ready for storage at 4°C.

57. The method of claim 38, comprising storing the urine sample ready for storage at room temperature.

58. The method of claim 56, wherein DNA content in the urine sample is stable after a 15-day to 30-day storage time.

59. The method of claim 57, wherein DNA content in the urine sample is stable after a 1-week to 2-week storage time.

60. A method for detecting the presence or absence of one or more analytes in a urine sample collected from a subject, wherein the method comprises using a processed urine sample of any one of claims 16 to 30.

61. The method of claim 60, wherein the analyte is a virus.

62. The method of claim 61, wherein the virus is a HPV.

63. The method of claim 61, wherein the detection of the analyte comprises detecting DNA of the virus.

64. A method for detecting the presence or absence of an analyte in a urine sample collected from a subject, wherein the method comprises:

(1) using a processed urine sample of any one of claims 16 to 30; and

(2) extracting DNA from the processed urine sample, comprising:

(a) contacting the urine sample with magnetic nanoparticles and a protease to produce a pre-treated urine sample;

(b) lysing the pre-treated urine sample obtained in step (a) in a lysis solution to produce a lysed urine sample;

(c) washing the magnetic nanoparticles obtained in step (b) with a first washing buffer;

(d) washing the magnetic nanoparticles obtained in step (c) with a second washing buffer;

(e) collecting magnetic nanoparticles in the urine sample obtained in step (d); and

(f) washing off DNA from the collected magnetic nanoparticles obtained in step (e) with an elution buffer to obtain extract DNA.

65. The method of claim 64, wherein the lysis solution comprises guanidinium isothiocyanate, Triton X-100, Tris-HCl, EDTA, and isopropanol, wherein the guanidinium isothiocyanate has a concentration of about 1 to 2 M; wherein the Triton X 100 has a concentration of about 1 to 2%;

wherein the Tris-HCl has a concentration of about 5 to 10 mM and the lysis solution has a pH of about 6-7;

wherein the EDTA has a concentration of about 3 to 5 mM;

and

wherein the isopropanol has a volume of about 50% to 80% (v/v) of the lysis solution.