[0014a] In one aspect of the present disclosure, there is provided a method of extracting cell-free DNA and microvesicular RNA from a biological sample comprising:

(a) providing a biological sample;

(b) contacting the biological sample with a capture surface under conditions sufficient to retain cell-free DNA and microvesicles from the biological sample on or in the capture surface, wherein the capture surface comprises three membranes that are positively charged and functionalized with quaternary ammonium;

(c) contacting the capture surface with a phenol-based lysis reagent while cell-free DNA and the microvesicles are on or in the capture surface, thereby releasing the cell-free DNA and microvesicular RNA from the sample and producing a homogenate; and

(d) extracting the cell-free DNA, the microvesicular RNA, or both the cell-free DNA and microvesicular RNA from the homogenate.

[0014b] In another aspect of the present disclosure, there is provided a method of extracting cell-free DNA and microvesicular RNA from a biological sample comprising:

(a) providing a biological sample;

(b) contacting the biological sample with a capture surface under conditions sufficient to retain cell-free DNA and microvesicles from the biological sample on or in the capture surface, wherein the capture surface comprises one or more beads that are positively charged and functionalized with quaternary ammonium ;

(c) contacting the capture surface with a phenol-based lysis reagent while cell-free DNA and the microvesicles are on or in the capture surface, thereby releasing the cell-free DNA and microvesicular RNA from the sample and producing a homogenate; and

(d) extracting the cell-free DNA, the microvesicular RNA, or both the cell-free DNA and microvesicular RNA from the homogenate.

[0015] In some embodiments, the capture surface is a membrane. In one embodiment, the membrane comprises regenerated cellulose. For example, the membrane has a pore size at least 1 μm, such as for example, in a range between 2-5 μm. In some embodiments, the membrane has a pore size in a range between 3-5 μm. In some embodiments, the membrane comprises polyethersulfone (PES).

What is claimed is:

1. A method of extracting cell-free DNA and microvesicular RNA from a biological sample comprising:

(a) providing a biological sample;

(b) contacting the biological sample with a capture surface under conditions sufficient to retain cell-free DNA and microvesicles from the biological sample on or in the capture surface, wherein the capture surface comprises three membranes that are positively charged and functionalized with quaternary ammonium;

(c) contacting the capture surface with a phenol-based lysis reagent while cell-free DNA and the microvesicles are on or in the capture surface, thereby releasing the cell-free DNA and microvesicular RNA from the sample and producing a homogenate; and

(d) extracting the cell-free DNA, the microvesicular RNA, or both the cell-free DNA and microvesicular RNA from the homogenate.

2. The method of claim 1, wherein step (d) comprises adding chloroform to the homogenate.

3. The method of claim 1, wherein each of the membranes is an anion exchanger functionalized with quaternary ammonium $R\text{-}CH_2\text{-}N^+(CH_3)_3$.

4. The method of any of claims 1 to 3, wherein the membrane has a pore size of at least 3 μm.

5. The method of any one of claims 1 to 4, wherein said three membranes are directly adjacent to one another.

6. The method of any one of claims 1 to 5, wherein the three membranes are identical to each other.

7. The method of any one of claims 1 to 6, wherein each of the three membranes comprises regenerated cellulose.

8. The method of any one of claims 1 to 3, 5 to 7, wherein each of the three membranes has a pore size in a range between 2-5 μm.

9. A method of extracting cell-free DNA and microvesicular RNA from a biological sample comprising:

(a) providing a biological sample;

(b) contacting the biological sample with a capture surface under conditions sufficient to retain cell-free DNA and microvesicles from the biological sample on or in the capture surface, wherein the capture surface comprises one or more beads that are positively charged and functionalized with quaternary ammonium ;

(c) contacting the capture surface with a phenol-based lysis reagent while cell-free DNA and the microvesicles are on or in the capture surface, thereby releasing the cell-free DNA and microvesicular RNA from the sample and producing a homogenate; and

(d) extracting the cell-free DNA, the microvesicular RNA, or both the cell-free DNA and microvesicular RNA from the homogenate.

10. The method of claim 9, wherein step (d) comprises adding chloroform to the homogenate.

11. The method of claim 9, wherein the one or more beads are an anion exchanger functionalized with quaternary ammonium $R\text{-}CH_2\text{-}N^+(CH_3)_3$.

12. The method of any one of claims 1 to 11, wherein the biological sample is plasma or serum.

13. The method of any one of claims 1 to 12, wherein the biological sample is between 0.2 to 4 mL.

14. The method of any one of claims 1 to 13, wherein the biological sample is urine, cerebrospinal fluid or cell culture supernatant.

15. The method of any one of claims 1 to 14, wherein step (a) further comprises processing the biological sample by filtering the biological sample.

16. The method of claim 15, wherein the filtration is performed using a 0.8 µm filter.

17. The method of any one of claims 1 to 16, wherein step (b) further comprises a centrifugation step after contacting the biological sample with the capture surface.

18. The method of any one of claims 1 to 17, wherein step (b) further comprises washing the capture surface after contacting the biological sample with the capture surface.

19. The method of any one of claims 1 to 18, wherein step (c) further comprises a centrifugation step after contacting the capture surface with the phenol-based lysis reagent.

20. The method of any one of claims 2 or 10, further comprising adding a control to the homogenate prior to adding chloroform to the homogenate.

21. The method of any one of claims 1 to 20, wherein the method further comprises:
(e) ethanol conditioning of the extraction from step (d);
(f) binding of the ethanol-conditioned extraction to a silica column; and
(g) eluting the extraction from the silica column.