Determining the Potential Application of Graflex DNA Extraction Buffer for Use in Salivary Extraction in Forensic Science

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Abstract

In forensic science, one of the most important methods to identify the source of unknown body fluids is polymerase chain reaction in order to provide more DNA to compare with evidence. Although PCR can multiply nucleic acids to allow for higher quantities of yield, the process requires an adequate template, so the products used in the DNA extraction have to be as sensitive as possible.

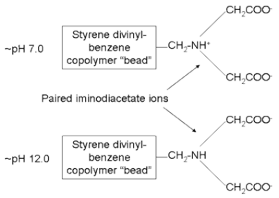
Introduction

Graflex DNA Extraction Buffer contains graphene oxide. Due to the unique, two dimensional crystal composition of graphene, its theoretical surface area is high, allowing for good mechanical strength along with enhanced conductivity and efficiency as potential benefits. (Liu, 2013). Since Graflex is designed to bind to small quantities of DNA, it acts similar to Chelex extraction, but can also be compared to Qiagen extraction as well, both of which are two of the main extraction methods used to extract DNA for forensic identification applications. Alternatively, Graflex extraction is effective in attracting and binding target nucleic acids without the use of detergents or chemical interferents, which improves recovery levels and provides better quality data. Graflex extraction buffer releases targets from surfaces and is able to concentrate them for analysis within minutes, which is much faster than current methods of extraction and has produced improved analyte recovery, giving a higher yield in one study (Alkaloid, 2007). When compared to commercial kits such as Invisorb Spin Forensic Kit Procedure and PureLink Genomic DNA Kit Procedure, Graflex showed around eight times more nucleic acid yield than DNA recovery by the PureLink or Invisorb kits. These studies are promising, but additional forensic validation and evaluation is needed before implementation as a routine method.

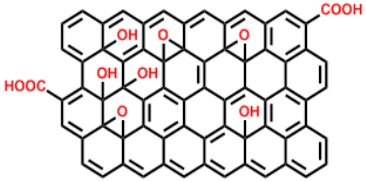
Materials

- BT Chelex 100 Resin 100g 100-200 mesh, sodium form, Lot No. 64015500
- Qiagen Protease 7.5AU Lot No. 148025584
- QIAamp DNA Mini Kit (50) Lot No. 154017844
- Graflex DNA Buffer

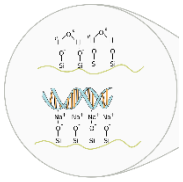
Methods



Chelex Extraction uses Chelex 100 resin which is a styrene divinylbenzene copolymer ion exchange resin.

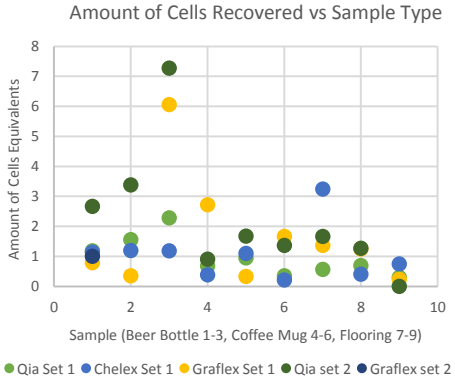


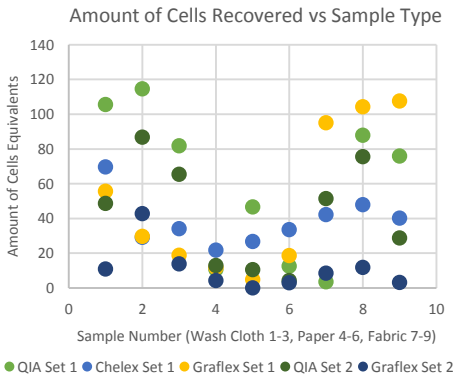
Graflex DNA is an extraction buffer composed of graphene oxide. Due to its hexagonal lattice plane of carbon atoms, it has a unique 2D crystalline composition that is only a few atoms thick. Its theoretical surface area is high, allowing for good mechanical strength, enhanced conductivity and efficiency.



Qiagen Extraction is a silica capture-salting out procedure.

Results





Cell Equivalents Recovered vs Sample Type

	Chelex	Qiagen	Graflex
Beer Bottle	1.1417	1.1792	0.7858
	1.1917	1.55	0.3475
	1.1833	2.2792	6.0583
	N/A	2.6667	2.4417
	N/A	3.375	3.35
	N/A	7.275	0
Coffee Mug	0.3783	0.675	2.7167
	1.1000	0.95	0.3275
	0.2050	0.3517	1.6583
	N/A	0.9	0.18
	N/A	1.6667	0.3992
	N/A	1.3667	0.41

	Chelex	Qiagen	Graflex
Laminate Flooring	3.2417	0.5625	1.3667
	0.4017	0.6875	1.2417
	0.7475	0.2921	0.2333
	N/A	1.6583	0
	N/A	1.2667	1.2333
	N/A	0	0.5333
Wash Cloth	69.6667	105.4167	55.6667
	29.0833	114.5833	29.6667
	34.0833	81.6667	18.8333
	N/A	48.6667	10.9167
	N/A	86.6667	42.6667
	N/A	65.4167	13.75

	Chelex	Qiagen	Graflex
Colored Paper	21.7500	10.6667	11.8333
	26.7500	46.6667	4.7917
	33.5000	12.4583	18.5833
	N/A	12.9167	4.175
	N/A	10.5833	0
	N/A	4.175	2.9
Blue Fabric	42.1667	3.4417	95
	47.9167	87.9167	104.1667
	40.1667	75.8333	107.5
	N/A	51.4167	8.5833
	N/A	75.4167	11.8333
	N/A	28.75	3.1833

Conclusion

After comparing the initial triplicate sample sets of Chelex, Qiagen, and Graflex DNA methods of extraction, it has been determined that Chelex produces the lowest amount of cell equivalents on average, but is the most consistent. As for Qiagen, it is currently the industry standard and has proven itself by producing the highest amount of cell equivalents on average for almost every sample set, but did show a high amount of variance. As for Graflex DNA, it produced almost as many cell equivalents on average as Qiagen for most sample sets and even produced more equivalents on a quarter of the sample sets; however, it had the most variability of the three methods. Since Graflex DNA and Qiagen competed for variability and production quantity, another sample set was testing in triplicate for both methods. The result showed that Graflex was more variable and was almost able to produce as much quantity as Qiagen.

These sets of experiments were conducted with the first product of Graflex DNA and since then, Connecticut Analytical Corporation has created an updated version which shows greater potential. A change that could improve the performance of the product is finding the ideal oxidation of graphene oxide for DNA binding. If more DNA is able to bind, yields will theoretically increase.

References

"Alkaloid Extraction Protocol." *Alkaloids – Secrets of life* (2007): 235. Web.

Liu, Li, Fazhong Zhang, Yingyan Mao, Shipeng Wen, Yong Ma, and Tao Xing. Method for Preparing a Graphene Oxide/cardbon White/rubber Nanometer Composite Material. Beijing University of Chemical Technology and Shandong Linglong Tyre Co. Ltd, assignee. Patent WO2013123800 A1. 29 Aug. 2013. Print.

Acknowledgements

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