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iSWAB-DNA: The Sample Collection Device for High-Quality Genomic DNA Compatible with Multiple Extraction Methods.

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Introduction

Genomic testing has revolutionized the field of molecular diagnostics, enabling researchers, healthcare professionals, and patient to gain valuable insights into genetics. In recent years, there has been a growing focus on noninvasive sample collection methods - buccal swabs and saliva for genomic testing. It has proved to be a valid replacement for blood samples for analyzing genomic material. Buccal swab collection was shown to have the highest compliance from the users. However, the quality of genomic material and the ratio of high-quality host DNA for downstream analysis such as PCR and genotype analysis was lower for buccal swab compared to blood samples. The iSWAB-DNA device from Mawi DNA Technologies provides an innovative solution to the challenges posed by existing oral collection methods. With its innovative non-toxic stabilization buffer, the iSWAB-DNA device blocks prokaryotic cells, slowly lyses eukaryotic cells, and stabilizes the integrity of the DNA under room temperature. Furthermore, the nature of the stabilization buffer makes it compatible with most commercially available extraction kits to generate high quality DNA. In this study, we tested buccal swab samples with four DNA extraction kits to determine their compatibility in obtaining high-quality DNA from the iSWAB-DNA device.

Methods

Sample extraction and collection:

Ten buccal swabs samples were collected in iSWAB-DNA-250 devices from ten donors according to the respective standard instructions for use (IFU). All collected samples were mixed at 12 rpm for 24 hours to simulate transportation. No incubation at 37 °C period is required prior to any extraction protocol. Samples was extracted using QIAamp Blood DNA Kit (Qiagen, Cat #51185), Mag-Bind® Blood & Tissue DNA HDQ 96 Kit (Omega Biotek, Cat# M6399-01), Chemagic DNA Saliva Kit (Perkin Elmer, Cat# CMG-1037) and Promega's Wizard DNA extraction kit (Promega, Cat# A1120, A1123, A1125 and A1620). Detailed protocols will be provided upon request.

DNA quantification and qualification:

DNA quantity and integrity was measured using Nanodrop One Microvolume UV-Vis Spectrophotometer (Thermo Fisher Scientific Cat. # ND-ONE-W4) and TapeStation 4150 System with Agilent Genomic DNA ScreenTapes (Agilent, Cat. # 5067-5365). Bacterial DNA ratio was assessed with qPCR targeting 16S rRNA gene. Detailed protocols will be provided upon request.

Results and Discussion

To help customers use the devices with their preferred DNA extraction kits, Mawi DNA Technologies has collaborated with various partners to generate application notes that provide detailed instructions on how to obtain high-quality DNA from iSWAB-DNA devices with different extraction methods. These application notes can be located on Mawi's website for both manual and automated extractions. In this study, four extraction kits including Mag-Bind® Blood & Tissue DNA HDQ, Promega's Wizard DNA, Chemagic DNA Saliva Kits and QIAamp Blood DNA extraction kits were chosen to be presented for their compatibility with iSWAB-DNA devices. Among the four kits, QIAamp Blood DNA and Promega's Wizard DNA kits are spin column-based extraction methods, Mag-Bind® Blood & Tissue DNA HDQ and Chemagic DNA Saliva kits are magnetic beads-based extraction methods. Except for the Promega's Wizard kit,

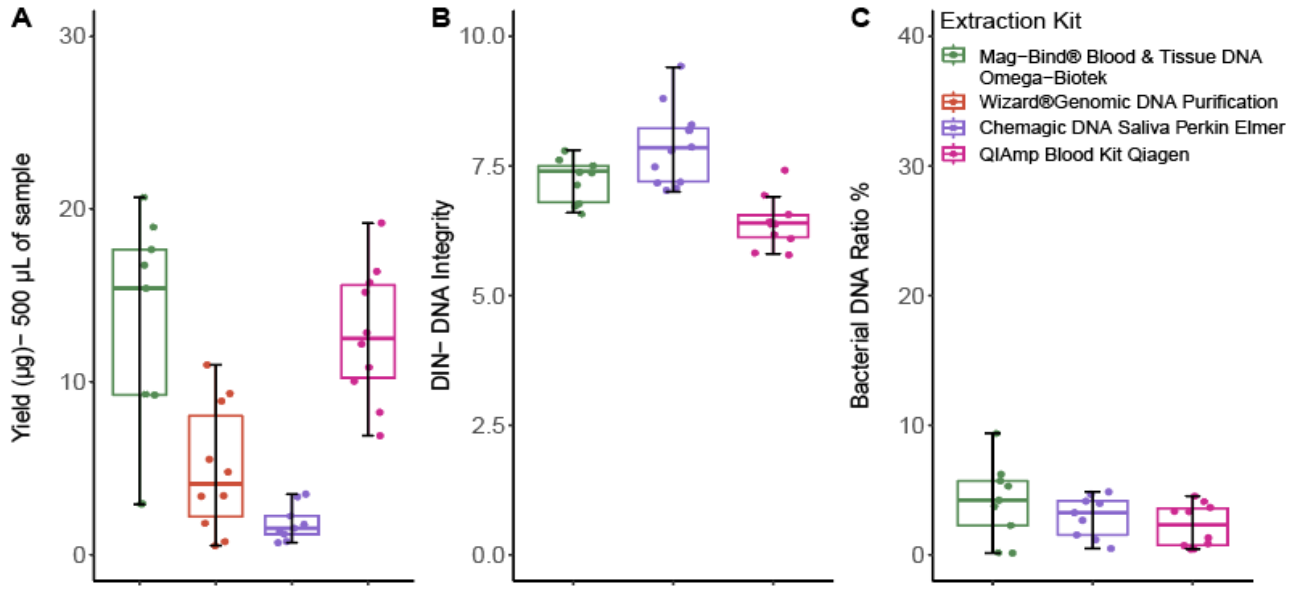

Figure 1: Internal validation extraction kits with iSWAB-DNA devices. A, DNA yield (µl) of the whole devices (iSWAB-DNA-250). B, DNA Integrity. The DIN range is typically between 1 and 10, with 10 being the highest value. C, Bacterial Ratio (%).

which is limited to manual extraction, the other three kits can be performed using both manual and automated methods.

Mag-Bind Blood & Tissue DNA kits produced the highest yield followed by QIAamp Blood Extraction Kit, Wizard DNA extraction kit and Chemagic DNA Saliva (Figure 1A). Though Chemagic DNA Saliva yielded the lowest amount of DNA, successful whole genome sequencing was confirmed through collaboration efforts.

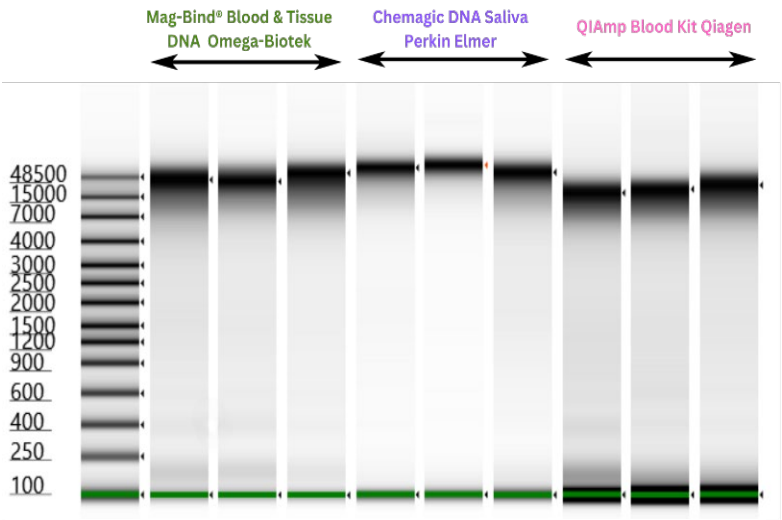

Figure 2: Gel image of purified DNA from three samples with extraction kits.

All three kits tested were shown to generate good quality of DNA supported by high DIN (Figure 1B), high molecular weight and condensed DNA bands (Figure 2) and low bacterial DNA ratio (Figure 1C). QIAamp Blood Extraction Kit had slightly lower DIN number compared to the other two extraction kits (Figure 1B). This may be attributed to the fact that the QIAamp Blood Mini Kit is a column-based extraction kit, which may cause DNA fragmentation due to the high centrifugation process during purification. The bacterial ratio of samples from all extraction kits was lower than 10%, with an average around 5-6% (Figure 1C).

Conclusion

iSWAB-DNA devices are compatible with the chemistry of most DNA extraction kits, whether spin-column based, or magnetic beads based. The purified DNA from iSWAB-DNA devices extracted using various kits has been shown to be of high quality and quantity, making it compliance for a wide range of downstream applications. The versatility of iSWAB-DNA devices provides customers with the flexibility to establish a streamlined workflow that suits their specific needs.