MAGNETIC BEAD EXTRACTION OF DNA FROM SEMEN, BLOOD, VAGINAL, AND BUCCAL CELLS: EVALUATIONS FOR A STREAMLINED DIFFERENTIAL EXTRACTION METHOD

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Nine commercially available magnetic bead products were compared with the phenol method for the extraction of DNA from semen, blood, vaginal, and buccal cells. Magnetics beads tested included BioMag® beads (Polysciences, Inc.), estapor® superparamagnetic microspheres (Bangs Laboratories, Inc.), Sera-Mag™ magnetic microparticles (Seradyne, Inc.), Sphero™ CMX-10-10, Sphero™ CM-15-10, Sphero™ CMS-40-10 (Spherotech, Inc.), GenoMag mini-prep kit (Abgene North America), Dynabeads® M-270 (Dynal), and Dynabeads® DNA DIRECT™ (Dynal). All magnetic beads, except for Dynabeads™ DNA DIRECT™ contained surface carboxylate groups. DNA is bound to the surface of carboxylated magnetic particles under conditions of high polyethylene glycol and salt concentrations. The mechanism by which Dynabeads® DNA DIRECT™ captures DNA is proprietary, and is based on the torsional strain of the DNA molecule.

Dynabeads® DNA DIRECT™ were determined to be inappropriate for use on forensic samples attached to solid substrates since maximum DNA yields are obtained from intact cells present in a liquid medium. In addition, DNA not under torsional strain, or degraded, will not be captured.

Yields of DNA extracted from ~1,500 sperm with Sphero™ CMX-10-10, CM-15-10, and CMS-40-10 magnetic beads, and the GenoMag mini-prep kit were lower than that obtained with the phenol method. Extraction of DNA with BioMag® beads, estapor® superparamagnetic microspheres, Sera-Mag™ magnetic microparticles, and Dynabeads® M-270 gave yields comparable to the phenol method (~4.8 ng; 3 pg/sperm), and DNA was high molecular weight.

To determine to lower limit at which magnetic bead purified DNA could be analyzed by STR analysis, DNA extracted from ~ 150 sperm (yield ~450 pg; ~300 pg amplified) with BioMag® beads, estapor® superparamagnetic microsphere, Sera-Mag™ magnetic microparticles, and Dynabeads® M-270 was amplified using the Ampf*l*STR Profiler Plus™ typing system (Applied Biosystems). Amplification products were resolved and detected using the ABI Prism® 310 capillary electrophoresis instrument (Applied Biosystems). Amplification was inhibited in reactions containing BioMag® and Sera-Mag™ DNA. Differential amplification was observed among Dynabeads® M-270 samples. Amplification profiles of estapor® most closely resembled those of phenol extracted DNA. Amplification was inhibited when estapor® and Dynabeads® M-270 extracted DNA was amplified without prior elution of the beads from the DNA. Complete profiles were obtained when DNA extracted from > 1500 sperm (>4 ng; 2 ng amplified) with estapor® and Dynabeads® M-270 were amplified. Except that the yield of DNA is lower, similar results were obtained with DNA extracted from dried semen on swabs.

Based on ethidium bromide visualization, the quality of DNA extracted from buccal and vaginal cells on swabs and bloodstains with estapor® and phenol were similar. However, the yield of DNA depended on the number of cells from which the DNA was extracted and the volume of beads used to extract DNA. Electropherograms of estapor® and phenol purified DNA from blood, buccal, and vaginal cells were similar (2 ng amplified). Estapor® microparticles were found to capture fragmented DNA.