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Screening of Dried Matrix Spot Collection Devices to be Used for Nutritional Biomarker Analysis

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Abstract

Dry Matrix Spots (DMS) are dried spots of body fluids, including blood, serum, urine, saliva and breast milk. DMS have been employed as a convenient sample matrix to collect in non-clinical and remote settings. DMS can be collected by staff with minimal training, and for a limited time, they can be stored and transported without a cold-chain. Historically, nutritional biomarkers (NB) were collected using S&S (now Whatman) 903 cards in the form of dried blood spots (DBS). This form of blood collection provided multiple benefits, but limitations existed related to volume estimates, chromatographic affects, and storage stability. Using this type of sample collection, the separation of erythrocytes (RBCs) from serum does not occur. Aging of the blood, exposure to elevated humidity and temperature can alter the concentrations of most analytes.

Objective To evaluate blood collection devices to identify ones best suited to obtain DMS for measurement of NBs.

Methods We obtained samples of 10 commercial blood collection devices. Criteria were established to identify successful collection devices. Ideally, devices should separate RBCs from serum without gradient or chromatographic effects, provide adequate and quantifiable volume, reproducibility, moderate stability with minimal refrigeration, and simple collection. NBs were chosen from those identified by BOND working groups[1]. The analytical methods to evaluate the NBs must be sensitive (≥ppb), affordable, reproducible (±15%), accurate (±15%) and rugged.

Results Essentially all commercial products did not meet the criteria. Many do not separate RBCs from serum, do exhibit chromatographic effects, or provide too little serum for analytical testing. We have identified a device (Vive-Bio, Atlanta, GA) that allows the separation of RBCs in a vertical fashion with the concurrent separation and collection of a hemoglobin-free serum sample into a highly absorbent collection pad. The transfer efficiency is high providing adequate volume to perform analytical tests (~60%, ~10uL). We have conducted preliminary short-term stability studies on several NBs.

Conclusions A blood collection device has been identified which achieves the verticle separation of RBCs from serum. Advantages of this device over traditional DBS include: availability of RBCs for quantification of RBC folate, better serum volume estimation, direct serum measures of zinc, ferritin, RBP, AGP, CRP, thyroglobulin, homocysteine, methylmalonic acid, vitamins B12 and D.

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