

From Collection to Confirmation: Why Oral Fluid Stabilization Matters

Collection is Only the Beginning

Oral fluid is widely used for drug testing because collection is rapid, noninvasive, and easily observed. However, collection is only the first step in the analytical process. Measured concentrations can subsequently be influenced by collection materials, storage time, temperature, buffer chemistry, specimen composition, and analyte properties.

During this pre-analytical interval, drugs may adsorb to collection surfaces, become less recoverable during storage, or undergo chemical transformation. Because these effects are analyte- and system-dependent, collection devices must be evaluated not only for specimen acquisition, but for their ability to preserve analyte availability and integrity until testing.^{1,3}

Mechanisms of Analyte Loss

Adsorption to Collection Materials

Collection materials are not analytically inert. Drugs may adsorb to swabs, pads, tubes, or other surfaces, and recovery can vary substantially by analyte and device.^{1,4} THC is a well-established example. Kauert and colleagues recovered only **37.8% and 55.6%** of THC from an absorptive collection pad at 10 and 100 ng/mL, respectively, using the standard elution procedure; an additional methanol wash recovered approximately 25% more.⁵ Separate work demonstrated THC adsorption to polypropylene containers.⁶ This effect is not limited to cannabinoids: Cohier and colleagues observed collector-related methadone loss, while evaluation of swabs from 15 commercial collection devices found acceptable 80–120% recovery in only **44.1% of swab-analyte combinations across 49 compounds**.^{4,7}

Storage Associated Loss

Measured concentrations may continue to change after collection due to time, temperature, device chemistry, and specimen composition. A decrease does not necessarily identify a single mechanism; continued adsorption, incomplete desorption, and chemical instability may all contribute.

Romeuf et al. found that THC and CBD on dry FLOQSwabs® stored at room temperature lost approximately **85% of their initial concentrations after 120 hours**.⁸ Benzodiazepines have also shown substantial losses during simulated ambient shipping, with several compounds below 60% recovery after seven days and clonazepam and flunitrazepam among the least stable.⁹

Refrigeration improves stability for many analytes but does not preserve all drugs equally. Cohier et al. reported decreases in methamphetamine, codeine, and buprenorphine by Day 14 even at 4 °C.⁷ Additionally Oral fluid is a complex biological matrix containing epithelial cells, proteins, enzymes, and microorganisms. Matrix composition can influence measured stability; in Cohier's study, the presence of oral cells significantly affected THC concentrations during refrigerated storage.⁷

Chemical Transformation

Instability may alter an analyte's chemical identity rather than simply reduce its recoverable concentration. The hydrolysis of 6-monoacetylmorphine (6-MAM) to morphine is an important example. Ventura and colleagues observed 6-MAM degradation in untreated oral fluid, while citrate buffer at pH 4 with sodium azide substantially improved stability under the tested conditions.¹⁰ Because 6-MAM is a specific marker of heroin exposure, preservation of its chemical identity is analytically important.

Stability is Analyte, Temperature, and Device Dependent

There is no single stability profile for oral fluid specimens. Performance depends on the analyte, collection material, preservation chemistry, temperature, storage duration, and biological matrix. Analytes in untreated oral fluid can lose **more than 50%** of their starting concentration with a combination of the factors described above. Marchei and colleagues found significantly greater stability across multiple psychoactive drugs in buffered than in neat oral fluid.² Authentic cannabinoid specimens likewise showed better THC stability in buffered device-collected oral fluid than in expectorated specimens.³

Together, these findings support treating collection and storage as part of the analytical method. A collection system should therefore be evaluated for **analyte recovery, matrix effects, and stability throughout the intended transport and testing interval.**

Applying these Principles to Xpeedy®

Xpeedy® was designed around these pre-analytical considerations. After oral fluid saturates the collection sponge, the collector is inserted into a tube containing proprietary stabilization buffer. The sponge is compressed and locked into the bottom of the tube, rapidly releasing analytes while remaining in place for continued elution during transport and storage. The approximately **1:1 oral fluid-to-buffer ratio** limits dilution while providing immediate contact with stabilization medium.

Performance studies demonstrate **>90% recovery within one minute across 23 analytes**. Matrix-effect testing of 48 analytes produced bias within $\pm 30\%$ in the evaluated LC-MS/MS workflow. All 23 analytes remained within $\pm 20\%$ of initial concentrations through Day 14 at 4 °C; 22 of 23 remained within that range through Day 14 at room temperature, with THC within $\pm 20\%$ through Day 10.

These findings demonstrate how recovery, matrix effects, and stability should be evaluated together when considering an oral fluid collection system.

Selected References

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