An Overview of Hair Testing For Drug And Alcohol Abuse
By Joseph Salerno, Science Writer, USDTL

Drug and alcohol testing using hair specimens is a powerful alternative to conventional testing in urine, blood, or oral fluid. Hair is a reservoir matrix that provides a long-term window of detection of drug and alcohol use. Composed of a protein called keratin, hair is able to trap and retain drug and alcohol biomarkers in the keratin matrix by multiple routes, including blood, sebum, sweat, and environmental exposure.

The main path by which biomarkers enter hair is through the blood vessels that feed the growing hair from the base. Hair grows outward from the skin starting at the root within the hair follicle. Biomarkers traveling through blood vessels enter the root of the hair and become trapped in the core as the hair emerges.

Sebaceous glands in the hair follicles deposit an oily substance known as sebum to lubricate the growing hair shaft. Drug and alcohol biomarkers secreted in the sebum can be deposited on and absorbed by hair.

Hair becomes saturated with sweat as we perspire. Biomarkers can be secreted through the sweat glands and are absorbed by the keratin matrix as the hair is bathed in sweat. These three routes, blood, sebum, and sweat account for the bulk of biomarker deposition onto hair specimens.

Environmental exposure is a fourth route of drug biomarker incorporation into hair. For example, when drugs such as marijuana, methamphetamine, or crack cocaine are smoked, drug residue in the air can be deposited on, and incorporated into, the hair shaft. Environmental exposure drug testing differs from normal testing. Because drugs were not ingested by the person being tested, drug metabolites often will not be present in the hair sample. As such, exposure testing can and should report a positive result even in the absence of the drug metabolite. Typical workplace drug testing only allows a positive result to be reported when metabolites are present in the hair sample. Thus, using workplace testing standards is not a proper method for exposure testing, because it runs the risk of reporting false negative results. (More information on environmental exposure testing can be found in our January 2014 Forensic Quarterly Newsletter, or at our website www.USDTL.com.)

The average rate of growth for hair is a half inch per month, and a 1.5 inch hair sample of about 200 strands (the width of a #2 pencil) that has been cut close to the scalp will typically give a three month window of detection for drug and alcohol use. It takes 10-14 days for biomarkers to be deposited in the hair root and then emerge past the scalp line, and drugs and alcohol can be typically detected in hair samples approximately two weeks after ingestion.

If head hair is not available for drug testing, body hair can be tested. The interpretation of body hair results is limited due to insufficient research. Head and body hair samples should never be mixed together. Research suggests that body hair can have as much as a 12 month window of detection for drugs, as opposed to the three month window for head hair. The window of detection for alcohol biomarkers in body hair has not been determined scientifically, and alcohol testing in body hair is not recommended. (See Ask the Toxicologist on page 2 for more info.)

To learn more about hair testing, including articles, research, and our hair testing annotated bibliography, visit us at www.USDTL.com.

References
Ask The Toxicologist

Q: Is it possible to determine how much or how often a person has been using a substance of abuse based on the result of a drug or alcohol biomarker test?

A: This is a very common question. Unfortunately the answer is no. There are simply too many variables involved to be able to make a determination of how often or how much a person is using a particular substance based on the levels that are reported in a drug or alcohol test.

Sample types such as hair and fingernails are known as reservoir matrices. Over time, drugs will collect in a reservoir matrix, however, they can also degrade in the matrix. This build-up and break-down of drug and alcohol biomarkers happens at the same time, making it impossible to accurately determine the amount of substance ingested at any one time.

Personal metabolism also plays a large part in how drug and alcohol biomarkers are collected in reservoir matrices. Age, body mass, overall health, and other factors can all affect how much of a substance may get trapped in a reservoir matrix. The number of doses required to generate a positive test result is highly variable from one donor to the next. This is especially true for alcohol biomarker testing.

When testing any reservoir matrix, you are unable to back-track and determine time, dosage, or frequency because there are simply too many variables involved. In the end, a drug test using a reservoir matrix only indicates the presence or absence of a drug or alcohol biomarker within an appropriate window of detection. Attempting to determine the amount, manner, or timing of substance ingested from the test results is speculation at best. Care should be taken to avoid such assumptions.

Q: How does the window of detection for body hair differ from that of scalp hair?

A: Body hair has up to a twelve month window of detection for drugs versus scalp hair which typically has a three month window. This is due to several differences in the growth characteristics of the two. The interpretation of body hair results is limited. The window of detection for alcohol biomarkers in body hair has not been determined scientifically, and alcohol testing in body hair is not recommended.

Body hair and scalp hair both experience a dormant phase called telogen, which follows the end of the growth phase of the hair. Scalp will grow for a long length of time, typically anywhere from 2-6 years, and then will enter its dormant phase. Scalp hair’s dormant phase is approximately three months long, again, varying from one individual to the next. Body hair, on the other hand, only grows for 4-6 months before entering a dormant phase that lasts, on average, about nine months.

In the time that body hair is lying dormant on the body, it is still being bathed in sweat and sebum (see the cover article for more details on these substances). Drug and alcohol biomarkers can be absorbed from these fluids as they coat the body hair, and the result can be a potential window of detection stretching back as much as a full twelve months.

In contrast, scalp hair doesn’t encounter sweat and sebum nearly as much as body hair. Even though scalp hair may be present for a greater length of time while growing, longer hair typically hangs more loosely from the scalp and doesn’t encounter sweat and sebum farther along the hair strands. Based on the best available research, the window of detection is reliable only in the first 1.5 inches of scalp hair, which accounts for about 3 months of drug and alcohol use history.

Body hair and scalp hair should never be mixed together due to these differences. Mixing them would confuse the window of detection for drug test results.

Marijuana in Hair And Fingernails
July 9, 2014

Joseph Jones, USDTL Vice President of Operations, will give this webinar detailing the art and science of detecting marijuana usage in hair and fingernails. Register to participate at our website www.USDTL.com.
Use of Alcohol, Cigarettes, and Marijuana Before Age 16 Associated with Higher Rates of Substance Use Dependence

CESAR FAX, Volume 23, Issue 7

**Lifetime Dependence by Age of First Use of Alcohol, Cigarettes, and Marijuana**

(n=4,245 users of alcohol, cigarettes, and marijuana ages 24 to 32 participating in the nationally representative Add Health Survey*)

<table>
<thead>
<tr>
<th>Ever Dependent† On:</th>
<th>Started Using All Three Drugs Before Age 16</th>
<th>Started Using All Three Drugs After Age 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol</td>
<td>25%</td>
<td>16%</td>
</tr>
<tr>
<td>Nicotine</td>
<td>47%</td>
<td>27%</td>
</tr>
<tr>
<td>Marijuana</td>
<td>21%</td>
<td>8%</td>
</tr>
<tr>
<td>Other Illegal Drugs</td>
<td>20%</td>
<td>6%</td>
</tr>
</tbody>
</table>

Early multiple substance use is associated with higher rates of substance use dependence, according to an analysis of data from the National Longitudinal Study of Adolescent Health (Add Health). One-fourth of adults ages 24 to 32 who reported using alcohol, cigarettes, and marijuana before the age of 16 met the criteria for alcohol dependence at some point in their life, compared to 16% who reported first using any of these substances when they were 16 or older. Furthermore, early users of all three substances were more than twice as likely to meet the criteria for marijuana dependence (21% vs. 8%), and more than three times as likely to meet the criteria for dependence on other illegal drugs (20% vs. 6%). According to the authors, “[t]he strongest predictor of problematic involvement with substances in young adulthood is the additive effect of psychoactive substances used before age 16. Prevention programs that emphasize delayed use of an individual drug—be it alcohol, tobacco, or marijuana—could therefore yield improved outcomes by having a broader focus across multiple substances” (p. 60).

*Add Health collected data from a nationally representative sample of adolescents in grades 7 through 12 during the 1994-1995 school years and continued following them into young adulthood with four in-home interviews, most recently in 2008, when they were between ages 24 and 32. Data analyzed for this study only included respondents who reported having ever used alcohol (more than 2-3 times), marijuana, and cigarettes (at least 1 cigarette every day for 30 days) and reported their age at onset of each respective substance use.

†Ever met DSM-IV criteria for dependence as of 2008, when respondents were ages 24 to 32.

SOURCE: Adapted by CESAR from Moss, H.B., Chen, C.M., Yi, H-y, “Early Adolescent Patterns of Alcohol, Cigarettes, and Marijuana Polysubstance Use and Young Adult Substance Use Outcomes in a Nationally Representative Sample,” Drug and Alcohol Dependence 136: 51-62, 2014. For more information, contact Howard Moss at psych.hmossmd@gmail.com.

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**USDTL Will Present Late Breaking Research on Heroin Detection at the 2014 CPDD Annual Meeting**

Dr. Irene Shu will present results from USDTL’s research and development to improve heroin detection at the 76th Annual Meeting of the College on Problems of Drug Dependence, June 14-19, 2014, in San Juan, Puerto Rico. Dr. Shu’s presentation will be given during the Late Breaking Research session, on Wednesday, June 18, 2014, between 4:45-5:45 pm. Dr. Shu and USDTL President Douglas Lewis will be available for questions after the session.

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Upcoming Events:

- June 11-13 – 19th Meeting of the Society of Hair Testing at the 2014 Analytical Clinical and Forensic Toxicology Meeting – Bordeaux, France
- June 14-19 – College on Problems of Drug Dependence 76th Annual Meeting – San Juan, Puerto Rico
- June 21-25 – Research Society on Alcoholism 37th Annual Scientific Meeting – Bellevue, WA
- July 13-16 – National Council of Juvenile and Family Court Judges 77th Annual Conference – Chicago, IL
- September 3-6 – California Society of Addiction Medicine, Addiction Medicine Review Course – Anaheim, CA