

# Urine Creatinine / INTERPRETATION AND THC/CREATININE RATIOS

## INFORMATION SHEET

### CREATININE INTERPRETATION

#### Introduction

*In an effort to further enhance the reliability of analyzing urine specimens for drugs of abuse, Redwood Toxicology Laboratory (RTL) routinely determines the creatinine concentration in all specimens submitted. Creatinine is a by-product of muscle metabolism that is excreted in the urine. Its measurement is routinely used clinically to evaluate kidney function. Additionally, urinary creatinine determination is an important parameter for evaluating the validity of a urine specimen for drugs of abuse detection. Because of the potential consequences of a positive drug test, an individual may be motivated to beat the drug test by various techniques. One of the most common practices used to avoid a positive drug test is the intentional consumption of excess fluid in a relatively short period of time in an effort to flush their system. This is commonly referred to as water-loading or dilution and can result in the drug being below the positive cut-off concentration. Thus, even though an individual may have recently used drugs, intentional dilution can lower the drug concentration, resulting in a false negative drug test.*

*Another important aspect of creatinine interpretation is its use to monitor abstinence from marijuana. The concentration of the THC metabolite, carboxy-THC, can fluctuate from day-to-day depending upon a person's fluid intake. The calculation of the carboxy-THC to creatinine ratio is of considerable value when trying to determine if an individual has abstained from marijuana use.*

#### Dilution

A search of the Internet will quickly reveal many websites, that market products “guaranteed” to beat the drug test. A majority of these sites advertise teas, carbohydrate drinks, and/or other liquid concoctions whose primary action is based on excessive fluid

intake. These products have names such as Detoxify Carbo Clean, Ultimate Blend, Naturally Klean Herbal Tea, Goldenseal, Certo, and The Eliminator to name a few.

The following is an example of a product's Internet advertisement:

*Easy & Convenient. When you want a drink with quick cleansing power, the #1 seller in the Industry is the ideal choice. READY-CLEAN is an easy-to-use cleansing beverage. Simply drink, and you're clean after one hour with a clinically proven cleansing power for up to five full hours. There is no mixing. No lengthy procedures. It is that easy. Thousands of consumers have trusted the Powerful effects of READY-CLEAN and its #1 status is proof of its superior cleansing abilities.*

*IF TIME PERMITS: For the two days prior to the days of your deadline avoid toxins and consume a minimum of (6) 16 ounce glasses of water per day.*

- 1. It is permissible to consume up to 20 oz. of fluids every two hours until taking READY-CLEAN and 16 oz. of fluid every two hours thereafter.*
- 2. Begin taking READY-CLEAN at least 60 minutes prior to your deadline.*
- 3. Drink entire contents of bottle.*
- 4. Wait 15 minutes. Refill the READY-CLEAN bottle with water, shake and drink.*
- 5. Urinate frequently to remove toxins. Eat light meals the day of your deadline.*

*Figure 1: Internet product advertisement promoting a cleansing formula—guaranteed to beat the drug test.*

The measurement of creatinine can aid in establishing if any of these products were used. Creatinine production and excretion is directly related to muscle mass and is sex and age dependent. Normal random urine creatinine concentrations range from 40-300 mg/dL in males and 37-250 mg/dL in females. Values as low as 17 mg/dL have been observed in rare instances. Certain physiological conditions such as diabetes may result in consistently dilute urine specimens. Scientific water loading studies in which participants used specified amounts of cocaine and marijuana determined that subjects consistently produced dilute urine specimens upon drinking large volumes of water (2-4 quarts) and corresponding urinary drug concentrations declined below cut-off concentrations. Dilute urines—generally observed at 2 hours and persisted for up to 5 hours after liquid consumption.

Numerous scientific studies have been conducted in an effort to establish criteria to determine forensically dilute specimens based on creatinine concentrations. Several of these studies have recommended that creatinine concentrations below 45 mg/dL be used as a basis to determine if a urine specimen has been physiologically or non-physiologically dilute and if a corresponding negative drug result is valid. Federal regulations set forth by SAMHSA, have two critical points for creatinine concentration to assess the validity of a urine specimen for drug testing. One critical point is set at less than 20 mg/dL while the second is set at less than or equal to 2 mg/dL. These creatinine concentrations, in conjunction with a corresponding specific gravity level, are used to report a urine specimen as either dilute or substituted because it is not consistent with clinical characteristics associated with normal human urine.

### Recommendations

RTL's creatinine criteria reflect the critical points set forth by SAMHSA to report dilute or abnormally diluted urine specimens. RTL believes that the scientific evidence supports these values and provides a strong basis to defend the interpretation in medical-legal settings.

In conclusion, low urine creatinine values may indicate that an individual attempted to beat the drug test by drinking excessive fluid in an effort to flush the drugs from his system. When low creatinine concentrations are observed, it should be a concern for the agency performing the urine collection.

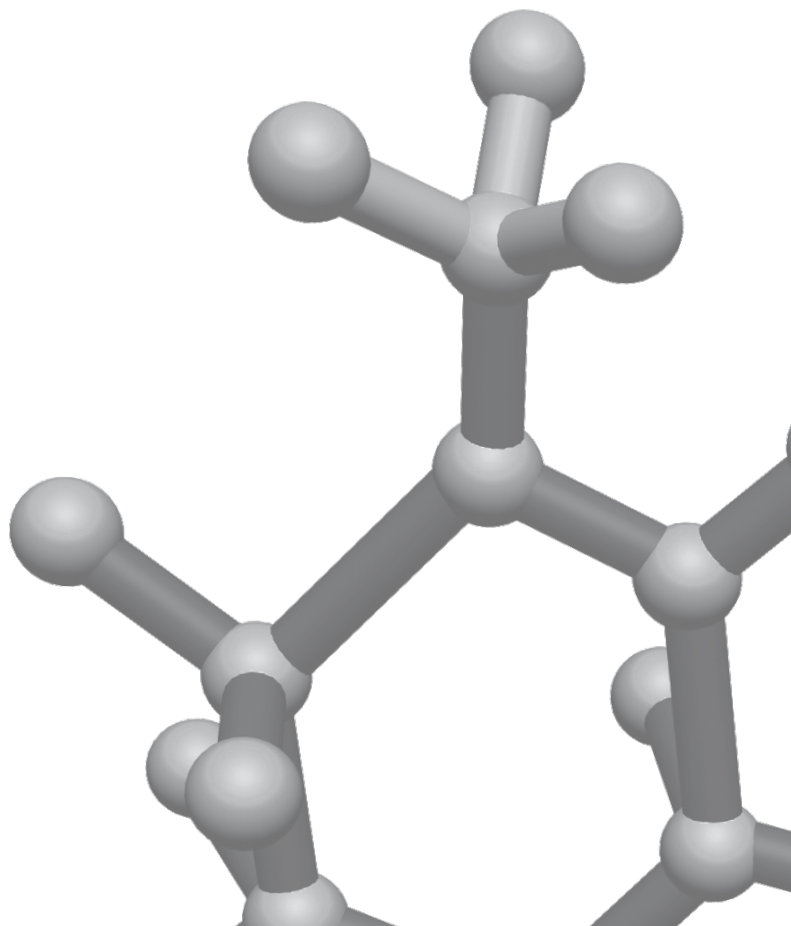
	Cocaine (Benzoylcegonine)	None Detected
	Benzodiazepines	None Detected
	Alcohol (Ethanol)	None Detected
POS----->	THC (Marijuana) Confirmed by RIA.	300
	Creatinine	50 mg/dL

*Figure 2: Sample Toxicology Report indicating normal levels of creatinine.*

	Cocaine (Benzoylcegonine)	None Detected
	Benzodiazepines	None Detected
	Alcohol (Ethanol)	None Detected
POS----->	THC (Marijuana) Confirmed by RIA.	300
	Creatinine Specimen is abnormally dilute.	1.7 mg/dL

*Figure 3: Sample Toxicology Report indicating abnormal levels of creatinine.*

If an individual produces urine with low creatinine concentrations, RTL recommends that the frequency of urine collections be increased and if possible, the donor be instructed to donate his urine either in the morning or within two hours of being notified that they are to provide a urine specimen. Additionally, they should limit their water intake to two eight-ounce glasses within two hours of the collection. These factors would minimize the likelihood of dilute urines and beating the drug tests by flushing the drug from their system.



## THC/CREATININE RATIOS

### Introduction

*THC is one of the numerous cannabinoid chemicals present in marijuana as well as the primary psychoactive ingredient. Cannabinoid metabolites appear in urine within two to four hours after smoking marijuana and may persist up to 30 days (at the 50 ng/mL cut-off concentration) depending upon a person's previous pattern of abuse. In general, infrequent use of marijuana may only be detected for 1-3 days after use. Regular use, several times per week, may be detected for 7-10 days, while chronic use of marijuana may be detectable for up to 30 days. Routine passive inhalation to marijuana will not cause a positive urine drug test for THC at a 50 ng/mL screening cut-off concentration.*

*The measurement of creatinine concentrations is an important variable to monitor when attempting to determine if an individual has abstained from marijuana between successive urine specimens. The concentration of the THC metabolite, carboxy-THC, can fluctuate from day-to-day depending upon a person's fluid intake. Increased fluid intake will lower both the carboxy-THC and creatinine concentration in a urine specimen while dehydration will have the opposite effect.*

*Calculation of the carboxy-THC to creatinine ratio neutralizes any change in the carboxy-THC concentration due to variation in a person's hydration state. This calculation makes it possible to compare urine specimens to establish if renewed use of marijuana has occurred.*

### Semi-quantitative RIA Results

The radioimmunoassay (RIA) values reported by Redwood Toxicology Laboratory for THC (marijuana) are only to be interpreted as an estimation of the concentration of total cannabinoids (marijuana metabolites) present in a urine specimen. Urinary cannabinoid values are difficult to interpret due to variables such as frequency of use, duration of use, amount used, and an individual's liquid consumption. Therefore, positive RIA results for THC (cannabinoids) indicate use of marijuana but numerous additional considerations, such as THC/Creatinine ratio are required to establish renewed or continued use.

Based on our experience at RTL, the following offers some general guidelines for interpreting laboratory RIA results:

RIA Value	Use Pattern
> 500	Possible recent/high use
250-500	Possible continued elimination in chronic use or recent use in infrequent user
<250	Possible terminal elimination in chronic use or recent use in infrequent user

The use of the RIA values provides preliminary clinical information for single use of marijuana. Because the analysis of a single urine specimen cannot typically distinguish between very recent use and chronic use, the exact time of use cannot be determined with any certainty. A more reliable determination of renewed use of marijuana requires the comparison of the THC/Creatinine ratios between multiple urine specimens. This ratio can be calculated by dividing the "THC" value by the Creatinine value then multiplying by 100. In general, an increase of more than 50% in the THC/Creatinine ratios between two urine specimens provides clinical evidence of possible renewed use. If the THC/Creatinine results are to be used for punitive or administrative purposes, GC/MS confirmation analysis must be performed to provide a definitive interpretation of renewed marijuana use.

The following graph is actual data from a client with a chronic history of smoking marijuana who was being routinely monitored for drug use:

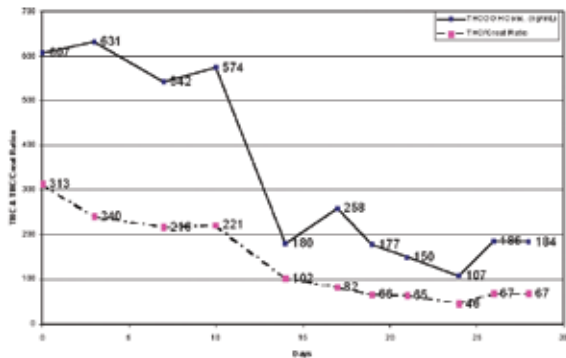


Figure 4: Chronic marijuana smoker, routinely monitored.

The top curve represents the THC (cannabinoid) values based upon the RIA analysis while the bottom curve is a plot of the respective “THC/creatinine” ratios. Although the graph shows an increase in the THC value from 180 to 258 between days 14 and 17, respectively, the corresponding ratios actually decreased from 102 to 82. Thus, although the THC values might have caused concern of renewed marijuana use, the THC/creatinine ratios actually decreased. This decrease in the ratio is more indicative of continued elimination of marijuana.

A plot of the THC and THC/creatinine ratios from another subject yields a different interpretation:

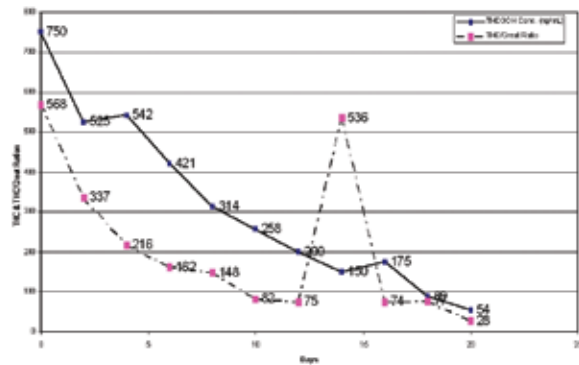


Figure 5: THC and THC/creatinine ratios with strong clinical evidence of renewed use.

The data reveals decreasing “THC” values of 200 and 150 for days 12 and 14, respectively. In contrast, the corresponding THC/Creatinine ratios show a sharp increase from 75 to 536, respectively. Although the THC values do not suggest renewed use between the two urine specimens, the ratios provide strong clinical evidence of renewed use. For conclusive evidence, only these two urine specimens need to be confirmed by GC/MS analyses. If the increase in the ratios is further substantiated with GC/MS analyses, then it can be concluded, with a high degree of scientific certainty, that the individual had used marijuana between the two urine collections.

Finally, although an initial EIA positive test in combination with a RIA semi-quantitative positive result provides preliminary interpretation information, clinical consideration and professional judgment should be considered for more reliable interpretation. Redwood Toxicology Laboratory (RTL) strongly recommends consultation with a toxicologist, and a gas chromatography/mass spectrometry (GC/MS) confirmation prior to any administrative or legal action.