

Kinetics of ethyl sulfate and ethyl glucuronide after medium dose ethanol

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AIMS: The direct ethanol metabolites ethyl glucuronide (EtG) and ethyl sulfate (EtS) become more and more important for forensic applications as they remain positive for up to 80 hours after consumption of one single ethanol dose. As there are few studies about EtG in serum, and none about serum EtS, further experience about the kinetics of EtG and EtS in the human body, especially in blood, is needed.

METHODS: 13 voluntary social drinkers consumed white wine, calculated with the Widmark formula, to a blood alcohol concentration between 0.05 and 0.08 % . Blood samples were collected every 30 minutes, urine every 2 hours for 10 hours each, plus 4 urine samples from the next two days. The samples were analyzed for ethyl glucuronide and ethyl sulfate by LC-MS/MS in one single run of a validated method

RESULTS: The volunteers consumed between 0.49 and 0.78 g ethanol/ kg body mass. Peak serum EtG- and EtS concentrations in serum were 1.2 – 4.9 $\mu\text{mol}/\text{L}$ (2.9 $\mu\text{mol}/\text{L} \pm 1.3 \mu\text{mol}/\text{L}$) and 1.0 – 6.4 $\mu\text{mol}/\text{L}$ (2.8 $\mu\text{mol}/\text{L} \pm 1.6 \mu\text{mol}/\text{L}$) and were reached between 2.33 h and 4.97 h (4.03 h \pm 0.85 h) after start of drinking (2.10 – 3.92 h (2.97 h \pm 0.52 h) for EtS). 11 of the volunteers still had EtG in the last blood sample, only two had EtS, more than 10 hours after alcohol consumption. One person showed no EtS in serum at all, the other 10 were EtG-positive for 3.75 to 9.50 hours after start of drinking.

Urinary concentrations ranged from 104 to 805 $\mu\text{mol}/\text{L}$ (average 401 $\mu\text{mol}/\text{L} \pm 232 \mu\text{mol}/\text{L}$) for EtG and 46 to 533 $\mu\text{mol}/\text{L}$ (266 $\mu\text{mol}/\text{L} \pm 153 \mu\text{mol}/\text{L}$) for EtS which peaked between 5.08 and 7.42 h (6.16 h \pm 0.86 h) (EtG) and 3.08 and 7.42 h (5.33 h \pm 1.18 h) (EtS). 4 of the subjects still had EtG in the last urine sample (longer than 44 h), the other 9 persons produced the last EtG-positive sample between 26.58 and 35.75 hours after start of drinking. The profile for EtS was a little different, as 1 person had an EtS-positive result in the last sample after 70 hours, 2 persons after more than 47 hours and from the remaining 10 volunteers' urine, EtS had disappeared between 22.83 and 35.75 hours after start of alcohol consumption.

CONCLUSIONS: EtG and EtS are detectable in serum and urine for a longer time than ethanol itself and the metabolites show a wide interindividual variation. No correlation could be found between the maximum concentration of any metabolite and the amount of alcohol consumed or the blood alcohol concentration and the detection time window.

KEYWORDS: *Ethyl glucuronide, Ethyl sulfate, Ethanol markers, Kinetics*

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