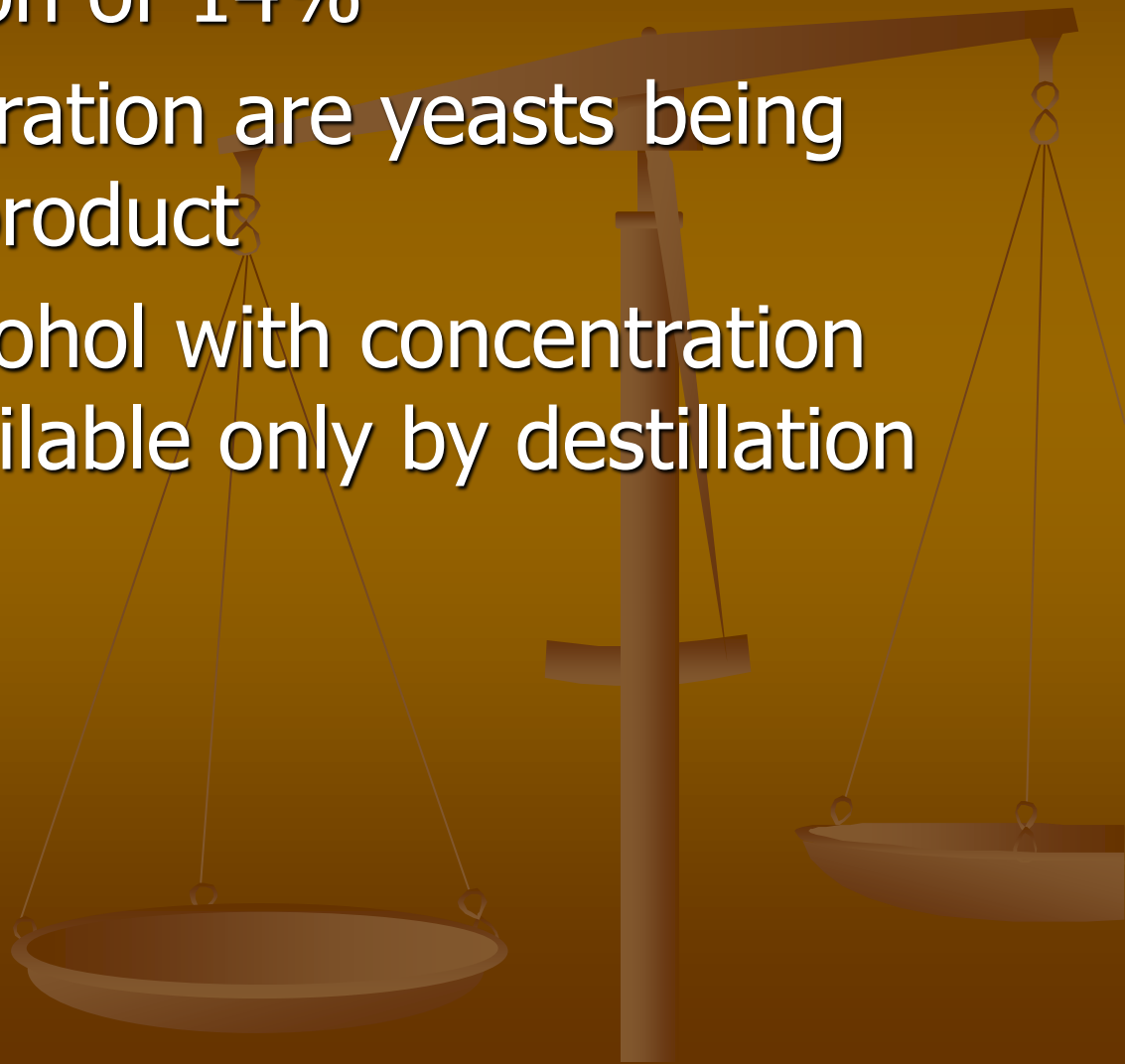
Alcohol

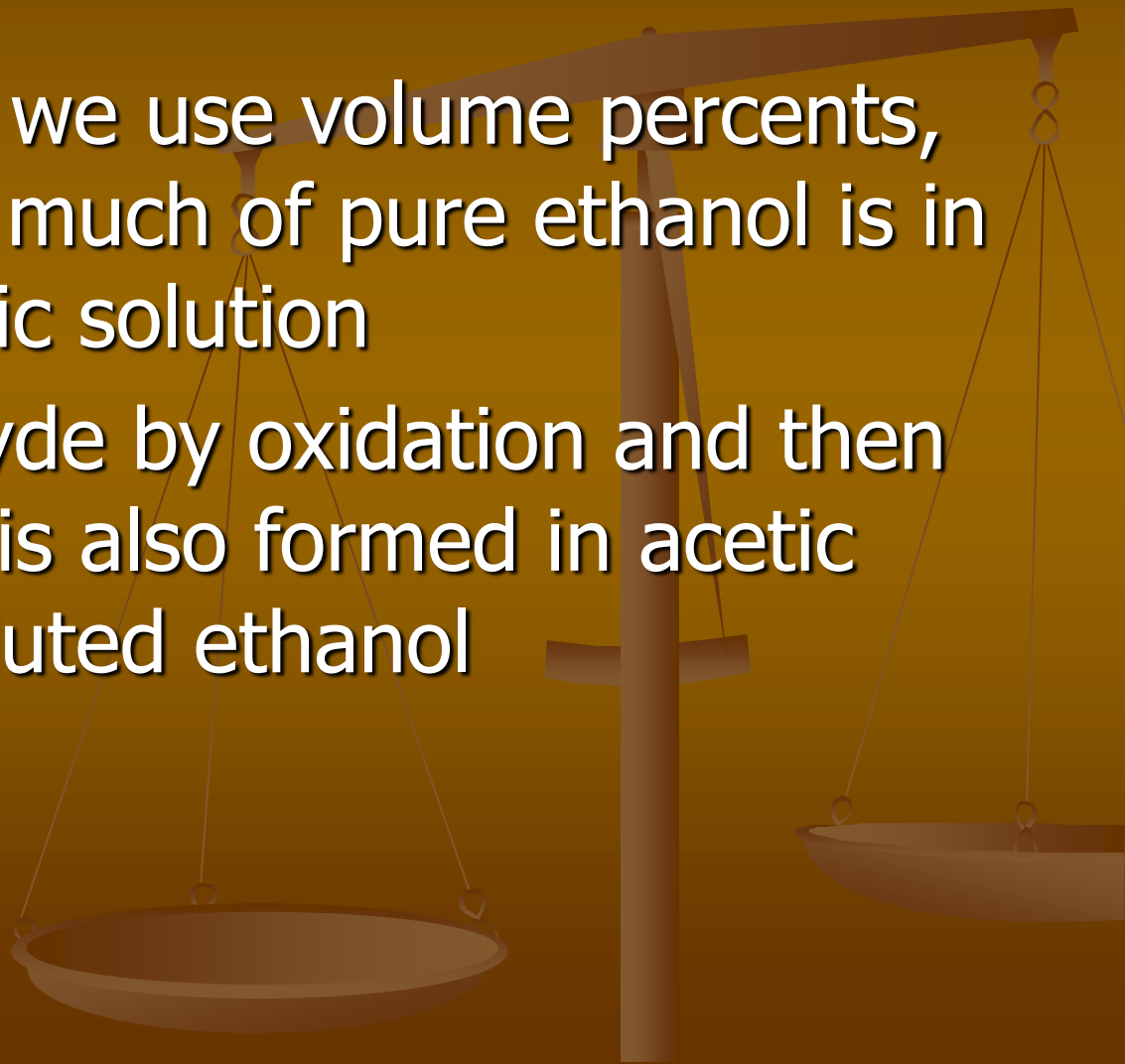
Ing. Jaroslav Zikmund

- It's formed in fermentation of sugar by yeasts up to concentration of 14%
- In higher concentration are yeasts being destroyed by its product
- Preparation of alcohol with concentration above 15% is available only by destillation



- Pure ethanol is colorless liquid of typical aroma; it boils at 78,3°C and melts at -114°C

- In case of ethanol we use volume percents, which means how much of pure ethanol is in 100 liters of aquatic solution
- It gives acetaldehyde by oxidation and then acetic acid, which is also formed in acetic fermentation of diluted ethanol

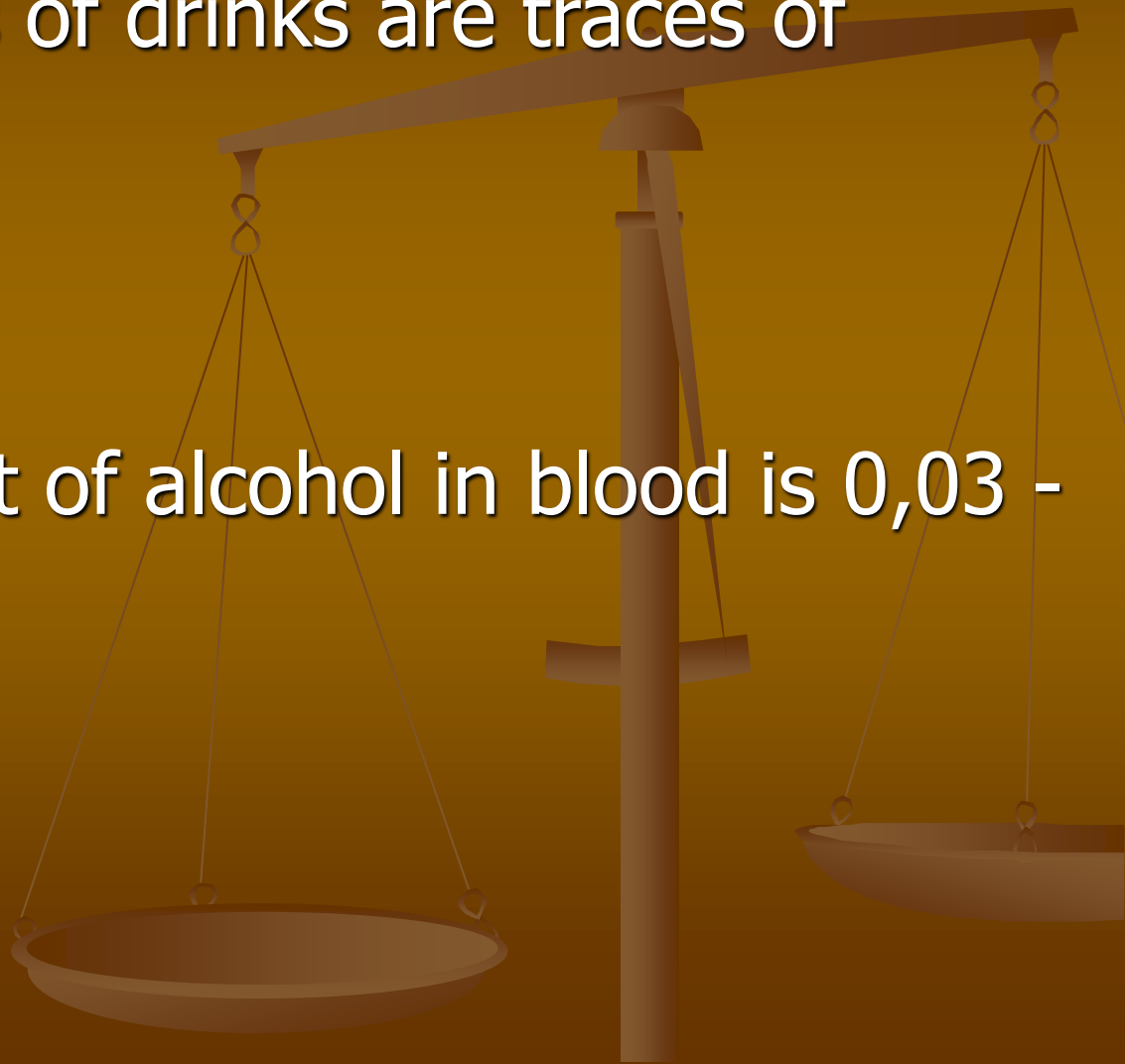


- Concentrated ethanol has heat-like flavour. Ethanol consumed in small amount is intoxicant, consummation of larger amount at once cause urgent poisoning, frequent consummation cause chronicle poisoning.

- For production purpose is made inedible - denaturation
- -by adding such substances, that can't be removed so easily.

- In blood of man, who never consumed alcohol, is amount of ethanol 0,003 $g.kg^{-1}$. However, in lots of drinks are traces of alcohol.

- Average amount of alcohol in blood is 0,03 - 0,05 $g.kg^{-1}$.



Metabolism

Resorption

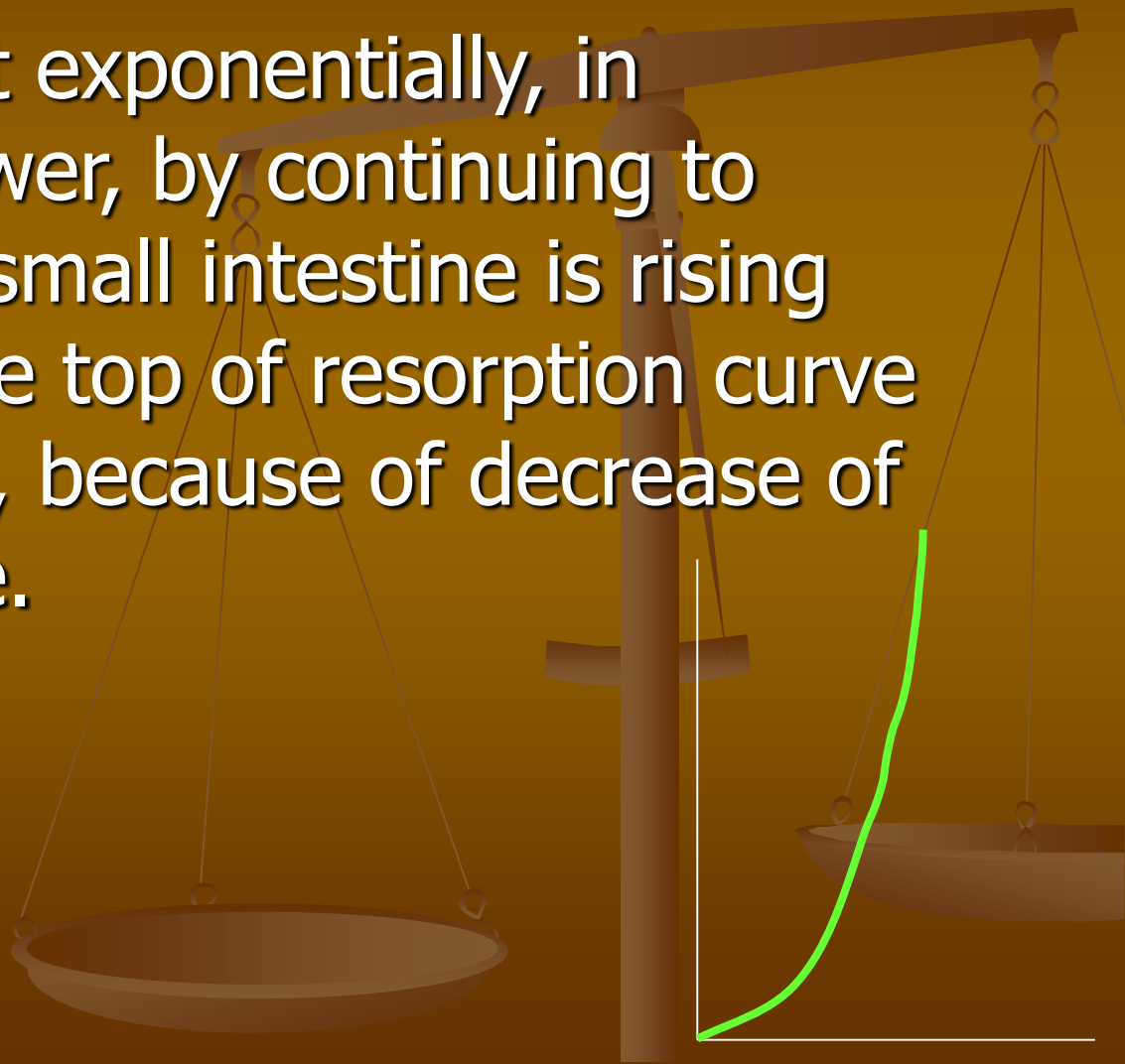
- it's a simple diffusion
- resorption of alcohol starts in mouth

  however, the amount of alcohol absorbed by buccal mucosa stays under the level of elimination so the amount of alcohol in blood is almost unchanged.

- in stomach is absorbed about 20% of drunken alcohol
- 80% of drunken alcohol is absorbed in duodenum and the upper part of small intestine

Resorption

- It‘s rising almost exponentially, in beginning is slower, by continuing to duodenum and small intestine is rising faster and on the top of resorption curve is slowing down, because of decrease of diffusion voltage.



Resorption

- speed of resorption of alcohol to blood and organism depends on diffusion declivity and on size of alimentary tract from which the resorption can proceed.
- Absorption speed also depends on content of stomach and condition of food.

Resorption

- Stress and tiredness slow the resorption down, because of slowing of stomach activity, even pylorospasm. As well, people, who are not used to drink alcohol, or in case of drinking against free will, the resorption is slower.

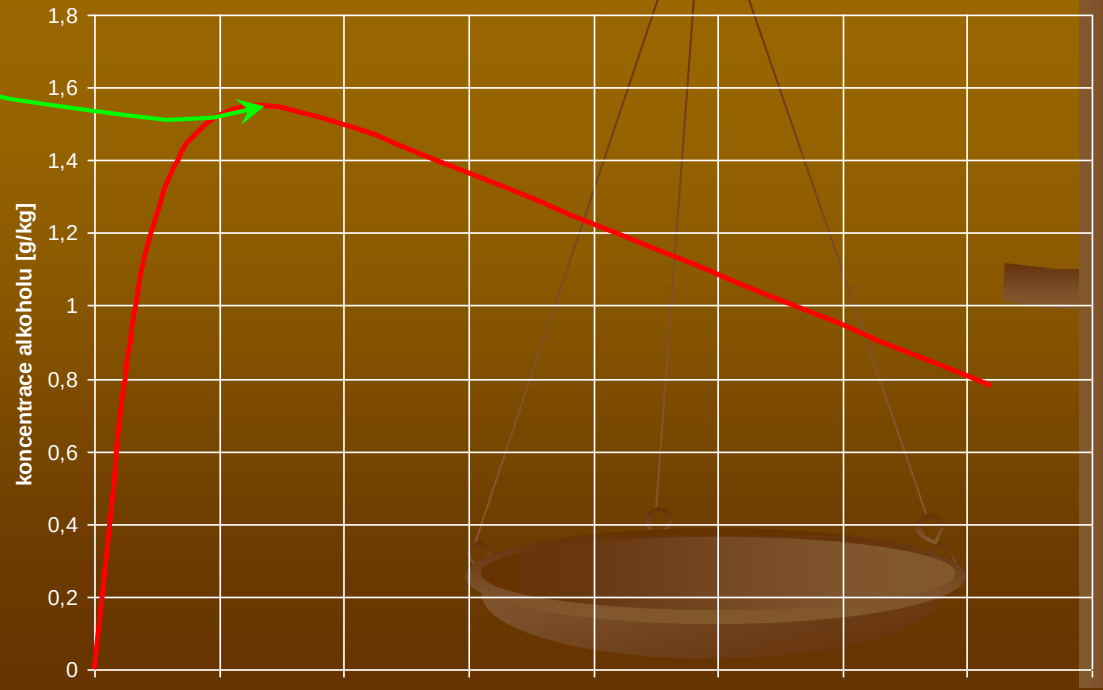
- Physical effort increases the speed of resorption in parallel with increasing of metabolism. We must consider illness of alimentary tract.

Resorption

- In moment, when the curve of amount of alcohol in blood is in its top, the resorption of alcohol is not at end, not even in case of one-shot drinking. In that moment, when the concentration of alcohol in alimentary tract is higher than in blood, the resorption still continues.

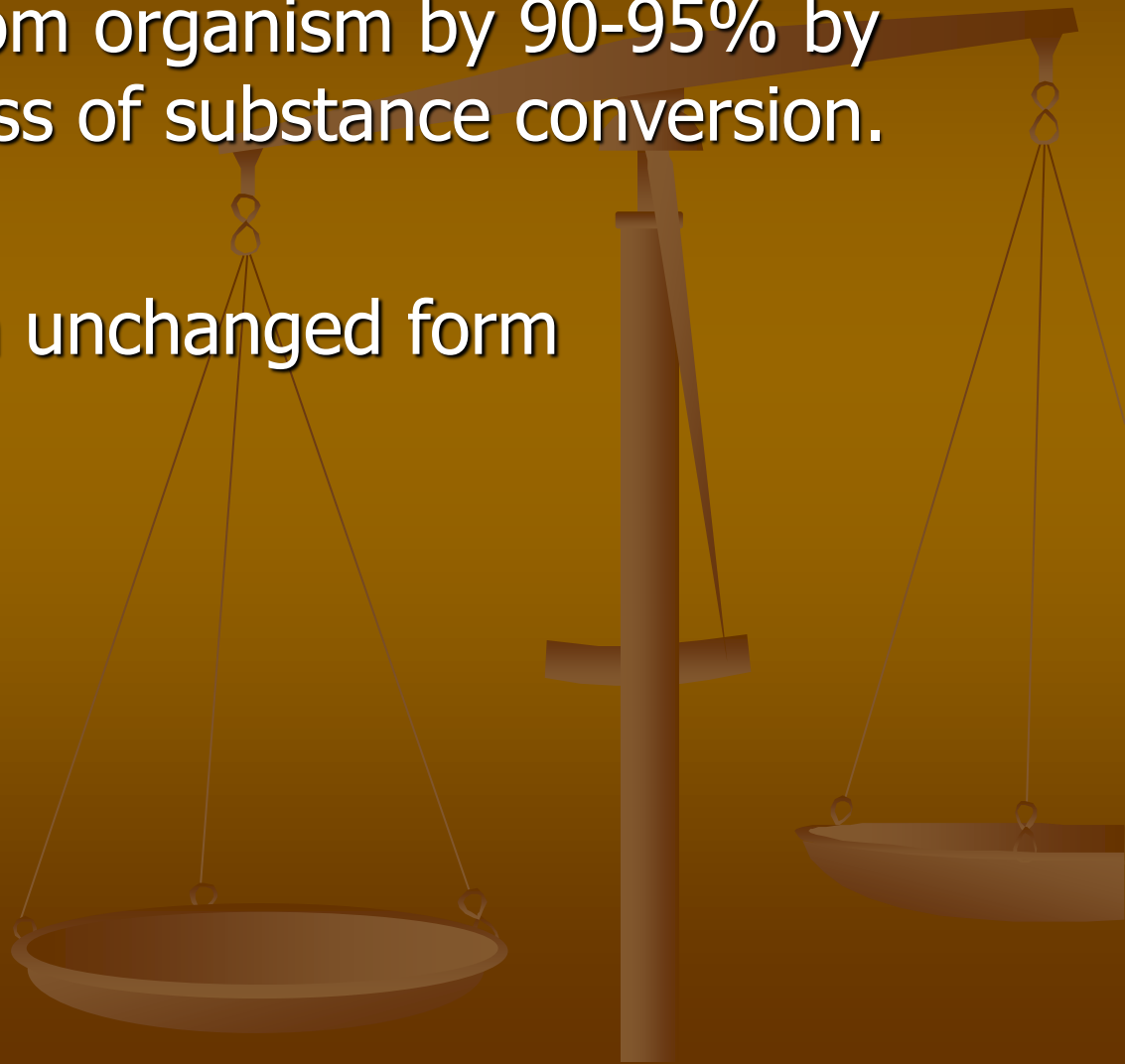
Resorption

- The top of the curve just shows, that there's a balance between infiltration of alcohol from alimentary tract to blood and its proceed from blood further into organism.



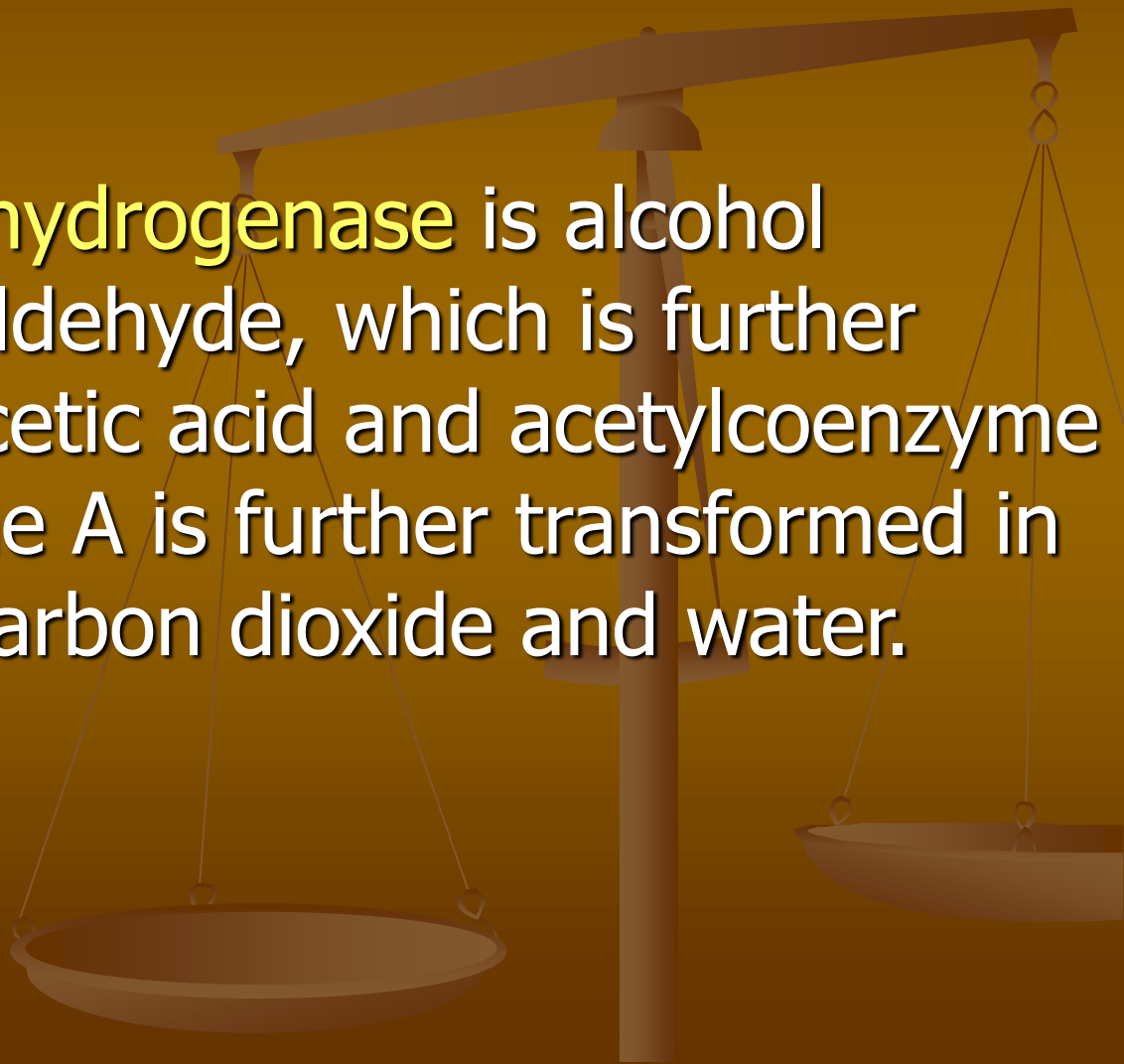
Elimination

- Alcohol excrets from organism by 90-95% by oxidation in process of substance conversion.
- 5-10% excretes in unchanged form
- 4-7% by breath
- 1-3% by urine



- Oxidation of alcohol runs from 60 to 90% in livers.

- Due to alcoholdehydrogenase is alcohol changed to acetaldehyde, which is further transformed to acetic acid and acetylcoenzyme A. Acetylcoenzyme A is further transformed in Krebs's cycle to carbon dioxide and water.



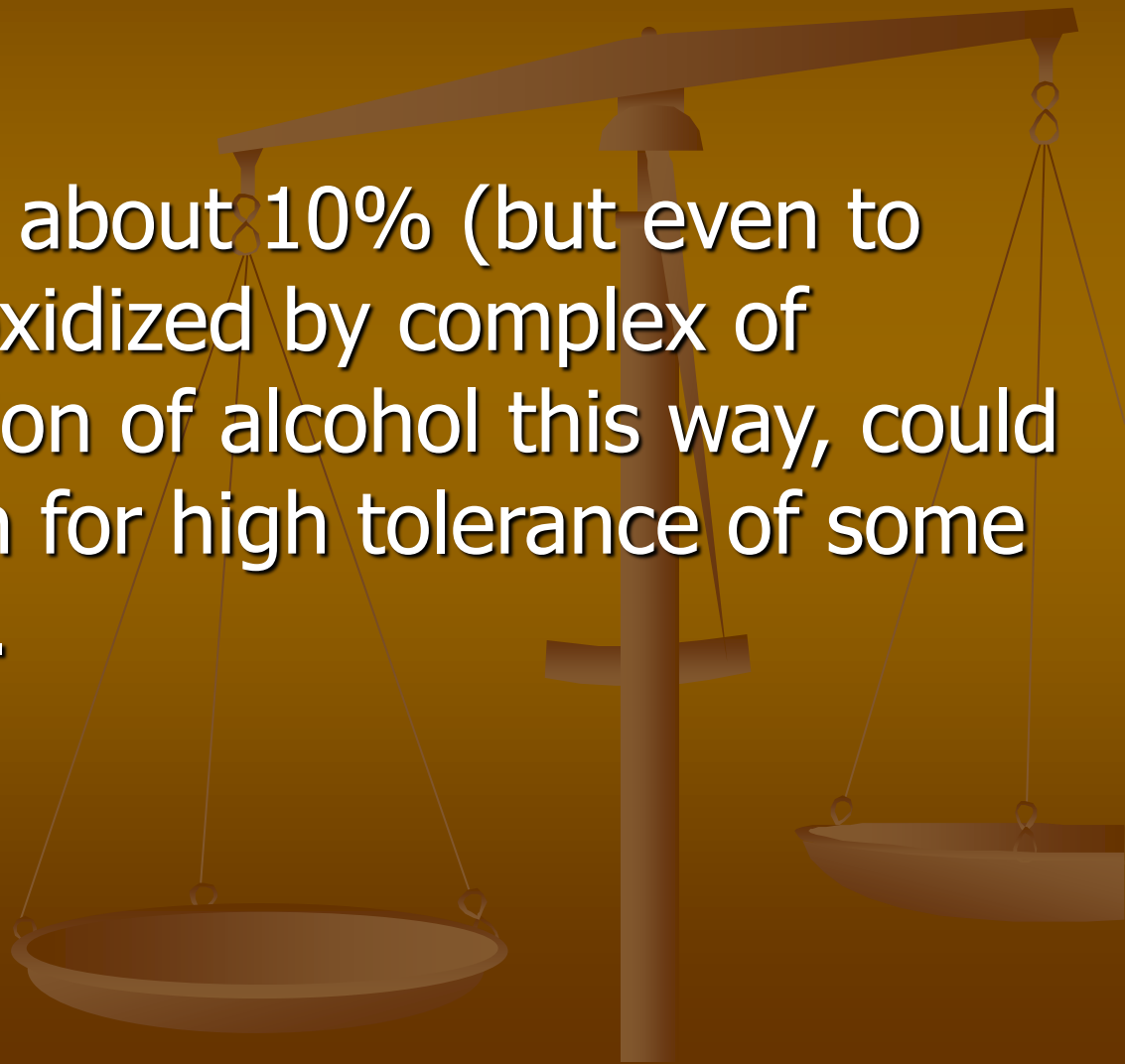
- Oxidation of alcohol runs from 60 to 90% in livers.

microsomal ethanol oxidation system

- MEOS system is particularly active with high concentrations 'of alcohol. This enzyme system also breaks alcohol down to acetaldehyde. Under continuous stimulation, this system grow develop stronger and stronger, so that a larger volume of alcohol per unit of time can be broken down under constant use

- Oxidation of alcohol runs from 60 to 90% in livers.

- In lower amount, about 10% (but even to 40%) is alcohol oxidized by complex of catalases. Oxidation of alcohol this way, could be an explanation for high tolerance of some people to alcohol.



methanol CH_3OH

- Is natural part of some fruit juices, is created of pectin (by hydrolysis of methoxyl group catalyzed by pektinmethylesterase) to pectin acid and methanol.
- Juice of black currant includes 70-176 $mg.l^{-1}$ methanol
- Apple juice includes 36-88 $mg.l^{-1}$
- Methanol in different spirits is from pectine. In process of fermentation are better conditions for activity of pectinmethylesterases, and therefor the amount of alcohol is higher than in juices.
- Amounts in spirits are:

  cognacs 320 to 400 $mg.l^{-1}$

  Plum brandy 3 950 to 7 320 $mg.l^{-1}$

  Fruit destilates 790 to 3 950 $mg.l^{-1}$

  vodka 79 to 158 $mg.l^{-1}$

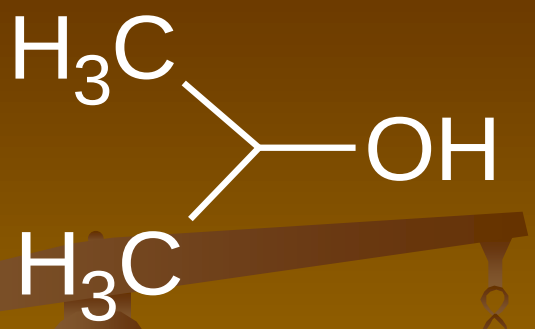
methanol CH_3OH

Lethal dose 30 – 100 g

After consummation appear pain in limbs, stomach, shakes, blindness, convulsions before death ,death after 2-3 days

Larger effect than ethanol (slower excretion - 5-10 times). Several hours or days between first drink and first symptoms. In body is oxidized to formaldehyde and formic acid.

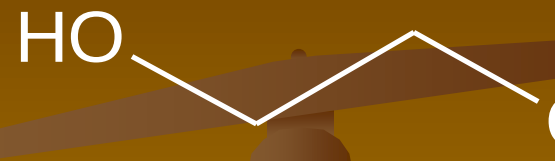
propan-2-ol



- cleaning compound
- not condensing Ca^{2+}
- stronger narcotic effect than alcohol
- coma by lower concentrations than in case of ethanol

etylenglykol

- non-freezing substances



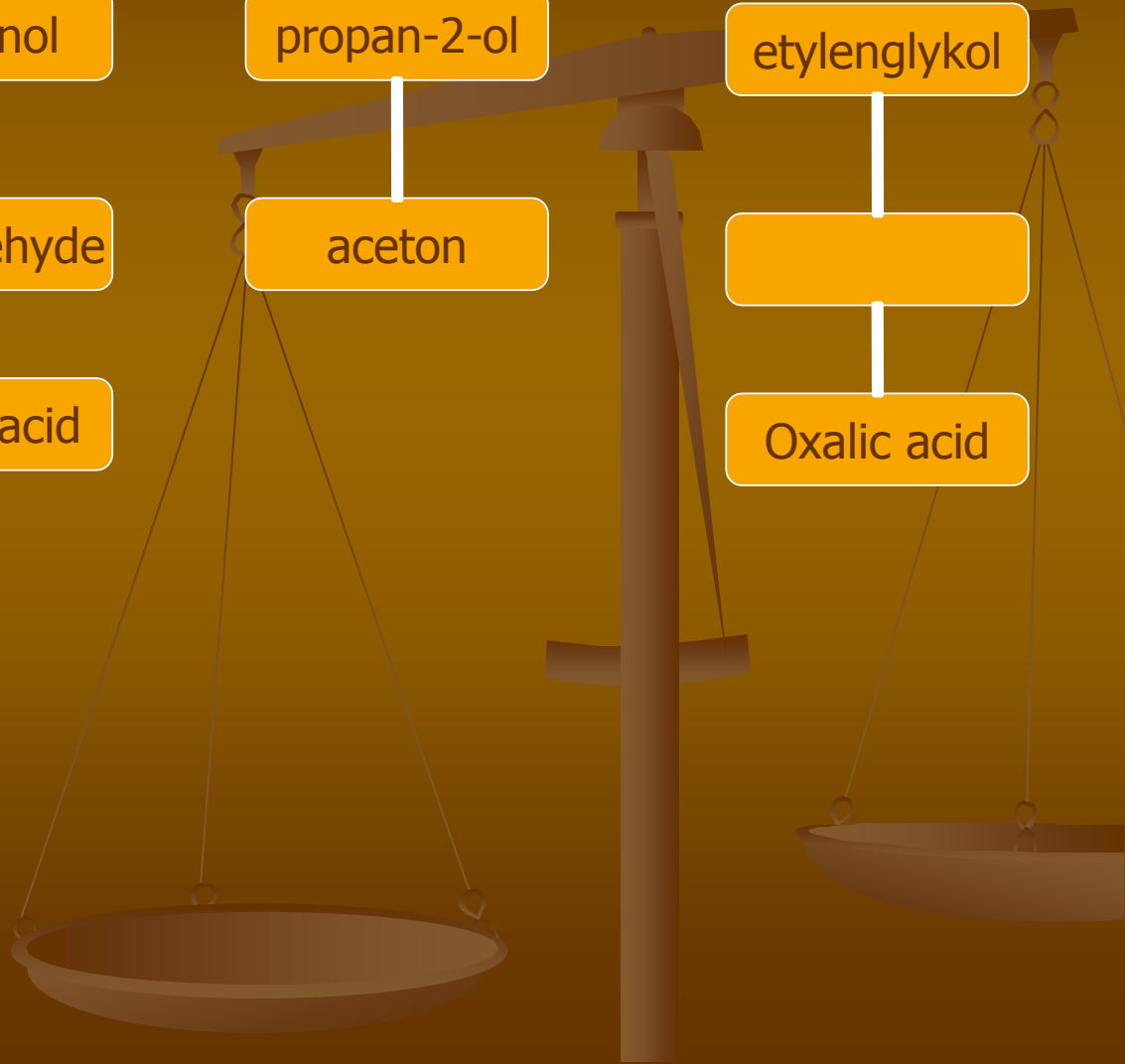
- Fridex
- in body is oxidized to oxalic acid, which caused poisoning
- symptoms of intoxication and ,lost of balance, unconsciousness, coma
- latency time to 20 hours
- death after 2-7 hours

ethanol → acetaldehyde → Acetic acid → acethyl Co A → $CO_2 + H_2O$

methanol → formaldehyde → Formic acid

propan-2-ol → aceton

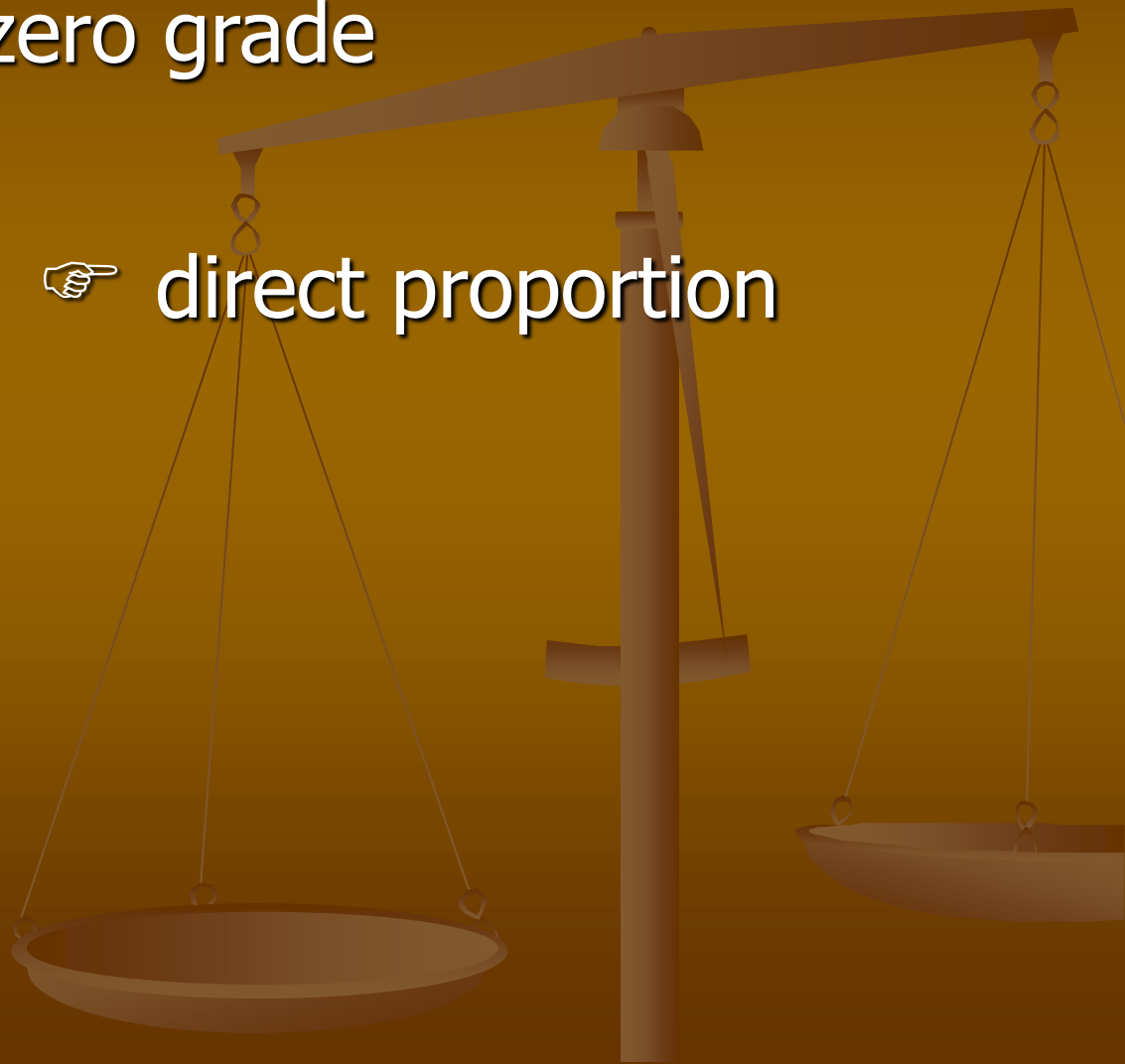
etylenglykol → [ ] → Oxalic acid



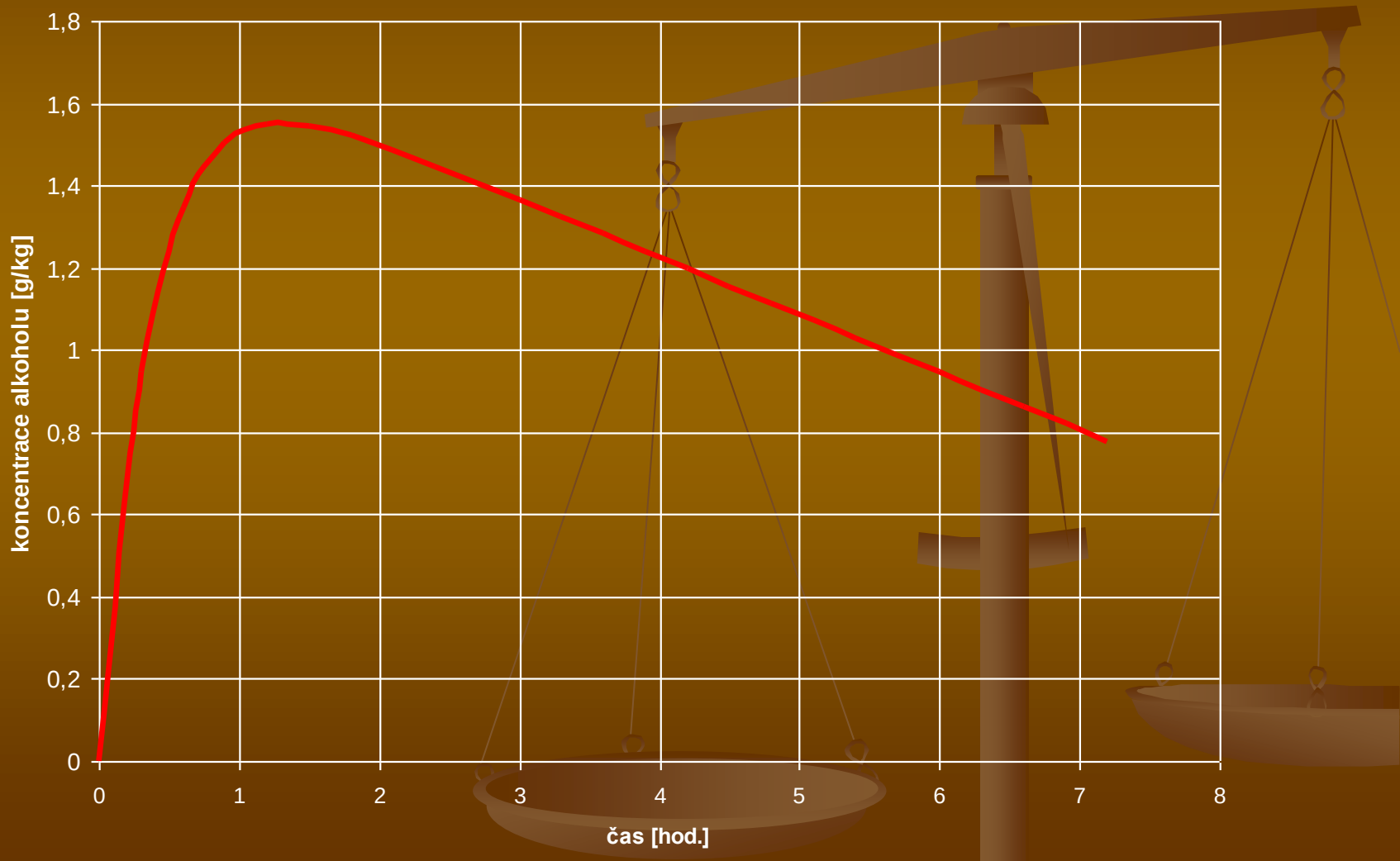
Kinetics

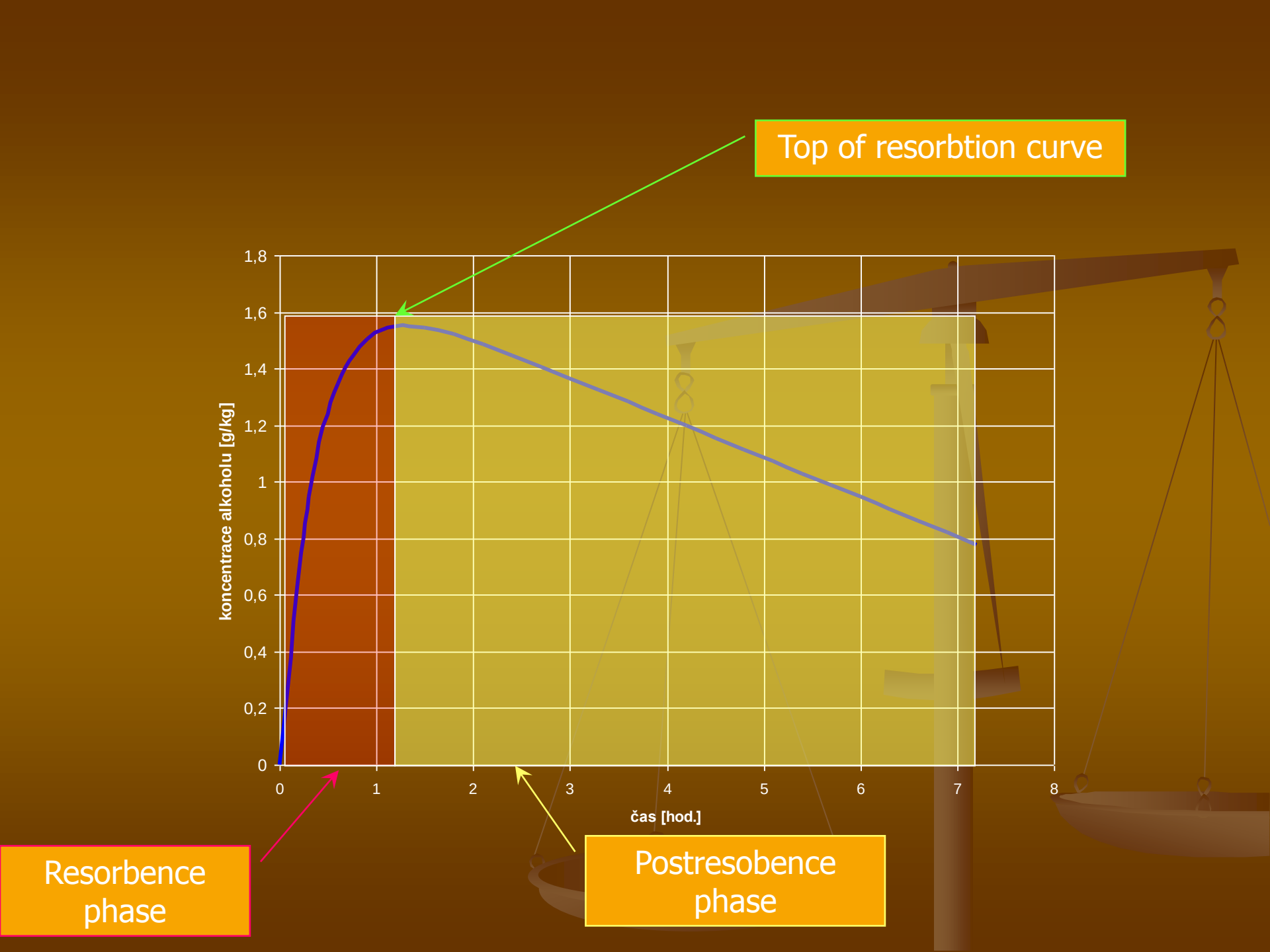
Metabolism kinetics

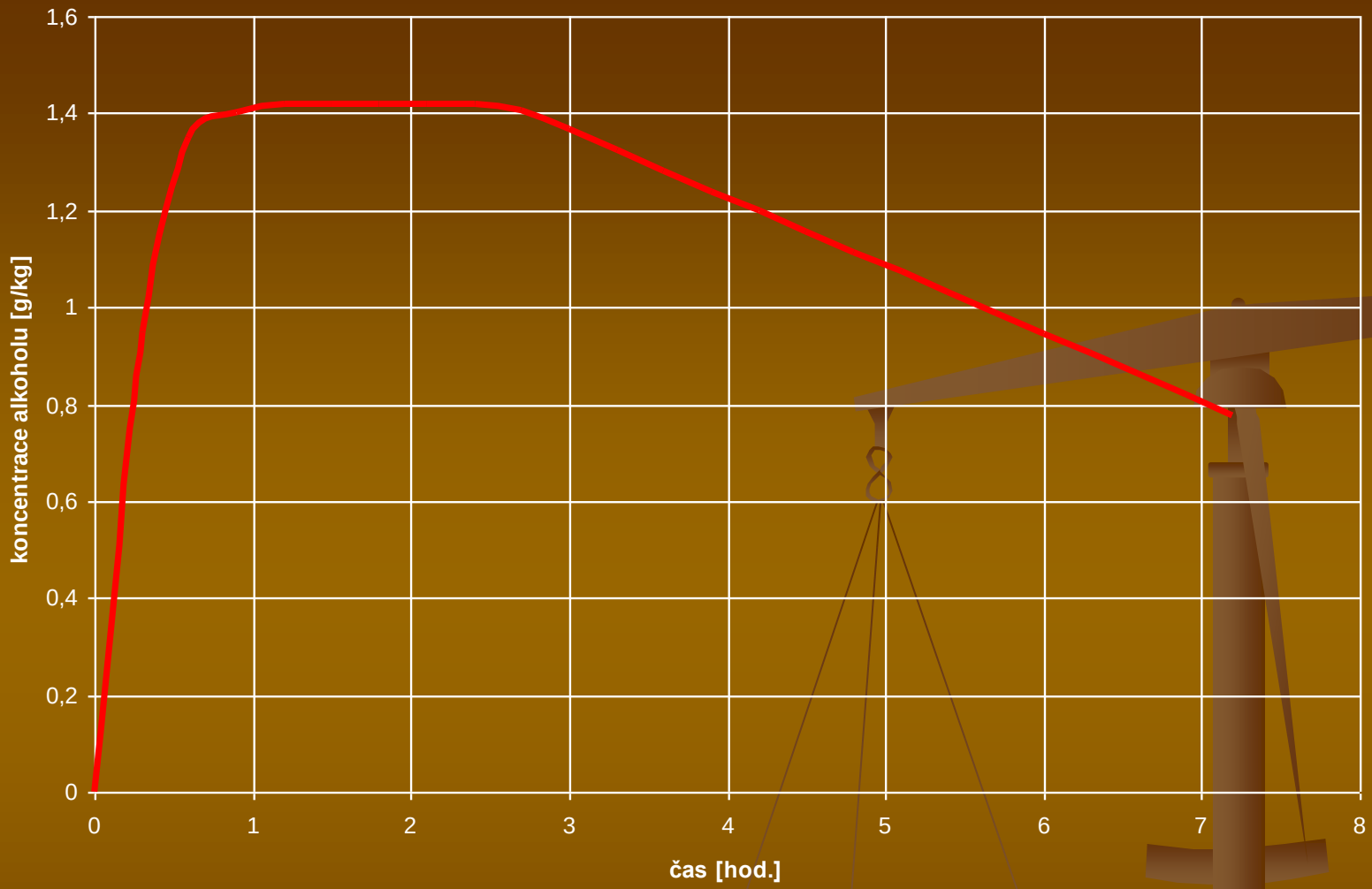
- final kinetics is zero grade
- Constant speed ☞ direct proportion



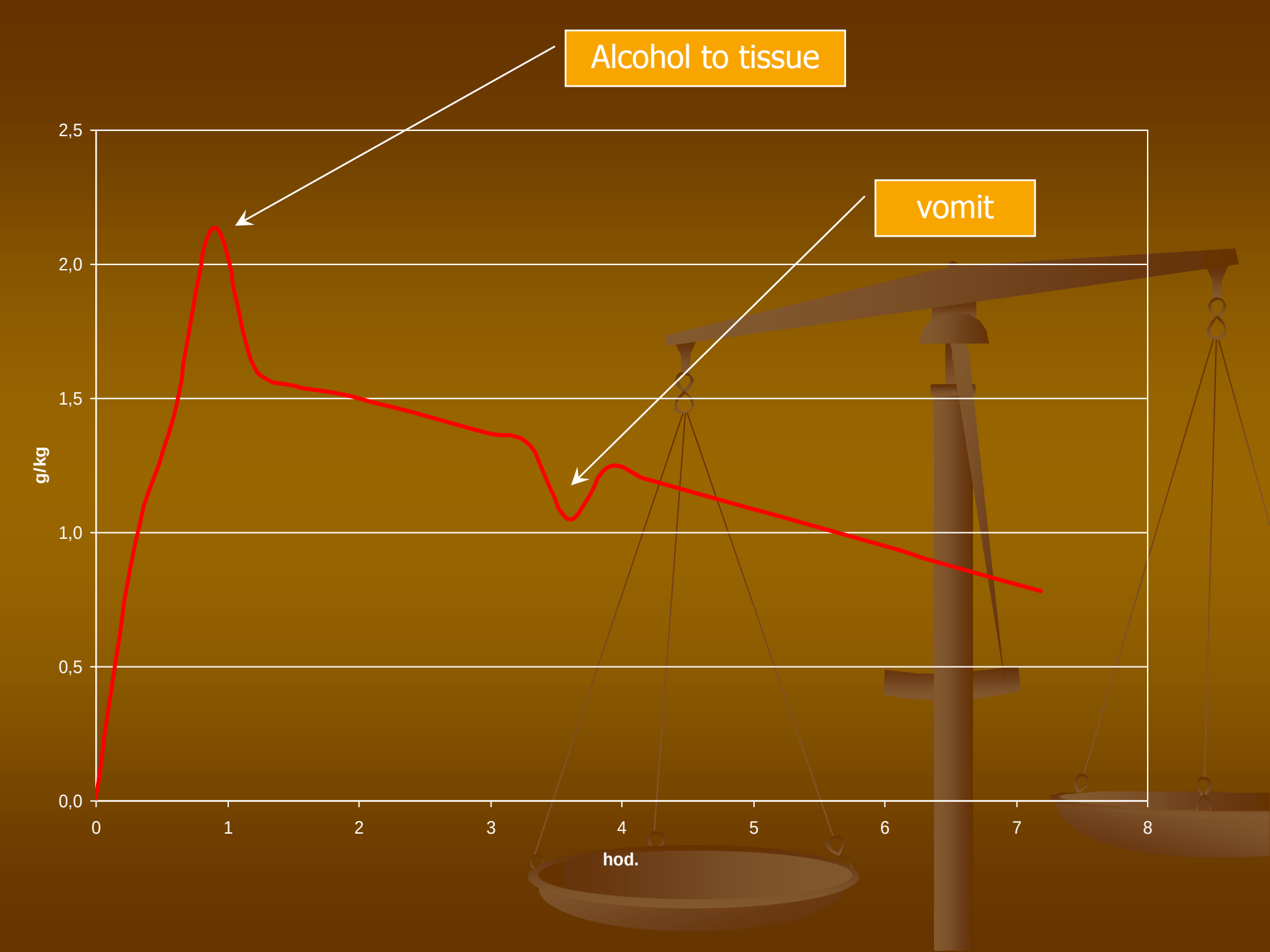
Optimal shape of resorption curve

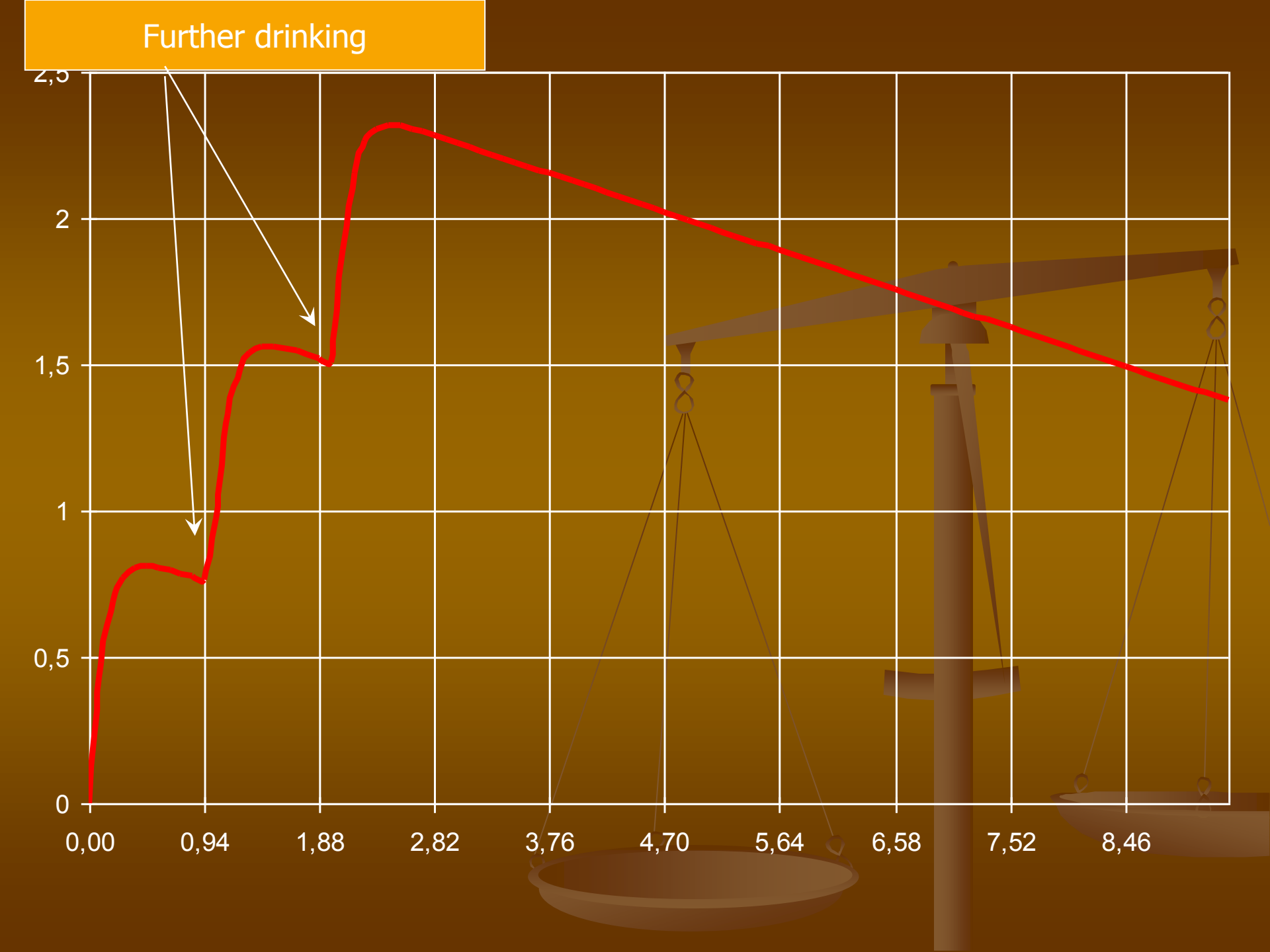



Top of resorbtion curve
koncentrace alkoholu [g/kg]
1,8
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0
0
1
2
3
4
5
6
7
8
čas [hod.]
Resorbence phase
Postresobence phase



Consumation of low-alcohol drink (beer), or larger meal will make longer resorbtion


Alcohol to tissue
vomit
2,5
2,0
1,5
1,0
0,5
0,0
g/kg
0
1
2
3
4
5
6
7
8
hod.


Further drinking
2,5
2
1,5
1
0,5
0
0,00
0,94
1,88
2,82
3,76
4,70
5,64
6,58
7,52
8,46

Lay-out of alcohol in organism

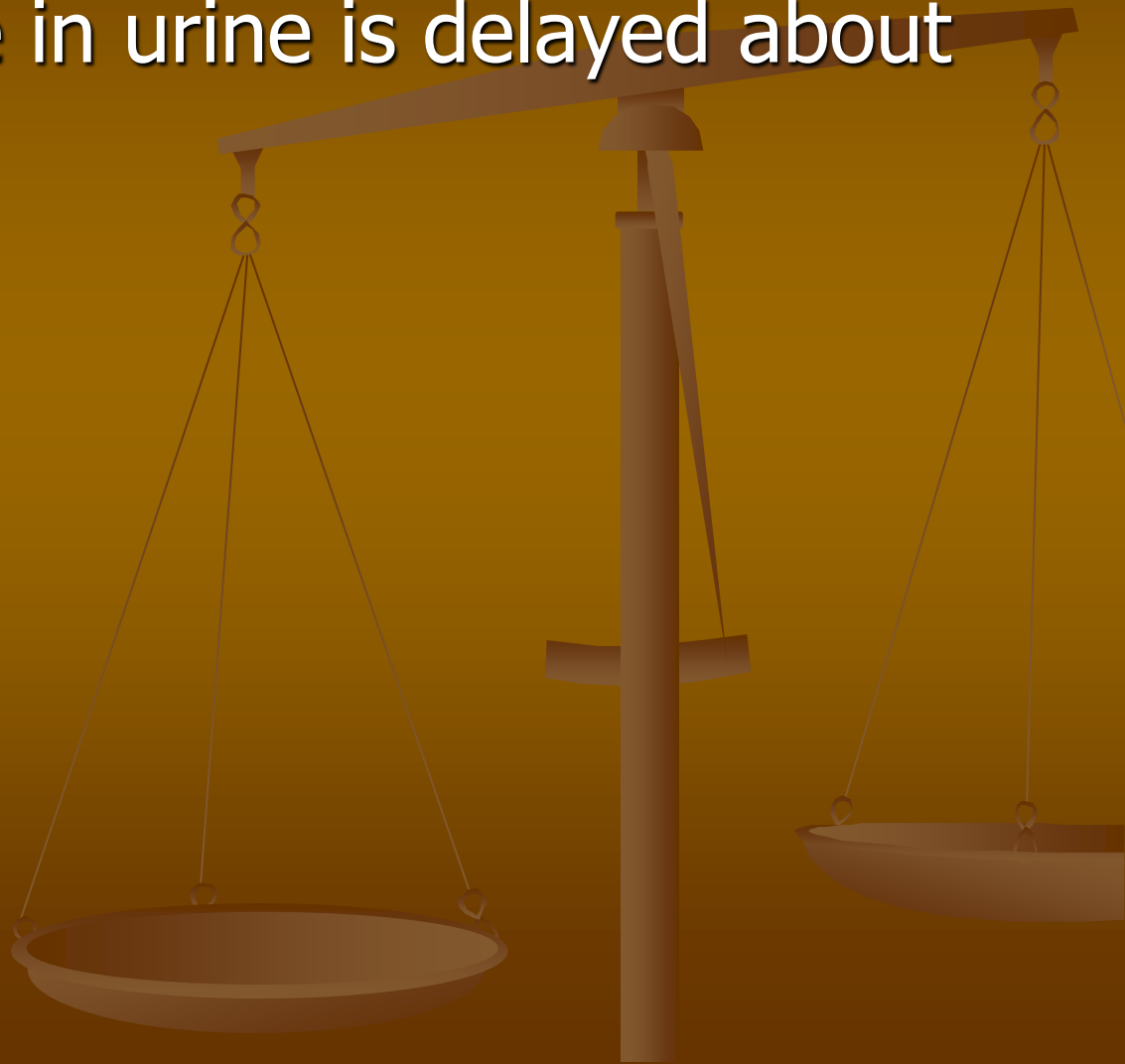
Alcohol in urine

- it's excreted to urine in unchanged form by simple diffusion
- kidneys are not increasing concentration of alcohol
- there is no braking point of excretion

- concentration of alcohol in urine from kidneys calyx is equal (after calculation of proportion between water and dry mass) to concentration in blood

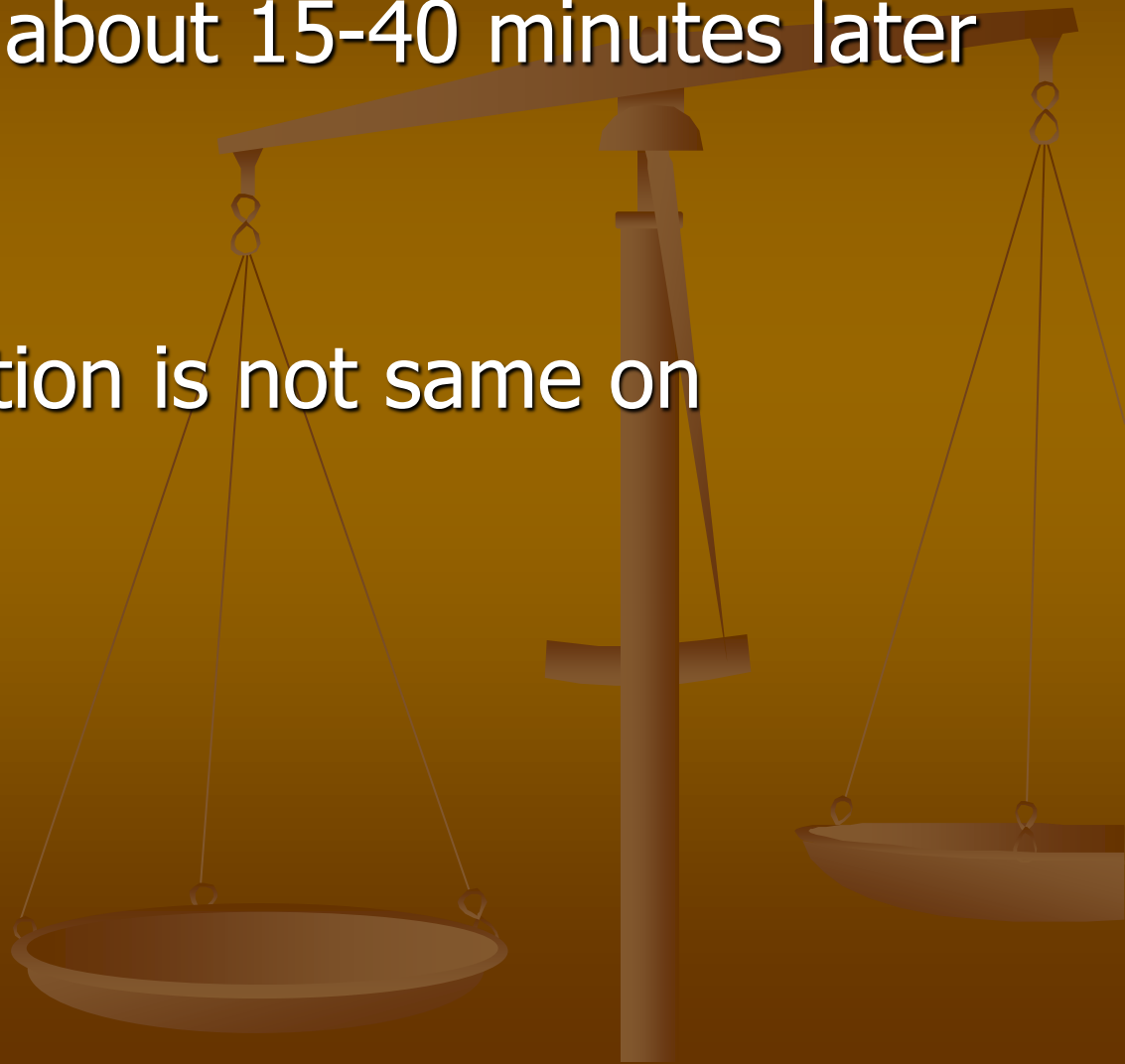
Alcohol in urine

- the top of curve in urine is delayed about 10-30 minutes



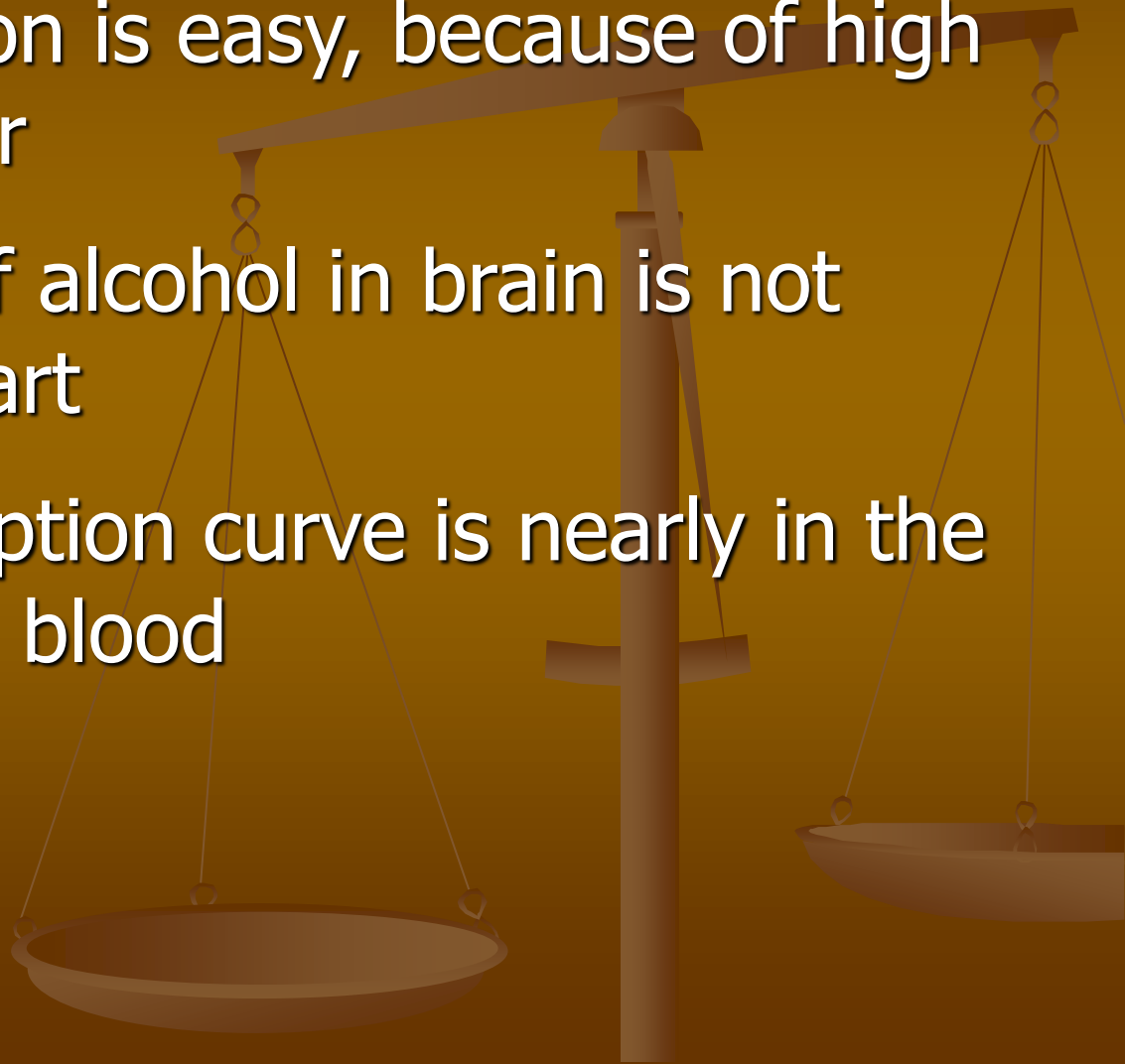
Alcohol in coeliolymph

- maximal values about 15-40 minutes later than in blood
- speed of saturation is not same on different places



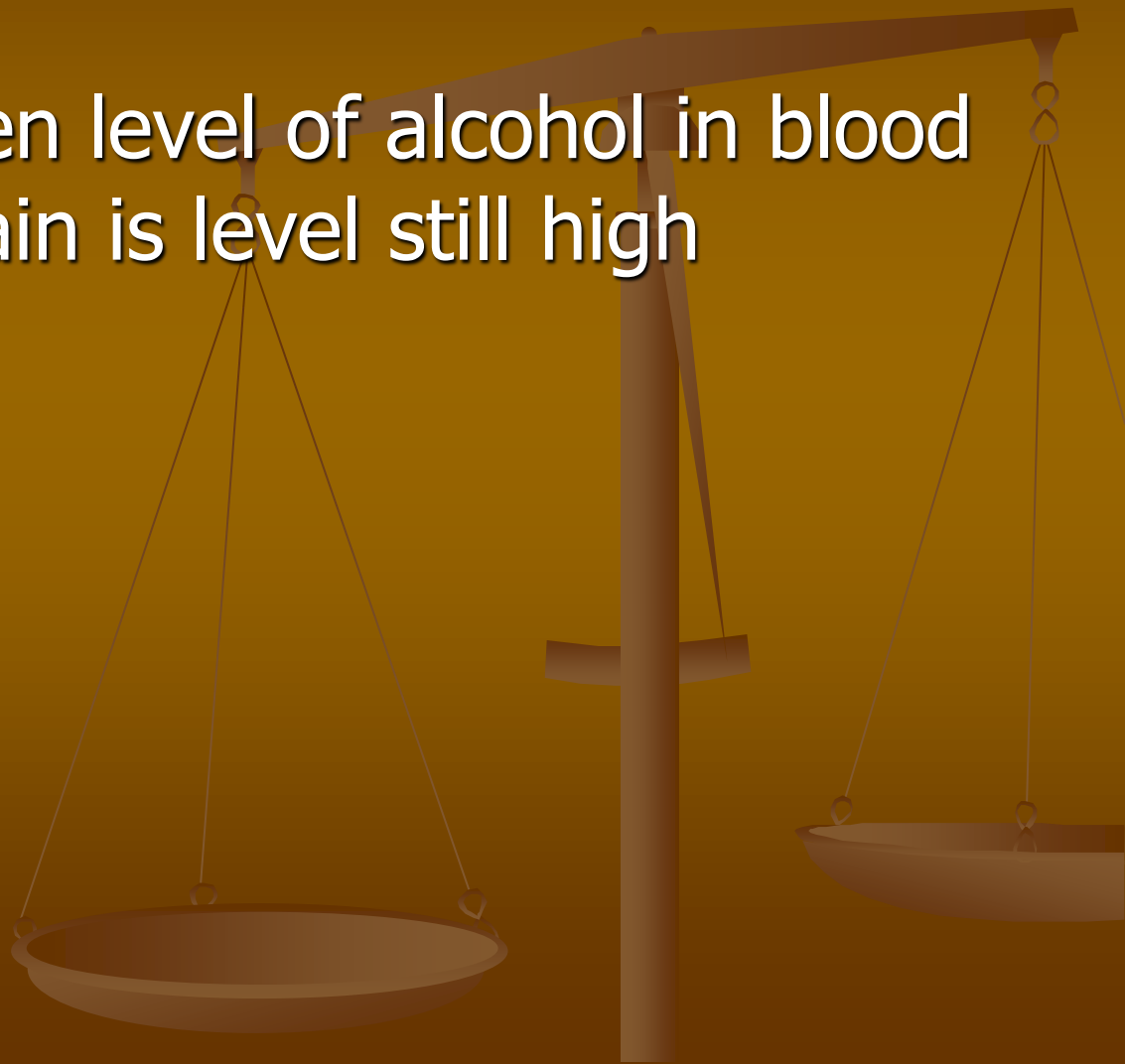
Brain matter

- alcohol saturation is easy, because of high amount of water
- concentration of alcohol in brain is not equal in each part
- the top of resorption curve is nearly in the same time as in blood



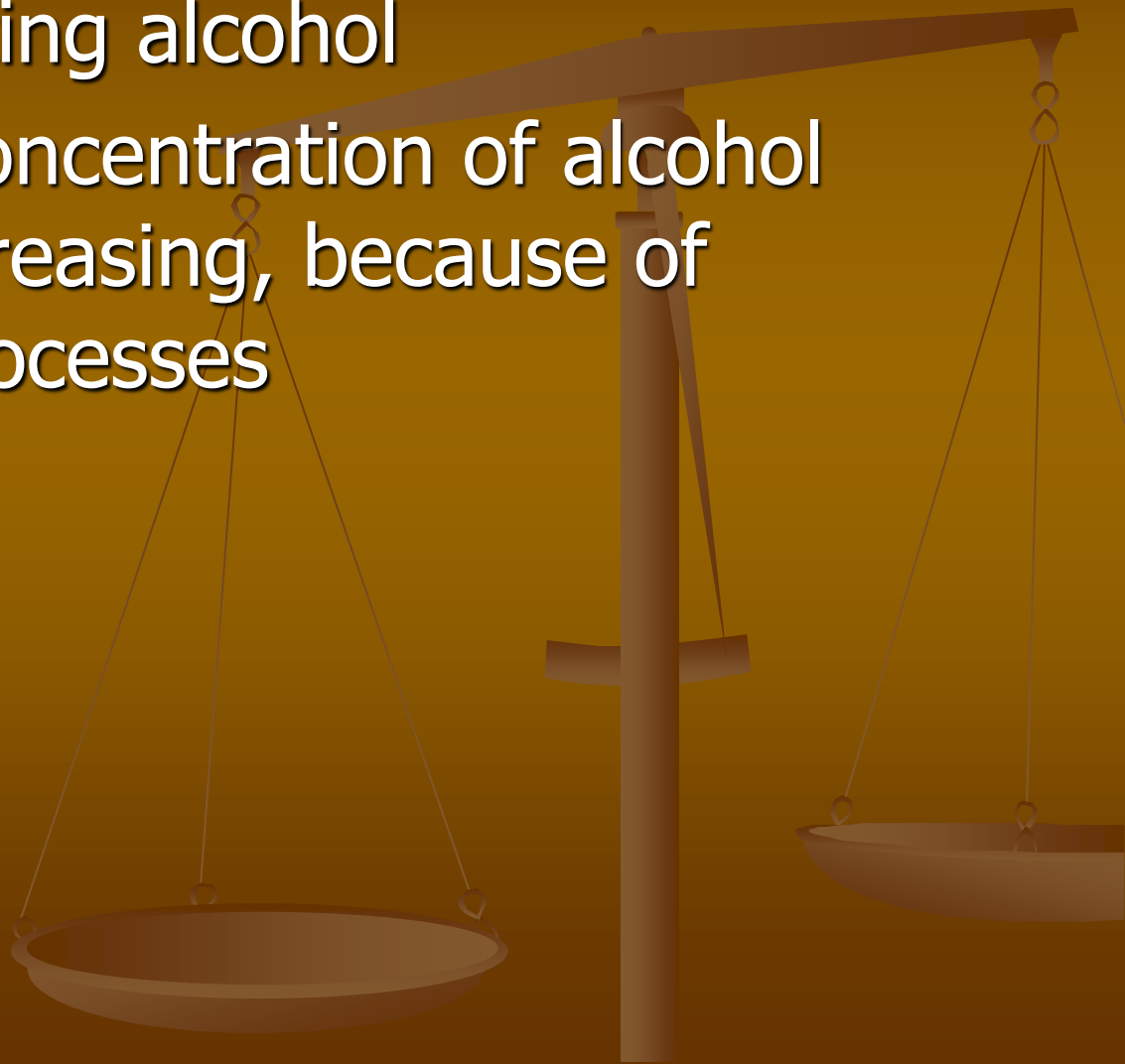
Brain matter

- in moment, when level of alcohol in blood is normal, in brain is level still high



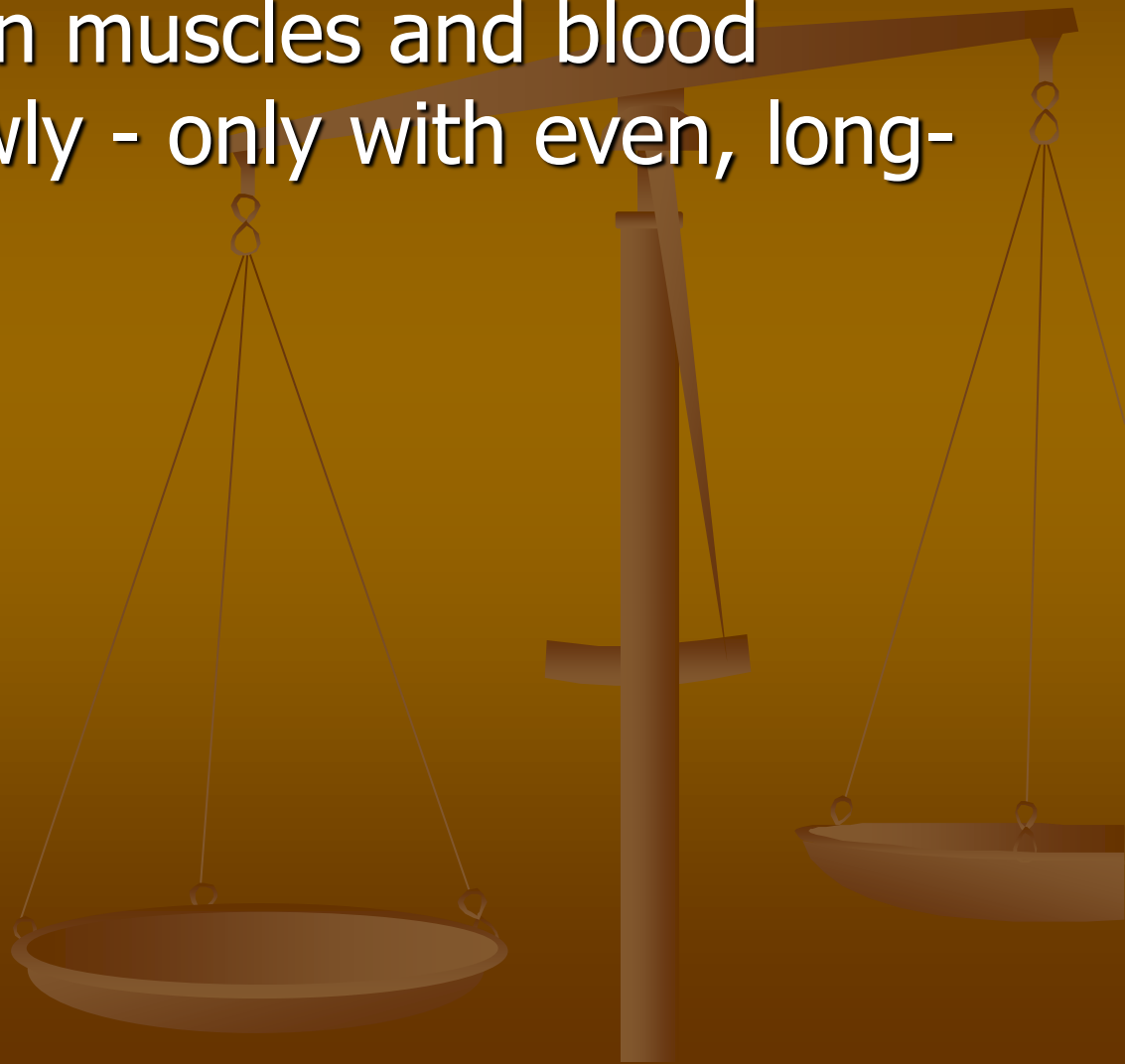
Livers

- are not cumulating alcohol
- after death is concentration of alcohol remarkably decreasing, because of fermentative processes



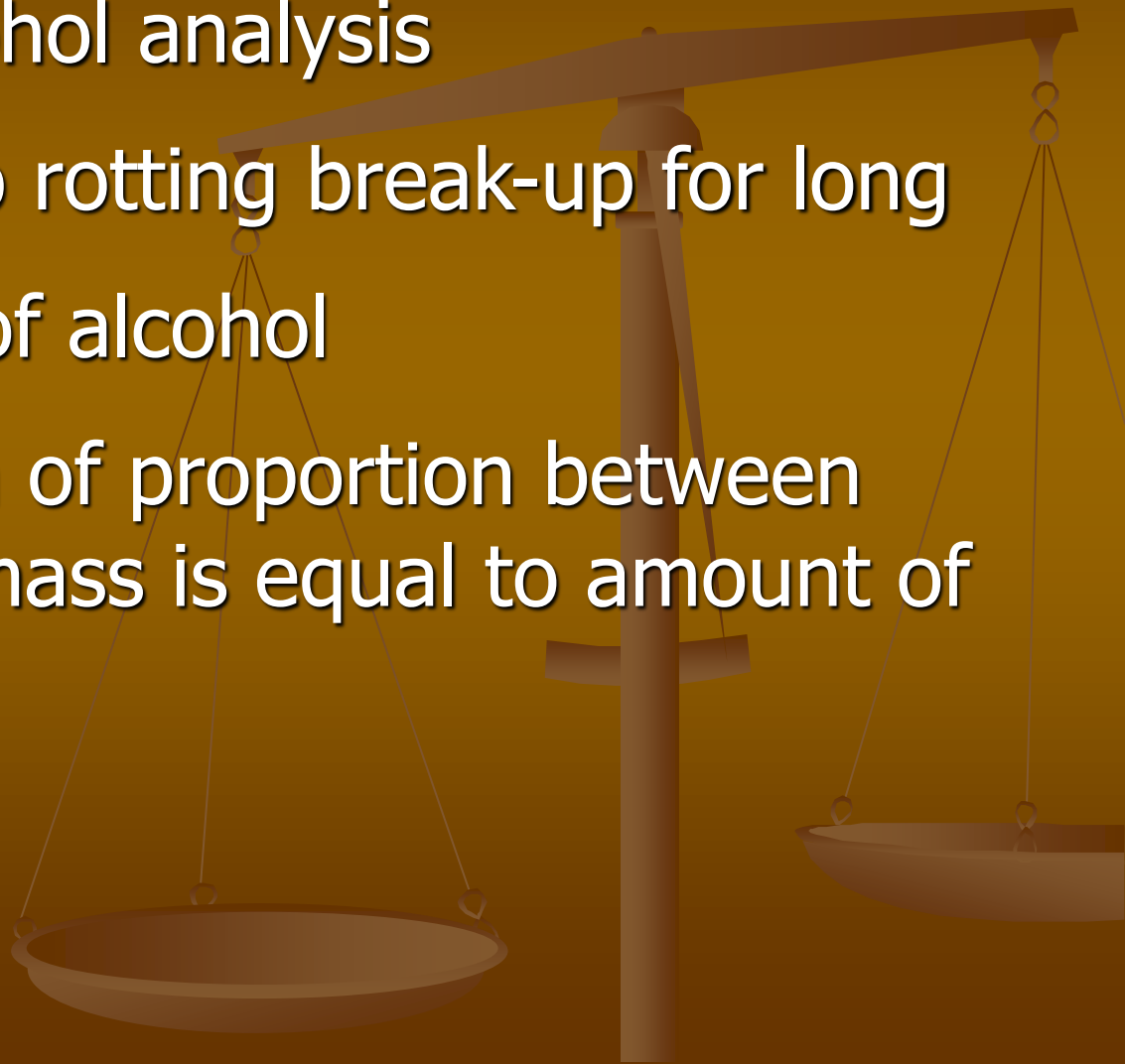
Muscles

- balance between muscles and blood comes very slowly - only with even, long-term drinking.



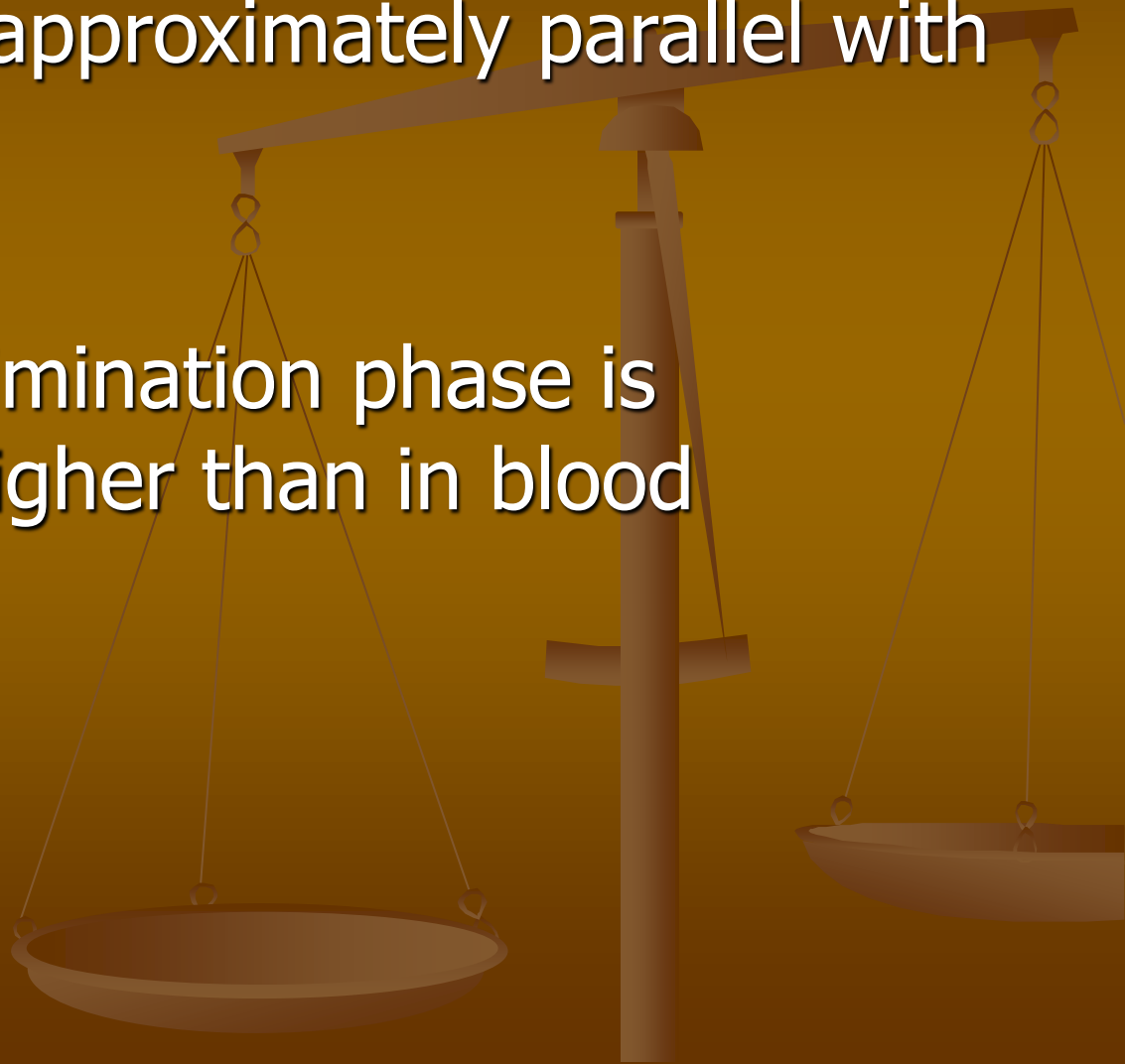
Synovial fluid

- suitable for alcohol analysis
- is not subject to rotting break-up for long
- fast saturation of alcohol
- after calculation of proportion between water and dry mass is equal to amount of alcohol in blood



Saliva

- the curve goes approximately parallel with blood
- at the end of elimination phase is concentration higher than in blood

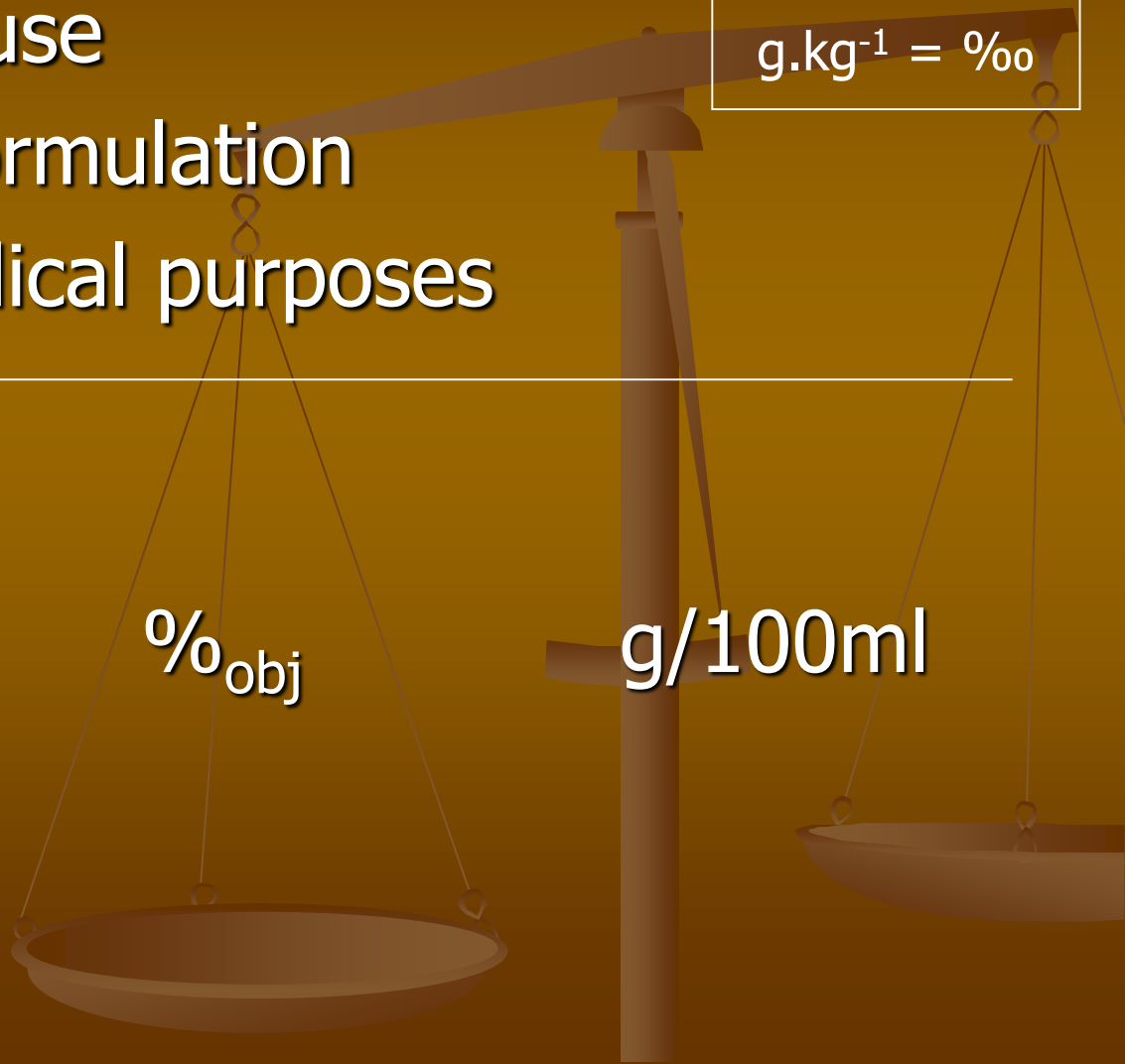


Formulation of concentration of alcohol

$g.kg^{-1}$	forens use
‰	older formulation
$mmol.l^{-1}$	for medical purposes

$g.kg^{-1}$ = ‰

$g.l^{-1}$ $\%_{hm}$ $\%_{obj}$ g/100ml



Effect intensity

Effect intensity depends on:

amount of alcohol in blood	level of alcoholic affection is matches to amount of alcohol in blood, therefor it's possible to assign level of affection with amount of alcohol
on shape of curve of alcohol in blood	in resorbtion phase is CNS affected much more than by same amount in postresorbtion phase
habituation	affect of people who are used to dring is lighter
age	affect of children and adolescents is heavier
others	? ? ?

Amount of alcohol in blood and affects

g.kg^{-1}	affect
to 0,2	Sure fyziologic level
to 0,3	May be increased fyziologic level, not drunken level
0,4 - 0,5	Malfunctions of vestibular apparatus and sences
0,5 - 1,0	drinking
1,0 - 1,5	Light drunkenness
1,5 - 2,0	medium drunkenness
2,0 - 3,0	Heavy drunkenness
3,0 - 4,0	intoxication
above ?	Deadly intoxication

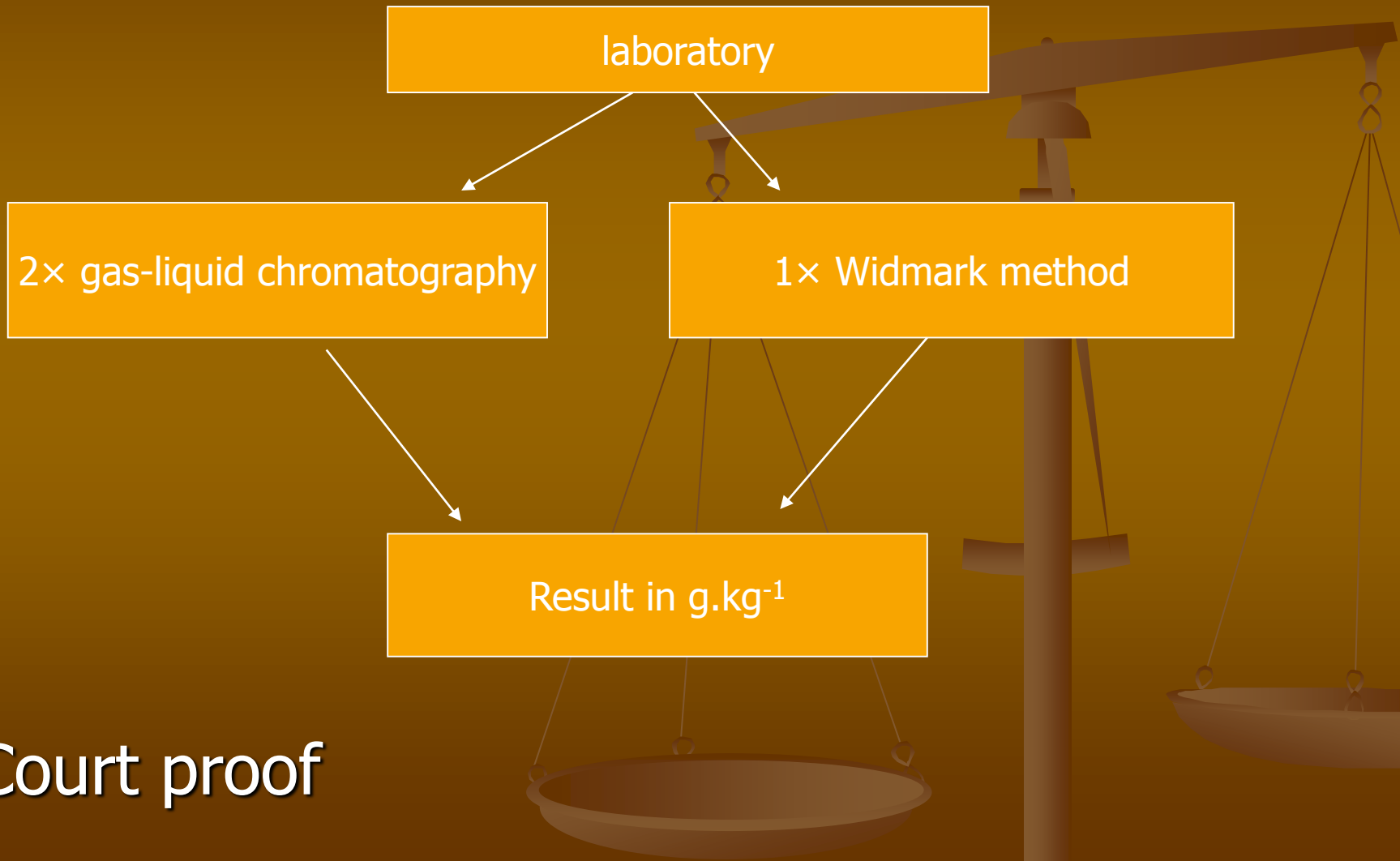
Determination of alcohol in blood

- Detection tubes
- breath analyzators

- Quick approximate finding of alcohol in blood of investigated person

- Result is not a proof

Determination of alcohol in blood

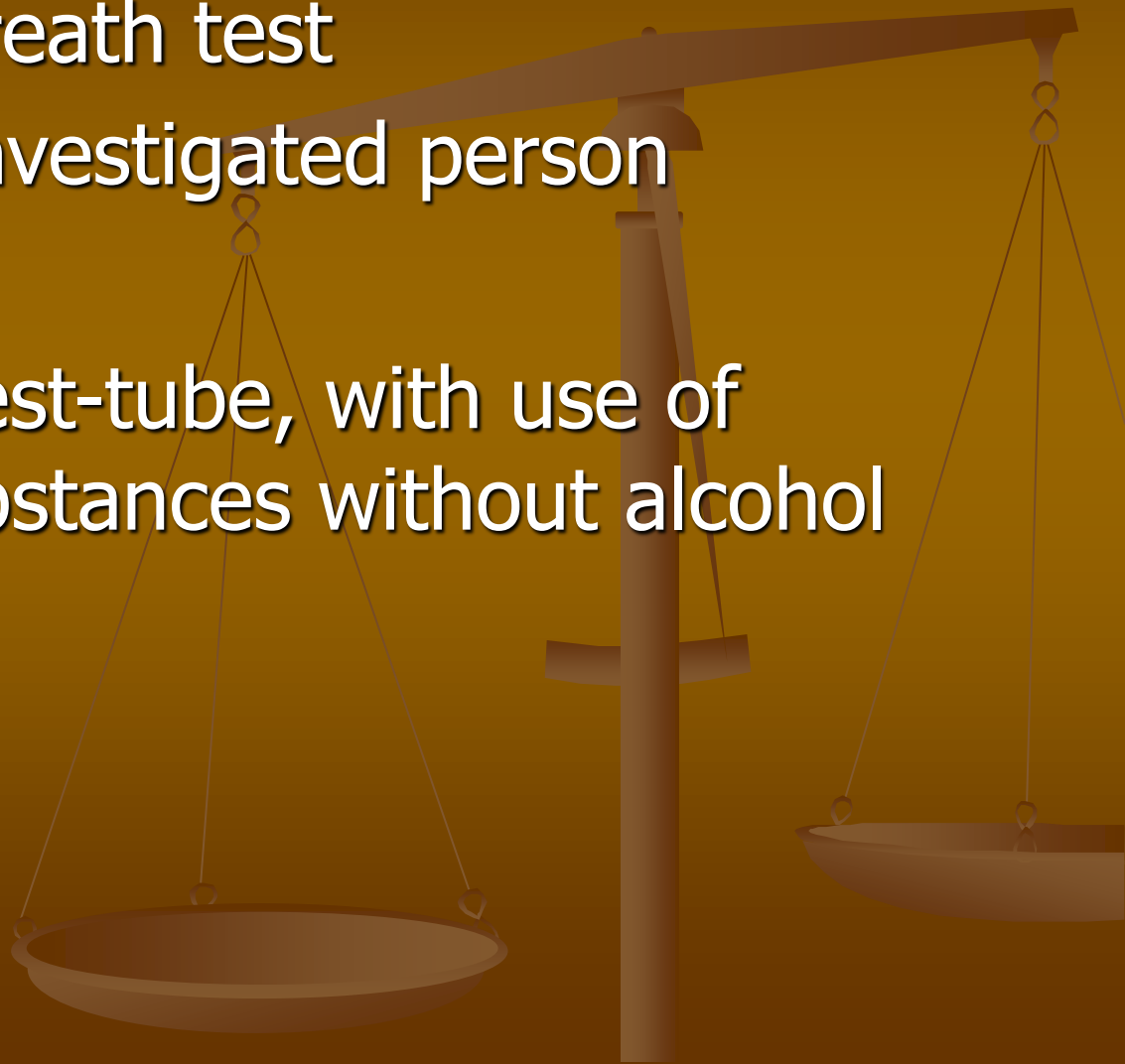


Court proof

Taking blood sample

- After positive breath test
- With agree of investigated person

- Taking of one test-tube, with use of desinfection substances without alcohol



Sanction

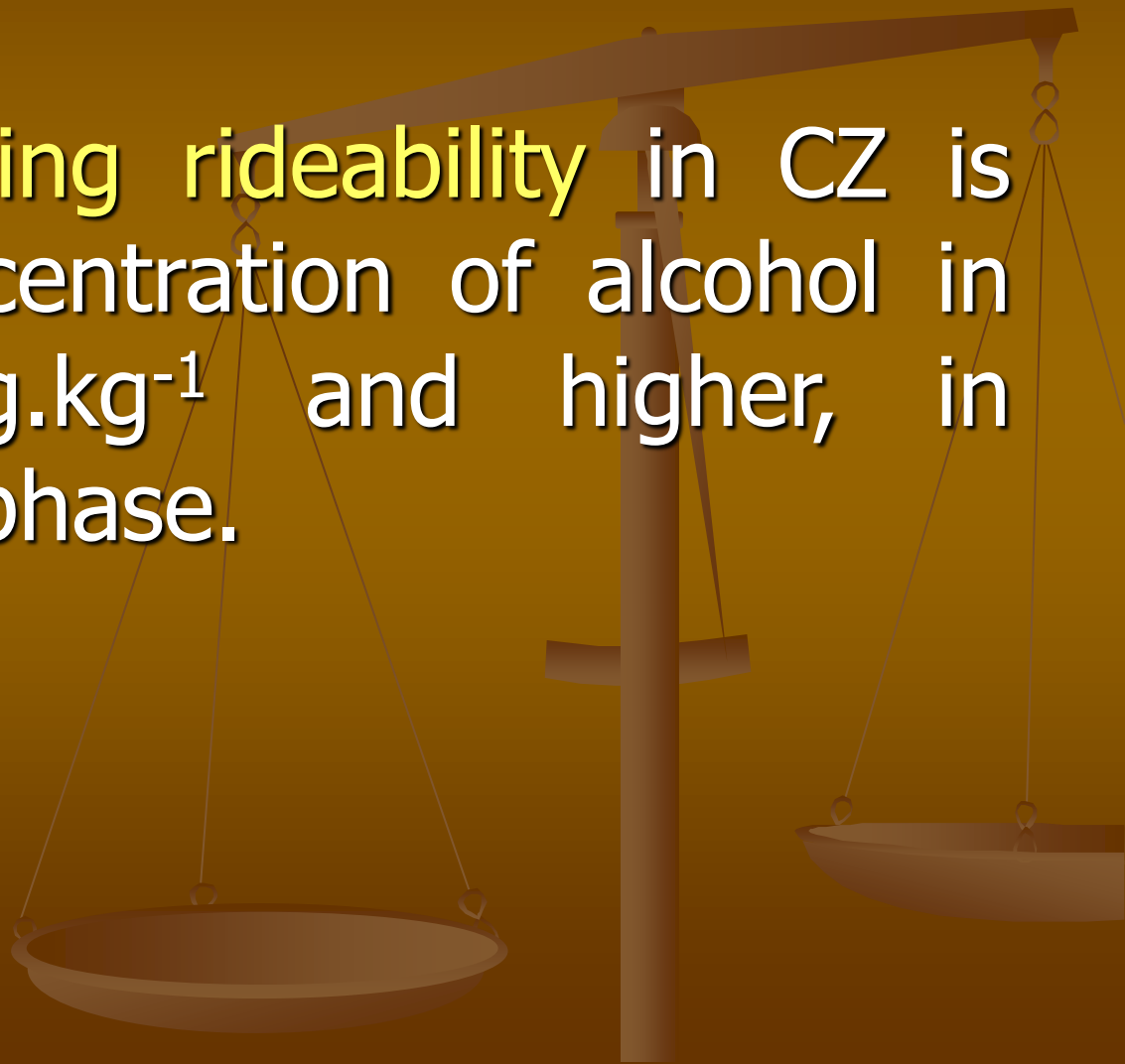
Penal law § 201
Threat under influence of alcohol

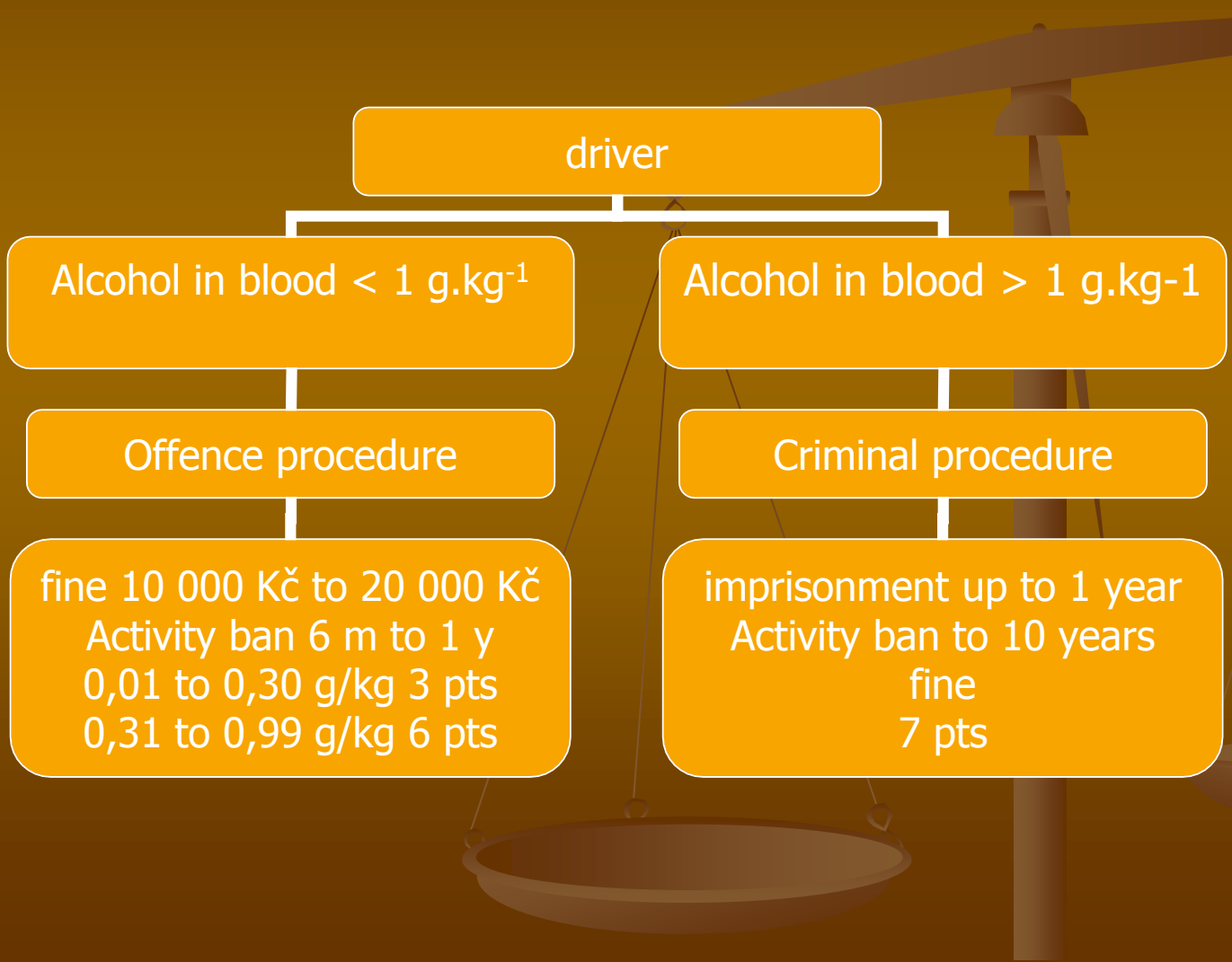
He who does, in status interdicting rideability, which was caused by effect of habit forming substance, his job or another activity, where he can endanger life or health of people or cause damage on property,

a. ačkoliv byl za takový čin v posledních dvou letech odsouzen nebo z výkonu trestu odnětí svobody uloženého za takový čin propuštěn,
b. ačkoliv byl za obdobný čin spáchaný pod vlivem návykové látky v posledních dvou letech postižen,
c. spáchá-li takový čin při výkonu zaměstnání nebo jiné činnosti, při kterých je vliv návykové látky zvlášť nebezpečný, zejména řídi-li hromadný dopravní prostředek, nebo
d. způsobí-li takovým činem, byť i z nedbalosti, jinému ublížení na zdraví nebo větší škodu na cizím majetku nebo jiný vážný následek,

Will be punished by imprisonment up to one year or activity ban or fine.

Status interdicting rideability in CZ is set, when concentration of alcohol in blood is 1 $g.kg^{-1}$ and higher, in postresorption phase.

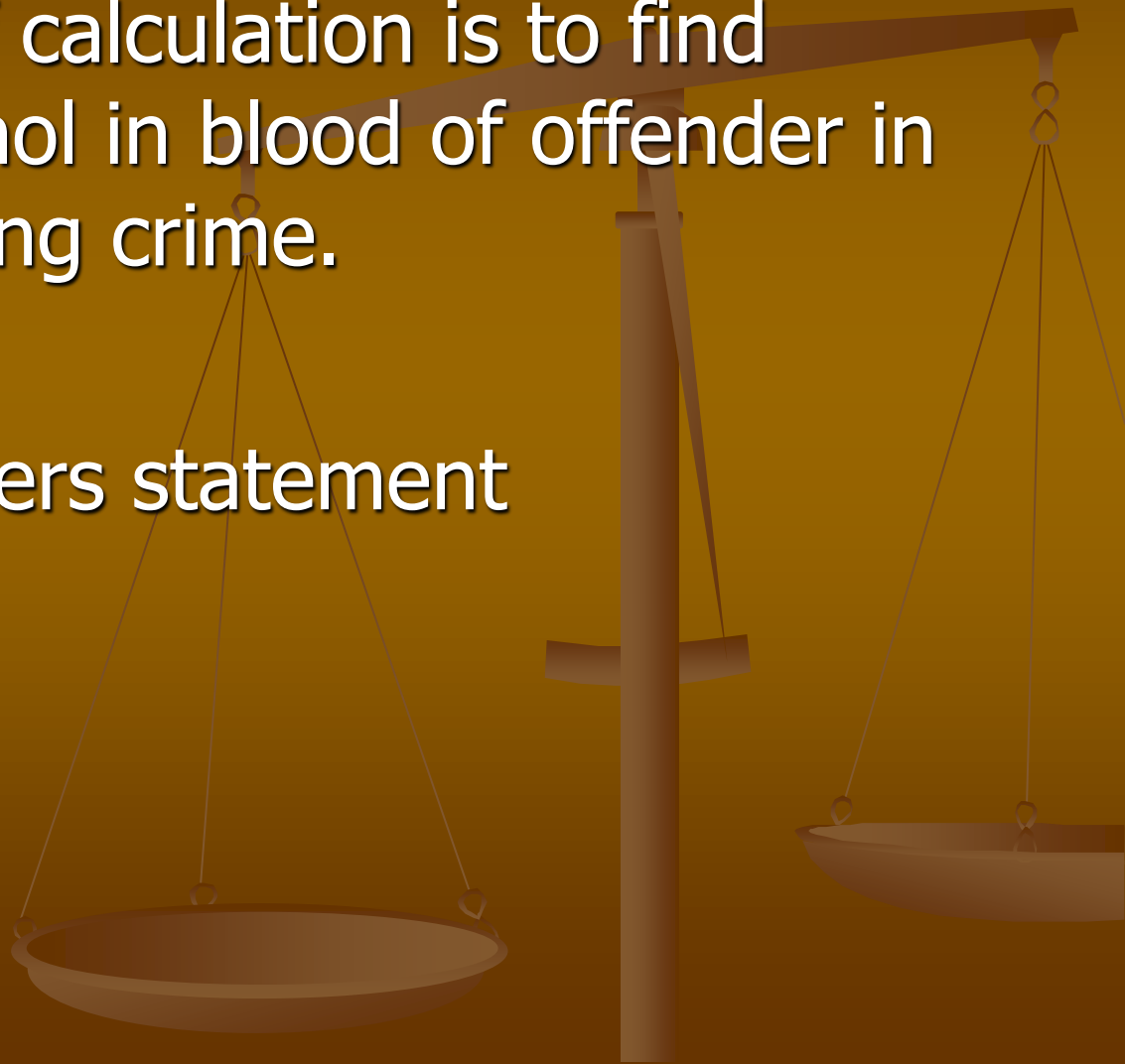



driver
Alcohol in blood < 1 g.kg-1
Alcohol in blood > 1 g.kg-1
Offence procedure
Criminal procedure
fine 10 000 Kč to 20 000 Kč
Activity ban 6 m to 1 y
0,01 to 0,30 g/kg 3 pts
0,31 to 0,99 g/kg 6 pts
imprisonment up to 1 year
Activity ban to 10 years
fine
7 pts

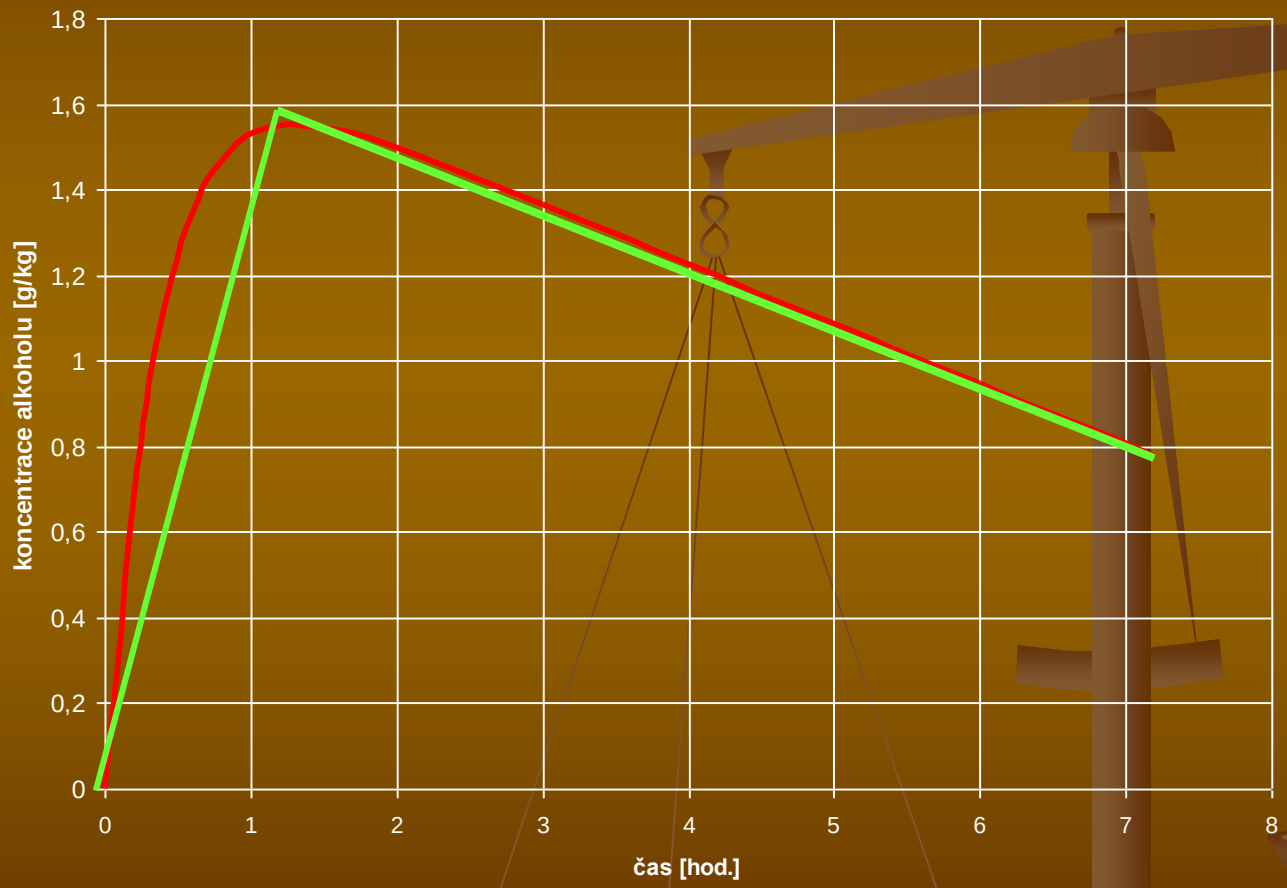
Calculations

Calculations

- The meaning of calculation is to find amount of alcohol in blood of offender in time of commiting crime.
- To prove offenders statement



Simplifying presumption



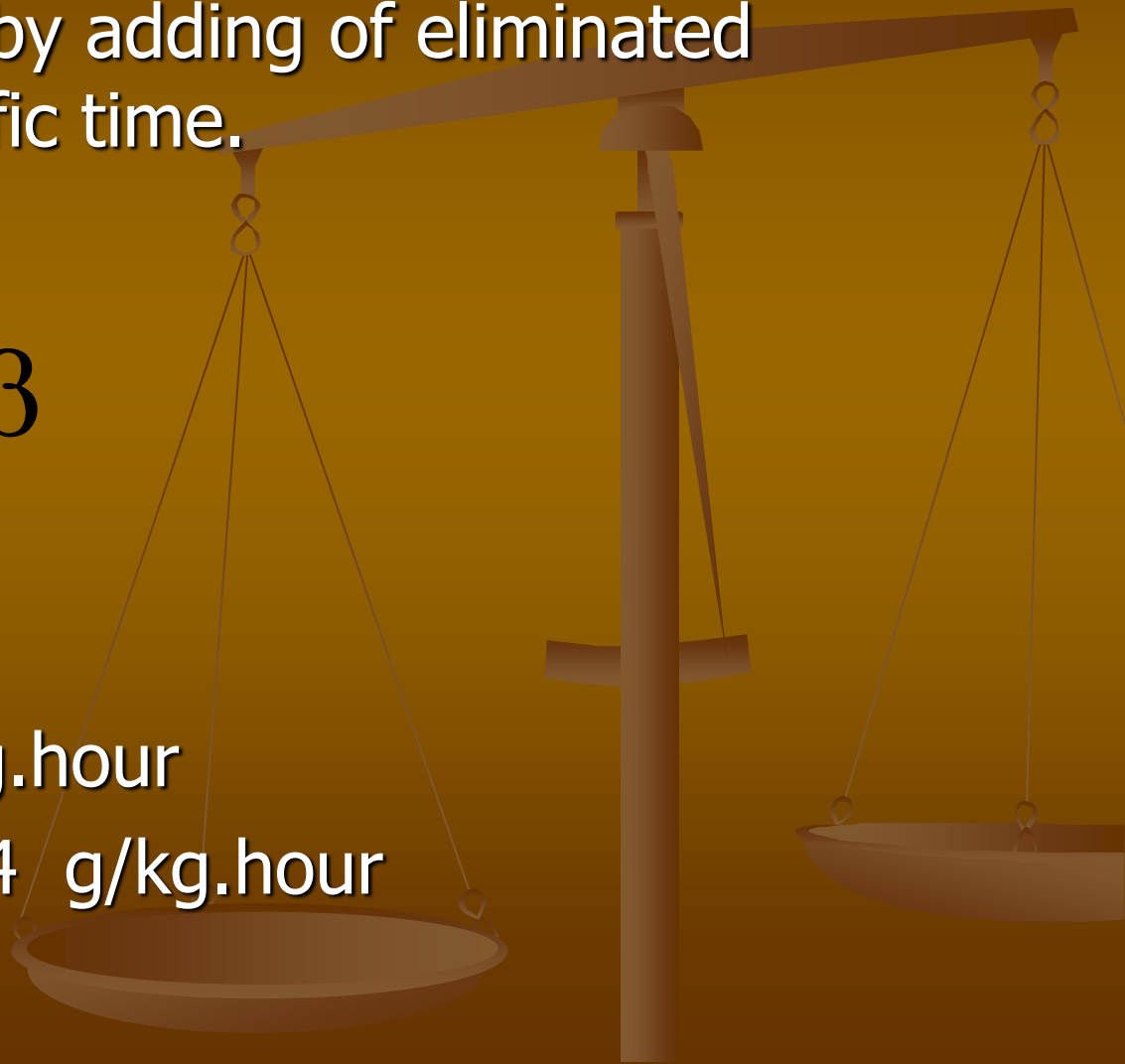
Backward calculation

Of amount is made by adding of eliminated alcohol during specific time.

$$c_i = c_0 + \Delta t.\beta$$

β = 0,12 - 0,20 g/kg.hour

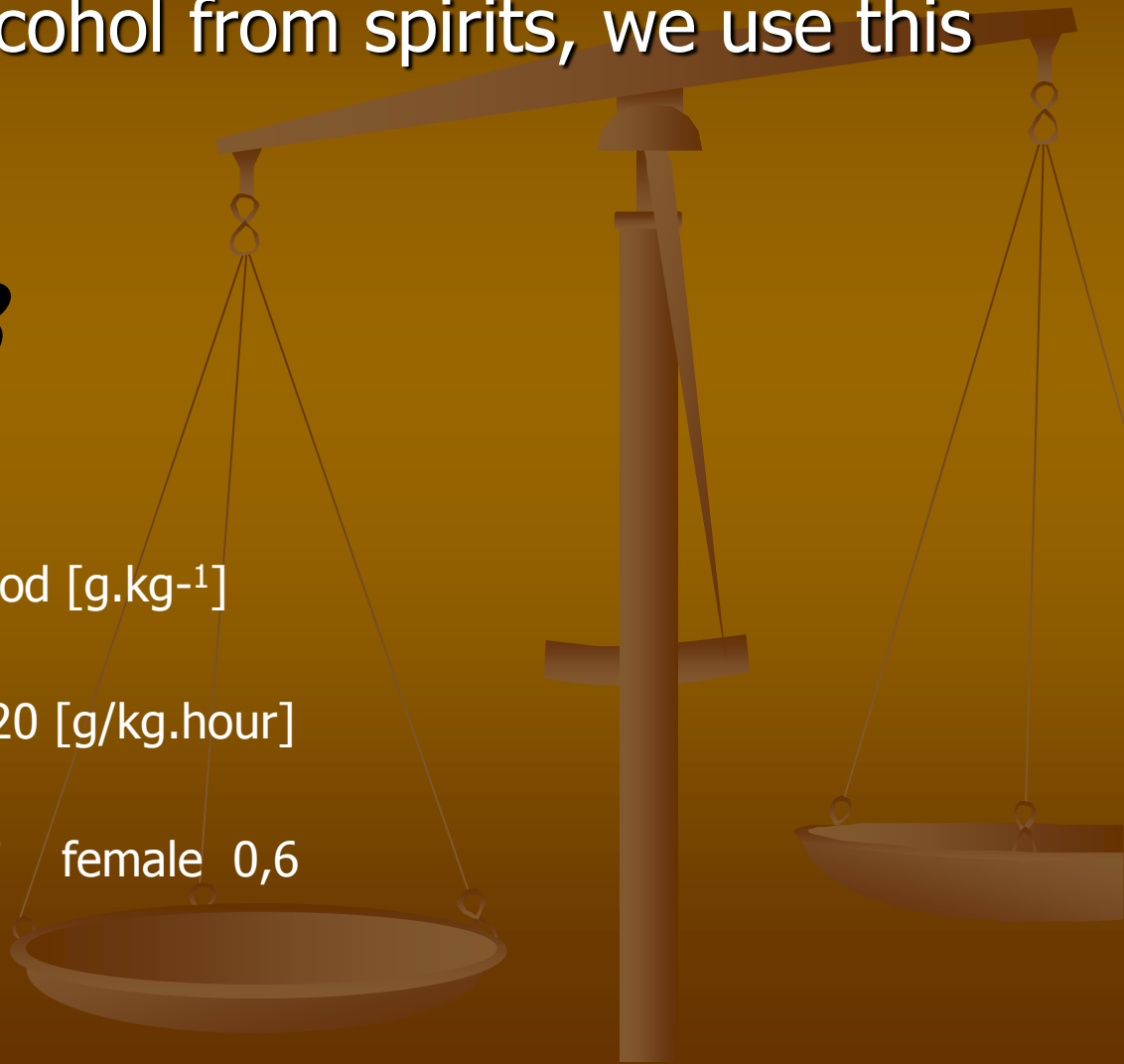
over 2 g/kg 0,24 g/kg.hour



Balance calculation

To find amount of alcohol from spirits, we use this formula:

$$c_i = \frac{a}{p.r} - \Delta t.\beta$$



c – concentration of alcohol in blood [g.kg^{-1}]

a – consumed alcohol [g]

β – factor of elimination 0,12 - 0,20 [g/kg.hour]

p – body weight [kg]

r – factor of reduction – male 0,7 female 0,6

Δt – time dilatation [hour.]

Thank you for attention

http://www.zikmund.org
http://go.funpic.hu