Alcohol metabolism and its effects on human health

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Objectives

The objectives of this project are:

- ❑ Understanding alcohol metabolism.
- ❑ Alcohol effects on human health.

To understand it's effects on health we'll see its impact on different organs and tissues.

Alcohol metabolism

1- Oxidative (hepatic)→ 95%<

a) Ethanol metabolism

➡ Alcohol dehydrogenase (cytosol)

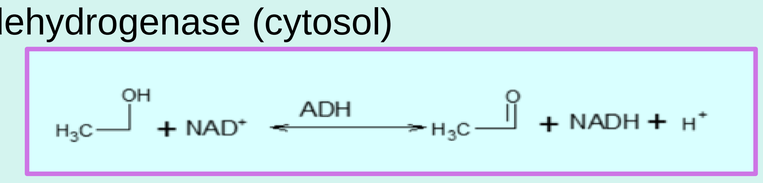

Figure 1. Oxidation of ethanol to acetaldehyde, through a reaction mediated by alcohol dehydrogenase (Cazorla del Águila 2019).

➡ Microsomal oxidative system (ER)

➡ Catalase-Peroxidase system (mitochondria, peroxisome

b) Acetaldehyde metabolism (mitochondria)

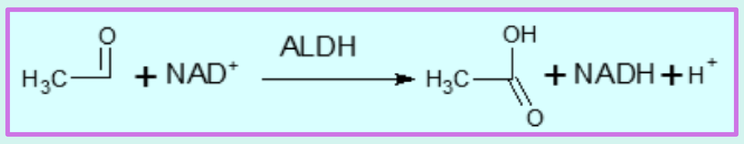

Figure 2. Transformation of acetaldehyde into acetic acid, by enzyme aldehyde dehydrogenase (Cazorla del Águila 2019).

2- Non-Oxidative→ 5%>

➡ Formation of ethyl esters of fatty acids

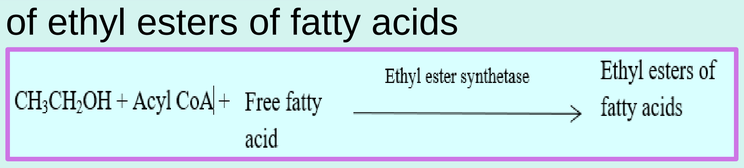

Figure 3. Reaction of ethanol with free fatty acids and acyl CoA to obtain ethyl esters.

➡ Formation of phosphatidylethanol

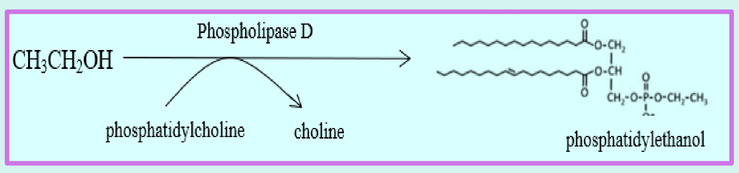

Figure 4. Synthesis of phosphatidylethanol by the reaction of ethanol with phosphatidylcholine by the enzyme phospholipase D (Hill-Kapturczak et al. 2019).

3- Elimination

Acetic acid → Acetate → Acetyl CoA → Krebs Cycle / Fatty acid synthesis

1% of total elimination of ethanol is linked to non-metabolic factors

Conclusions

- ❑ Alcohol is unquestionably harmful to people's health.
- ❑ Alcohol does not affect all people in the same way, its effects depend on various parameters such as age, sex, genetics, diet…
- ❑ To understand the totality of alcohol effects, more studies are needed controlling all the possible variables (age, sex …). In this way we would have more precise and accurate results.
- ❑ The alcohol industry generates many profits, so it will be difficult to impose strict penalties to limit alcohol consumption.
- ❑ One way to prevent alcohol consumption is education and prevention, especially at an early age, starting at groups with big influence such as family, school and friends.

Effects

Benefits

Moderate alcohol intake → ↑ High-density lipoprotein (HDL), Polyphenols (from wine)

↓ Coronary heart disease risk (ex. Atherosclerosis), Risk of ischemia, Reduces free radical damage

Alcohol intake ≠ better health → to prove this health claims, future studies, have to take care of other variables such as patients' diet or lifestyle to more accurate results.

Toxic effects

a) On cellular level

↑Alcohol = ↑ Membrane fluidity

↓ Electron transport chain activity = ↓ATP
↓ ATPase activity
↓ ATP use
↓ O_2 consume
↑ Mitochondrial cytochrome P450 = ↑Reactive oxygen species (ROS)
Inhibits active transport of Na, K, aa, catecholamines…

b) On heart

- Degeneration of myocardial tissue
- Hearth's enlargement and muscle loss
- Fibrosis
- Intracellular edema
- Lymphocytic infiltration
- Vasodilatation

→ ↓ Contractile function

c) On stomach

Lesions on the vascular endothelium of gastric mucosa

- Edematous and congestive mucosa
- Gastric mucosa presents scattered bleeding lesions
- Focal hemorrhage
- Gastric necrosis
- Large and deep gastric ulcers
- Secretory cells atrophy

d) On liver

Alcoholic steatosis / Steatohepatitis → Liver fibrosis → Cirrhosis → Liver failure

e) On nervous system

Tremors
Hallucinations
Seizures
Deliriums
Agitation
Autonomic dysfunction
Inhibition of serotonin, dopamine, norepinephrine…

Permanent nerve damage
↓
Neurodegenerative disease (Parkinson, Alzheimer…)