Alcoholic beverages and human beeing



The genesis of ALCOHOL word

Arabic words

al-kuhl Delicate, Fine powder al-ghoul Bad ghost

ALCOHOL

Several meanings in nowadays vocabulary (alcoholic beverage, ethanol, chemical compound)

Alcohols - the group of organic chemical compounds which are hydrocarbons derivatives in which one or more hydrogen atoms has been substituted with OH group

Program of the lecture

The reasons, ways and styles of drinking alcoholic beverages > The economic aspects of alcoholic beverages > Chemical and physical properties of ethanol Content of ethanol in blood and breathing out air > Absorption, distribution and elimination of ethano Metabolism of ethanol Short and long time effects of ethanol consumption Hang over (acetic aldehyde and its properties)/disulfiram Adverses and benefitials of alcoholic beverage

Ethanol in food industry

- 1. Beer (content of ethanol 3-7%)
- 2. Wine (content of ethanol 10-20%)
- 3. Vodka, cognac, whisky
 - (content of ethanol 38-50%)
- 4. Other alcoholic beverages

WHEN ?

The reasons for alcoholic beverages drinking

Assisting reasons

Pain and tiredness reduction

Social factor Intergration, comunication help, giving in suggestions

Physiological factor Relax, fear reduction, restrain

Spiritual factor

The element of ceremonis , rituals and customs

Economical and political factors

Feeling of ethanol effects on organism

Jack London in one of his books wrote: "The only think left is to look for solace in alcohol, which is always promissed by bloody flask but never given

What people drink alcoholic beverages for?



What people drink alcoholic beverages for?



Alcoholic beverages market in Poland



Alcoholic beverages market in Poland



Excise tax in Europe

Minimum = 550 euro per 1 hektoliter of pure ethanol

Poland – 4960 Germany - 5355 Lithuania – 5257 Bohemia – 4607 Slovakia – 4439 Russia – 2100 Belorus – 1602 **Ukraine - 1428**

VODKA VODKA VODKA

Permision for alcoholic beverages trading



Beer production and sale in Poland The value of beer sale in **Biggest producers** bilions zł. Kompania 35 Żywiec Piwowarska 21,04 20,33 20,03 19,73 22 19 16 13 Carlsberg Polska 13 5.9 10 2010* 2012* 2009 2011* **Royal Unibrew** others

Avarage Pole drinks around 180 pints of beer per year

Economical data on spirit beverages

3 200 000 hectolitres – year production of spirit beverages3.35 bilion euro – the vaue of spirit beverages production

00 workers

TRANSPORT

PACKIGING

2.2 bilion euro in total goverment incom per year Vat, excise, income tax, insurance

360 bilions of added value

SERVICES

Industrial sectors affected by spirit sector

RETAILERS

Dr hab. Piotr Koczoń, Facuty of Food Sciences, Department of Food Chemistry, WULS

STORAGE

Vodka sale in Poland in 2005-2009



Polish vodka export (bilion zł.)

10 biggest export markets 2005 (value in bilion zł.)

| USA | 109.1 | Germany | 5.2 |
|---------------|-------|-------------|-----|
| France | 22.6 | Hungary | 6.0 |
| Italy | 10.6 | Mexico | 5.2 |
| Canada | 9.4 | Switzerland | 3.5 |
| Great Britain | 8.7 | Bulgaria | 3 |

Physical properties of ethanol

Colurless liquid with characteristic odour and taste

Flameable liquid, burns with light-blue flame

Boiling point: 78° C, melting point: -115° C, ignition temperature (flash point): 11° C; autoignition temperature: 425° C, explosion concentration of vapours: 3.1% - 20%

Miscible with water in any ratio

The 95.6% of ethanol mixture with water is known as spirit

100% ethanol is known as **absolute alcohol**

| Volume concentration [% v/v] | Weight concentration [% w/w] | Density [g/cm³] |
|------------------------------------|------------------------------------|--------------------|
| 100.0 | 100.0 | 0.79 |
| 95.0 | 92.4 | 0.81 |
| 70.0 | 62.4 | 0.89 |
| 40.0 | 33.3 | 0.95 |

Electronic charge distribution in ethanol molecule



The structure of ethanol molecule



The pair of free electrons

The electronic charge distribution Dipole momentum – 1.684 Debyes



Hydrogen bondsaround 20kJ/mol in ethanol





 $C_{2}H_{5}OH + BH \xrightarrow{\bigcirc} \swarrow C_{2}H_{5}O^{\ominus} + BH$ $C_{2}H_{5}OH + H^{\oplus} \longrightarrow C_{2}H_{5} - \overset{\oplus}{O} - H_{H}$

pK_{ethanol} = 18

Examples of acid – base reactions of ethanol

$C_2H_5OH + NaOH \longrightarrow C_2H_5ONa + H_2O$

Sodium ethoxide

 $C_2H_5OH + HCI \longrightarrow C_2H_5 - CI + H_2O$

Ethyl chloride

Ethanol reactions

Reactions running within OH group (e.g. estrification)

$C_2H_5OH + HO - NO_2 \iff C_2H_5ONO_2 + H_2O$

$C_2H_5OH + C_3H_7COOH \longrightarrow C_2H_5OCOC_3H_7 + H_2O$



Ethanol reactions

Reactions based on exchange of OH group

 $C_2H_5OH + H - I \longrightarrow C_2H_5I + H_2O$

Combustion

 $C_{2}H_{5}OH + 3O_{2} \longrightarrow 2CO_{2} + 3H_{2}O$ $C_{2}H_{5}OH + 2O_{2} \longrightarrow 2CO + 3H_{2}O$ $C_{2}H_{5}OH + O_{2} \longrightarrow 2C + 3H_{2}O$



Reactions based on modification of both radical and OH group

$C_2H_5OH \xrightarrow{\text{oxidation}} CH_3CHO \xrightarrow{\text{oxidation}} CH_3COOH$

Oxidation reaction

Oxidation reactions

 $3C_2H_5OH + Cr_2O_7^{2-} + 8H^+$ oxidation \rightarrow $3CH_3CHO + 2Cr^{3+} + 7H_2O_3^{-}$

 $3C_2H_5OH + 2Cr_2O_7^2 + 16H^+ \xrightarrow{\text{oxidation}} 3CH_3COOH + Cr^{3+} + 11H_2O$

 $5C_2H_5OH + 4MnO_4^- + 12H^+ \xrightarrow{\text{oxidation}} 5CH_3COOH + 4Mn^{2+} + 11H_2O$

Formation of ethanol

$C_6H_{12}O_6$

fermentation

Yeast's action

$C_2H_5OH + 2CO_2$

Another methods to form ethanol



 $CH_3 - CH_2I \longrightarrow C_2H_5OH + I^-$

 $CH_3 - CH_2CI \longrightarrow C_2H_5OH + HCI$

Ethanol level in human blood followed the food consumption



Absorption phase Equilibrium phase Elimination phase

15

Ethanol level in blood without food consumption



Elimination phase: aproximately 10 - 12 gram of ethanol per kg of body mass per hour (for man)

Absorption phase

Equilibrium phaase

Elimination phaasequilibrium phaase

Erik Widmark formula



P – content of ethanol in blood (‰)
A – amount of ethanol consumed (grams)
K – coefficient around 0.7 (man) and 0.6 (woman)
W – body weight (g)

Calculations with use of Widmark formula

 $P = \frac{A}{K \times W}$

P - ? (‰)
A - 1 beer
K - 0.7
W - 98 kg = 98000 grams

$P = \frac{15.8}{0.7 \times 98000}$

1 beer consumed by a men of 98 kg

A = 15.8 grams

 $P = 29 \times 10^{-4} = 0.23\%$



Details of calculations

Amount of ethanol in air unit (usually in dm³, say 0.4 mg/dm³)

1 dm³ air

0.4 mg of ethanol

2100:1 coefficient $1 \text{ dm}^3 = 1 \text{ kg} = 1000 \text{ g} = 10^6 \text{mg}$

1 mg of ethanol in airin2100 mg in 1 dm³ of blood0.4 mg of ethanol in airinX mg in 1 dm³ of blood

 $X = 840 \text{ mg}_{\text{in 1 dm}}^3$ of blood

840 mg _{ethanol} in x mg _{ethanol} in

10⁶mg blood 10³mg blood

Promile definition

x = 0.84%o

Details of calculations

Amount of ethanol in air unit (usually in dm³, say 0.4 mg/dm³)

0.4 mg of ethanol

1000:1 coefficient Presumption $1 \text{ dm}^3_{\text{air}}$ $1 \text{ dm}^3 = 1 \text{ kg} = 1000 \text{ g} = 10^6 \text{mg}$

1 mg of ethanol in airin1000 mg in 1 dm 3 of blood0.4 mg of ethanol in airinX mg in 1 dm 3 of blood

 $X = 400 \text{ mg}_{\text{in 1 dm}}^3 \text{ of blood}$

400 mg _{ethanol} in 10⁶mg _{blood} x mg _{ethanol} in 10³mg _{blood} Promile definition

x = 0.4%

Details of calculations

Amount of ethanol in air unit (usually in dm³, say 0.4 mg/dm³)

0.4 mg of ethanol 1 dm^3_{air} 3500:1
coefficientPresumption $1 \text{ dm}^3 = 1 \text{ kg} = 1000 \text{ g} = 10^6 \text{ mg}$ 1 mg of ethanol in air
0.4 mg of ethanol in airin
in $3500 \text{ mg}_{in 1} \text{ dm}^3$ of blood
X mg in 1 dm³ of blood

 $X = 1400 \text{ mg}_{\text{in 1 dm}}^{3} \text{ of blood}$ $1400 \text{ mg}_{\text{ethanol}} \text{ in } 10^{6}\text{mg}_{\text{blood}}$ $x \text{ mg}_{\text{ethanol}} \text{ in } 10^{3}\text{mg}_{\text{blood}}$ Promile definition

x = 1.4%o

Ethanol absorption

Mood changes, experienced as pleasure by most consumers



The topic concentration occures after 30 – 90 minutesafter consumption

DISTRIBUTION OF ETHANOL IN ORGANISM

- Different way of digestion
- No transformations followed by transportation to tissues and cells
- Direct transport to blood vessels

Blood system

Availability of body mass for ethanol: Man ~ 70% body mass Woman ~ 60% body mass

EXAMPLE:

Man body mass 85 kg, available: 59.5 kg

Woman body mass 60 kg, available: 36 kg

0.26‰

0.44‰

0,5 L of beer (4% v/v) contains around 20 ml of ethanol which is 15.8 g (d = 0.79 g/cm³) Appoximately as in 50 grams of vodka

Effects peculiar to ethanol blood concentration

0.3 – 0.5 promiles

Slight inbalance and visual disturbance, euphoria, criticism decrease

0.5 – 0.7 promiles

Aggressivness, verbosity, self-control descrease, false evaluation of own possibilities

0.7 – 2.0 promiles

Real inbalance, disturbance of coordination and dexterity, pain treshold decrease, intelectual disorder, reaction time delay, irritability, tolerance decreaase, aggressive reactions, sexual excitment, blood preasure increase, heart action increase

2.0 – 3.0 promiles

Speach disorder (sluring), peculiar way of moving (vawing, wide legs, falling), sleepy, strongly decreased ability to control behavior

3.0 – 4.0 promiles

Blood pressure decrease, body temperature decrease, physiological reflex decrease or disappearance, deep conciousness disorders leading to coma

> 4.0 promiles

Coma, respiratory system disorder, cardiovascular system disorder, possibility of paralysis of those systems by ethanol **LIFE-THREATENING STATE**



Oxidation of ethanol with use of liver ADH and ALDH

$CH_3CH_2OH + NAD^+ \rightarrow CH_3CHO + NADH + H^+$





Permanent oxidation of NADH in oxidation chain causes start of specific metabolic mechanisms producing oxidative equivalents necessary to recover NAD+

Lost of antioxidants (e.g. glutation), that can not be regenerated with lack of NADP

MEOS – Microsomal Ethanol Oxidizing System

Start - ethanol concentration 108,5 mM/dm³

ETHANOL

HYDROXYETHYL RADICAL

Formation of this radical is induced by action of ethanol on CYP2E1

polienylophosphatilidylocholin (PPC) Stops this activation Factors necessary for MEOS to occur

NADPH, O₂ NADPH reductase of cytochrome C Isocitrate Isocitrate dehydrogenase of cytochrome P450 (CYP2E1)

transformations

ACETIC ALDEHYDE

Non-oxidative metabolism of ethanol

Membrane of neurons of grey matter in brain

Synthezis of fatty acid esters

Disturb funcions of mitochondrion

Break cell membranes

Ethyl esters of fatty acids

ETHANOL C₂H₅OH

Phosphatate diethanols

Phospholipaze D

It transforms phospholipids (lecithine as a first) to form phosphatidic acid (PA). This path is vital in information transfer Not metabolised in human organism

Occurs only with chronic ethanol consumption

Exact impact on cells is unknown

Disturb action of PLD (Phospholipaze D)

High Km for ethanol



Effect of ethanol on labyrinth



Endolymph (lat. *endolimfa*) – gel liquid feeling membrane structure of labyrinth

Ethanol effects the nerve endings (axons)

1.8‰ of ethanol in blood — 6.5‰ in endolymph

Elimination

12 hours

44 hours

The rate of ethanol elimination

Example

Presuming that regular man is able to metabolize 10 ml of ethanol per hour, calculate how long does it take to eliminate five bottles of beer (500 cm³) containing 4% of ethanol?

Amount of pure ethanol consumed = $500 \text{ cm}^3 \text{ x} 5 \text{ bottles x} 4\% = 125 \text{ cm}^3$

 10 cm^3 - 1 hour 125 cm³ - x hours x = 12.5 hours

KAC - kacenjamer

HANGOVER

The next day effect

- Headache and dizziness
- Increadible dryness
- Rebel in the stomach, vomiting
- Body shaking, hands and palms peculiarly
- Light, sound, smell, touch: cause a pain (oversensitivity)
- Tiredness, whit no possibility to sleep
- Concentration problems
- Visual disturbance
- Psychological weariness
- Diarrhoea, lack of appetite

Ethanol poisoning Professional name

Hangover sources

Acetic aldehyde and its reactivity Brain dehydration Traces of methanol in alcoholic beverages Antioxidative potential decrease

Methods to avoid

- Drink a glas of milk before
- Do not drink without consumption
- Do not mix alcoholic beverages
- Drink a lot of water between shots
- Drink a half liter of water before sleeping
- Eat sweet stuff e.g. jam, honey
- Do not drink too much dark beverages ae.g. porto, sherry red wine

Effects Eat owl eggs –Pilinius theory

Psychological effects, decrease in intelectual ability, increase in heart attack, and cardiovascular disease, decrease in resistance, for long time (up to several hours) disturbance in proper organism functionation

Acetic aldehyde

Esperal - disulfiram

Places of aldehyd adducts formation

- Membrane proteins of red bodies of blood
- Lypoproteins related to heart attack
- TUBULIN białko występujące w "microtubules" odpowiedzialne za dzielenie się białek oraz ich transport wewnątrz komórek
- ➢ Hemoglobin
- > Albumin
- Kolagen main protein in connective tissues
- Selected enzymes , e.g. CYP2E1
- Membrane of hepatoctes
- Biogenic amines

N – acetylocystein

Asians

Poisoning with acetic aldehyde is manifested by:

- Red face
- Skin changes
- Breathless
- Increase heart rate
- Fear against dead
- vomiting

Lysine-aldehyde adducts are recognised as foreign bodies and antibodies are formed to remove them

Reactions of acetic aldehyde with lisine and other aminoacids containing NH₂ group

Methanol

Headache – *"*theory of next one"

Methanol consumption cure: Immediately drink 100 ml of ethanol

Dehydratation, dryness in throat



Negative effects of ethanol consumption

blood-sludging - red bodies aglomerates causing blocking vessels followed by oxygen deficiency and dead of cells



Positive effects of ethanol consumption (forbiden fruit)

Increase of diameter of vessels – blood can circulate Faster, cells mainly in brain are better equiped

Increase of "good" cholesterol level

Advantage modification of some factors of blood cloting

White wine contains substances that kills salmonella

Diuretic properties of beer. Recomended for patients with kidnej stones and sand problems

Benefitial effect of consumption of small amounts of ethanol for heart and vessles human system (1999 British Medical Journal) – decrease of 10-40% coronary disease as compared to non-drinkers

The New England Journal of Medicine – it reduces 20% of apoplexy

Drinking 2 units of ethanol per day halves getting cold. The condition is not to smoke. Cigarettes are said to remove all benefitial effects of alcohol

Small amount of ethanol

12 grams for woman18 grams for man

Americans define a dose of alcohol ("drinks") in specific units — oz (ounce liquid containing around 28 ml). One drink refers to 12 oz of beer (around 330 ml), 5 oz of wine (around 140 ml) or 1,5 oz of spirit beverages 40% (around 40 ml).

NOT WINE ALONE

Benefits of ethanol are independend on the source of this compound

Bone system

- increase bone density,
- decresed risk of bone deformations following bone althropy

Metabolic syndrom

- up to 20 drinks/month 5% lower risk of disease
 - **Over 20 drinks/mounth**
- 6% lower risk of disease

Diabetics type II

6 – 48 g/day and night
30% lower risk of disease
over 48 g/day and night
Increased risk of disease

For both man and woman independent on (BMI).

Beer and wine provide with minerals and vitamins. Mug of beer contain 50 mg of Ca and 0,1 mg of iron, while glass of wine provides 10 mg of calcium and as much as 1 mg of iron. Beere is good source of vitamin B, as well as phosphorous, potassium and magnesium. No one of alcoholic beverages contain vitamin A, C or D (unless they are added on peropuse.

To drink and not be drunk

(dihydromyricetin, DHM)

Blocks of GABA receptors OH





rats

and



© Dennis Holmes Designs * www.ClipartOf.com/43180

With DHM (1mg/kg) injection

Rats got drunk but time required was much longer

Alcohol effects disapeared very quickly, after 15 minutes

Having free acces to alcohol they did not increased amount – no alcoholism effect

No alcohol tollerance developed

Without DHM (injection)

Within 2 hours rats consumed equivalent of 15-20 beers

Rats got drunk

Lying upside down could not change their position



Some effects of beer drinking





Publi T



Belly increase Stomach distention



Effects of wine drinking

Getting drunk



E

NOW CHEAPER THAN GAS DRINK, DON'T DRIVE



Napoleon

Bonaparte



Having fun, discussing, ellse?



Remainding, getting younger





ORNE NICHARY VERTILE V



Daren.

