Urinalysis. Urine sediment

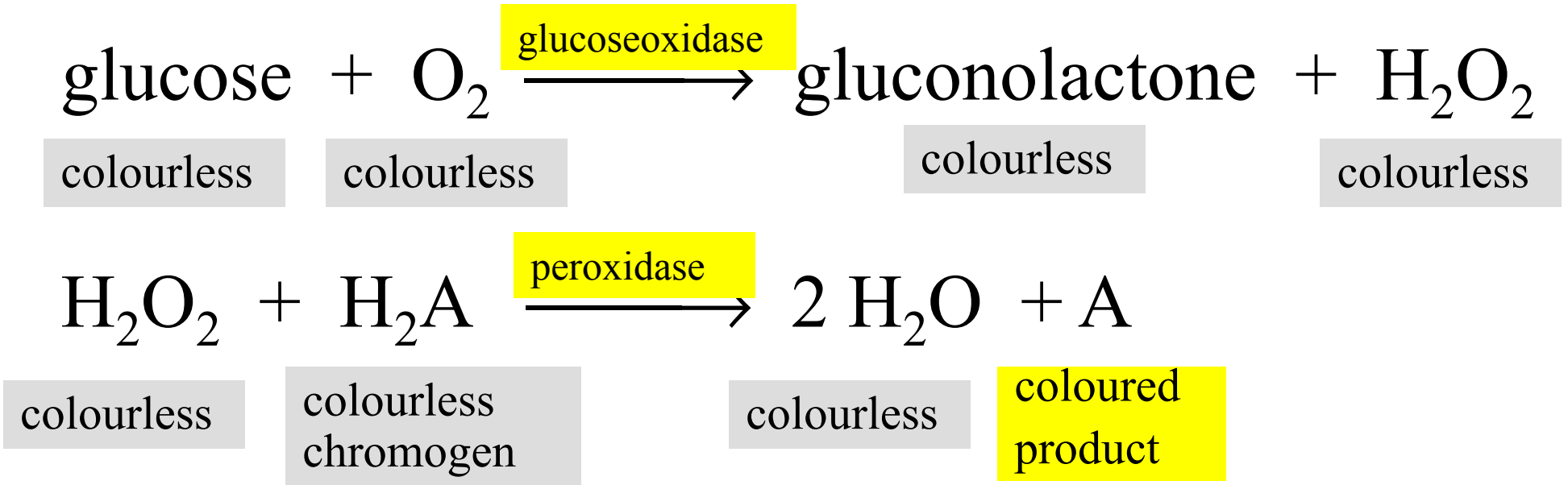
Seminar No. 13

Q. 2

Test for Glc, KB

Test for	Reagent(s) / Principle	Problem(s)
Glucose	glucoseoxidase + peroxidase	ascorbate → false negativity peroxides → false positivity
KB	sodium nitroprusside $Na_2[Fe(CN)_5NO]$	fresh sample needed to prevent the decarboxylation of acetoacetate

Enzymatic test for glucose



Test for blood (Hb), bilirubin

Test for	Reagent(s) / Principle	Problem(s)
Blood	peroxidase like activity of heme	Fe salts → false positivity
Bilirubin Ubg	diazonium salts give coloured azo-compounds R-N=N-R’	fresh sample needed

Test for proteins, nitrites

Test for	Reagent(s) / Principle	Problem(s)
Proteins	Protein error of some acid-base indicators	Sensitivity mainly for albumin
Nitrites	$Ar\text{-}NH_2 + HNO_2 + HCl \rightarrow$ $Ar\text{-}N{\equiv}N^+ Cl^- + 2\ H_2O$ $\downarrow$ H-Ar' $Ar\text{-}N{=}N\text{-}Ar' + HCl$	•Fresh urine needed •Absolutly clean vessels •4 h urine retention in bladder •No antibiotics •High ascorbate → false negativity

Urine sediment

- suspension material obtained by centrifugation of fresh urine sample under defined condition
- semiquantitative × quantitative
- **chemical sediment** – crystals of various compounds (salts)
- **biological sediment** – cells (RBC,WBC), casts, bacteria

Factors involved in renal stones formation

- increased concentrations of certain ions (Ca^{2+}, Mg^{2+} ...)
- extreme values of pH of urine
- low intake of fluid (low diuresis)

Insoluble compounds

Compound	Insolubility pH range		
	Acid	Neutral	Alkaline
Uric acid			
Ammonium hydrogen urate			
Calcium oxalate			
Calcium hydrogen phosphate			
Hydroxyapatite			
Ammonium magnesium phosphate			

Write formulas

Calcium oxalate

Calcium hydrogen phosphate

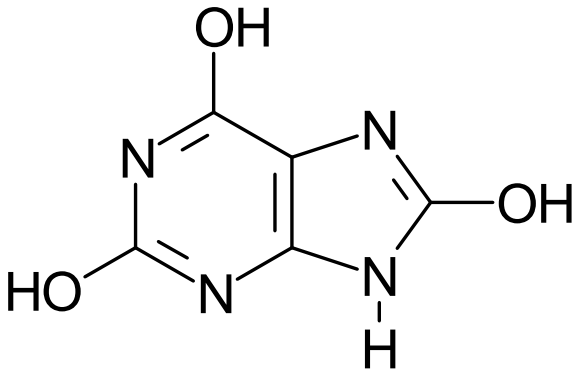
Hydroxyapatite

Ammonium magnesium phosphate

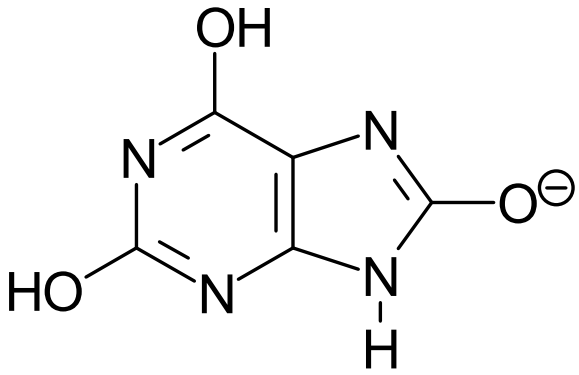
Calcium oxalate	$Ca(COO)_2$
Calcium hydrogen phosphate	$CaHPO_4$
Hydroxyapatite	$Ca_5(PO_4)_3OH$
Ammonium magnesium phosphate	NH_4MgPO_4

Uric acid (lactim) is a diprotic acid

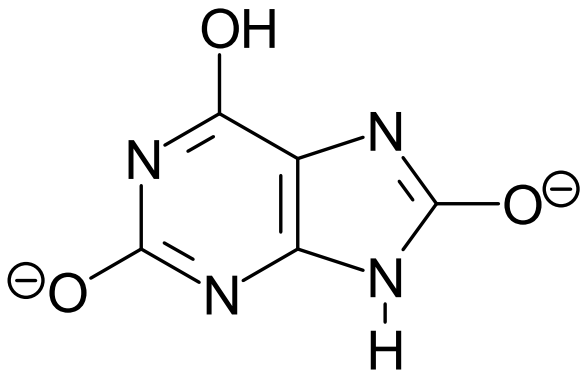
$pK_{A1} = 5.4$ $pK_{A2} = 10.3$



uric acid



hydrogen urate



urate

2,6,8-trihydroxypurine

Mineralogical name	Chemical name
Weddellit	calcium oxalate dihydrate
Whewellit	calcium oxalate monohydrate
Struvit	magnesium ammonium phosphate hexahydrate
Brushit	calcium phosphate dihydrate
Uricit	uric acid

Q. 7

Q. 8

Bacterial urease catalyzes the hydrolysis of urea

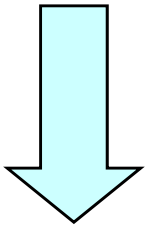
$$H_2N\text{-}CO\text{-}NH_2 + H_2O \rightarrow 2\,\mathbf{NH_3} + CO_2$$

ammonia

weak base

$$NH_3 + H_2O \leftrightarrows NH_4^+ + \mathbf{OH^-}$$

ammonium



alkaline urine $\Rightarrow$ precipitation of $CaHPO_4$

Q. 10

- oxalates
- see the table in lab manual, p. 109

There are <u>three</u> sources of oxalic acid in the body

Three sources of oxalic acid in the body

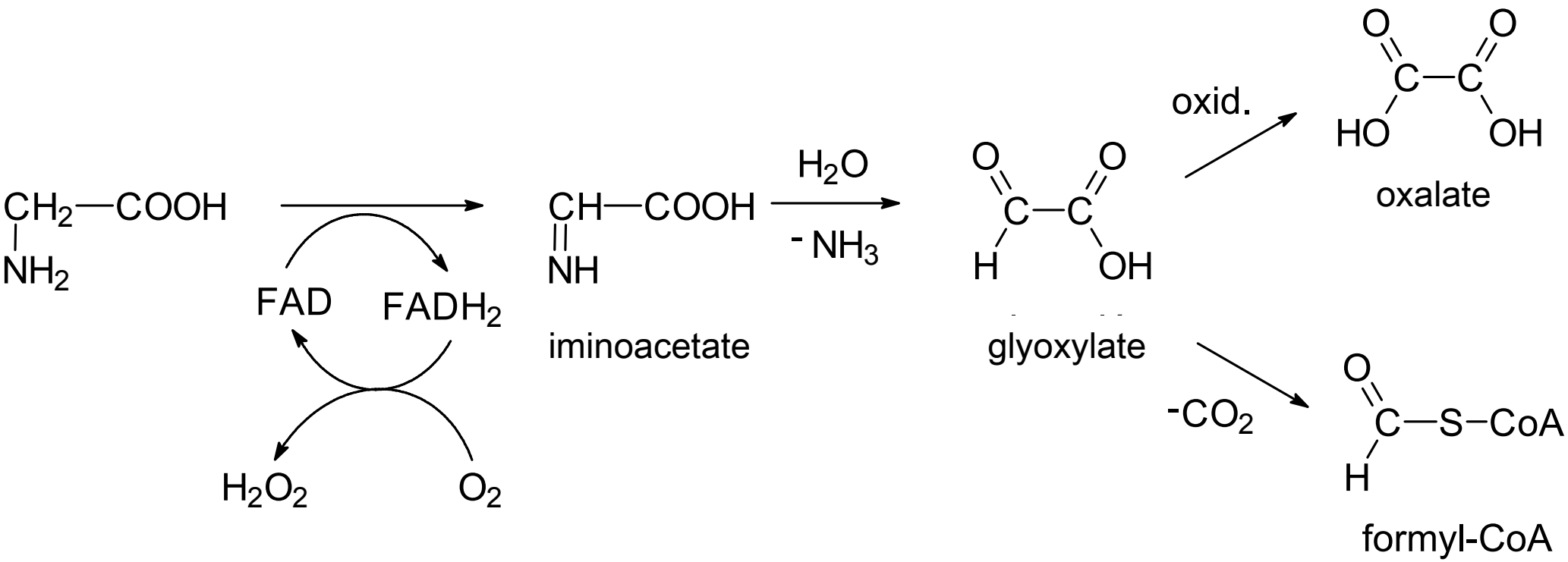
60 % catabolism of glycine and ethanolamine

30 % catabolism of ascorbate

10 % plant food

Glycine → oxalate

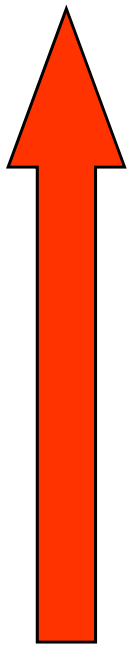
Glycine → oxalate



Ethanolamine → oxalate

Content of oxalic acid in some plant foods

Food	Content (mg/kg)
Spinach	5000 - 10000
Chard (mangold)	5000 - 9000
Rhubarb	2000 - 9600
Tea	6000 - 7000
Cocoa	3000 - 4500
Bamboo	1600 - 4500
Beetroot	300 - 1400
Cabbage	100 - 1200
Wheat flour	400 - 750
Brocoli	100 - 500
Tomatoes	50 - 100

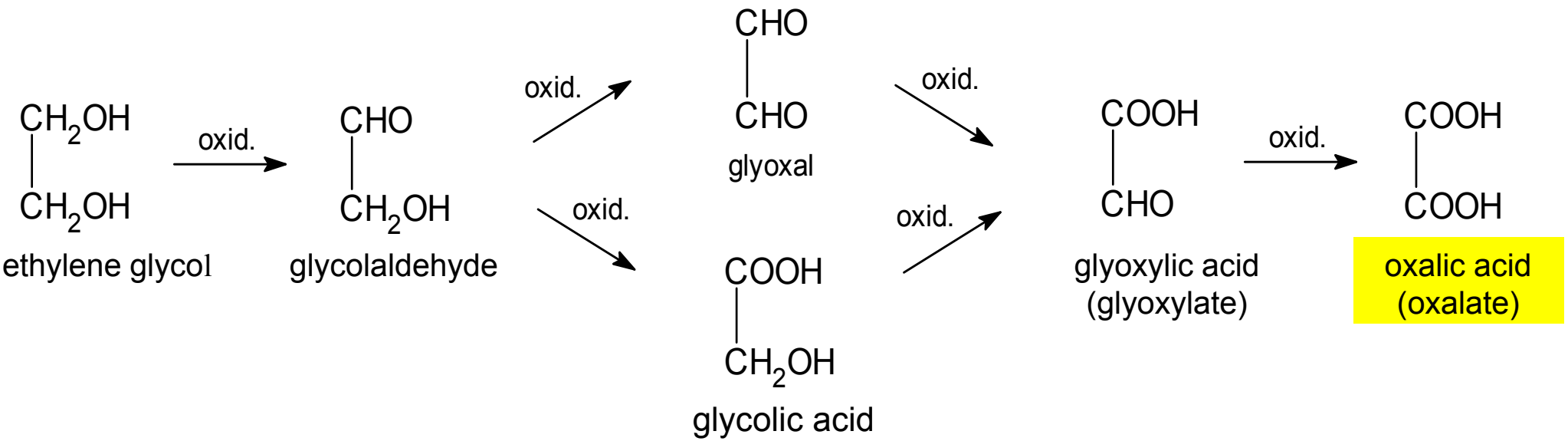


Chard (mangold)

Rhubarb

- a herb with long reddish leaf-stalks, rich in oxalic acid
- rhubarb juicy stalks are edible when cooked and sweetened

Intoxication and oxidation of ethylene glycol leads to oxalic acid through a number of intermediates



Q. 12

Some food components conduce to urolithiasis

Food	Commentary
Meat (excess)	cystein catabolized to $SO_4^{2-} + 2H^+ \Rightarrow$ urine acidification
Milk products	rich in Ca^{2+} and phosphates
Mineral waters	some of them are rich in Ca^{2+} and Mg^{2+}
Spinach	contains oxalic acid (up to 1 %)
Rhubarb	contains oxalic acid (up to 1 %)
Vitamin C (excess)	catabolized to oxalic acid

Substance	Plasma concentration (mmol/l)	Urine excretion (mmol/d)
Na^+	133 - 150	100 - 260
K^+	3.8 - 5.5	40 - 90
Ca^{2+}	2.0 - 2.7	1 - 6
Mg^{2+}	0.6 - 1.0	1 - 12
HCO_3^-	21 - 27	1 - 2
Cl^-	97 - 108	120 - 260
$H_2PO_4^-$ + HPO_4^{2-}	0.7 - 1.5	10 - 30
SO_4^{2-}	0.2 - 0.5	8 - 35
Urea	2 - 8	330 - 600
Uric acid	200 - 420 µmol/l	2 - 3
NH_4^+	5 - 50 µmol/l	30 - 50
α-Amino nitrogen	2 - 4	4 - 14
Creatinine	50 - 125 µmol/l	9 - 16
Total proteins	65 - 85 g/l	< 150 mg/d