



**King Saud University
College of Medicine
Department of Pathology
Clinical Biochemistry unit**

Urinalysis

**Practical Biochemistry
Renal System Block
First Year**





OBJECTIVES

It is expected that by the end of this practical class, the students should be able to:

1. Understand the physical and chemical of urine in health and disease
2. Perform urinalysis using Dipsticks.
3. Recognize the value of urinalysis as a tool for diagnosis of diseases e.g. metabolic diseases, kidney disorders and for urinary tract infections (UTIs).
4. Interpret the results of urinalysis and correlate it with the patient's clinical findings.



Plan of work:

1. The presentation about urinalysis will be given for (20 minutes).
2. Hands-on practical for urinalysis using (dipstick) will be conducted for about (20 minutes) for 3 different urine samples.
3. Students will be asked to record their results in the urinalysis report sheet provided in the handout, commenting on both physical and chemical properties of urine.
4. Sign for attendance.

Physical and chemical examination of urine

The urinalysis is an essential part of the diagnostic evaluation for all urinary and many metabolic diseases. Its assessment includes evaluation of physical characteristics (color, clarity, odor and volume), chemical parameters (blood, glucose, ketones, bilirubin, urobilinogen, nitrite, and protein). For more details see the below tables.

Table 1: Physical Properties of urine:

PARAMETER	NORMAL	ABNORMAL	POSSIBLE CAUSES
Volume	0.4-2.0 L/day	Polyuria	Diabetes, chronic renal failure
		Oligouria	Dehydration, Acute renal failure
Appearance	Clear	Cloudy	Presence of pus cells, bacteria, salt or epithelial cells
Colour	Pale Yellow	Colorless	Excessive fluid intake, uncontrolled DM, chronic renal failure
		Orange	Dehydration, carotenoid ingestion
		Yellow-Green	Jaundice
		Red	Blood, drugs etc
		Dark brown-black	Methemoglobin, alkaptonuria, melanoma, black water fever
		smoky	glomerulonephritis
Odor	Urineferous	Fruity	Diabetic ketoacidosis
		Ammoniacal	Contaminated and long standing exposed urine
		Mousy	Phenylketonuria
		Burnt sugar	Maple syrup urine disease
Deposits	None	Crystals, salts or cells	Blood clots, necrotic tissues and urinary stones
Reaction (pH)	4.6 - 7.0	Acidic	ketosis (diabetes mellitus & starvation), severe diarrhea, metabolic and respiratory acidosis, excessive ingestion of meat and certain fruits
		Alkaline	Respiratory and metabolic alkalosis, Urinary tract infection, Vegetarians

Table 2: Chemical Properties of urine:

PARAMETER	NORMAL	ABNORMAL	POSSIBLE CAUSES
Protein	< 200mg/day	Proteinuria	Nephrotic syndrome, glomerulonephritis,, multiple myeloma, lower UTI, tumors or stones
Glucose	None	Glucosuria	Uncontrolled DM, gestational diabetes, Fanconi's syndrome
Ketones	None	Ketonuria	Diabetic ketoacidosis, Glycogen storage disease, starvation, Prolonged vomiting, Unbalanced diet: high fat & Low CHO diet
Nitrite	None	Detected	UTI
Bilirubin	None	Detected	Hepatic and post-hepatic jaundice
Urobilinogen	<i>Normal Trace (1mg/dl)</i>	> 2 mg/dl	Jaundice
Blood	None	Hematuria	Acute & chronic glomerulonephritis, <i>Trauma</i> , <i>cystitis</i> , <i>renal calculi and tumors</i> , Bleeding disorders (<i>Hemophilia</i>).
		Hemoglobinuria	Hemoglobinopathies, Malaria, Transfusion reaction (<i>Blood Incompatibility</i>)

Principle:

Dipsticks are plastic strips impregnated with chemical reagents which react with specific substances in the urine to produce color-coded visual results. They provide quick determination of pH, protein, glucose, ketone, urobilinogen, bilirubin, blood, hemoglobin, nitrite, and specific gravity. The intensity of the color



produced relates to the concentration of the substance in urine.

Color controls are provided against which the actual color produced by the urine sample can be compared. The reaction times of the impregnated chemicals are standardized.

Experimental design:

A. Carefully read the attached case scenario.

B. Perform the following procedure for the provided urine samples:

1- Dip the strip in the urine sample provided then remove it immediately.

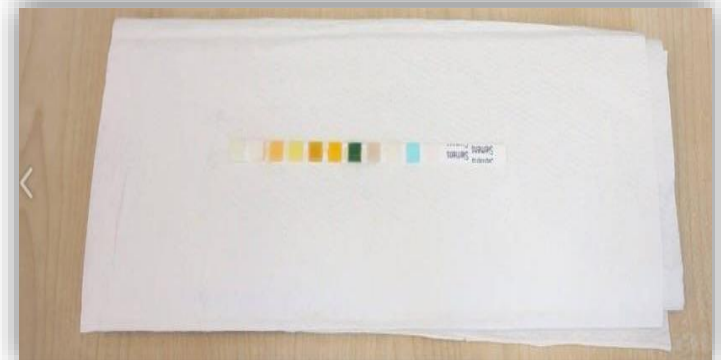
2- Remove the excess urine and keep the strip in a horizontal position.

3- Read the color produced within 30-60 seconds (Color changes after 2 minutes are of no significance).

4- Match the color changes to the color scale provided.

5- Give a full report about:

- Physical examination.
- Chemical examination.



Urinalysis Report

Name:

ID :

I. Physical Examination:

1. Appearance :

2. Color :

3. Odor :

4. Deposits :

5. Specific gravity :

6. Reaction (pH) :

II. Chemical Examination:

Item	Observation	Comment
Protein		
Glucose		
Ketones		
Nitrite		
Bilirubin		
Urobilinogen		
Blood		



Urinalysis Report :

Name:

ID :

I. Physical Examination:

1. Appearance :
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II. Chemical Examination:

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Urobilinogen		
Blood		

CASE STUDY

Case I:

A 12-year-old girl, a known patient with type 1 diabetes mellitus, presented to her pediatric assessment unit drowsy with short history of vomiting and abdominal pain. On examination:

- Tachycardia (rapid heart rate), tachypnea (rapid respiration rate) with a fruity smell on breath.
- Blood pressure: **85/50 mmHg** (Reference range: 100/66-135/85mmHg)
- blood sugar: **26.7 mmol/L** (Reference range: 3.9-5.6 mmol/L)
- HbA1C: **9.9%** (Reference range: 5.7-6.4%)
- Blood pH: **7.1** (Reference range: 7.35–7.45)
- Circulating Ketone bodies: **positive**

A mid-stream urine sample was collected for complete urinalysis.

Sample: I

1. Perform urinalysis using dipsticks and give a full report regarding:
 - Physical examination.
 - Chemical examination.
2. What is the most likely diagnosis?

CASE STUDY

Case II:

A 49-old woman with a history of diabetes mellitus came to hospital with fever, weakness and dysuria (pain during urination) for the last three days.

The results of her laboratory tests were as follows:

Test	Result	Reference range
Fasting blood glucose	7.5	3.9-5.6 mmol/L
Creatinine	75	55-120 mmol/L
Urea	3.7	2.5-6.4 mmol/L
Sodium	140	135-145 mmol/L
Potassium	3.9	3.5-5.1 mmol/L

A mid-stream urine sample was collected for complete urinalysis.

Microscopic examination of urine showed:-

- WBCs: > **100/HPF** (Reference range: 2-3/HPF)
- RBCs: **50/HPF** (Reference range: 0-2/HPF)

Sample: II

1. Perform urinalysis using dipsticks and give a full report about:

- Physical examination.
- Chemical examination.

2. What is the most likely diagnosis?

CASE STUDY

Case III

A 6-year-old boy, developed marked edema over a period of few days and his mother had noted puffiness around the eyes, characteristically in the morning and also his urine had become frothy.

His general practitioner ordered the following investigations that showed the following:

Test	Result	Reference range
Creatinine	58	55-120 mmol/L
Urea	3.4	2.5-6.4 mmol/L
Sodium	136	135-145 mmol/L
Potassium	4.0	3.5-5.1 mmol/L
Total protein	34	60-80 mmol/L
Albumin	14	35-50 mmol/L
Cholesterol	11	3.2-5.2 mmol/L
Triglycerides	15	0.5-2.27 mmol/L

A mid-stream urine sample is requested for complete urinalysis.

Sample: III

- 1. Perform urinalysis using dipsticks and give a full report about:**
 - **Physical examination.**
 - **Chemical examination.**
- 2. What is the most probable diagnosis?**