chemical analysis of water

Part 1

3. Chemical analysis of water

- Except in the cases in which, the presence of toxic impurities is suspected, the chemical analysis of water has not the same importance for veterinary as for human sanitation. However, the results of the chemical examination of water are valuable as they indicate a pollution of water through human and animal matters.
- Therefore, we are going to satisfy ourselves with a few qualitative tests, which are simply and easily performed with a few reagents.

1. Reaction

a- P.H: -

* Good water should be **neutral** in reaction.

* Alkaline water may be due to the presence of putrefactive products or decomposition of organic matters.

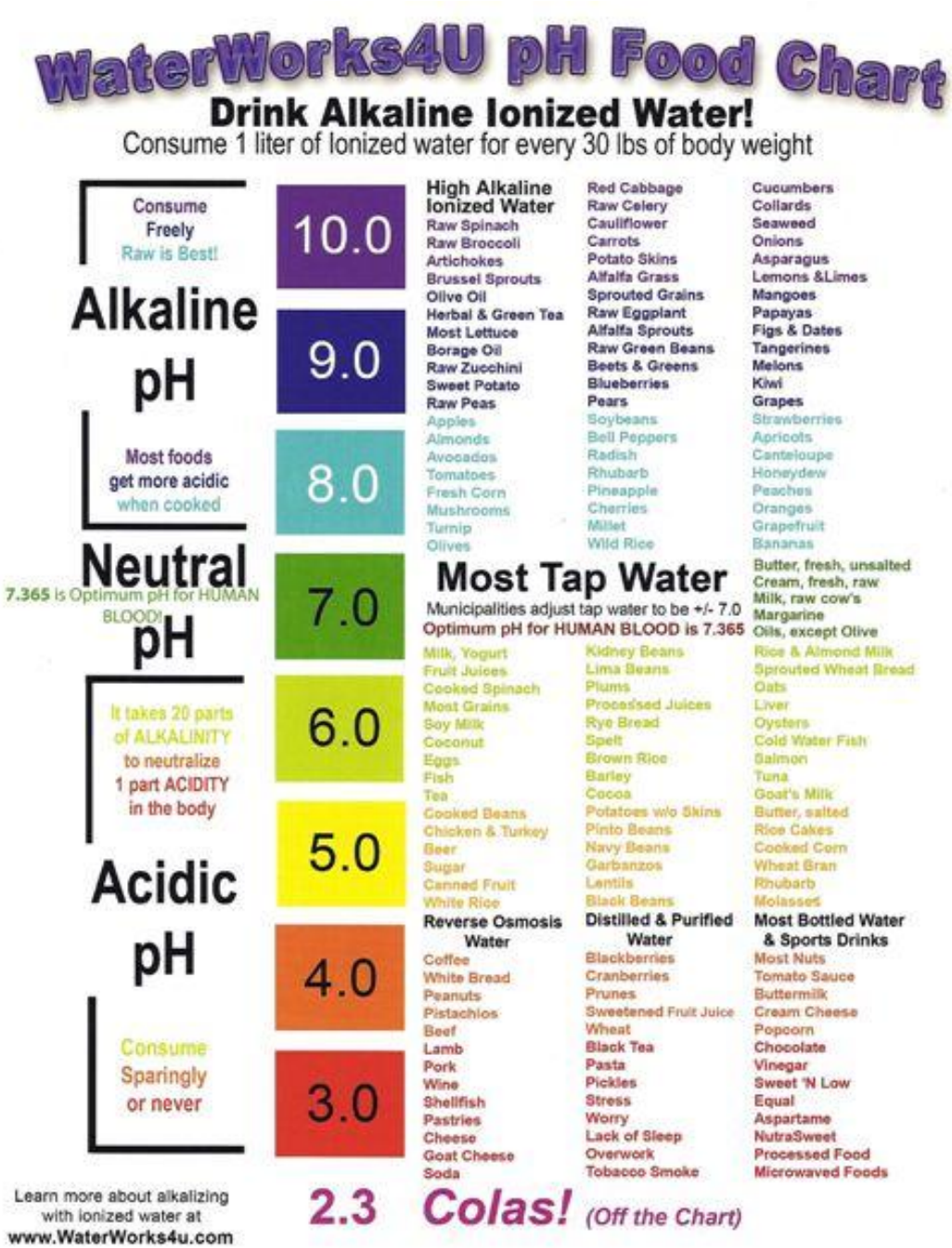
* Acid water may be due to the presence of **carbonic acid.**

* Water polluted by industrial effluents may contain free mineral acidity from strong acids and their soft action.

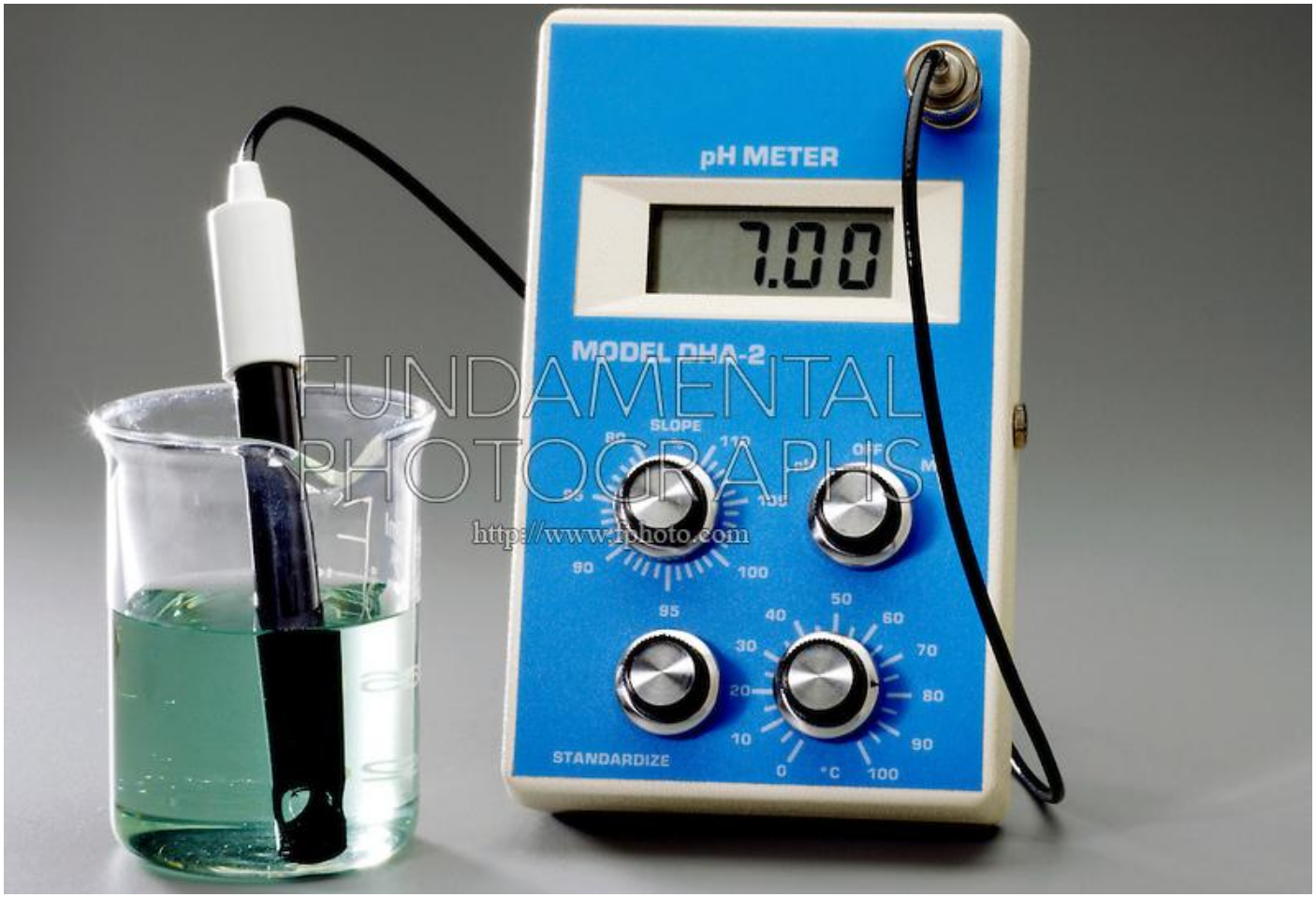
Reaction of water can be detected by: -

1. ***Litmus paper.***
2. ***P.H. meter.***

Representative pH values	
Hydrochloric Acid, 10M	
Lead-acid battery	
Gastric acid	
Lemon juice	
Cola	
Vinegar	
Orange or apple juice	
Tomato Juice	
Beer	
Acid Rain	
Coffee	
Tea or healthy skin	
Urine	
Milk	
Pure Water	
Healthy human saliva	
Blood	
Hand soap	



PH meter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Quality considerations: -

* The P.H. of water ranges from **5.5** to **9**, but most surface water fall in P.H. between **7.0** and **8.5** usually due to the presence of bicarbonates and carbonate ions.

* Water with a P.H. below **6.0** may cause excessive corrosions in the plumbing systems while water with P.H. above **8.5** suggests excessive sodium.

* Knowledge of the water P.H. is useful in determining the necessary measures for corrosion control, sanitation and adequate disinfection.

* It is recommended that P.H. of water for dairy houses use fall between **6.8** and **8.5**.

b- Gases: -

- **1. Testing for Co2 gas: -**
- Add **5** drops of **1%** ph.ph. alcoholic solution to about **100** cc of the water sample. If the **ph.ph**. is decolourised, free carbonic acid or free acid is present. If this decolourization is no longer take place after boiling the water, it proves that free **carbonic acid** is the cause of the original decolourization of the fresh water.

Hygienic significance:

- Sea water is the main reservoir of Co2 and regulate its content in atmosphere.
- Higher Co2 is accompanied with high methane and H2S where anaerobic fermentation take place.
- Also, high level is related to industrial pollution and associated with low oxygen level and low PH of the water source.
- Surface water contains usually less than **10** mg / liter free ***Co2***, although some ground water from deep layers may contain more than **100** mg / liter.
- The free carbon dioxide content of water can be reduced by aeration.

2. Testing for H2S gas: -

- Sulfates are reduced by anaerobic organisms to sulphides that possess characteristic bad odor.

Detection: -

*physically **H2S** is characterized by its bad odor.

* Chemically, by boiling water in a flask having a piece of filter paper soaked in **lead acetate**, fixed at the neck of the flask. If this paper turned black due to **lead sulphide**, this indicated the presence of **H2S** gas.

Presence of H2S indicates contamination and decomposition of organic matter.

2. Determination of total solids

- **100** ml of the water sample is transferred to a previously weighed **porcelain** dish, then place in a boiling water bath until complete evaporation. The sample then dried for **1** hour at a temperature ranged from **103 - 105** C in a thermostatically controlled hot air avon. The end result is determined by obtaining two successive constant weights.

The total residue in mg / liter is calculated according to the following equation: -

$$\text{Total residue} = \frac{A - B \times 100}{\text{ml. of the sample}}$$

- A = Weight of the dish containing the dried residue.
- B = Weight of the dish alone.

Hygienic importance: -

1. Drinking water standards recommended that total dissolved solids not exceeds **500** mg / liter.
2. High amount of total solids in water may leads to:

a- gastro intestinal disturbances.

b- May lead to lowering the daily milk production to great extent.

c- High concentration of mineral salts, particularly sulfates and chlorides are associated with corrosion damage in the water systems.

d- Indicate possible animal or vegetable pollution.

3. Determination of organic matter

- ***Reagents: -***

1. Dilute **sulphuric acid** (**1:3** volume of distilled water).

2. **Ammonium oxalate** solution.

3. Standard **potassium permanganate** solution:

1 ml of this solution =1 ml of oxalate solution =0.1 mg oxygen.

4. Water sample.

Procedure: -

1. In an Erlenmeyer flask, add : -

- **100** cc of the water sample.
- + **10** cc of the standard **potassium permanganate solution.**
- + **10** cc of diluted **sulphuric acid**.

2. Put the flask for **30** minute in a boiling water bath for digestion.

3. After digestion, add **10** cc of **ammonium oxalate** solution.

4.Titrate against standard **potassium permanganate** solution until obtain a faint pink color and record the reading (R1).

5.Blank test is also made using the procedure described previously (by using distilled water and record the amount of **pot. Permanganate** exhausted, R2).

- **Calculation: -**

  Oxygen consumed in part / million =

$$\frac{R1-R2}{\text{Amount of water sample}} \times 100$$

- i.e. oxygen consumed in mg / liter.

source of organic matter:

-They can originate from animal or human excretions (feces and urine).

-faulty drainage system.

-bacterial cell contaminant.

Hygienic significance of organic matter:

-the maximum permissible quantity(M.P.Q) is 3-4 ppm.

-water sample with organic matter more than 3 ppm is rejected.

-water sample with organic matter below or within the range should be examined chemically and bacteriologically before use for drinking.

Presence of organic matter will decrease the efficiency of chemical disinfectants.

4. Determination of ammonia

Procedure: -

- **1. Qualitative method: -**

To **50** ml of water sample in a Nessler tube, add 1 ml of Nessler`s reagent. If it give

a pale **yellow** color, this indicates small amount of ammonia.

If **reddish brown** color, it indicates a moderate amount of ammonia.

Reddish brown ppt. Indicates a large amount of ammonia.

- **2. Quantitative estimation: -**

By the use of Konig`s scale apparatus which have drum carrying the colors of series of prepared solutions of knowing ammonia content (the color range from **yellow** to **brown**).

- Put **50** ml of the water sample in the Nessler`s tube and then add 1 ml of Nessler`s reagent Compare the colour developed on the scale to get the percentage of ammonia percent in the water sample.

Sources and uses of ammonia:

1-organic matter decomposition from sewage pollution.

2-fertilizer and animal feed reduction.

3-manufacture of fibers, plastics, explosives, paper and rubber.

4-it is used as a coolant in metal processing and as a starting product for many nitrogen-containing compounds.

5-ammonia and ammonium salts are used in cleansing agents as food additives.

Hygienic significance:

-M.P.L. = 0.0 to 0.5 ppm.

-it is present in variable concentrations in many surface and ground water supplies.

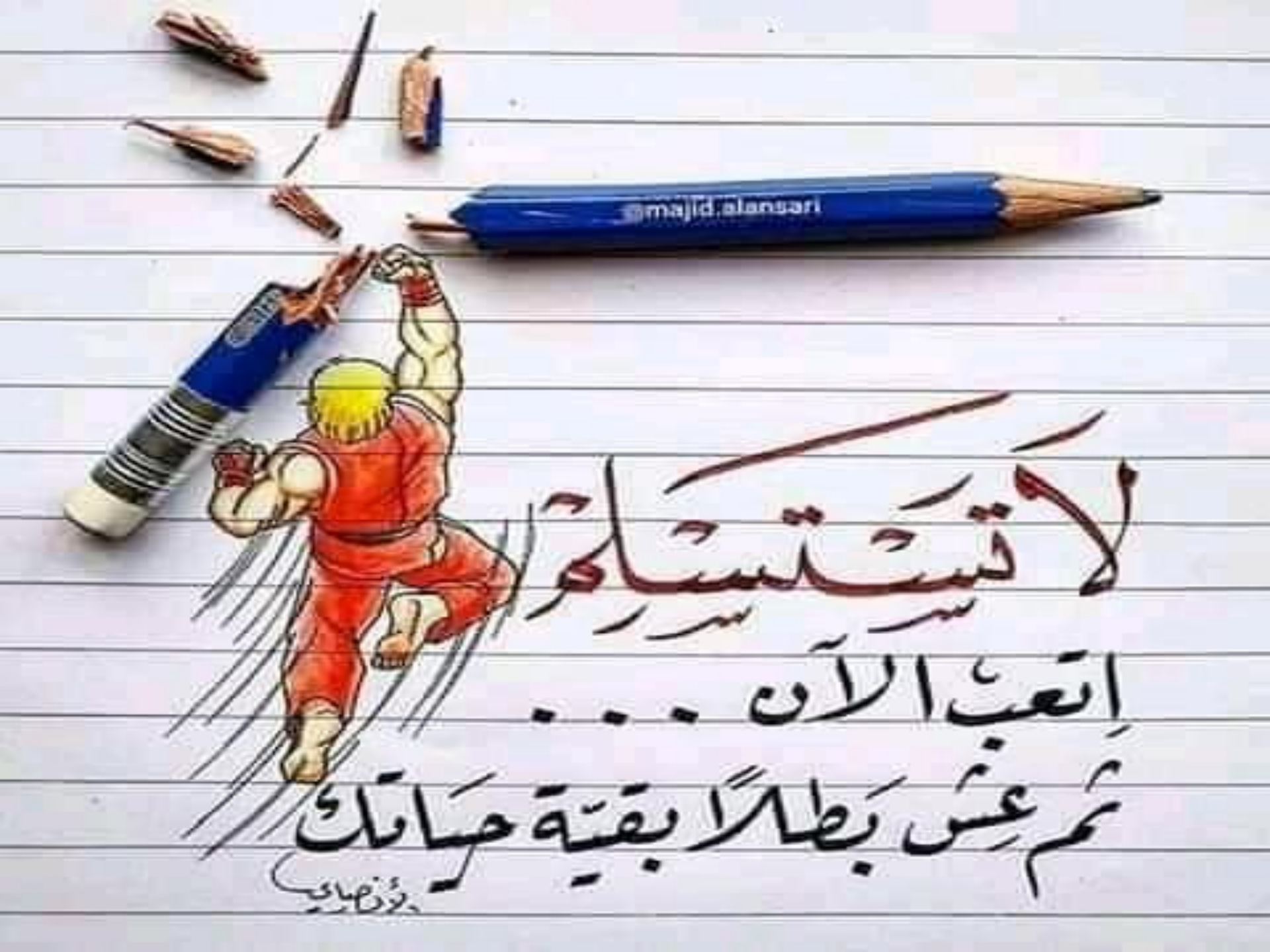
-it is a product of microbiological activity originating in water either from the decomposition of organic matter or from the reduction of nitrites.

Subsequently, the presence of ammonia in water may be due to harmless origin or due to seriously polluted sources.

-it is a significant pollutant because its reaction with chlorine results in compounds with less disinfecting efficiency than free chlorine.

-it is toxic to aquatic living system.

-it is an indicator of recent sewage pollution.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5. Determination of nitrites

a- Qualitative estimation: -

- **Reagents: -**

a- **Sulphanilic acid** reagent.

b- **Naphthylamine** solution.

- **Procedure: -**

1-To **1** ml of water sample in a colorless cylinder, add **1** ml of **sulphanilic acid** and shake well.

2-After **1-2** minutes, add **1** ml of **alphanaphthylamine** in **Hcl.**

3-The developed pink colour indicates the presence of nitrites and visually compared with a series of prepared colour standards of known nitrite content.

b- Quantitative estimation: -

- **Reagents: -**

1. Water sample.
2. Concentrated **sulphuric acid**.
3. **Zinc iodide** starch solution.

Procedure: -

In a test tube add: -

- **10** cc of the water sample.
- + **3.5** drops of **sulphuric acid**.
- + **0.5** cc of **zinc iodide starch** solution.

*If it gives a **blue** color directly.....**0.50** mg nitrite / liter

*If it gives a **blue** colour after **30** seconds.....**0.30** mg nitrite / liter

*If it gives a **blue** colour after **1** minute..... . .....**0.15** mg nitrite / liter

*If it gives a **blue** colour after **3** minutes..... .... **0.10** mg nitrite / liter

*If it gives a **blue** colour after **10** minutes.....**0.05** mg nitrite / liter

Hygienic significance:

-MPL is zero.

-natural water is free from nitrites.

Surface water, unless badly polluted with sewage effluents, frequently contain more than 0.1 mg/L of nitrite nitrogen.

Thus, presence of nitrites together with high ammonia levels in surface water generally shows recent or intermediate sewage pollution or sewage effluents.

Moreover, the presence of nitrites in the ground water may be a sign of sewage pollution.

-nitrites are intermediate products during the biological oxidation of ammonia to nitrate.

It may also arise from bacterial reduction of nitrites.

- Thank you