NUTRITION

BIOC 314

MODULE 1: FOOD ANALYSIS

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<table>
<thead>
<tr>
<th>Week #</th>
<th>topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction + lab safety</td>
</tr>
</tbody>
</table>
| 2      | **Module 1: Food Analysis**  
  - Determination of carbohydrates:  
    *Colorimetric determination of sugars in dates by using phenol-sulfuric acid method  
    *Differentiation between starch in white and whole-wheat bread |
| 3      |  
  - Determination of lipids:  
    Determination of total lipids in food by Bligh and Dyer Method |
| 4      |  
  - Determination of protein:  
    Determination of protein in food by kjeldahl method |
| 5      |  
  - Determination of vitamins:  
    *Determination of vitamin c in foods by iodometric aseay  
    *Determination of nicotinic acid in food |
| 6      |  
  - Determination of minerals:  
    Determination of chloride content in cheese |
| 7      |  
  - Determination of water:  
    Determination of water content in cow’s milk  
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| 9      | **Module 2: Nutrition**  
  - Energy balance and healthy body weights |
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| 11 | - Planning a healthy diet:  
    Principles of meal planning  
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<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Dietary guidelines and my pyramid</td>
</tr>
</tbody>
</table>

Each student will choose a case and apply all what she/he had learned in nutrition module
Carbohydrates are one of the three macronutrients that provide energy to our bodies.

It can be classified as **simple** or **complex**. Simple carbohydrates are commonly referred to as sugars where as complex carbohydrates are referred to as polysaccharides. Starch, glycogen and cellulose are examples of polysaccharides.

**Sugars** such as glucose and fructose is naturally occur in honey, fruits and fruit juices.

**Dates** are good example of sugar-rich fruit since 100gm of dates contain 63 gm sugar as shown in the table below.

<table>
<thead>
<tr>
<th>Dried dates (edible parts)</th>
<th>Nutritional value per 100 g (3.5 oz)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy</strong></td>
<td>280 kcal 1180 kJ</td>
</tr>
<tr>
<td><strong>Carbohydrates</strong></td>
<td>75 g</td>
</tr>
<tr>
<td>- Sugars</td>
<td>63 g</td>
</tr>
<tr>
<td>- <strong>Dietary fibre</strong></td>
<td>8 g</td>
</tr>
<tr>
<td><strong>Fat</strong></td>
<td>0.4 g</td>
</tr>
<tr>
<td><strong>Protein</strong></td>
<td>2.5 g</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td>21 g</td>
</tr>
<tr>
<td><strong>Vitamin C</strong></td>
<td>0.4mg</td>
</tr>
<tr>
<td><strong>Manganese</strong></td>
<td>0.262 mg</td>
</tr>
</tbody>
</table>
Carbohydrates are destroyed by strong acids (such as sulfuric acid) and/or high temperature. Under these conditions a series of complex reactions takes place:

These products then condense with phenolic compounds such as phenol to produce a stable orange-yellow compounds that are useful for carbohydrates analysis.
Therefore, a standard curve must be used. Ideally, the standard curve will be prepared using mixtures of the sugars present in the same ratio as they are found in the unknown.

If this is not possible, D-Glucose is used to prepare the standard curve.

**Materials**

1- Spectrophotometer and colorimetric tubes.
2- Syringe dispenser for sulfuric acid or 5ml cylinder.
3- Pipette 1ml.
4- Blender or mortar.
5- Dates.
6- Phenol 5%: dissolve 50gm of redistilled phenol in water and dilute to 1-L.
7- Sulfuric acid, 96% Reagent grade.
8- different Sugar solution (fructose 0.01, 0.03, 0.05, 0.07 mg/ml).

**Method**

1- Preparation of date's homogenate

1- Weigh accurately 1 date, then weigh 1 gram of it (from the pulp).
2- Homogenize in 50ml of distilled water in a warring blender.
3- Boil for 10 min.
4- Cool, and filter in a 100 ml volumetric flask, and complete to volume with water. Shake well to mix. Decolorize with charcoal if necessary.
5- Dilute 1ml of the above solution to 100ml and use it as unknown
Measuring the sugar content

<table>
<thead>
<tr>
<th></th>
<th>Tube 1</th>
<th>Tube 2</th>
<th>Tube 3</th>
<th>Tube 4</th>
<th>Unknown tube</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard fructose</strong></td>
<td>1 ml of 0.01 mg/ml</td>
<td>1 ml of 0.03 mg/ml</td>
<td>1 ml of 0.05 mg/ml</td>
<td>1 ml of 0.07 mg/ml</td>
<td></td>
</tr>
<tr>
<td><strong>Unknown solution</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 ml</td>
</tr>
<tr>
<td><strong>5% phenol And mix well</strong></td>
<td>1 ml</td>
<td>1 ml</td>
<td>1 ml</td>
<td>1 ml</td>
<td>1 ml</td>
</tr>
<tr>
<td><strong>Sulfuric acid And mix well</strong></td>
<td>5 ml</td>
<td>5 ml</td>
<td>5 ml</td>
<td>5 ml</td>
<td>5 ml</td>
</tr>
</tbody>
</table>

Boil all the tubes for 5 min.

Stand all the tubes in air for 10 min.

Cool to room temperature

Read the absorbance of the yellow-orange color at 490 nm for hexoses.

**Calculations**

- Fill the table with your results:

<table>
<thead>
<tr>
<th>Conc. (mg/ml)</th>
<th>absorbance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>0.07</td>
<td></td>
</tr>
</tbody>
</table>

- Draw a standard curve of conc. Vs. abs.??
- Determine the concentration of the sugar from the standard curve?
  (suppose it is 0.05 mg/ml).
  
  0.05 mg/ml = 0.00005 g/ml
  
  0.00005g/ml × 100 ×100 (for the dilution)= 0.5 gm/ 1 gm of date
- Calculate the kcal provided by the whole date (suppose that the weight of the whole date was 10 gm)?
  *The whole date contains 5 gm of sugar
  1 gm of sugar → 4 kcal
  5 gm → ?

  The Kcal provided by the whole date from sugar = 5×4 = 20 Kcal

**Advantages of the method**

- This method is simple, rapid, sensitive, specific for all carbohydrates and widely applied.
- Under proper conditions, the phenol-sulfuric method is accurate to +/- 2%
- All classes of sugars, including sugar derivatives and oligo- and polysaccharides can be determined by this method.

**References**

Differences between starch in white and whole-wheat bread

Background

- Both white and whole wheat bread are made from wheat flour.
- Wheat berries used to make flour have 3 parts:
  - **the bran**: rich in nutrients and fiber
  - **the endosperm**: contains starch and proteins
  - **the germ**: rich in vitamins and minerals

- White flour uses only the endosperm, while whole-wheat flour uses all the three parts.
  - We can conclude that white bread contains more starch than whole-wheat bread

Principle

Starch consists of two types of molecules:

- Amylose (10-20%)
- Amylopectin (80-90%)

Amylose in starch is responsible for the formation of a deep blue color in the presence of iodine. The iodine molecule slips inside of the amylose coil.
Materials

1- Iodine.
2- Part from whiten bread.
3- Part from brown bread.
4- Dishes.

Procedure

1- Cut pieces of white and brown bread in 2 dishes.
2- Add drop of iodine solution on the bread by droper.
3- Record your observation.
4- How the color of iodine change and why?

References


http://www.elmhurst.edu/~chm/vchembook/548starchiodine.html
Lipids, proteins, and carbohydrates constitute the principal structural components of foods.

The general classification of lipids that follows is useful to differentiate lipids in foods:

**Background**

- Lipids, proteins, and carbohydrates constitute the principal structural components of foods.
- The general classification of lipids that follows is useful to differentiate lipids in foods:

**General Classification**

- **Simple lipids**: ester of fatty acids with alcohol
  - **Fats** (esters of fatty acids with glycerol)
  - **Waxes** (esters of fatty acids with long-chain alcohols such as vitamin A esters)

- **Compound lipids**: compounds containing groups in addition to an ester of a fatty acid with an alcohol
  - **Phospholipids** (glycerol esters of fatty acids, phosphoric acids, and other groups containing nitrogen such as phosphatidyl choline)
  - **Cerebrosides** (compounds containing fatty acids, a carbohydrate, and a nitrogen moiety)
  - **Sphingolipids** (compounds containing fatty acids, a nitrogen moiety and phosphoryl group)

- **Derived lipids**: substances derived from neutral lipids or compound lipids

Foods may contain any or all types of the lipid compounds previously mentioned.

Determination of total lipids in food by Bligh and Dyer Method
Lipids are soluble in organic solvents and insoluble in water. Therefore, water insolubility is the essential analytical property used as the basis for the separation of lipids from proteins, water, and carbohydrates in foods.

**Solvent selection:**

Ideal solvents for fat extraction should have:

1. A high solvent power for lipids and low or no solvent power for proteins, amino acids, and carbohydrates.
2. Evaporate readily and leave no residue
3. Have a relatively low boiling point
4. Nonflammable
5. Nontoxic in both liquid and vapor state
6. Should penetrate sample particles readily
7. Inexpensive.

For general extraction of almost all lipids from biological samples, either a mixture of ethanol and ethyl ether or a mixture of chloroform and methanol is used.

The lipids are generally bound to proteins in the biological samples and in that situation (as lipoprotein) cannot be efficiently extracted by non-polar organic solvents alone. The inclusion of methanol or ethanol helps in breaking the bonds between the lipids and proteins.

**Materials**

1. Samples such as chocholate, chips, etc.
2. Distilled water
3. Conical flasks, beakers, fin capillary
4. Chloroform and ethanol mix. (2:1 v/v)
5. centrifuge
1- Weigh 2g of sample.
2- Grind it with 10 ml of distilled water
3- Transfer in conical flask with 30 ml of chloroform and ethanol mixture (2 : 1 v/v) and mixed well.
4- For complete extraction, it is advisable to keep this for 30 minutes at room temperature in dark place.
5- At the end of this period centrifuge for 10-15 minutes at 2000-3000 rpm.
6- Generally 3 layers are seen, a clear lower layer of chloroform containing the entire lipid.

7- The methanol layer is discarded and the lower layer is carefully collected free of inter phase either by sucking out with a fin capillary or by filtration through glass wool.
8- The organic layer "lower layer" is taken in a pre-weighed beaker (W1) and carefully evaporated by keep the sample in warm water bath. It is also advisable to keep the sample covered with a dark paper to protect from light, because some lipids get polymerized or decomposed on exposure to light and heat.

9- When the solution is free of organic solvents, the weight is determined again (W2).

**Calculations**

- The weight of lipids = W1 – W2 = z gm lipids/2 gram sample.
- Calculate the kcal provided by the sample?

1 gm of lipid → 9 kcal
z gm → ?

The Kcal provided by the sample = Z × 9 = Y Kcal

**References**

Determination of proteins in food by kjeldahl method

Background

The kjeldahl method was developed in 1883 by a Danish chemist called John Kjeldahl. This method is used to determine the amount of nitrogen in foods. Then, a conversion factor is needed to convert the measured nitrogen concentration to a protein concentration.

The kjeldahl method can be divided into 3 steps:

1. Digestion
2. Distillation
3. Titration

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Principle

1. Digestion

The food is digested by heating it in the presence of sulfuric acid (an oxidizing agent which digests the food).

Such reactions can be speeded up by adding a catalyst such as potassium sulfate, which raises the boiling point of the digesting acid and thus the temperature of the reaction.

Digestion converts any nitrogen in the food into ammonia, and other organic matter to water and carbon dioxide.
Ammonia is not liberated in an acid solution because the ammonia is in the form of ammonium ion \((\text{NH}_4^+)\) which binds to the sulfate ion \(\text{SO}_4^{2-}\) and thus remains in the solution:

\[
\text{NH}_4^+ + \text{SO}_4^{2-} \rightarrow (\text{NH}_4)_2\text{SO}_4 \quad \text{ammonium sulfate}
\]

To separate the ammonia from the digestion mixture, the solution must be made alkaline by adding sodium hydroxide, which converts ammonium sulfate into ammonia gas:

\[
(\text{NH}_4)_2\text{SO}_4 + 2 \text{NaOH} \rightarrow 2\text{NH}_3 + 2\text{H}_2\text{O} + \text{Na}_2\text{SO}_4
\]

The ammonia gas that is formed is distilled into a receiving flask which contains boric acid and Tashiro indicator (methylene blue and methyl red).
The low PH of the solution in the receiving flask converts ammonia gas into the ammonium ion, and simultaneously converts the boric acid to the borate ion:

\[
\text{NH}_3 + \text{H}_3\text{BO}_3 \text{ (boric acid)} \rightarrow \text{NH}_4^+ + \text{H}_2\text{BO}_3^- \text{ (borate ion)}
\]

Borate anion (proportional to the amount of nitrogen) is titrated with 0.02 N hydrochloric acid:

\[
\text{H}_2\text{BO}_3^- + \text{H}^+ \rightarrow \text{H}_3\text{BO}_3
\]

**Materials**

1. Protein sample such as milk, cheese, meat,…etc.
2. Potassium sulfate
3. Conc. Sulfuric acid
4. Round-bottom flask
5. 250 ml volumetric flask
6. 45% sodium hydroxide (freshly prepared)
7. 2% boric acid
8. Tashero indicator= methylin blue: methyl red (2:1)
9. 0.02 N hydrochloric acid

**Procedure**

1- Weigh out 1 gram of the sample and grind it. Then, put it a round-bottom flask.
2- Add 1 gram of the catalyst.
3- Add 20ml concentrated sulfuric acid and start heating until the color of the sample becomes black.
4- Continue the heating at low temperature until boiling ends.
5- Rise the temperature until the sample become colorless.
6- Cool the flask.
7- Transfer the solution into 250 ml volumetric flask and complete the volume with distilled water.
8- Repeat the previous steps but without the food sample → (blank)

A reagent blank should be run to subtract reagent nitrogen from the sample nitrogen

**2 distillation**

1- Pipette 10 ml from the solution into sample tube in the kjeldahl instrument (distillation unit k-314) .
2- Add 10 ml sodium hydroxide and start heating.
3- The ammonia is received in the receiving flask which contains 10 ml boric acid and 4 drops from Tashiro indicator.
4- Distillation will take about 15 minutes, where the color of the solution changed from pink to green.

**3 titration**

1- Fill the buret with 0.02 N HCl.
2- Titer the solution in the receiving flask until purple color appears.
3- Repeat the same steps on the blank.
Calculations

1L \( 1N \) of HCl = atomic weight of N

1 ml (0.02 N) of HCl = \( \frac{14}{1000 \times 50} \) g of N

(ml of acid needed for sample – ml of acid needed for blank) = ??

No. of grams of N = \( \frac{(corrected \text{ acid} \text{ value}) \times 0.00028 \text{ g}}{1 \text{ ml}} \times 250 \text{ (for dilution)} = Y \text{ gm} \)

\[ % \text{ N} = \frac{Y}{\text{ sample weight} \times \text{ volume used}} \times 100 = \frac{Y}{0.1 \times 10} = Z\% \]

Then, a factor is used to convert %N to % crude protein. Since most proteins contain 16% N, so the conversion factor is 6.25 (100/16 = 6.25)

\[ \text{% N} \times 6.25 = \% \text{ protein} \]

Conversion factors for various foods are given in the table below

<table>
<thead>
<tr>
<th>Food</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Animal origin</strong></td>
<td></td>
</tr>
<tr>
<td>Eggs</td>
<td>6.25</td>
</tr>
<tr>
<td>Meat</td>
<td>6.25</td>
</tr>
<tr>
<td>Milk</td>
<td>6.38</td>
</tr>
<tr>
<td><strong>Vegetable origin</strong></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>5.83</td>
</tr>
<tr>
<td>Corn (maize)</td>
<td>6.25</td>
</tr>
<tr>
<td>Millets</td>
<td>5.83</td>
</tr>
<tr>
<td>Oats</td>
<td>5.83</td>
</tr>
<tr>
<td>Rice</td>
<td>5.95</td>
</tr>
<tr>
<td>Rye</td>
<td>5.83</td>
</tr>
<tr>
<td>Sorghums</td>
<td>6.25</td>
</tr>
<tr>
<td>Wheat: Whole kernel</td>
<td>5.83</td>
</tr>
<tr>
<td>Bran</td>
<td>6.31</td>
</tr>
<tr>
<td>Endosperm</td>
<td>5.70</td>
</tr>
<tr>
<td>Beans: Castor</td>
<td>5.30</td>
</tr>
<tr>
<td>Jack, lima, navy, mung</td>
<td>6.25</td>
</tr>
<tr>
<td>Soybean</td>
<td>5.71</td>
</tr>
<tr>
<td>Velvet beans</td>
<td>6.25</td>
</tr>
<tr>
<td>Peanuts</td>
<td></td>
</tr>
</tbody>
</table>
Advantages

1- Applicable to all types of foods
2- Inexpensive

Disadvantages

1- Measures total organic nitrogen not just protein nitrogen
2- Time consuming
3- Corrosive reagent

References

3- http://www-unix.oit.umass.edu/~mcclemen/581Proteins.html
Determination of vitamin C in food by Iodometric Aseay

Background

- Vitamin C is a water-soluble vitamin that is necessary for normal growth and development.
- It is called also Ascorbic acid.
- It is found in green peppers, citrus fruits, strawberries, tomatoes, broccoli, turnip greens and other green sweet and white potatoes, and cantaloupe.
- Fish and milk contain small amounts.

principle

Vitamin C can be assayed by direct titration with iodine. Iodine oxidizes the dihydroxy-functional group to an alpha diketone group in the dehydro-ascorbic acid product.

Materials

1- Iodine 0.1 N, freshly prepared.
2- Standard ascorbic acid 0.1 gm/100 ml.
3- Starch indicator 1%.
4- Source of vitamin C such as Tang, tablets, fruit juice, ect.

**procedure**

1- Weigh accurately about 20 g of the sample of dehydrated juice solid provided (Tang) or 10 ml if you are using juice.
2- Add about 100 ml of water to the flask just before it is to be titrated, followed by 5 ml of starch solution.
3- Cover the opening of the flask with plastic or aluminum foil, and shake well to dissolve the sample completely. Then, punch the foil to admit the tip of your burette.
4- cover the burette with aluminum foil . then, Insert burette tip through the foil covering the mouth of the flask and titrate to the first appearance of the blue starch-triiodine color, with 0.1 N iodine solution
5- Repeat the titration.

**Calculations**

\[
1 \text{L} 1 \text{N} \text{ of } I_2 = \text{M.wt of ascorbic acid.}
\]

\[
1 \text{ml} (0.1 \text{N}) \text{ of } I^- = \frac{176.14}{100 \times 10 \times 2} \text{ gm ascorbic acid}
\]

1 ml (0.1 N) of I\(^-\) = 0.008806 gm of ascorbic acid.

(titr no. ) of I\(^-\) = ??

No. of grams of ascorbic acid in the sample = \( \frac{(\text{titr no.}) \times 0.008806 \text{ gm}}{1 \text{ ml}} \) = Y gm

Gm% ascorbic acid = \( \frac{Y}{\text{sample weight}} \times 100 = z\% \)
Niacin, also known as nicotinic acid or vitamin B3, is a water soluble Vitamin. Nicotinamide is the amide of nicotinic acid. In cells, niacin is incorporated into nicotinamide adenine dinucleotide (NAD) and nicotinamide adenine dinucleotide phosphate (NADP) which play essential roles in energy metabolism in the living cell and DNA repair.

- Niacin is found in whole grain foods such as brown rice and whole wheat bread. Other good sources of niacin are yeast, tuna and salmon, beef, peanuts, and mushrooms.

**Principle**

Nicotinic acid is pyridine-3-carboxylic acid, and can be determined by direct titration with carbonate-free 0.1 N sodium hydroxide using phenol red or phenolphthalein as indicator.

**Materials**

1. yeast

**Phenolphthalein** is a complex organic dye that is colorless in acidic solutions and pink in solutions that are slightly alkaline, or basic.
Procedure

1- Weigh accurately about 2g of sample.
2- Grind thoroughly in a mortar with about 10 ml of distilled water
3- centrifuge at 3000 rpm for 10 min.
4- transfer supernatant into conical flask for titration
3- Add about drops of either phenol red or phenolphthalein.
4- Titrate with 0.1 N NaOH until the end point is reached.

Calculations

1L 1N of sodium hydroxide = M.wt of nicotinic acid

1 ml (0.1 N ) NaOH = \(\frac{123.11}{100\times10}\) gm of nicotinic acid

1ml (0.1 N ) NaOH = 0.0123 gm of nicotinic acid

(titr no.) = ??

No. of grams of nicotinic acid in the sample = \(\frac{(titr\ no.) \times 0.0123}{1\ ml}\) = Y gm

Gm % nicotinic acid = \(\frac{Y}{\text{sample weight}}\times 100\) = Z

References

http://hgic.clemson.edu/factsheets/hgic4076.htm
webhost.bridgew.edu/ihutchins/11%2520
Sodium chloride is added to cheese to enhance its taste, and also as a preservative so that some types of cheese will keep well at room temperature. In the industrial preparation of certain cheeses, such as mozzarella, it is important to check that the quantity of salt added is of an optimum concentration.

**Background**

**Sodium chloride** is added to cheese to enhance its taste, and also as a preservative so that some types of cheese will keep well at room temperature. In the industrial preparation of certain cheeses, such as mozzarella, it is important to check that the quantity of salt added is of an optimum concentration.

**Principle**

Sodium chloride is precipitated in acidic solution with silver nitrate; the excess unreacted silver nitrate is determined by back titration with thiocyanate solution.

**Step 1**

An excess volume of a silver nitrate solution is added to the solution containing chloride ions, forming a precipitate of silver chloride. The term ‘excess’ is used as the moles of silver nitrate added are known to exceed the moles of sodium chloride present in the sample so that all the chloride ions present will react.

\[
\text{Ag}^+\text{(aq)} + \text{Cl}^-\text{(aq)} \rightarrow \text{AgCl}_{(s)}
\]
The solution is titrated with potassium thiocyanate. The titrate remains pale yellow as the excess (unreacted) silver ions react with the thiocyanate ions to form a silver thiocyanate precipitate.

$$\text{Ag}^+_{(aq)} + \text{SCN}^-_{(aq)} \rightarrow \text{AgSCN}_{(s)}$$

Ferric alum is used as an indicator. Once all the silver ions have reacted, the slightest excess of thiocyanate reacts with $\text{Fe}^{3+}$ to form a dark red complex.

$$\text{Fe}^{3+}_{(aq)} + \text{SCN}^-_{(aq)} \rightarrow [\text{FeSCN}]^{2+}_{(aq)}$$

Materials

1. 0.05 M silver nitrate
2. Conc. Nitric acid
3. Potassium thiocyanate
4. Ferric alum indicator
5. Starch, freshly prepared.
**Procedure**

1. Weigh accurately a sample of cheese (about 1.5 g) into a conical flask.
2. Add 10 ml water and heat the flask to about 75 °C in water bath for 10 minutes.
3. Add 25 ml of standard 0.05 M silver nitrate, using a pipette.
4. Add 5 ml conc. nitric acid.
5. Digest the cheese curd by boiling gently for 10 minutes.
6. Cool, and add about 50 ml water.
7. Filter quantitatively.
8. Titrate with standard potassium thiocyanate using iron (III) alum (Ferric alum) indicator (2 ml).

**Left flask:** before the titration endpoint, addition of SCN-ions leads to formation of silver thiocyanate precipitate, making the solution cloudy. Here the solution also takes a faint yellow color due to the color of the Cheese extract. **Centre flask:** at the endpoint all the free silver ions have been precipitated by SCN-. The slightest excess of SCN- forms a dark red colored complex with the Fe3+ ions from the ferric ammonium sulfate indicator, giving the solution a slight orange/red coloration. **Right flask:** If addition of SCN- is continued past the endpoint, further ferric thiocyanate complex is formed and a stronger dark red color results.

**important message**

the titration should be stopped when the first trace of dark red color is observed
Calculations

1L 1N of silver nitrate = M.wt. of sodium chloride

1 ml (0.05N) of silver nitrate = \( \frac{58.443 \text{ g}}{1000 \times 20} \) of NaCl

1 ml (0.05N) of silver nitrate = 0.0029 g of NaCl

(25 ml - TITER NO.) = ??

Number of grams of sodium chloride = \( \frac{(25 \text{ ml} - \text{TITER NO.}) \times 0.0029}{1 \text{ ml}} \) = Y gm

% NaCl = \( \frac{Y}{\text{sample weight}} \times 100 \) = Z g%

Safety

Concentrated nitric acid is very corrosive. Wear safety glasses and take great care handling the concentrated acid. Safety glasses should be worn throughout the method, especially during the sample preparation.
The quantities of the main milk constituents can vary considerably depending on the individual animal, its breed, stage of lactation, age and health status. The average composition of cow’s milk is shown in table (1).

**Table (1): composition of cow’s milk**

<table>
<thead>
<tr>
<th>Main constituent</th>
<th>Range (%)</th>
<th>Mean (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>85.5 – 89.5</td>
<td>87.0</td>
</tr>
<tr>
<td>Total solids</td>
<td>10.5 – 14.5</td>
<td>13.0</td>
</tr>
<tr>
<td>Fat</td>
<td>2.5 – 6.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Proteins</td>
<td>2.9 – 5.0</td>
<td>3.4</td>
</tr>
<tr>
<td>Lactose</td>
<td>3.6 – 5.5</td>
<td>4.8</td>
</tr>
<tr>
<td>Minerals</td>
<td>0.6 – 0.9</td>
<td>0.8</td>
</tr>
</tbody>
</table>

As shown, Water is the main constituent of milk.

**Principle**

The water can be easily extracted from the sample, and therefore determined, by using acetone. This is because:

1. acetone is **miscible** with water
2. both have lower boiling points which mean they will be evaporated before any other major components such as lipids, proteins, carbohydrates and minerals
Miscibility is a term commonly used in chemistry that refers to the property of liquids to mix in all proportions, forming a homogeneous solution. By contrast, substances are said to be immiscible if in any proportion, they do not form a solution. For example, diethyl ether is fairly soluble in water, but these two solvents are not miscible since they are not soluble in all proportions.

## Materials
1. crucibles
2. Milk
3. Acetone
4. Hot plates

## Procedure
1- pipette 5 ml of milk into this crucible and weight it =x1
2- add 1 ml acetone and evaporate the milk to dryness on a hot plate (do not char the milk)
3- after complete evaporation of water, weigh the crucible again=x2

## Calculations

Weight of water= weight of crucible with milk (x1) – weight of crucible with dry milk (x2)

Water %= \( \frac{(x1 - x2)}{5} \times 100 \)

## References
3- body fluids lab manual
4- [http://www-unix.oit.umass.edu/~mcclemen/581moisture.html](http://www-unix.oit.umass.edu/~mcclemen/581moisture.html)
Citric acid is a weak organic acid which contains 3 carboxylic acid groups.
It is a natural preservative and is also used to add an acidic, or sour, taste to foods and soft drinks.
Citric acid exists in greater than trace amounts in a variety of fruits and vegetables, most notably citrus fruits.
In biochemistry, it is important as an intermediate in the citric acid cycle, and therefore occurs in the metabolism of virtually all living things.

We can determine the amount of citric acid in a given volume of fruit juice by titrating the juice with a standard NaOH solution to form salt and water as shown in the equation below:

\[ \text{C}_3\text{H}_5\text{O(COOH)}_3 + 3\text{NaOH} \rightarrow \text{C}_3\text{H}_5\text{O(COONa)}_3 + 3\text{H}_2\text{O} \]

**Materials**

1. Fruit juice
2. Distilled water
3. Sodium hydroxide (0.5 M)
4. Phenolphthalein
**Procedure**

1- in a conical flask, add 10 ml of the juice
2- add 30 ml of distilled water
3- add 3 drops of ph.ph
4- titrate the sample with sodium hydroxide until a pink color appears.

**Calculations**

- calculate the moles of sodium hydroxide used?

\[ M = \frac{\text{no. of moles}}{V \text{ in liter}} \]

\[ \text{No. of moles} = M \times \frac{V \text{ in ml}}{1000} = M \times \frac{\text{TITR NO.}}{1000} = x \text{ mol} \]

- calculate the moles of citric acid in your sample?

1 mol of citric acid \[ \rightarrow \] 3 moles of sodium hydroxide

\[ ?? \rightarrow x \text{ moles of sodium hydroxide} \]

\[ \text{No. of moles of citric acid in the sample} = \frac{x \text{ mol}}{3 \text{ mol}} \times 1 \text{ mol} = y \text{ mol} \]

- calculate the grams of citric acid in the sample?

\[ \text{moles} = \frac{\text{wt}}{m.wt} \]

\[ \text{Wt} = \text{moles} \times m.wt = y \text{ mol} \times 192.12 \text{ g/mol} = z \text{ gram.} \]

**References**

http://en.wikipedia.org/wiki/Citric_acid

webhost.bridgew.edu/ihutchins/11%2520
A soft drink (also referred to as soda or carbonated beverage) is a non-alcoholic beverage. They are called "soft" in contrast to "hard drinks" — that is, alcoholic beverages. These drinks typically contain water — often carbonated water — and a flavoring agent. Many of these beverages are sweetened by the addition of sugar or high-fructose corn syrup, or — in the case of "diet" drinks — with a sugar substitute. They may also contain ingredients such as caffeine and fruit juice.

In this lab you will determine the densities of standard sucrose solutions. (Since sucrose and fructose are both sugars and have very similar aqueous densities, different standard sucrose solutions can be used as an indicator of the % sugar in various soft drinks.) From these densities you can make a standard calibration curve of density vs. % sugar. Then you will determine the densities of various soft drinks. Using your standard calibration curve you will find the % sugar of these soft drinks and then calculate the number of grams of sugar in these drinks.

**Materials**

1. Standard sucrose solutions (0%, 5%, 10%, 15%, 20%)
2. Beakers
3. Samples of soft drinks
4. scale

**Method**

1. Determine the weight (mass) of the standard sugar solutions by pipeting 10 mL of each standard solution (0%, 5.00%, 10.00%, 15.00%, and 20.00%) into a beaker and weighing.
2. Determine the weight (mass) of the soft drinks by pipeting 10 mL of each soda into a beaker and weighing.

**Calculations**

<table>
<thead>
<tr>
<th>% sugar (g/100ml)</th>
<th>Mass of 10 ml</th>
<th>Density=mass/volume (g/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0% (water)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>? % soft drink (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>?% soft drink (2)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Draw a calibration curve of densities vs. % sugar?

From the curve determine the % sugar of each sample of soft drink?

Calculate the no. of grams of sugar per can? (suppose that the % sugar is 8 and the can volume is 335 ml? (8% sugar= 8 gm/100ml)

8 gm $\rightarrow$ 100ml

? gm $\rightarrow$ 335 ml

No. of gm of sugar in can= $\frac{8 \times 335 \text{ ml}}{100 \text{ ml}}$ = z gm
Acidulants reduce the soft drink’s pH and thereby assist in beverage preservation for long-term storage.

Acidulants can also be used as chelating agents, buffers, coagulators, and flavoring agents. In the latter role, the acidulant imparts a tart taste.

The most common acidulants used in soft drinks are phosphoric and citric acids.

Phosphoric acid is more effective in lowering the pH than organic acids, while citric acid produces a stronger tartness.

Phosphoric acid is commonly found in colas whereas citric acid is typically added to fruit flavored beverages.

**Background**

phosphoric acid (H3PO4) and its anions (H2PO4, HPO42-, and PO43-) are colorless, they cannot be directly determined using visible-light spectrophotometry. Instead, we will quantitatively convert them into a colored substance, whose absorbance can be easily measured. To do this, we will react the phosphates in the soft drink with the molybdate ion, MoO4^2-. The initial product of this reaction is the phosphomolybdate ion, [PO4•12MoO3]3-. This complicated monster is also colorless, but when reduced (we'll use SnCl2) it turns into a material, of unknown composition, called molybdenum blue. Molybdenum blue is intensely colored, and when we measure the concentration of this material, we can relate that concentration to the concentration of the phosphates present in the initial soda.
**Materials**

1. Standard (P) (0.004 mg/ml)  
2. Samples of soft drinks  
3. Distilled water  
4. Ammonium molybdate  
5. SnCl₂

**Method**

Prepare 3 test tubes as the following:

<table>
<thead>
<tr>
<th>tube</th>
<th>sample</th>
<th>standard</th>
<th>Blank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard(P)</td>
<td>-</td>
<td>1ml</td>
<td>-</td>
</tr>
<tr>
<td>Sample(soft drink)</td>
<td>1ml</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D.W</td>
<td>3ml</td>
<td>3ml</td>
<td>4ml</td>
</tr>
<tr>
<td>Ammonium molybdate</td>
<td>0.8 ml</td>
<td>0.8 ml</td>
<td>0.8 ml</td>
</tr>
<tr>
<td>SnCl₂</td>
<td>0.2 ml</td>
<td>0.2 ml</td>
<td>0.2 ml</td>
</tr>
</tbody>
</table>

- Leave for exactly 5 min.  
- Read the absorbance at 620 nm

**Calculations**

\[ C_{unk} = \frac{A_{unk}}{A_{std}} \times C_{std} = z \text{ mg/ml} \]

**References**