Chapter 9

ESTIMATION OF CALCIUM IN SOME MILK SAMPLES

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INTRODUCTION

Calcium, the most abundant mineral in our body, makes up about 1.5 to 2% of the body weight and 39% of total body minerals. Approximately 99% of the calcium exists in the bones and teeth. The remaining 1% of calcium is in the blood, extracellular fluids and within the cells of all tissues, where it regulates many important metabolic functions[1].

Even though only 1% of calcium in the body is found outside the bone, this form of calcium is critical for many functions in the body. Therefore, its level is maintained in a narrow range in the blood and tissues.

Calcium deficiency disease, also known as hypocalcemia, occurs when we don't intake enough calcium. This increases the risk of developing diseases such as osteoporosis. We should consume the recommended amount of calcium per day through the food we eat. If necessary, we can take calcium supplements to get enough calcium[2].

The natural aging process can cause calcium deficiency disease. Most of the calcium in our body is stored in our bones. As we age out, bones become thin or less dense. So we should increase our daily calcium supplement. It is vital for women to consume the recommended daily amount of calcium during middle age. This is when most women approach menopause. A decline in the hormone estrogen during menopause causes women's bones to thin faster. Most menopausal women should increase the amount of calcium in the foods they eat to reduce the risk of brittle bone disease (osteoporosis) and calcium deficiency disease[3].

ESTIMATION OF CALCIUM

Calcium can be estimated by volumetric and gravimetric methods. Volumetric estimation can be done by permanganometry or complexometry. In permanganometry, calcium is precipitated in basic medium as calcium oxalate, dissolved in hot H_2SO_4 and the oxalic acid formed is titrated against standard $KMnO_4$ solution[4].

$$CaCl_2 + (NH_4)_2C_2O_4 \rightarrow CaC_2O_4 + 2\ NH_4Cl$$

$$CaC_2O_4 + H_2SO_4 \rightarrow H_2C_2O_4 + CaSO_4$$

$$2KMnO_4 + 3\ H_2SO_4 + 5\ H_2C_2O_4 \rightarrow K_2SO_4 + 2\ MnSO_4 + 10\ CO_2 + 8\ H_2O$$

In complexometry, calcium is estimated by titrating against standard EDTA solution using murexide (ammonium purpurate) as the indicator. The metal-indicator complex, being less stable, is converted to more stable metal-EDTA complex during titration.

In gravimetry, the precipitated calcium oxalate is ignited in a previously weighed silica crucible and is estimated[4] as $CaCO_3$.

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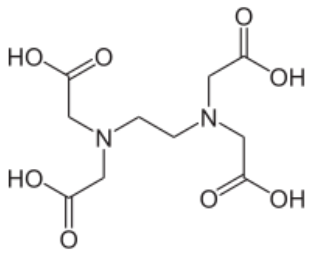
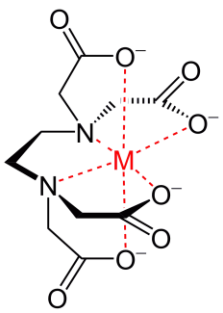
$$CaCl_2 + (NH_4)_2C_2O_4 \rightarrow CaC_2O_4 + 2\ NH_4Cl$$

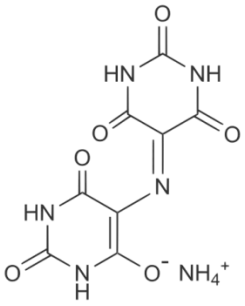
$$CaC_2O_4 \rightarrow CaCO_3 + CO$$



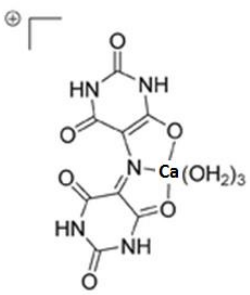
Structure of EDTA



Structure of Metal-EDTA complex



Structure of Murexide



Structure of Metal-indicator complex

DETERMINATION OF CALCIUM CONTENT IN MILK

Weigh accurately a definite amount of milk samples using an electronic balance. Transfer it into a 100 mL beaker and dissolved in minimum amount of conc. HCl. The solution is strongly heated to convert the calcium into soluble $CaCl_2$. It is then quantitatively transferred into a 100 mL standard flask and make up to the mark. Shake the solution for uniform concentration. Pipette out a definite volume (depending on the amount of calcium content) into a 250 ml conical flask, add NaOH pellets until the solution become alkaline (confirmed by using a P^H paper), add about 50 mg of murexide indicator and titrated against the standard EDTA solution from the burette till the colour changes from red to purple. Titrations are repeated till concordant values are obtained. From the titre values, amount of calcium in the various milk samples can be calculated[4-6] (Table 1).

MILK SAMPLES

Buffalo Milk

Cow Milk

Goat Milk

Milma Milk

Good Life Milk

PDDP Milk

Table 1: Calcium content in different milk samples

Sl. No.	*Name of milk*	*Weight of the milk (g)*	*% of calcium*	
			Experimental	*Theoretical*
1	Cow milk	20.1630	0.1140	0.120
2	Goat milk	20.3216	0.0788	0.134
3	Buffalo milk	20.4887	0.1730	0.180
4	PDDP milk	20.4412	0.0790	0.104
5	Good life milk	20.4743	0.0995	0.126
6	Milma milk	20.3066	0.1272	0.150

Milk is one among the calcium rich food item. We examined the milk of different animals (cow, buffalo and goat), as well as the milk samples of different companies. Out of three milk samples of different animals studied, buffalo milk contains high calcium content

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and goat milk contains the least. Discrepancy between theoretical and experimental value is less in cow milk and more in goat milk. Out of the three different brands of milk samples studied, Milma milk is with most calcium content and PDDP milk with the least. Discrepancy between theoretical and experimental value is less in milma milk and more in good life milk (**Figure 1**).

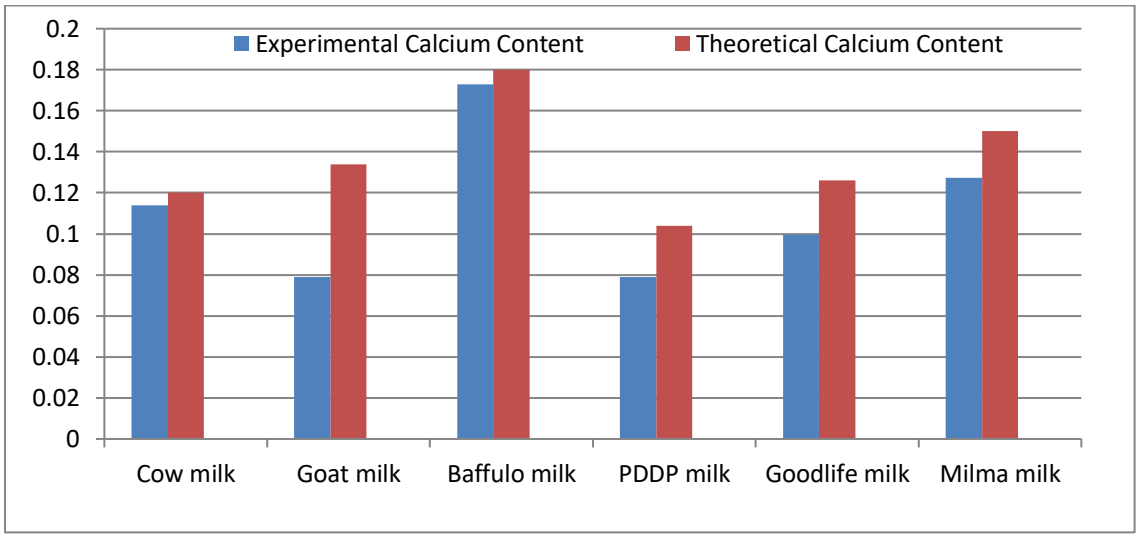

Figure 1: Comparison between theoretical and experimental calcium content in milk samples

The amount of calcium that is completely assimilable by human body is a big concern yet to be studied.

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