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**A CASE STUDY**

# Determination of macro and micro nutrients and nutritional profile of vegetables

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Vegetables included in daily schedule of diet *viz.*, sweet pepper, cauliflower, carrot, cabbage, lettuce, spinach, tomato, potato, reddish, and bottle gourd are good for human health. Vegetables intake is beneficial for obese as they furnish fat to a lesser extent. The determination of nutrient analysis (total protein, fat, carbohydrate, ash, energy value and moisture content) of vegetables is important to plan the diet for various therapeutic purposes. Macro nutrients *viz.*, calcium (Ca), magnesium (Mg), potassium (K), sodium (Na), and phosphorus (P) and micro nutrients *viz.*, iron (Fe), zinc (Zn), manganese (Mn), copper (Cu), nickel (Ni) and selenium (Se) elements have importance for the several purposes like formation of blood, bones and teeth even other tissues, osmoregulation of body fluids, control of physico-chemical process etc. This paper elaborates the various methods used to determine the nutrient profile and mineral analysis of vegetables in detail.

**Key words :** Vegetables, Human health, Nutrient profile, Minerals

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## INTRODUCTION

Increasing population of the world has doubled the food demands and inundated the available land resources. Alongside other food alternatives, vegetables are considered cheap source of energy (Alertor *et al.*, 2002). Vegetables are the fresh and edible portions of herbaceous plants. They are important food and highly beneficial for the maintenance of health and prevention of diseases. They contain valuable food ingredients which can be successfully utilized to build up and repair the body (Hussain *et al*., 2009). Vegetables are valuable in maintaining alkaline reserve of the body and are rich sources of essential nutrients such as carbohydrates, carotene, protein, vitamins, calcium, iron, ascorbic acid and palpable concentration of trace minerals (Salunkhe and Kadam, 1995). These vegetables will continue to remain a basic source of energy for developing countries. More cheaper and qualitative food alternatives have been stressed and recognized by many stakeholders from national's governments to international agencies like Food and Agricultural Organization (FAO, 1993; Tiaga *et al*., 2008 and Khan *et al*., 2003).

Vegetables contribute minerals, vitamins and fibre to the diet. Minerals are naturally occurring inorganic substances with a definite chemical composition and an ordered atomic arrangement (Donoghue, 1990). Minerals are very important and essential ingredients of diet required for normal metabolic activities of body tissues. Out of 92 naturally occurring minerals 25 are present in living organisms. They are constituent of bones, teeth, blood, muscles, hair and nerve cells. Vitamins cannot be properly assimilated without the correct balance of minerals (Sonni Alveez, 2002). Among the plants, vegetables are the excellent sources of minerals and

contribute to the RDA of these essential nutrients.

Carbohydrates, fats and proteins are the essential nutrients of life. The quality and quantity of proteins in the seeds are basic factors and important for the selection of plants for nutritive value, systematic classification and plant improvement programs (Nisar *et al.*, 2009). Besides these nutrients, the moisture, fibre, ash contents and the energy values of individual vegetable and plant species have also been regarded important to the human health and the soil quality (Hussain *et al.*, 2010). Nutrient analysis of edible fruits and vegetables plays a crucial role in assessing their nutritional significance. The considerable use of vegetable species by the local people in their diet as well as the presence of underutilized vegetables motivated us to carry out the nutrient analysis. Some of these vegetables have medicinal importance and also make a valuable addition to the diet.

## RESEARCH METHODOLOGY

**Plant collection:**

The vegetable species were collected randomly. The woody part and dirt were removed from the vegetables prior to analysis and a composite sample analyzed for nutrient analysis and minerals. Three replications of each of these samples were analyzed for their proximate composition and mineral contents to evaluate their nutritive value in human food.

**Sample treatment :**

The samples were manually washed with distilled water and residual moisture evaporated at room temperature. These were oven dried in paper envelope at 55ºC for 24 hours and ground into fine powder using pestle and mortar and sieved through 20-mesh sieve (Abuye *et al.*, 2003). The dried powdered samples were used for the analyses. For moisture content determination, however, fresh samples were used.

**Nutritional analysis**:

***Determination of moisture content:***

Method: Dry the empty dish and lid in the oven at 105ºC for 3h and transfer to desiccators to cool. Weigh the empty dish and lid. Weigh about 3g of sample to the dish and spread the sample uniformly. Place the dish with sample in the oven and dry for 3h at 105ºC.After drying, transfer the dish with partially covered lid to the desiccators to cool. Reweigh the dish and its dried sample (AOAC, 2000).

Calculation

$$\text{Moisture (\%)} = \frac{W\ 1 - W_2}{W_1} \times 100$$

$W_1$ = Weight (g) of sample before drying

$W_2$ = Weight (g) of sample after drying

***Determination of ash content:***

Method: Place the crucible and lid in the furnace at 550ºC overnight to ensure that impurities on the surface of crucible are burned off. Then cool the crucible in the dessicator for 30 minutes. Weigh the crucible and lid to 3 decimal places. Weigh 5g sample into the crucible and heat over low bunsen flame keeping them half covered. When fumes are no longer produced, place crucible and lid in furnace. Heat at 550ºC overnight. During heating, do not cover the lid. Place the lid after complete heating to prevent loss of fluffy ash. Then cool down in the dessicator. Weigh the ash with crucible and lid when the sample turns to gray. If not, return the crucible and lid to the furnace for the further ashing

Calculation:

$$\text{Ash (\%)} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100$$

This ash can be reserved for conducting mineral analysis of sample using AAS.

**Determination of crude fibre content:**

The crude fibre content was determined using the acid-base method. Two gram of powdered sample was poured into measured sinister digesting thimbles of a tecator filler equipment. The thimbles were hooded after measuring the samples. Already boiled 30 ml HCl solution was introduced into each of the thimbles through a funnel and allowed to digest for 30 min. Later 30 ml NaOH solution was introduced into each thimble and again allowed to digest for 30 min. The thimbles were washed with hot boiling distilled water. The thimbles were then removed from the hood and take into the oven maintained at 100°C to dry before cooling in the desiccators. The thimbles were re-weighed and the difference between the final weight and the initial weight of the used thimbles was determined.

**Determination of protein content:**

Method: Place 0.5-1.0g sample in digestion flask and add 5 g of Kjedahl catalyst and 200ml of conc.

$H_2SO_4$. Prepare a tube containing the above chemical except sample as blank. Place flasks in inclined position and heat gently unit frothing ceases. Boil briskly until solution clears. Then cool and add 60 ml of distilled water cautiously. Immediately connect flask to digestion bulb on condenser and with tip of condenser immersed in standard acid and 5-7 drops of mix indicator in receiver. Rotate flask to mix content thoroughly; then heat until all $NH_3$ is distilled. Remove receiver, wash tip of condenser and titrate excess standard acid distilled with standard NaOH solution.

Calculation:

$$\text{Protein (\%)} = \frac{\text{(A - B) x N x 1.4007 x 6.25}}{\text{W}}$$

A = volume (ml) of 0.2 N HCl used sample titration
B = volume (ml) of 0.2 N HCl used in blank titration
N = normality of HCl
W = weight 9g) of sample
14.007 = atomic weight of nitrogen
6.25 = the protein- nitrogen conversion factor

**Determination of fat content:**

The fat content of the samples was done using Soxhlet type of the direct solvent extraction method.

Method: Place the bottle and lid in the incubator at 105ºC overnight to ensure that weight of bottle is stable. Weigh about 3-5 g of sample to filter paper and wrap. Then take the sample into extraction thimble and transfer into soxhlet. Fill petroleum ether about 250 ml into the bottle and take it on the heating mantle. Connect the soxhlet apparatus and turn on the water to cool them and then switch on the heating mantle. Heat the sample about 14h (heat rate of 150 drop/min). Then evaporate the solvent by using the vacuum condenser. Incubate the bottle at 80 - 90ºC until solvent is completely evaporated and bottle is completely dry. After drying, transfer the bottle with partially covered lid to the dessicator to cool. Reweigh the bottle and its dried content (AOAC, 2000).

Calculation :

$$\text{Fat (\%)} = \frac{\text{Weight of fat}}{\text{Weight of sample}} \text{ x 100}$$

The energy values (kcal/100 g) were determined by multiplying the values of carbohydrates, lipids and proteins by a factor of 4, 9, and 4 respectively, and taking the sum expressed in kilocalories (Okwu and Morah, 2004) .The total carbohydrates were determined by difference method [100 - (proteins + fats + moisture + ash in percentage)]. All the proximate values were reported in percentage.

**Mineral analysis:**

Accurately weighed sample (3 g) in a crucible was subjected to ashing in furnace for 4 hour at 550 ºC. After cooling in desiccator, 2.5 ml of 6N $HNO_3$ was added to the crucible. The solution was filtered and diluted up to 100 ml with distilled water. The solution was analyzed for Ca, Mg, Na, K, P, Fe, Cu, Zn, Ni, Mn, and Se by using Atomic Absorption Spectrophotometer (AAS-Perkin Elmer, Model analyst 700). The results were obtained while using a working standard of 1000 ppm for each of the element (Khan *et al.*, 2008).

## RESEARCH FINDINGS AND ANALYSIS

Vegetables are good sources of fibre which lowers the body cholesterol level, consequently decrease the risk of cardiovascular diseases. It is required that vegetables should be used frequently as they are good for heath and provides all the essential nutrients for normal body functions when consumed in appropriate combination. The high crude protein contents of these vegetables may encourage their uses as high protein sources in some food formulations. It has been reported that protein-calories malnutrition deficiencies is a major factor responsible in nutritional pathology (Roger *et al.*, 2005). Plant food that provide more than 12.0 per cent of its calorific value from protein are considered good source of protein (Pearson, 1976). Minerals are important for vital body functions such as acid base and water balance. Calcium and phosphorus are the minerals present in the largest quantity in the structure of the body and in the bones. Na and K are used as an electron carrier in the body. Fe is an important constituent of Hb. Vegetables contribute these minerals and enhance their availability in daily life. The vegetables were found to be good sources of Ca, Mg, P, Na, K, Ni, Cu, Fe, Zn and Mn. These vegetables considered as sole source of macro and micro elements and can be used as one of the potential sources of the elements in the diet. The positive impact of zinc supplementation on the growth of some stunted children, and on the prevalence of selected childhood diseases such as diarrhoea, suggests that zinc deficiency is likely to be a significant public health problem, especially in developing countries (Osendarp and Black, 2003). According to FAO's food balance data, it has been

calculated that about 20 per cent of the world's population could be at risk of zinc deficiency. The average daily intake is less than 70 μg per day (Holt and Brown, 2004). Biologically, nickel also plays a key role in plants. As a matter of fact urease (an enzyme whish assist in the hydrolysis of urea) contains nickel. Other nickel containing enzymes include a class of superoxide dismutase (Sezilagyi *et al*., 2004). These nickel containing enzymes play integral role in human biological system. Dairy products supply 50-80 per cent of dietary calcium in most industrialized countries, while foods of plant origin supply about 25 per cent.

**Conclusion:**

The vegetables have the potential to provide sufficient amount of nutrients needed for normal body function, maintenance and reproduction. They were envisaged as a good source of fibre, fats, carbohydrates and energy values, hence, capable of providing energy to the consumer. Vegetables are poor source of fat that make them good food for obese people. They are good source of fibre and can decrease the concentration of high cholesterol level in body. The vegetables intake in different combination is essential for the maintenance of healthy life and normal body functioning.

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