Role of Horticulture in Human Nutrition: An Analytical Review

Chitrasena Padhy 1, Simadri Behera 2
1. Assistant Professor, M S Swaminathan School of Agriculture, Centuion University of technology and Management, Paralakhemundi, Dist: Gajapati, Odisha.
2. Retd. Agriculture Officer, Govt. of Odisha, Paralakhemundi, Dist: Gajapati, Odisha

ABSTRACT:
Vegetables play an important role in human nutrition. Fruit and vegetables are packed full of goodness and often contain a number of essential vitamins and minerals that cannot be found in other types of foods or they may contain higher levels of these nutrients than other foods. Vegetables and fruit provide a significant part of human nutrition, as they are important sources of nutrients, dietary fiber, and phytochemicals. A diet rich in vegetables and fruits can lower blood pressure, reduce risk of heart disease and stroke, prevent some types of cancer, lower risk of eye and digestive problems, and have a positive effect upon blood sugar which can help keep appetite in check. The higher the average daily intake of fruits and vegetables, the lower the chances of developing cardiovascular diseases. Fruits and vegetables contain indigestible fiber, which absorbs water and expands as it passes through the digestive system. This can calm symptoms of an irritable bowel and, by triggering regular bowel movements, can relieve or prevent constipation. Eating fruits and vegetables can also keep eyes healthy, and may help prevent two common aging-related eye diseases—cataracts and macular degeneration. Vegetables and fruit, particularly leafy vegetables, have been implicated in nearly half the gastrointestinal infections caused by norovirus. These foods are commonly eaten raw and may become contaminated during their preparation by an infected food handler. Hygiene is important when handling foods to be eaten raw, and such products need to be properly cleaned, handled and stored to limit contamination.

Introduction:
Fruits, nuts, and vegetables play a significant role in human nutrition, especially as sources of vitamins (C, A, B6, thiamine, niacin, E), minerals, and dietary fiber (Quebedeaux and Bliss, 1988; Quebedeaux and Eisa, 1990; Wargovich, 2000). Their contribution as a group is estimated at 91% of vitamin C, 48% of vitamin A, 27% of vitamin B6, 17% of thia-mine, and 15% of niacin in the U.S. diet. Fruits and vegetables also supply 16% of magnesium, 19% of iron, and 9% of the calories. Legume vegetables, potatoes, and tree nuts (such as almond, filbert, pecan, pistachio, and walnut) contribute about 5% of the per capita availability of proteins in the U.S. diet, and their proteins are of high quality as to their content of essential amino acids. Nuts are a good source of essential fatty acids, fiber, vitamin E, and minerals. Other important nutrients supplied by fruits and vegetables include folacin, riboflavin, zinc, calcium, potassium, and phosphorus. Several reports have shown that adequate intake of fruits and vegetables form an important part of a healthy diet and low fruit and vegetable intake constitute a risk factor for chronic diseases such as cancer, coronary heart disease (CHD), stroke and cataract formation (VanDuyn & Pivonka, 2000). Scientific evidence indicates that frequent consumption of fruits and vegetables can prevent oesophageal, stomach, pancreatic, bladder and cervical cancers and that a diet high in fruits and vegetables could prevent 20% of most types of cancers (Crawford et al., 1994).

Nutrition is most absolutely necessary for normal body functions. We obtain this nutrition through chemicals found in food. Just like your body, food is a combination of chemicals, some of which are essential for normal body functions. These essential chemicals are called nutrients. A nutrient is defined as a chemical whose absence from diet for a long enough time results in a clearly defined
change in health. We need nutrients for normal body growth and development, for managing cells and tissues, for fuel to do physical and metabolic processes. Foods provide six major classes of nutrients viz., carbohydrates, lipids, proteins, minerals, vitamins and water. The first five are called essential nutrients. Carbohydrates, protein and fats are called macronutrients because our bodies need large quantities of them. Our body requires comparatively small amounts of vitamins and minerals, so they are called micronutrients. Aside from nutrients, there are many other chemical substances, but they do not fit the classical definition of a nutrient. These include dietary fiber, enzymes and phytochemicals. The latest development in the field of nutrition is research on phytochemicals (plant chemicals), popularly called as antioxidants. They are abundantly found in fruits and vegetables and play a vital role in reducing the risk of many chronic diseases including cardiovascular, cancer, and diabetes, macular and neurological degeneration.

Fruits and vegetables as sources of vitamins, minerals and antioxidants:
Fruits and vegetables play an important role in human nutrition and health, particularly as sources of vitamin C, thiamine, niacin, pyridoxine, folic acid, minerals and dietary fibre (Wargovich, 2000). In the USA, the consumption of fruits and vegetables as a group is known to contribute to an estimated intake of 91% of vitamin C, 48% of vitamin A, 30% of folate, 27% of vitamin B6, 17% of thiamine and 15% of niacin. It is also known that fruit and vegetable intake supply 16% of magnesium, 19% of iron and 9% of the calories (United States Department of Agriculture, 2000). Other vital nutrients supplied by fruits and vegetables include riboflavin, zinc, calcium, potassium and phosphorus. Some components of fruits and vegetables (phytochemicals) are strong antioxidants and modify the metabolic activation and detoxification/disposition of carcinogens and may even influence processes that may change the course of the tumor cell (Wargovich, 2000). Although antioxidant capacity varies greatly among fruits and vegetables (Kalt, 2002), it is better to consume a variety of them rather than limiting consumption to a few with the highest antioxidant capacity. The United States Department of Agriculture (2000) encourages consumers to take at least two servings of fruits and at least three servings of vegetables per day, choose fresh, frozen, dried or canned forms of a variety of colours, kinds and choose dark-green leafy vegetables, orange fruits, vegetables and cooked dry beans and peas regularly. However, in some countries, consumers are encouraged to eat at least 10 servings of fruits and vegetables per day. There is evidence that consumption of whole foods is better than isolated food components such as dietary supplements and nutraceuticals. For instance, previous reports (Souton, 2000; Seifried et al. 2003) showed that increased consumption of carotenoid-rich fruits and vegetables offer a better protective effect than carotenoid dietary supplements by increasing LDL-oxidation resistance, lowering DNA damage and inducing higher repair activity in human volunteers who participated in a study conducted in European countries such as Italy and Spain. High consumption of tomatoes and tomato products have been associated with reduced carcinogenesis, especially of prostate cancer and is thought to be due to the presence of lycopene, which gives red tomatoes their colour (Giovannucci, 2002).Boileau et al. (2003) observed that the use of tomato powder significantly reduced prostate carcinogenesis in rats. Examples of fruits and vegetables recommended for daily consumption include spinach, orange, mango, carrot, melon, pineapples red grapefruit etc.

Importance of Fruit and vegetable in Human health and disease prevention:
Fruit and vegetable intake has been shown to have positive effects in terms of weight management and obesity prevention (Tohill et al ., 2004).Duncan et al. (1983) conducted a study using a diet rich in fruits and vegetables and low in fats versus a diet which was higher in fats but lower in fruits and
vegetables. Several cohort studies have examined the relationship between fruit and vegetable intake and coronary heart disease. These studies reported an inverse relationship between intake of fibre from fruits and vegetables and the risk of developing coronary heart disease. Meta-analyses of previous studies showed an inverse association between fruit and vegetable consumption and the occurrence of stroke which supports the concept that fruit and vegetable consumption has the potential to protect against cardiovascular events (Daucher et al., 2005; He et al., 2006). Daucher and co-workers (2006) carried out a meta-analyses of cohort studies and observed that the risk of developing coronary heart disease decreased by 4% for each additional portion per day intake of fruit and vegetables and by 7% for fruit consumption, indicating that fruit offer a more protective effect in reducing the risk of developing coronary heart disease (CHD). It has been observed that clinical and biological investigations support the protective effect offered by the intake of fruit and vegetables against coronary heart disease. Interestingly, the relationship is biologically valid with many clinical and laboratory data showing that the micro- and macro-constituents of fruit and vegetables improve important risk factors of CHD such as hypertension, dyslipidaemia and diabetes (Appelet al., 1997; Van Duyn et al., 2000; Bazzano et al., 2003. Ness and Powles (1997) reviewed evidence about fruit and vegetable intake and the development of coronary heart disease and found a significant inverse association between the amount of fruits and vegetables consumed and the incidence of coronary heart disease. Alonso et al. (2004) also reported a similar association between fruit and vegetable consumption and decreased blood pressure. High blood pressure increases the risk of heart disease and stroke (Chobanian et al., 2003). Adding more fruits and vegetables to a healthy diet is one possible pathway to reduce blood pressure. In the Dietary Approaches to Stop Hypertension (DASH) study ( Appelet al., 1997), 459 people with and without high blood pressure were randomly assigned to one of three diets: a) a typical American diet that provided about 3 servings per day of fruits and vegetables and one serving per day of a low-fat dairy product, b) a fruit and vegetable diet that provided 8 servings per day of fruits and vegetables and one serving per day of a low-fat dairy product or c) a combination diet (called the DASH diet) that provided 9 servings per day of fruits and vegetables and 3 servings per day of low-fat dairy products. After 8 weeks, the blood pressures of those on the fruit and vegetable diet were significantly lower than those on the typical American diet. The incidence of cataracts has been reported to be related to oxidative damage of proteins in the eye’s lens which is induced by long-term exposure to ultraviolet light. The cloudiness and discoloration of the lens resulting from such exposure have been known to lead to vision loss that becomes more severe with age. The results of various prospective cohort studies tend to suggest that diets rich in fruits and vegetables, particularly carotenoid and vitamin C-rich fruits and vegetables are associated with decreased incidence and severity of cataracts (Brown et al., 1999; Jacques et al., 2001; Christen et al., 2005). High intakes of broccoli and spinach have been reported to be associated to reduced cataracts among USA males (Brown et al., 1999).

**Functions of Foods:**
Do you “eat to live” or “live to eat”. For most of us the first is certainly true, you must eat to live. But there may be times that it is enjoyment that is more important than nourishment. Factors such as age, sex, genetic makeup, occupation, lifestyle, family, and cultural background affect our daily food choices. We use food to express friendship, bond, relationship, creativity, and demonstrate feelings through gifts. Preference for food begins early and is mainly determined by age. Young children prefer sweet or familiar foods; babies and toddlers are generally willing to try new things. Teenagers
are strongly influenced by preferences and habits of their peers. Let us see what these factors are and examine them closely with functions of food.

(i) **Food satisfies hunger**: Hunger is a symptom indicating that the body’s need for energy is not being met. Hunger is characterized by physical weakness, intermittent sensation of tension in the abdominal region (hunger pangs) and a driving urge to find food. When the person is under starvation, the body itself is used as source of energy and stored carbohydrate, fat reserves and proteins are all used for fulfilling the energy demand.

(ii) **Food satisfies social needs**: Social factors exert a powerful influence on food choice. Eating is also a social event that brings together different people for a variety of reasons (e.g. religious or cultural celebrations, business meetings and family dinners). Foods may also help one to achieve status, especially in these days, where eating out habits have more common, inviting your friends, relatives and boss to dine for a party are all instruments to develop social rapport. Serving foods at social events – banquets, dinners, award functions, parties and meetings have all become important status symbols in modern times.

(iii) **Cultural and religious needs**: Like social needs cultural and religious factors also influence food choices. In many cultures, food has symbolic meaning related to family traditions, social status, and health. In certain cultures, use of spices and herb teas for purposes ranging from allaying anxiety to preventing cancer and heart diseases are very popular. Foods also form an important part of religious rites, symbols and customs as well as daily activities that are intended to promote an orderly relationship with supernatural forces.

(iv) **Food builds body tissues and regulates body processes**: Nutrients are required for the general growth of the body. Proteins are required for building tissues. Calcium and phosphorus are involved in the development of skeleton and teeth. Fat and lipids are required for body building processes.

(v) **Foods are protective in function**: Fruits and vegetables are called as functional foods because apart from nutrients, which are required to fulfill body’s physiological needs, they also contain antioxidants, which protect the body against diseases such as cancer and cardiovascular diseases. Common antioxidants found in fruits and vegetables are ascorbic acid, β-carotene, phenolics and flavonoids.

(vi) **Food supplies energy**: One of the main reasons we eat foods and nutrients it contains, is for energy. Every cellular reaction, every muscle movement every nerve impulse requires energy. Three of the nutrient classes, carbohydrate, fat and proteins are sources of energy. These nutrients can be broken down completely (metabolized) to yield energy in a form that cells can use. The commonly used standard for measurement of energy value of substances is calorie.

**Fruits and Vegetables**

Eat your fruits and vegetables" is one of the tried and true recommendations for a healthy diet. Eating plenty of fruits and vegetables can help you ward off heart disease and stroke, control blood pressure and cholesterol, prevent some types of cancer, avoid a painful intestinal ailment called diverticulitis, and guard against cataract and macular degeneration, two common causes of vision loss. National Cancer Institute (NCI), has sponsored a “5 A Day for Better Health” program to encourage public to include more fruits and vegetables in their diet. Fruits and vegetables contain wealth of nutrient and non-nutrient substances called as phytochemicals that contain protective, disease preventing compounds. More than 900 different phytochemicals have been identified as components of food, and many more phytochemicals continue to be discovered today. It is estimated that there may be more than 100 different phytochemicals in just one serving of vegetables. These popularly known as antioxidants can scavenge or mop off the harmful free radicals produced in the
body. Free radicals damage cellular membranes, proteins and DNA and cells and produce a range of diseases in body. Phenols, flavonoids, anthocyanins and carotenoids are some of the important antioxidant found in fruits and vegetables. In this section we will study the nutrient and non-nutrient components of fruits and vegetables.

The edible portion of most types of fruits contains 75-95% of water. Fruits usually are low in calories and with the exception of avocados and olives, contain practically contain no fat. Fruits contain substantial carbohydrates such as fructose, sucrose and starch and are also low in proteins except for tree nuts (walnuts, pecan, pistachio and walnuts). Nutritionally fruits are significant source of vitamin A and C. The vitamin precursor carotene, which is converted in the body to vitamin A, is abundant in mango, papaya, apricots, peaches, cantaloupes and bananas. For vitamin C, citrus fruits guava, papaya, gooseberry and small berry fruits are good sources. Fruits are plentiful in potassium and low in sodium and hence eating fruits helps maintain blood pressure in heart patients. Large amounts of calcium are present in dried fruits and moderate quantities in oranges, raspberries and strawberries. Iron is significant amounts in dates, figs bananas, apricots and raisins. Usually fruits are low in vitamin B, however orange juice is a good source of thiamine and folate. Bananas and watermelon are good source of vitamin B6.

Vegetables are generally good source of mineral substances in comparison to fruits, which are rich in vitamins. In general vegetables are low in calories except soybean, lima beans, cow peas, potato and taro, which are abundant in carbohydrates. They are also low in protein except legumes (peas, beans) and low in fat except soybean.

Vegetables are abundant in vitamin A, ascorbic acid, protein (legumes) and fiber. Carrots, sweet potatoes, green leafy vegetables and tomato are best sources of vitamin A among vegetables. Hot chili peppers, squash, turnip greens and spinach are also good sources.

We have earlier pointed out that besides nutrients, fruits and vegetables are also rich in antioxidants. Recent research has shown phenolics, flavonoids and anthocyanins are among the most potent antioxidants found in fruits and vegetables. Red or purple colour of some fruits and vegetables is due to presence of anthocyanin pigment. Lycopene is a carotenoid pigment found in tomatoes, grapefruit, guava and water melon believed to be protective against heart disease and prostrate cancer. Lutein, a yellow pigment found in marigold petals and green leafy vegetables reduces the risk of age related macular degeneration and cataract. Onions and citrus fruits are good for our bones and reduce the risk of osteoporosis in elderly women.

**Enzymes and Pigments:**

Fruits and vegetables apart from being rich in vitamin and minerals are rich in colour imparting pigments and enzymes. The chief pigments of fruits and vegetables are carotenoids, chlorophyll and anthocyanin. Carotenoids are naturally taking place compounds that give the deep yellow, orange and red colours to fruits and vegetables such as apricots, carrots and tomatoes, orange, capsicum, mango and papaya. Carotenoids also are plentifully found in in dark green vegetables, such as spinach, but the dense chlorophyll marks the carotenoid colours. The major carotenoids found in fruits and vegetables include alpha-carotene, β-carotene, lutein, lycopene and zeaxanthin. The body can convert α-carotene, β-carotene and cryptoxanthin to retinol so they are called pro-vitamin A carotenoids. Lycopene, lutein and zeaxanthin donot have pro-vitamin A activity. Lycopene is the orange- red pigment of tomatoes. Chlorophyll is the green pigment of stem and leaves of plants. Two types of chlorophyll occur in plants, namely Chl a and Chl b in ratio of 3a:1b.
Table 1: Vitamin content in fruits and vegetables

<table>
<thead>
<tr>
<th>Product</th>
<th>Calorific value (cal/100g)</th>
<th>Vitamin A (IU/100g)</th>
<th>Vitamin B (mg/100g)</th>
<th>Vitamin C (mg/100g)</th>
<th>Nicotinic acid (mg/100g)</th>
<th>Riboflavin (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apple</td>
<td>56</td>
<td>-</td>
<td>0.03</td>
<td>2</td>
<td>0.2</td>
<td>0.03</td>
</tr>
<tr>
<td>Aonla</td>
<td>59</td>
<td>-</td>
<td>0.03</td>
<td>700</td>
<td>0.2</td>
<td>0.03</td>
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<tr>
<td>Banana</td>
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<td>-</td>
<td>0.04</td>
<td>19</td>
<td>0.3</td>
<td>0.03</td>
</tr>
<tr>
<td>Guava</td>
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<td>-</td>
<td>0.03</td>
<td>300</td>
<td>0.2</td>
<td>0.03</td>
</tr>
<tr>
<td>Lime</td>
<td>59</td>
<td>26</td>
<td>0.02</td>
<td>63</td>
<td>0.1</td>
<td>0.02</td>
</tr>
<tr>
<td>Mango</td>
<td>50</td>
<td>4800</td>
<td>0.04</td>
<td>24</td>
<td>0.3</td>
<td>0.05</td>
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<tr>
<td>Orange</td>
<td>49</td>
<td>350</td>
<td>0.05</td>
<td>68</td>
<td>0.3</td>
<td>0.06</td>
</tr>
<tr>
<td>Papaya</td>
<td>40</td>
<td>2020</td>
<td>0.04</td>
<td>46</td>
<td>0.2</td>
<td>0.05</td>
</tr>
<tr>
<td>Pear</td>
<td>47</td>
<td>14</td>
<td>0.02</td>
<td>-</td>
<td>0.2</td>
<td>0.03</td>
</tr>
<tr>
<td>Pineapple</td>
<td>50</td>
<td>60</td>
<td>0.03</td>
<td>63</td>
<td>0.2</td>
<td>0.04</td>
</tr>
<tr>
<td>Tomato</td>
<td>21</td>
<td>320</td>
<td>0.04</td>
<td>32</td>
<td>0.4</td>
<td>0.05</td>
</tr>
<tr>
<td>Leafy Vegetables</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cabbage</td>
<td>33</td>
<td>2000</td>
<td>0.06</td>
<td>124</td>
<td>0.4</td>
<td>0.12</td>
</tr>
<tr>
<td>Drum stick</td>
<td>96</td>
<td>11300</td>
<td>0.06</td>
<td>220</td>
<td>0.8</td>
<td>0.12</td>
</tr>
<tr>
<td>Radish leaf</td>
<td>33</td>
<td>6700</td>
<td>0.05</td>
<td>65</td>
<td>0.5</td>
<td>0.12</td>
</tr>
<tr>
<td>Spinach</td>
<td>32</td>
<td>5500</td>
<td>0.05</td>
<td>48</td>
<td>0.5</td>
<td>0.11</td>
</tr>
<tr>
<td>Roots and Tubers</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Carrot</td>
<td>47</td>
<td>2000-4300</td>
<td>0.04</td>
<td>3</td>
<td>0.4</td>
<td>0.02</td>
</tr>
<tr>
<td>Onion</td>
<td>51</td>
<td>-</td>
<td>0.08</td>
<td>11</td>
<td>0.4</td>
<td>0.01</td>
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<tr>
<td>Potato</td>
<td>99</td>
<td>40</td>
<td>0.10</td>
<td>17</td>
<td>1.2</td>
<td>0.01</td>
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<tr>
<td>Radish</td>
<td>21</td>
<td>-</td>
<td>0.06</td>
<td>15</td>
<td>0.4</td>
<td>0.02</td>
</tr>
<tr>
<td>Sweet Potato</td>
<td>159</td>
<td>-</td>
<td>0.05</td>
<td>-</td>
<td>0.3</td>
<td>0.01</td>
</tr>
<tr>
<td>Yam</td>
<td>79</td>
<td>434</td>
<td>0.06</td>
<td>-</td>
<td>0.7</td>
<td>0.08</td>
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<tr>
<td>Other Vegetables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Brinjal</td>
<td>34</td>
<td>5</td>
<td>0.05</td>
<td>23</td>
<td>0.8</td>
<td>0.06</td>
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<tr>
<td>Ash gourd</td>
<td>15</td>
<td>-</td>
<td>0.06</td>
<td>5</td>
<td>0.4</td>
<td>0.01</td>
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<tr>
<td>Cauliflower</td>
<td>39</td>
<td>38</td>
<td>0.10</td>
<td>66</td>
<td>0.9</td>
<td>0.08</td>
</tr>
<tr>
<td>French been</td>
<td>26</td>
<td>221</td>
<td>0.08</td>
<td>14</td>
<td>0.3</td>
<td>0.06</td>
</tr>
<tr>
<td>Cucumber</td>
<td>14</td>
<td>-</td>
<td>0.03</td>
<td>7</td>
<td>0.2</td>
<td>0.02</td>
</tr>
<tr>
<td>Lady Finger</td>
<td>41</td>
<td>58</td>
<td>0.06</td>
<td>16</td>
<td>0.6</td>
<td>0.06</td>
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<td>Pea</td>
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<td>0.25</td>
<td>9</td>
<td>0.8</td>
<td>0.01</td>
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<tr>
<td>Pumpkin</td>
<td>28</td>
<td>84</td>
<td>0.06</td>
<td>2</td>
<td>0.5</td>
<td>0.04</td>
</tr>
<tr>
<td>Snake gourd</td>
<td>22</td>
<td>160</td>
<td>0.04</td>
<td>-</td>
<td>0.3</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Fruits and vegetables also contain certain specialized chemicals called enzymes. These are important in fruits because of the chemical changes that they initiate. Ficin in figs and papain in papaya are the
major proteolytic enzymes. These enzymes can react with proteins of the human skin and cause dermatitis. Phenoloxidases in potatoes, apples, pears, grapes, strawberries, and figs are responsible for the discoloration of cut surfaces when exposed to air. Other enzymes responsible for color changes in fruits and vegetables are chlorophyllases, anthocyanases and peroxidase. Lipoxigenase and lipase are the enzymes linked with off-flavour in frozen peas and beans. Citrus fruits and tomatoes are rich in pectin esterase, and pears and tomatoes in polygalacturonase, both being pectolytic enzymes responsible for softening of fruit texture during ripening.

Processed fruits and vegetables:
Fruits and vegetables are highly decayable in nature because of their high moisture content. They cannot be stored for longer periods and thus there is a need to process them. Processed fruits and vegetables available as canned, frozen, dried and juices are beneficial, are available all year round and have a longer shelf life. It is generally believed that fresh fruits and vegetables are always the most nutritious and processed products are inferior. However this is a misconception and fruits and vegetables if processed within hours of harvesting are equally nutritious and healthier than their raw counterparts. Post harvest handling, storage and processing by canning, dehydration, freezing and fermentation do alter the nutrient composition of fruits and vegetables to some extent. Especially, vitamin C and carotenoids are highly inclined to oxidation and thermal abuse during processing. Losses in nutrients also occur during handling, transportation, storage and retail display; in fact fruits and vegetables, which we consider fresh, reach us after many days after their harvest. However these losses can be minimized if processing takes place immediately after harvest. Canned and frozen fruits and vegetables are good as their fresh counterparts and in some cases even better. Canned produce prepared from freshly harvested produce, maintains majority of the nutrients even though the heating process destroys some vitamins. Similarly frozen vegetables are are equally good as fresh vegetables.

Factors affecting the nutritional qualities:
Climatic conditions, especially temperature and light intensity, have strong effect on the nutritional quality of fruits and vegetables. Soil type, the rootstock used for fruit trees, mulching, irrigation, fertilization, and other cultural practices influence the water and nutrient supply to the plant, which can affect the composition and quality attributes (appearance, texture, taste and aroma) of the harvested plant parts (Goldman et al., 1999). Maturity at harvest and harvesting method influence the commodity’s quality and extent of physical injuries. Delays between harvest and consumption or processing can result in losses of flavor and nutritional quality. The magnitude of these losses increases with exposure to temperatures, relative humidities, and/or concentrations of oxygen, carbon dioxide, and ethylene outside the ranges that are optimum for each commodity during the entire post harvest handling system (Lee and Kader, 2000). Climatic conditions such as temperature and light intensity have been shown to have a strong effect on the nutritional quality of fruits and vegetables (Mozafar, 1994). Low temperature is believed to favour synthesis of sugar and vitamin C while short duration decreases the rate of ascorbic acid oxidation. Maximum beta-carotene content in tomatoes occurs at a temperature range of 15 to 21 o C but beta-carotene content is reduced if temperatures are higher or lower than this range, mainly due to the temperature sensitivity of lycopene, the precursor to beta-carotene and lutein. The B vitamins are crop specific with reference to temperature sensitivity. Warm season crops (beans, tomatoes, peppers, melons)produce more B vitamins at high (27 to 30 degree C) versus low (10 to 15 o C) temperatures. In contrast, cool season crops such as broccoli,cabbage, spinach, peas produce more B
vitamins at low versus high temperature. It has been reported that light intensity has little effect on the B vitamins but as light intensity increases, vitamin C increases and total carotenoids and chlorophyll decrease (Gross, 1991).

**CONCLUSION:**
There is increasing confirmation that consumption of whole foods is better than isolated food components. For example, increased consumption of carotenoid rich fruits and vegetables was more fruitful than carotenoid supplements in increasing LDL oxidation resistance, lowering DNA damage, and inducing higher repair activity in human volunteers who participated in a study conducted in France, Italy, Netherlands and Spain (Southon, 2000). Similar comparative studies are needed on other constituents of fruits and vegetables and on the bioavailability of nutrients taken as dietary supplements or as foods that contain these nutrients.

Regular eating of a vegetable rich diet has positive effects on health since phytonutriceuticals of vegetables can provide safety to the human body from several types of chronic diseases. The process by which vegetables decrease risk of disease is complex and largely unknown. Various elements of the whole food are likely to contribute to the overall health benefit. Various phytonutriceuticals having antioxidant properties may work directly by quenching free radicals or indirectly by participating in cell signaling pathways sensitive to redox balance. Nutrients such as potassium contribute to blood pressure regulation. The dietary fiber content and type of different vegetables may also contribute to the overall health benefit, such as improving bowel transit, lowering cholesterol, helping manage blood glucose concentrations, and by transporting a sufficiently great amount of minerals and phytochemicals linked to the fibre matrix through the human gut. Finally, increasing vegetables in the diet may lessen the intake of saturated fats, trans fats, and foods with higher caloric density, all of which may be related to a healthier overall diet.

For an adequate supply of vitamins, minerals and other compounds from fruits and vegetables, it is important to buy fresh fruits and vegetables without bruises, soft spots, mold, decay or broken skins. It is very important to clean with water all fruits and vegetables before cutting and is also advisable to store fruit and vegetables in the refrigerator but once cut or sliced, fruits and vegetables should be placed in a refrigerator in tightly fastened plastic bags and consumed within two to three days. There is a need for more controlled, clinical intervention trials in order to confirm findings that approve the view that consumption of fruits and vegetables promotes health and reduces the risk of developing chronic diseases. Accurate checking of dietary intake remains difficult and cost-efficient methods for estimating fruit and vegetable intake are needed to be able to confirm the relationship between fruit and vegetable consumption. Although research evidence supports the collaboration between fruit and vegetable consumption and decreased incidence and mortality of chronic diseases such as obesity, different cancers and cardiovascular diseases, disagreements still exist in the science community with reference to their association, therefore further studies with large population groups over long periods of time is recommended.

**References**


