NCDS : ROLE OF DIETARY ANTIOXIDANTS IN PREVENTION AND MANAGEMENT

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Abstract

Non-communicable disease continues to be an important public health problem in India, being responsible for a major proportion of mortality and morbidity. Demographic changes, lifestyle modifications, increasing urbanization, lack of physical activity besides these environmental factors certain other factors contribute in development of oxidative stress like inflammation, stress, accumulation of toxins and immune down regulation thus pushing us towards non-communicable diseases. A variety of free radical scavenging antioxidants are present in dietary sources like green leafy vegetables, fruits etc, their consumption provides antioxidants to the body which act as inhibitors in the process of free radical generation. The main strategies are proposed to deal with the problem estimate need and advocate for action, develop national policies, strategies and plans for the prevention and care .

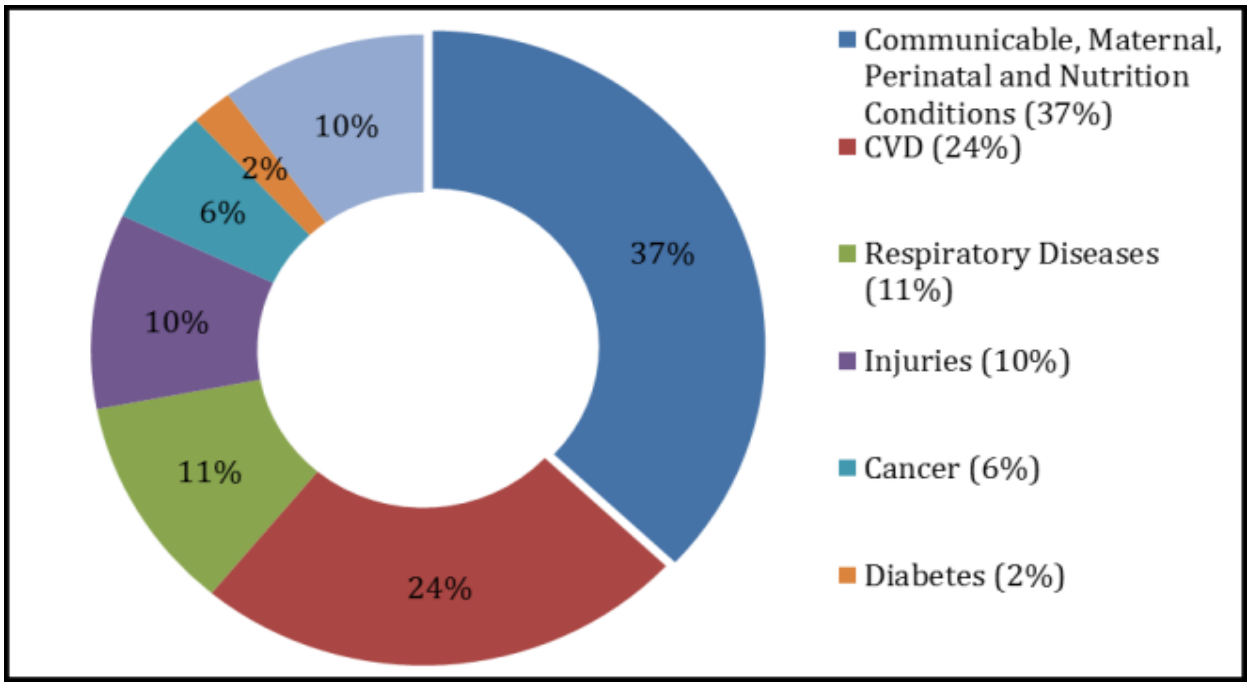
Introduction

Non-communicable diseases (NCDs) are the number one cause of death and disability in the world. The term NCDs refers to a group of conditions that are not caused by an acute infection, result in long-term health consequences and often create a need for long-term treatment and care. These conditions include cancers, cardiovascular disease, diabetes and chronic lung illnesses. Many other important conditions are also considered NCDs, including injuries and mental health disorders In Last few years we have witnessed major heath transitions propelled by socioeconomic and technological changes that profoundly altered life expectancy and ways of living. The most common pervasive change of these health transitions are the rising burden of non communicable diseases (NCDs). It is accelerating in mostdeveloping countries(Reddy and Katan 2004).

According to NFHS (2003) NCDs are responsible for 32% of all deaths in the country, out of which CVD constituted 13%, injuries8.7%, chronic respiratory disease 6.7%, cancer 3.4% and diabetes 0.2%. the prevalence of hypertension ranges from 10-15% amongst the adult population in urban areas 3-8% in rural areas ranges from 10-15% amongst the adult population in urban areas 3-8% in rural areas.

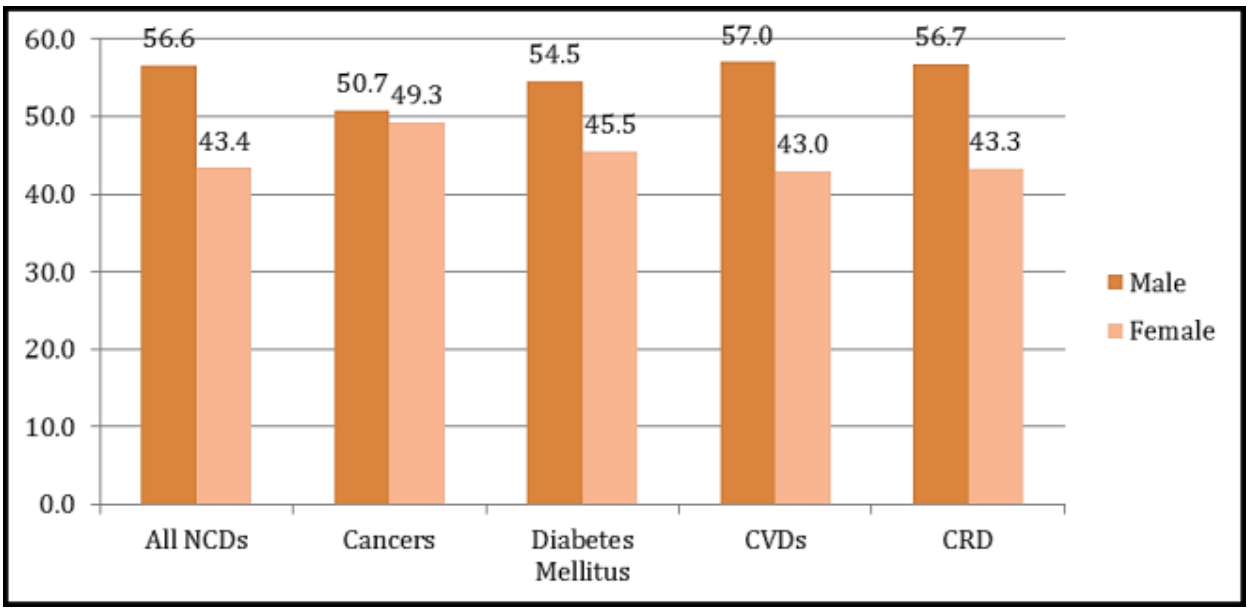
According to the recent statistics on NCDs shown in graph 1, 53 percent of the 24 percent of all deaths. Chronic respiratory diseases (CRDs), cancers and diabetes accounted for 11, 6 and 2 percent of all

deaths, respectively (Sharma 2012).



Source: Non-communicable Diseases Country Profile 2011, World Health Organization (W HO)

Figure 2 shows the gender-wise percentage distribution of deaths due to NCDs in India and findings shows that deaths due to NCDs are more in males as compared to females. According to WHO, only 35 percent of the deaths in India due to NCDs, occurred in the younger age group (under age 60).(Sharma 2012)



Source Global Health Observatory, World Health Organization 2011

Risk factors of NCDs

Public Health Experts predicted a global epidemic of Non Communicable Disease on the basis of current trends. Various behavioral risk factors like smoking, unhealthy diet, stress at home and work place, consumption of alcohol, sedentary lifestyle etc. are known to be the risk factors for various chronic diseases. The National Sample Survey Organization, 2012 reports that prevalence rates of tobacco use in urban and rural areas among male is 43% and64.4% respectively. Consumption of tobacco in females is also prevalent both in rural and urban areas i.e. 15% and 7%. Therefore the risk factor associated with the use of tobacco can lead to the development of ischemic heart disease(15%), myocardial infarction (48%) and stroke cases (22%). According to NFHS 3- 35% of every married males reports consumption of alcohol in India. Alcohol consumption is much higher in slum areas of Meerut, Indore, Mumbai , Nagpur and Chennai. Besides this physical inactivity is another important cause leading to death of approximately 3.2 million people each year. People who are insufficiently physically active have a 20% to 30% increased risk of various types of NCDs. The National Nutrition Monitoring Board (NNMB), data for adults also shows that obesity is identified as a leading cause of NCDs. It also highlighted that the prevalence of overweight and obesity is found to be highest in middle income countries as compared to low income countries. At least 2.8 million people die each year as a result of being overweight and obese. Unhealthy diet is also potent cause of increasing high mortality rates worldwide. Most populations consume much higher levels of salt than recommended by WHO which is an important determinant of high blood pressure and cardiovascular risk. Hypertension is estimated to cause 7.5 million deaths, about 12.8% of all deaths and it is a major risk factor for cardiovascular disease. Raised cholesterol is estimated to cause 2.6 million deaths annually and also increases the risk of heart disease, stroke and cancers. (WHO 2008).

Economic implications of NCDs

Non communicable disease affect adults in their productive years, require costly long term treatment and care. Therefore people have greater socio economic impact than other health conditions. Increased NCD levels can: can reduce labour supply and outputs, increase costs to the employers (from absenteeism and higher health care coverage costs), lower returns on human capital investment, reduced domestic consumption and lower tax revenue as well as increased public health social welfare expenditures. Several researches were undertaken to qualify the economic impact.According to World Bank Report (2011) Economic implications of NCDs result in the share of out pocket health expenditure increase 32% to 47% between 1995-96 and 2004. According to the Shobhana et al (2000) the out of pocket spending by a sample of about 600 diabetic in patients in Chennai during hospitalization was about rupees 5,300. Diabetic with the longer history (> 5 years) spent 70 % more during their hospitalization as compared to those with a recent history of diabetes.

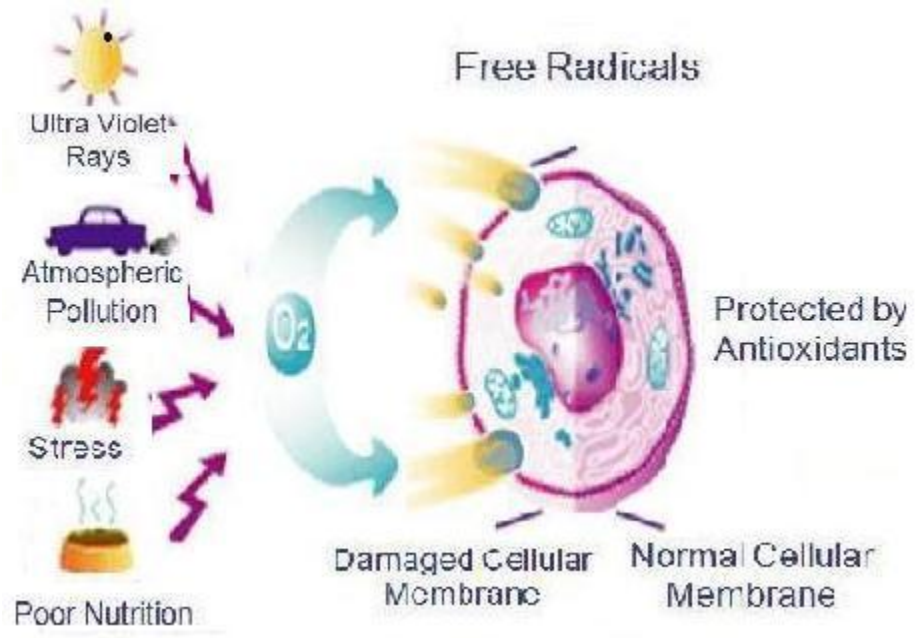
In India, Mahal et al. (2010) found that between two study periods (1995–96 and 2004) the share of NCDs in total out-of-pocket health expenditures in India increased from 31.6% to 47.3%, suggesting a growing importance of NCDs in terms of their financial impact on households and a higher financial risk burden on affected individuals and households. The odds of incurring catastrophic hospitalization expenditures were nearly 160 percent higher with cancer 30 percent greater for CVD or injuries than when hospitalization is due to a communicable disease. The current financing burden for NCD treatment falls disproportionately on the poor.

In 2008, India spent 4.2 percent of its GDP on health care. Public expenditures total approximately 1.1 percent of GDP, leaving most funding coming from private sources. Of private resources, 74.4 percent is out of pocket. Treatment cost is almost double for NCDs as compared to other conditions and illnesses.

With the chronic nature of NCDs and the high cost for some medications, financial vulnerability is likely the result and this accounts for some of the distress financing of care.(Sharma 2012)

Antioxidants: An Overview

Antioxidants are the compounds that inhibit or delay the oxidation process by blocking the initiation or propagation of oxidizing chain reactions. The major action of antioxidants in the cells is to prevent damage due to the action of reactive oxygen species (Srinivasan and Gayatri 2012). Antioxidant enzymes (made in the body) and antioxidant nutrient (found in food) can scavenge/deactivate reactive free radical turning them into harmless particles (Chu et al 2002). Antioxidants are classified into two broad divisions, depending on whether they are soluble in water (hydrophilic) or in lipids (hydrophobic). In general, water-soluble antioxidants react with oxidants in the cell cytosol and the blood plasma, while lipid-soluble antioxidants protect cell membranes from lipid per oxidation.



Source-mangosteen-natural remedies.

Free radicals are highly reactive compounds, they are chemical species associated with an odd or unpaired electron and can be formed when oxygen interacts with certain molecules. They are neutral, short lived, unstable and highly reactive to pair with the odd electron and finally achieve stable configuration. Once formed these highly reactive radicals can start a chain reaction and are capable of attacking the healthy cells of the body. Due to this the cells lose their structure and function poorly or die. Diseases linked to oxygen radical and reactive oxygen species (ROS) include cancer, atherosclerosis, heart disease, stroke, diabetes mellitus, rheumatoid arthritis, osteoporosis, ulcers etc. Studies have suggested that antioxidant supplements have proved to be beneficial for the health. We know that diet and nutrition are important factors in the promotion and maintenance of good health at all stages of

life. Plants containing phenolics have been reported to possess strong antioxidant properties, antioxidants are compound that inhibit or delay the oxidation process by blocking the initiation or propagation of oxidizing chain reactions. They function as free radical scavenger, complexes of pro-oxidant metals; reducing agents and quenchers of single oxygen formation. (Jacab and Shenbagarman 2011). Wolhuter (2001) suggests that oxidative stress and inflammatory processes linked to free radical over generation may be the key in the generation of insulin resistance, diabetes, cardiovascular disease and other chronic diseases.

Antioxidants play a major role in controlling the oxidative stress in the development and progression of various human diseases and promoting the positive health and well being. Antioxidants are produced either endogenously or received from exogenous sources. Antioxidants reduces the oxidative stress may be either mild or severe and remains the cause of several diseases such as cardiovascular diseases, neurological diseases, malignancies, renal diseases, diabetes, inflammatory problems, skin diseases, aging, respiratory diseases, liver diseases and different types of viral infections. According to WHO (2009) report on global strategy for the prevention and management of chronic diseases stated that there is a need of surveillance the risk factors, promotion of health and improving health care. Action must be taken against tobacco control, promoting healthy diet, promoting physical activity and reducing harmful use of alcohol. The Global Strategy on Diet Physical Activity and Health endorsed by the World Health Assembly stated that use of healthy diet which includes consumption fresh fruits, vegetables, pulses and legumes, whole grains etc. help in the reduction of oxidative stress in the body as they contain ample amount of antioxidants

Dietary Sources of Antioxidants

There are various sources of antioxidant available in the nature and they are constantly used in the food industry. Typical antioxidants permitted as the food additives are butylated hydroxy anisole (BHA), butylated hydroxy toluene (BHT), pueraria glycoside (PG), and tertiary-butylatedhydroquinone (TBHQ). However the emphasis is made on the natural plant based antioxidants. (Jacab and Shenbagarman 2011). Various types of antioxidants are present in the diet like Vitamin E, because it is fat soluble, α tocopherol is at unique position to safeguard cell membranes. It is found in oils, walnuts , peanuts, almond avocado etc. Vitamin C is also known as ascorbic acid, is water soluble vitamin, it scavenges free radicals of aqueous environment. It is commonly found in citrus fruits like oranges , amla, lemon etc. Beta carotene is also a water soluble , is the most widely studied, 600 carotenoids identified till date. It is the best quencher of singlet oxygen (as energized but unchanged form of oxygen that is toxic to cells). Good sources of Beta Carotene are green leafy vegetables, papaya, pumpkin etc. especially green leafy vegetables are popular source of beta –carotene in many countries of the world, Studies have reported that several green leafy vegetables are rich sources of antioxidants. (Venkataswami 2012)

Mubarack and Doss (2010) reported in their study that several herbs and spices have good antioxidant activity, including rosemary, sage, thyme, nutmeg, turmeric, white pepper, chilly, ginger and several Chinese medicinal plant. Medicinal plants are a source of great economic value because it posses the potential compounds which are beneficial for consumption of human beings.

Researchers suggest that the consumption of fresh fruits, vegetables, whole grains and pulses which are rich in antioxidants reduces the risk of diet related non communicable diseases. Various plant material present on the earth possess ample amount of antioxidant activity such as phenolic and phytochemical. (Shrinivasan & Gayatri 2012) conducted a study on enzymatic and non enzymatic antioxidant activities of the red and black berry bearing variety of solanum nigrum.(makoya).The findings revealed that methanolic extract of black berry bearing leaves were found to contain highest amount of enzymatic antioxidant like catalase (177.66U/g) peroxidase(11.64 U/g), superoxidase dismutase (6.24 U/g), polyphenol oxidase (0.0038U/g) and glutathione-S-transferase (0.375U/g) and non enzymatic antioxidant such as tocopherol(7.038 mg/g), ascorbic acid(5.180 mg/g), carotenoids(1.680 mg/g), polyphenols (0.892 mg/g) reduced glutathione(0.335 mg/g) and flavonoids(2.14 mg/g) followed by the methanolic extract of red berry bearing leaves which contain enzymatic antioxidant like catalase(163.80U/g) peroxidase(10.40 U/g), superoxidase dismutase (5.84 U/g), polyphenol oxidase (0.0036U/g) and glutathione-S-transferase (0.267U/g) and non enzymatic antioxidant such as tocopherol(6.900 mg/g), ascorbic acid(4.585 mg/g), carotenoids(1.420 mg/g), polyphenols (0.72 73mg/g) reduced glutathione(0.204 mg/g) and flavonoids(2.04 mg/g) respectively.

Banu, Tyagi & Singh (2012) estimated composition, functional properties and antioxidant activities of multigrain composite mixes. The multigrain composite mixes were prepared from different cereals, legumes, millets, nuts along with condiments in different proportions. The results of the study revealed that it had moisture, carbohydrate, protein, crude lipid and ash. Energy value ranged from 1600 to 17oo k J /100 g . The mix also had fairly good amount of thiamine and riboflavin content varied from 0.23 to 0.45 mg%. Dietary fiber was in the range of 12.4-16.5% . In vitro starch digestibility varied from 60-76%. Phytic acid content in these multigrain mix ranged from 1.2-1.5%, DPPH free radical scavenging activity ranged from 1.9-3.9%. These multigrain can be used in different food formulations because it contain fairly good amount of total antioxidant content which when consumed helps in reducing the risk of diet related non communicable diseases. Kowsalya and Indira (2010) also developed Amaranthus nutritious mix and developed extruded products from mix .The findings of the study revealed that the formulated nutritious mix could be developed into extruded products like vermicelli and swirl pasta. The developed products with amranthus incorporations were highly acceptable from the organoleptic evaluation of commonly consumed recipes.

Role of Antioxidants in addressing NCDs

The emergence of dietary compounds with health benefits offers an excellent opportunity to improve public health and thus, this category of compounds has received much attention in recent years from the scientific community, consumers and food manufacturers. The list of dietary active compounds (vitamins, probiotics, bioactive peptides, antioxidants.) is endless, and scientific evidence to support the concept of health promoting food ingredients is growing steadily.

The following factors have been associated with lower risks of NCDs:

- High intakes of fresh fruits and vegetables
- Frequent intake of fish
- Diets which are rich in whole grains, legumes, fresh fruits and vegetables and fish, and low in refined grains, processed meats, sweets, desserts, sweetened drinks.

Numerous studies have been conducted in high-income countries to assess the effectiveness of behavioral interventions designed to increase fruit and vegetable consumption (Cauwenberghe et al 2010, Rees, et al 2013), primarily in children as evidence suggests that dietary patterns established during childhood are predictive of patterns later in life(Lien et al 2010, Kelder 1994). Most studies have observed small to moderate improvements in fruit and vegetable consumption, some studies suggest that such small-scale interventions may not be cost–effective and that larger scale policies and programmes that influence price and/or availability of fruits and vegetables should also be considered (Cobiac,Vos &Veerman 2010).

Balasasirekha & Lakshmi (2010) studied the effect of cloves and turmeric on hyperlipidemic and diabetes patients. They suggested that successful treatment of controlling diabetes can be achieved through diet as certain compounds present in spices are more effective in controlling serum lipids and blood sugar. The findings of the study showed the impact of supplementation has a positive effect on lipid profile. The mean values of a total cholesterol , triglyceride ,HDL cholesterol, LDL cholesterol VLDL cholesterol were found to be 251.2 mg/dl,169.33 mg /dl to 170.07 mg /dl ,38.94 mg /dl respectively. It proved that spice supplementation has a sustainable strategy in the management of hyperlipidemia and diabetes mellitus, which is further beneficial in long run to control over harmful diseases. Umamaheshwari & Srividhya (2009) highlighted that there is an impact of raw onion on systolic and diastolic blood pressure. A considerable reduction from 149 mm Hg to 130 mm Hg in systolic and 104 mmHg to 90 mm Hg in diastolic was observed on the supplementation of raw onion. The impact of raw onion showed a significant increase in high density lipoprotein. It raised the level of high density lipoprotein (good cholesterol) to the extent of 20 to 25 per cent. Hence primary preventive measure should emphasize on simple dietary practices. Kuna & Khader (2009) conducted a study on hypoglycemic, hypocholesterolemic and hypotensive effects of gymnema sylvestre (gurmur) leaves in type II diabetic subjects. It is a traditional medicinal plant , the results revealed that it is rich in protein (13..71g), fiber (12.13g), ash (9.45), iron (33mg/100g), potassium (508.7mg/100g),and calcium (452.5 mg/100g) and low in anti nutrients like oxalates (0.0694),tannins (0.381) and polyphenols (1.089). The saponin content was (15.36%), the antioxidant activity was 83.63 percent. The gymnema leaf was microbiologically evaluated for total bacterial count and fungal count. Gymnema sylvestre (gurmar) leaf powder (3g) was supplemented in the form of capsules to a diabetic subjects showed a steady and significant decrease in the mean fasting blood glucose level in the experimental group it was found to be 26 percent less than control group to which no leaf powder was supplemented. There is also reduction in cholesterol (18.64%), HDL (2.53%), and LDL (20.04 %) levels, the observation from the present study revealed the decrease in blood pressure which corresponds to 10.13 and 12.74 percent in experimental group. Therefore the use of unconventional medicinal plant source like Gymnema sylvestre leaves as a

therapeutic supplement can be commercialized and put to use to slowdown the progression of diabetes, thereby having tremendous potential to mitigate the associated clinical and cost repercussions of Type II diabetes mellitus.

Kowsalya, Ramalingam and Ithayamalar (2008) conducted a study on impact of supplementation of food based antioxidant mix on the antioxidant status of selected breast cancer patients. The antioxidant mix was prepared from using antioxidant rich foods such as wheat flour, roasted bengal gram, oats powder, amaranthus powder and soy flour . The salient findings of the study proved that the supplementation of antioxidant mix brought about a significant improvement in plasma vitamin E, super oxidase dismutase and total antioxidant activity .The mean increment was found to be 0.5 mg/l,0.11mg/dl and 0.94m mol/l respectively. The findings of the present study implies the improvement in the antioxidant status of breast cancer patients Kowsalya and Preethi (2008) conducted a study on the impact of Amaranthus based antioxidant food mix on blood glucose and antioxidant profile of type II Diabetes. The present study has specific objective of observing the impact of supplementation of amaranths incorporated antioxidant food mix on the blood glucose level and antioxidant profile of type 2 diabetes. The antioxidant mix was prepared using antioxidant rich food such as wheat flour, roasted bengal gram, soya flour, and amla powder and amaranths powder. The salient findings of the study proved that the supplementation of antioxidant mix brought about a significant improvement in plasma vitamin A, vitamin C, vitamin E, Selenium, Copper , Zinc and blood glucose levels. The mean reduction in the blood glucose level in the subjects was 23.9mg/dl. There is also a significant decrease in the total cholesterol and was found to be 22.96 mg/dl. Supplementation with the antioxidant food mix brought significant importance in reducing blood glucose levels.

Conclusion

India is facing a growing burden of Non Communicable Diseases day by day. It disproportionately affect low- and middle-income countries where nearly three quarters of NCD deaths are 28 million. An important way to reduce NCDs is to focus on lessening the risk factors associated with these diseases. There is a need to develop solutions which exist to reduce the common modifiable risk factors (mainly tobacco use, unhealthy diet and physical inactivity, and the harmful use of alcohol)(WHO 2016). It is over viewing from the above mention studies that the consumption of natural antioxidants can improve the quality of life of the patients suffering from Non Communicable Diseases (NCDs) by reducing the oxidative stress caused by various agents. It is believed that the consumption of dietary antioxidant reduces the risk of several Non Communicable diseases like Cancer, Hypertension, Cardiovascular diseases etc (Gupta and Prakash 2009). Hence it is essential to enrich our diet with antioxidants to protect against harmful diseases. The possible toxicity of synthetic antioxidants has resulted in decreased use of these compounds. The emphasis is made on natural plant based antioxidant s(Jacob and Shenbagaraman2011). Natural antioxidants were known to exhibit a wide range of biological effects including antibacterial, antiviral, anti inflammatory and vasodilatory activities (Gulchin, Huyut, Elmatas and Enain 2010).

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