



# **Introduction**

in both developing and newly developed countries, place additional burdens on already overtaxed national health budgets (World Health Organization [WHO],2007).

Diabetes affects millions of people. Worldwide, 3.2 million deaths are attributable to diabetes every year. At least one in ten deaths among adults between 35 and 64 years old is attributable to diabetes. The global prevalence of Type 2 diabetes is expected to double in the period 2000 to 2025 and may reach a level of almost 30 million people, that is, 5.6 per cent of total global population by the year 2025 (Sunkin *et al.*,2000). WHO, (2007) estimates that over the next 10 years (2008-2017), India will lose \$ 558 billion in fore national income due to heart disease, stroke and diabetes alone. Without urgent action, diabetes associated deaths will increase by more than 50 per cent in the next ten years taking toll of the social and human capital in the country. This year alone more than 274,000 people will die of Type 2 diabetes, making it the sixth leading cause of death by disease. Each day over 4,400 people in India are diagnosed with this chronic life debilitating, expansive and pro-aging disease (Margaret and Stuart, 2008).

Heart disease has been one of the leading causes of death globally for the past 80 years and is a major cause of disability. Around 80 per cent of these deaths occurred in Low and Middle Income Countries (LMIC). If appropriate action is not taken, by 2015, an estimated 20 million people will die from cardiovascular disease every year, mainly from heart attacks and strokes (Lori *et al.*, 2006).

Of the 10.7 million deaths from cardiovascular disease every year in India, 4.2 million are due to ischemic heart disease, 2.5 million due to cerebrovascular disease, and an additional 3.9 million due to hypertensive and other heart conditions. As well, at least 20 million people survive heart attacks and strokes every year, a significant proportion of them requiring costly clinical care, which puts a huge burden on long-term care resources. CVD affects people in their mid-life years, undermining the socioeconomic development, not only of affected

## I. INTRODUCTION

Health is a fundamental human right and a worldwide social goal. It encompasses all humans regardless of age. Geographical conditions, culture, economic status and lifestyle of people have foremost impact on their health. Needless to say that 'Food' is a fundamental need in determining the very existence of living; it also plays a leading role in shaping the health, both physical and mental; of people around the world across time and space. The cultural evolution of human race has been parallel with the style of consumption of food with perfect matching with the geographical conditions and life style of the people. We have now arrived at a time that the food style of the people is not in conformity to the accustomed geographical or cultural conditions. Rapid changes in diets and lifestyles that have occurred with industrialization, urbanization, economic improvement and market globalization have been accelerating since the past decade. This dynamics has a significant impact on the health and nutritional status of populations, particularly in developing countries and in countries in transition (United Nations [UN], 2007 and Kazunobu, 2007).

Changes in the world food economy are reflected in shifting dietary patterns, for example, increased consumption of energy-dense diets high in fat, particularly saturated fat and low in unrefined carbohydrates (Food and Agriculture Organization [FAO], 2007). These patterns are pooled with a decline in energy expenditure that is associated with a sedentary lifestyle like motorized transport, labour-saving devices in the home, the phasing out of physically demanding manual tasks in the workplace and leisure occasion that is preponderantly devoted to physically undemanding pastimes. Poor food habits and sedentary hedonistic lifestyle have resulted in the perpetuation of diseases like obesity, diabetes mellitus and Cardio Vascular Diseases [CVD]. If this is the scenario amidst affluent population, malnutrition and low immunity- perpetuating secondary diseases are abounding with the poor of the population (Thompson *et al.*, 1994). These increasingly significant causes of disability and premature death

individuals, but also families and nations. Lower socioeconomic groups generally have a greater prevalence of risk factors, diseases and mortality in developed countries, and a similar pattern is emerging as the CVD epidemic matures in developing countries (WHO, 2007) and in India, hyperlipidemia has been the chief precipitating factor in CVDs.

Hyperlipidemia is an excess of lipids, largely cholesterol and triglycerides, in the blood. It is also called hyperlipoproteinemia because these fatty substances travel in the blood attached to proteins as lipoproteins. The best-known lipoproteins are Low Density Lipoprotein (LDL) and High Density Lipoprotein (HDL). Excess LDL cholesterol contributes to the blockage of arteries, which eventually leads to 'heart attack'.

In contrast, the lower the level of HDL cholesterol, the greater is the risk of coronary heart disease. As a result, HDL cholesterol is commonly referred to as the "good" cholesterol. Low HDL cholesterol levels are typically accompanied by an increase in blood triglyceride levels. Studies have shown that high triglyceride levels are associated with an increased risk of coronary heart disease (Gupta, 2000).

Low immune function refers to an under active and poor performing immune system. The immune system's prime function is to protect the body against infection and the development of diseases. Support and enhancement of the immune system is perhaps the most important step in achieving resistance to disease and reducing susceptibility to colds, flues, tuberculosis and cancer. Supporting the immune system involves a health promoting lifestyle, stress management, exercise, diet and the appropriate use of nutritional supplements and herbal medicines. Recurrent or chronic infections-even very mild colds-only occur when the immune system is weakened. The health of the immune system is greatly impacted by a person's emotional state, level of stress, lifestyle, dietary habits and nutritional status. Nutrient deficiency is the most frequent cause of a depressed immune system (Khan and Salflar , 2006).

One such immune suppressed infection is Tuberculosis (TB) which is a contagious infection, which spreads through the air. The source of infection is people with TB affected lungs (pulmonary TB). When infectious people cough, sneeze, talk or spit, they propel TB germs, known as bacilli, into the air. The immune system "walls off" the TB bacilli which can lie dormant for years. Failure of the immune system to control infection with TB bacilli leads to active TB disease (Gajalakshmi, 2006).

Overall, one third of the world's population is currently infected with the TB bacillus. Around 5- 10 per cent of people who are infected with TB become sick at some time during their life. According to the WHO, India has the largest number of infections, with over 1.8 million cases with the incidence rate of 385 cases per 100,000 normal people (UN Weekly Newsletter, 2004).

Thus in India, as narrated afore, we have taken cognizance of three major disease conditions: Diabetes, CVD in affluent population, and Tuberculosis, a widely prevalent immunodeficiency triggered disease in poor population. There arises a contingency to address all the afore narrated disease conditions in an integrated approach by food science and nutrition and social commitment. While the former forms the basis of the present investigation, the latter vests with the Government and Civil Societies.

In such a context, there arises an essentiality for addressing the entire gamut of issue through one single medium 'Dietary modification'. Dietary modification plays an immense task in prevention and treatment strategies for these disease conditions. Several antioxidant and nutrient rich foods have been identified in ameliorating the conditions associated with the scourge and the role of wheat have been highlighted in many supplementation studies conducted world over and for the present study, wheat is chosen as a principal input playing a major role in the proposed dietary supplementation in a zealous attempt to make it as a major factor in the 'dietary modification' discussed afore. But the proposed supplementation of wheat is not *per se* wheat as conventionally understood but in

the forms of 'wheat germ' 'wheat bran' and 'wheat grass'. The rationale of choosing these forms is recounted as under.

Wheat is the staple food of millions of people. It is also an important part of the daily diet of many millions more. World wheat production increased at a rate of 7.3 per cent per year between 1999 and 2005. There are many factors that influence the pattern of wheat consumption in the world which include price, supply, consumer income, availability of substitutes and politics (United States Department of Agriculture Foreign Agricultural Services, 2006). The quest for the nutritional potentials of wheat has been extensive and scientific studies have further contributed in suggesting optimal methods of harnessing the nutritive contents of wheat. This quest started with the consumption of whole grain products.

Whole grain products are an important source of dietary fibre. Four medium slices of wholemeal bread, for example, would provide 7.6g fibre which is 42 per cent of the Recommended Daily Amount (RDA). Whole grain wheat contains useful amounts of several of the B vitamins including thiamine, riboflavin and niacin and also vitamin E. The vitamin and mineral content of wheat will depend on the proportion of germ, bran and endosperm present. It also contains the minerals potassium, iron, magnesium and zinc as well as trace elements such as selenium (Centro Internacional de Mejoramiento de Maiz y Trigo [CIMMYT], 2005).

The health benefits of wheat depend entirely on the form in which it is eaten. For instance wheat, in the form of bleached white flour formed after 60 per cent processing has only very least amount of nutrients. Despite its health benefits, wheat is seldom consumed as 'whole grain', due to customary and traditional practice and the myriad culinary recipes which by and large identify wheat in the cuisine as a 'bleached white flour'. Milling of wheat generates by-products like wheat germ and bran, which can be used to improve the technological performance and/or to integrate foods with healthy compounds (Esposito, 2005).

Wheat germ is the most important nutritious part of wheat grain separated by ultra modern milling technology which keeps free radical in check which in turn helps to prevent heart diseases, cancers and diabetes. It is also very important for vitality and healthy heart further lowering the risk of coronary heart diseases and helps to reduce obesity and delays ageing process. It contains about 27-28 g protein which is rich in all the essential amino-acids particularly lysine. The presence of sugar in germ makes it acceptable and tasty. Over 80 per cent of fat present in wheat germ is made up of Poly Unsaturated Fatty Acids (PUFA). Three table spoons of wheat germ will provide 20 per cent Dietary Reference Intake of folic acid and vitamin E required for pregnant women (Nurhan and Minquan ,2003).

Bran is the hard outer layer of grain and consists of combined aleurone and pericarp. Along with germ, it is an integral part of whole grains, and is often produced as a by-product of milling in the production of refined grains. When bran is removed from grains, they lose a portion of their nutritional value. Bran is particularly rich in dietary fibre, and omegas and contains significant quantity of starch, protein, vitamins and dietary minerals.

Wheat bran, one of the richest sources of dietary fibre can reduce the fasting and post lunch glucose level in diabetics. Wheat bran acts as phytoestrogens and is believed to protect against hormonally mediated breast, prostate and colon cancers. Wheat bran is used widely as a laxation aid. Wheat bran can help in weight control as it can replace high fat and high calorie food and leads to reduction in calories. Also addition of fibre in diet leads to a feeling of fullness and aids avoid 'over eating'. As dietary fibre requires more energy to be digested, it can help in burning excess calories (Frische *et al.*,2003).

Yet another form of wheat that helps to combat these debilitating diseases is wheatgrass, which refers to the young grass of the common wheat plant, *Triticum aestivum* providing chlorophyll, amino acids, minerals, vitamins, and active enzymes. Wheatgrass is a powerhouse of nutrients and vitamins for the

human body. In the form of fresh juice, it has high concentrations of chlorophyll, active enzymes, vitamins and other nutrients. It has been reported that the chlorophyll has regenerative properties and studies have supported its power as an immune booster, free radical fighter, energizer and promoter of healthy blood circulation. It is a powerful antioxidant with properties of antibiotic and anti-inflammatory actions (Steve, 2004).

Potentials to unravel the immense nutraceutical benefits of wheat germ, bran and grass need to be studied in depth to address the health issues of the population, of both the affluent and the have-nots. This zealous venture claims realistic significance as they are capable of enhancing the health of diabetic, hyperlipidemic and the tuberculosis population: a commonly seen amalgamation in all developing countries.

The study attains significance under the pretest that the studies in India despite its massive production have not adequately exploited the viability of wheat in the forms of wheat germ, bran and grass. The present study is intended to fill this gap. The bountiful production of wheat and its high consumption among Indian populace are the encouraging factors for this intended investigation that attains social relevance too. The present study aims at redefining “wheat” as it is conventionally understood and utilized in India. It is now wheat germ, wheat bran and wheat grass that gains more attention. Against such a backdrop, the present study on the **“Impact of supplementation of wheat germ, bran and grass on diabetic, hyperlipidemic and tuberculosis subjects”** has been undertaken with the following specific objectives:

- a. Analyze the nutrient content of wheat germ, bran and grass and estimate the phytosterol content of wheat germ and
- b. Supplement wheat germ, bran and grass individually and in combination to selected subjects of diabetes, hyperlipidemia and tuberculosis and evaluate the impact.

## II. REVIEW OF LITERATURE

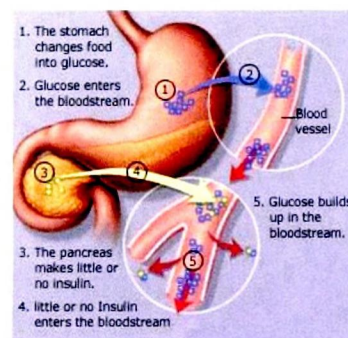
The literature pertaining to the study entitled “Impact of supplementation of wheat germ, bran and grass on diabetic, hyperlipidemic and tuberculosis subjects” is reviewed under the following headings:

- A. Diabetes - the global threatener
- B. Hyperlipidemia – the health cracker
- C. Tuberculosis – the human waster
- D. Significance of wheat germ, bran and grass

### A. Diabetes - the global threatener

Diabetes is one of the most common non communicable diseases and one of the most challenging health problems in the twenty first century (Zimmet *et al.*, 2001 and Center for Disease Prevention and Control [CDPC],2006). The physiology behind diabetes is that when sugar in our blood cannot be utilized adequately by the cells in the body, the level of blood sugar increases beyond the normal limit causing diabetes, not only does the sugar in the

blood increases but also the metabolism of carbohydrates, protein and fat. The carbohydrate, fat and protein metabolism thus gets disturbed. The normal mechanism in the body involves a hormone “Insulin” which is essential for the utilization of glucose produced by beta-cells of islets of langerhans of pancreas and also prevents the rise in blood glucose and maintains its level within certain normal limits (Raghuram *et al.*, 2007).



Glucose metabolism in diabetes

In diabetes, this insulin is either not produced in adequate quantities or act properly due to which the cells cannot utilize the glucose. Glucose keeps accumulating in the blood but cells are starved of glucose (Anant, 2001 and Almuda *et al.*, 2004).