Introduction

INTRODUCTION

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Every human being is the author of his own health or disease.

- Lord Buddha

Cardiovascular disease is today the largest single contributor to global mortality and will continue to dominate mortality trends in the future (WHO, 2009a). A major challenge in human health over the next 50 years is to reduce the impact of chronic diseases including heart diseases, many cancers, type II diabetes, and obesity (Martin *et al.*, 2011). By 2030, non-communicable diseases will account for more than three-quarters of deaths worldwide and cardiovascular disease alone will be responsible for more deaths than infectious diseases, maternal and perinatal conditions and nutritional disorders combined (Beaglehole and Bonita, 2008).

Cardiovascular diseases can be considered as the "Walking Time Bomb" as about one fourth of these deaths are sudden (Braunwald, 2010). Even assuming no increase in cardiovascular disease risk factors, most countries, especially India and South Africa, will see a large number of individuals between 35 and 64 years die of cardiovascular diseases over the next 30 years, as well as an increasing level of morbidity among middle aged individuals related to heart disease and stroke (Gaziano *et al.*, 2010). There is no nation in which the prevalence of cardiovascular disease will not rise in the next decade (Kones, 2011). Cardiovascular disease threatens to cripple India's workforce and stunt India's growth if timely and appropriate public health measures are not instituted and it is estimated that by 2020, cardiovascular disease will be the largest cause of disability and death in India (Goenka *et al.*, 2009).

The causes of cardiovascular diseases include imbalanced diet, inadequate physical activity and tobacco use which are called modifiable risk factors, the effects of which may show up as raised blood pressure, blood glucose, blood lipids, overweight and obesity which are called intermediate risk factors. Elimination of these modifiable risk factors would prevent 80 per

cent of premature heart disease, 80 per cent of premature stroke, 80 per cent of type 2 diabetes and 40 per cent of cancer (WHO, 2009b).

These risk factors lead to cholesterol disorders or scientifically termed as dyslipidemia which refers to the clinical conditions produced by lipid aberrations, thus raising the cholesterol, triglycerides and a variety of lipoprotein levels. Cholesterol is essential for cell structure and responsible to supply blood and oxygen to the myocardium of the heart. But, if mismanaged, cholesterol disorder counteracts as harm to the body. Hyperlipidemia leads to the development of atherosclerosis (thickening, hardening and blocking of large and medium arteries resulting from lipid accumulation in the artery wall) and later to the progression of coronary cardiovascular morbidity and mortality (Mestas and Ley, 2008). Atherosclerosis begins at an early age and progresses throughout life and primordial prevention is successful in combating cardiovascular disease and protect against other degenerative diseases.

Another concept of concern in terms of cardiovascular disease is the free radicals that have been implicated in the aetiology of several human diseases and may result in damage to membrane lipids, proteins, nucleic acids, and carbohydrates, which can result in cancer, neurological diseases, lung diseases, diabetes, cardiovascular diseases, autoimmune diseases, premature aging, and eye diseases (Lachance *et al.*, 2001).

In the age of many degenerative diseases, antioxidants play a leading role in neutralizing the highly reactive and destructive free radicals. An antioxidant is a molecule stable enough to donate an electron to a rampaging free radical and neutralize it, thus reducing its capacity to damage. These antioxidants delay or inhibit cellular damage mainly through their free radical scavenging property. Some of such antioxidants, including glutathione, ubiquinol, and uric acid, are produced during normal metabolism in the body. Other lighter antioxidants are found in the diet. Although there are several enzyme systems within the body that scavenge free radicals, the principal antioxidants are vitamin E (α tocopherol), vitamin C (ascorbic acid), and vitamin A (β carotene) (Lobo *et al.*, 2010). The body cannot manufacture these nutrients, hence they must be supplied in the diet.

Recent researches indicate that antioxidant vitamins and minerals can help in the prevention and possible reversal of numerous chronic degenerative disorders. Synthetic antioxidants such as butylated hydroxytoluene and butylated hydroxyanisole have recently been reported to be dangerous for human health intensifying the search for effective, nontoxic natural compounds with antioxidant activity in the recent years (Gulcin, 2010). There are a number of epidemiological studies that have shown inverse correlation between the levels of established antioxidants/phytonutrients and occurrence of cardiovascular diseases, cancer or mortality due to these diseases.

It is important to develop cost-effective context-specific identification and reduction strategies for cardiovascular disease and diabetes risk, based on available resources. These should be complemented with population-based prevention strategies focusing on the control and reduction of behavioural and metabolic risk factors by targeting their key determinants (Simmons *et al.*, 2010).

'Prevention has become the true medical miracle'

- Otis R. Rowen

Diet has long been linked to the development of obesity, diabetes, and cardiovascular diseases and dietary modification is one of the cornerstones of chronic disease prevention. Diet and nutrition play a critical role in causation of major cardiovascular diseases and, along with physical activity, influence many of the biological variables that mediate the risk of these diseases. It is further estimated that up to 30 per cent of deaths from coronary heart disease are due to unhealthy diets (Rao, 2010). Currently available evidences strongly indicate that cardiovascular health is heavily influenced by the quality of dietary fat and the quantity of fruits and vegetables consumed (Hu, 2009).

The health benefits of a diet rich in fruits, vegetables and legumes have been recognized recently (Hervert-Hernández *et al.*, 2011). There is substantial evidence that nutrients contained in vegetables such as dietary fibre, folate, antioxidant vitamins and potassium are associated with lower risk of cardiovascular disease. However, the precise mechanisms for the effects of these individual nutrients remain poorly understood. Besides dietary

improvements, research is underway to identify natural foods having a cholesterol reducing effect (Mridha *et al.*, 2010).

Food ingredients, besides providing nutrition, have always formed an important source of chemical compounds, which can be used for medicinal purposes. Rapid advances in medicinal and nutritional sciences have changed the perspective of food from its traditional role for survival and enjoyment to a new status "food as medicine" (Nelson, 1999). There is a growing realization about food that can be utilized both nutritionally and medically which can be inherently safe due to its natural origin, economically cheap and of great nutritional importance. However, from 1988–2006, the consumption of vegetables or fruits was nearly halved, level of physical activity also fell, while alcohol consumption rose. Patients with diabetes or heart disease also reported poor dietary patterns and physical activity (American Heart Association, 2011).

Food based approach is coming to the forefront as a major modifiable determinant of chronic diseases, with scientific evidence increasingly supporting the view that alterations in diet have strong effects on health throughout life. Most importantly, dietary adjustments may not only influence present health, but may determine whether or not an individual will develop such diseases much later in life. Although drug treatment may be appropriate among individuals at high risk of cardiovascular diseases, adoption of a heart healthy diet is preferable to long-term medication in the general population in order to prevent or delay the onset of disease and to reduce the burden on health services (Brunner *et al.*, 2009). The American Heart Association (AHA) incorporated the powerful principle of primordial prevention in defining "ideal cardiovascular health" as a goal in reducing cardiac and stroke mortality by 20 per cent by the year 2020 (Lloyd-Jones *et al.*, 2010).

In this context, research on functional foods as an area of food science is developing for the past few decades. Many foods derived from plants naturally contain compounds beneficial to human health and can often prevent certain diseases. The benefits that such foods delivered genuinely are 'decoded as drug like claims'. Concurrently India is endowed with traditional

foods which provide health benefits that are disease preventive, immune boosters and performance helpers (Narayana, 2010).

A food ingredient is regarded as functional if it is satisfactorily demonstrated to affect beneficially one or more target functions in the body beyond adequate nutritional effects. Even in recent times, plants have been an important source of modern drugs like aspirin, ephedrine, digoxin, quinine and tubocurarine, to name only a few (Ansari and Inamdar, 2010). It has been noted that the original source of many important pharmaceuticals in current use are plants which have been used by indigenous people, who have a rich knowledge on medicinal and edible plants (Motlhanka and Makhabu, 2011).

A comparative evaluation of different foods revealed that plant foods can make the biggest contribution to meeting the great challenge of chronic diseases and contribute significantly to promote human health (Martin *et al.*, 2011). Components that make foods functional are dietary fibers, vitamins, minerals, antioxidants, oligosaccharides, essential fatty acids (omega-3), and lignins. Indian systems of medicine believe that complex diseases can be treated with complex combination of botanicals than, with single drugs. Wholesome foods are hence used in India as functional foods rather than supplements (Lobo *et al.*, 2010).

Both scientists and the general population are interested in traditional medicine in recent years for a number of reasons, which include high price of allopathic drugs, side-effects and toxicities of modern synthetic drugs, and the realization that phytochemicals present in plants can be effective therapeutic agents by themselves or serve as effective adjunct therapies to modern drugs. There are also epidemiological evidences and interventional studies to correlate higher level of antioxidant-rich food uptake with lower incidence of cardiovascular diseases (Terao, 2009).

Green gram (*Phaseolus aureus* Roxb) commonly known as moong dhal is a protein rich staple food and contains about 25 per cent protein, which is almost three times that of cereals (Pande *et al.*, 2011). It supplies protein requirement of vegetarian population of the country. It is consumed in the form of split as well as whole pulse and forms an essential supplement to

cereal based diet. The moong dal khichdi is recommended to the ill or aged person and children as it is easily digestible and considered as a complete diet (Kamini and Sarita, 2011). Ancient ayurveda considers green gram as best among all legumes and suitable for consumption in both diseased and healthy conditions. It is free of the 'heaviness and tendency to flatulence' associated with other pulses. The biological value improves greatly, when wheat or rice is combined with green gram because of the complementary relationship of the essential amino acids (Goyal and Khan, 2010). It is particularly rich in leucine, phenylalanine, lysine, valine, and isoleucine.

Carrots (*Daucus carota* L.) contain a wide array of phytochemicals including carotenoids, phenolics, α-tocopherol, polyacetylenes, isocoumarins, and sesquiterpenes. Carrots are most known for their pro-vitamin A carotenoids but also contain other phytochemicals with documented health benefits. The phytochemicals in coloured carrots present a challenge and opportunity due to the wide diversity of potent bioactive compounds. Varieties of carrots have also been recognized for their antioxidant and anti-inflammatory properties (Metzger and Barnes *et al.*, 2009).

Amla (*Emblica officinalis* Gaertn.) is an important dietary source of vitamin C, minerals, and also phenolic compounds, tannins, phyllembelic acid, phyllemblin, rutin, curcuminoides and emblicol. All parts of the plant are used for medicinal purposes. Especially, the fruit has been used in Ayurveda as a potent rasayana and traditional medicine for the treatment of diarrhoea, jaundice and inflammation. In addition, the pulp of the fruit is smeared on the head to alleviate headache and dizziness. Recently, amla extract has been tested for various pharmacological activities. The fruit extract was reported to have hypolipidimic, antidiabetic and anti-inflammatory activities and inhibit retroviruses such as HIV and tumour development (Yokozawa *et al.*, 2007).

Drumstick leaves (*Moringa oleifera*) have the highest contents of total carotene and β carotene. They are also an excellent source of other nutrients and phytonutrients, which are shown to have positive health effects. Drumstick leaves may have an unacceptably bitter taste, due to the presence of polyphenols which are reported to have multiple beneficial biological effects, including antioxidant activity, anti-inflammatory action, inhibition of

platelet aggregation, antimicrobial activities and anti-tumour activities, and are therefore a much-researched topic in recent years. Drumstick leaves are reported to contain alkaloids, flavonoids, anthocyanins, proanthocyanidins and cinnamates and is highly reputed in folklore and traditional system of medicine as a remedy for a variety of ailments (Nambiar, 2010).

Wheat germ (Triticum aestivum) is the embryo from which the seed germinates to form the sprout that becomes the green wheat grass. Several studies have indicated superiority of wheat germ over other milled products as a nutritive supplement. Wheat germ contains very high levels of essential amino acids and is an excellent source of lysine, methionine and threonine, which are absent in many other cereal proteins. Wheat protein isolates are currently of special interest to processors and consumers due to its low fat content and can serve as a substitute for egg and dairy proteins (Hassan *et al.*, 2010).

Flax *(Linum usitatissimum)* is an annual plant of the linaceae family. It was used for medicinal purposes in ancient Egypt and Greece, mainly to relieve abdominal pains and also as energy source. Flax is considered a functional food because it contains alpha-linolenic acid, lignans and polysaccharides, all of which have positive effects in disease prevention (Bozan and Temelli, 2008). Although scientific evidence supports flax seed consumption, many people are still unaware of the benefits provided by this product and its possible applications in the food preparations (Udeniqwe *et al.,* 2009). Health benefits of flax lignans reside in their antioxidant capacity as sequesterants of hydroxyl radicals thereby protect against damage to DNA (Hu *et al.,* 2007).

Diet based methods of prevention would not only be more feasible, but ultimately more cost effective. With recent scientific advances, natural products and health promoting foods have received extensive attention from both health professionals and the common population. Functional foods play positive roles in maintaining well being, enhancing health, and modulating immune function to prevent specific diseases. They also hold great promise in clinical therapy due to their potential to reduce side effects and significant advantages in reducing the health care cost (Ramaa *et al.*, 2006). These

botanicals are well accepted as complementary medicine in modern medical practices, in view of their synergism and compatibility (Ali *et al.*, 2009).

Fortunately, most premature cardiovascular deaths are preventable. Therefore, prevention becomes vital and diet has shown beneficial effects to protect from cardiovascular diseases. Findings from laboratory, clinical and epidemiological studies indicated that consumption of functional foods prevents several major diseases, such as cancer and heart disease, prompting health authorities to promote consumption of these foods (He *et al.*, 2006).

Different types of foods differ widely in their nutrient content (Morgan and Worsley, 2011). In addition, method of preparation like frying, peeling, use of baking soda in cooking, type of water and storage conditions like heat, air, light and humidity, affect the nutrient content of foods. Foods also differ in the manner in which they are prepared and eaten, and the amounts in which they are eaten daily. Such differences have important implications for analysis of food intake and chronic disease risks. Foods are extremely biochemically complex and contain compounds which may interact with one another. Therefore, the effect of a particular food in the human body cannot be completely described by the effects of nutrients singly. The biochemical complexity of food ingredients as delivery systems for protective nutrients and functional components cannot be underestimated.

Hence, the cardio protective effects of these functional foods can be best studied only when specific amounts of these foods under minimal processing is taken for a specified period of time. Though several studies have evaluated the effects of these functional foods as part of the daily diet in processed forms, there is less number of studies incorporating powdered, unprocessed forms of a combination of these functional foods in the form of a food mix.

Although safe and effective preventive treatments are available at low cost, they have not been effectively implemented. Intervention studies in this direction intended to curb the prevalence of cardiovascular diseases are still largely missing from the health care services of most low and middle income countries. The development and implementation of strategies to prevent and

treat cardiovascular diseases in these countries will require major efforts to direct scarce resources to interventions that are cost effective, culturally appropriate, and sustainable. Public health interventions which influence lifestyle behaviours through policy, public education or a combination of both, have been demonstrated to yield rich dividends in reducing the risk of cardiovascular disease in populations as well as in individuals (Goenka *et al.*, 2009).

Knowledge is an important prerequisite for implementing both primary as well as secondary preventive strategies for cardiovascular disease. Lack of awareness of the risk of cardiovascular diseases may impede preventive efforts as well as the adoption of positive lifestyle changes. The Non Communicable Disease Alliance, with The World Heart Federation (Franco et al., 2011) is aggressively urging implementation of the WHO 2008–2013 Action Plan for the Global Strategy for the Prevention and Control of Non Communicable Diseases and the Global Strategy on Diet, Physical Activity and Health for primordial prevention and control of cardiovascular diseases. Whether framed as disease prevention or health promotion, these goals require vigilant self management to engage in correct behaviour to proactively modify one's risk factors for disease wherein the concept of individual responsibility is strikingly evident in the term modifiable risk factors. Health promotion/disease prevention presumes a high level of self regulation and a willingness to control one's behaviour to avert risk of death or disability (Nelkin, 2003).

Counselling is the means by which a person helps another to clarify his/her life situations and to decide on further lines of action (Burnard, 1992). Counselling in the health care setting means a dialogue between a client/patient and a health care provider with the basic aim of solving a problem and providing a change in behaviour. Diet counselling involves constant interaction between the counsellor and the clients/patients about therapeutic diets to produce a change in food behaviour. It is also targeted at healthy people who could also benefit from changes in food intake and habit for preventive health to reduce the risk of developing chronic diseases (Ndiokwelu and Ndiokwelu, 2006).

Poor compliance to dietary recommendations, unhealthy lifestyle and mismanagement of cardiovascular emergencies reflect the dearth of awareness among the community. For years, the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC, 2004) and the American Heart Association (AHA) have recommended that physicians help patients at risk for cardiovascular diseases to set dietary and physical activity goals to control blood pressure and reduce their cardiovascular risk.

The report of the American College of Cardiology Foundation and American Heart Association (ACCF/AHA, 2009) on primary prevention of cardiovascular disease included both dietary intake counselling and physical activity counselling as key performance measures for all adult patients, regardless of reason for visit. Despite both clinical evidence and national recommendations, physician counselling and diet management remains suboptimal. However, this task is often left unaccomplished.

With this background the present study has been undertaken with the following objectives, To

- Develop functional food mixes for cardiovascular disease
- Evaluate the food mixes developed in terms of acceptability and nutrient content
- Assess the nutritional status and blood parameters of selected adults with cardiovascular diseases
- Supplement the diets of selected adults with cardiovascular disease with the developed food mixes for a period of six months
- Evaluate the effect of the developed food mixes using various parameters and
- Impart diet counselling using various methods and evaluate its impact on adults with cardiovascular diseases.