Effect of Bitter Gourd for the Management of Type II Diabetes Mellitus

Abirami, P

(12PFN001)

Thesis submitted to the

Avinashilingam Institute for home science and

Higher Education for Women

Coimbatore - 641043

In partial fulfillment of the requirement for the degree of

Master of Science in Food Science and Nutrition

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Signature of the

Head of the Department

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

I. INTRODUCTION

"Health is a state of complete harmony of the body, mind and spirit. When one is free from physical disabilities and mental distraction, the gates of the soul open"

- Iyengar

Type 2 diabetes mellitus (T2DM), formerly known as non-insulin-dependent Diabetes mellitus or adult-onset diabetes is a metabolic disorder that is characterized by high levels of blood glucose as a result of insulin resistance and relative insulin deficiency. The World Health Organization (WHO) definition of type II diabetes mellitus is increased glucoselevels on two occasions: Of either fasting plasma glucose ~7.0 mmol/L or with a glucosetolerance test , two hours after the oral dose a plasma glucose ~ 11 .1 mmol/L. (Jorge,2011)

According to World health organization report (2012) every 100 hospitalized patients. 7 per cent in the developed and 10 per cent in developing countries are due to health associated infection. In intensive care unit, the figure even rises up to 30 per cent.

Non communicable diseases fully consistent with International foundation of Red cross strategy (2020) under strategic aim to enable healthy and safe living .It encourages "action on the underlying social, behavioral and environmental factors that determine good health" and inclusive public health system. (http://www.IFRC.org)

Non communicable diseases are also known as chronic diseases of long duration and slow in progress. They are of four types such as cardiovascular disease, cancer, chronic respiratory disease and diabetes (WHO, 2013)

Non communicable diseases kill more than 36 million people each year. Nearly 80 per cent are of non -communicable death.29 million of all death occurs in low and middle income countries. More than 9 million of all death contributed to non-communicable diseases occur before the age 60, 90 per cent of all these premature death occur in low and middle income countries (Jyotisithag *et al*., 2011)

The prevalence of diabetes for all age groups worldwide was estimated to be 2.8 per cent in 2000 and 4.4 per cent in 2030. The total number of people with diabetes is projected to be rise from 171 million in 2000 to 366 million in 2030.(Wild, 2004)

India leads the world with largest number of diabetic subjects earning the dubious distinction of being termed the “diabetes capital of the world”. According to the Diabetes Atlas 2006 publishedby the International Diabetes Federation, the number of people with diabetes in India currently around 40.9 million is expected to rise to 69.9 million by 2025 unless urgent preventive steps are taken (Mohan *et al*., 2007)

In India a large population is insulin resistant and prevalence of diabetes is high. It is estimated that about 9 per cent of Indians suffer from diabetes. The prevalence is increasing alarmingly in urban India. It has doubled last three decades .Prevalence of diabetes 2-3 fold higher in urban rural India and occurs at a much younger age in Indians. More than 90 per cent of all diabetes belongs to type II diabetes mellitus. Diabetes exists in all populations with variation in prevalence between ethnic group and geographic areas. India currently has 62.4 million diabetes based on the current rates prevalence of diabetes in India is expected to reach100 million by 2030 (Hemalatha, 2013)

The urban population in developing countries is projected to be double between 2000 and 2030.The most important demographic change to diabetes prevalence across the world appears to be increase in population of people >65 years of age (Sarahwild *et al*., 2004)

The prevalence of diabetes and pre-diabetes in three states (Tamil Nadu, Maharashtra and Jharkhand) and one union territory (Chandigarh) of Indiaestimate that, in 2011, Maharashtra will have 6 million individuals with diabetes and 9.2 million with prediabetes, Tamil Nadu will have 4.8 million with diabetes and 3.9 million with prediabetes, Jharkhand will have 0.96 million with diabetes and 1.5 million with prediabetes, and Chandigarh will have 0.12 million with diabetes and 0.13 million with prediabetes. Projections for the whole of India would be 62.4 million people with diabetes and 77.2 million people with pre diabetes (Anjana *et al*., 2011)

In the poorest countries, people living with diabetes and their family bear almost entire cost of medical care. In India, people with low income suffer from diabetes spend an average of 25 per cent of their income. In Latin America and Caribbean family pay 40-60 per cent, USA -50 per cent. Considering mainly the effects of premature mortality WHO estimates that (between 2005 and 2014) diabetes, heart disease and stroke combined will cost

- ✓ 555.7 billion in national income of china
- ✓ 303.2 billion in the Russian federation
- ✓ 336.6 billion in India
- ✓ 49.2 billion in Brazil
- ✓ 2.5 billion in poor countries like Tanzania (International diabetic federation 2006)

A modest reduction in carbohydrate intake associated with improvements in glycemic control and low carbohydrate diets can be particularly effective in associated with weight loss (www.diabetesorg.UK, 2009)

In urban south Indians, total dietary carbohydrate and glycaemic load are associated with increased and dietary fibre with decreased risk of type II diabetes (Mohan *et al.,* 2008)

Good nutrition and regular exercise can help to prevent, manage medical complications of diabetes and help patient live longer and healthier lives (Simon, 2012)

Physical activity protects against development of type II diabetes mellitus. Regular physical activity improves insulin resistance and lipid profile and lowers blood pressure. The metabolic effects in type II diabetes are lost within 3-10 days of stopping regular exercise (Kavanagh *et al*., 2011)

For patients who are unable to achieve the life style goals, exercise and losing weight, metformin has also been proven effective, especially in younger obese patients. Acrobase when tolerated at maximum effective dose, may also confer a moderate risk reduction (Leena *et al*., 2010)

The main components of the life style interventions include weight loss, reduction in fat intake and increased fiber intake (Deakin.et.al 2011)

Lowering glycemic index of the diet appears to be effective method to improve glycemic control in diabetes. Incorporating a low glycemic index diet as a part of life style thus yields a good potential benefit for long term glycemic control (Thomas *et al*., 2010).

Insulin and other diabetes medications are designed to lower blood glucose levels when diet and exercise alone are not sufficient for managing diabetes. But the effectiveness of these medications depends on the timing and size of the dose. (Mayo Foundation, 2011)

In comparison to conventional drugs, medicinal plants and herbs possesses no side effects and are easily available. They are relatively low cost, better cultural acceptability and compatibility with the human body for primary health care, herbal medicines are still the mainstay of about 75-80 per cent in world population, mainly in developed countries but the last few days seen a major increase in consumption in developed countries (Kamboj, 2000)

Indian herbs such as *Memordica charantina, Pterocar pusmarsupium* and *Trigonella foenumgracium, Coccnia cordifolia* have been reported to have hypoglycemic effect in type II diabetes through stimulating or regenerating effect on beta cells or through extra pancreatic effect (Saxena *et al.,* 2004).

Bitter gourd is a low cost vegetable that is available whole year at local market in southern and eastern Asia and tropical Africa (Sridhar *et al.,* 2008)

Momordica charantia (bitter melon) is a popular fruit used for the treatment of diabetes and related conditions amongst the indigenous populations of Asia, South America, India and East Africa. Abundant pre-clinical studies have documented the anti-diabetic and hypoglycaemic effects of *M. charantia* through various postulated mechanisms (Leung *et al.,* 2009)

Bitter gourd is a popular vegetable in Asian countries. In recent years researches worldwidehave started to focus anti diabetic effect on bitter gourd.There

are three groups of components in bitter melon such as Charatin, polypeptide b, oleanoic acid glycosides have found to be responsible for its blood sugar lowering action (www.http://the national bitter melon council, 2008)

Bitter gourd with the high amount of saponin and lipids are effective in the prevention and treatment of diabetes. The white bitter gourd varities have low saponin concentration and may be less effective .total lipids and fatty acid composition seems to depend more on maturity of the fruits that on difference between varities. Hence bitter gourd varities that are not too immature and gently processed can be used for the prevention and treatment of diabetes mellitus. It is proved that Bitter gourd is very effective in glaciated hemoglobin levels, decreasing body weight and oxidative stress in type II diabetic mice (Sandra *et al*., 2010)

Not all of bitter melon have active constituents have been identified but plants containing alkaloids, glycosides, peptides, acids, curcubitins, memordine and proteins. It is through the primary constituents responsible for the hypoglycemic properties are charantin, insulin like peptide, curcubutanoids, memordicin and oleanolic acid. Depending upon the condition of the disease different parts of the plant such as leaves, dried, fresh fruit, wine, whole plant, fresh juice are used medicinally. Powdered, dried fruit has been dosed in the range of 3-15g/day and an aqueous decoction of the fruit has ranged from 100-200mg/day (Hudson, 2012)

With this view, the present study entitled “Effect of Bitter gourd for the Management of Type II diabetes with the following objectives

- Elicit information on demographic profile of selected diabetic subjects.
- Evaluate the nutritional status of the subjects
- Asses the dietary habits and life style pattern of the subjects
- Supplementation of bitter gourd powder for the management of diabetes mellitus. and
- Evaluate the impact of supplementation using various parameters

II. REVIEW OF LITERATURE

The review of literature pertaining to the present study entitled "**Effect of Bitter gourd for the management of Type II Diabetes Mellitus"** is presented under the following headings.

A. Non communicable diseases – A global problem
B. Prevalence and factors influencing Diabetes Mellitus
C. Management of Diabetes Mellitus
D. Prevention and Treatment of Type II Diabetes Mellitus
E. Food based approach – Bitter gourd a boon to Diabetes Mellitus

A. NON COMMUNICABLE DISEASES - A GLOBAL PROBLEM

Non Communicable Diseases (NCDs) are also known as chronic diseases that are not passed from one person to another person. They are of long duration and generally slow in progression. The four main types of Non communicable diseases are cardiovascular diseases, Cancers, chronic respiratory disease and diabetes. 80 percent of Non-communicable deaths with 29 million occur in low and middle income countries. (Http://www.who.int)

The present trend like smoking, alcohol, physical inactivity and western diet consumption is continued with the health system in low and middle income countries will be unable to support the burden of disease (Abdesslam *et al.,* 2011)

NCDs are the leading cause of death in the world, responsible for 63 per cent deaths worldwide in 2008. NCDs accounts for 53 percent of deaths in India. Based on available evidence cardiovascular diseases (24 percent), chronic respiratory diseases (11 percent), cancer (6 percent) and diabetes (2 percent) are the leading cause of mortality in India (Kalpana, 2013)

Non communicable disease prevention and control programs in India should have a comprehensive approach to policy measures involving multiple stake holders , population based risk factors modification and evidence based cost effective management of individual with disease (Mohan *et al.,* 2012)

According to (www.gbchealth.com 2013) the burden of Non Communicable diseases estimates to be

Diabetes	• **Type II diabetes prevalence has more than doubled since 1980, from an estimated 153 million to about 347 million in 2008.** • **By 2030, 7.8 per cent of the world's adult population is expected to be living with diabetes** • **WHO projects that diabetes deaths will double between 2005 and 2030**
Cardio Vascular Disease (CVD)	• CVD is the number one cause of death globally • By 2030, almost 23.6 million people will die from CVDs, mainly from heart disease and stroke
Cancer	• 7.8 million people died from cancer in 2008, accounting for 13 per cent of deaths worldwide • By 2030, the burden of cancer is expected to increase to 22 million cases. This is a 73 per cent increase compared to 2008

A large percentage of NCDs can be prevented by reducing the four main shared risk factors like tobacco use, physical inactivity, harmful use of alcohol and unhealthy diet. At least 80 per cent of premature heart disease, stroke and Type II Diabetes can be prevented. (www.world heart.org)

The recent political recognition of the importance of the global burden of non-communicable diseases is welcome, but it remains to be seen how political commitments will translate into practical action, particularly in resource-limited settings where the challenges of providing adequate care and treatment are significant. The growing global burden of non-communicable diseases is now killing 36 million people each year and needs urgent and comprehensive action. The critical

issues that need to be resolved to ensure that recent political commitments are translated into practical action including

(i) Categorizing and prioritizing NCDs in order to inform donor funding commitments and priorities for intervention

(ii) Finding the right balance between the relative importance of treatment and prevention to ensure that responses cover those at risk, and those who are already sick Defining the appropriate health systems response to address the needs of patients with diseases characterized by long duration and often slow progression

(iii) Research needs, in particular translational research in the delivery of care and

(iv) Sustained funding to support the global NCD response (Maher *et al.,*2012)

B. PREVALENCE AND FACTORS INFLUENCING DIABETES MELLITUS.

The risk of getting Type II diabetes was associated with high, middle and low income countries and overall. The strength of the associations was consistent in high-income countries, whereas there is a strong need for further investigation in middle- and low-income countries (Emilie *et al*., 2011).

According to (Ranil *et al*., 2012) prevalence of PRE- DIABETES: DIABETES in regional countries were

Countries	Pre-diabetes: diabetes	Year
Bangladesh	4.7 per cent :8.5 per cent	2004 – 2005 (Rural)
India	4.6 per cent :12.5 per cent	2007 (Rural)
Maldives	3.0 per cent : 3.7 per cent	2004 (National)
Pakistan	3.0 per cent : 7.2 per cent	2002 (Rural)
Sri Lanka	11.5 per cent :10.3 per cent	2005 – 2006 (National)

Type II diabetes affect 16 million adults in United States and many as two third of the cases are undiagnosed. The incidence is higher among minority groups.

Type II Diabetes Mellitus believed is due to combination of genetic and lifestyle factors. Risk is increased in individuals who are overweight in those who have a body type with more fat in the abdominal region and in people with a family history of diabetes (Smotin *et al*., 2003).

The prevalence of diabetes was 1598/100,000(95 percent cl 462,1753 among men and 1054/100,000 (95 per cent cl 974,1134) among women in India. Rural-Urban and marked geographic variation were found with higher rates in South North and eastern parts of India. Weekly and daily fish intake contributed to a significant high risk of diabetes among both men and women. Risk of Diabetes increased with increased BMI, age and wealth status of both men and women. Daily consumption of pulse, beans, or fruits was associated with a reduced risk of diabetes among women whereas non- significant inverse association were observed in case of men (Agrawal *et al.,* 2011)

The prevalence of impaired glucose tolerance is thought to be around 8.7 per cent in urban areas and 7.9 per cent in rural areas. It is thought that around 35 per cent of impaired glucose tolerance sufferers go on to develop Type II Diabetes, so India is genuinely facing a healthcare crisis (www.diabetes.co.Uk)

The age and gender adjusted prevalence of metabolic syndrome, using the Indian Diabetic Federation criteria, in the South Indian population was 73.3 per cent. The prevalence was higher in women (83.3 Per cent), compared to men (65.3 per cent). In subjects with Diabetes Mellitus, without and with metabolic syndrome, the prevalence of retinopathy was 21.3 Per cent and 16.9 per cent ($p = 0.057$); prevalence of nephropathy was 20.5 per cent and 18.0 per cent ($p = 0.296$), and prevalence of neuropathy was17.2 per cent and 19.4 per cent ($p = 0.353$) respectively (Rajiv *et al.,* 2010).

In Tamil Nadu the urban prevalence has been reported as 14-16 percent and rural prevalence in 10-12 percent (www.Annual Research - India.co.in)

Amritha Diabetes and Endocrine Population Survey (ADEPS 2005) identified 9 percent reported- prevalence and 10.5 percent prevalence of newly detected

diabetics among semi-urban and urban adult residents aged 18 years and above in Central Kerala (Menon *et al* ., 2006).

Prevalence of risk factors for diabetes is very high and increasing in Kerala. This situation is largely attributable to rapid changes in the lifestyle of people living in this state of India. The findings from the systematic review and focus groups identified many environmental and personal determinants of these unhealthy lifestyle changes, including: less than ideal accessibility to and availability of health services; cultural values and norms; optimistic bias and other misconceptions related to risk (Daivadanam *et al*., 2013).

According to Chandalia (2007) factors likely to influence, increase and decrease prevalence of Type II diabetes include

S.No	Factors	Factor likely to increase prevalence	Factor likely to decrease prevalence
1	Demography of the population	Increasing life span	Increase in younger age groups
2	Obesity	Increasing obesity	Decreasing obesity
3	Education	Continuing lower educational status	Rapidly increasing general and health education
4	Income	Increasing income (specially when accompanied by poor educational inputs)	Increasing income (specially when accompanied by enhanced educational inputs)
5	Genetic factors	Increased prevalence till adverse environment has acted on most genetically susceptible population	Stabilizing influence of genetically non-susceptible group
6	Physical activity	Decreased activity due to urbanization and poor built environment	Increased physical activity by introducing healthy lifestyle through education and better town planning
7	Diet	Increased calories, saturated fat, sugar and refined food intake	Decreased calories, saturated fat, sugar and refined food intake
8	Mental stress	High stress with poor quality of life	Peaceful and good quality of life

Myocardial infarction, heart failure and renal disease had the greatest fiscal impact because of the total number of patients experiencing them (7.2 per cent, 14.0 per cent and 11.0 per cent respectively) and their associated costs with 12-month mean allowed amounts were $US14853, $US11257 and $US13876, respectively and 12-month mean charged amounts were $US41695, $US30066 and $US34987, respectively (Elise, 2008)

C. MANAGEMENT OF DIABETES MELLITUS

Improving patient's self-efficacy beliefs with reference to diabetes management may be important to achieving clinical control of disease, and has implications on how health care is organized in the hospital setting. It appears that health care delivery inputs, patient's personal characteristics including education and attitude, and family support for care are completely processed to determine self-efficacy, which ultimately influences disease outcomes. Disease management interventions which focus on providing patients with the confidence for self-management, thereby improving self-efficacy, may therefore lead to better patient outcomes, as well as greater patient satisfaction. This will require better organization of care at the institutional level, as well as greater interface with patients and families to provide the necessary skills and support to enhance self-management (Kavita *et al.,* 2011)

To establish individualized evidence-based recommendations for the people with diabetes and those at high risk of developing Type II diabetes which include:-

- support self- management to reduce the risk of diabetes and its associated co-morbidities
- promote quality of life and healthy lifestyles
- provide flexibility and meet the needs of all individuals, including those with co-morbidities such as celiac disease and cystic fibrosis (Diabetes UK organization 2011).

Life style modifications

Type II diabetes is a major public health issue in most countries around the world. Efficacy trials have demonstrated that lifestyle modification program can significantly reduce the risk of Type II diabetes. Two key challenges are:

- to develop programs that are more feasible for “real world” implementation
- to extend the global reach of such programs, particularly to resource-poor countries where the burden of diabetes is substantial (Braian *et al*., 2011)

According to Kumar (2012) the management of diabetes is achieved by lifestyle changes which include

- **Weight reduction** : which helps the body to become more sensitive to insulin and use glucose more effectively
- **Physical activity** : regular moderate physical activity helps manage weight and reduce blood glucose levels. It may also improve blood pressure and cholesterol
- **Balanced diet** : inclusion of less fat diet, especially saturated fat and more fruit, vegetables and high fiber foods in the diet.
- **Stop smoking** : smoking causes insulin resistance and increasing the risk of vascular disease
- **Blood pressure and cholesterol should check regularly**

Exercise based approach

Smoking and low fruit and vegetable consumption were significantly higher among lower socioeconomic groups. Physical inactivity was less prevalent in populations of low socioeconomic status, especially in low-income countries (Ahmad *et al.,* 2012).

Obesity and physical inactivity are cause of developing Diabetes Mellitus (Strom *et al.,* 2011).

Compared to men without T2DM, men with T2DM had higher depressed mood as well as lower perceived general health and social functioning. Men with

Type II Diabetes Mellitus also had and muscle strength as well as being slower to complete physical performance tasks. In those with T2DM, depressed mood was highly was correlated with fasting glucose but not the functional measures (Itamer *et al*., 2012)

Two randomized trials each found that lifestyle interventions including ∼150 min/week of physical activity and diet-induced weight loss of 5–7% reduced the risk of progression from impaired glucose tolerance impaired glucose tolerance to Type II diabetes by 58 per cent. A cluster-randomized trial found that diet alone, exercise alone, and combined diet and exercise were equally effective in reducing the progression from impaired glucose tolerance (Ronald *et al.,* 2006).

Physical activity can help prevent or delay the onset of Type II diabetes. It is particularly effective in the prevention of Type II diabetes in people who are sedentary. Physical activity appears to be the strongest predictor in reducing the incidence of Type II diabetes in the absence of any change in weight, blood pressure or cholesterol (National heart foundation of Australia 2006).

Pranayama or alternate nostril breathing in Yoga useful in diabetes as Alternate nostril breathing has calming effect on nervous system, which reduces stress levels, helping in diabetes treatment. Also research has shown that Bhramari and Bhasrika Pranayama help in diabetes (Yogacharya *et al.,* 2013)

The majority of Sri Lankan adults were highly active physically. Female, gender, old age, urban living, Muslim ethnicity and tertiary education were all significant predators of physical inactivity. Physical inactivity was associated with obesity, diabetes, hypertension and metabolic syndrome (Kutulanda *et al.,* 2012)

Drug based approach

Management of Type II diabetes with oral hypoglycemic agents appears to be sub optimal for many patients. Oral treatment is not started until glycemic control is poor, and many patients do not receive adequate monitoring or have poor glycemic control following treatment with oral agents. Many patient with a high pre-treatment hba1c are not controlled on a single oral agent even at high dose suggesting that earlier more aggressive treatment in primary care is required (Melanie *et al.,*2007)

Both lifestyle modification and metformin significantly reduced the incidence of diabetes in Asian Indians with impaired glucose tolerance, there was no added benefit from combining them. The relative risk reduction was 28.5 per cent with lifestyle modification, 26.4 per cent with metformin and 28.2 per cent with lifestyle modification combined with metformin (Ramachandran *et al.,* 2007).

According to Gernetol (2011), Diabetes affects 21.2 percent of older adults and 50.9 percent of prevalent cases are treated pharmacologically.

Diet based approach

No universal dietary Strategy prevents or delays the onset of diabetes. It is achieved together with the maintenance of ideal body weight, promotion of the "Prudent diet" (characterized by a high intake of food groups that generally recommended for health promotion, particularly plant based foods and a lower intake of red meat products, sweets, high fat diary and refined grains) or a Mediterranean dietary pattern rich in olive oil, fruits and vegetables, including whole grains, pulses and nuts , low fat diet moderate alcohol consumption appears as a best strategy to reduce diabetes risk, especially if dietary recommendation taken into account individual preference thus long term adherence to diabetes (Salvado *et al.,* 2011)

A healthy, plant-based diet that is low in saturated fat and refined carbohydrates but high in whole grains, vegetables, legumes, and fruits, coupled with resistance and aerobic exercise regimens, are recommended for patients with T2DM (Daniel, 2013)

The interact study has confirmed that an higher consumption Mediterranean dietary pattern is associated with a significant reduction (-12 percent) in the risk of developing Type II Diabetes Mellitus compared with individuals with low adherence to Mediterranean diet in a large coherent of healthy subjects from Mediterranean and non- Mediterranean countries (Rosalba *et al*.,2013)

A low glycemic index is beneficial in controlling post prandial hyperglycemia. Oats and oat products are abundant in beta-glucan which could lower the glycemic index of products and foods. When oat products is add into the diet and fed for

streptozotocin induced diabetic rats, it significantly decreases fasting blood glucose and glycosylated serum proteins (Ruiling *et al.,* 2011)

The diets that produced the biggest improvements in glycemic control were the Mediterranean and high-protein diets which dropped HbA1C by a clinically significant 0.47 per cent and 0.28 per cent, respectively, compared with their control diets, while the low-GI and low-carbohydrate diets reduced HbA1C by an average of 0.14 per cent and 0.12 per cent. The Mediterranean and low-carbohydrate diets proved to be the most effective for weight loss (1.84 kg and 0.69 kg, respectively) compared to control diets. All diets generally had a modest effect on lipids (cholesterol profile), with most of the diets driving up HDL but only the Mediterranean diet lowering triglycerides (a type of fat that circulates in the blood stream that tends to rise with high blood sugar (Jennifer, 2013)

Substances such as caffeine, chlorogenic acid and magnesium, have been suggested as responsible for the protective effect in the risk of Diabetes Mellitus (Type II) although habitual moderate coffee intake seems to be safe and reduce the risk of Diabetes Mellitus (Type II). Researchers state that it is early to recommend an increase in coffee consumption as a public health strategy for preventing diseases (Gustavo *et al.,*2009)

D. PREVENTION AND TREATMENT OF TYPE II DIABETES MELLITUS

Maintaining blood glucose levels, blood pressure, and cholesterol at or close to normal can help delay or prevent diabetes complications. (www.international diabetes association)

Prevention of diabetes is our most powerful intervention, and successful implementation of these proven strategies should be considered first for the treatment of diabetes. The first step in diabetes prevention is identifying patients who are at highest risk. This group includes individuals of any age who are overweight and obese (BMI > 25 kg/m^2) with at least one risk factor (such as high-risk ethnic group, first-degree relative with diabetes, personal history of gestational diabetes, or sedentary lifestyle). The American Diabetes Association (ADA) recommends that these patients should be screened every 3 years. All other patients should begin screening at the age of 45 years (Clinical Diabetes, 2010)

The economic effects of three policy measures against prevention of diabetes which include the following:

- Diabetes prevention program
- Tax on sugars and
- Combining the above two methods

The biggest economic benefit is obtained with simultaneous sugar tax and prevention program policy. The gain from these preventive measures is 0.09 percent in terms of gross profit. Investment is 0.16 percent higher and household Consumption is 0.33 percent higher when compared with a no policy situation. Government consumption is reduced by over half a percent (Karriena, 2013)

The Japanese Diabetes Outcome intervention Trial-1 a nation- wide trial to prevent the development of Type II Diabetes Mellitus in high risk individual using telephone delivered intervention (Sakene *et al.,* 2013)

According to the U.S. Centers for Disease Control and Prevention's (CDC) National Diabetes Fact Sheet, nearly 26 million American adults and children have diabetes. About 79 million Americans aged 20 years and older have pre-diabetes, a condition that increases the risk for developing diabetes (Simon, 2013)

Complications of diabetes

India has the highest number of people with diabetes in the world. Diabetic foot care is one of the most ignored aspects of diabetes care in India. Due to social, religious, and economic compulsions, many people walk barefoot. Poverty and illiteracy lead to the usage of inappropriate foot wear and late presentation of foot lesions (Kshitij *et al.,* 2008)

The prevalence of micro albuminuria and that of macro albuminuria Individuals with macro albuminuria in comparison to micro- or normal albuminuria showed a greater prevalence of diabetic retinopathy and also a greater severity of the disease (Rani *et al*., 2011)

Complication rates were high (27.2 per cent had macro-vascular complications and 53.5 per cent had micro-vascular complications), particularly in

Russia, and use of vascular disease preventative drugs was lower than expected. Age, BMI, diabetes duration, Low density lipoprotein cholesterol, and blood pressure were positively associated, and high density lipoprotein cholesterol negatively associated, with macro- and micro-vascular complications. HbA_{1c} and fasting plasma glucose levels were negatively associated with macro-vascular complications, which may be linked to the cross-sectional study design (Leon *et al.,* 2013).

Type II diabetes is typically a chronic disease associated with a ten-year-shorter life expectancy. This is partly due to a number of complications with which it is associated, including two to four times the risk of cardiovascular disease, including ischemic heart disease and stroke; a 20-fold increase in lower limb amputations, and increased rates of hospitalizations. In the developed world, and increasingly elsewhere, Type II diabetes is the largest cause of non-traumatic blindness and kidney failure.It has also been associated with an increased risk of cognitive dysfunction and dementia through disease processes such as Alzheimer's disease and vascular dementia. Other complications include: acanthosis nigricans, sexual dysfunction, and frequent infections (www.wikipedia.com).

There is a high frequency of Heart Failure (HF) accompanied by an increased mortality risk for patients with diabetes. The poor prognosis of these patients has been explained by an underlying diabetic cardiomyopathy by hypertension and ischemic heart disease (David *et al*., 2004)

Every 6^{th} individual in the population of Type II diabetes is likely to have albuminuria. Subjects with micro-albuminuria were around 2 times as likely to have DR as those without micro-albuminuria, and this risk became almost 6 times in the presence of macro-albuminuria (Padmaja *et al*., 2011).

Retinopathy was diagnosed in 1176 (28.9 per cent), nephropathy in 1323 (32.5 per cent), neuropathy in 1225 (30.1 per cent), cardio vascular disease in 780 (19.2 per cent) and peripheral vascular disease was present in 735 (18.1 per cent) patients (Agarwal *et al.,* 2004).

There is a high frequency of heart failure (HF) accompanied by an increased mortality risk for patients with diabetes. The poor prognosis of these patients has been explained by an underlying diabetic cardiomyopathy by hypertension and ischemic heart disease (David *et al*., 2004)

The complexity of chronic diabetes or lack of awareness leads to sudden onset of diabetes poses a significant risk of occurrence of ketoacidosis and diabetic coma, if untreated (Ramanchawla *et al*., 2013)

ill effects to the economy

Population-based survey recipients found that increased income tends to increase overall food market size among low- and middle-income countries but the level of food importation significantly shifts the content of markets such that a greater proportion of available joules is composed of sugar and related sweeteners. Sugar exposure statistically explained why urbanization and income have been correlated with diabetes rates (Basu *et al.,* 2012)

According to (Hyacinthe *et al.,* 2013) the following countries spends more of their expenditure for treatment of diabetes.

Authors*	Countries	Spending on medicines as a percentage of total expenditure on diabetes (%)
Rayappa *et al*. (1999)	India	32
Elrayah *et al*. (2005)	Sudan	36 (only insulin)
Villarreal-Ríos *et al*. (2000)	Mexico	37
Khowaja *et al*.(2007)	Pakistan	46
Grover *et al*. (2005)	India	62

The cost of diabetes care is high and is escalating worldwide. In 2007, the world spent an estimated 215–375 billion dollars for diabetes care. It is likely to rise from 234 to 411 billion in the next 20 years (Broen *et al.,* 2006)

According to the National Sample Survey Organization the share of non-communicable disease in our health expenses increased 31.6 percent in 1995-1996 to 47.3 percent in 2004(Michael *et al*., 2012.)

A recent study by us in India showed a two fold increase in expenditure on diabetes care in urban areas from 1998–2005. The median expenditure had risen from INR 4200/- (USD 95) to INR 9000/- (USD 203). The indirect cost is more difficult to assess and much higher than the direct cost. The proportion of annual income spent on health care is around 25–30% by the poor people. It has also been shown that cost increases many fold in the presence of complications (Ramachandran *et al*., 2008).

Myocardial infarction, heart failure and renal disease had the greatest fiscal impact because of the total number of patients experiencing them (7.2%, 14.0% and 11.0%, respectively) and their associated costs with 12-month mean allowed amounts were $US14853, $US11257 and $US13876, respectively, and 12-month mean charged amounts were $US41695, $US30066 and $US34987, respectively(Elise 2008)

E. FOOD BASED APPROACH - BITTER GOURD A BOON TO DIABETES MELLITUS

The genus *Memordica-L.,* best known for the bitter gourd comprises several species of medicinal importance in Asia and Africa. Besides the cultivated Bitter gourd other species occur species occur in the wild state and are species occur in India and among them among only three species *Memordica charantina, Var Muricata (wild) m.sahayadrica* are distributed in western Ghats (John *et al.,* 2006)

Bitter gourd is a Slender-stemmed tendril climber of the *curcubitaceae* family, the older stem is often flattened and fluted to 6 m or longer. Leaves alternate, cut into 5–7 narrow-based lobes. The lobes are mostly blunt, but have small marginal points, up to about 12 cm long, very thin-textured, and characteristically pungent and aromatic. Flowers are yellow on short (female) or long (male) peduncles that are short-lived. Fruit narrowed to both ends, ribbed with prominent tubercles on the ribs, 8 to 15 cm long, orange when ripe and then becoming soft fleshy and opening to reveal pendulous seeds covered with red pulp (Ivan *et al*., 2003)

Bittergourd (*Momordica charantia*) is one of the most popular vegetables grown in India. It is commonly known as bitter melon or Karela. The fruits of bittergourd are rich in folate and vitamin C and are used in a variety of culinary

preparations. The medicinal value of the gourd in the treatment of infectious diseases and diabetes is attracting the attention of scientist worldwide (Gupta *et al*., 2012)

Bitter gourd contains substances with anti-diabetic properties such as charantin, vicine and polypeptide-p, as well as other unspecific bioactive components such as antioxidants. Metabolic and hypoglycemic effects of bitter gourd extracts have been demonstrated in cell culture, animal, and human studies. Bitter gourd has the potential to become a component of the diet or a dietary supplement for diabetic and pre-diabetic patients. Well-designed interdisciplinary research by nutritionists, medical doctors, and agronomists is needed before a dietary recommendation can be given and a product brought to the market Bitter gourd has the potential to become a component of the diet or a dietary supplement for diabetic and pre-diabetic patients (Michael *et al.,* 2008)

Chemical constituents from whole plants, fruits, and seeds of bitter melon have been isolated and described. Bitter melon fruit contains triterpene lycosides, including the characteristic mormordin and charantin. Other triterpene glycosides (the momordicosides), vitamins, including beta carotene, ascorbic acid, niacin, and thiamin, elemental compounds (eg, iron, iodine, magnesium, sodium, calcium), and fatty acids, including stearic, palmitic, and oleic, are also present. Insulin-like compounds, or compounds exerting hypoglycemic activity, have been described. Bitter melon seeds and the pericarp contain compounds like phenolics catechin and epicatechin, gallic, gentisic, vanillic acids, and also components like lutein, lycopene, carotenes, xanthins, momordicosides, and vicine. The seed essential oil contains sesquiterepene, phenylpropanoids, and monoterpenes, including nerolidol (Horax *et al.,* 2010)

Experimental findings with respect to the mechanism of action of memordica charantina fruit extract in alloxan diabetic rats suggest that it enhances insulin secretion by the islets of Langerhans, reduces glycogenesis in liver tissue, enhances peripheral glucose utilization and increases serum protein levels and treatment restores the altered histological architecture of the islets of Langerhans. Hence, the biochemical, pharmacological and histo pathological profiles of *Memordica charantina* extract clearly indicate its potential anti-diabetic activity and other

beneficial effects in amelioration of diabetes associated complications. Further evaluation of its antilipidemic activity in old obese rats demonstrated significant lowering of cholesterol and triglyceride levels while elevating HDL-cholesterol levels. Also, the extract lowered serum lipids in alloxan diabetic rats, suggesting its usefulness in controlling metabolic alterations associated with diabetes (Feamandes *et al.,*2007).

Health benefits of Bitter gourd

The vegetable is very low in calories, providing just 17 calories per 100g. Its pods are rich in phytonutrients like dietary fiber, minerals, vitamins and anti-oxidants.

- ✓ Bitter melon notably contains phyto-nutrient, **polypeptide-P**; a plant insulin known to lower blood sugar levels
- ✓ Fresh pods are an excellent source of **folates**, contain about 72 µg/100g.
- ✓ Fresh bitter melon is an excellent source of vitamin-C
- ✓ It is an excellent source of health benefiting flavonoids such as ß-carotene, α-carotene, lutein, and zea-xanthin and vitamin –A
- ✓ Pantothenic acid (vitamin B-5), pyridoxine (vitamin B-6) and minerals such as iron, zinc, potassium, manganese and magnesium..(www.Nutrition and you .com 2011)

The Indian traditional system of medicine prescribed traditional plant therapies to prevent and manage hyperglycemia. Among such plants *Momordica charantia* (MC) shown to reduce hyperglycemia. Alcohol and aqueous extracts of MC (50, 100 and 200 mg/kg/day) is evaluated in a pilot study (plasma glucose > 180 mg/dl, 21 days), a chronic study in alloxanized rats (plasma glucose >280 mg/dl, 120 days) and streptozotocin (STZ) mice (plasma glucose >400 mg/dl, 60 days). In the pilot study, the maximum anti hyperglycemic effect occurred with an aqueous extract of MC at third week of supplementation. In chronic alloxanized rats, the selected dose of MC led to a significant fall of 64.33 per cent, 66.96 per cent, 69.7 per cent and 70.53 per cent in plasma glucose levels at 1, 2, 3 and 4 months, respectively. In

chronic STZ diabetic mice, MC led to a mean reduction of 15.37 per cent, 18.68 per cent and 22.86 per cent in plasma glucose levels on days 40, 50 and 60 of supplementation The alteration in hepatic and skeletal muscle glycogen content and hepatic glucokinase, hexokinase, glucose-6-phosphate and phosphofructokinase levels in diabetic mice were partially restored by MC (Rathi *et al.,* 2002)

III METHODOLOGY

The methodology pertaining to the study on **"Effect of Bitter gourd for the Management of Type II Diabetes Mellitus"** involved following steps:-

PHASE I

A. Selection of locale

B. Selection of subjects

C. Formulation of tool and collection of data

D. Nutritional assessment of the selected diabetics

1. Anthropometric measurement

a. Weight

b. Height

c. Body Mass Index (BMI)

d. Waist circumference

e. Hip circumference

f. Waist/hip ratio

2. Diet survey

3. Evaluation of bio chemical parameters

a. Blood glucose level (fasting and post prandial)

PHASE II

A. Conduct acceptability trials for of Bitter Gourd powder

B. Nutrient content of the supplement

PHASE III

A. Supplementation of bitter gourd powder.

B. Evaluation of the effect of supplementation

PHASE I

A. Selection of locale

The present study was conducted by the investigator at Arunachala Diabetic Centre, R.S.puram and Avinashilingam Institute for Home Science and Higher Education for Women, Ramalingam Colony in Coimbatore. These centers were selected for the study due to its easy access by the investigator and also availability of adequate number of diabetics who were interested and willing to give written consent for the study.

B. Selection of subjects

About one hundred subjects were selected from the age group 35-75 years of both sexes. For all selected diabetic individual fasting and post prandial blood glucose level were estimated in the beginning of study period. Among the one hundred subjects selected based on their willingness to give consent for the study, the experimental group (N=10) were selected using the inclusion criteria as following

- Fasting blood glucose within the range of 120-140mg/dl
- Post prandial blood glucose within the range of 160-200mg/dl

An ethical clearance was approved from the Institutional Ethics Committee approval no. AUW.IHEC-2013/AP-01 of our university (Avinashilingam Institute for Home Science and higher education for women) to conduct the study.

C. Formulation of tool and collection of data

An interview schedule was formulated to elicit information on the demographic profile including age, sex, education, family type, monthly income, food habits and dietary pattern through interview and observation method. Details on type, duration of disease, familial disposition of disease, and subject's knowledge on bitter gourd were also recorded. The investigator administered the interview schedule to all the selected one hundred diabetic subjects and required information was elucidated. The interview schedule was given in Appendix I

C. Nutritional assessment of selected diabetics

Anthropometry involves in obtaining physical measurement of an individual and relating them to standards that reflects the growth and development of an

individual. The physical measurement are components of the nutritional assessment and useful for evaluating over nutrition and under nutrition (Krause, 2007)

1. Anthropometric measurement

a. Weight

Body weight is the most widely used and simplest reproducible anthropometric measurement for the evolution of nutritional status (Bamji *et al*., 2009). The weight of all selected subjects were determined by making them stand barefooted and erect on a portable weighing scale to accuracy of 0.1kg (Brahmam *et al*., 2005) (Plate III)

b. Height:

Height of an individual is principally a measure of skeletal bone tissue. The height of an individual is influenced by both genetic and environmental factors the maximum growth potential of an individual is determined by hereditary while the environmental factors most important being nutrition and morbidity, determine the extent of exploitation of that genetic potential (Bamji *et al*., 2009)(Plate II)

c. Body mass index (BMI):

BMI determines if weight is appropriate for the height and thus has a good correlation with fitness (Bamji *et al.,* 2009)

WHO 2000 has explained BMI as a simple index of weight for height that is commonly used to classify adult as overweight and underweight. It was described by Quetlet and also called Quetlet Index

$$\text{BMI} = \frac{\text{Weight (in kg)}}{\text{Height}^2 \text{ (in m)}}$$

A recent article in Lancet suggest the cut off points for Asians should be set as between 22 and 25 for overweight and between 26 and 31 for obesity (WHO Lancet, 2004)

d. Waist circumference

The distance around the smallest girth below the rib cage and the above umbilicus (belly button) is a measure of waist circumference. Waist circumference

was measured by using a stretchable fiber glass tape around the body, crossing just above the hip bone. The tape was tightened without crushing (Hammond, 2008)

Waist circumference is a valuable indication of fat distribution and abdominal fat. In general, women with a waist circumference of greater than 35 inches have a high risk of central obesity related health problems. To measure the waist circumference, the investigator placed a non-stretchable fiber glass tape around standing subjects waist crossing just above upper hip bone and making sure that the tape remind on a horizontal plane on all sides (Mahan and Stump, 2004)

e. Hip circumference

The subject was made to stand erect with feet together the tape was measured to the nearest millimeter using a non stretchable fiber glass tape (Hammond, 2008) (Plate IV)

f. Waist/hip ratio

According to Boyle *et al,* (2001) the waist circumference should be taken at narrowest circumference between ribs and hips. For all the selected subjects Waist Hip Ratio (WHR) was computed by dividing subject's waist circumference in centimeter by hip circumference in centimeters.

$$\text{WHR} = \frac{\text{Waist circumference (cm)}}{\text{Hip circumference (cm)}}$$

Weight, Height, Waist and Hip circumference, Waist/Hip ratio and Body mass index were calculated as a part of nutritional assessment procedure. (Plate V)

2. Diet survey

According to Bamji *et al*. (2009) diet is a vital determinant of health and nutritional status of people .Precise information of food consumption pattern of people through application of appropriate methodology is often needed not only for assessing the nutritional status of people, but also for elucidating the relationship of nutrient intake with deficiency as well as degenerative diseases. From the one hundred selected diabetics, ten subjects were randomly selected (five from experimental group and five from control group) and for them individual dietary

consumption was done using 24 hour recall method. From this, mean food and nutrient intake of the subjects was calculated by using “Nutritive value of the Indian foods” and compared with Recommended Dietary Allowance given by ICMR (2010)

3. **Evaluation of biochemical parameters**

Biochemical tests are the most objectives and sensitive measure of nutritional status. Biochemical measure a nutrient/metabolite in one or more body fluid such as blood, urine or in feces (Paul *et al*., 2004). For the experimental and control groups, biochemical estimation for blood glucose, (fasting and post prandial) were estimated before and after supplementation period.(Plate V)

a. Blood glucose level

Blood glucose was estimated by GOD-PAP methodology (Trinder, 1969) about seven ml of the venous blood was drawn with the help of qualified lab technician and the blood was estimated for blood glucose (fasting) for all one hundred diabetics. For the analysis of post prandial blood sugar about two ml of the venous blood was collected 120 minutes after breakfast consumption .Blood samples were collected from one hundred subjects for the estimation of blood glucose level and the values were recorded.

Blood sugar level (fasting and post prandial) was recorded for the experimental and control groups were recorded before and after supplementation period of 45 days.

PHASE II

A. CONDUCT OF ACCEPTIBILITY TRIALS FOR BITTER GOURD POWDER

Bitter gourd was roasted and incorporated in dhal powder. The chief factors governing the selection of these were the case of preparation, taste, familiarity, and suitability to ones dietary habits and economically viable.

PREPARATION OF BITTER GOURD DHAL POWDER

Bitter gourd (55g), red gram dhal (6g), Bengal gram dhal(6g), dried chili(1g), pepper(1g) , tamarind (2g), cumin(1g) and salt (to taste) were added to prepare the powder.

All the above listed items are dry roasted and powdered to make the bitter gourd dhal powder. The required quantities of the ingredients were purchased from the departmental stores and market in Coimbatore city.

Bitter gourds were incorporated at 40 per cent in the supplementation. During the course of study standard powder were kept as the reference powder and powder at different levels of incorporation were adjusted against standard recipes.

Preparation and acceptability trials of the incorporated bitter gourd dhal powder were done in Foods laboratory of the Foods Science and Nutrition department at Avinashilingam Institute for Home science and Higher Education for Women, Coimbatore.

In order to test the acceptability of the powder, sensory evaluation test was done by a 30 semi trained panel members using numerical scores. A five point score card was formulated for the acceptance of color, taste, flavor and texture and scores were given according to the degree of acceptance. The acceptability trials were carried out thrice to get the reliable results. The scores were analyzed to obtain significant and appropriate results for the best acceptable products. The powder which secured maximum score was considered as highly acceptable and selected for supplementation.

B. NUTRIENT CONTENT OF THE SUPPLEMENT

The best acceptable combination was selected for the supplementation and for that the nutritive value were calculated for selected nutrients by using Nutritive value of Indian foods ICMR (2010) and nutrients content is prescribed below.

NUTRIENT CONTENT OF 20g OF THE BITTER GOURD DHAL POWDER

Ingredients	Quantity (g)	Energy (k.cal)	Carbohydrate (g)	Protein (g)	Fat (g)	Fiber (g)	Iron (mg)	Calcium (mg)	Magnesium (mg)
Bitter gourd	55	6.6	1.3	0.11	0.05	0.33	0.25	11	18.5
Bengal gram	6.0	24.18	3.8	1.2	0.3	0.07	0.31	3.36	7.8
Red gram	6.0	20.1	3.4	1.3	0.10	0.09	0.16	3.4	5.4
Dry chili	1	0.29	0.03	0.02	_	0.06	0.04	0.3	2.72
Tamarind	2	5.66	1.3	0.06	_	0.11	0.34	3.4	0.82
Pepper	1	3.04	0.49	0.11	0.06	0.14	0.12	4.6	1.7
Cumin	1	3.56	0.36	0.18	0.15	0.12	0.11	10.8	4.75
Salt	2	-	-	-	-	-	-	-	-
Total	**74**	**63.43**	**10.66**	**2.98**	**0.66**	**0.92**	**1.34**	**37.8**	**41.3**

20g of supplementation of Bitter Gourd dhal powder provides 63.43 k.cal of energy, 10.66g of Carbohydrate, 2.98g of Protein, 0.66g of Fat, 0.92g of fiber 1.34mg of Iron, 37.8mg of Calcium and 41.3mg of Magnesium.

PHASE III

A. Supplementation of bitter gourd powder

For the supplementation study group (experimental) was supplemented with 20g of bitter gourd dhal powder and group II acts as control group without any supplementation.

All the subjects in group I were given demonstration and for them supplementation was prepared by investigator and the powder was distributed for one week as trial. From the second week onwards the supplementation was distributed and asked individuals to consume daily both mixed along with lunch items. This supplementation powder was distributed personally by the investigator to the individual subjects in sealed packets every week.

Plate VI shows the supplementation in sealed packets.

During supplementation period extra care is taken to ensure that the selected subjects in experimental group of the study group were consuming the entire portion of supplementation without any wastage

The experimental group was supplemented with bitter gourd in the form of powder for a period of forty five (45) days using the above stated criteria, 10 diabetics were selected as control group without any supplementation.

Plate VII shows the subjects consuming bitter gourd dhal powder along with lunch.

B. Evaluation of the effect of supplementation

Effect of supplementation was evaluated through fasting blood glucose level, post prandial blood glucose level, and anthropometric measurement values of both experimental and control groups are given in appendix II.

For the experimental and control groups the blood glucose level was estimated for both experimental and control groups. The data thus collected were consolidated analyzed and the statistical appraisal were done to find out the blood glucose level of the diabetic subjects. The results thus obtained are presented in the next chapter.

FIGURE I - RESEARCH DESIGN

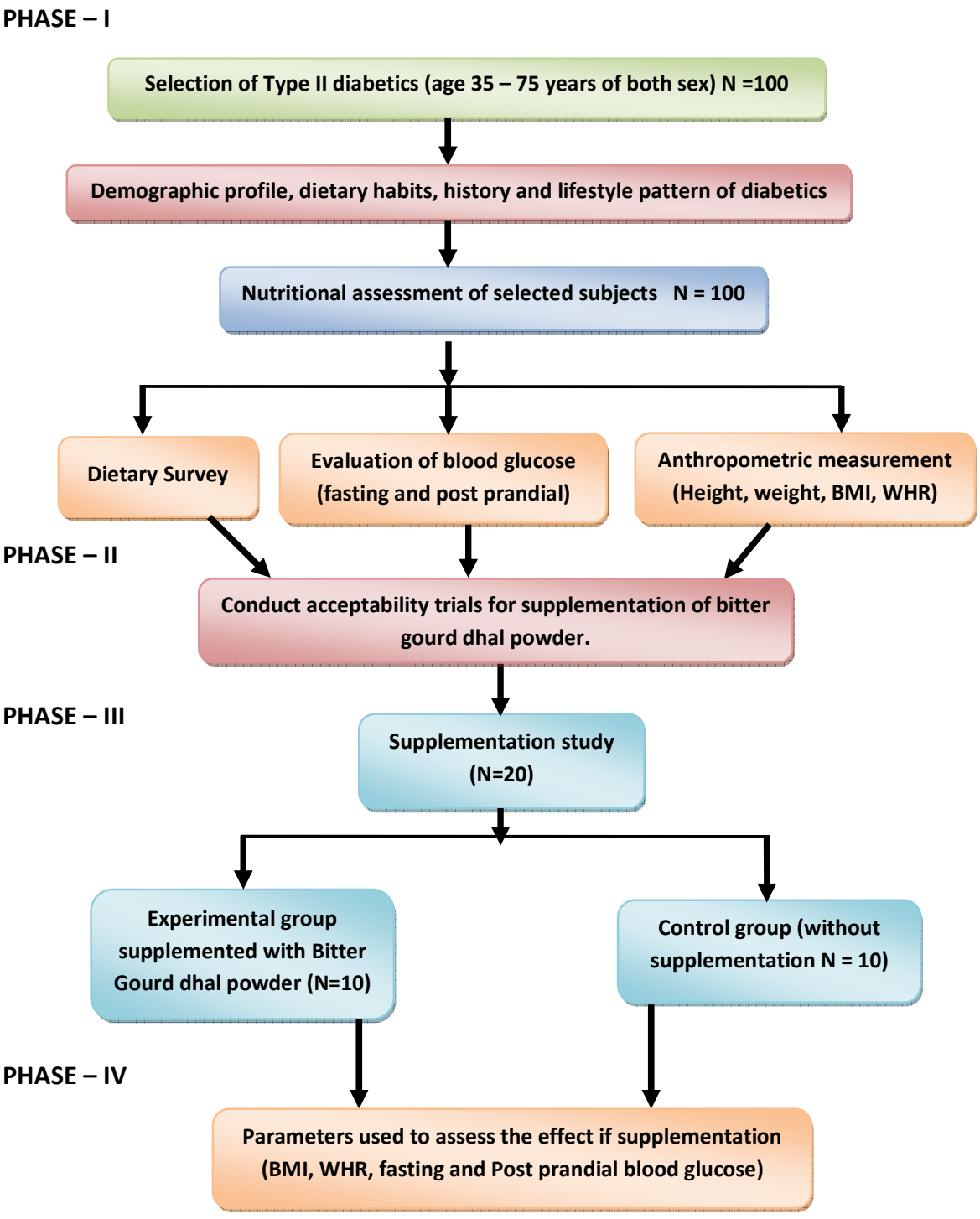


PLATE I - MEASUREMENT HEIGHT

PLATE II - MEASUREMENT OF WEIGHT

PLATE III - MEASUREMENT WAIST OF DIABETIC SUBJECTS

PLATE IV - MEASUREMENT OF HIP OF DIABETIC SUBJECTS

PLATE V

BIOCHEMICAL ESTIMATION

PLATE VI - BITTER GOURD DHAL POWDER IN SEALED PACKETS

PLATE VII - SUBJECTS CONSUMING SUPPLEMENTATION OF BITTER GOURD

IV RESULT AND DISCUSSION

The result pertaining to the study on **"Effect of Bitter Gourd for the management of Type II Diabetes Mellitus"** is discussed under the following headings.

A. Demographic profile of the selected diabetics

1. Age and sex wise distribution
2. Type of activity
3. Occupational status
4. Income level
5. Type of the family

B. Dietary pattern of the selected diabetics

1. Dietary habits
2. Meal pattern
3. Dietary consumption pattern
4. Types of fats and oils used

C. Lifestyle pattern of the selected diabetics

1. Exercise pattern
2. Smoking pattern
3. Alcohol consumption pattern
4. Chewing habits
5. Consumption pattern of coffee / tea/ milk

D. Family history and personal details of the selected diabetics

1. Family history
2. Personal history

    a. Duration of the disease

    b. Symptoms

    c. Complication

    d. Mode of treatment

E. consumption of Bitter gourd

1. Health benefits of Bitter gourd
2. Source of information
3. Actual Consumption of Bitter Gourd
4. Consumption of Bitter gourd along with seeds
5. Purchase of Bitter Gourd
6. Cooking methods
7. Quantity consumed
8. Processing of bitter gourd to reduce its bitterness

F. Nutritional assessment of the selected diabetics

1. Anthropometric measurement
2. Food and nutrient intake
3. Biochemical parameters

G. Effect of supplementation of bitter gourd of the experimental and control groups.

1. Body mass Index (BMI)
2. Waist / hip ratio
3. Blood glucose level (fasting and post prandial)

A. DEMOGAPHIC PROFILE OF THE SELECTED DIABETICS.

1. Age and sex wise distribution.

Information collected on demographic profile with regard to age, sex, occupational status, income and type of family of the selected subjects were consolidated, and presented below.

Age and sex wise distribution of the selected diabetic subjects is presented in Table I

TABLE I

AGE AND SEX WISE DISTRIBUTION (N = 100)

Age (years)	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
30-40	3	5.6	4	8.5	7	7
40-50	10	18.8	20	42.6	30	30
50-60	23	43.5	14	29.7	37	37
60-70	14	26.4	7	14.8	21	21
70-80	3	5.7	2	4.3	5.	5
TOTAL	**53**	**100**	**47**	**100**	**100**	**100**

Table I revealed that out of one hundred selected subjects surveyed 53 per cent were males and 47 per cent were females. Between the age range of 30 - 40 and 40 - 50 there were seven per cent and thirty per cent of diabetics respectively and thirty seven per cent of diabetics were in the age range of 50-60 years. In the age group of 60-70 years there were twenty one per cent and five per cent of the subjects were in the age group of 70-80 years.

The prevalence rate in the age group of 50-60 years was quite higher in both males (43.5 per cent) and females (29.7 per cent) when compared to others.

2. Type of activity

The following Table II depicts the activity pattern of the selected diabetic subjects

TABLE II

TYPE OF ACTIVITY

Activity pattern	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Sedentary	21	39.6	14	29.8	35	35.0
Moderate	23	43.4	17	36.2	40	40.0
Heavy	-	17.0	16	34.0	25	25.0
TOTAL	**53**	**100**	**47**	**100**	**100**	**100**

Among the 53 male diabetic subjects 39.6 per cent were doing sedentary activity. Around 43.4 per cent were doing moderate and 17.0 per cent were doing heavy activity.

The sedentary and moderate activities of the females were 29.8 per cent and 36.2 per cent respectively and 34.0 per cent of the women were doing heavy activity.

3. Occupational status

The occupational status of the selected subjects is categorized and tabulated in Table III.

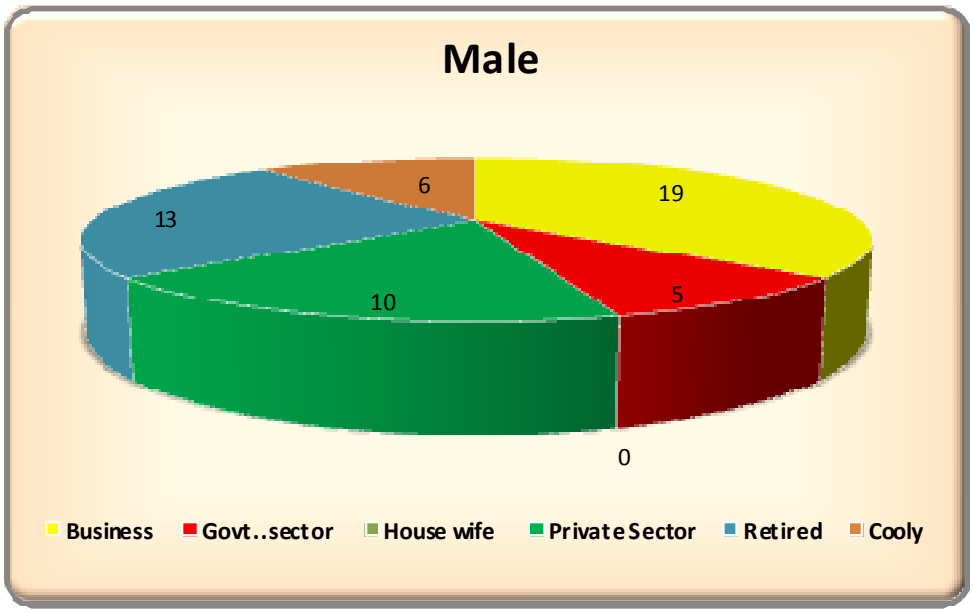
TABLE III

OCCUPATIONAL STATUS

Occupational status	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Business	19	35.8	-	-	19	19
Govt..sector	5	9.4	9	14	14	14
Housewife	-	-	26	55.3	26	26
Private Sector	10	18.9	12	25.5	22	22
Retired	13	24.6	-	-	13	13
Cooly	6	11.3	-	-	6	6
TOTAL	**53**	**100**	**47**	**100**	**100**	**100**

From the one hundred diabetic subjects 35.8 per cent of male subjects were involved in their own business, 9.4 per cent of male and 14 per cent of female were involved in government sector. Around 55.3 per cent of female involved in household work.18.9 per cent of male and 25.5 per cent of female were working in private sectors, 24.6 per cent of male subjects were retired from their jobs and 11.3 per cent of male were involved in other activities like cooly.

Figure II reveals the occupational status of selected diabetics



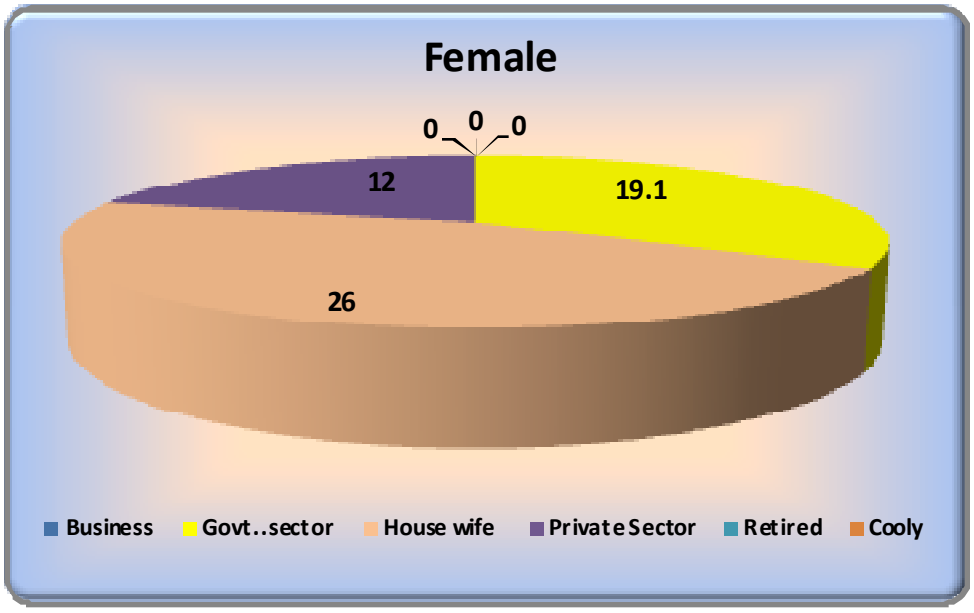


FIGURE II - OCCUPATIONAL STATUS

4. Income level

The monthly income level of the selected diabetics is given in Table IV

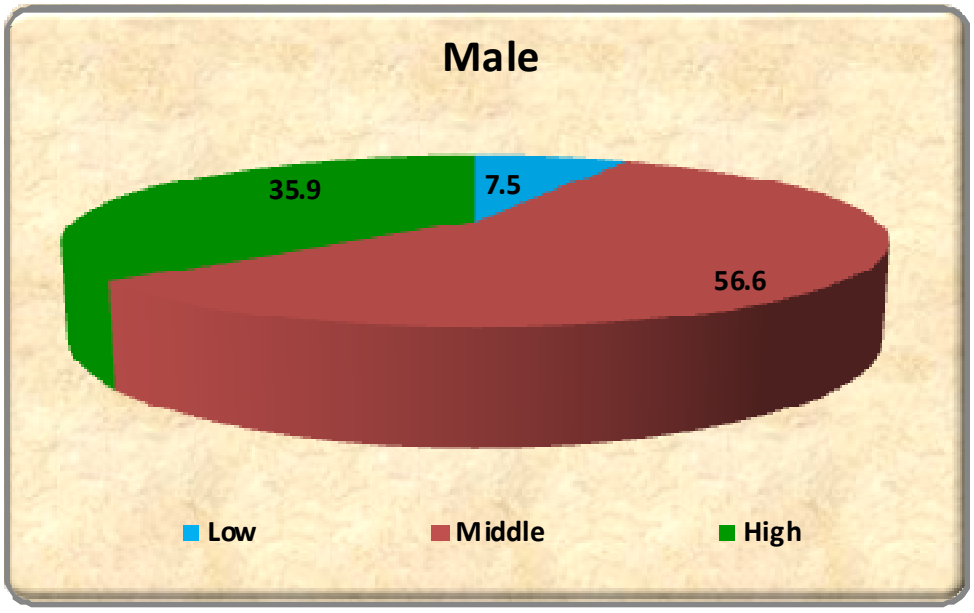
TABLE IV

INCOME LEVEL

Family income	Category	Male		Female		Total	
		Number	Per cent	Number	Per cent	Number	Per cent
Lesser than 5241Rs	Low	4	7.5	5	10.7	9	9
20,693Rs63,889Rs	Upper Middle	30	56.6	25	53.2	55	55
Greaterthan63,894Rs	High	19	35.9	17	36.1	36	36
TOTAL		**53**	**100**	**47**	**100**	**100**	**100**

Table IV revealed that majority of families (55 per cent) was in the middle income group 9, and 36 per cent of the subjects belongs to low, and high income groups respectively. Present study revealed that the prevalence of diabetics has tremendously increased among middle income group than low, middle and high income group.

Figure III shows the income level of selected diabetics



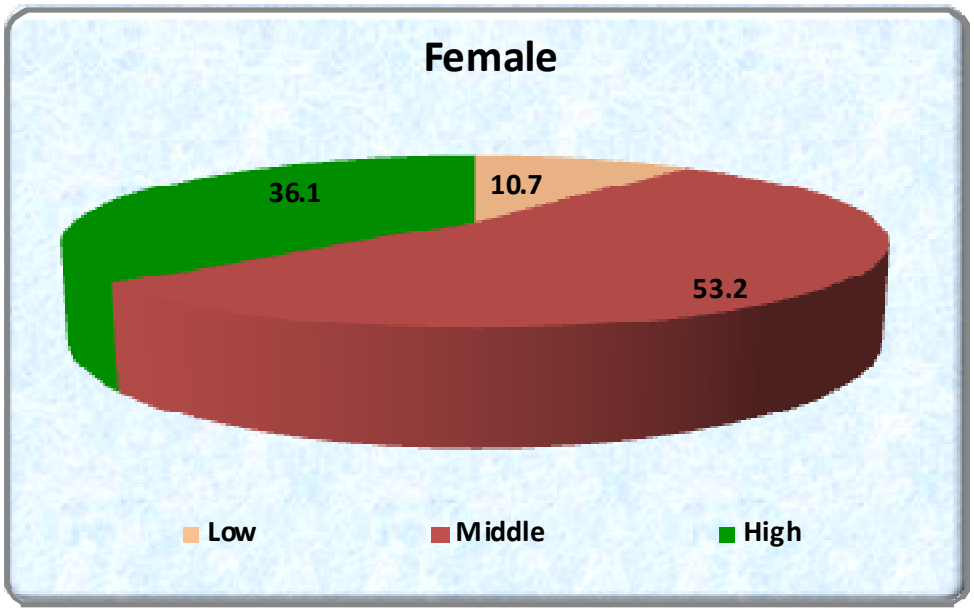


FIGURE III- INCOME LEVEL

5. Type of the family

From the results, it was clear that 72 per cent of the subjects belong to nuclear family and 28 per cent of subjects belong to joint family system.

Majority of the subjects observed were belongs to nuclear family.

B. DIETARY PATTERN OF THE SELECTED DIABETIC SUBJECTS

1. Dietary habits

Among the one hundred selected diabetic subjects, it is revealed that 90 per cent of male and female consuming non-vegetarian food items. Only 7 per cent subjects consuming vegetarian food items. 3 per cent of subjects belong to ova vegetarian category.

It was clear that majority of males and females consuming non-vegetarian foods regularly.

2. Meal pattern

Information on the consumption of meals in a day by selected diabetics given in Table V.

TABLE V

MEAL PATTERN

No. of meal per day	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
2	1	1.9	4	8.5	5	5
3	34	64.1	22	46.9	56	56
4	18	40	21	44.6	39	39
TOTAL	**53**	**100**	**47**	**100**	**100**	**100**

From the Table V it is recorded that majority of diabetic male and female (56 Per Cent) had the habit of consuming 3 meals per day 39 per cent of diabetics consuming 4 meals per day less than 5 per cent of diabetics consuming 2 meals per day.

3. Dietary consumption pattern.

Dietary pattern of the selected Diabetics is given in table VI

TABLE VI

DIETARY CONSUMPTION PATTERN

Food groups	Frequency	Male		Female		Total	
		Number	Per cent	Number	Per cent	Number	Per cent
Cereals	Daily	53	53	47	47	100	100
Pulses	Daily	53	53	47	47	100	100
Green Vegetables	Daily	20	37.7	15	31.9	35	35
	Weekly	22	41.6	16	34.0	38	38
	Bi weekly	7	13.2	12	25.5	19	19
	Occasionally	4	7.5	4	8.6	8	8
	Total	**53**	**100**	**47**	**100**	**100**	**100**
Other Vegetables	Daily	18	34	15	32	33	33
	Weekly	26	49	15	32	41	41
	Biweekly	5	9.5	10	21.2	15	15
	Occasionally	4	7.5	7	14.8	11	11
	Total	**53**	**100**	**47**	**100**	**100**	**100**
Roots and tubers	Daily	10	18.9	8	17.0	18	18
	Weekly	24	45.3	20	42.6	44	44
	Biweekly	6	11.3	6	12.8	12	12
	Occasionally	13	24.5	13	27.6	26	26
	Total	**53**	**100**	**47**	**100**	**100**	**100**
Nuts and oil seeds	Weekly	19	35.8	4	8.5	23	23
	Occasionally	26	49.0	18	38.3	44	44
	Never	8	15.2	25	53.2	33	33
	Total	**53**	**100**	**47**	**100**	**100**	**100**
Fruits	Daily	10	18.9	6	12.8	16	16
	Weekly	14	26.4	12	25.5	26	26
	Occasionally	13	24.5	20	42.6	33	33
	Never	16	30.2	9	19.1	25	25
	Total	**53**	**100**	**47**	**100**	**100**	**100**

Food groups	Frequency	Male		Female		Total	
		Number	Per cent	Number	Per cent	Number	Per cent
Milk	Daily	53	53	47	47	100	100
Sugar & Jaggery	Daily	20	26	15	15	55	35
Meat	Weekly	22	41.5	17	36.2	39	39
	Biweekly	21	39.7	22	46.8	43	43
	Occasionally	10	18.8	8	17.0	18	18
	Total	**53**	**100**	**47**	**100**	**100**	**100**
Oil	Daily	53	53	47	47	100	100

One hundred per cent of male and female consume cereals and pulses every day. Among the diabetics selected only 37.7 per cent of male and 31.9 per cent of female consume green leafy vegetables daily, 41.6 per cent of male and thirty four per cent of female consume weekly, 13.2 per cent of male and 25.5 per cent of females are consuming biweekly and 7.5 per cent of male and 8.6 per cent of female consume occasionally.

Thirty four per cent of male and thirty two per cent of female consume other vegetables daily, whereas forty nine per cent of male and thirty two per cent of female consume weekly.9.5 per cent of male and 21.2 per cent of female consume biweekly 7.5 per cent of male and 14.8 per cent of female consume other leafy vegetables respectively.

On discussing consumption of roots and tubers were consuming by daily (18 per cent) weekly (44 per cent) biweekly(12 per cent) occasionally(26 per cent) respectively. Roots and tubers mostly consumed were onion.

Nuts and oil seeds consumed by subjects weekly and occasionally were twenty three per cent and forty four per cent respectively. Thirty three per cent of the Diabetic subjects do not consume Nuts and Oilseeds.

Since the diabetics aware that fruits like (Sapota, Pineapple etc.,) may elevate the blood sugar level. The consumption pattern were daily (16 per cent)weekly(26 per cent) and occasionally(33 per cent).25 per cent of the selected diabetics do not consume fruits.

All the selected diabetics consume milk and milk products every day. Only 35 per cent consume sugar, weekly (39 per cent), biweekly (43 per cent), occasionally(18 per cent). All the one hundred diabetic subjects consume fats and oils daily.

4. Types of fats and oil used.

Table VII gives details on the type of cooking oil used by the selected diabetics.

TABLE VII

TYPES OF FATS AND OIL USED

Type of oil*	Per cent
Gingelly	30.1
Sunflower	18.9
Refined oil	16.8
Ghee	12.7
Butter	10.2
Palm oil	8.2
Groundnut oil	2.0
Rice bran	1.0

* Multiple Responses

It is obvious that Gingelly, Sunflower and refined oil were the major oil included by selected diabetic subjects. Majority of diabetes used Gingelly oil (30.1 per cent), Sunflower oil (18.9 per cent) and Refined oil(16.8 Per cent).

12.7per cent of diabetics are using ghee and 10.2 per cent of diabetics use butter respectively. Very few subjects use palm oil (8.2 per cent), Ground nut oil (2.0 per cent) and Rice bran oil (1.0 per cent) respectively.

C.LIFE STYLE PATTERN OF THE SELECTED DIABETICS.

1. Exercise pattern

The habit of doing exercise of one hundred diabetic subjects is consolidated and presented in table VIII.

TABLE VIII

EXERCISE PATTERN

Types of exercise	Male			Female		
	Daily	Weekly	Occasionally	Daily	Weekly	Occasionally
	%	%	%	%	%	%
Moderate Exercise						
Walking	30	16.7	-	10.5	-	-
Gardening	-	8.5	-	-	15.7	-
Housework	-	2.1	-	60.5	-	-
Vigorous Exercise						
Jagging	-	17.2	-	-	5.3	-
Yoga	25.5	-	-	7.9	-	-

From Table VIII it is clear that thirty per cent of male has the habit of walking daily and 16.7 per cent of male had habit of walking weekly whereas 10.5 per cent of female has habit of walking daily.8.5 per cent of 15.7 per cent of female has habit of gardening weekly.2.1 per cent of male has habit of doing house work weekly whereas 60.5 per cent of female has habit of doing house work daily.17.2 per cent of male and 5.3 per cent of female has habit of jogging weekly.25.5 per cent of male and 7.9 per cent of female has habit of practicing yoga daily.

2. Smoking pattern

Table IX represents the smoking pattern of selected male subjects.

TABLE IX

SMOKING PATTERN

Pattern of smoking	Number	Per cent
Yes	6	11.3
NO	47	88.7
Total	**53**	**100**
Types		
Cigarettes	5	83.3
Beedi	1	16.6
Total	**6**	**100**
Numbers smoked per day		
1-5	6	100

From Table IX it revealed that among the selected male subjects 11.3 per cent had the habit of smoking and 88.7 per cent do not smoke. Among the smokers 88.3 per cent had the habit of smoking cigarette and 16.6 per cent had the habit of smoking beedi.100per cent of subjects smoke 1-5 cigarettes and beedi per day and not more than that. None of the female subjects has the habit of smoking.

3. Alcohol consumption pattern.

Alcohol consumption expressed by the male selected diabetics expressed in Table X

TABLE X

ALCOHOL CONSUMPTION PATTERN

Frequency of consumption			Duration of consumption		
Details	**Number**	**Per cent**	**Details**	**Number**	**Per cent**
Habitual	3	5.7	< 5	7	87.5
Occasional	5	9.43	5-10	1	12.5
None	45	85	10-15	0	0
Total	**53**	**100**	**> 15**	**8**	**100**

Among the 53 male diabetic subjects, 85 per cent do not have the habit of consuming alcohol. 5.7 per cent and 9.43 per cent had the habit of consuming

alcohol habitually and occasionally. Among the 8 alcohol consuming diabetic subjects, 87.5 per cent had the habit of consuming alcohol for the past 5 years and 12.5 per cent had the habit of consuming alcohol for 5-10 years period. None of the female subjects had the habit of consuming alcohol.

4. Chewing habits.

Table XI gives information regarding chewing habit of the diabetes.

TABLE XI

CHEWING HABITS

Chewing habit	Male		Female	
	Number	Per cent	Number	Per cent
Yes	3	5.7	1	2.1
No	50	94.3	46	97.9
Total	**53**	**100**	**47**	**100.**
Types				
Pan masala	2	66.7	-	-
Beetle leaves	1	33.3	1	100
Total	3	100	1	100
Dration				
<5years	1	33.3	1	100
5-9 years	2	66.7	-	-
Total	**3**	**100**	**1**	**100.**

Table XI shows that 5.7 per cent of male and 2.1 per cent of female had the habit of chewing. Among the 5.7 per cent of male, 66.7 per cent and 33.3 per cent had the habit of consuming pan masala and beetle leaves respectively. 2.1 per cent of female had habit of consuming beetle leaves.

5. Consumption pattern of Coffee / Tea / Milk

Details regarding the consumption of coffee / tea / milk by selected diabetics given in Table XII

TABLE – XII

CONSUMPTION PATTERN OF COFFEE / TEA / MILK

Beverages	N=35 (with sugar)			N = 65 (without sugar)		
	Male	Female	Total	Male	Female	Total
Coffee	47.0	55.6	51.4	38.9	44.8	41.5
Tea	35.3	35.3	34.3	50.0	41.4	46.1
Milk	17.7	11.1	14.2	11.1	13.8	12.4
Total	**100**	**100**	**100**	**100**	**100**	**100**

From table XII it is observed that 51.4 per cent of subjects having the habit of drinking coffee with sugar. Thirty four per cent had the habit of consuming tea with sugar. Around 14.2 per cent of subjects have the habit of drinking tea and milk with sugar. Sixty five subjects do not have coffee, tea and milk with sugar.

From the table it is very clearly shows that diabetic subjects were the habit of drinking their beverages without sugar.

D. FAMILY AND PERSONAL HISTORY OF THE SELECTED DIABETES

1. Family history

The family history of the diabetic subjects is discussed in table XIII.

TABLE XIII

FAMILY HISTORY

Relationship*	Subjects
	Per cent
Subjects with family history	53
Subjects without family history	47
Total	100
Details	
Both parents	40.0
Father	32.1
Mother	17.0
Brother	7.5
Sister	5.7
Grand Parents	2.0
Total	**100.00**

*multiple responses

From above table it is revealed that 53 per cent had family history of diabetes and 47 per cent do not had the family history of diabetes.

Above 40 per cent of diabetes had family history from both parents 32 per cent and 17 per cent had history of diabetics from father and mother respectively 7.5 per cent and 5.7 per cent had history of diabetes from brother and sister, 2.0 per cent of diabetes has history from grandparents respectively.

2. Personal history

a. Duration of the disease

Among the one hundred diabetic subjects 22 per cent were having the disease for less than five years. 49 per cent were suffering from diabetes for the past 5-10 years. 8 per cent and 21 per cent of them were suffering from 10-15 years and more than 20 years respectively.

b. Symptoms

Symptoms of the selected diabetic subject are depicted in table XIV.

TABLE XIV

SYMPTOMS

Symptoms *	Number	Per cent
Hyperglycemia	64	21.8
Polyphagia	58	19.4
Polyuria	53	17.6
Polydipsia	46	15.4
Weight loss	30	10.0
Constipation	19	6.3
Infection	18	6.0
Wound healing	12	4.0

*Multiple Responses

Among the one hundred diabetic subjects symptom such as hyperglycemia (21.8 per cent), polyphagia (19.4 per cent), Polyuria (17.6 per cent), Polydipsia (15.4 per cent), weight loss (10Per cent),constipation(6.3 per cent), Infection (6 per cent) and wound healing(4Per cent).The subjects were unaware of symptoms of insomnia and ketoacidosis.

c. Complication

TABLE XV

COMPLICATION

Complications	Per cent
Hyper tension	24.4
Cardiovascular disease	24.4
Kidney disease	24.4
Liver disease	19.5
Diabetic foot	7.3

Among the selected one hundred diabetics, complications namely hypertension (24.4 per cent), cardiovascular disease (24.4 per cent), kidney disease (24.4 per cent) liver disease (19.5 per cent) and diabetic foot (7.3 per cent) were present.

d. Mode of treatment.

Majority of the subjects were solely depends on Allopathic treatment (77 per cent) (18 per cent) of the subjects depends on Ayurveda treatment (2 per cent) of subjects depends on homeopathy and Unani treatments. One per cent of the subject depends on Unani form of treatment

E. CONSUMPTION OF BITTER GOURD

1. Health benefits of bitter gourd

Among the one hundred diabetic subjects sixty one per cent of subjects know the health benefit of bitter gourd. Thirty nine per cent of subjects were unaware about the health benefit of bitter gourd.

2. Source of information

Among the sixty one diabetic subjects, twenty per cent gained the information from doctor. Eighteen per cent of people obtained the information from family members. Twelve per cent and eight per cent obtained the information from neighbors / friends and others. Two per cent obtained the information from market and only one per cent had obtained the information from radio.

3. Actual consumption of bitter gourd

The below table XVI depicts the consumption of bitter gourd among diabetics

TABLE XVI

CONSUMPTION OF BITTER GOURD

Consumption pattern	Male		Female	
	Number	Per cent	Number	Per cent
Daily	0	-	1	2.1
Weekly once	30	56.6	17	36.2
Weekly twice	20	37.7	22	46.8
Occasionally	2	3.8	4	8.5
Never	1	1.9	3	6.4
Total	**53**	**100**	**47**	**100**

From the above table it was observed that 2.1 per cent of female consume bitter gourd daily. About 56.6 per cent of male and 36.2 per cent of female consume bitter gourd weekly once. 37.7 per cent of male and 46.8 per cent of female consume bitter gourd weekly twice. Around 3.8 per cent of male and 8.5 per cent of female consume occasionally and 1.9 per cent of male and 6.4 per cent of female never consume bitter gourd

4. Consumption of bitter gourd along with seeds

Among 96 diabetic subjects with consuming bitter gourd, sixty six per cent consume along with seeds and thirty per cent do not consume seeds.

5. Area of purchase of bitter gourd

The below table XVII depicts the area of purchase of bitter gourd

TABLE XVII

PURCHASE OF BITTER GOURD

Place of purchase	Number	Per cent
Sandy	14	14.6
Market	40	41.7
Street Venders	29	30.2
Super market	6	6.2
Own garden	6	6.2
Others	1	1.0
Total	**96**	**100**

The below table depicts that 14.6 per cent of subjects purchase bitter gourd from sandy. 41.7 per cent and 30.2 per cent purchase from market and street venders 6.2 per cent purchase from the super market and their own garden respectively one per cent purchase from other sources.

6. Cooking method of bitter gourd

The below table XVIII depicts about the cooking method of bitter gourd.

TABLE XVIII

COOKING METHODS USED

Cooking method	Number	Per cent
Braising	32	33.4
Shallow fat fried	22	22.8
Deep fat fried	14	14.6
Stewed	3	3.2
Boiled	1	1.0
Raw	1	1.0
Others	23	24
Total(subjects consume bitter gourd)	96	100

Among the one hundred diabetic subjects, 96 people consume bitter gourd and 4 do not consume bitter gourd.

Among the 96 subjects, 33.4 per cent consume in the form of braising 22.8 per cent consume in the form of shallow fat fried 14.6 per cent and 3.2 per cent consumes in the form of deep fat fried and stewed. One per cent consumes in the form of boiled and raw form of bitter gourd. Around twenty four per cent consumes the other forms of bitter gourd like kolambu and thokkuvarities.

7. **Quantity consumed by the subjects**

Among the 96 subjects twenty two per cent consumes bitter gourd less than100g. Forty seven per cent consumes between 100-200g.Twenty seven per cent consumes >200g.

8. Processing of bitter gourd to reduce its bitterness

The below table XIX depicts the subject treat, the bitter gourd to reduce its bitterness.

TABLE XIX

PROCESSING OF BITTER GOURD TO REDUCE ITS BITTERNESS

Treatment	Number	Per cent
No treatment	53	55.2
Treatment done to reduce bitterness	43	44.8
Total	96	100
Treatments		
With salt water	20	46.5
With tamarind water	22	51.1
With rice water	1	2.4
Total	**43**	**100.**

The above table reveals that among 96 per cent of the bitter gourd consuming diabetic subjects,55.2 per cent do not undergo any treatment with bitter gourd to reduce its bitterness.44.8 per cent undergo treatment of bitter gourd to reduce its bitterness.

Among 44.8 per cent, 46.5 per cent and 51.1 per cent undergo treatment with salt water and tamarind water respectively 2.4 per cent alone undergoes treatment with rice water.

F. NUTRITIONAL ASSESMENT OF SELECTED DIABETICS

1. Anthropometric measurement

a) Height

Table XX gives the height wise distribution of the selected type II diabetics subjects

TABLE XX

HEIGHT OF THE SELECTED SUBJECTS

Height (cm)	Male		Female		Standard Height (NCHS, 2005)
	Number	Per cent	Number	Per cent	
140-149	3	5.7	13	27.6	Male – 173.5 cm Female 159.5cm
150-159	18	34	13	27.6	
160-169	22	41.5	17	36.2	
170-179	10	18.8	4	8.6	
Total	**53**	**100**	**47**	**100**	

Among the one hundred selected diabetics 5.7 per cent of male 27.6 per cent of female had their height ranging between 140-149cm, white 34 per cent of male and 27.6 per cent of female had their height between 150-159cm. About 41.5 per cent of male and 36.2 per cent of female had their height ranged between 160-169cm. 18.8 per cent of male and 8.6 per cent of female were ranged between 170-179cm.

b. Weight of the selected diabetics

The weight in kg was measured distributions of male and female Diabetics studies in accordance with their body weight given in table XXI

TABLE XXI

WEIGHT OF THE SELECTED DIABETICS

Weight (kg)	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
41-50	7	13.2	5	10.6	12	12
51-60	15	28.3	16	34.0	31	31
61-70	60	30.0	60	34.0	32	32
71-80	10	18.9	4	18.5	14	14
>80	5	9.4	6	12.7	11	11
TOTAL	**53**	**100**	**47**	**100**	**100**	**100**

Male 60kg Female 50 kg (ICMR, 2002) .The above table reveals that, 13.2 per cent of male and 10.6 per cent of female had their weight between 41 – 50kg. 28.3 per cent of male and 34 per cent of female and their weight between 51-60kg. 30.0 per cent of male and 34 per cent of female had their weight between 61-70kg.18.9 per cent of male and 8.5 per cent of female had their weight between 71-80kg. 9.4 per cent of male and 12.7per cent of female had their weight greater than 80.

C. Body Mass Index

Table XXII depicts that body mass index of the selected diabetics

TABLE XXII

BODY MASS OF THE SELECTED DIABETICS

BMI	Obesity grade	Female		Male		Total	
		Number	Per cent	Number	Per cent	Number	Per cent
>18.5	Underweight	9	19.1	7	13.2	16	16
18.5-25.0	Normal	17	36.1	25	47.1	42	42
25.0-30.0	Overweight	15	32.0	15	28.3	30	30
>30.0	Obese	6	12.8	6	11.4	12	12
TOTAL		**47**	**100**	**53**	**100**	**100**	**100**

ICMR (2010) categorized BMI values below 18.5 as underweight range between 18.5-25.0 as normal underweight BMI range 25.1-30.0 as overweight and range above 30.0 as obese values.

From table XXII it is observed that 16 per cent of subject had their BMI below 18.5 forty two per cent of male and female diabetic subjects had their BMI around 18.5-25.0. Around 30 per cent of male and female subjects had their BMI between 25.0 – 30.0 which belongs to Grade I obesity. Twelve per cent of male and female subjects had BMI above 30 which belong to grade II obesity.

From the above table it is observed that majority of male 36.1 per cent and female 47.1 per cent had their BMI between18.5-25.0.

d. Waist to hip ratio of selected diabetics

Table XXIII present the waist – Hip ratio of the selected diabetics

TABLE XXIII

WAIST HIP RATIO OF THE SELECTED DIABETICS

S.No	Waist hip ratio	Male		Female		Total	
		Number	Per cent	Number	Per cent	Number	Per cent
1.	0.80-0.85	0	0	1	2.1	1	1
2.	0.86-0.90	2	3.8	16	34.0	18	18
3.	0.91-0.95	22	41.5	17	36.2	39	39
4.	0.96-1.00	24	45.3	8	17.1	32	32
5.	1.01-1.05	5	9.4	5	10.6	10	10
TOTAL		**53**	**100**	**47**	**100**	**100**	**100**

From the table XXIII it is revealed that one per cent of subjects had their waist hip ratio between 0.80-0.85. Eighteen per cent of the diabetic subjects had their waist hip ratio between 0.86-0.90. Thirtynine per cent and thirty two per cent of the diabetic subjects had their WHR between 0.91-0.95 and 0.96-1.00 respectively. Around 10 per cent of the diabetic subjects had WHR between 1.01-1.05

e. Food and nutrient intake of selected diabetics

a. Mean food intake of selected Diabetics (male)

The mean intake of selected male Diabetics is shown in table XXIV

TABLE XXIV

MEAN FOOD INTAKE OF SELECTED DIABETICS (MALE)

Food groups (g)	RDA (ICMR, 2010)(g)	Experimental Group (male)		Control Group (male)	
		Actual Intake(g)	% Deficit / Excess	Actual Intake(g)	% Deficit / Excess
Cereals	450	260	-44	260	-44
Pulses	75	50	-33	35	-53
Greens	100	120	+20	80	-20
Roots and tubers	200	40	-80	60	-70
Other vegetables	200	180	-10	150	-25
Fruits	100	80	-20	56	-44
Milk	300	210	-30	210	-30
Fats and oils	30	10	-67	15	-50
Sugar	30	10	-67	15	-50
Non –veg		60		50	

From the above table it was observed that consumption of cereal was less than recommended dietary allowance by forty four per cent in both experimental and control group.

. The consumption of pulses was deficient by thirty three and fifty three per cent in experimental and control groups respectively. Intake of other vegetables was excess in experimental group by 20 per cent and deficient in control group with 20 per cent .The intake of roots and tubers was deficient in experimental and control groups by 80 and 70 per cent respectively. The consumption pattern of other vegetables was deficient in experimental and control groups by 10 and 25 per cent respectively. Intake of fruits was deficient in experimental and control groups by 20 per cent and 44 per cent correspondingly. Consumption of oil and milk were deficient in both experimental and control groups by (30 per cent) and (67 and 50 per cent) Consumption of sugar in every group was less than RDA due to the diabetic condition. In both experimental and control groups intake of roots and tubers milk and milk products, fat, oil, sugar and sugar products were generally deficient in experimental and control groups

b. Mean food intake of selected Diabetics (Female)

The mean intake of selected female Diabetics is shown in table XXV

TABLE XXV

MEAN FOOD INTAKE OF SELECTED DIABETICS FEMALE

Food groups (g)	RDA (ICMR, 2010)(g)	Experimental group(Female)		Control group(female)	
		Actual Intake(g)	% Deficit / Excess	Actual Intake(g)	% Deficit / Excess
Cereals	300	200	-33	350	+16
Pulses	120	90	+25	70	-41
Greens	100	100	-	80	-20
Roots and tubers	200	45	-77	70	-65
Other vegetables	200	180	-10	140	-20
Fruits	100	96	-4	40	-60
Milk	300	210	-30	210	-30
Fats and oils	30	10	-66	13	-56
Sugar	30	10	-66	15	-50
Non veg		50		50	

From the above table it was observed that cereal consumption is deficient in experimental groups by 33 per cent and more in control group by 16 per cent. The consumption of pulses was increased in excess in experimental group by 25 per cent and deficient in control groups by 41 per cent. The consumption of greens was equal to RDA and it was 20 per cent deficient in control groups. The intake of roots and tubers was deficient in experimental and control groups respectively by 77 per cent and 65 per cent respectively. The consumption of other vegetables was deficient in experimental and control groups by 10 and 20 per cent. The consumption of fruits was deficient in experimental group by (4 per cent)and control groups by (60 per cent). The consumption of milk, fat and oil were deficient in both experimental and control groups.

Consumption of sugar in every group was less than RDA due to the diabetic condition

c. Mean nutrient intake of the selected Diabetics male

Table XXVII shows the mean nutrient intake of male selected Diabetics

TABLE XXVI

MEAN NUTRIENT INTAKE OF SELECTED DIABETICS (MALE)

Nutrients	RDA (ICMR, 2010)	Experimental Group		Control Group	
		Actual Intake	% Deficit / Excess	Actual Intake	% Deficit / Excess
Energy (Kcal)	2875	1858	-35	1378	-52
Protein (g)	60	70	+16	55	-8
Fat (g)	20	18	-10	34	+74
Carbohydrate (g)	-	260	-	316	-
Fiber (g)	40	54	+35	35	-13
Calcium (mg)	400	600	+50	550	+37.5
Iron (mg)	28	19	-47	8	-71
β-carotene (µg)	2400	1242	-48	1717	-28
Thiamine (mg)	1.4	1.84	+29	1.02	-27
Riboflavin (mg)	1.6	1.23	-25	1.11	-30
Niacin (mg)	18	18	-	16	-11
Vitamin C (mg)	40	265	+162	101	+152

The intake of calories was observed to be decreased in both experimental and control groups by 35 per cent and 52 per cent respectively. The intake of protein is more16 in experimental groups and reduced in control groups by 8 per cent.The intake fiber was increased in experimental groups by 35 per cent and decreased in control groups by 13 per cent respectively. The intake of iron was deficient in both experimental and control groups by 47 and 71 per cent

respectjvely. The intake of beta-carotene and riboflavin are observed to be reduced in both experimental and control groups respectively by (48, 28 per cent) and (25, 30 per cent). The intake of Thiamine was increased in experimental groups by 29 per cent and deficient in control group by 27 per cent. Vitamin c is observed to be increased in both experimental and control groups by 162 and 152 per cent.

d. Mean nutrient intake of the selected Diabetics male

Table XXVII shows the mean nutrient intake of female selected Diabetics

TABLE XXVII

MEAN NUTRIENT INTAKE OF SELECTED DIABETICS FEMALE

Nutrients	RDA (ICMR, 2010)	Experimental (Female)		Control Group (Female)	
		Actual Intake	% Deficit / Excess	Actual Intake	% Deficit / Excess
Energy (Kcal)	2225	2316	+4	2233	-
Protein (g)	50	60	+20	40	-20
Fat (g)	20	35	+75	32	+59
Carbohydrate (g)	-	414	-	403	-
Fiber (g)	40	16	-60	12	-70
Calcium (mg)	400	500	+25	450	+11
Iron (mg)	30	26	-13	20	-33
β-carotene (µg)	2400	1600	-33	1200	-50
Thiamine (mg)	1.1	2	+100	1.87	+70
Riboflavin (mg)	1.3	1	+7	1	+7
Niacin (mg)	14	22	+57	20	+42.8
Vitamin C (mg)	40	289	+623	280	+600

The intake of calories was not observed to be more in experimental and control groups. The intake of protein was increased in experimental group and deficient in control groups by 20 per cent respectively. The intake of fat is found to

be increased in both experimental and control groups by 20 per cent respectively. The intake of fiber was found to be decreased in both experimental and control groups by 60 and 70 per cent respectively. Intake of calcium found to be increased around 25 per cent in experimental groups and 11 per cent among control groups respectively. Intake of thiamine, riboflavin, niacin and vitamin c is observed to be increased in both experimental and control groups of iron is found to be decreased in experimental and control groups correspondingly by 13 and 33per cent.

3. Biochemical profile of the selected Diabetics

a. Mean blood glucose levels

Table XXVIII shows the mean blood glucose of the selected hundred Diabetics

TABLE XXVIII

MEAN BLOOD GLUCOSE LEVELS

Blood glucose(mg/dl)	Mean+ SD	Normal value*
Fasting	175.17±53.28	70-120(mg/dl)
Post prandial	211.23±57.17	80-140(mg/dl)

*Bamji (2009) and NCEP(2009)

The mean fasting blood glucose level of the selected one hundred diabetics was 175.17mg/dl, but the normal value of fasting blood glucose level is 70-110mg/dl. The mean post prandial blood glucose level for the one hundred diabetics was 211.23mg/dl but the normal value for post prandial blood glucose level was 80-140 mg/dl.

G.EFFECT OF SUPPLEMENTATION OF BITTER GOURD DHAL POWDER

1. Body mass index of experimental and control groups

Table XXIX presents the body mass index of the selected diabetics in experimental and control groups

TABLE XXIX

BODY MASS INDEX OF THE BOTH EXPERIMENTAL GROUPS AND CONTROL GROUPS

BMI WHO, 2009	Obesity grade	Experimental group		Control group	
		Initial	Final	Initial	Final
		%	%	%	%
Below 18.5	Underweight	10	10	-	-
18.5 – 22.9	Normal	10	40	50	40
23 – 24.9	Overweight	30	30	10	20
Above 25	Obese	50	20	40	40

From the above table it is observed that in case of experimental group 80 per cent of the diabetics were overweight and obese initially and after intervention it was reduced to 50 per cent, with regards to normal category 20 per cent was increased to 50 per cent. In case of control group no big change in BMI was recorded. So, the present study reveals that supplementation of Bitter Gourd dhal powder helps to reduce body weight.

Figure IV shows the Basal Mass Index of both experimental and control groups

2. Waist hip ratio of experimental and control groups

Table XXX presents the Waist Hip ratio of Experimental and control Groups

TABLE XXX

WAIST HIP RATIO OF EXPERIMENTAL AND CONTROL GROUPS

Waist – Hip Ratio	Experimental group				Control group			
	Male		Female		Male		Female	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
	%	%	%	%	%	%	%	%
0.80-0.85	-	-	-	16	-	-	-	-
0.86-0.90	-	66	29	42	-	-	60	-
0.91-0.95	66	34	42	42	40	60	40	60
0.96-1.00	34	-	29	-	60	40	-	40
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

According to NIN (2005) the standard waist hip ratio for reference men and women is 0.95 and 0.80 respectively.

In the experimental group the waist hip ratio in the range of 0.91-0.95 is 66 per cent is reduced to 34 per cent in males. Females who had waist hip ratio in the range of 0.96-1.00 are significantly reduced after supplementation. There is no much significant reduction is observed in control groups.

Figure V shows the Waist Hip Ratio of both experimental and control groups

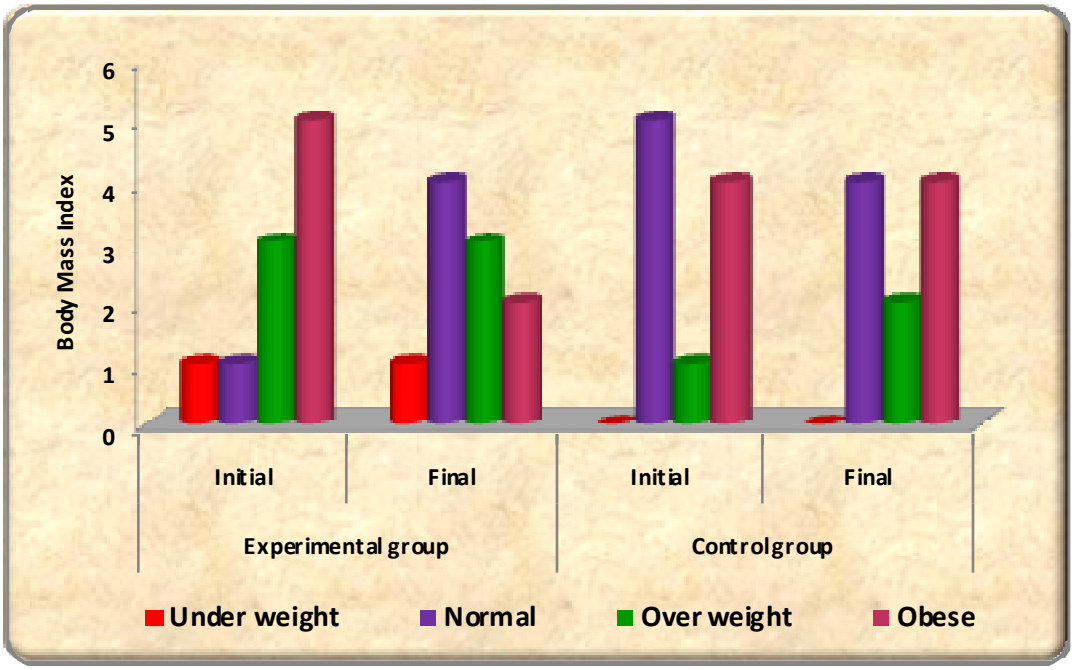


FIGURE IV - BODY MASS INDEX OF THE BOTH EXPERIMENTAL AND CONTROL GROUS

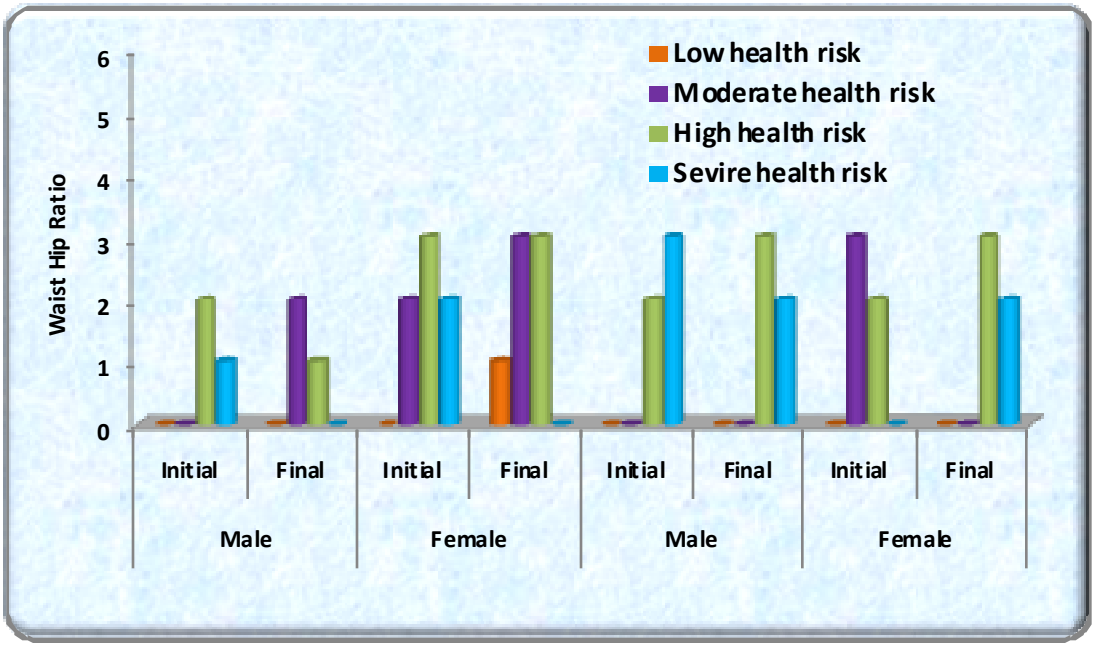


FIGURE V - WAIST HIP RATIO OF EXPERIMENTAL AND CONTROL GROUPS

3. Blood glucose level (fasting and post prandial)

a. Blood glucose level of experimental and control groups

The blood glucose level (fasting and post prandial) of experimental group before and after supplementation and control groups is presented in XXXI

TABLE XXXI

BLOOD GLUCOSE LEVEL OF THE EXPERIMENTAL AND CONTROL GROUPS

Blood glucose	Experimental group(n=10)				Control group(n=10)			
	Initial	Final	Difference mean	't' value	Initial	Final	Difference mean	't' value
Fasting blood glucose(mg/dl)	162.6±22.4	141.8±38	20.8	1.949*	183±53.1	194.7±54.39.3	11.7	0.461^{NS}
Post prandial blood glucose(mg/dl)	236.3±38.01	189.0±36.3	47.3	2.697*	233.9±41.26	246.10 + 46.43	12.2	0.589^{NS}

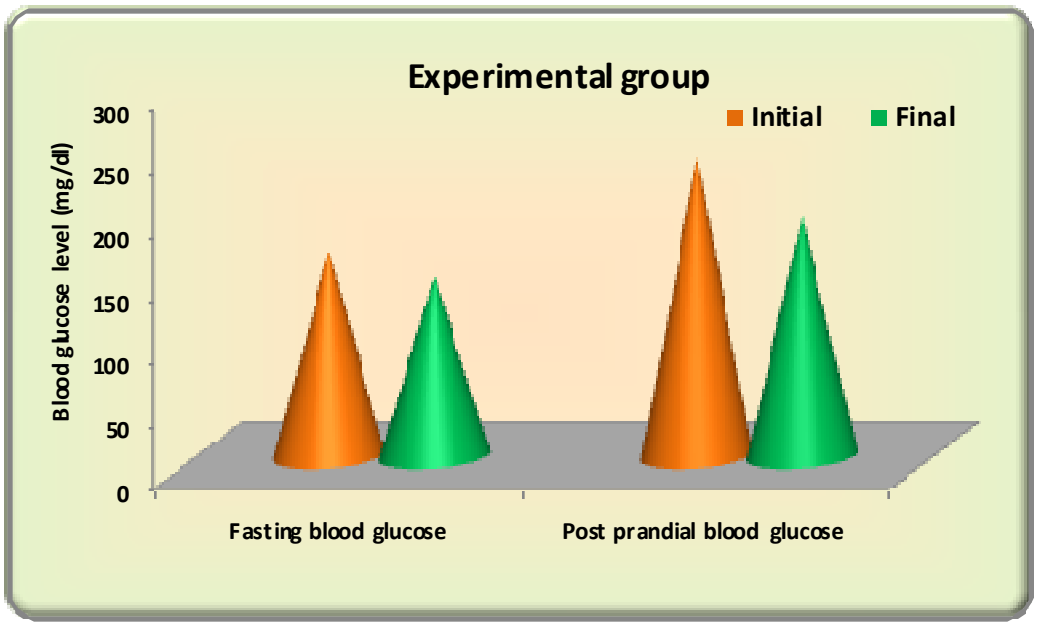
*- Significant at 5% NS -not significant

The mean fasting blood glucose level of diabetic subjects in experimental group was 162.6 mg/dl and has reduced to 141.8 mg/dl after the supplementation of bitter gourd. The mean post prandial blood glucose level of diabetic subjects in control group was 236.3 mg/dl and has reduced to 189.0 mg/dl after supplementation of bitter gourd.

With regards to the non -supplemented diabetics, the mean fasting blood glucose level of diabetic subjects in control group was 183mg/dl and had increased to 194.7 mg/dl .The level of mean post prandial blood glucose level of diabetic subjects in control group was233.9 mg/dl and increased to 246.10 mg/dl respectively after the study period.

From the results obtained it is revealed that supplementation of bitter gourd helps to reduce blood glucose level (fasting and post prandial)

Figure VI shows the blood glucose level of both experimental and control groups



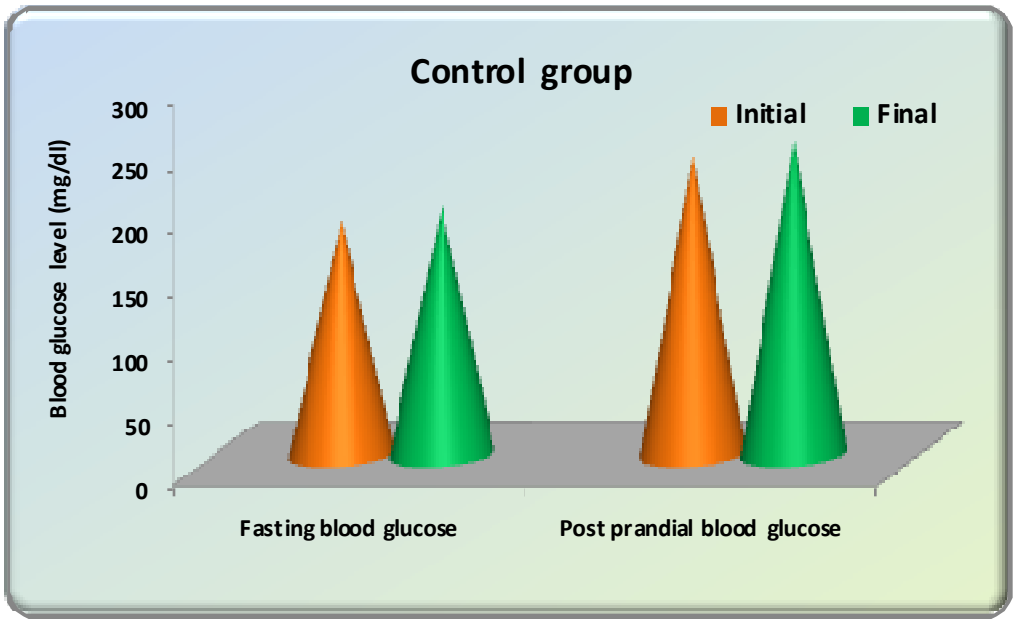


FIGURE VI - BLOOD GLUCOSE LEVEL OF THE EXPERIMENTAL AND CONTROL GROUPS

V SUMMARY AND CONCLUSION

The summary and conclusion of the present study entitled **"Effect of Bitter Gourd for the management of Type II Diabetes Mellitus"** is presented below

Diabetes Mellitus represent an enormous medical social and economic burden to the public. Many genetic and life style factors involved in the etiology of diabetes. India ranks first and thus also described as the "Diabetic capital of the world". Recent researches focuses on the traditional and herbal medicines for the management of diabetes, Among that Bitter Gourd is the popular vegetable used in many countries which has the good property of reducing blood glucose level.

Hence the present study was under taken with an objective to select and study the demographic information, nutritional status of diabetics, medical history, and to study the impact of bitter gourd for the management of diabetes.

Two centers were selected to conduct the study namely Avinashilingam Institute for Home Science and Higher Education For Women and Arunachala Diabetic Centre in Coimbatore district was selected with the co- operation of Physician and concerned authorities of the study one hundred diabetics were selected initially. An interview schedule was formulated to elicit information regarding the socio economic status including age, educational status, income and type of family, dietary habits, lifestyle pattern such as exercise and presence of additive habits like chewing, smoking, drinking and also health status, and also the details regarding the consumption of bitter gourd.

The results pertaining to the study are summarized as follows

- Majority of the subjects (53 per cent) were males and (47 per cent) were females belonging to age group of 50-60 years
- Majority of the subjects (40 per cent) were doing moderate type of activity, 35 per cent were doing sedentary type of activity and 25 per cent were doing heavy activity.
- From the results it was revealed that 19 per cent involved in their own business, 14 and 22 per cent were involved in the government and private

jobs.13 per cent of the subjects were retired and 6 per cent were cooly and 26 per cent of female subjects were involved in house hold work.

- Majority of the subjects (72 per cent) belong to nuclear family and (28 per cent) of subjects belong to joint family system.

- From the survey it was found that 90 per cent consuming non-vegetarian food items. Seven per cent of the subjects are consuming vegetarian food items And 3 per cent of subjects belong to ova vegetarian

- It was noted that majority of diabetic subjects(56 Per cent) had the habit of consuming 3 meals per day 39 per cent of diabetics were consuming 4 meals per day and less than 5 per cent of diabetics consuming 2 meals per day.

- All the diabetics consuming cereals, pulses and milk every day. Majority of the diabetic subjects 38 per cent consumed green leafy vegetables weekly.

- It was seen majority of diabetics (41 per cent) were consuming other vegetables weekly. The diabetic subjects (18 per cent) were consuming roots and tubers daily, mostly consumed roots and tubers are onion and ginger. Almost 26 per cent were consuming fruits weekly.

- In present study, all diabetic subjects were consuming milk and milk products daily. About (43 per cent) were consuming non- vegetarian weekly, about 35 per cent of diabetics were consuming sugar daily.

- Selected diabetics consuming were using gingelly oil (30 per cent) for daily cooking followed by sunflower oil (18.9 per cent) and other oils are moderately used.

- The present study showed that 40.5 per cent of subjects had the habit of walking daily. 60 per cent of females were involved in the house hold activity. Among one hundred diabetics few of them were doing gardening, jogging and yoga.

- Among 53 male diabetics only 11.3 per cent had the habit of smoking. 83 per cent smoke cigarette and 16 per cent smoke beedi. Mostly 100 per cent of smokers had habit of smoking daily.
- Among the 53 diabetic male subjects 14 per cent had the habit of consuming alcohol. All the subjects consume alcohol more than 5 years.
- About 5.7 per cent of male and 2.1 per cent of female subjects had habit of chewing, 66.7 per cent of male were consuming pan masala and 33.3 per cent of male and 1 female subjects were consuming beetle leaves. All the subjects had the chewing habit for more than 5 years.
- One hundred diabetic subjects had the habit of drinking hot beverages. Around 35 per cent has the habit of consuming beverages with sugar and 65 per cent consuming beverages without sugar.
- Majority of subjects (53 per cent) had diabetics of history of diabetics and (47 per cent) do not had the history of diabetics.49 per cent were suffering from diabetes for 5 – 10 years.
- Majority of diabetics had symptom such as hyperglycemia (21.8 per cent), polyphagia (19.4 per cent), Polyuria (17.6 per cent), Polydipsia (15.4 per cent), weight loss (10 per cent), constipation (6.3 per cent), Infection (6 per cent) and wound healing (4Per cent).None of the subjects were recorded the symptoms of insomnia and ketoacidosis.
- In present study complications are noted namely hypertension (24.4 per cent), cardiovascular disease (24.4 per cent), kidney disease (24.4 per cent) liver disease (19.5 per cent) and diabetic foot (7.3 per cent) were present.
- Majority of the subjects (77 per cent)were solely depends on Allopathic treatment (18 per cent) of the subjects depends on Ayurveda treatment and 2 per cent of subjects depends on homeopathy and Unani treatments.1 per cent of the subject depends on Unani form of treatment
- Among the one hundred diabetic subjects sixty one per cent of subjects know the health benefit of bitter gourd. Thirty nine per cent of subjects were unaware about the health benefit of bitter gourd.

- Among the sixty one diabetic subjects, twenty per cent gained the information from doctor. Eighteen per cent of people obtained the information from family members. Twelve per cent and eight per cent obtained the information from neighbors / friends and others. Two per cent obtained the information from market and only one per cent had obtained the information from radio.

- Majority of the subjects 46 per cent consume bitter gourd weekly twice and 36 per cent consumes bitter gourd weekly once.

- Majority of the diabetic subjects (96 per cent) with consuming bitter gourd, (66 per cent) consume along with seeds and (30 per cent) do not consume seeds.

- Majority of the diabetics 33.4 per cent consume in the form of braising and 22.8 per cent consume in the form of shallow fat fried. The other forms of bitter gourd consumed were in the form of deep fat fried, stewed, kolambu, thokku, boiled and raw form of bitter gourd

- Among 96 per cent of the bitter gourd consuming diabetic subjects, 55.2 per cent do not undergo any treatment with bitter gourd to reduce its bitterness. 44.8 per cent undergo treatment of bitter gourd to reduce its bitterness.

- Majority of male 36.1 per cent and female 47.1 per cent had their BMI between 18.5-25.0. 16 per cent of subjects had their BMI below 18.5. Around 30 per cent of subjects had their BMI between 25.0 – 30.0 which belongs to Grade I obesity. Twelve per cent of the subjects had BMI above 30 which belong to grade II obesity

- Majority of the subjects had their WHR between 0.96-1.00. Thirty two per cent had their BMI between 0.96-1.00. 10 per cent of the diabetic subjects had WHR between 1.01-1.05. Eighteen per cent of the male and female diabetic subjects had their waist hip ratio between 0.86-0.90. One per cent of subjects had their waist hip ratio between 0.80-0.85.

- In concern to food intake the consumption of cereals, pulses, vegetables, green leafy vegetables, roots, tubers and milk and milk products were deficient in both experimental and control groups.

- Regarding the nutrient intake both experimental and control groups were deficient in protein, calcium, beta carotene and riboflavin.

- The mean fasting blood glucose level of the selected one hundred diabetics was 175.17mg/dl and mean post prandial blood glucose level for the one hundred diabetics was 211.23mg/dl.

- Majority of the subjects 80 per cent of the diabetics were overweight and obese initially and after intervention it was reduced to 50 per cent, with regards to normal category 20 per cent was increased to 50 per cent. In case of control group no big change in BMI was recorded.

- Majority of the subjects waist hip ratio in the range of 0.91-0.95 is 66 per cent is reduced to 34 per cent in males. Females who had waist hip ratio in the range of 0.96-1.00 are significantly reduced after supplementation. There is no much significant reduction is observed in control groups

- The mean fasting blood glucose level of diabetic subjects in experimental group was 162.6 mg/dl and had reduced to 141.8 mg/dl. The mean post prandial blood glucose level of diabetic subjects in control group was 236.3mg/dl and had reduced to 189.0 mg/dl after supplementation of bitter gourd.

CONCLUSION

From the results obtained for blood glucose level (fasting and post prandial) it was revealed that supplementation of bitter gourd is highly helpful in the management of diabetes. Bitter Gourd is the locally available vegetable with low cost and very popular among Asian countries. From the results it is observed that supplementation of bitter gourd is very helpful in the management of diabetes when consume in desirable quantity.

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APPENDIX - I

INTERVIEW SCHEDULE TO ELITIC THE BACKGROUND INFORMATION, DIETARY PATTERN , DIETARY SURVEY, LIFE STYLE PATTERN , HISTORY , BITTERGUARD DETAILS AND ANTHROPOMETRIC MEASUREMENT OF DIABETIC INDIVIDUALS

I. BACK GROUND INFORMATION OF THE SUBJECTS

1. Name :

2. Age :

3. Address :

4. Phone no / mobile no :

5. Sex :

6. Activity: ☐ Sedentary ☐Moderate☐Heavy

7. Occupation :

8. Type of Family : ☐ Nuclear☐ Joint

9. No of Family Members :

10. Total family income (HUDCO 2004)

☐ Below Rs.5000 ☐ Rs.5000 - 10,000

☐ Above Rs.10000 -20000 ☐Above Rs.20000

11. Nature of job: ☐Permanent ☐ Temporary

12. Types of job :☐ Shift ☐Regular

II. DIETARY PATTERN:

13. Dietary habit : ☐Vegetarian ☐Non – vegetarian ☐ova vegetarian

15. Daily meal pattern: ☐2 ☐ 3 ☐ 4

16. Do you drink Milk / Coffee / Tea:☐Yes ☐No

If yes,☐With Sugar ☐Without Sugar

17. Do you take lunch from home? Yes No

If No, where else do you eat? Hotel Mess Canteen Any other

18. Daily Meal Pattern

Meal/ Day	Menu	Ingredients	Quantity consumed
1			
Break fast			
Mid-morning			
Lunch			
Tea time			
Dinner			
2			
Break fast			
Mid-morning			
Lunch			
Tea time			
Dinner			
3			
Break fast			
Mid-morning			
Lunch			
Tea time			
Dinner			

III.DIETARY SURVEY19. Details of food consumption / month

S.No	Food Items	Daily	Weekly once	Weekly Twice	Occasionally	Never
1.	**Cereals and millets** Rice Ragi Wheat Millet Any other					

2.	**Pulses** Bengal gram dhal Black gram dhal Red gram dhal Green gram Green gram dhal Soya bean Any other					
3.	**Vegetables** Bitter gourd Ridge gourd Ladies finger Bottle gourd Brinjal Any other					
4.	**Roots and tubers** Potato Onion Carrot Beet root Yam Any other					
5.	**Green leafy vegetables** Agathi Amaranth Drumstick leaves Fenugreek Corriander leaves Curry leaves					
6.	**Nuts and oil seeds** Coconut Groundnut Seasame Almond Pista Cashewnut					
7.	**Fruits** Apple Banana Grapes Mango Papaya Guava Lime Pomegranate Sapota					

8.	**Milk and milk products** Milk 1. cow 2.Baffalo Curd Butter milk Ghee Cheese Panneer					
9.	**Sugar and Jaggery** Sugar Honey Jaggery Palm jiggery					
10.	**Non vegetarian** Egg Chicken Fish Crab/Prawn Beef/Pork Meat					

20. Fats and oils used for cooking

S.No	Types of fats and oils	Quantity(g/ml)
1	Butter	
2	Ghee	
3	Hydrogenated oil	
4	Gingelly oil	
5	Ground nut oil	
6	Palmolein oil	
7	Sunflower oil	
8	Refined oil	
9	Rice bran oil	
10	Red palm oil	
11	Any other	

IV. LIFE STYLE PATTERN

22. Do you have the habit of doing regular exercise?

☐Yes ☐No,If yes,

☐ Daily

☐ Weekly once

□ Weekly twice

□ Infrequent

Duration of exercise ----------

23. Types of exercise

a. Moderate intensity b. **Vigorous intensity**

□Walking □Jogging

□Gardening □Cycling

□House work □Swimming

□Shuttle/tennis □Volley ball

b. Do you practicing any yoga regularly? □ Yes □No If Yes Duration _____

24. Do you have the habit of smoking? □Yes□ No

If yes, No of cigarettes/beedi/cigar/per day

□Regular □occasional □ex- smoking

How long do you have the habit of smoking?Duration: Years _____, Months _____

25. Do you have the habit of drinking? □Yes □No If yes,

□Habitual□occasional

Duration of drinking Duration: Years _____, Months _____

26. Other habits (do you have the habit of chewing)

□, Tabacco □ Panmasala Beetle leaves □None

Duration: Years _____, Months

V. HISTORY OF DIABETES

27. Did you know already that you are a diabetic patient?□Yes □No If yes,

How long you have this disorder? Duration: Years _____,

Months_____, Days _____

28. Do you have any family history of diabetes mellitus? ☐Yes ☐No If yes,

Relationship	Age	No. of years
Both parents		
One of the parents		
Grand parents		
Other relatives		
None		

29. Are you taking any treatment for diabetes?

☐Yes ☐No If yes, what type of treatment?

☐ Naturopathy ☐ Ayurveda ☐ Homeopathy ☐ Siddha ☐ Unani ☐ Allopathy

30. What are the symptoms you have?

S.No	Symptoms	At present
1	Polyuria	
2	Polyphagia	
3	Polydipsia	
4	Weight loss	
5	Hyperglycemia	
6	Poor wound healing	
7	Constipation	
8	Insomnia	
9	Infections	
10	Ketoacidosis	

32. Do you have any of these following problems?

Type of problem	Duration
Hyper tension	
Cardiovascular disease	
Kidney disease	
Liver disease	
Diabetes foot disease	
Any other	

VI.BITTER GOURD DETAILS

32. Have you ever heard about the health effects of the bitter gourd to cure diabetes?

☐ Yes ☐ No

33. Where did you get the information about the health effect of Bitter gourd from?

- ☐ Market
- ☐ Radio/ Media
- ☐ Neighbors or friends
- ☐ Family members
- ☐ Doctor
- ☐ Others, please specify

34. How often you consume bitter gourd. Give details

- ☐ Daily
- ☐ More times a week
- ☐ Once a week
- ☐ Once a month
- ☐ Other, please specify

35. How do you eat/drink the bitter gourd? (Give only the 1-3 most often used preparations)

- ☐ Raw(eg. As a salad)
- ☐ As a tea
- ☐ As a juice
- ☐ Boiled
- ☐ Stewed
- ☐ Curry
- ☐ Deep fat fried
- ☐ Shallow fat fried
- ☐ Other, please specify

36. When you eat bitter gourd, approximately, how much do you eat?

□ <100 g □ 100-200 □ g>200 g

37. Where do you usually get the bitter gourd from

- □ Market
- □ Super market
- □ Own garden
- □ Neighbors or friends
- □ Street vendors
- □ Others, please specify

37. How do you prepare bitter gourd before cooking?

- □ No treatment before cooking
- □ Soak in tamarind water
- □ Soak in salt water
- □ Soak in water in which rice was soaked and washed
- □ Any other: Why do you do this?

38. Do you remove the seeds before eating / drinking? □ No □ Yes

VII.ANTHROPOMETRIC MEASUREMENT

39. Height of cm :

40. Weight in Kgs :

41. BMI (Body Mass Index) :

42. Hip in cm :

43. Waist in cm :

44. Waist/hip :

Biochemical examination:.

S. No	Name of the test	Initial	Final	Difference
1.	Fasting blood glucose level			
2.	Postprandial blood glucose level			

APPENDIX - II

BMI OF SELECTED DIABETICS (N=100)

17.8	28.9	17.3	23.9	16.8	32.5	16	22.2	28.5	28
23.4	25.2	20.3	25.6	21.3	32.7	17.5	22.4	25	25
24.5	18.3	23.8	17.1	22.3	30.8	18	24.2	26.9	26
25	21.2	28.7	24	24.6	32.8	18.1	21.5	28	27
17.4	23.8	18.3	24	16	32.8	22.1	20.9	27.5	28
22.7	28.4	24.5	28.4	21.5	30.8	20.0	22.6	25.1	23.9
24.2	17.7	23.9	18.4	24.1	41.2	23.3	23.4	27	24
25	20.7	29	23.2	28.7	35	23.3	25.7	26.5	24.3
17.4	20.5	18.3	24.3	38	36	20.1	28.7	23	22.3
22.2	28.4	20.7	24.6	35.6	33	21.5	25.2	27.4	24.1

WHR OF SELECTED DIABETICS (N=100)

0.81	0.92	0.96	0.90	0.89	0.93	0.91	0.99	1.00	1.0
0.91	0.97	0.88	0.87	0.89	0.91	0.94	0.97	1.00	1.05
0.92	0.86	0.92	0.87	0.92	0.92	0.94	0.99	0.98	1.04
0.96	0.90	0.94	0.87	0.93	0.95	0.92	0.96	1.00	0.98
0.87	0.94	0.99	0.89	0.91	0.92	0.93	0.96	0.98	0.99
0.92	0.94	0.90	0.89	0.92	0.91	0.93	0.97	1.00	1.02
0.94	0.97	0.92	0.87	0.93	0.94	0.91	0.97	0.98	1.04
0.97	0.86	0.94	0.86	0.95	0.92	0.94	0.96	0.99	1.02
0.89	0.91	0.96	0.90	0.91	0.95	0.92	0.96	0.98	1.02
0.93	0.91	0.89	0.90	0.92	0.95	0.96	1.00	0.99	1.04

BLOOD GLUCOSE LEVEL OF ONE HUNDRED DIABETIC SUBJECTS

Fasting	Post prandial	Fasting	Post prandial
85	185	210	212
92	185	143	254
103	174	108	208
133	211	164	174
135.6	161.6	202	264
270	360	120	180
151	175.3	200	273
130	149	293	290
190	220	130	150
166	200	200	225
202	270	170	190
302	264	110	127
120	340	190	230
113	180	220	247
194	238	218	230
100	255	160	169
110	150	170	190
190	168	200	215
120	200	288.6	312
383	412	291	377

Fasting	Post prandial	Fasting	Post prandial
206	269	110	127
200	273	190	230
200	229.5	220	247
293	340	111	121
144.5	227.2	136	146
150.3	186.7	200	230
104	225	170	190
200	240	218	230
200	240	200	212
140	168	121	130
159	200	136	146
145	259	200	220
170	273	190	210
173	274	147	160
190	285	159	169
130	200	194	163
143	239	214	167
184	230	210	212
192	235	143	254
200	214	108	208
190	270	164	174
270	159	154	160
245	164	160	190
134	159	170	200
144	157	170	210
212	230	270	280
122.3	140	208	274
137	140	146	170
117	123	152	163
221.4	159	173	189
139	150	160	176
254	160	174	180

BLOOD GLUCOSE LEVEL OF EXPERIMENTAL GROUPS

Initial		Final	
Fasting	Post prandial	fasting	Post prandial
140	168	136	122
159	200	150	190
145	259	100	149
170	273	130	190
173	274	150	210
190	285	170	260
130	200	114	179
143	239	138	200
184	230	165	190
192	235	165	200

BLOOD GLUCOSE LEVEL OF CONTROL GROUPS

Initial		Final	
Fasting	**Post prandial**	**Fasting**	**Post prandial**
200	214	210	215
190	270	194	274
210	212	230	242
143	254	170	290
108	208	115	218
164	174	180	195
202	264	200	240
120	180	134	183
200	273	200	270
293	290	340	334