ABSTRACT

Diabetes must be taken seriously by everyone, including healthcare professionals and decision-makers, as well as those who have it or are at high risk of developing it. Diabetes remains a severe and growing problem to public health and places a huge burden on persons affected and their families. Diabetes patients run the risk of acquiring a number of crippling and fatal complications, which would necessitate more frequent medical attention, lower quality of life, and early death. Diabetes is one of the top 10 killers on a global scale.

The 10th latest edition of the IDF Diabetes Atlas published in 2021 documents a sustained rise in diabetes prevalence around the world, proving that the disease poses a serious threat to the health and well-being of people, families, and nations.

Diabetes is becoming more prevalent in persons 65 years and older as the population as a whole continues to age. According to statistics, 33% of persons 65 and older have diabetes. This population is more at risk of having diabetes-related problems such as hypoglycaemia (low blood sugar), renal failure, and heart disease than younger people living with diabetes (Endocrine society, 2022).

Promoting a lifestyle that includes a balanced diet, use of functional foods, regular exercise, quitting smoking, and maintenance of a healthy body weight is the cornerstone of type 2 diabetes care. In recent years, there has been rising evidence that functional foods and their bioactive substances, due to their biological qualities, may be utilised as supplemental treatment for type 2 diabetes mellitus.

One of the healthiest seeds for persons with diabetes is pumpkin seeds. These seeds are rich in antioxidants, phytochemicals, fatty acids, vitamins, and minerals that are good for diabetes to improve lipid profile. Secondly, pumpkin seeds amongst the prime functional food are the need-of-the-hour.

The present study was planned with 3 phases. In phase I, nutrient profiling of pumpkin seed was carried out under which parameters such as proximate composition, vitamin and mineral composition, fatty acid profile, antioxidant activity and phytochemical screening were studied. Analysis was carried out in NABL accredited laboratory. In phase IIA, 8 pumpkin seed incorporated recipes were standardized and developed at different dosage of pumpkin seeds. 20 semi trained panel members using composite scoring test and hedonic rating scale carried out sensory evaluation of developed recipes. In phase IIB, 10gm pumpkin seed incorporated recipes were further evaluated for its Glycaemic index and Satiety index. GI was calculated by measuring incremental area under curve of test recipes and SI was calculated by using Visual analog scale. In phase III, for the evaluation of pumpkin seed supplementation 90 elderly type 2 diabetic subjects were enrolled from urban Vadodara and data regarding baseline information, anthropometric measurements, biophysical parameters, medical history, diet history, quality of life, physical activity was collected by using standard tools and techniques. Data on few biochemical parameters such as haemoglobin levels, Fasting blood sugar, Glycated haemoglobin, lipid profile, kidney function test, liver function test and inflammatory markers was also collected before and after an intervention.

In phase I, Nutrient, antioxidants, fatty acids and phytochemical screening of pumpkin seeds was carried out. Pumpkin seeds (100g) contained 35.94 grams of proteins. Pumpkin seeds contain the highest concentrations of zinc (8.6 mg/100 g) and magnesium (678 mg/100 g), respectively, among all the minerals found in pumpkin seeds. Antioxidants found in pumpkin seeds suggested that the seeds' capacity to scavenge free radicals. Presence of various unsaturated fatty acids like linoleic acid, hexadecenoic acid, oleic acid and phytochemicals such as flavonoids, tocopherol were reported in pumpkin seeds.

In phase IIA, Pumpkin seeds were incorporated in dosage of 2g, 5g and 10g in eight eqi-carbohydrate Indian traditional recipes and standardized. Recipes were developed by using different cooking methods such as methi muthiya and palak dhokla by steaming, vegetable cutlet and thalipith by shallow frying, chevda and vegetable poha by roasting, vegetable upma and vegetable pulao by boiling method. Sensory evaluation by 20 semi

trained panel members was carried out by using hedonic rating scale and composite scoring test. Out of the eight recipes, vegetable thalipith (sample 2) was well regarded while vegetable upma (sample 3) received the least favourable reviews from the semi-trained panel. Recipes such as palak dhokla, roasted chevda, vegetable poha and vegetable cutlet that included 10g of pumpkin seeds had the highest level of acceptability and liking. The dishes that included 10g of pumpkin seeds had the highest level of acceptability and liking.

In phase II B, glycemic index and satiety index of pumpkin seed incorporated recipes was evaluated. Eight recipes at incorporation of 10gm of pumpkin seeds were tested on 10 adult healthy subjects who met inclusion and exclusion criteria for the enrollment. The ISO protocol for glycemic index (ISO 26642:2010) was followed for GI evaluation of recipes. After adding 5gm of pumpkin seeds, methi muthiya and vegetable upma were discovered to have the lowest glycemic index readings, at 45±10.2 and 47.75±9.2, respectively. In comparison to the other 8 recipes, Roasted Poha Chevda had the greatest glycemic response (65.5±7.2). Vegetable upma was the least filling recipe, and thalipith was the most satisfying.

In phase III, 90 subjects were enrolled for the supplementation as per inclusion and exclusion criteria. Subjects were distributed randomly in 3 groups for intervention of 3 months. Group 1 received 10gm pumpkin seed, group 2 received 15gm pumpkin seed and group 3 was treated as Control group. Pumpkin seed supplementation had no effects on the subjects' anthropometry measurements. A small improvement in the individuals' quality of life and reduction in diabetes distress was seen. Two participants from each intervention group moved from the hypertension to the pre-hypertensive category after the intervention.

Fasting blood sugar, glycated haemoglobin, total cholesterol, and LDL cholesterol levels among experimental groups all significantly decreased as a result of pumpkin seed administration. 7% reduction in Fasting Blood Glucose (FBS) was observed among group 1 and 8.5% reduction was noted for group 2. HbA1C levels were reduced by 9.4% among group 1 and 12% among group 2. For Total cholesterol (TC), 6% reduction

among group 1 and 7.7% reduction among group 2 was noted. LDL cholesterol levels were reduced by 3.7% and 6% in group 1 and group 2 respectively. Kidney and liver function tests had no adverse effect of pumpkin seed supplementation. Positive correlation between BMI and Fasting blood glucose of experimental group was noted depicting as BMI was increased, fasting blood glucose levels increased.

Thus, Hypoglycaemic and hypolipimic effect of pumpkin seed was observed among type 2 diabetic old age subjects when supplemented with pumpkin seeds for the duration of 90 days. Pumpkin seeds have the potential to be used as a functional food in management of Diabetes mellitus and associated co-morbidities.