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CHEMICAL AND PHYTOCHEMICAL CHARACTERIZATION OF SUNFLOWER (HELIANTHUS) SEED POWDER TO CHECK ITS THERAPEUTIC PROPERTIES FOR THE MANAGEMENT OF INSULIN RESISTANCE IN DIABETIC HUMAN SUBJECTS

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Abstract

Diabetes mellitus (DM) is regarded as one of the top ten main causes of death globally, creating a huge global health burden due to its rising prevalence and consequences. It is a chronic metabolic condition characterized by persistent hyperglycemia caused by either inadequate insulin synthesis or poor insulin utilization, which results in glucose intolerance and systemic metabolic deregulation. Diabetes has long-term implications such as cardiovascular disease, nephropathy, neuropathy, and retinopathy, thus good treatment measures are critical for lowering morbidity and death. Despite the extensive use of synthetic antidiuretic pharmaceuticals, herbal remedies are gaining popularity due to their efficacy, safety, and less side effects. These natural remedies serve to adjust insulin sensitivity, control glucose metabolism, and minimize oxidative stress, all of which help manage diabetes. Among these, sunflower (Helianthus) has received interest for its potential as a functional herbal intervention in diabetes treatment. Current research was investigated to evaluate the therapeutic properties against diabetes for this purpose firstly the sunflower seeds powder was evaluated for it proximate,mineral and phytochemical analysis which showed that it contains the appreciable amount of all essential nutrients and can be used for various disease after that clinical trail was conducted on the human diabetic patients that were selected on the basis of their consent and inclusion and exclusion criteria in which 30 females were divided in to 3 groups in which G_0 were as control group and G_1 AND G_2 were as treatment group that were receiving the dose of 6g and 12 g of sunflower seeds for the periods of 2 months.The influence of sunflower seed powder on diabetes patients' blood sugar levels was checked every seventh day for 2 months, and HbA1c assessments were done initially and after 2 months. The results showed that 12g sunflower seed powder for 60 days showed highly significant results against random blood sugar levels and HbA1c without showing any adverse effects.

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INTRODUCTION

Diabetes mellitus (DM) is a metabolic condition that causes hyperglycemia, glucose intolerance, impaired insulin production and peripheral sensitivity, and β-cell dysfunction. Diabetes is regarded as one of the oldest ailments worldwide. (Shin, H. D et al.,2004). Chronic hyperglycemia is a metabolic disease characterized by either insufficient insulin production, decreased insulin action, or both. Notably, insulin is a key anabolic hormone that affects the metabolism of carbs, lipids, and proteins. (Poznyak A.et al ., 2020)

Diabetes-related metabolic problems mostly impact adipose tissue, skeletal muscles, and the liver as a result of insulin resistance. (Rossi, M. C.et al., 2019). The intensity of symptoms varies according to the length and type of diabetes. Individuals with high blood sugar levels, particularly those without insulin, such as children, may have symptoms such as increased hunger, polydipsia, dysuria, weight loss, and visual issues. Some persons with diabetes may not feel any symptoms; especially type 2 diabetic patients in the early stages. (Barnett, A. Het al ., 1981)

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Approximately 75-80% of the world's population, particularly in underdeveloped nations, rely on herbal medicine for primary healthcare.(Kamboj, 2000).

Herbal remedies have been developed over centuries of practice by indigenous physicians. Herbal medications are widely used in underdeveloped countries for basic health care because to their low cost, cultural acceptance, compatibility with the human body, and few adverse effects. (Vickers and Zollman, 1999).

Many herbal medications on the market lack pharmacological approval to ensure safety and efficacy. Herbal formulations can be selected, prepared, and applied based on thousands of years of history. To be considered a credible alternative to contemporary medicine, therapeutic products must undergo rigorous scientific and clinical validation to ensure their safety and effectiveness. (Shaw et al., 1995).

Everyone's main priority is their health. To address the growing number of health issues, a multidisciplinary approach is necessary to address the underlying causes of these disorders.. Sunflower seeds are widely recognized for their significant health benefits. (Anjum FA,et al.,2012)

Sunflower (Helianthus annuus), a popular oil seed crop grown for its seeds, is the world's second largest producer of edible oil, behind soybean oil. (Robertson JA, Burns EE. (1975)

Sunflower (Helianthus annuus) is a miracle oil seed crop that is grown worldwide for its seeds. Sunflower seeds, a nutrient-dense diet, may help with chronic inflammatory illnesses, bacterial and fungal infections, cardiovascular and skin problems, and even cancer. (Stefansson BR. (2007) Sunflower seeds provide these advantages because they include phytosterols, unsaturated fatty acids, proteins, and a range of vitamins and minerals. Sunflower seeds have been shown to be helpful in a variety of clinical situations.. Sunflower seeds are rich source of phytoesterol which may serve as a preventive measure for breast cancer. (Ruggio DM, Ashraf- and Khorassani M. (2005) .It has been observed that beta-Sitosterol, most abundant phytosterol inhibits the growth of several specific types of tumour cells in vitro and decreases the size and the extent of tumor metastases in vivo too (Awad AB,,,et al 2007)

Although standard antidiabetic medicines such as metformin and insulin treatment are commonly used to manage diabetes, natural options such as sunflower seeds are gaining popularity due to their potential health advantages. Sunflower seeds include bioactive substances such as linoleic acid and phylloquinone, which have been shown to improve insulin sensitivity and control blood glucose levels.

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MATERIALS AND METHODS

Collection and preparation (Sunflower (Helianthus) powder

Sunflower (Helianthus) seeds were bought from the local market and are and ground in a fine powder and pack into bags to avoid contamination for further usage of analysis

Chemical and phytochemical Characterization of sunflower seed powder

Sunflower seeds powder was subjected to various assays for further usage as clinical investigation

Proximate analysis

Sunflower seeds powder was firstly analyzed for moisture, ash, crude, fat, protein, crude fiber and nitrogen extract as done by according to their standard procedures using AOAC (2012) techniques Donahue, C. J., & Rais, E. A. (2009).

Minerals Determination

Zinc phosphorus along with, Mg, K, Ca were analyzed by in the sunflower seed powder by using specific protocols (Hagemann, S. G., Lisitsin, V. A., & Huston, D. L. (2016).

Phytochemical analysis of sunflower seed powder

Phytochemical analysis of sunflower seeds powder investigated for determination of total phenolic content (TPC) and total flavonoids content (TFC) TFC was determined using a colorimetric method as described by (Scalbert, A., et all ., 2011)

Evaluation of Therapeutic properties of sunflower seeds powder for the regulation of blood glucose level in human patients

On the basis of results of raw material analysis the sunflower seeds were checked against the diabetes management in human patients for this purpose female diabetic patients were selected by taking their consents or on the basis of inclusion and exclusion criteria and then divided into groups of treatment as experimental trail and gave them different doses of sunflower seeds powder after breakfast for the periods of 2 months (8weeks)

Selection of diabetic subjects

30 female type 2 diabetic patients of age 30-60 years were selected from the the different areas

Exclusion limits:

Any patient who was taking insulin or other drugs that might have an effect on glucose metabolism was not included. Women who were lactating or pregnant were also excluded from this study.

Inclusion Range:

All diabetic patients undergo with a detailed medical evaluation which including medical history and physical examination by a doctor. This study included females of ages 30 and 60 years who had fasting blood glucose levels between 135 and 150mg/dl. Patients were divided into three groups of 30 subject each, with the following conditions as in **table 1.**

Experimental study design

30 female patients were selected were divided into 3 groups in which G_0 were not receiving any treatment and G1 and G2 were receiving different doses of sunflower seed 6g for G1 and 12g for G2 group for the periods of 2 months and they random glucose levels were measured weekly through the trail and their blood parameters were checked before initiation and termination of trail.

Groups	Title	Treatment
G_0	Diabetic control group	Not received any dose
G_1	Diabetic treatment group 1	6g sunflower seeds powder
G_2	Diabetic treatment group 2	12g sunflower seeds powder

G_0 Diabetic control group

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G_1 Diabetic treatment 1 group 1
G_2 Diabetic treatment group 2

Collection of Serum for biochemical analysis

Blood samples were systematically collected from the subjects' antecubital veins before and after the study period, following an overnight fasting protocol to ensure metabolic stability, utilizing disposable plastic syringes under stringent aseptic precautions; immediately after collection, the blood was transferred into anticoagulant-treated test tubes to prevent coagulation, ensuring optimal sample integrity for subsequent HbA1c analysis, which was conducted across all
(Miedema, K. .2005)

STATISTICAL ANALYSIS

2 way anoca were observed on each analysis by using Denis, (J. B. 1998).

RESULTS

Proximate analysis

The percentages of proximate analysis showed the following results as shown in **Table 2:** Proximate analysis of fenugreek seeds powder

Proximate analysis	**Contents (%)**
Moisture	5.87 ±0.08
Crude protein	27.08±0.68
Crude fat	23.14±1.2
Crude fiber	11.30±0.09
Total carbohydrates	37.4±0.03
Ash	3.28±0.09

Minerals analysis of sunflower seeds powder: The mineral analysis shows that sunflower seeds are rich of trace elements and can be used for the treatment of various problems

Table 2: Mineral composition of sunflower powder

Minerals	**Concentration (mg/100g)**
Zinc	6.87±10.8
Potassium	1000.4±9.8
Phosphorus	1153.7±1.17
Calcium	73.17±0.28
Iron	3.87±0.11

Antioxidant analysis of Sunflower seeds powder

Phytochemical analysis of sunflower seed powder was investigated for determination of total phenolic content (TPC) and total flavonoids content (TFC). The TPC was stated in gallic acid equivalents (mg GAE/g sample) as 153.39±13.29. And TFC was stated in catechin equivalents (mg CAE/g sample) as 2.55±0.22.

Table 4: The significant amount of TPC and TFC depicted

Phytochemicals	Content
TPC	153.39±13.29mg GAE/g
TFC	2.55±0.22 mg CAE/g

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Therapeutic investigation of sunflower seed powder **for the management of blood sugar level in human female subjects**

The purpose of this investigation was conducted to elucidate the nutraceutical worth of sunflower seed powder against diabetes in human female subjects. Bio evaluation was conducted for a period of 60 days. Patients of control group Go were not given Sunflower seed powder and were only recommended to use their regular medications. G1 (Diabetes treatment group) was given sunflower seed powder of 6g per day along with their regular medicines for a time span of 60 days. G2 (diabetes treatment group) was given a dose of 12g/day of sunflower seed powder of along with their regular medicines for 60 days.

Random and Fasting blood sugar levels

Random blood sugar levels of diabetic patients were checked every seventh day for 2 months. Results showed significant reduction in random blood sugar levels.

Table 5: Mean±S.D values for fasting glucose levels

Groups	**Fasting glucose (mg/dL), day 0**	**Fasting glucose (mg/dL), last day of study**
G_0	181	159
G_1	132	122
G_2	125	97

Table 6: Mean Value of Random Blood Sugar (mg/dl) from 0-60 days.

Groups	Before treatment	7 day	14th day	21st day	28th day
G_0	13.40±1.11	10.8 ± 1.41	9.9±1.82	8.5±1.82	7.5 ± 2.11
G_1	13.31±1.12	9.5±2.12	7.8±1.41	6.5±1.41	6.35 ±1.32
G_2	13.50±1.11	9.3±1.21	7.0±1.93	6.1± 1.93	6.0± 1.31

HbA1c analysis

During the early period of therapy, no statistically significant alterations were identified; however, a comparison with the control group revealed substantial modifications. After 60 days, all trial participants had a complete HbA1c level evaluation, which revealed extremely significant improvements in glycemic management. The control group had an average HbA1c level of 7.9%, whereas Group 1, which got 6g of sunflower seed powder, had a HbA1c level of 6.31%, and Group 2, which received 12g of sunflower seed powder, had a HbA1c level of 6.1%. Metabolic regulation. Interestingly, despite the increasing dosage, the most evident therapeutic effectiveness was obtained with a 3g increase in sunflower seed powder, indicating an optimal dose-dependent relationship in which moderate supplementation offers maximal glycemic advantages compared to excessive consumption. These findings highlight the potential of sunflower seed powder as a functional dietary intervention in diabetes care, necessitating additional mechanistic research and long-term clinical studies to further understand its involvement in insulin sensitivity and metabolic control.

DISCUSSION

Diabetes mellitus is a serious global health issue, impacting millions of people globally and causing considerable morbidity and mortality. Chronic hyperglycemia owing to insulin resistance or insufficiency causes consequences such as cardiovascular disease, neuropathy, nephropathy, and retinopathy. The rising prevalence of diabetes, particularly Type 2, has motivated researchers to investigate alternate nutritional therapies alongside standard pharmaceutical treatments. (Adugba, A. O., et al.,2024)

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investigate alternate nutritional therapies alongside standard pharmaceutical treatments. (Rehman, A et al .,2021)

Therefore, alternative medicinal plants possess great importance as they are indigenous, cost effective, and food-based. Researchers are now looking for herbal and plant based medications to discern their effectiveness and protective role in diabetic subjects. One of the herbal plants is Sunflower (Helianthus).that can be used in various ways (Buhalova, D et al., 2014).

Recent study has shown that sunflower seed powder can modify insulin-related gene expression, hence improving glucose homeostasis in animal settings. A study on the effects of sunflower seed powder on high-fat diet-induced prediabetes found that supplementation significantly increased the expression of insulin receptor (INSR), insulin-like growth factor 1 (IGF-1), and glucose transporter 2 (GLUT2), indicating that it has the potential to prevent insulin resistance. Furthermore, sunflower seeds have a low glycemic index, making them an excellent dietary component for maintaining stable blood glucose levels. (Pal, D. (2011).

So in current research Sunflower seed powder was prepared and the chemical analysis was analyzed at initial level to check it's for further investigation the proximate contents showed that the raw material contained appreciable amount of various nutrients and can be used for further researches because sunflower seeds are well known for their high proximate composition and mineral profile, making them an important nutritional resource. Their proximate analysis shows a high concentration of crude protein, crude fat, crude fiber, ash, and moisture, with processing processes having a major impact on these values. Sunflower seeds' high lipid content makes them a good source of edible oil, and their protein composition increases their nutritional value. (Akande, K. E. (2011). Furthermore, the mineral analysis identifies the presence of important minerals such as calcium, magnesium, phosphorus, potassium, and iron, all of which play critical roles in physiological function and general health. (Omonov, O et al 2023). Mineral content varies between sunflower genotypes and environmental circumstances, altering nutritional efficiency. Various processing processes, including as roasting, boiling, and mechanical extraction, have been demonstrated to modify both proximate composition and mineral bioavailability, making the seeds more suitable for human consumption and industrial purposes. Comparative studies indicate that sunflower seeds have a nutritional advantage comparable to other oilseeds, making them a sustainable and efficient alternative for the food and feed sectors. For deeper insights, research such as this study gives further investigation of sunflower genotypes and their nutritional qualities. (Zheljazkov, V. D.,2014).The investigation of compositional and mineral content of sunflower seed powder reflects that it has good amount of protein which is important in muscle building. The seeds of this herb are also being conventionally used for lowering blood glucose levels and for treating some indicators like eczema, gout, diarrhea, abdominal discomforts, burns, stomach, disperse cold and lowers pain, treat appetite issues and inflammations of skin (Rehman, A., et al 2021)

The phytochemical analysis was also showed the significant amount of of TPC and TFC s the strong antioxidant potential and it was found for various researches that sunflower seed powder is rich in these compounds which are good for removing oxidative stress in the body due to any disease, and also removes free radicals in the body. (Žilić, S., et al 2010)

The purpose of the current study was to evaluate Sunflower (Helianthus) impact on diabetic patients considering the considerations. TPC and TFC were estimated for investigating the antioxidant potential and it was found that this herb is rich in these compounds which are good for removing oxidative stress in the body due to any disease, and also remove free radicals in the body. Several studies have looked at the Total Phenolic Content (TPC) and Total Flavonoid Content (TFC) of sunflower seeds, emphasizing its antioxidant qualities and health benefits. Research has demonstrated that sunflower hybrids contain considerable levels of phenolic chemicals, which contribute to their antioxidant activity and free radical scavenging ability. (Carelli, A. A., et al 2005)

The therapeutic investigation showed that the effect of sunflower seed powder on diabetes. The patients have 6 g of sunflower has remarkable difference in random and fasting glucose level along with hba1c as

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well as the patients that were receiving 12 g doe if sunflower seeds were also showed more improvement in their blood parameters and they are most oppose to the regulation of glucose showing any adverse effects. Recent study has shown that sunflower seed powder can modify insulin-related gene expression, hence improving glucose homeostasis in animal settings. A study on the effects of sunflower seed powder on high-fat diet-induced prediabetes found that supplementation significantly increased the expression of insulin receptor (INSR), insulin-like growth factor 1 (IGF-1), and glucose transporter 2 (GLUT2), indicating that it has the potential to prevent insulin resistance. Furthermore, sunflower seeds have a low glycemic index, making them an excellent dietary component for maintaining stable blood glucose levels. (Adugba, A. O., et al 2024)

Despite these promising results, more clinical trials are needed to develop standardized guidelines for sunflower seed powder use in diabetes control. Future study should look at long-term effectiveness, proper dose, and potential interactions with standard antidiuretic drugs to establish its feasibility as a supplemental therapy. The use of sunflower seed powder into dietary plans may provide a cost-effective and accessible method of enhancing glycemic management and lowering diabetes-related comorbidities.

CONCLUSION

Sunflower seed powder has shown interesting therapeutic qualities in the control of glucose levels, making it a possible supplemental intervention for diabetes treatment. Sunflower seeds are high in bioactive components such as polyunsaturated fatty acids, magnesium, and vitamin E, which help to increase insulin sensitivity, glucose metabolism, and reduce oxidative stress, all of which are important for glycemic management. Sunflower seed supplementation has been shown in studies to affect insulin receptor function, control glucose transporter expression, and reduce HbA1c levels, indicating that it can help maintain stable blood sugar levels.Furthermore, its low glycemic index makes it an appropriate dietary component for diabetics, since it reduces postprandial glucose spikes and promotes long-term metabolic health. Finally, sunflower seed powder is a low-cost and easily available way to improve glycemic control, providing a natural alternative to traditional diabetes care measures. Its therapeutic potential requires additional exploration in order to fully realize its advantages in diabetes prevention and management.

Conflict of Interest

The authors declared that there is no conflict of interest in this paper.

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