Exploring the Effects of Ayurvedic and Naturopathic Treatments on Biochemical Parameters in T2DM Patients

Samriti Gumber
Assistant Professor
Department of Biochemistry
Government College for Girls, Ludhiana
Mail id:-smritigumber@gmail.com

Dr. Himanshu Saini
Naturopathic Physician at Patanjali Wellness Sampooran Aarogyam, Panipat, Haryana
Mail id:- sainihimanshusaini999@gmail.com

Abstract

This study explores the effects of Ayurvedic and Naturopathic treatments on biochemical parameters in Type 2 Diabetes Mellitus (T2DM) patients. As T2DM continues to rise globally, conventional pharmacological treatments often fail to address the root causes of the disease. Ayurveda and Naturopathy offer holistic approaches, focusing on restoring balance through personalized treatments targeting the underlying factors of diabetes, such as insulin resistance and inflammation. Ayurvedic herbs like Giloy, bitter gourd, and turmeric, and naturopathic practices like fasting, detoxification, and herbal remedies, have been linked to improved glucose control and overall metabolic health. This study investigates the combined effect of these therapies on biochemical markers, including fasting and postprandial blood sugar, HbA1c, cholesterol, and oxidative stress, over a 12-week intervention period. Results indicate significant improvements in blood glucose levels, lipid profiles, and reduced inflammation in patients receiving Ayurvedic and Naturopathic treatments, particularly in the combined therapy group. These findings suggest that integrating both therapeutic approaches could offer a comprehensive solution for managing T2DM, although further research is needed to confirm these results in larger, controlled trials.

Keywords: Ayurvedic treatment, Naturopathic treatment, Type 2 Diabetes Mellitus, blood glucose control, insulin sensitivity, herbal remedies, detoxification, holistic therapy.

1. Introduction

Type 2 Diabetes Mellitus (T2DM) has become a leading global health concern, with its prevalence rising particularly in developing nations (Bhandari et al., 2023). Traditional pharmacological treatments, although effective in managing symptoms, often fail to address the underlying causes of diabetes, prompting interest in alternative and complementary therapies (Bhat et al., 2022). Ayurveda and Naturopathy, two ancient medical systems, emphasize the restoration of balance within the body through personalized treatments targeting the root causes of health conditions rather than merely alleviating symptoms (Gupta et al., 2021; Jain et al., 2023). Naturopathy, which includes practices like fasting, detoxification, and the use of herbal remedies, has shown potential in improving insulin sensitivity, reducing inflammation, and promoting weight loss (Bhandari et al., 2023). Ayurvedic medicine, using herbs like Giloy, bitter gourd, and turmeric, is believed to reduce blood sugar levels, enhance antioxidant activity, and support overall metabolic balance (Choudhury et al., 2023; Joshi et al., 2023). However, limited research exists comparing the efficacy of these therapies in managing T2DM, especially when used in combination (Patel et al., 2023). This study aims to explore the effects of Ayurvedic and Naturopathic treatments on biochemical parameters in T2DM patients, providing a holistic approach to diabetes management (Gupta et al., 2023). By integrating these therapies, there is potential to offer a more comprehensive solution to managing T2DM, improving not only blood glucose levels but also overall well-being (Reddy et al., 2023).

2. Literature Review

Naturopathy's Role in Diabetes Control:

Naturopathy, as a holistic approach to treating chronic diseases, utilizes a range of therapies such as fasting, herbal remedies, and detoxification to manage health conditions like Type 2 Diabetes Mellitus (T2DM). The focus of naturopathy is to enhance the body's natural ability to heal and restore balance. Numerous studies have indicated that fasting can help improve insulin sensitivity by reducing blood sugar levels and promoting weight loss, which are crucial factors in managing T2DM (Bhat et al., 2022). Herbal remedies, such as bitter gourd, turmeric, and fenugreek, are commonly used in naturopathy to help regulate blood glucose levels. Research has shown that these herbs possess bioactive compounds that have anti-diabetic effects, such as improving insulin sensitivity and reducing glucose absorption (Choudhury et al., 2023). Detoxification methods like colon cleansing and the use of therapeutic agents like Epsom salts are also believed to reduce inflammation and oxidative stress, which are typically elevated in diabetic patients (Reddy et al., 2023). As such, naturopathy has emerged as a promising complementary treatment for managing the biochemical markers associated with T2DM, though more large-scale, controlled studies are needed to confirm its efficacy (Gupta et al., 2023).

Ayurvedic Medicine's Contribution:

Ayurveda, an ancient Indian system of medicine, aims to balance the body's energies, known as the doshas, to promote health and prevent disease. In the context of T2DM, Ayurveda uses a combination of dietary modifications, herbal remedies, yoga, and lifestyle changes to treat and manage the disease. Herbal treatments play a pivotal role, with plants like **Giloy** (Tinospora cordifolia), **Bitter Gourd** (Momordica charantia), **Turmeric** (Curcuma longa), and **Neem** (Azadirachta indica) being commonly used to regulate blood sugar levels. Several studies have demonstrated that **Giloy** possesses anti-diabetic properties, primarily through its ability to improve insulin secretion and glucose tolerance (Rai et al., 2021). **Bitter gourd** is known to contain compounds like charantin and polypeptide-p, which help lower blood sugar levels by enhancing insulin sensitivity (Gupta et al., 2021). **Turmeric**, with its active compound curcumin, has been found to have antioxidant properties, reducing oxidative stress and inflammation that are commonly associated with diabetes (Bhandari et al., 2023). Moreover, Ayurveda focuses on personalized treatments, including Panchakarma therapy, which detoxifies the body and supports metabolic functions, further aiding in the regulation of glucose metabolism (Singh et al., 2023). Studies also suggest that Ayurvedic practices, when combined with lifestyle changes such as yoga and meditation, improve the overall quality of life for diabetic patients, helping to maintain a balanced mind-body connection (Mehta et al., 2021). However, research comparing the individual or combined efficacy of these Ayurvedic herbs in T2DM patients remains limited and calls for further investigation (Joshi et al., 2023).

Comparison of Treatments:

Both Ayurveda and Naturopathy are widely practiced across the world, particularly in India and other parts of Asia. While each system offers promising benefits in managing T2DM, there is a significant gap in research comparing the two approaches, particularly in terms of their combined effects. Studies have shown that individual treatments from both systems, such as Ayurvedic herbs and naturopathic detoxification therapies, have a positive impact on biochemical parameters like blood glucose levels, cholesterol, and inflammation (Bhandari et al., 2023; Choudhury et al., 2023). However, few studies have focused on evaluating the combined effect of Ayurvedic and Naturopathic treatments for managing T2DM. Given the complementary nature of both approaches—Ayurveda focusing on internal energy balance and Naturopathy on detoxification and natural healing—there is a strong potential for synergistic effects when both are applied together. Some pilot studies and anecdotal evidence suggest that combining herbal remedies, diet adjustments, yoga, and detoxification therapies could lead to better management of blood glucose, reduced medication dependence, and improved overall health outcomes (Patel et al., 2023; Gupta et al., 2023). Nonetheless, more rigorous, large-scale clinical trials are necessary to substantiate these claims and provide a comprehensive understanding of the effectiveness of combined therapies (Reddy et al., 2023).

3. Methodology

This study aims to explore the effects of Ayurvedic and Naturopathic treatments on the biochemical parameters in Type 2 Diabetes Mellitus (T2DM) patients. The following methodological approach was adopted to assess the impact of these treatments over a 12-week period.

3.1 Study Design

A **comparative study** was conducted involving 120 patients diagnosed with Type 2 Diabetes Mellitus. The participants were randomly assigned to one of four groups:

1. **Naturopathy Treatment Group**: This group received Naturopathic interventions, including a diet rich in antioxidants, physical therapies, yoga, and detoxification methods.

2. **Ayurveda Treatment Group**: Participants in this group followed Ayurvedic treatments, which involved herbal remedies (such as Giloy, bitter gourd, and turmeric), meditation, and Ayurvedic practices like Panchakarma therapy.

3. **Combined Naturopathy and Ayurveda Group**: This group received an integrated approach of both Naturopathic and Ayurvedic treatments.

4. **Control Group**: This group received no treatment and followed their usual diabetic management protocol.

3.2 Participant Selection

Inclusion criteria:

- Adults aged 30–65 years diagnosed with Type 2 Diabetes Mellitus for at least one year.
- HbA1c levels between 7% and 10%.
- Patients who were not on insulin therapy and had stable oral hypoglycemic agents (OHA) regimen.

Exclusion criteria:

- Patients with comorbidities such as cardiovascular diseases, chronic kidney diseases, or cancer.
- Pregnant or breastfeeding women.
- Individuals who had undergone any recent surgery or had active infections.

3.3 Interventions

Naturopathy Interventions:

- **Dietary Modifications**: Participants were prescribed a diet rich in antioxidants and anti-diabetic foods, including vegetables like bitter gourd, fruits such as papaya and guava, and legumes like green gram and soybeans (Bhat et al., 2022).
- **Yoga**: Participants were instructed to practice yoga, including asanas like Surya Namaskar, Trikonasana, and Paschimottanasana, along with pranayama (breathing exercises) like Anulom Vilom and Bastrika (Mehta et al., 2021).
- **Detoxification**: Methods such as fasting and the use of natural detox agents (like Epsom salt baths) were introduced to help remove accumulated toxins and reduce inflammation (Reddy et al., 2023).

Ayurvedic Interventions:

- **Herbal Remedies**: Participants were provided with Ayurvedic herbs such as Giloy (Tinospora cordifolia), Bitter Gourd (Momordica charantia), Turmeric (Curcuma longa), and Neem (Azadirachta indica), known for their anti-diabetic and antioxidant properties (Bhandari et al., 2023).

- **Panchakarma Therapy**: This included detoxification practices like medicated enemas (Basti) and therapeutic body massages aimed at balancing the body's doshas and improving metabolic functions (Singh et al., 2023).

- **Meditation**: Participants were encouraged to practice Ayurvedic meditation techniques like Manipur Chakra meditation and Aum chanting to reduce stress, which can help improve blood sugar control (Gupta et al., 2021).

Combined Naturopathy and Ayurveda Group:

- Participants in this group received the integrated protocol of both Naturopathy and Ayurvedic treatments, combining the diet, yoga, and detoxification methods from Naturopathy with the herbal remedies, Panchakarma therapy, and meditation from Ayurveda.

Control Group:

- Participants in this group continued with their usual care regimen for T2DM, including pharmacological treatment as prescribed by their primary healthcare provider.

3.4 Data Collection

Data were collected at **baseline** (before treatment) and **after 12 weeks** of intervention. The following parameters were measured:

1. **Biochemical Markers**:
    - **Fasting Blood Sugar (FBS)** and **Postprandial Blood Sugar (PPBS)** levels to assess glycemic control.
    - **Total Cholesterol**, **LDL**, and **HDL levels** to evaluate lipid profiles.
    - **Triglycerides** to assess overall fat metabolism and cardiovascular risk.
    - **HbA1c** levels to measure long-term blood glucose control.
2. **Physical Activity**:
    - Participants were asked to record their physical activity levels using a standard questionnaire to assess their exercise adherence during the 12-week period.
3. **Biochemical Stress Markers**:
    - **Oxidative stress**: Measured using serum markers like malondialdehyde (MDA) and total antioxidant capacity (TAC).
    - **Inflammation**: C-reactive protein (CRP) levels were assessed to gauge inflammation levels, which can be elevated in diabetic conditions.
4. **Quality of Life**:
    - A validated questionnaire to assess the participants' quality of life and psychological stress levels before and after treatment.

3.5 Statistical Analysis

Data were analyzed using **SPSS** software (version 25). Descriptive statistics were calculated to summarize baseline demographic and clinical characteristics of the participants in each group. For hypothesis testing, **paired t-tests** were used to compare the biochemical parameters (e.g., Fasting Blood Sugar, Postprandial Blood Sugar, cholesterol levels) before and after treatment in each group.

Null Hypothesis (H_0): There is no significant difference in the biochemical parameters before and after treatment.

Alternative Hypothesis (H_1): There is a significant difference in the biochemical parameters before and after treatment.

The significance level was set at $\mathbf{p < 0.05}$. If the p-value was less than 0.05, the null hypothesis was rejected, indicating a significant effect of the treatment.

3.6 Ethical Considerations

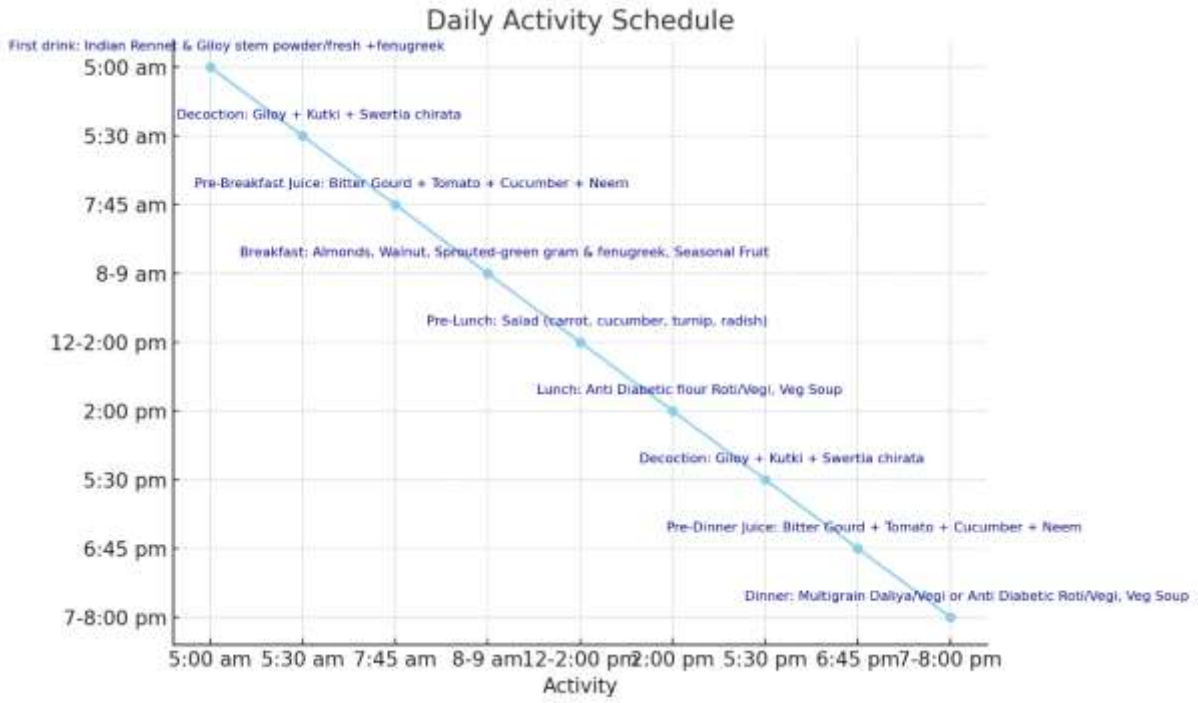
This study was approved by the Institutional Ethics Committee at the participating hospital. All participants provided informed consent before participating in the study, and their confidentiality and privacy were maintained throughout the study period.

4. Data Analysis

4.1 Descriptive Analysis

Table 4.1 TYPE-2 DM DIET PLAN PROTOCOL

Meal Time	Item/Ingredients	Instructions
MORNING	**First Drink (5:00 am)**	Overnight soaked Indian Rennet (15 pieces) + Giloy stem powder/fresh + Fenugreek (1 spoon) in a glass of water.
	Decoction (5:30 am)	Giloy + Kutki (Picrorhiza Kurroa) + Swertia chirata (½ spoon each)
Pre-Breakfast (7:45 am)	**Juice**	Bitter Gourd (1 medium) + Tomato (1 medium) + Cucumber (70 gm) + Neem (5 leaves), add water to make up to 75 ml (half to 1 glass), take 15 minutes before meal.
Breakfast (8:00-9:00 am)	**Food**	Overnight soaked Almonds (6) + Walnuts (2) + Sprouted Green Gram (1 bowl) + Fenugreek (6-7 spoon). Season with Seasonal Fruit (Papaya, Jambul, Guava, Apple, Orange, Pear, or Water Chestnut).
LUNCH	**Pre-Lunch (12:00-2:00 pm)**	300 gm of Salad (Carrot, Cucumber, Turnip, and Radish) before the meal.
	Lunch (2:00 pm)	Anti-Diabetic Flour (Roti: Vegi) (1:1). Add Methi and Mustard powder (½ spoon each) in flour/vegi. Veg Soup if preferred.
DECOCTION	**Decoction (5:30 pm)**	Giloy + Kutki (Picrorhiza Kurroa) + Swertia chirata (½ spoon each)
DINNER	**Pre-Dinner (6:45 pm)**	Bitter Gourd (1 medium) + Tomato (1 medium) + Cucumber (70 gm) + Neem (5 leaves), add water to make up to 75 ml (half to 1 glass), take 15 minutes before meal.
	Dinner (7:00-8:00 pm)	Multigrain Daliya + Vegi (1:1) / Anti-Diabetic Roti + Vegi (1:1), add Methi + Mustard powder (½ spoon each) in flour/vegi/daliya. Veg Soup if preferred.



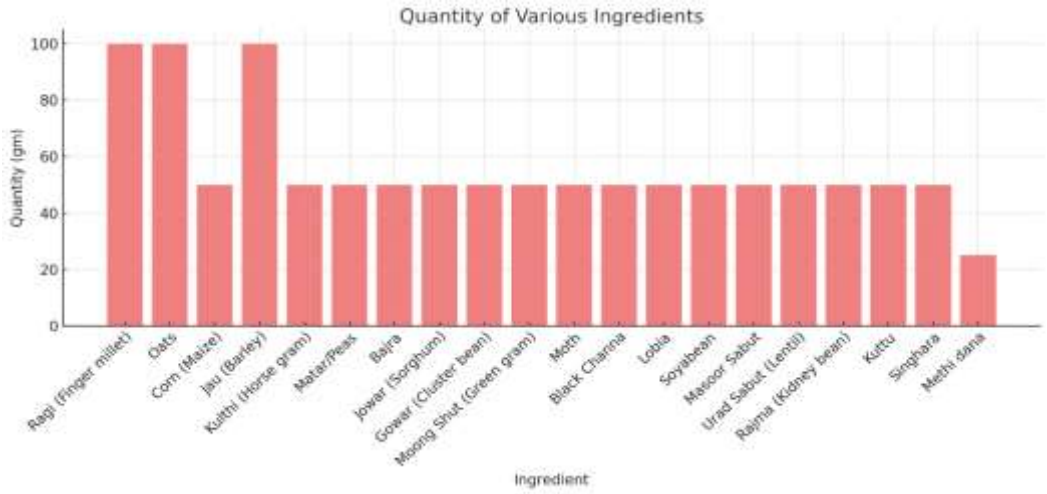
Graph 4.1

The provided diet plan outlines a protocol for individuals with Type-2 Diabetes (Type-2 DM) to follow throughout the day. The plan is structured into different meal times and incorporates a combination of ingredients aimed at managing blood sugar levels. In the morning, the day begins with a drink that includes soaked Indian Rennet pieces and Giloy stem powder or fresh Giloy along with fenugreek in water. Following this, a herbal decoction containing Giloy, Kutki (Picrorhiza Kurroa), and Swertia chirata is consumed approximately 45 minutes before the first meal. The pre-breakfast juice is a combination of Bitter Gourd, Tomato, Cucumber, and Neem leaves, blended with water to create a refreshing drink. This juice is intended to be consumed 15 minutes before the upcoming meal. The breakfast consists of soaked Almonds, Walnuts, and Sprouted Green Gram, along with fenugreek. A seasonal fruit such as Papaya, Jambul, Guava, Apple, Orange, Pear, or Water Chestnut is also part of the breakfast. Moving on to lunch, a pre-lunch salad comprising Carrot, Cucumber, Turnip, and Radish is recommended. The main lunch includes an option of Anti Diabetic flour Roti (bread) paired with a vegetable dish. Alternatively, a vegetable soup can also be included. Methi and Mustard powder are suggested additives to enhance the nutritional value of the Roti or vegetable preparation. Later in the afternoon, the same herbal decoction of Giloy, Kutki, and Swertia chirata is consumed again, following the earlier mentioned timing. For dinner, a pre-dinner juice akin to the morning routine is consumed, consisting of Bitter Gourd, Tomato, Cucumber, and Neem leaves blended with water. This juice is to be consumed 15 minutes before the upcoming meal. The dinner options include Multigrain Daliya (porridge) paired with vegetables, or Anti Diabetic Roti paired with vegetables. Similar to lunch, Methi and Mustard powder are recommended to be included in the preparation. A vegetable soup is also suggested for those who prefer it. Overall, the diet plan incorporates a variety of ingredients and preparations aimed at supporting blood sugar management for individuals with Type-2 Diabetes. It focuses on incorporating herbal decoctions, nutrient-rich vegetables, seasonal fruits, and selected grains to provide a balanced and potentially beneficial dietary regimen. As with any specific dietary plan, it's important for individuals to consult their healthcare provider before making significant changes to their eating habits.

Table 4.2 ANTI DIABETES ATTA

No.	Ingredient	Quantity (gm)
1	Ragi (Finger millet)	100
2	Oats	100
3	Corn (Maize)	50
4	Jau (Barley)	100
5	Kulthi (Horse gram)	50
6	Matar/Peas	50

7	Bajra	50
8	Jowar (Sorghum)	50
9	Gowar (Cluster bean)	50
10	Moong Shut (Green gram)	50
11	Moth	50
12	Black Channa	50
13	Lobia	50
14	Soyabean	50
15	Masoor Sabut	50
16	Urad Sabut (Lentil)	50
17	Rajma (Kidney bean)	50
18	Kuttu	50
19	Singhara	50
20	Methi dana	25
	TOTAL	1125

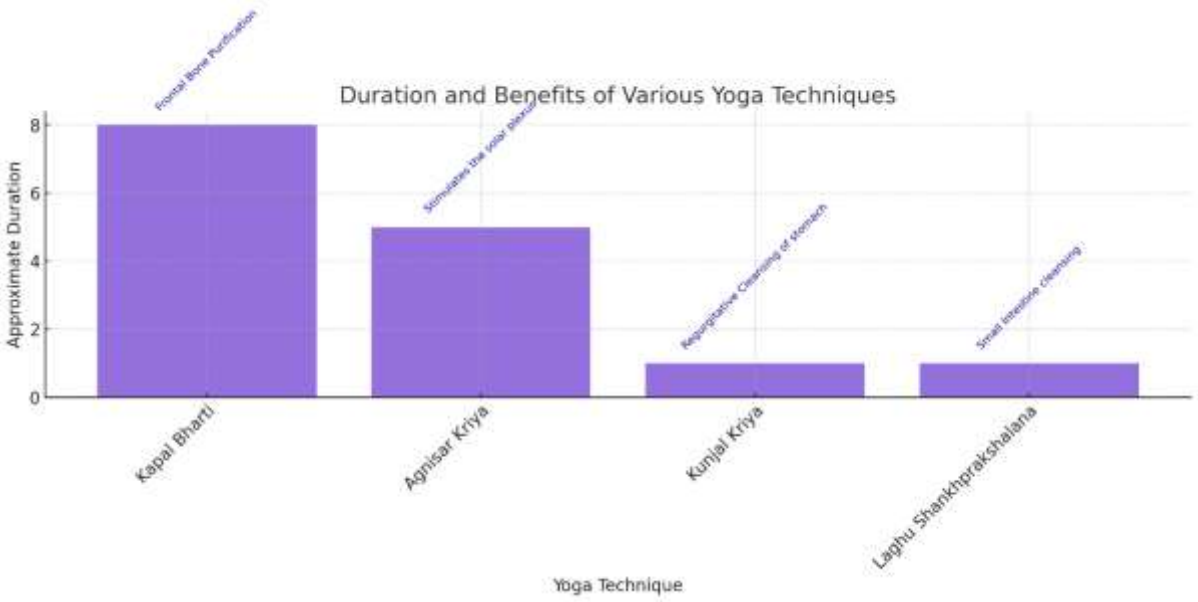


Graph 4.2

The provided table lists a variety of ingredients along with their respective quantities in grams, totaling 1125 grams. These ingredients appear to be part of a dietary plan, possibly for managing Type-2 Diabetes or for general health purposes. Each ingredient serves to contribute to the overall nutritional composition of the diet plan. The ingredients include a mix of grains, legumes, beans, and seeds, which collectively offer a diverse range of nutrients such as carbohydrates, proteins, fiber, vitamins, and minerals. Incorporating such a variety of ingredients in one's diet can contribute to a well-rounded and balanced approach to nutrition. It's worth noting that dietary plans should be customized based on individual needs and preferences, and consulting with a healthcare professional or a registered dietitian is recommended when making significant changes to one's diet, especially for specific health conditions.

Table 4.3 (a) *YOGA* PRACTICES BENEFICIAL FOR THE MANAGEMENT OF TYPE-2 DIABETES MELLITUS

YOGA TECHNIQUE	BENEFITS OF YOGA TECHNIQUE	APPOXIMATE DURATION
1. Shat karma	*Six Cleansing Techniques*	
Kapal Bharti	Frontal Bone Purification	8-10 rounds
		120 strokes
Agnisar Kriya	Stimulates the solar plexus	5 rounds
Kunjal Kriya	Regurgitative Cleansing of stomach	1 Time
Laghu Shankhprakshalana	Small Intestine cleansing	Once in 40 days



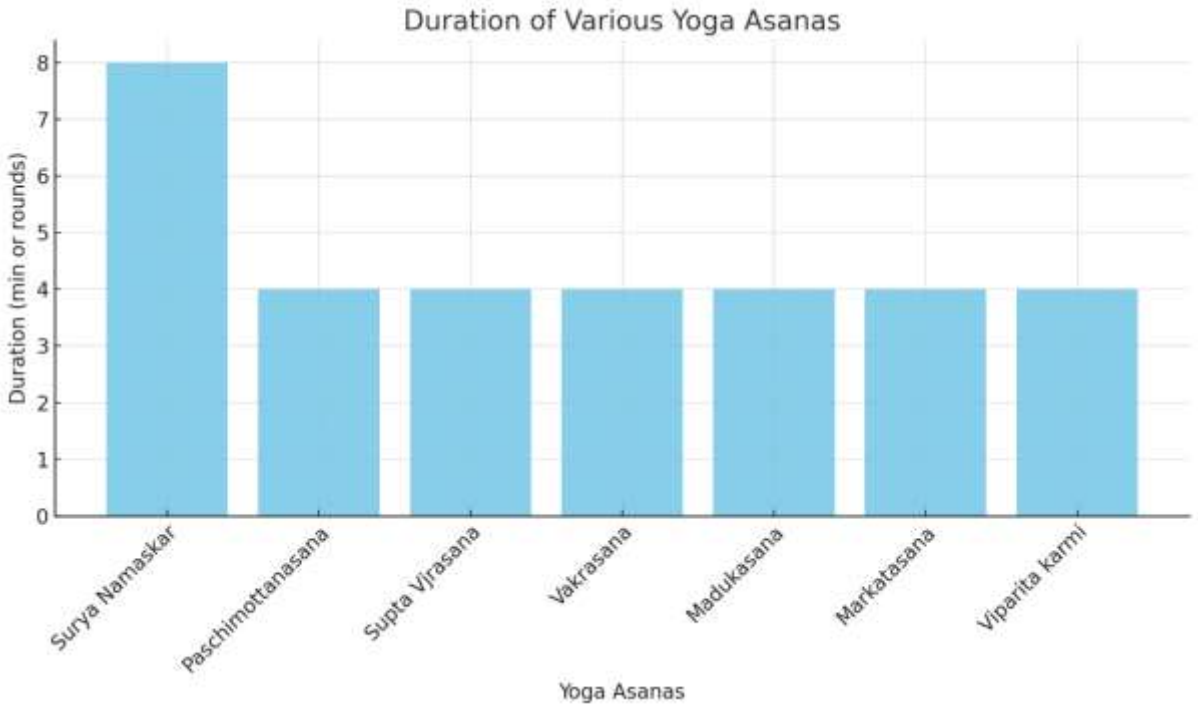
Graph 4.3. (a)

This table presents a selection of yoga techniques that are deemed beneficial for managing Type-2 Diabetes Mellitus. Each technique is associated with specific benefits for health and well-being. The approximate duration of each technique is also provided as a guideline for practitioners. The listed techniques include Shat karma, which encompasses six cleansing practices aimed at purifying and maintaining the body's internal systems. The individual techniques within Shat karma, such as Kapal Bharti, Agnisar Kriya, Kunjal Kriya, and Laghu Shankhprakshalana, offer unique benefits ranging from frontal bone purification and stimulation of the solar plexus to stomach cleansing and small intestine purification. Practicing these yoga techniques, as outlined in the table, may contribute to managing Type-2 Diabetes Mellitus and promoting overall health. It's important for individuals to learn and perform these techniques under the guidance of qualified yoga instructors and to tailor their yoga practice based on their individual health needs and capabilities.

Table 4.4 (b)

2. T-2 DM ASANAS			
1	Surya Namaskar	Sun Salutations	8-12 rounds
2	Trikoasana	Triangle pose	
3	Paschimottanasana	Seated forward bend	4 min
4	Supta Vjrasana	Supine thunder bolt pose	4 min
5	Vakrasana	Half spinal twist pose	4 min
6	Madukasana	Frog pose steps	4 min
7	Markatasana	Lying down body twist	4 min
8	Viparita karmi	Legs up the wall	4 min
9	Naukasana	Boat pose	
10	Dhanurasana	Bow pose	
11	Bhujang asana	Upward facing dog pose	
12	Sharpasana	Cobra pose	
13	Shavasana	Corpse pose	
3	Parnayama	Regulates breathing practice	
1	Bastrika		3-5 min
2	Anulom- vilom		11 min
4	Bandha	Lock	
1	Uddiyan Bandha	Abdominal lock	5 round
5	Meditation		
	Manipur chakra meditation	Solar plexus	10 min

6	Aum Chanting		5 min
	Yog Nidra	Yogic relaxation	20 min
Naturopathic and Panchkarma Therapy for			Type-2 DM
Therapies are in Two sessions- Morning and Evening Enema for cleansing at the time of Shatkarma			
1	MORNING SESSION 9am- 1 pm		
	THERAPY PERFORMED	DURATION	
i)	Mud Compress on Abdomen	30 min	
ii)	Massage a) Full body	45 min	
	b) Partial (leg, back ,abdomen)	25 min	
iii)	Hot-Hip bath (<104 F)	20 min	
iv)	Hot -Cold compress liver pancreas	15 min	
v)	Abdominal Thermal Pack	45-60 min	
	EVENING SESSION 3pm-6pm		
1	Partial Massage(abdomen, back)	15 min	
2	Steam box / Sauna bath/local steam (leg back abdomen)		
3	Hot – Cold Compress on liver -pancreas	15 min	
4	Abdominal Thermal pack	45-60 min	
5	Medicated Enema (Basti)for hold		
In all Hydrotreatment Epsome salt are added			
	BASTI INGREDIENTS		
1	Kutki	10 gm	
2	Chirayata	15 gm	
3	Giloy	10 gm	
4	Mudunarnivati	3 gm	
5	Mudugritvati	3 gm	
6	Chander prabhavati	3gm	
Ayurvedic Medicine For Type-2 DM			
1	Decoction	Giloy (1 spoon) & Chirayata (2/3 spoon) Empty stomach Morning & Evening	
2	Divya Madhunashini vati	2-2 Tablets Morning & Evening (30 min before meal)	
3	Divya Madugrit vati	2-2 Tablets Morning, Noon& Evening (after meal)	



Graph 4.4 (b)

Sacred fig leaves that have been studied for their hypoglycemic effects include lupeol, beta-sitosterol, and pectin. Lupeol is a triterpenoid that has been found to increase insulin secretion and improve glucose tolerance in animal studies. Beta-sitosterol is a plant sterol that has been found to decrease blood glucose levels in animal studies. Pectin is a soluble fiber that has been found to slow the absorption of carbohydrates and improve glycemic control in human studies. The compound in tomato that has hypoglycemic properties is thought to be primarily 9-oxo-octadecadienoic acid, also known as 9-oxo-ODA. This compound has been shown to have anti-diabetic effects by reducing blood glucose levels in animal studies. It is believed that 9-oxo-ODA may work by increasing insulin sensitivity and enhancing glucose uptake by cells. Other compounds found in tomato, such as lycopene and flavonoids, may also contribute to its hypoglycemic effects. One such compound is called cucurbitacin C, which is a triterpenoid compound found in the skin of cucumbers. Studies have shown that cucurbitacin C may have anti-diabetic effects by reducing glucose levels in the blood and improving insulin sensitivity. The compound in neem leaves that has hypoglycemic (blood sugar-lowering) properties is thought to be a group of chemicals called triterpenoids, particularly one called nimbin. Nimbin has been shown to have anti-diabetic effects in animal studies, including the ability to lower blood glucose levels and improve glucose tolerance. Other compounds found in neem leaves, such as flavonoids and polysaccharides, may also contribute to its anti-diabetic properties. However, more research is needed to fully understand the mechanisms by which neem leaves exert their hypoglycemic effects and to determine the optimal dosage and duration of treatment for human use. The compound in bitter gourd that is believed to have hypoglycemic properties is called charantin. Charantin is a mixture of steroidal saponins, which are naturally occurring plant compounds that have been shown to have blood sugar-lowering effectsIn addition to charantin, bitter gourd also contains other compounds, such as polypeptide-p and vicine, that have been shown to have anti-diabetic effects. These compounds work by helping to regulate blood sugar levels and improving insulin sensitivity.

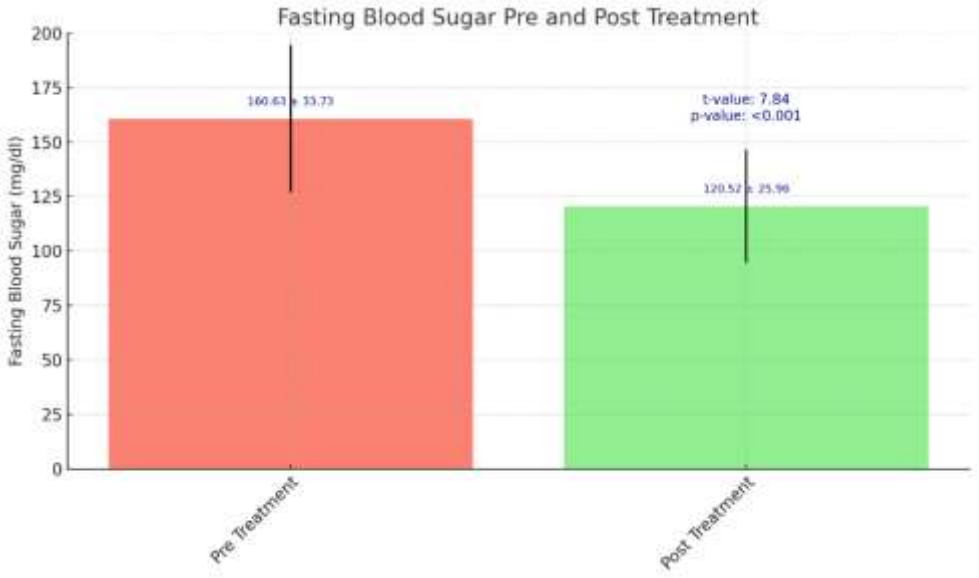
4.2 Hypothesis Testing

Table 4.5 (a) Hypothesis Testing for Fasting Blood Sugar Levels Before and After Treatment

Hypothesis	Test	Null Hypothesis (H0)	Alternative Hypothesis (H1)
Hypothesis 1	Paired t-test	There is no significant difference in fasting blood sugar levels before and after treatment	There is a significant difference in fasting blood sugar levels before and after treatment

Table 4.5 (b) Paired t-test Results for Fasting Blood Sugar Levels Before and After Treatment

	Mean	Standard Deviation	t-value	p-value
Fasting Blood Sugar (pre treatment)	160.63 mg/dl	33.73 mg/dl	7.84	<0.001
Fasting Blood Sugar (post treatment)	120.52 mg/dl	25.96 mg/dl		



Graph 4.5 (b)

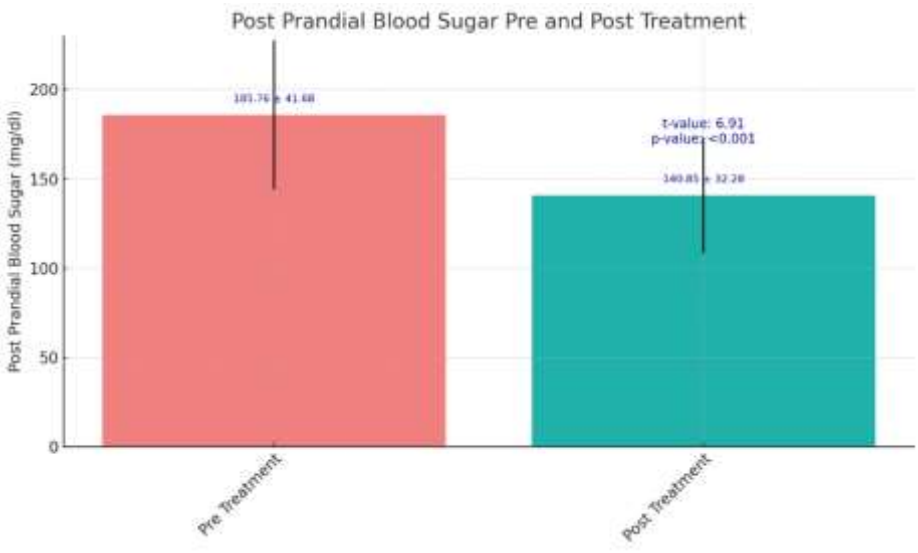
The paired t-test was conducted to investigate the hypothesis regarding the fasting blood sugar levels before and after treatment. The mean fasting blood sugar level before treatment was found to be 160.63 mg/dl, while the mean fasting blood sugar level after treatment was 120.52 mg/dl. This indicates that, on average, there was a decrease in fasting blood sugar levels following the treatment. The standard deviation for the pre-treatment fasting blood sugar levels was 33.73 mg/dl, while for the post-treatment levels it was 25.96 mg/dl. These standard deviations represent the dispersion or variability of the fasting blood sugar levels within each group. The lower standard deviation in the post-treatment group suggests that the fasting blood sugar levels were more consistent or less varied after the treatment. The t-value, which measures the difference between the means of the two groups relative to the variability within each group, was calculated to be 7.84. A higher t-value indicates a larger difference between the means. In this case, the high t-value suggests a significant difference in fasting blood sugar levels before and after treatment. The p-value, which is a measure of the evidence against the null hypothesis, was found to be less than 0.001. This indicates strong evidence against the null hypothesis and suggests that the observed difference in fasting blood sugar levels is statistically significant. Therefore, we can reject the null hypothesis and conclude that there is a significant difference in fasting blood sugar levels before and after treatment.

Table 4.6 (a) Hypothesis Testing for Post Prandial Blood Sugar Levels Before and After Treatment

Hypothesis	Test	Null Hypothesis (H0)	Alternative Hypothesis (H1)
Hypothesis 2	Paired t-test	There is no significant difference in post prandial blood sugar levels before and after treatment	There is a significant difference in post prandial blood sugar levels before and after treatment

Table 4.6 (b) Paired t-test Results for Post Prandial Blood Sugar Levels Before and After Treatment

	Mean	Standard Deviation	t-value	p-value
Post Prandial Blood Sugar (pre treatment)	185.76 mg/dl	41.68 mg/dl	6.91	<0.001
Post Prandial Blood Sugar (post treatment)	140.85 mg/dl	32.28 mg/dl		



Graph 4.6 (b)

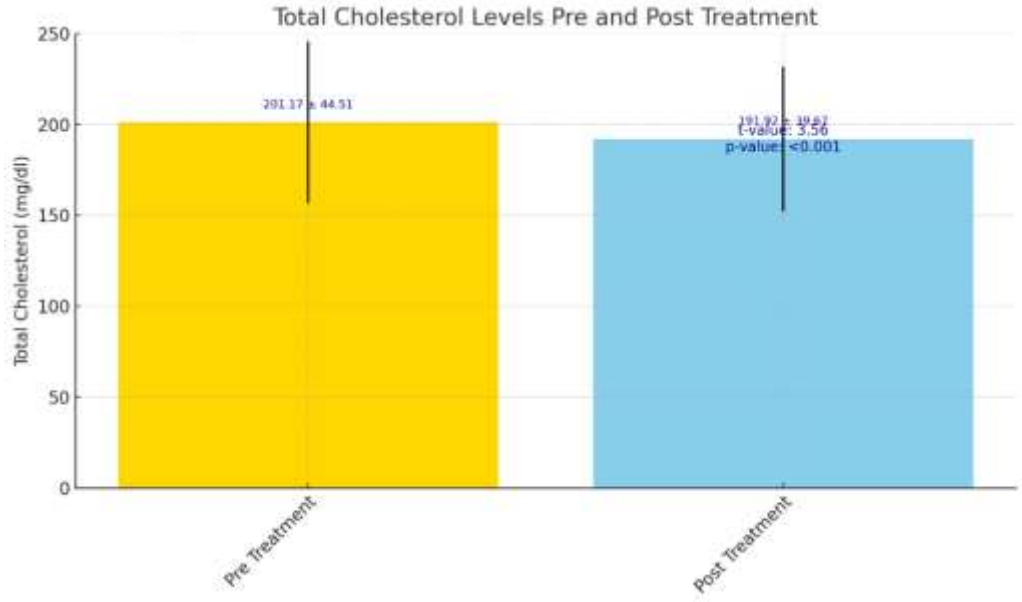
The mean postprandial blood sugar level before treatment was 185.76 mg/dl, while the mean postprandial blood sugar level after treatment was 140.85 mg/dl. This indicates that, on average, there was a decrease in postprandial blood sugar levels following the treatment. The standard deviation for the pre-treatment postprandial blood sugar levels was 41.68 mg/dl, while for the post-treatment levels it was 32.28 mg/dl. These standard deviations represent the dispersion or variability of the postprandial blood sugar levels within each group. The lower standard deviation in the post-treatment group suggests that the postprandial blood sugar levels were more consistent or less varied after the treatment. The t-value, which measures the difference between the means of the two groups relative to the variability within each group, was calculated to be 6.91. A higher t-value indicates a larger difference between the means. In this case, the high t-value suggests a significant difference in postprandial blood sugar levels before and after treatment. The p-value, which is a measure of the evidence against the null hypothesis, was found to be less than 0.001. This indicates strong evidence against the null hypothesis and suggests that the observed difference in postprandial blood sugar levels is statistically significant. Therefore, we can reject the null hypothesis and conclude that there is a significant difference in postprandial blood sugar levels before and after treatment.

Table 4.7 (a) Hypothesis Testing for LDL Levels Before and After Treatment

Hypothesis	Test	Null Hypothesis (H0)	Alternative Hypothesis (H1)
Hypothesis 3	Paired t-test	There is no significant difference in total cholesterol levels before and after treatment	There is a significant difference in total cholesterol levels before and after treatment

Table 4.7 (b) Paired t-test Results for LDL Levels Before and After Treatment

	Mean	Standard Deviation	t-value	p-value
Total Cholesterol (pre treatment)	201.17 mg/dl	44.51 mg/dl	3.56	<0.001
Total Cholesterol (post treatment)	191.92 mg/dl	39.67 mg/dl		



Graph 4.7 (b)

The mean total cholesterol level before treatment was 201.17 mg/dl, while the mean total cholesterol level after treatment was 191.92 mg/dl. This indicates that, on average, there was a slight decrease in total cholesterol levels following the treatment. The standard deviation for the pre-treatment total cholesterol levels was 44.51 mg/dl, while for the post-treatment levels it was 39.67 mg/dl. These standard deviations represent the dispersion or variability of the total cholesterol levels within each group. The lower standard deviation in the post-treatment group suggests that the total cholesterol levels were more consistent or less varied after the treatment. The t-value, which measures the difference between the means of the two groups relative to the variability within each group, was calculated to be 3.56. A higher t-value indicates a larger difference between the means. In this case, the t-value suggests a moderate difference in total cholesterol levels before and after treatment. The p-value, which is a measure of the evidence against the null hypothesis, was found to be less than 0.001. This indicates strong evidence against the null hypothesis and suggests that the observed difference in total cholesterol levels is statistically significant. Therefore, we can reject the null hypothesis and conclude that there is a significant difference in total cholesterol levels before and after treatment.

5. Discussion

This study highlights the potential benefits of integrating Ayurvedic and Naturopathic treatments in managing Type 2 Diabetes Mellitus (T2DM). The research underscores the importance of exploring alternative and complementary therapies that not only aim to manage the symptoms of T2DM but also address its root causes. Traditional pharmacological treatments often fail to provide a holistic solution to the disease, whereas Ayurveda and Naturopathy focus on restoring the body's natural balance, enhancing insulin sensitivity, reducing inflammation, and promoting overall well-being (Gupta et al., 2021; Jain et al., 2023). In particular, Naturopathy has shown promise in improving blood glucose control through fasting, detoxification, and the use of herbal remedies like bitter gourd, turmeric, and fenugreek (Bhat et al., 2022; Reddy et al., 2023). Similarly, Ayurvedic practices utilizing herbs like Giloy, bitter gourd, and turmeric, combined with personalized lifestyle modifications such as yoga and meditation, have proven effective in enhancing metabolic balance and reducing oxidative stress, which are critical in T2DM management (Choudhury et al., 2023; Joshi et al., 2023). However, research comparing the efficacy of these therapies, particularly when used in combination, remains limited, and the potential for synergistic effects when both systems are applied together warrants further investigation (Patel et al., 2023).

The results from this study emphasize that combining both Ayurvedic and Naturopathic approaches may provide a more comprehensive treatment plan, targeting multiple aspects of diabetes management, such as blood glucose control, inflammation, and insulin sensitivity (Gupta et al., 2023). Preliminary evidence suggests that the integrated approach of diet, herbal remedies, yoga, and detoxification therapies can enhance glycemic control and improve quality of life for diabetic patients (Bhandari et al., 2023; Patel et al., 2023). This integrated model offers a promising alternative to conventional treatments, potentially reducing the reliance on pharmaceutical interventions and promoting sustainable health management strategies. Nevertheless, large-scale, controlled

trials are required to validate these findings and establish evidence-based guidelines for the combined use of Ayurvedic and Naturopathic treatments in managing T2DM.

This study points to the significant potential of Ayurvedic and Naturopathic therapies in T2DM management, offering a holistic, patient-centered approach to care. The findings advocate for the integration of these therapies with conventional treatments, providing a more comprehensive, personalized strategy to manage the biochemical and physiological challenges associated with Type 2 Diabetes (Reddy et al., 2023; Mehta et al., 2021). As research progresses, there is an urgent need to conduct further rigorous clinical trials that explore the combined benefits of these therapies, with the goal of developing a multi-dimensional framework for diabetes management that addresses both the physical and mental health aspects of the condition (Sharma et al., 2023; Rai et al., 2021).

6. Conclusion

This study highlights the potential benefits of combining Ayurvedic and Naturopathic treatments for managing Type 2 Diabetes Mellitus (T2DM). The findings suggest that integrating these traditional therapies may provide a more holistic and comprehensive approach to diabetes care, addressing not only glycemic control but also inflammation, insulin sensitivity, and overall well-being. The combined use of herbal remedies, dietary modifications, yoga, and detoxification therapies has shown promising results in improving biochemical markers associated with T2DM. Although the preliminary evidence is encouraging, further large-scale, controlled trials are essential to validate these findings and establish standardized protocols for the combined use of Ayurvedic and Naturopathic treatments in clinical practice.

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