Review Article

TRADITIONAL AND COMPLEMENTARY MEDICINES IN THE MANAGEMENT OF TYPE 2 DIABETES MELLITUS: A NARRATIVE REVIEW

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ABSTRACT

Many individuals with diabetes often explore traditional and complementary medicines (TCM) as an alternative, believing in their perceived minimal side effects and enhanced effectiveness compared to conventional treatments for diabetes mellitus. This review aims to conduct a narrative review of TCM approaches for managing type 2 diabetes mellitus, focusing on diabetic parameters such as glycemic, lipid profiles, weight, and blood pressure. We searched PubMed and ScienceDirect using terms such as "traditional and complementary medicine," "type 2 diabetes mellitus," "diabetes mellitus," "management," and "herbal" over a period of 5 years (2017–2021). The screened articles were based on predefined inclusion and exclusion criteria, which were then validated and extracted. We included a total of 47 articles that met the criteria in this review and categorized them according to diabetic parameters (adapted from CPG Management of T2DM, 2020). The majority of herbal supplements (e.g., ginger, American ginseng, herbal mixtures), health supplements (e.g., *Gingko biloba*, zinc, vitamin D), dietary supplements (e.g., wheat germ and camel milk), and practices (e.g., acupuncture and homeopathy) exhibited positive effects, improving diabetic parameters towards their intended targets. This review can serve as a valuable reference for healthcare professionals involved in the management of this condition.

Keywords: Traditional and complementary medicine, Herbal, Health supplement, Diabetes mellitus

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1.0 Introduction

Diabetes mellitus is a chronic metabolic disorder that is characterised by persistent hyperglycemia due to insulin secretion defects where the pancreas does not produce enough insulin or when the body cannot use insulin effectively (1). Young children and adolescents are increasingly reporting the onset of type 2 diabetes mellitus, a metabolic disorder typically associated with the elderly (1). T2DM is characterised by the destruction of beta cells and insulin resistance, resulting in chronic hyperglycemia (2).

Diabetes mellitus prevalence has also increased alarmingly in recent years. Globally, 537 million adults currently suffer from diabetes, and projections indicate that this figure will rise to 643 million by 2030 (2, 3). Meanwhile, in Malaysia, the prevalence of diabetes has increased from 11.2% in 2011 to 13.4% in 2014, and according to the 2019 National Health and Morbidity Survey (NHMS), one in five adults has diabetes. According to reports, diabetes mellitus caused 41,237 deaths in Malaysia in 2021.

If Type 2 diabetes mellitus is not properly controlled and left untreated for the long term, it can cause complications for the patient. Diabetes complications, which are common in patients with type 2 diabetes, lead to morbidity and mortality among diabetic patients. We can generally classify the chronic complications of diabetes into two types: microvascular and macrovascular, with the former having a substantially higher prevalence than the latter. Neuropathy, nephropathy, and retinopathy are examples of microvascular problems, while cardiovascular disease, stroke, and peripheral artery disease (PAD) are examples of macrovascular complications (3, 4).

Traditional and complementary medicine (TCM) is a health practice with strong historical and cultural roots. Since it has often evolved as part of a particular cultural heritage, the forms of traditional medicine vary widely across the region, and some forms are highly developed and well documented (5). Apart from conventional treatment, diabetic patients also choose TCM as an option for treating their condition. Doubts about hospital treatment and long waiting hours for therapy and medicine draw individuals to TCM. They chose TCM due to their belief that it has little negative effect on controlling pain and curing ailments (6).

The objective of this review is to perform a literature search on the TCM approach in the management of type 2 diabetes mellitus based on diabetic parameters. The review adopts a narrative approach, which involves exploring existing knowledge and evidence from a variety of sources. This evidence assists healthcare professionals and researchers in making informed decisions and designing future studies.

2.0 Materials and Methods

We used two databases for the literature search: PubMed and ScienceDirect. The keywords used during the searching process included “traditional and complementary medicine”, “type 2 diabetes mellitus”, “diabetes mellitus”, “management”, “herbal”, “herbal drugs”, “herbal supplement”, “health supplement”, “supplement”, “dietary supplement”, “vitamins”, “cinnamon”, “bitter gourd”, “fenugreek”, “practices”, “TCM practices”, “traditional and complementary practices”, “yoga”, “acupuncture”, “aromatherapy”, “ayuverdic”, “tai chi”, “acupuncture”, "acupressure", and “homeopathy”. We conducted the literature search over a period of 1 month (April–May 2022). We filtered the articles based on their abstract and title relevance. We only accepted a randomized controlled trial (RCT) on type 2 diabetes

mellitus in human subjects. In addition, we accepted only English-language articles published within a five-year period, from January 2017 to December 2021. This review rejected studies involving animal subjects, viewpoints, population surveys, case reports, and reviews. Team-member research then validated the selected articles. We sorted and compiled the data in the Table of Evidence using Excel. The components of the Table of Evidence included authors, publication year, location, type of intervention, active ingredient(s), population, study design, management/intervention, and diabetic parameters. Diabetic parameters included hemoglobin A1c (HbA1c), fasting blood glucose (FBG), postprandial blood glucose (PPBG), triglycerides, low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, weight, and blood pressure. We adapted these parameters from the Clinical Practice Guidelines for Management of Type 2 Diabetes Mellitus, 6th Edition, 2020 (36). All selected articles were validated or verified by two researchers to ensure that they fulfilled all inclusion and exclusion criteria and were relevant to answering the objectives.

3.0 Results and Discussions

We determined that 93 articles met the inclusion and exclusion criteria. The articles were further evaluated and reviewed, and a total of 47 articles were accepted. The flowchart below (Figure 1) summarized the process.

We categorized the articles into four distinct categories: glycemic profile, lipid profile, blood pressure, and weight. These are the parameters or outcomes commonly measured for type 2 DM as outlined in the Clinical Practices Guidelines for Type 2 Diabetes Mellitus (36). A total of 27 RCTs focused on herbal supplements, 13 on health supplements, and 2 on dietary supplements.

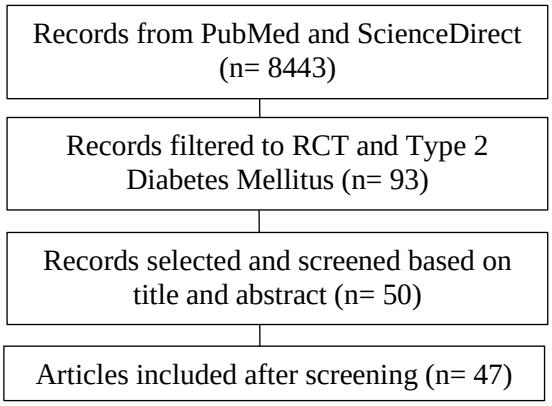

Figure 1: Flow Chart of the Literature Search

There are five (5) RCTs involved in TCM practice usage: one RCT on homeopathy, one RCT on aromatherapy, one RCT on acupressure, and one RCT on acupuncture (Tables 1 and Table 2).

Table 1 shows the studies' geographical distribution, with most conducted in Asian rather than Western countries. Asian nations adopt and use TCM approaches more frequently than Western nations, reflecting this disparity.

3.1 Glycaemic Profile

3.1.1 HbA1C

Researchers reported 39 RCTs on the effects of herbal supplements, health supplements, dietary supplements, and TCM practices on HbA1c levels. A 2020 RCT in Iran found that a combination of herbal *Capparis spinosa*, *Rosa canina*, *Scurida securigera*, *Silybum marianum*, *Urtica dioica*, *Trigonella foenum graecum*, and *Vaccinium arcstostaphylos* significantly reduced HbA1C levels in patients with type 2 diabetes mellitus ($p = 0.028$) (28). The information mentions (Table 1) that the studies are predominantly from Asian countries, suggesting a potential bias in the geographical distribution. This could limit the generalizability of the findings, as different populations may have distinct responses to treatments.

Table 1: Traditional and complementary medicine randomized controlled trial articles on type 2 diabetes mellitus.

Author (s)	Publication Year	Location	Type of intervention	Active Ingredient (s)	Population	Study design
Mehrzadi *et al*. (28)	2020	Iran	Herbal supplement	*Capparis spinosa, Rosa canina, Scurida securigera, Silybum marianum, Urtica dioica, Trigonella foenum graecum* and *Vccinium arcstostaphylos*	150 diabetes patients • Placebo - 50 • Interventions - 50 • 50 (received metformin)	Randomized controlled trial
Nigam & Nambiar (29)	2019	India		*Aegle marmelos* (L) Correa	60 patients • Control – 30 • Interventions - 30	
Abdoli *et al*. (34)	2017	Iran		*Juglans regia* L. leaf (Walnut leaf)	37 patients • Placebo -18 • Interventions - 19	
Tahmasebi *et al.* (30)	2019	Iran		*Berberis vulgaris* root	80 patients • Placebo – 40 • Interventions - 40	
Lazavi *et al.* (31)	2018	Iran		Barberry	46 patients • Control – 23 • Interventions - 23	
Leone *et al.* (35)	2018	Saharawi		*Moringa oleifera*	17 patients Day 1 • Placebo – 8 • Interventions – 9 Day 2 • Placebo -9 • Interventions -8	
El Gayar, *et al.* (9)	2019	Egypt		Ginger	80 patients • Placebo – 40 • Interventions - 40	
Gholinezhad *et al.* (38)	2019	Iran		Ginger	42 patients • Placebo – 21 • Interventions- 21	Double-blind, randomized controlled trial
Carvalho *et al*. (39)	2020	Brazil		Ginger	103 patients • Placebo – 56 • Interventions - 47	

Vuksan *et al.* (10)	2018	Canada	American Ginseng (*Panax quinquefolius* L.	24 patients • Placebo – 11 • Interventions - 13
Hashemi *et al*. (32)	2020	Iran	Pomegranate Seed	60 patients • Placebo - 30 • Interventions - 30
Abdollahi *et al.* (33)	2019	Iran	Reseveratol	71 patients • Placebo – 36 • Interventions - 35
Chan *et al*. (48)	2021	China	Billberry	20 patients • Placebo – 10 • Interventions - 10
Haidari *et al*. (49)	2020	Iran	Dill (*Anethum graveolens*)	42 patients • Placebo – 21 • Interventions - 21
Khalili *et al.* (13)	2017	Baghiatallah	Silymarin, Olibanum and Nettle	60 patients • Placebo – 30 • Interventions - 30
Tian *et al.* (15)	2017	China	Jinlida	186 patients • Placebo – 94 • Interventions - 92

Pan *et al*. (16)	2021	China	Jinlida	138 patients
				• Control – 35
				• Interventions
				  ○ Jinlida – 34
				  ○ Jinlida + Metformin – 33
				• 36 (received metformin)

Huang *et al.* (17)	2019	Taiwan	YH1 (50% *Rhizoma coptidis* and 50% SLBZS)	41 patients • Placebo – 20 • Interventions - 21
Wasana *et al.* (50)	2021	India	*Coccinia grandis* Linn.	145 patients • Placebo – 72 • Interventions - 73
Riche *et al.* (47)	2017	US	Mulberry leaf	24 patients • Placebo – 12

					• Interventions - 12	
Najdi *et al.* (51)	2019	Jeddah		Fenugreek	12 patients (ITT principle) • Placebo – 6 • Interventions - 6	
Tonelli *et al.* (52)	2021	Brazil		*Bauhinia forficate* Link (pata-de-vaca)	80 patients • Placebo – 35 • Interventions - 45	
Adab *et al*. (41)	2019	Iran		Turmeric	75 patients • Placebo -39 • Interventions - 36	
Neta *et al*. (53)	2021	Brazil		*Curcuma longa* L.	61 patients • Placebo – 28 • Interventions - 33	
Mobasseri *et al.* (46)	2020	Iran		Saffron	57 patients • Placebo – 27 • Interventions - 30	
Lira Neto *et al.* (19)	2021	Brazil		Cinnamon	140 patients • Placebo – 69 • Interventions - 71	
Zare *et al.* (18)	2018	Iran		Cinnamon	138 patients • Placebo ○ BMI <27 - 32 ○ BMI ≥27 - 37 • Interventions ○ BMI <27 - 33 ○ BMI ≥27 - 36	Triple-blind, randomized controlled trial
Hamedifard *et al.* (42)	2020	Iran	Health supplement	Magnesium and Zinc	55 patients • Placebo – 28 • Interventions - 27	Double-blind, randomized controlled trial
Aziz *et al.* (20)	2018	Malaysia		*Ginkgo biloba*	47 patients • Placebo – 20 • Interventions - 27	
Talenezhad *et al.* (54)	2020	Iran		L-carnitine	70 patients (ITT principle) • Placebo -35 • Interventions – 35	
Nazem *et al*. (23)	2019	Iran		Zinc	70 patients • Placebo -35	

				• Interventions – 35	
Raygan *et al*. (55)	2018	Iran	Vitamin D and probiotics (*Lactobacillus acidophilus, Bifidobacterium bifidum, Lactobacillus reuteri*, and *Lactobacillus fermentum*)	60 patients (ITT principle) • Placebo – 30 • Interventions - 30	
Upreti *et al*. (21)	2018	India	Vitamin D	60 patients (ITT principle) • Placebo – 30 • Interventions - 30	
El-Aal *et al*. (24)	2018	Palestine	Vitamin C and Vitamin E	40 patients (all received metformin) • Placebo – 10 • Interventions ○ Vitamin C – 10 ○ Vitamin E – 10 ○ Vitamin C and E - 10	
Samadi *et al*. (27)	2017	Iran	Propolis	57 patients • Placebo – 27 • Interventions - 30	
Afsharpour *et al.* (26)	2019	Iran	Propolis	60 patients • Placebo – 30 • Interventions - 30	
Stranges *et al*. (56)	2018	Canada	Selenium	491 patients • Placebo – 126 • Interventions - 365	
Braxas *et al*. (43)	2019	Iran	Genistein	54 patients • Placebo – 26 • Interventions - 28	
Said *et al*. (22)	2020	Egypt	Vitamin A, E and Zinc	98 patients • Control – 27 • Interventions ○ AE – 36 ○ AEZ - 35	Randomized controlled trial
Satapathy, *et al.* (57)	2020	India	Folic acid and Vitamin B12	75 patients • Control – 19 • Interventions	Triple-blind, randomized controlled trial

					○ Folic acid - 18 ○ Vitamin B12 - 19 ○ Folic acid + Vitamin B12 - 19	
Fallah *et al.* (44)	2020	Iran	Dietary supplement	Camel Milk	36 patients • Placebo -17 • Interventions - 19	Randomized controlled trial
Mohammadi *et al*. (45)	2019	Iran		Wheat Germ	75 patients • Placebo – 37 • Interventions - 38	Double-blind, randomized controlled trial
Nasiri Lari *et al.* (58)	2020	Iran	Practices	(Aromatherapy) *Lavandula angustifolia* Mill.	37 patients • Placebo – 11 • Interventions – 26 After 1 week, crossover • Placebo – 26 • Interventions - 11	Randomized controlled trial
Salmani Mood *et al.* (59)	2021	Iran		Acupressure	60 patients • Placebo – 30 • Interventions - 30	
Kazemi *et al*. (60)	2019	China		Acupuncture	80 patients (ITT principle) • Placebo – 40 • Interventions - 40	
Mourao *et al.* (61)	2019	Brazil		(Homeopathy) *Berberis, Belladona, Mercurius solubilis, Hepar sulphur, Pyrogenium*	80 patients • Placebo – 40 Interventions - 40	Double-blind, randomized controlled trial

**Control means: This means they did not receive any placebo*

Table 2: Traditional and complementary medicine management and parameters involved in type 2 diabetes mellitus.

	Type of Intervention	**Active Ingredient**	**Management/ Intervention**	**Parameters measured (P value / %)**							
				Glycaemic Profile			**Lipid Profile**			**Blood Pressure**	**Weight**
Mehrzadi *et al.* (28)	Herbal supplement	*Capparis spinosa, Rosa canina, Scurida securigera, Silybum marianum, Urtica dioica, Trigonella foenum graecum* and *Vccinium arcstostaphylos*	2 capsules once a day before meal for 3 months	**0.028**	**0.001**	-	0.898	0.275	0.229	-	-
Nigam & Nambiar (29)		*Aegle marmelos* (L) Correa	100 ml once a day for 60 days	**<0.001**	**<0.001**	**<0.001**			**<0.01** in male	SBP - **<0.05** DBP - **<0.05**	-
Abdoli *et al.* (34)		*Juglans regia* L. leaf (Walnut leaf)	1 capsule three times a day for 3 months	**0.003**	**0.029**	**0.008**	0.294	0.054	0.327	-	-
Tahmasebi *et al.* (30)		*Berberis vulgaris* root	1000 mg two times a day for 6 weeks	**-**	**0.013**	0.221	0.58	0.003	0.02	SBP – 0.37 DBP – 0.30	-
Lazavi *et al.* (31)		Barberry	200 ml once a day for 8 weeks	0.398	**<0.001**	**-**	0.096	0.360	0.293	SBP - **<0.001** DBP – **0.003**	Weight - **<0.001**
Leone *et al.* (35)		*Moringa oleifera*	20 g of MO leaf powder (MOR20) for 2 days	-	**-**	**0.003**	-	-	-	-	-
El Gayar, *et al.* (9)		Ginger	3 capsules once a day for 8 weeks -1 capsule (600 mg)	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	-	-
Gholinezhad *et al.* (38)		Ginger	2 tablets twice a day for 8 weeks	**0.008**	**0.03**	**-**	0.19	0.74	**0.04**	-	-

		-1 tablet (500 mg)								
Carvalho *et al*. (39)	Ginger	2 capsules of ginger daily for 90 days -1 capsule (600 mg)	0.144	**0.001**	-	0.985	**0.018**	0.098	-	-
Vuksan *et al*. (10)	American Ginseng (*Panax quinquefolius* L.)	1 g three times a day, 40 mins before meal for 8 weeks	**0.041**	**0.008**	-	-	**0.003**	0.326	**SBP – 0.001** DBP – 0.123	Weight – 0.454
Hashemi *et al*. (32)	Pomegranate Seed	5 g twice a day (morning on empty stomach, night before bedtime) for 8 weeks	**0.001**	**0.002**	-	0.26	-	-	-	-
Abdollahi *et al*. (33)	Resveratroll	500 mg twice a day for 8 weeks	0.27	**0.001**	-	0.95	0.42	**0.05**	-	Weight – 0.96
Chan *et al*. (48)	Billberry	2 capsules twice a day for 8 weeks with 6 weeks washout period in between -1 capsule (350mg)	0.07	0.96	-	0.992	0.413	0.733	SBP – 0.429 DBP – 0.559	-
Haidari *et al*. (49)	Dill (*Anethum graveolens*)	1 capsule three times a day for 8 weeks -1 capsule (1 g)	-	0.668	-	0.055	**0.029**	**0.007**	-	-
Khalili *et al*. (13)	Silymarin, Olibanum and Nettle	1 capsule three times a day for 90 days -1 capsule (200 mg Silymarin, 200 mg Olibanum and 200 mg Nettle)	**<0.01**	**<0.01**	**<0.01**	**0.01**	0.74	0.37	-	-
Tian *et al*. (15)	Jinlida	1 bag of granules three times a day for 12 weeks -1 bag (9 g)	**0.013**	**0.036**	**0.018**	-	-	-	-	-
Pan *et al*. (16)	Jinlida	1 bag of granules three times a day for 16 weeks -1 bag (9 g)	Group B (Jinlida) - **<0.01** Grou	Group B (Jinlida) - **<0.05** Group D (Jinlida +Metfor	2 hr - Group B (Jinlida) - **<0.01** Group D (Jinlida	-	-	-	-	-

			p D (Jinlida +Metformin) - **<0.01**	min) - **<0.01**	+Metformin) - **<0.01**					
Huang *et al*. (17)	YH1 (50% *Rhizoma coptidis* and 50% SLBZS)	Two package of granules three times a day with warm water after meal for 12 weeks -1 package (3 g)	**0.008**	**0.066**	2h - **0.006**	**0.004**	**0.023**	0.059	-	Weight – **0.030**
Wasana *et al*. (50)	Linn (*Coccinia grandis*)	One capsule once a day for 18 months -1 capsule (500 mg)	**<0.001**	**<0.001**	-	**<0.001**	0.650	0.646	-	-
Riche *et al*. (47)	Mulberry leaf	1000 mg three times a day for 3 months	0.051	-	**<0.05**	-	-	-	SBP – 0.87 DBP – 0.20	Weight – 0.098
Najdi *et al.* (51)	Fenugreek	1 capsule after breakfast, 2 capsules after lunch, and 1 capsule after dinner for 12 weeks -1 capsule (500 mg)	0.38	0.63	-	0.56	0.09	0.48	-	-
Tonelli *et al.* (52)	*Bauhinia forficate*	300 mg once day for 4 months	**<0.001**	**0.01**	-	0.35	-	0.33	-	-
Adab *et al*. (41)	Turmeric	3 capsules once day for 8 weeks -1 capsule (700mg)	0.90	0.57	-	**<0.001**	**0.009**	0.06	-	Weight - **<0.001**
Neta *et al.* (53)	*Curcuma longa* L.	500 mg/5 mg *Curcuma longa* L./piperine once a day for 120 days	**0.028**	0.070	-	0.132	0.608	0.720	SBP – 0.673 DBP – 0.370	-
Mobasseri *et al*. (46)	Saffron	1 capsule once a day for 8 weeks -1 capsule (100 mg)	-	**<0.001**	-	-	-	-	SBP – **0.002** DBP – **0.037**	-

Lira Neto *et al*. (19)		Cinnamon	2 capsules twice a day for 90 days -1 capsule (750 mg)	**0.001**	**0.001**	-	-	-	-	-	-
Zare *et al*. (18)		Cinnamon	1 capsule twice a day for 3 months -1 capsule (500 mg)	**<0.001**	**<0.001**	**0.049**	**<0.001**	0.155	0.006	-	-
Hamedifard *et al*. (42)	Health supplement	Magnesium and Zinc	250 mg Mg/150 mg Zn once a day for 12 weeks	-	**0.03**	-	0.30	0.97	**0.04**	-	-
Aziz *et al*. (20)		*Ginkgo biloba*	1 capsule once a day for 90 days -1 capsule (120 mg)	**<0.001**	**<0.001**	-	-	-	-	-	-
Talenezhad *et al*. (54)		L-carnitine	2 tablets once a day for 12 weeks -1 tablet (500 mg)	-	0.555	-	0.451	0.812	**0.022**	-	Weight – 0.185
Nazem *et al*. (23)		Zinc	1 capsule twice a day for 8 weeks -1 capsule (25 mg)	**<0.001**	**<0.001**	-	**0.01**	**0.01**	**<0.001**	-	**Weight - <0.001**
Raygan *et al*. (55)		Vitamin D and probiotics	50,000 IU vitamin D3 and 8 × 109 CFU/g probiotic (each 2 × 109) every 2 weeks for 12 weeks	-	0.51	-	0.37	0.33	**0.004**	SBP – 0.85 DBP – 0.69	Weight - 0.64
Upreti *et al*. (21)		Vitamin D	60,000 IU every week for first six weeks and then once every 4 weeks for 24 weeks	**0.006**	**<0.001**	**<0.001**	0.39	**0.05**	**0.17**	SBP – **0.002** DBP – **0.03**	-
El-Aal *et al*. (24)		Vitamin C and Vitamin E	• Group II: metformin and 500 mg vitamin C twice a day,	< 0.05	< 0.05	-	Group II & IV (< 0.05)	NS	Group IV (< 0.05)	NS	-

		• Group III: metformin and 400 mg vitamin E twice a day and • Group IV: metformin, 500 mg of vitamin C and 400 mg of vitamin E twice a day for 90 days				Group III (NS)		Group II & III (NS)		
Samadi *et al.* (27)	Propolis	300 mg propolis pills, three times a day for 12 weeks	**0.004**	**0.001**	-	0.350	0.270	0.380	-	Weight – **0.009**
Afsharpour *et al*. (26)	Propolis	500 mg capsules three times a day for 8 weeks	**0.04**	**0.04**	2hr – **0.042**	-	-	--	-	Weight – 0.42
Stranges *et al.* (56)	Selenium	100 mg/d, 200 mg/d, 300 mg/d once a day for for 2 years	0.16	-	-	-	-	-	-	-
Braxas *et al*. (43)	Genistein	2 capsules once a day for 12 weeks -1 capsule (54 mg)	**<0.001**	**<0.001**	-	**0.01**	0.653	0.024	-	Weight – 0.531
Said *et al*. (22)	Vitamin A, E and Zinc	• AE group - 50,000 IU vitamin A (1 capsule) and 100 mg vitamin E (1 capsule) • AEZ group - 50,000 IU vitamin A,	**0.005**	**0.002**	2hr – **0.002**	0.146	0.831	0.105	-	-

			100 mg vitamin E and 75 mg zinc (1 capsule) -for 12 weeks								
Satapathy, *et al*. (57)		Folic acid and Vitamin B12	• Group A: Folic Acid 5 mg once a day for 8 weeks • Group B: Vitamin B12 (Methylcobalamin) 500 mg once a day for 8 weeks • Group C: Both Folic Acid 5 mg once a day and vitamin B12 (Methylcobalamin) 500 mg once a day for 8 weeks	Group A – 1.00 Group B – **0.043** Group C – **0.020**	-	-	-	-	-	-	-
Fallah *et al.* (44)	Dietary supplement	Camel Milk	500 ml of milk once a day for 3 months	**0.001**	**0.02**	-	0.51	0.90	**0.03**	-	-
Mohammadi *et al*. (45)		Wheat Germ	20 g wheat germ twice a day for 12 weeks	0.15	0.11	-	0.29	0.72	**<0.01**	SBP – 0.96 DBP – 0.21	-
Nasiri *et al.* (58)	Practices	(Aromatherapy) *Lavandula angustifolia* Mill.	3 drops of oil and smell it rhythmically and slowly for 5 mins at bed time for 2 periods of 4 weeks followed by washout	-	0.246	-	-	-	-	SBP – 0.70 DBP – 0.63	Weight – 0.90

		period for 1 week for 9 weeks								
Salmani *et al*. (59)	Acupressure	20 mins a day for 1 month	0.78	**<0.001**	-	-	-	--	-	-
Kazemi *et al*. (60)	Acupuncture	12 sessions in 6 weeks (three times per week for 2 weeks, then two times per week for 2 weeks, and then once-weekly for 2 weeks), and maintenance treatment was undertaken for two sessions every other week (in total, 14 sessions of treatment during 10 weeks) - One session (20 minutes)	**0.000**	**0.000**	-	-	-	-	-	-
Mourao *et al*. (61)	(Homeopathy) *Berberis, Belladona, Mercurius solubilis, Hepar sulphur, Pyrogenium*	• *Berberis* (two tablets, two times a day for 45 days) • *Mercurius solubilis / Belladona / Hepar sulphur* (two tablets, 3 times a day for 15 days) • *Pyrogenium* - 200, (single weekly dose, for 2 weeks)	**0.000**	-	-	**0.000**	**0.000**	**0.000**	-	-

NS = non-significant, SBP = systolic blood pressure, DBP = diastolic blood pressure

The author also emphasized the antihypoglycemic mechanism of the herbals, but did not specifically mention any herbals that lower the HbA1c level. Correa or *Aegle marmelos* reduces HbA1c levels by 20% (p = <0.001) (29). Walnut leaf also significantly reduces HbA1c levels in patients (p = 0.03). *Juglans regia*, or walnut leaf, regenerates beta cells, restoring insulin sensitivity as well as facilitating the utilization of glucose by peripheral tissues (8).

Although the exact mechanism of American ginseng's favourable effect on HbA1c remains unclear, it displays a p-value of 0.041 (10). Pomegranate seed powder also produced a significant effect on HbA1c level with a p-value<0.001 (32). Pomegranate seed increased insulin secretion, activated and upregulated glucose transporter type 4 expression, and increased peroxisome proliferator (12). Combinations of silymarin, olibanum, and nettle have a significant effect on HbA1c levels (13). The pathway mechanism for each herb is different, in which silymarin induces insulin secretion while olibanum is an insulin mimetic, thereby increasing insulin sensitivity (14).

Jinlida alleviates insulin resistance and has a greater impact on patients with higher HbA1c levels at baseline. The higher the HbA1c levels at baseline, the greater the reduction in HbA1c after intervention (15). YH1 is a herbal combination that contains 360.9 mg of berberine. It reduced the HbA1c level by 11.1%, with a p-value of 0.008. The authors looked at their results and compared them to those of berberine in a previous study. They found that the YH1 herb combination had a greater effect on lowering HbA1c than berberine alone (17).

Overall, most research does not explain how herbal supplements lower HbA1C levels. However, since each chosen study was a randomized controlled trial (RCT), it is certain that the herbal supplements were effective in lowering HbA1C over the study period.

3.1.2 Fasting Blood Glucose (FBG)

Mehrzadi *et al*. (2021) (28) conducted an RCT where they found that taking 2 capsules of the herbal combination once a day after a meal for 3 months significantly decreased fasting blood glucose (p = 0.001). One of the herbs, *Caesalpinia spinose*, lowers blood sugar by stopping the phosphoenolpyruvate carboxykinase enzyme and hepatic gluconeogenesis. *S. securigera* increased insulin levels while silymarin decreased plasma glucose and lipid peroxidase levels (13, 28). A. marmelos reduced fasting blood glucose by 20% (p = 0.001) by improving peripheral glucose utilization and inhibiting its gluconeogenic function (29). Walnut leaf, or *J. regia L*., also produced a significant effect on lowering fasting blood glucose (p = 0.029) (34).

Taking 1000 mg of *Berberis vulgaris* two times a day for six weeks also helps in reducing fasting blood glucose (p = 0.013). We can attribute its hypoglycaemic effect to the inhibition of the alpha-glucosidase enzyme and the reduction of intestinal blood glucose absorption (30). Barberry is also reported to have an effect on FBG (p<0.01) due to the presence of berberine compounds, which then affect the glucose metabolism through many pathways (31).

Similar to the HbA1c result, only two of the RCTs on ginger produced significant results in reducing FBG levels (9, 39). American ginseng also produced a significant effect on FBG level (p = 0.008). The authors observed an increase in insulin secretion during this trial, but further mechanistic studies are necessary (10). Administration of 5 g of pomegranate seed once a day helps lower FBG levels (p = 0.002) (32). Apart from that, resveratrol also significantly

decreases FBG level (p = 0.001), although it gives no favourable result on HbA1c. The authors noted that this result is due to the patients in this study having controlled diabetes mellitus and a shorter duration of intervention (33).

In a RCT involving a combination of silymarin, olibanum, and nettle, FBG was significantly decreased (p<0.01). Silymarin significantly reduced the FBG level by 20 mg/dL, while olibanum and nettle showed no significant effect (13). The authors also stated that this combination is more prominent in reducing HbA1c levels (13).

Similar to HbA1c, the study by Pan *et al*. (2021) (16) on Jinlida also demonstrated significant results compared to Tian *et al*. (2018) (15). In addition, the combination of Jinlida and metformin demonstrates a strong significant effect, with a p-value of less than 0.001, when compared to Jinlida used alone (15, 16). *Coccinia grandis* and *Bauhinia fortifaca* also recorded significant results in lowering FBG levels with p-values<0.001 and 0.01, respectively (50, 52). *G. biloba*, another well-known health supplement, is proven to reduce FBG levels significantly (p = <0.001). The change in FBG was consistent with the decrease in HbA1c level, which showed that *G. biloba* as an adjuvant to metformin produced benefits in the glycaemic profile (20).

Similar to HbA1c level, monotherapy of zinc and vitamin D, combination of vitamin E and vitamin C, and combination of vitamin A, vitamin E, and zinc produced significant effects in lowering HbA1c level (21–24). Genistein also had favourable effect on lowering FBG levels in patients (p<0.001) (43). 500 ml of camel milk once a day helps in decreasing FBG levels (p = 0.02) (44).

3.1.3 Postprandial Blood Glucose (PPBG)

Moringa oleifera has a significant effect on PPBG (p < 0.003). The findings showed that *M. oleifera* reduced PPBG by inhibiting alpha-amylase activity, thereby reducing glucose intestinal absorption (35). Unlike HbA1c and FBG level results, only one clinical trial using ginger as an intervention reported a notable change in the PPBG level of diabetic patients (9).

Apart from the monotherapy of herbal supplements, the combination of herbs also gives favourable results on the PPBG level. *Silymarin, olibanum*, and nettle effectively reduced PPBG levels (p<0.001). However, the authors did not provide a detailed discussion of the exact mechanism (13). Khalili *et al*. (2017) (13) also concluded that polyherbal formulations may provide multiple benefits, including glycemic control efficacy and decreasing adverse events (13).

Jinlida with a higher baseline HbA1c level have a greater reduction in PPBG levels (15). It has greater benefits for patients with poorly controlled diabetes and long-term impaired beta cells (15). In the study by Pan *et al*. (2021) (16), Jinlida can also be an alternative to metformin in newly diagnosed T2DM with a slightly elevated glucose level (16).

Another herb combination, YH1, has a significant effect on PPBG level (p = 0.006) (17). The PPBG level was the subject of only one RCT on cinnamon (p = 0.049) (18). Apart from that, vitamin D and combinations of vitamin A, vitamin E, and zinc reported significant results with p-values <0.001 and 0.002, respectively (21, 22).

3.2 Lipid Profiles

Clinical Practices Guidelines for Management of T2DM, 2020 further categorize lipid profiles into triglycerides, LDL, and HDL levels (36). A reduction in triglyceride levels was observed in RCTs involving herbal supplements (*A. marmelos* or Correa) (p<0.001). This occurs through triglyceride hydrolysis activation and reduces blood cholesterol (29).

Ginger is another herb that effectively reduces triglycerides and LDL levels, as well as improving HDL levels. Ginger lowers cells' uptake of oxidised LDL because it alters the shape of lipoprotein receptors (37). Out of three RCTs on ginger, one reported significant result on triglycerides ($p<0.001$), LDL ($p<0.001$), and HDL level ($p<0.001$). The other two only have significant changes in HDL ($p = 0.04$) and LDL ($p = 0.018$) levels, respectively (38, 39). These results differ due to intervention duration and ginger consumption.

Vuksan *et al.*'s (2019) (10) study on American ginseng only showed a significant result on the LDL level ($p = 0.003$). The authors noted that this underscores the need for further clinical studies on the ginseng effect on lipid profile, as the current evidence relies solely on traditional beliefs and preclinical research (10). In contrast to ginseng, resveratrol only showed a significant value in HDL level ($p = 0.05$). This is due to resveratrol's action in increasing carnitine palmioyl transferase-1, thereby reducing fatty acid synthase and acetyl-CoA gene expression (33).

The RCT on *Anethum graveolens* showed significant results on LDL ($p = 0.029$) and HDL ($p = 0.007$) levels, while the triglyceride level showed a slight reduction ($p = 0.055$). We still need to determine the mechanism of *A. graveolans'* lipid-lowering effect. Proposals suggest that the mechanism of the lipid-lowering effect could stem from the suppression of acetyl-CoA carboxylase and HMG-CoA reductase activity, which leads to decreased cholesterol absorption and fatty acid synthesis, and the stimulation of cholesterol clearance by elevated LDL receptors (40).

Apart from that, the combination of silymarin, olibanum, and nettle has significantly reduced triglyceride levels ($p = 0.01$) (13). Other combinations of herbs, such as YH1, also reduced the triglycerides ($p = 0.004$) and LDL levels ($p = 0.023$). Researchers are still investigating the exact mechanism of lipid-lowering, and further research is necessary (17). Turmeric, one of the oldest and most established herbs for managing diabetes mellitus, also gave significant results in triglycerides ($p<0.001$) and LDL levels ($p = 0.009$). The mechanism behind this is the same as in *A. graveolans*, where turmeric suppresses the HMG-CoA reductase enzyme and affects the LDL receptors, thus impairing cholesterol absorption (41).

Genistein, which is found in soy-based foods, was reported to have a positive effect on triglyceride levels ($p = 0.01$), and the mechanism behind it is the enhancement of fatty acid catabolism (43). Practices of TCM, such as homoeopathy, also significantly improved the lipid profile (61). In dietary supplements, both camel milk and wheat germ significantly improve HDL levels, with p-values of 0.03 and <0.01, respectively. Camel milk contains linoleic acid, which reduces triglycerides and LDL levels. Wheat germ, on the other hand, is rich in polyunsaturated fatty acids, tocopherols, and phytosterols, and these compounds are capable of affecting lipid values (45).

3.3 Blood Pressure

Administration of 200 ml of barberry once a day for 8 weeks, as conducted by Lazavi *et al*. (2018) (31) in Iran, had a significant effect on decreasing blood pressure ($p = 0.001$) and DBP ($p = 0.003$). American ginseng (*Panax quinquefolius* L) significantly improved SBP ($p<0.001$) by improving vascular function (10). To achieve this, individuals should take 1 g of American ginseng three times a day for 8 weeks. Saffron also helps in reducing blood pressure, where its anti-hypertensive properties lie in its compounds such as safranal, picrocrococin, crocin, and crocetin (46). To achieve this therapeutic effect, 100

mg of saffron was taken for 8 weeks, as highlighted by Mobasseri *et al.* (2020) (46).

3.4 Weight

In type 2 diabetes mellitus patients, there are 13 RCTs that have an impact on weight. Out of 13 RCTs, 6 are herbal supplements, 6 are health supplements, and 1 is aromatherapy. Out of 13 RCTs, eight of them were not significant in reducing weight. A Canadian study on American ginseng found no significant weight reduction ($p = 0.454$), and the patients maintained their weight throughout the intervention (10). In the resveratrol study by Abdollahi *et al.* (2019) (33), there was a reduction in weight, though it was not significant ($p = 0.96$). It did, however, show a significant result in other anthropometric measures such as waist circumference, fat mass, and trunk fat mass. The duration of the intervention and long-term supplementation may be factors that affect the parameters (33).

In one RCT by Lazavi *et al.* (2018) (31), conducted on 46 patients in Iran, taking 200 ml of barberry juice once a day for 8 weeks helped reduce weight ($p<0.001$). There were no side effects reported in this article (31). Another study conducted in Iran by Adab *et al*. (2019) (41) on 75 patients showed a reduction in weight ($p<0.001$) in diabetic patients when turmeric was used as an intervention. The researchers packaged the turmeric as 700 mg capsules, which the patients consumed once a day for 8 weeks. Turmeric reduced weight through an increase in basal metabolic rate and reduced adipose tissue due to a decreased level of inflammatory cytokines (41).

Huang *et al.* (2019) (17) conducted another RCT in China, which found that diabetic patients who consumed two packages of YH1 granules three times a day with warm water after meals for 12 weeks experienced a significant weight reduction ($p = 0.030$). YH1 is a combination herbal supplement consisting of *Rhizoma coptidis* and Shen Ling Bai Zhu San (SLBZS). There were no serious side effects observed; however, there were incidences of diarrhea classified below two (2) levels of severity as measured using the Common Terminology Criteria for Adverse Events (CTCAE) grading system. When consuming YH1, there were cases of gastrointestinal adverse effects, including nausea, bloating, and gastroesophageal disease. The treatment was temporarily withdrawn. The YH1 intervention also reported hypoglycemia, which we resolved by lowering the dosage of sulfonylureas (17).

Apart from that, minerals such as zinc also showed a significant weight reduction in diabetic patients. This was shown in a study done by Nazem *et al.* (2019) (23) in Iran, where 25 mg of zinc was consumed twice a day, which helped in weight reduction (<0.001) in the patients (23). Samadi *et al.* (27) also reported that taking 300 mg of propolis three times a day for 12 weeks will help in reducing weight ($p = 0.009$) (27). However, in the Iran RCT on propolis by Afsharpour *et al*. (2019) (26), there was no significant weight reduction ($p = 0.42$; 26). The differences between these two RCTs were the quantity and duration of the management; in Samadi *et al*. (2017) (27), the dosage was 300 mg of propolis consumed three times a day for 12 weeks, whereas in Afsharpour *et al*. (2019) (26), the dosage was 500 mg of propolis consumed three times a day for eight weeks (26, 27).

3.4 Limitations

This review utilized only two databases, which limited the thoroughness and comprehensiveness of the article search. Apart from that, during the searching process, articles related to TCM practices such as acupuncture and acupressure were very limited, as these two practices were more focused on their results on diabetic complications than diabetic parameters.

4.0 Conclusion

This narrative review highlights the potential benefits of traditional and complementary medicine (TCM) approaches to managing type 2 diabetes mellitus (T2DM). Through a meticulous search on PubMed and ScienceDirect, using specific keywords and focusing on studies from the last five years (2017–2021), we included 47 articles that met our predefined criteria. These articles provided insights into various TCM practices, including herbal, health, and dietary supplements, as well as alternative practices like acupuncture and homeopathy. Our findings indicate that many of these TCM approaches exhibit positive effects on key diabetic parameters such as glycemic control, lipid profile, weight, and blood pressure.

The studies reviewed suggest that herbal supplements like ginger, American ginseng, and herbal mixtures, along with health supplements such as *Ginkgo biloba*, zinc, and vitamin D, and dietary supplements like wheat germ and camel milk, can effectively improve diabetic parameters. Additionally, we found that practices like acupuncture and homeopathy positively contribute to the management of T2DM. These outcomes support the growing interest among individuals with diabetes in exploring TCM as an alternative or complementary option to conventional treatments, largely due to the perceived minimal side effects and enhanced effectiveness.

In summary, this review underscores the potential of TCM in the comprehensive management of type 2 diabetes mellitus. It provides valuable insights for healthcare professionals seeking to incorporate TCM approaches into their practice, offering an evidence-based reference for improving patient outcomes. Further research is necessary to explore the mechanisms and long-term effects of complementary and alternative medicines, ensuring their safe and effective integration into diabetes care protocols, as interest in these medicines continues to grow.

Author Contributions

IZN: Methodology, Formal analysis, Writing – draft corrections. **NWZ**: supervision, main idea, methodology, writing – draft corrections.

Conflict of Interest

No conflicts of interest to disclose.

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