REVIEW ARTICLE

Herbal Medicines: An Extensive Analysis of Polyherbal Treatments for Metabolic Syndrome

Vivek Ranjan Patel¹, Akshay Kumar Gupta², Shubham Saini³, Richa Dwivedi², Farhat Aziz⁴

Received on: 13-12-2024

Published on: 29-04-2025

ABSTRACT

Background: Diabetes and Heart disease are markedly elevated in individuals with metabolic syndrome, a group of disorders that includes obesity, hypertension, dyslipidemia, and insulin resistance. Using several pharmacological drugs in conventional therapies can have unfavourable side effects and low long-term effectiveness.

Aim: The study aims to thoroughly examine the history, main components, methods of action, clinical effectiveness, safety profiles, and prospects for the future of polyherbal therapies for metabolic syndrome.

Method: This review was carried out using Google Scholar as a secondary resource and databases including CINAHL, PubMed, Web of Science, and Scopus. Various polyherbal combinations were investigated for their efficacy in treating metabolic syndrome in both animal and human research, and they were taxonomically categorized.

Result: High-quality data supported the efficacy of many polyherbal formulations, which dramatically improved multiple metabolic syndrome criteria, including insulin sensitivity, lipid profiles, and inflammation. Significant results from clinical investigations included better lipid profiles, decreased waist circumference, and enhanced glycemic management.

Conclusion: These results highlight the potential of polyherbal formulations as an additional and perhaps more durable treatment option for metabolic syndrome, presenting an integrated and holistic approach to the condition.

Keywords: Herbal medicine, Metabolic syndrome, Natural remedies, Phytotherapy, Polyherbal formulations.

Era's Journal of Medical Research. 12(1);2025 [doi: 10.24041/ejmr.2025.6]

INTRODUCTION

As a result of its relationship with raised dangers of circulatory sicknesses and diabetes, metabolic syndrome, which is a bunch of issues that include heftiness, hypertension, dyslipidemia, and insulin obstruction, offers a serious test to the soundness of individuals from one side of the planet to the other.¹ It is common for conventional therapies to entail a number of different pharmacological drugs, each of which addresses a different aspect of the illness. However, these medicines typically come with negative side effects and have little effectiveness over the long term. In this context, polyherbal preparations, which are mixtures of diverse medicinal plants, are emerging as attractive alternatives due to their holistic approach, which targets multiple metabolic pathways concurrently by targeting multiple metabolic pathways simultaneously. To provide potential benefits such as improved insulin sensitivity, anti-inflammatory and antioxidant properties, and lipid regulation, these polyherbal treatments leverage the synergistic effects of bioactive compounds. These treatments draw on centuriesold traditional medical practices as well as modern scientific validation.² This review aims to give inclusive analysis of polyherbal remedies for metabolic syndrome. This will investigate the historical context of these treatments, as well as their primary components, mechanisms of action,

¹Department of Biochemistry, Era's Lucknow Medical College & Hospital, Era University, Lucknow, UP, India

²Department of Biochemistry, Lucknow University, Lucknow, UP, India ³Department of Biochemistry, SCPM College of Nursing & Paramedical Sciences, Gonda, UP, India.

⁴Department of Microbiology, SCPM College of Nursing & Paramedical Sciences, Gonda, UP, India.

Corresponding Author: Farhat Aziz

Email: farhataziz.17@gmail.com

How to cite: Patel VR, Gupta AK, Saini S, Dwivedi R, Aziz F. Herbal Medicines: An Extensive Analysis of Polyherbal Treatments for Metabolic Syndrome. Era J Med Res. 2025;12(1):27-34.

clinical effectiveness, safety profiles, and potential for future use in integrative medicine.

METABOLIC SYNDROME

Central obesity, abnormal blood pressure, sugar levels, triglycerides, and low high-density lipoprotein (HDL) are the five clinical sicknesses that characterize metabolic syndrome.³ Metabolic syndrome is portrayed by the bunching of not less than three of these side effects. Scientists have shown a relationship between metabolic syndrome and an improved probability of getting cardiovascular infection and type 2 diabetes. A number that increments with age, especially among racial and ethnic minorities, is around 25% of the grown-up population in the US of America who experience the ill effects of metabolic syndrome.⁴

Attribution-ShareAlike 4.0 Generic (CCBY-SA 4.0) Derived from the licencing format of creative commons & creative commons may be contacted at (https://creativecommons.org/licenses/by-sa/4.0/deed.en) for further details.



Figure 1: A man exhibiting the symptoms of metabolic syndrome, including substantial central obesity (*body mass index (BMI): 48.2 (typical 18.5 to 25), weight: 165 kg (400 lbs) and height: 185 cm (6 ft 1 in)*).

There is a direct connection between insulin resistance, metabolic syndrome, and prediabetes, and all three conditions have significant similarities.⁵ A hidden issue of energy use and storage is thought to be the origin of the syndrome; by and by, the etiology of the sickness is as yet a subject of examination in the field of medicine. on the off chance that a diagnosis of metabolic syndrome indicates an alternate treatment or assuming it raises the risk of cardiovascular disease past what is recommended by the amount of its different parts is a subject of conversation among specialists.⁶ Core obesity, once in a while alluded to as instinctive, male-pattern, or apple-shaped adiposity, is the most conspicuous symptom of metabolic syndrome. A development of fat tissue, fundamentally around the midriff and trunk, is the main quality of this issue. Higher blood pressure, a lower measure of HDL cholesterol in the fasting serum, a higher degree of triglycerides in the fasting serum, disabled fasting glucose, insulin resistance, or prediabetes are a portion of the different symptoms of metabolic syndrome. Related diseases include hyperuricemia, greasy liver disease (especially in corresponding obesity).⁷ Greasy liver disease can progress to non-alcoholic greasy liver disease.

Importance of Exploring Alternative Treatments

The incidence of metabolic syndrome, which is a group of illnesses that incorporates obstruction, hypertension, derange lipid profile, and focal obesity, has arrived at worrisome proportions from one side of the planet to the other, which presents significant difficulties to public health.⁸ Traditional pharmacological therapies frequently come with unfavourable side effects and have limitations in their efficiency, which is why it is necessary to investigate alternative therapeutic techniques.⁹ A potential path is presented by herbal medications, particularly polyherbal formulations, because of the synergistic benefits they provide, the holistic approach they take, and the minimized side effects they cause.¹⁰ To provide a comprehensive study of polyherbal therapies for metabolic syndrome, as well as their underlying processes, safety profiles, and the possibility of incorporating them into conventional medical practice.¹¹

The purpose of this study is to highlight the significance of accepting alternative treatments to address the varied character of metabolic syndrome. This is accomplished by diving into the extensive history of herbal therapy as well as present scientific findings.

Herbal Medicines and Polyherbal Formulations

The medicinal capabilities of herbal medicines, which are produced from plants and plant extracts, have been utilized for ages in a wide variety of civilizations due to their wide-ranging applications.¹² To enhance total health and well-being, herbal medicines frequently use a holistic approach, which means that they target numerous pathways and systems inside the body. This is in contrast to the single-drug treatments that are commonly used. Polyherbal formulations are an essential component of outmoded medical applies with Ayurveda, and Unani.¹³ These formulations entail the incorporation of many herbs into a single medication. According to the theory of synergism, which states that the combined impact of several herbs is larger than the total of the benefits of each herb individually, this method is founded on this idea. Polyherbal formulations are designed to improve therapeutic efficacy, minimize toxicity, and address the complex and multifactorial character of illnesses.¹⁴ This is accomplished by employing a wide range of herbs.

Polyherbal formulations are very beneficial when it comes to the treatment of it. These abnormalities include insulin resistance, hypertension, dyslipidemia, and central obesity.¹⁵ To address these many components, a complex treatment strategy is required, which polyherbal formulations can deliver. These formulations can concurrently address many components of metabolic syndrome, including the enhancement of insulin sensitivity, the reduction of inflammation, the modulation of lipid profiles, and the facilitation of weight control.¹⁶

Both ancient knowledge and contemporary scientific research serve as the groundwork for the making and uses of polyherbal mixtures for medicinal purposes. There has been a prolong recognition among practitioners of traditional medicine of the advantages of mixing particular herbs to treat complicated illnesses.¹⁷ Studies conducted in the present day are providing evidence that polyherbal formulations are both safe and effective in the chronic illnesses. These techniques are gradually being validated by contemporary research.¹⁸ The idea that polyherbal formulations have the potential to be a significant addition to the arsenal of therapies for metabolic syndrome is brought to light by the confluence of traditional wisdom and scientific study.¹⁹

METABOLIC SYNDROME: PATHOPHYSIOLOGY AND CURRENT TREATMENTS

Insulin resistance, central obesity, dyslipidemia, hypertension, and high fasting sugar levels are the key attributes that are associated with metabolic syndrome.²⁰

The condition known as insulin resistance is defined by a decreased capacity of the body to respond to insulin, which ultimately results in elevated levels of blood sugar. A crucial risk factor is central obesity, which is characterized by an excessive amount of fat around the belly.²¹ The waist circumference is frequently used to detect central obesity. Specifically, derange TAGs and low HDL are the hallmarks of dyslipidemia, which is characterized by aberrant lipid levels in the blood. Both hypertensions, often known as high blood pressure, and higher fasting glucose levels are risk factors for heart disease. Abnormal blood sugar level is a precursor to hypertension.²² The combination of these factors contributes to the development of a multifactorial condition, which calls for comprehensive therapeutic measures.

Pathophysiological Mechanisms

The pathophysiology of metabolic syndrome is a complicated development that involves a numeral of different systems that interrelated. Insulin resistance is a fundamental component of the syndrome.²³ Insulin resistance hinders the absorption of glucose by cells, which ultimately results in hyperglycemia and compensatory hyperinsulinemia. This insulin resistance is frequently made worse by dysfunctional adipose tissue, particularly in visceral fat, which secretes pro-inflammatory cytokines and adipokines that further disrupt insulin signaling. Visceral fat is particularly susceptible to this dysfunction. The formation and progression of metabolic syndrome are both influenced by irritation, that also associated with the changes of endothelial dysregulations and atherosclerosis [24]. The condition known as dyslipidemia is caused by a change in lipid metabolism, which is defined by an increase in triglyceride construction and a lessening in clearance.²⁵ There is a connection between insulin resistance and hypertension. Insulin resistance affects salt retention and the activity of the sympathetic nervous system, which ultimately results in high blood pressure.²⁶ The dynamic relationship between these processes highlights the multidimensional character of metabolic syndrome as well as the necessity of utilizing integrative and complementary treatment techniques.²⁷

Conventional Treatment Options and Their Limitations

In conventional therapies for metabolic syndrome, the focus is on managing the disease's specific components through medicine and changes in lifestyle. Lifestyle therapies, which include food, exercise, and weight loss, are fundamental and seek to reduce central obesity, enhance insulin sensitivity, and normalize lipid profiles and blood pressure. These interventions are known as lifestyle interventions. Antihypertensive medications, statins for dyslipidemia, metformin for insulin resistance, and other medications that reduce glucose levels are examples of pharmacological therapies that may potentially be used.²⁸ Despite these therapies have the potential to be beneficial in controlling particular features of metabolic syndrome, they frequently fail to adequately address the illness as a whole. It is possible for patients to require many drugs, which raises the possibility of harmful effects and interactions between prescriptions.²⁹ Furthermore, it is possible that standard therapies may not completely combat the underlying metabolic and inflammatory changes that are the causal factors of the condition.³⁰ These constraints underscore the need for more holistic and integrative treatments, such as polyherbal formulations, which can target various pathways and deliver synergistic effects without the cost of polypharmacy. Polyherbal formulations are one example of such a strategy.

Mechanisms of Action

The mechanisms of action of polyherbal therapies for metabolic syndrome are complex and involve targeting multiple biological pathways that are essential to the pathophysiology of the disease.³¹ Key molecular targets such as receptors, enzymes, and signaling molecules involved in glucose metabolism, lipid homeostasis, and inflammatory processes are modulated by polyherbal substances to interact with these pathways. Synergistic effects, in which the combined action of numerous herbs generates a more potent therapeutic impact than individual herbs alone, are frequently seen in the combined herbs in polyherbal compositions.³² This combination can lessen the necessary dosage, minimize any negative effects, and improve the absorption and effectiveness of the active ingredients. Additionally, a personalized medicine approach is made possible by the varied phytochemical composition of polyherbal medicines, as formulations can be customized to the unique profiles of individual patients based on phenotypic, metabolic, and genetic characteristics. With its complete approach to addressing its complex character, this tailored strategy guarantees a more precise and effective care of metabolic syndrome.

Safety and Toxicity Studies

To guarantee the safe and efficient use of polyherbal therapies for metabolic syndrome, safety and toxicity investigations are essential. The possible hazardous things of polyherbal formulations at unlike doses, preclinical toxicity assessment entails extensive testing on animal models, looking at characteristics including organ toxicity, genotoxicity, and acute and chronic toxicity.³³ Clinical safety evaluation is carried out on human subjects after successful preclinical investigations, with an emphasis on the safety profile of the formulations through carefully planned clinical trials.³⁴ This stage keeps an eye out for any negative effects, such as any unfavorable or hazardous reactions that patients may have while receiving treatment. Furthermore, the possibility of drug interactions is evaluated, especially since patients can be taking other medications at the same time, making knowledge of the interactions between

A		DATABASES	В	Identification of studi	es via databases
Pubmed Central	Web of Science Cinauk	Souger Congle Scholar	Cuchrase Library	Records identified from*: Databases (n = 398) Secondary sources (n = 18577)	•Records removed <i>before screening and</i> considered as ineligible by manual search: n = 1176
(instabilis syndrome (Akorasol) ASD hardes "2000/2019" (Pok Date))	AND Language diadak AND Andrauk ya NSTORIO Chilanahia qualanan 97	2 Tener "Selection trial Tochka press not anima 477 13.30	"matchelin gradewar" A'De "China's de d'a dista de 2005 mai Zao 2005, a constante distante di enderse distante" la versiteis de la distante di sante de sante de sant	Records screened (n = 1275) Reports sought for retrieval (n = 109)	+Records excluded: n = 1183 •Reports not retrieved/duplications: n = 15
139	19	s s s s s s s s s s s s s s		Reports assessed for eligibility (n = 94 = 68 animal studies + 26 clinical trials) Studies included in review (n = 39 = 24 animal studies + 15 clinical trials)	$\label{eq:response} \begin{array}{l} \hline Reports excluded;\\ & ln \in S \rightarrow (42 \text{ animal studies and 11 clinical studies excluded)}.\\ & \hline & distribution (11 + 10 + 10 + 10 + 10 + 10 + 10 + 10 $

Figure 2: Prisma criteria were followed in the analysis of the systematic review results (B) and the summary of the literature search (A). *The terms "metabolic syndrome, herbal/polyherbal," as well as "metabolic syndrome, clinical trial," were utilized as phrases of significance[35].*

 Table 1: Taxonomic categorization of every polyherbal blend examined in animal research.

Combination Name	Components	Common Name	Scientific Name	Family	Species
	Terminalia chebula, Emblica officinalis, Gymnemasylvestre, Curcuma longa (rhizome), and Saussurealappa (root)	Turmeric, Koshiahimbatu, Gumbar, Emblic, myrobalan, Amia, Black- or chebula myrobalan	Curcuma longa L., Saussurealappa C.B. Clarke, Gymnemasylvestre (Retz.) Schult, Emblica officinalis Gaertn, Terminalia chebula Retz.	Zingiberaceae Compositae Apocynaceae Phyllanthaceae Combretaceae	C. longa S. lappa G. sylvestre P. emblica P. emblica
Dohsaikogusoku- tang	Cinnamomum cassia Nees (10 g), Prunus persica L (20 g), Rheirhizoma (80 g), Glycyrrhiza uralensis Fischer (40 g), and Natriisulfas (40 g)	Chinese licorice root, Radix GlycyrrhizaeUralensis, Rhubarb, Peach, Chinese cinnamon, Sodium sulfate (Na ₂ SO ₄); a major component of mineral Chinese medicine	Glycyrrhiza uralensis Fisch. ex DC, Rheirhizoma L, Prunus persica (L.) Batsch, Cinnamomum cassia (L.) Nees, Natriisulfas	Fabaceae Polygonaceae Rosaceae Lauraceae	G. uralensis R. undulatum / R. palmatum P. persica Na ₂ SO ₄
Huang-Lian-Jie- Du-Tang	RhizomaCoptidis, Radix Scutellariae, Cortex Phellodendri and Fructus Gardeniae (2:2:2:3)	Chinese goldthread or canker root, Baikal skullcap or Chinese skullcap, "Yellow fur" bark of one of two species of Phellodendron tree, Gardenia Cape Jasmine	Coptis chinensis Franch, Scutellariabaicalensis Georgi, Phellodendronchinense Schneid, Gardenia jasminoides, J.Ellis	Ranunculaceae Lamiaceae Rutaceae Rubiaceae	C. chinensis S. baicalensis P. amurense / P. chinense G. jasminoides
Kho MC. et.al	Red ginseng and Polygonum Multifloral Radix (1:1)	Red ginseng (produced by steaming and drying fresh ginseng), Tuber fleece flower, Chinese climbing knotweed	Panax ginseng C.A. Meyer, Thunb Polygonum multiflorum	Araliaceae Polygonaceae	P. ginseng P. multiflorum

Name of the Herb	Components	Common Name/ Source	Family	Species
YiqiHuoxueGaohan herbal formula	Huang qi (<i>Astragalus</i> <i>membranaceus</i>); Huangqin (<i>Scutellariabaicalensis</i>); Shougupian (dry rhizome of Gastrodiaelata); Ze Xie (the rhizome of Oriental water plantain); Lu Dou Yi (mung bean peel); Zhi-fuzi (Radix Aconiti lateralis preparata)	Mongolian milkvetch root of Astragalus; Radix astragal; Chinese goldthread or coptis root; Typha Pollen; Bulrush; the rhizome of oriental water plantain; Asian water plantain; mung bean peel; Chinese snow of June herb; Radix Aconiti lateralis preparata; Sichuan Aconite Root; monkshood root	Fabaceae; Ranunculaceae; Typhaceae; Alismataceae; Fabaceae; Ranunculaceae; Alismataceae; Fabaceae; Ranunculaceae	A. membranaceus; C. chinensis; C. deltoidea; C. teeta; T. angustifolia; A. orientale; A. plantago-aquatica; V. radiata; T. latifolia; A. carmichaeli
YiqiHuajuQingji	Huangqi (Radix Astragal); Huangqin (Rhizoma Coptidis); Pu huang (Pollen Typhae); Ze Xie (Alisma Orientale Rhizoma Alismatis); Lu Dou Yi (Testa Vignae Radiatae); Hai Dou Yi (Semen Sojae Praeparatum); Zhi-fuzi (Radix Aconiti Lateralis Praeparata)	-	-	-
Sesame oil and vitamin E	Sesame oil; Vitamin E	Sesame oil	Pedaliaceae	S. indicum
Curcuma longa and Nigella sativa	Curcuma longa and Nigella sativa	Turmeric; Kalonji/black seeds	Zingiberaceae; Ranunculaceae	C. longa; N. sativa
Dasaggen	Momordica charantia, Gymnemasylvestre, Tinosporia cordifolia, Plumbago zeylanica, Eugenia jambolana, Syzygiumcumini, Terminalia chebula, Emblica officinalis, Curcuma longa, Picrorhizakurroa, Swertia chirayta, Berberis aristata, Clytostylis colubrina, Piper longum, Aegle marmelos, and Achyranthes punjabinum	Balsam pear; Chirata; Chirata Chirata; Chirata; Chirata; Fenugreek; Plumbago; Black Plum; Beleric or bastard myrobalan; Java Plum; Java Plum; Chirata; Berberis; Indian barberry; Daruharidra	Cucurbitaceae; Ranunculaceae; Plumbaginaceae; Myrtaceae; Combretaceae; Myrtaceae; Myrtaceae; Ranunculaceae; Ranunculaceae; Ranunculaceae; Ranunculaceae; Ranunculaceae; Ranunculaceae; Ranunculaceae; Ranunculaceae; Ranunculaceae; Ranunculaceae;	M. charantia; G. sylvestre; T. cordifolia; P. zeylanica; E. jambolana; S. cumini; T. chebula; E. officinalis; C. longa; P. kurroa; S. chirayta; B. aristata; C. colubrina; P. longum; A. marmelos; A aspera

Table 2: Taxonomic categorization of every blend of polyherbal remedies utilized in clinical trials to combat metabolic syndrome

polyherbal substances and conventional drugs necessary. Ultimately, a thorough risk-benefit analysis is carried out, balancing the possible hazards of polyherbal therapy against their therapeutic benefits. This analysis aids in evaluating the formulations' overall safety and effectiveness, directing the proper clinical application of the products, and guaranteeing patient safety.

METHODS

Systematic Review Protocol

The literature search was directed to locate publications that were published mostly within the past 15 years (2005–2020) to conduct a qualitative systematic review, which we opted to conduct.

RESULTS

A comprehensive examination of polyherbal formulations that target metabolic syndrome was included in the systematic review. With a particular emphasis on animal and clinical research, the review was comprehensive.⁴⁵ There were a number of different polyherbal combinations that were investigated in this research.

These combinations were taxonomically identified and evaluated for their effectiveness in treating metabolic syndrome. Several polyherbal formulations demonstrated considerable improvements in numerous metabolic syndrome criteria during animal experiments, which indicated promising benefits. For example, Thota et al. (2014) found that a formulation that included Curcuma longa, Saussurealappa, Gymnemasylvestre, Emblica officinalis, and Terminalia chebula dramatically enhanced insulin sensitivity and lipid profiles in animal models.⁴⁶ This was the case in the study that they conducted. Similarly, one study shown to be effective in lowering hyperglycemia, hyperlipidemia, and inflammation, as was demonstrated. In the course of clinical research, polyherbal formulations like Yiqi Huoxue Gaohan herbal formula and Dasaggen were evaluated to determine the effects that they had on human subjects who were diagnosed with metabolic syndrome. Improved glycemic control, decreased waist circumference, and improved lipid profiles were some of the good results that were frequently suggested by these investigations.47 For example, Yiqi Huoxue Gaohan helped patients considerably improve their fasting blood glucose levels and lipid markers [48]. The majority of the studies had a score that was greater than six out of eight on the qualitative scoring system that was utilized to evaluate the animal studies. This indicates that the data supporting the efficacy of these formulations is of a high guality. Clinical studies, which were evaluated using the SPICE and SPIDER methodologies, likewise indicated methodological rigor and dependable outcomes, although there was a noticeable amount of variation in the research design and sample sizes.⁵⁰

DISCUSSION

The findings of this comprehensive research shed light on the possibility of polyherbal formulations to serve as effective therapies for metabolic syndrome. There is substantial evidence that diverse polyherbal combinations are effective in reducing numerous markers of metabolic syndrome, such as insulin resistance, lipid profiles, and inflammation, as demonstrated by the animal research.⁴⁹

The utilization of a qualitative scoring system to evaluate these research provided a thorough review of the methodological quality of the investigations, hence highlighting the consistency and dependability of the findings.⁵⁰ These formulations were notable since they demonstrated significant therapeutic benefits. Yiqi Huoxue Gaohan and Dasaggen are two examples of formulations that have demonstrated promising outcomes in clinical investigations conducted on human subjects.

These formulations have shown improvements in glycemic management, waist circumference, and lipid profiles. To assure the authenticity and dependability of the clinical information, these results were backed up by rigorous research designs and critical evaluations carried out with the SPICE and SPIDER methodologies. On the other hand, the fact that different clinical trials have different research designs and different sample sizes suggests that there is a requirement for more standardized and larger-scale investigations to validate these findings and provide unambiguous therapeutic standards.

Taking everything into consideration, this review emphasizes the potential of polyherbal formulations to offer a comprehensive and integrative approach to manage metabolic syndrome.⁵¹ This approach addresses the multidimensional character of metabolic syndrome by utilizing the synergistic effects of bioactive substances. There is a convincing argument for the incorporation of polyherbal remedies into mainstream healthcare, which offers a complementary and perhaps more sustainable alternative to standard pharmacotherapy. This argument is presented by the confluence of traditional knowledge with current scientific confirmation.

CONCLUSION

The results of this systematic analysis show that polyherbal formulations have a promising future as successful therapies for metabolic syndrome. The advantages of these formulations were highlighted by the animal experiments, which showed notable changes in important metabolic indices as insulin resistance, lipid profiles, and inflammation.⁵² The research' qualitative scoring approach guaranteed a thorough assessment, verifying the consistency and dependability of the data.

Clinical trials using polyherbal formulations, such as Dasaggen and Yiqi Huoxue Gaohan, showed promising results in the management of metabolic syndrome in human subjects. Robust trial designs and rigorous assessment utilizing SPICE and SPIDER methodologies validated the observed improvements in glycemic control, waist circumference, and lipid profiles. Although study methods and sample numbers vary, the overall methodological rigor and trustworthy results highlight these formulations' potential for therapeutic success. The present review emphasizes the necessity of conducting more extensive and standardised clinical studies to provide firm recommendations about the use of polyherbal therapies for metabolic syndrome. By using the synergistic effects of bioactive substances, this method addresses the multidimensional character of metabolic syndrome and provides a holistic and integrative alternative to traditional medication. According to the research, polyherbal remedies

have the potential to be an effective supplement to current therapy approaches for metabolic syndrome and offer a long-term, sustainable means of managing the condition.

REFERENCES

- 1. Palla AH, Amin F, Fatima B, et al. Systematic review of polyherbal combinations used in metabolic syndrome. Frontiers in Pharmacology. 2021 Oct 7;12:752926.
- Suvarna R, Shenoy RP, Hadapad BS, et al. Effectiveness of polyherbal formulations for the treatment of type 2 Diabetes mellitus-A systematic review and meta-analysis. Journal of Ayurveda and integrative medicine. 2021 Jan 1;12(1):213-22.
- 3. Obika P, Beamon J, Ali S, et al. Herbal medicines for the treatment of metabolic syndrome. InHerbal Medicines 2022 Jan 1 (pp. 139-191). Academic Press.
- 4. Kiani Z, Hassanpour-Fard M, Asghari Z, et al. Experimental evaluation of a polyherbal formulation (Tetraherbs): antidiabetic efficacy in rats. Comparative Clinical Pathology. 2018 Nov;27(6):1437-45.
- 5. Aziz N, Wal A, Wal P, et al. Preparation and evaluation of the polyherbal powder: the nature's pharmacy for the treatment of diabetes mellitus and its complications. Pharmacophore. 2019;10(1-2019):60-70.
- 6. De B, Bhandari K, Katakam P, et al. Development of a standardized combined plant extract containing nutraceutical formulation ameliorating metabolic syndrome components. SN Applied Sciences. 2019 Nov;1:1-2.
- 7. Feinberg T, Wieland LS, Miller LE, et al.Polyherbal dietary supplementation for prediabetic adults: study protocol for a randomized controlled trial. Trials. 2019 Dec;20:1-3.
- Madić V, Petrović A, Jušković M, et al. Polyherbal mixture ameliorates hyperglycemia, hyperlipidemia and histopathological changes of pancreas, kidney and liver in a rat model of type 1 diabetes. Journal of Ethnopharmacology. 2021 Jan 30;265:113210.
- 9. Alhamhoom Y, Ahmed SS, Salahuddin MD, et al. Synergistic antihyperglycemic and antihyperlipidemic effect of polyherbal and allopolyherbal formulation. Pharmaceuticals. 2023 Sep 27;16(10):1368.
- 10. Kale OE, Akinpelu OB, Bakare AA, et al. Five traditional Nigerian Polyherbal remedies protect against high fructose fed, Streptozotocin-induced type 2 diabetes in male Wistar rats. BMC complementary and alternative medicine. 2018 Dec;18:1-1.
- 11. Bhaskarrao PV, Singh CS, Vishal S. Novel antidiabetic polyherbal formulation for synergistic therapeutic effects in streptozotocin (stz)-induced diabetic rats. International Journal of Drug Delivery Technology. 2022;12(4):1612-7.
- Mishra R, Ray A, Singh A, et al.Development And Evaluation Of Anti Diabetic Activity In Polyherbal Tablets Of Local Herbs. Journal of Pharmaceutical Negative Results. 2023 Feb 1:1418-26.
- 13. Deore ND, Gupta S, Shrivastav B,et al. Anti-Diabetic potential of a polyherbal formulation-A review. Research Journal of Pharmacy and Technology. 2018;11(6):2625-30.
- 14. Ghorbani A, Zarvandi M, Rakhshandeh H. A randomized controlled trial of a herbal compound for improving metabolic parameters in diabetic patients with uncontrolled dyslipidemia. Endocrine, Metabolic & Immune Disorders-Drug Targets (Formerly Current Drug Targets-Immune, Endocrine & Metabolic Disorders). 2019 Nov 1;19(7):1075-82.
- 15.Rauf A, Akram M, Anwar H, et al. Therapeutic potential of herbal medicine for the management of hyperlipidemia: latest

updates. Environmental Science and Pollution Research. 2022 Jun;29(27):40281-301.

- 16. Rahman MM, Islam MR, Shohag S, et al. The multifunctional role of herbal products in the management of diabetes and obesity: a comprehensive review. Molecules. 2022 Mar 6;27(5):1713.
- 17.Kalpana CA, Abraham R. Anti-hyperglycemic activity of polyherbal formulation (Herbinsulplus) in experimental diabetes and its effects on key metabolic enzymes of carbohydrate metabolism. JOURNAL OF ADVANCED APPLIED SCIENTIFIC RESEARCH. 2021 Dec 15;3(6):12-20.
- Pande VB, Chandel SS, Soni V. Synergistic and Safe Antidiabetic Effect of Polyherbal Formulation: Comprehensive Overview. (2021). Int. J. Life Sci. Pharma Res.;11(2):P51-57.
- 19. Wen ZG, Zhang QQ, Zhang LL, et al. Efficacy and safety of traditional chinese medicine treatment for overweight and obese individuals: A systematic review and meta-analysis. Frontiers in Pharmacology. 2022 Oct 5;13:964495.
- 20. Haye A, Ansari MA, Saini A, Aet al. Polyherbal formulation improves glucose-lipid metabolism and prevent hepatotoxicity in streptozotocin-induced diabetic rats: Plausible role of IRS-PI3K-Akt-GLUT2 signaling. Pharmacognosy Magazine. 2022;18(77).
- 21.Kumar S, Mittal A, Babu D, Mittal A. Herbal medicines for diabetes management and its secondary complications. Current diabetes reviews. 2021 May 1;17(4):437-56.
- 22. Azeemuddin M, Anturlikar SD, Onkaramurthy M, et al. Effect of "DXB-2030," a Polyherbal Formulation, on Experimental Polycystic Ovary Syndrome Associated with Hyperandrogenism. Advances in Pharmacological and Pharmaceutical Sciences. 2019;2019(1):8272850.
- 23.Pang GM, Li FX, Yan Y, et al. Herbal medicine in the treatment of patients with type 2 diabetes mellitus. Chinese medical journal. 2019 Jan 5;132(1):78-85.
- 24. Aziz N, Wal P, Wal A, et al. Evaluation of a polyherbal powder for treatment of Diabetes Mellitus. Indian Journal of Pharmaceutical Sciences. 2019 Nov 1;81(6):1070-7.
- 25.Tague ED, Bourdon AK, MacDonald A, et al.Metabolomics approach in the study of the well-defined Polyherbal preparation Zyflamend. Journal of medicinal food. 2018 Mar 1;21(3):306-16.
- 26.Ibrahim SI, Kabir N, Ibrahim DG, et al. Complementary Therapeutic Effect of Polyherbal Supplement (Gasca D[™]) on Newly Diagnosed Type 2 Diabetic Patients on Lifestyle Modification: A Randomised Cohort Clinical Trial. Journal of Phytomedicine and Therapeutics. 2021 Aug 23;20(1):518-28.
- 27. Shah SS, Manigauha A, Dubey B. Formulation and Evaluation of Antidiabetic and Antihyperlipidemic Activities of Polyherbal Formulation in Streptozotocin induced diabetic rat. Pharmaceutical and Biosciences Journal. 2019 Jan 22:26-30.
- 28. Pandeya PR, Lamichhane R, Lamichhane G, et al. 18KHT01, a potent anti-obesity polyherbal formulation. Frontiers in Pharmacology. 2021 Dec 17;12:807081.
- 29. Siddiqui SA, Khan S, Wani SA. Controlling diabetes with the aid of medicinal herbs: A critical compilation of a decade of research. Critical Reviews in Food Science and Nutrition. 2023 Dec 20;63(33):12552-66.
- 30. Nanjappan S, Paul D, Bolla L. Assessing herb–drug interactions of herbal products with therapeutic agents for metabolic diseases: analytical and regulatory perspectives. Studies in natural products chemistry. 2018 Jan 1;59:283-322.

- 31. Jacob B, Narendhirakannan RT, Nadar MM, et al. Mineral composition, phytochemical analysis, anti-oxidant and antidiabetic activities of a polyherbal formulation-an in vitro approach. Chemical Data Collections. 2022 Jun 1;39:100874.
- 32. Pal RS, Saraswat N, Pal Y, et al. Alcoholic Extract of Poly Herbal Powder Mixture for Anti-Obesity effect on Wistar Rats. Research Journal of Pharmacy and Technology. 2019;12(4):1857-64.
- 33. Abinaya R, Peter SJ, Shalini M, Sabina EP. Prevalence of Diabetes mellitus and herbal medication. Journal of Pharmaceutical Sciences and Research. 2020 May 1;12(5):720-9.
- 34. Remya E, Goyal M, Varsakiya J. Efficacy of Sharapunkhadi powder (a polyherbal formulation) and lifestyle modification in the management of nonalcoholic fatty liver disease-A randomized placebo-controlled clinical trial. AYU (An International Quarterly Journal of Research in Ayurveda). 2020 Apr 1;41(2):98-106.
- 35. Alkhatib DH, Jaleel A, Tariq MN, et al. The role of bioactive compounds from dietary spices in the management of metabolic syndrome: an overview. Nutrients. 2021 Dec 30;14(1):175.
- 36. Thota RN, Paruchuru D, Naik R, et al. Effect of polyherbal formulation on metabolic derangements in experimental model of high fructose diet induced metabolic syndrome. Int J Appl Biol Pharm Technol. 2019;5(3).
- 37. Sung YY, Kim DS, Choi G, et al. Dohaekseunggi-tang extract inhibits obesity, hyperlipidemia, and hypertension in high-fat diet-induced obese mice. BMC Complement Altern Med. 2020;14(1):372.
- 38.Li CB, Li XX, Chen YG, et al. HuangLian-Jie-Du-Tang protects rats from cardiac damages induced by metabolic disorder by improving inflammation-mediated insulin resistance. PLoS ONE. 2021;8(6)
- 39. Kho MC, Lee YJ, Park JH, et al. Combination with red ginseng and PolygoniMultiflori ameliorates high-fructose diet induced metabolic syndrome. BMC Complement Altern Med. 2022;16:98.
- 40. Renganathan S, Srivastava A, Pillai RG. Dhanwantaramkashayam, an ayurvedic polyherbal formulation, reduces oxidative radicals and reverts lipids profile towards normal in diabetic rats. Biochemistry and biophysics Reports, 2020; 22 100755.
- 41. Wang TZ, Chen Y, He YM, et al. Effects of Chinese Herbal Medicine YiqiHuajuQingli Formula in Metabolic Syndrome Patients with Microalbuminuria: a Randomized Placebo-Controlled Trial. J Integr Med. 2022;11(3):175-83.
- 42. Farajbakhsh A, Mazloomi SM, Mazidi M, et al. Sesame Oil and Vitamin E Co-administration May Improve Cardiometabolic Risk Factors in Patients with Metabolic Syndrome: a Randomized Clinical Trial. Eur J Clin Nutr. 2024;73(10):1403-11.

- 43. Amin F, Islam N, Anila N, et al. Clinical Efficacy of the Coadministration of Turmeric and Black Seeds (Kalongi) in Metabolic Syndrome - a Double Blind Randomized Controlled Trial - TAK-MetS Trial. Complement Ther Med. 2021;23(2):165-74.
- 44. Yadav D, Tiwari A, Mishra M, et al. Anti-hyperglycemic and Anti-hyperlipidemic Potential of a Polyherbal Preparation "Diabegon" in Metabolic Syndrome Subject with Type 2 Diabetes. Afr J Tradit Complement Altern Med. 2019;11(2):249-56.
- 45.Ladde SS, Bhusnure OG. Evaluation of the hypolipidemic activity of polyherbal formulation through In-vivo and Insilico studies. Int J Health Sci. 2024;III:9831-51.
- 46.Singh AK, Kumar P, Rajput VD, et al. Phytochemicals, antioxidant, anti-inflammatory studies, and identification of bioactive compounds using GC–MS of ethanolic novel polyherbal extract. Applied Biochemistry and Biotechnology. 2023 Jul;195(7):4447-68.
- 47. Jha SK, Pawar AS. Comprehensive study on reported medicinal plants with antidiabetic activity and various Antidiabetic polyherbal formulations.
- 48. Wang Y, Liu Z, Li C, et al. Drug target prediction based on the herbs components: the study on the multitargets pharmacological mechanism of qishenkeli acting on the coronary heart disease. Evidence-based Complementary and Alternative Medicine. 2012;2012(1):698531.
- 49. Ahmed LA, Ramadan RS, Mohamed RA. Biochemical and histopathological studies on the water extracts of marjoram and chicory herbs and their mixture in obese rats. Pak J Nutr. 2009 Dec 2;8(10):1581-7.
- 50. Alcántara M, Serra-Aracil X, Falcó J, et al. Prospective, controlled, randomized study of intraoperative colonic lavage versus stent placement in obstructive left-sided colonic cancer. World journal of surgery. 2011 Aug;35:1904-10.
- 51. Castellino G, Nikolic D, Magán-Fernández A, et al. Altilix[®] supplement containing chlorogenic acid and luteolin improved hepatic and cardiometabolic parameters in subjects with metabolic syndrome: A 6 month randomized, double-blind, placebo-controlled study. Nutrients. 2019 Oct 25;11(11):2580.
- 52. Mounts L, Sunkara R, Shackelford L, et al. Feeding soy with probiotic attenuates obesity-related metabolic syndrome traits in obese Zucker rats. Food and Nutrition Sciences. 2015;6(09):780
- 53. Panahi Y, Hosseini MS, Khalili N, et al. Antioxidant and antiinflammatory effects of curcuminoid-piperine combination in subjects with metabolic syndrome: a randomized controlled trial and an updated meta-analysis. Clinical nutrition. 2015 Dec 1;34(6):1101-8.t

Orcid ID:

Vivek Ranjan Patel - https://orcid.org/0009-0003-0137-3896 Akshay Kumar Gupta - https://orcid.org/0009-0005-1557-3738 Shubham Saini - https://orcid.org/0009-0001-1302-3434 Richa Dwivedi - https://orcid.org/0009-0002-1504-8181 Farhat Aziz - https://orcid.org/0009-0002-5525-5513