Research Output Journal of Engineering and Scientific Research 4(3): 77-83, 2025

ROJESR Publications Online ISSN: 1115-9790

https://rojournals.org/roj-engineering-and-scientific-research/ Print ISSN: 1115-6155

https://doi.org/10.59298/ROJESR/2025/4.3.7783

Plant-Derived Polyphenols in the Management of Obesity and Type 2 Diabetes: Mechanisms and Clinical Evidence

Kagambira Zimbuga M.

Faculty of Medicine Kampala International University Uganda

ABSTRACT

Obesity and type 2 diabetes mellitus (T2DM) are major public health concerns characterized by metabolic dysregulation, chronic inflammation, and insulin resistance. Plant-derived polyphenols, a diverse group of bioactive compounds found in fruits, vegetables, and medicinal plants, have garnered attention for their potential in mitigating these conditions. This review explores the mechanistic roles of polyphenols in modulating insulin sensitivity, lipid metabolism, and inflammation, with a focus on preclinical and clinical evidence. Key polyphenolic compounds such as flavonoids, phenolic acids, stilbenes, and lignans exhibit anti-obesity and anti-diabetic properties by activating AMPK, modulating gut microbiota, inhibiting adipogenesis, and reducing oxidative stress. We discuss polyphenol-rich plant sources, their bioavailability challenges, and translational potential in clinical settings. Emerging research underscores their therapeutic promise, yet further well-designed clinical trials are necessary to establish standardized recommendations for their use in obesity and diabetes management.

Keywords: Polyphenols, Obesity, Type 2 Diabetes, Insulin Sensitivity, Lipid Metabolism, Inflammation, Medicinal Plants

INTRODUCTION

Obesity and type 2 diabetes mellitus (T2DM) have reached alarming epidemic proportions worldwide, driven largely by modern sedentary lifestyles and the widespread consumption of high-calorie, nutrient-poor diets[1–3]. These metabolic disorders are deeply interconnected, with obesity serving as a significant risk factor for insulin resistance, which ultimately contributes to the onset and progression of diabetes[4–6]. The increasing prevalence of obesity and T2DM has placed a substantial burden on healthcare systems, necessitating the development of effective prevention and treatment strategies. Despite advances in medical science, managing these conditions remains challenging due to their multifactorial nature, which involves complex interactions between genetic, environmental, and behavioral factors. Therefore, addressing these metabolic disorders requires a multifaceted approach that integrates lifestyle modifications, pharmacological interventions, and alternative therapeutic options.

Current pharmacological treatments for obesity and T2DM, including metformin, sodium-glucose cotransporter-2 (SGLT2) inhibitors, and glucagon-like peptide-1 (GLP-1) receptor agonists, have demonstrated efficacy in improving glycemic control and promoting weight loss[7, 8]. However, these medications are often associated with various limitations, including gastrointestinal side effects, high costs, and challenges related to long-term adherence. Additionally, while pharmacotherapy provides symptomatic relief, it does not always address the underlying pathophysiological mechanisms driving obesity and diabetes. As a result, there has been growing interest in exploring alternative and complementary therapeutic approaches that are safer, more accessible, and potentially beneficial for long-term metabolic health. Natural bioactive compounds derived from plants, particularly polyphenols, have gained attention for their ability to modulate key metabolic pathways involved in glucose and lipid homeostasis[9].

Polyphenols, a diverse group of naturally occurring compounds found in fruits, vegetables, tea, coffee, and other plant-based foods, have been widely studied for their antioxidant, anti-inflammatory, and insulin-sensitizing properties[9, 10]. These compounds exert beneficial effects by targeting multiple molecular pathways, including the regulation of adipogenesis, enhancement of insulin signaling, and modulation of gut microbiota composition. Moreover, polyphenols have been shown to influence energy metabolism by activating key regulators such as AMP-activated protein kinase (AMPK) and peroxisome proliferator-activated receptors (PPARs), which play critical roles in glucose and lipid metabolism. Given their pleiotropic health benefits, polyphenols represent promising candidates for complementary therapies in obesity and diabetes management[11]. This review explores the mechanisms by which polyphenols influence metabolic regulation and discusses their potential applications in mitigating the burden of obesity and T2DM.

Polyphenols: Classification and Sources

Polyphenols are a diverse class of naturally occurring compounds found in plants, which have gained significant attention due to their potential health benefits[12–14]. They are primarily categorized into four main groups: flavonoids, phenolic acids, stilbenes, and lignans[14]. Each group exhibits distinct chemical structures and biological properties, contributing to various health-promoting effects, particularly in metabolic health. Flavonoids, the largest and most studied group, are widely distributed in plant-based foods, including tea, citrus fruits, and berries[15, 16]. They include well-known compounds such as quercetin, catechins, and anthocyanins, which possess strong antioxidant and anti-inflammatory properties[17, 18]. These bioactive molecules help combat oxidative stress, reduce inflammation, and improve endothelial function, which are critical factors in preventing cardiovascular diseases and metabolic disorders. Additionally, flavonoids play a role in modulating gut microbiota, enhancing beneficial bacterial populations, and thereby improving gut health and metabolic homeostasis[19]. Their presence in daily diets has been associated with reduced risks of obesity, diabetes, and other metabolic syndromes.

Phenolic acids represent another important class of polyphenols, predominantly found in coffee, whole grains, and vegetables[20]. These compounds, including ferulic acid and chlorogenic acid, are known for their potent antioxidant capabilities, which help neutralize free radicals and protect against cellular damage. Chlorogenic acid, for instance, is abundant in coffee and has been linked to improved glucose metabolism and weight management by modulating insulin sensitivity and lipid metabolism[21]. Ferulic acid, on the other hand, has demonstrated protective effects on the cardiovascular system by reducing arterial stiffness and lowering blood pressure. The bioavailability of phenolic acids varies depending on food processing and individual metabolic differences, but their consumption has consistently been linked to lower risks of chronic diseases such as type 2 diabetes, hypertension, and neurodegenerative disorders. Additionally, these compounds exert anti-inflammatory effects by modulating key signaling pathways involved in immune responses, further emphasizing their role in maintaining metabolic balance and overall health.[22]

Stilbenes, although less common in the diet compared to flavonoids and phenolic acids, have gained attention due to their presence in grapes and red wine, particularly resveratrol[23]. Resveratrol is one of the most extensively studied polyphenols due to its potential role in promoting longevity and preventing age-related diseases[24]. It functions as a powerful antioxidant, mitigating oxidative damage and reducing the risk of cardiovascular diseases by improving vascular function and lowering LDL cholesterol levels. Furthermore, resveratrol has been found to activate sirtuins, a family of proteins involved in cellular stress responses and metabolic regulation[25]. This activation is thought to contribute to its potential anti-aging properties and ability to improve insulin sensitivity, making it a promising compound for managing obesity and diabetes. Some studies have even suggested that resveratrol mimics the effects of caloric restriction, a well-known strategy for extending lifespan and improving metabolic health[24]. However, despite its promising effects, the low bioavailability of resveratrol in the human body presents a challenge for its widespread therapeutic use, necessitating further research into effective delivery methods and dietary sources that enhance its absorption.

Lignans, another significant group of polyphenols, are predominantly found in flaxseeds, sesame seeds, and whole grains[26]. These compounds, such as secoisolariciresinol, are unique in their ability to act as phytoestrogens, meaning they can mimic or modulate estrogen activity in the body. This property makes lignans particularly beneficial for hormonal balance, especially in postmenopausal women, where they may help reduce the risk of hormone-related conditions such as breast cancer and osteoporosis[26]. In addition to their estrogenic effects, lignans exhibit strong antioxidant and anti-inflammatory properties, contributing to cardiovascular health by reducing blood pressure and improving lipid profiles. They also play a crucial role in gut health, as they are metabolized by gut microbiota into enterolignans, which further exert beneficial effects on metabolism and immune function[27]. The inclusion of lignan-rich foods in the diet has been associated with improved metabolic health, lower risks of certain cancers, and enhanced overall well-being. Collectively, the four main groups of polyphenols provide a wide range of protective effects that underscore the importance of a plant-rich diet in promoting long-term health and preventing chronic diseases.

Mechanisms of Action in Obesity and T2DM Management

Polyphenols, bioactive compounds found abundantly in plants, have been the subject of growing interest for their potential to modulate insulin sensitivity, lipid metabolism, inflammation, and oxidative stress, particularly in the context of obesity and diabetes. In terms of improving insulin sensitivity, polyphenols have been shown to enhance the body's ability to regulate blood glucose levels[28]. One primary mechanism is the activation of

AMP-activated protein kinase (AMPK), a key metabolic sensor in cells that regulates energy balance. When activated by polyphenols, AMPK stimulates glucose uptake into tissues such as muscle and liver, thereby improving insulin sensitivity and helping to maintain proper blood glucose levels. Additionally, polyphenols enhance the activity of insulin receptor substrates (IRS), which play a pivotal role in insulin signaling[29]. This action ensures better cellular responsiveness to insulin, facilitating glucose transport and metabolism. Moreover, polyphenols protect pancreatic β-cells, which are responsible for insulin production, by reducing endoplasmic reticulum (ER) stress and mitigating oxidative damage [29]. ER stress is often associated with the dysfunction of β-cells, leading to impaired insulin secretion, while oxidative stress contributes to β-cell apoptosis, a factor in the progression of type 2 diabetes[30, 31]. By addressing these stressors, polyphenols help preserve β-cell function and improve overall insulin secretion.

In addition to improving insulin sensitivity, polyphenols also play a critical role in the regulation of lipid metabolism, a key factor in managing obesity and metabolic disorders[31]. Polyphenols exhibit potent anti-obesity effects through several mechanisms, including the inhibition of lipogenesis, the process of fat cell formation and lipid accumulation[32]. One of the key targets for polyphenols is the sterol regulatory element-binding proteins (SREBPs), which are transcription factors involved in the regulation of lipid biosynthesis. Polyphenols have been shown to downregulate SREBP activity, thereby reducing the synthesis of lipids and limiting excessive fat storage[32]. Furthermore, polyphenols promote fatty acid oxidation, a process that breaks down fatty acids to produce energy. This is achieved through the activation of peroxisome proliferator-activated receptor alpha (PPAR-α), a nuclear receptor that regulates the expression of genes involved in fatty acid oxidation. By stimulating PPAR-α, polyphenols enhance the body's ability to burn fat, contributing to weight management and a reduction in adiposity. Additionally, polyphenols have been found to modulate the gut microbiota, promoting the growth of beneficial bacteria and reducing harmful microbes[32]. This shift in the gut microbiome is thought to reduce systemic inflammation and adiposity, further aiding in the prevention and management of obesity-related conditions, such as type 2 diabetes.

The anti-inflammatory and antioxidant properties of polyphenols are central to their ability to combat chronic diseases like obesity and diabetes[14]. Chronic low-grade inflammation is a hallmark of both conditions, contributing to insulin resistance, metabolic dysfunction, and complications such as cardiovascular disease. Polyphenols exert anti-inflammatory effects by suppressing the activation of nuclear factor kappa B (NF-κB), a critical transcription factor that regulates the expression of pro-inflammatory cytokines, including tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6). These cytokines are involved in the inflammatory response and are often elevated in individuals with obesity and insulin resistance. By inhibiting NF-κB activation, polyphenols help to reduce the production of these pro-inflammatory markers, thereby alleviating chronic inflammation. Moreover, polyphenols enhance the activity of antioxidant enzymes such as superoxide dismutase (SOD) and glutathione peroxidase (GPx), which play crucial roles in neutralizing harmful reactive oxygen species (ROS) and maintaining cellular redox balance[33]. By boosting the activity of these enzymes, polyphenols help to reduce oxidative stress, which is closely linked to inflammation and the development of insulin resistance. Furthermore, polyphenols themselves act as potent antioxidants by scavenging free radicals, thus protecting cells from oxidative damage and mitigating the negative effects of oxidative stress on metabolic function.

Collectively, the modulation of insulin sensitivity, regulation of lipid metabolism, and anti-inflammatory and antioxidant effects of polyphenols make them powerful dietary components in the prevention and management of obesity, type 2 diabetes, and related metabolic disorders. Their ability to influence key metabolic pathways, such as glucose uptake, lipid synthesis, and fatty acid oxidation, provides a multifaceted approach to improving metabolic health. Additionally, their capacity to reduce inflammation and oxidative stress further supports their role in promoting long-term health and preventing the chronic complications associated with these conditions. As research continues to uncover the molecular mechanisms behind the effects of polyphenols, these compounds may become integral in the development of functional foods and therapeutic strategies aimed at addressing the growing global burden of obesity and diabetes.

Clinical Evidence on Polyphenols in Obesity and Diabetes Management

Epidemiological and Human Trials

Several clinical studies have provided strong evidence of the metabolic benefits of polyphenolic compounds in the management of type 2 diabetes mellitus (T2DM) and related metabolic disorders[34]. One such compound, resveratrol, has gained attention for its potential to improve insulin sensitivity and reduce fasting glucose levels in individuals with T2DM[35]. Resveratrol, a polyphenol found in red wine and grapes, works through several mechanisms, including the activation of sirtuins, which enhance cellular energy metabolism and insulin sensitivity[35]. In clinical trials, resveratrol supplementation has been shown to reduce fasting blood glucose and improve insulin resistance, making it a promising candidate for diabetes management[36]. Another well-researched polyphenol, epigallocatechin gallate (EGCG), found abundantly in green tea, has also shown significant metabolic benefits. EGCG has been linked to weight loss and improved glucose regulation, as it activates thermogenesis and fat oxidation pathways[37]. Clinical studies have confirmed that EGCG helps in reducing body fat and improves insulin sensitivity, which could be beneficial for individuals with obesity or prediabetes. Similarly, curcumin, the active component of turmeric, has demonstrated potential in glycemic control. Several studies have highlighted curcumin's ability to reduce blood glucose and improve insulin resistance in prediabetic individuals, suggesting its therapeutic role in the prevention of T2DM[38]. Moreover, anthocyanins, found in various fruits such as berries, have been shown to enhance the levels of adiponectin, a hormone that promotes lipid metabolism. Increased adiponectin levels are associated with improved insulin sensitivity and reduced inflammation, which are critical factors in managing obesity and metabolic disorders[39].

Challenges in Clinical Translation

Despite the promising metabolic benefits observed in various clinical trials, there are still several challenges in translating these findings into widespread clinical practice. One of the primary concerns is the bioavailability of polyphenolic compounds. Many polyphenols, including resveratrol and EGCG, have low bioavailability due to their poor absorption in the gastrointestinal tract and rapid metabolism in the liver. This significantly limits their effectiveness when administered orally, as only a small fraction of the active compounds reach the bloodstream in sufficient quantities to exert therapeutic effects. While various strategies, such as nanoencapsulation or the development of more bioavailable derivatives, are being explored, bioavailability remains a key barrier to the clinical success of polyphenol-based therapies. Furthermore, interindividual variability poses another challenge in the clinical translation of these polyphenols. Differences in genetic makeup, gut microbiome composition, and metabolic rates among individuals can result in varying responses to polyphenol interventions. For example, some individuals may metabolize certain polyphenols more efficiently, while others may have poor absorption or experience minimal effects. This variability complicates the identification of specific patient populations who would benefit the most from polyphenol supplementation. It also highlights the need for personalized approaches in the administration of polyphenolic compounds.

Additionally, there is a lack of standardization and dosage guidelines for the use of polyphenols in clinical settings. While numerous studies have examined the effects of polyphenols, there is no consensus on the optimal dosage, duration of supplementation, or the best form of administration. This variability in experimental protocols makes it difficult to draw definitive conclusions about the effectiveness of specific polyphenols. For instance, the dosage of resveratrol used in human studies has ranged from low (100 mg per day) to high (1000 mg per day), with differing outcomes, indicating that the therapeutic window for each compound is still unclear. Without standardized protocols, it is challenging to design large-scale clinical trials or recommend specific doses for therapeutic use. Furthermore, the interactions between polyphenols and other medications or treatments are not well understood, which raises concerns about their safety and efficacy when used alongside conventional therapies for metabolic diseases. Therefore, overcoming these challenges will require a more detailed understanding of the pharmacokinetics, optimal dosing strategies, and patient-specific factors that influence the effectiveness of polyphenolic compounds.

In sum, while polyphenols like resveratrol, EGCG, curcumin, and anthocyanins show promise in improving metabolic health and managing conditions like T2DM, there are significant obstacles to their clinical implementation. Addressing issues such as bioavailability, interindividual variability, and standardization of dosages will be crucial for realizing the full potential of these compounds in the treatment of metabolic disorders. As research continues to explore innovative methods of enhancing polyphenol delivery and personalized treatment approaches, these compounds may eventually become a valuable part of therapeutic strategies for managing diabetes and other metabolic diseases.

Future Directions

Advancing polyphenol research requires multifaceted approaches to optimize their therapeutic potential and enhance their clinical application. One critical area of development is the improvement of formulations. Polyphenols, despite their wide-ranging health benefits, often face limitations in bioavailability, which hinders their effectiveness. To overcome this challenge, researchers are exploring advanced strategies such as nanoencapsulation, where polyphenols are encapsulated in nanoparticles to protect them from degradation and improve absorption in the body. Additionally, synergistic formulations combining polyphenols with other bioactive compounds may enhance their efficacy by promoting better absorption or by targeting multiple pathways simultaneously.

Another vital aspect is the need for comprehensive clinical trials. While polyphenols show promising results in preclinical studies and small-scale human trials, larger, well-designed studies are necessary to establish their true clinical efficacy. Large-scale, placebo-controlled trials with diverse populations are essential to understand the optimal dosages, treatment durations, and potential side effects. These studies will help determine the most effective polyphenol interventions for managing conditions such as obesity and diabetes and provide a more robust evidence base for their integration into mainstream therapies. Furthermore, the future of polyphenol research must consider personalized nutrition approaches. Individuals vary in their genetic makeup, metabolic profiles, and responses to dietary interventions, which means that one-size-fits-all approaches may not be the most effective. By tailoring polyphenol interventions based on a person's genetic predispositions, gut microbiota composition, and metabolic characteristics, researchers can develop more precise and individualized treatment plans. This personalized approach would maximize the health benefits of polyphenols, particularly in managing complex conditions like obesity and diabetes.

CONCLUSION

Plant-derived polyphenols represent a promising complementary approach to managing obesity and diabetes through their diverse biological activities, including the modulation of insulin sensitivity, lipid metabolism, and inflammation. The current body of evidence is compelling, but more research is needed to refine dosage recommendations and address the challenges associated with bioavailability to ensure these compounds can be effectively utilized in clinical practice. With continued advancements in formulation techniques, clinical trials, and personalized interventions, polyphenols could become a cornerstone of dietary strategies for metabolic disease management.

REFERENCES

1. Annett, S., Moore, G., Robson, T.: Obesity and Cancer Metastasis: Molecular and Translational Perspectives. Cancers. 12, 3798 (2020). https://doi.org/10.3390/cancers12123798
2. Alum, E.U.: Optimizing patient education for sustainable self-management in type 2 diabetes. Discov. Public Health. 22, 44 (2025). https://doi.org/10.1186/s12982-025-00445-5
3. Uti, D.E., Atangwho, I.J., Omang, W.A., Alum, E.U., Obeten, U.N., Udeozor, P.A., Agada, S.A., Bawa, I., Ogbu, C.O.: Cytokines as key players in obesity low grade inflammation and related complications. Obes. Med. 54, 100585 (2025). https://doi.org/10.1016/j.obmed.2025.100585
4. Ashour, M.M., Mabrouk, M., Aboelnasr, M.A., Beherei, H.H., Tohamy, K.M., Das, D.B.: Anti-Obesity Drug Delivery Systems: Recent Progress and Challenges. Pharmaceutics. 15, 2635 (2023). https://doi.org/10.3390/pharmaceutics15112635
5. Bays, H.E., Fitch, A., Christensen, S., Burridge, K., Tondt, J.: Anti-Obesity Medications and Investigational Agents: An Obesity Medicine Association (OMA) Clinical Practice Statement (CPS) 2022. Obes. Pillars. 2, 100018 (2022). https://doi.org/10.1016/j.obpill.2022.100018
6. Barbieri, J., Fontela, P.C., Winkelmann, E.R., Zimmermann, C.E.P., Sandri, Y.P., Mallet, E.K.V., Frizzo, M.N.: Anemia in Patients with Type 2 Diabetes Mellitus. Anemia. 2015, 354737 (2015). https://doi.org/10.1155/2015/354737
7. Alum, E.U., Krishnamoorthy, R., Gatasheh, M.K., Subbarayan, S., Vijayalakshmi, P., Uti, D.E.: Protective Role of Jimson Weed in Mitigating Dyslipidemia, Cardiovascular, and Renal Dysfunction in Diabetic Rat Models: In Vivo and in Silico Evidence. Nat. Prod. Commun. 19, 1934578X241299279 (2024). https://doi.org/10.1177/1934578X241299279
8. Alum, E.U., Umoru, G.U., Uti, D.E., Aja, P.M., Ugwu, O.P., Orji, O.U., Nwali, B.U., Ezeani, N.N., Edwin, N., Orinya, F.O.: Hepato-Protective Effect Of Ethanol Leaf Extract Of Datura stramonium in Alloxan-Induced Diabetic Albino Rats. J. Chem. Soc. Niger. 47, (2022). https://doi.org/10.46602/jcsn.v47i5.819
9. Uti, D.E., Atangwho, I.J., Alum, E.U., Egba, S.I., Ugwu, O.P.-C., Ikechukwu, G.C.: Natural Antidiabetic Agents: Current Evidence and Development Pathways from Medicinal Plants to Clinical use. Nat. Prod. Commun. 20, 1934578X251323393 (2025). https://doi.org/10.1177/1934578X251323393
10. Chaudhury, A., Duvoor, C., Reddy Dendi, V.S., Kraleti, S., Chada, A., Ravilla, R., Marco, A., Shekhawat, N.S., Montales, M.T., Kuriakose, K., Sasapu, A., Beebe, A., Patil, N., Musham, C.K., Lohani, G.P., Mirza, W.: Clinical Review of Antidiabetic Drugs: Implications for Type 2 Diabetes Mellitus Management. Front. Endocrinol. 8, (2017). https://doi.org/10.3389/fendo.2017.00006
11. Rahman, Md.M., Dhar, P.S., Sumaia, Anika, F., Ahmed, L., Islam, Md.R., Sultana, N.A., Cavalu, S., Pop, O., Rauf, A.: Exploring the plant-derived bioactive substances as antidiabetic agent: An extensive review. Biomed. Pharmacother. 152, 113217 (2022). https://doi.org/10.1016/j.biopha.2022.113217
12. Alami, M., Boumezough, K., Zerif, E., Zoubdane, N., Khalil, A., Bunt, T., Laurent, B., Witkowski, J.M., Ramassamy, C., Boulbaroud, S., Fulop, T., Berrougui, H.: In Vitro Assessment of the Neuroprotective Effects of Pomegranate (Punica granatum L.) Polyphenols Against Tau Phosphorylation, Neuroinflammation, and Oxidative Stress. Nutrients. 16, 3667 (2024). https://doi.org/10.3390/nu16213667
13. Bié, J., Sepodes, B., Fernandes, P.C.B., Ribeiro, M.H.L.: Polyphenols in Health and Disease: Gut Microbiota, Bioaccessibility, and Bioavailability. Compounds. 3, 40–72 (2023). https://doi.org/10.3390/compounds3010005
14. Jin, Q., Liu, T., Qiao, Y., Liu, D., Yang, L., Mao, H., Ma, F., Wang, Y., Peng, L., Zhan, Y.: Oxidative stress and inflammation in diabetic nephropathy: role of polyphenols. Front. Immunol. 14, 1185317 (2023). https://doi.org/10.3389/fimmu.2023.1185317

15. AL-Ishaq, R.K., Abotaleb, M., Kubatka, P., Kajo, K., Büsselberg, D.: Flavonoids and Their Anti-Diabetic Effects: Cellular Mechanisms and Effects to Improve Blood Sugar Levels. Biomolecules. 9, 430 (2019). https://doi.org/10.3390/biom9090430
16. Kondža, M., Brizić, I., Jokić, S.: Flavonoids as CYP3A4 Inhibitors In Vitro. Biomedicines. 12, 644 (2024). https://doi.org/10.3390/biomedicines12030644
17. Sandoval, V., Sanz-Lamora, H., Arias, G., Marrero, P.F., Haro, D., Relat, J.: Metabolic Impact of Flavonoids Consumption in Obesity: From Central to Peripheral. Nutrients. 12, 2393 (2020). https://doi.org/10.3390/nu12082393
18. Mahboob, A., Samuel, S.M., Mohamed, A., Wani, M.Y., Ghorbel, S., Miled, N., Büsselberg, D., Chaari, A.: Role of flavonoids in controlling obesity: molecular targets and mechanisms. Front. Nutr. 10, (2023). https://doi.org/10.3389/fnut.2023.1177897
19. Thompson, A.S., Jennings, A., Bondonno, N.P., Tresserra-Rimbau, A., Parmenter, B.H., Hill, C., Perez-Cornago, A., Kühn, T., Cassidy, A.: Higher habitual intakes of flavonoids and flavonoid-rich foods are associated with a lower incidence of type 2 diabetes in the UK Biobank cohort. Nutr. Diabetes. 14, 32 (2024). https://doi.org/10.1038/s41387-024-00288-0
20. Sarkar, D., Christopher, A., Shetty, K.: Phenolic Bioactives From Plant-Based Foods for Glycemic Control. Front. Endocrinol. 12, (2022). https://doi.org/10.3389/fendo.2021.727503
21. Kanchanasurakit, S., Saokaew, S., Phisalprapa, P., Duangjai, A.: Chlorogenic acid in green bean coffee on body weight: a systematic review and meta-analysis of randomized controlled trials. Syst. Rev. 12, 163 (2023). https://doi.org/10.1186/s13643-023-02311-4
22. Nguyen, V., Taine, E.G., Meng, D., Cui, T., Tan, W.: Chlorogenic Acid: A Systematic Review on the Biological Functions, Mechanistic Actions, and Therapeutic Potentials. Nutrients. 16, 924 (2024). https://doi.org/10.3390/nu16070924
23. Koh, Y.-C., Lin, S.-J., Hsu, K.-Y., Nagabhushanam, K., Ho, C.-T., Pan, M.-H.: Pterostilbene Enhances Thermogenesis and Mitochondrial Biogenesis by Activating the SIRT1/PGC-1α/SIRT3 Pathway to Prevent Western Diet-Induced Obesity. Mol. Nutr. Food Res. 67, e2300370 (2023). https://doi.org/10.1002/mnfr.202300370
24. Li, Z., Zhang, Z., Ke, L., Sun, Y., Li, W., Feng, X., Zhu, W., Chen, S.: Resveratrol promotes white adipocytes browning and improves metabolic disorders in Sirt1-dependent manner in mice. FASEB J. Off. Publ. Fed. Am. Soc. Exp. Biol. 34, 4527–4539 (2020). https://doi.org/10.1096/fj.201902222R
25. Balata, G., Eassa, E., Shamrool, H., Zidan, S., Abdo Rehab, M.: Self-emulsifying drug delivery systems as a tool to improve solubility and bioavailability of resveratrol. Drug Des. Devel. Ther. 117 (2016). https://doi.org/10.2147/DDDT.S95905
26. Rodríguez-García, C., Sánchez-Quesada, C., Toledo, E., Delgado-Rodríguez, M., Gaforio, J.J.: Naturally Lignan-Rich Foods: A Dietary Tool for Health Promotion? Molecules. 24, 917 (2019). https://doi.org/10.3390/molecules24050917
27. Berenshtein, L., Okun, Z., Shpigelman, A.: Stability and Bioaccessibility of Lignans in Food Products. ACS Omega. 9, 2022–2031 (2024). https://doi.org/10.1021/acsomega.3c07636
28. Krawczyk, M., Burzynska-Pedziwiatr, I., Wozniak, L.A., Bukowiecka-Matusiak, M.: Impact of Polyphenols on Inflammatory and Oxidative Stress Factors in Diabetes Mellitus: Nutritional Antioxidants and Their Application in Improving Antidiabetic Therapy. Biomolecules. 13, 1402 (2023). https://doi.org/10.3390/biom13091402
29. Mamun, M.A.A., Rakib, A., Mandal, M., Kumar, S., Singla, B., Singh, U.P.: Polyphenols: Role in Modulating Immune Function and Obesity. Biomolecules. 14, 221 (2024). https://doi.org/10.3390/biom14020221
30. Ghanbari, A., Jalili, C., Shahveisi, K., Akhshi, N.: Harmine exhibits anti-apoptotic properties and reduces diabetes-induced testicular damage caused by streptozotocin in rats. Clin. Exp. Reprod. Med. 51, 324–333 (2024). https://doi.org/10.5653/cerm.2023.06254
31. Kulkarni, A., Muralidharan, C., May, S.C., Tersey, S.A., Mirmira, R.G.: Inside the β Cell: Molecular Stress Response Pathways in Diabetes Pathogenesis. Endocrinology. 164, bqac184 (2022). https://doi.org/10.1210/endocr/bqac184
32. Aloo, S.O., Barathikannan, K., Oh, D.-H.: Polyphenol-rich fermented hempseed ethanol extracts improve obesity, oxidative stress, and neural health in high-glucose diet-induced *Caenorhabditis elegans*. Food Chem. X. 21, 101233 (2024). https://doi.org/10.1016/j.fochx.2024.101233
33. Bešlo, D., Golubić, N., Rastija, V., Agić, D., Karnaš, M., Šubarić, D., Lučić, B.: Antioxidant Activity, Metabolism, and Bioavailability of Polyphenols in the Diet of Animals. Antioxidants. 12, 1141 (2023). https://doi.org/10.3390/antiox12061141
34. González, I., Lindner, C., Schneider, I., Diaz, E., Morales, M.A., Rojas, A.: Emerging and multifaceted potential contributions of polyphenols in the management of type 2 diabetes mellitus. World J. Diabetes. 15, 154–169 (2024). https://doi.org/10.4239/wjd.v15.i2.154

35. Zhu, X., Wu, C., Qiu, S., Yuan, X., Li, L.: Effects of resveratrol on glucose control and insulin sensitivity in subjects with type 2 diabetes: systematic review and meta-analysis. Nutr. Metab. 14, 60 (2017). https://doi.org/10.1186/s12986-017-0217-z
36. Mahjabeen, W., Khan, D.A., Mirza, S.A.: Role of resveratrol supplementation in regulation of glucose hemostasis, inflammation and oxidative stress in patients with diabetes mellitus type 2: A randomized, placebo-controlled trial. Complement. Ther. Med. 66, 102819 (2022). https://doi.org/10.1016/j.ctim.2022.102819
37. Mokra, D., Joskova, M., Mokry, J.: Therapeutic Effects of Green Tea Polyphenol (–)-Epigallocatechin-3-Gallate (EGCG) in Relation to Molecular Pathways Controlling Inflammation, Oxidative Stress, and Apoptosis. Int. J. Mol. Sci. 24, 340 (2022). https://doi.org/10.3390/ijms24010340
38. Zhang, D., Fu, M., Gao, S.-H., Liu, J.-L.: Curcumin and Diabetes: A Systematic Review. Evid.-Based Complement. Altern. Med. ECAM. 2013, 636053 (2013). https://doi.org/10.1155/2013/636053
39. Solverson, P.: Anthocyanin Bioactivity in Obesity and Diabetes: The Essential Role of Glucose Transporters in the Gut and Periphery. Cells. 9, 2515 (2020). https://doi.org/10.3390/cells9112515

CITE AS: Kagambira Zimbuga M. (2025). Plant-Derived Polyphenols in the Management of Obesity and Type 2 Diabetes: Mechanisms and Clinical Evidence. Research Output Journal of Engineering and Scientific Research 4(3): 77-83. https://doi.org/10.59298/ROJESR/2025/4.3.7783