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Popular Article

# Ginger: A Natural Remedy for Metabolic Syndrome

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## Introduction

Metabolic syndrome, stemming from poor dietary choices and sedentary lifestyles, poses a significant global public health challenge and is a key contributor to cardiovascular risk. The condition is characterized by a cluster of factors including obesity, dyslipidemia, hyperglycemia, hypertension and insulin resistance, which collectively contribute to its pathophysiology. Diagnosis typically requires the presence of at least three of these factors, as outlined by criteria such as those established by the National Cholesterol Education Program (Grundy, 2008). Cardiovascular disease (CVD) stands as a primary cause of morbidity and mortality worldwide, with metabolic risk factors including diabetes, high LDL-cholesterol, hypertension and obesity. Consequently, considerable efforts have been directed towards both preventing and treating metabolic syndrome to mitigate the risk of CVD (Lakka *et al.*, 2002).

Herbal medicines have garnered attention for their potential preventive and therapeutic effects, with various plants and their active constituents being studied for their efficacy in managing metabolic syndrome. Ginger, a member of the Zingiberaceae family, has been traditionally used in diverse cultures and is recognized for its medicinal properties. Rich in bioactive compounds such as gingerol, it exhibits antioxidant properties and has shown promise in addressing metabolic abnormalities associated with the syndrome, including hypertension, obesity, hyperglycemia and hyperlipidemia (Shirooye *et al.*, 2017). Its widespread availability,

coupled with its safety profile in culinary and folk medicine practices, positions ginger as a promising candidate for further exploration in the prevention and management of metabolic syndrome and its associated cardiovascular risks.

**Role of ginger in prevention of metabolic syndrome**

Ginger's role in preventing metabolic syndrome is multifaceted, encompassing its effects on various components of the condition. Firstly, its impact on diabetes is notable, as ginger has shown promise in regulating blood sugar levels, thus potentially mitigating hyperglycemia, a key feature of metabolic syndrome. Additionally, ginger exhibits effects on dyslipidemia, with research suggesting its ability to reduce plasma triglyceride levels and increase high-density lipoprotein cholesterol, thereby addressing lipid abnormalities associated with the syndrome. Furthermore, ginger demonstrates potential in combating obesity, another hallmark of metabolic syndrome, through mechanisms that may include appetite suppression and modulation of fat metabolism.

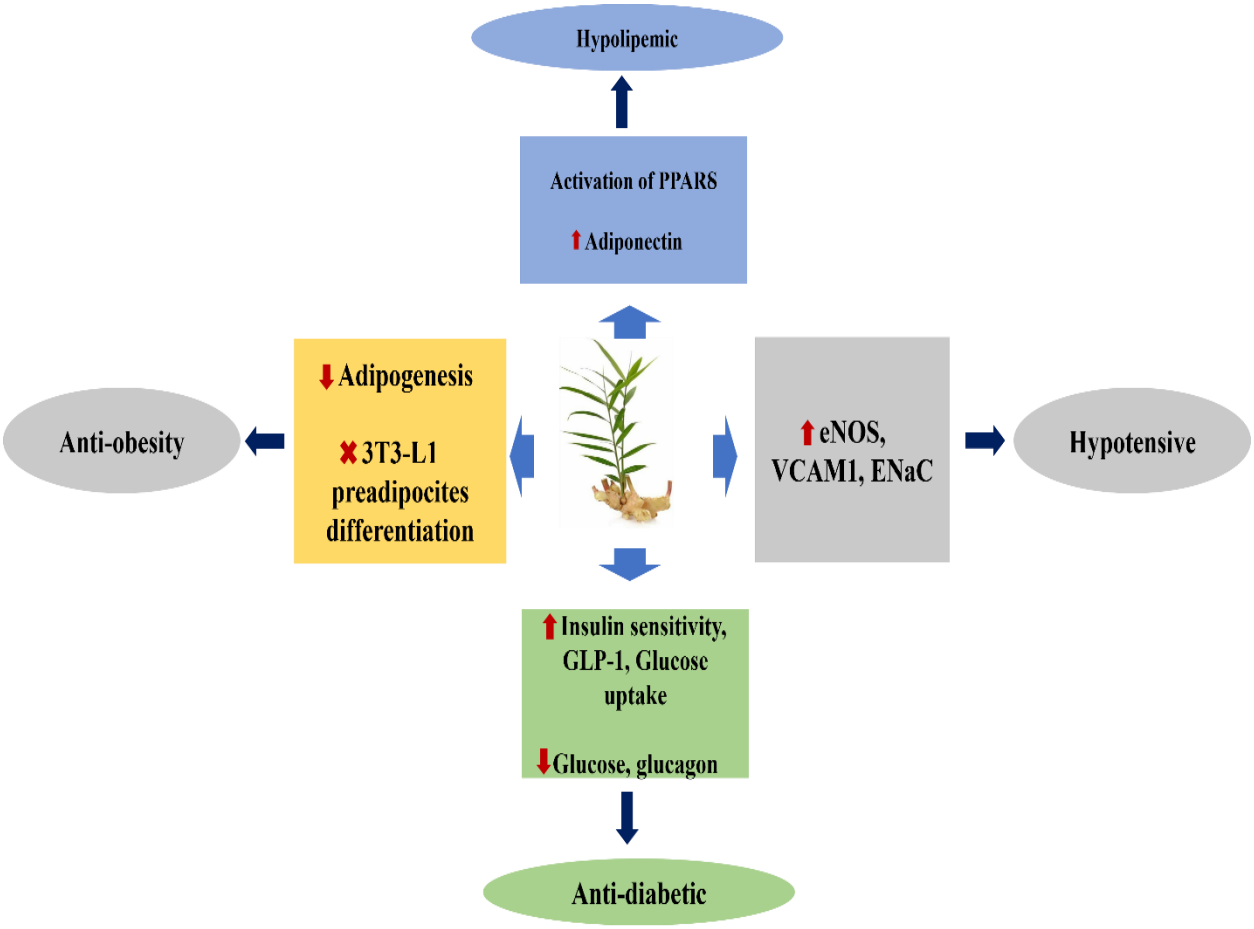


**Fig. 1: Schematic effects of ginger in metabolic syndrome**



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Lastly, its effect on hypertension is significant, as ginger has been reported to lower blood pressure levels, offering a potential avenue for managing this cardiovascular risk factor within the context of metabolic syndrome. Overall, the diverse pharmacological properties of ginger make it a promising candidate for interventions aimed at preventing and managing metabolic syndrome and its associated complications. The role of ginger and its components in metabolic syndrome have been presented in Figure 1.

**Effect on diabetes**

Ginger exerts a significant influence on diabetes through various mechanisms. Studies have indicated that ginger enhances insulin sensitivity and promotes glucose uptake, thus aiding in the regulation of blood sugar levels. Additionally, ginger has been found to increase the secretion of glucagon-like peptide-1 (GLP-1), a hormone involved in glucose metabolism and insulin secretion. Moreover, ginger demonstrates the ability to lower glucose levels while simultaneously reducing the secretion of glucagon, a hormone that elevates blood sugar levels (Wei *et al.*, 2017; Rameshrad *et al.*, 2020). These findings suggest that ginger may play a beneficial role in managing diabetes by modulating key physiological pathways related to glucose regulation and insulin secretion.

**Effect on dyslipidemia**

Ginger's impact on dyslipidemia involves several mechanisms, with research highlighting its ability to activate peroxisome proliferator-activated receptor gamma (PPARδ), a nuclear receptor involved in lipid metabolism regulation. By activating PPARδ, ginger may contribute to the modulation of lipid levels, potentially reducing triglyceride concentrations and promoting lipid homeostasis. Additionally, ginger has been shown to increase the secretion of adiponectin, an adipokine involved in regulating lipid and glucose metabolism (Ebrahimzadeh Attari *et al.*, 2018). Elevated adiponectin levels are associated with improved lipid profiles, suggesting that ginger's ability to enhance adiponectin secretion may contribute to its beneficial effects on dyslipidemia. These findings underscore ginger's potential as a natural therapeutic agent for addressing dyslipidemia and mitigating cardiovascular risk factors associated with metabolic syndrome (Li *et al.*, 2019).

**Effect on obesity**

Ginger's role in combating obesity involves inhibiting adipogenesis and suppressing the differentiation of 3T3-L1 preadipocytes, which are precursor cells involved in the formation of fat cells. By impeding adipogenesis, ginger may hinder the accumulation of fat tissue, thereby



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potentially reducing overall body fat mass. Furthermore, its ability to suppress the differentiation of preadipocytes suggests a mechanism by which ginger could limit the formation of new fat cells, contributing to the prevention of obesity (Misawa *et al.*, 2015). These findings underscore ginger's potential as a natural agent for addressing obesity and highlight its therapeutic promise in managing weight-related disorders.

**Effect on hypertension**

Ginger's efficacy in addressing hypertension involves multiple pathways, as evidenced by its ability to modulate various biomarkers associated with the condition. Gingerol, a key bioactive compound in ginger, has been shown to enhance the expression of hypertension biomarkers while simultaneously reducing lipid accumulation. This effect is achieved through the upregulation of phosphorylated endothelial nitric oxide synthase (eNOS) protein, which promotes vasodilation and regulates blood pressure (Akinyemi *et al.*, 2016). Additionally, gingerol influences the expression of vascular cell adhesion protein 1 (VCAM1), tumor necrosis factor alpha (TNFα) and epithelial sodium channel (ENaC) protein, potentially contributing to improved vascular function and blood pressure regulation. These findings, observed across various cell types including mouse preadipocytes (3T3-L1 cells), human embryonal kidney cells (HEK293 cells) and human umbilical vein endothelial cells (HUVECs), highlight ginger's promising role in managing hypertension through its multifaceted effects on vascular health and blood pressure regulation (Lee *et al.*, 2018).

**Conclusions**

Ginger and its bioactive constituents emerge as potent agents in the treatment of metabolic syndrome, exerting multifaceted effects on various physiological pathways. By augmenting the expression of endothelial nitric oxide synthase (eNOS) protein, vascular cell adhesion protein 1 (VCAM1), tumor necrosis factor alpha (TNFα) and epithelial sodium channel (ENaC), ginger contributes to the reduction of lipid accumulation, thereby addressing a key aspect of metabolic syndrome pathology. Furthermore, ginger demonstrates preventive and therapeutic potential by lowering fasting blood sugar (FBS) and hemoglobin A1C levels, thereby reducing insulin resistance and exhibiting antioxidant properties. Notably, ginger also influences lipid profiles, blood pressure and adiponectin levels while increasing leptin and high-density lipoprotein (HDL) cholesterol levels. Moreover, ginger's activation of the AMP-activated protein kinase (AMPK) signaling pathway contributes to enhanced skeletal muscle fat catabolism, underscoring its comprehensive utility in addressing the complexities of metabolic syndrome.



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## References

Grundy, S. M. (2008). Metabolic syndrome pandemic. *Arteriosclerosis, thrombosis, and vascular biology*, *28*(4), 629-636.

Lakka, H. M., Laaksonen, D. E., Lakka, T. A., Niskanen, L. K., Kumpusalo, E., Tuomilehto, J., & Salonen, J. T. (2002). The metabolic syndrome and total and cardiovascular disease mortality in middle-aged men. *Jama*, *288*(21), 2709-2716.

Shirooye, P., Hashem-Dabaghian, F., Hamzeloo-Moghadam, M., Afrakhteh, M., Bioos, S., & Mokaberinejad, R. (2017). A clinical comparative study of oral and topical ginger on severity and duration of primary dysmenorrhea. *Research Journal of Pharmacognosy*, *4*(1), 23-32.

Rameshrad, M., Razavi, B. M., Lalau, J. D., De Broe, M. E., & Hosseinzadeh, H. (2020). An overview of glucagon-like peptide-1 receptor agonists for the treatment of metabolic syndrome: A drug repositioning. *Iranian Journal of Basic Medical Sciences*, *23*(5), 556.

Wei, C. K., Tsai, Y. H., Korinek, M., Hung, P. H., El-Shazly, M., Cheng, Y. B., & Chang, F. R. (2017). 6-Paradol and 6-shogaol, the pungent compounds of ginger, promote glucose utilization in adipocytes and myotubes, and 6-paradol reduces blood glucose in high-fat diet-fed mice. *International journal of molecular sciences*, *18*(1), 168.

Li, J., Wang, S., Yao, L., Ma, P., Chen, Z., Han, T. L., & Wang, J. (2019). 6-gingerol ameliorates age-related hepatic steatosis: Association with regulating lipogenesis, fatty acid oxidation, oxidative stress and mitochondrial dysfunction. *Toxicology and applied Pharmacology*, *362*, 125-135.

Ebrahimzadeh Attari, V., Malek Mahdavi, A., Javadivala, Z., Mahluji, S., Zununi Vahed, S., & Ostadrahimi, A. (2018). A systematic review of the anti-obesity and weight lowering effect of ginger (Zingiber officinale Roscoe) and its mechanisms of action. *Phytotherapy research*, *32*(4), 577-585.

Misawa, K., Hashizume, K., Yamamoto, M., Minegishi, Y., Hase, T., & Shimotoyodome, A. (2015). Ginger extract prevents high-fat diet-induced obesity in mice via activation of the peroxisome proliferator-activated receptor δ pathway. *The Journal of nutritional biochemistry*, *26*(10), 1058-1067.

Akinyemi, A. J., Thomé, G. R., Morsch, V. M., Bottari, N. B., Baldissarelli, J., de Oliveira, L. S., & Schetinger, M. R. C. (2016). Effect of ginger and turmeric rhizomes on inflammatory cytokines levels and enzyme activities of cholinergic and purinergic systems in hypertensive rats. *Planta medica*, *82*(07), 612-620.

Lee, Y. J., Jang, Y. N., Han, Y. M., Kim, H. M., & Seo, H. S. (2018). 6-Gingerol normalizes the expression of biomarkers related to hypertension via PPARδ in HUVECs, HEK293, and differentiated 3T3-L1 cells. *PPAR research*, 1-15.



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