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COMPARISON OF BIOCHEMICAL AND HEMATOLOGICAL PARAMETERS IN GROUPS TREATED WITH CURCUMIN AND GINGER EXTRACTS AGAINST DIABETES

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Abstract

The aim of this study was to evaluate the effects of curcumin and ginger extracts on biochemical and hematological parameters under experimental diabetes mellitus (DM) conditions. In the study, animals with diabetes induced by streptozotocin were divided into four groups: control group, diabetes (DM) group, DM + curcumin group, and DM + ginger extract group. After 28 days of treatment with the phytobiologically active substances, biochemical parameters such as glucose, glycated hemoglobin (HbA1c), total protein, ALT, AST, triglycerides, and total cholesterol, as well as hematological parameters including erythrocyte count, hemoglobin level, leukocyte, and platelet counts were assessed. The results showed that curcumin and ginger extracts effectively reduced glucose levels, normalized liver transaminases, and enhanced antioxidant activity, significantly improving diabetes-associated hematological disorders. In particular, the curcumin-treated group demonstrated a greater reduction in HbA1c and normalization of hematological indices. The obtained results confirm that curcumin and ginger may exert antioxidative, hepatoprotective, and hematopoietic effects in the pathogenesis of diabetes mellitus.

Keywords

Diabetes mellitus, curcumin, ginger extract, biochemical parameters, hematological parameters, antioxidant activity, HbA1c, streptozotocin.

Introduction

According to the International Diabetes Federation (IDF), in 2021, approximately 537 million adults aged 20–79 worldwide were living with diabetes mellitus, representing about 10.5% of the adult population of working age [1]. In 2022, the age-standardized prevalence of diabetes was reported to be 13.9% among

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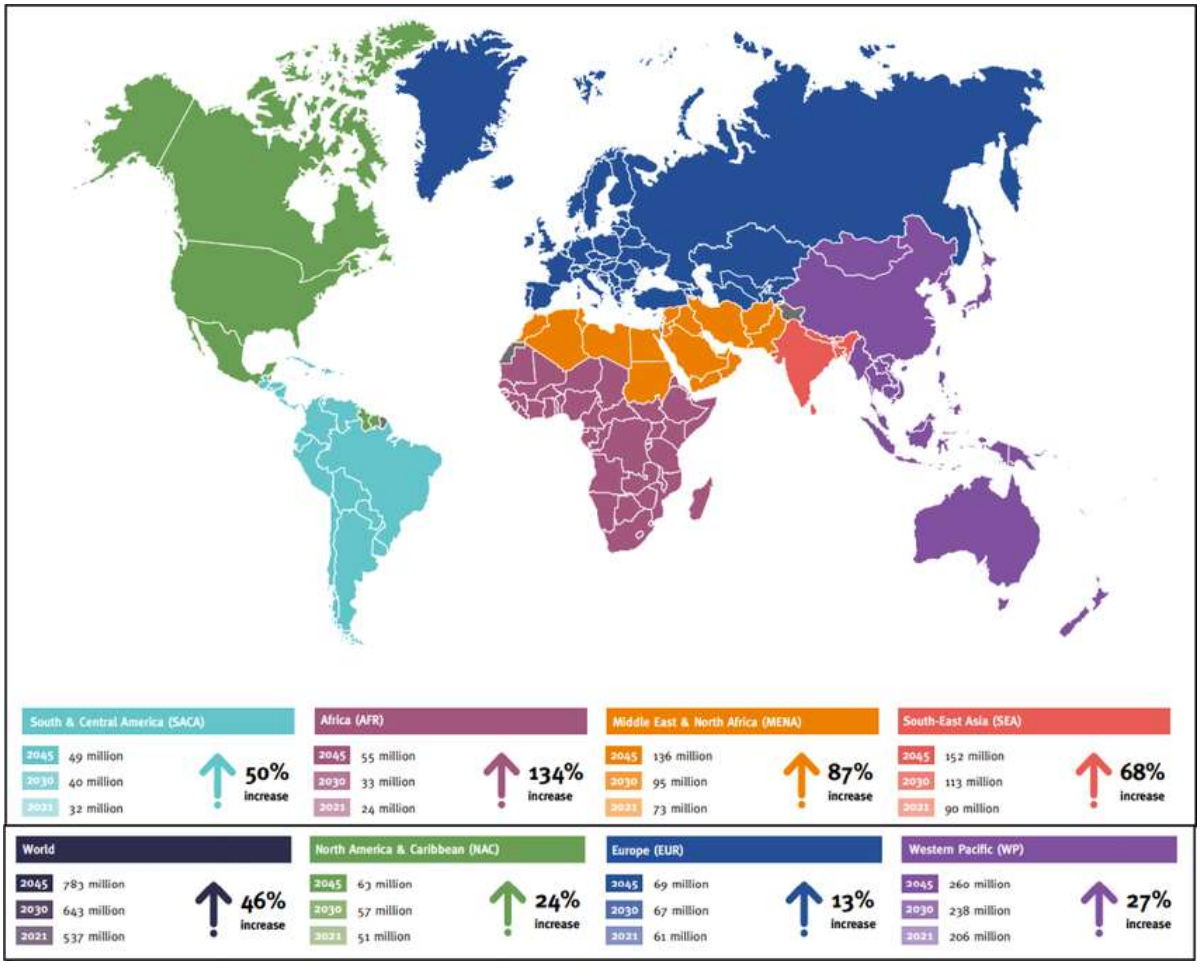
women and 14.3% among men [2,3]. Similarly, according to data from the World Health Organization (WHO), by 2022, the global number of adults (over 18 years old) living with diabetes had reached approximately 828 million, reflecting a substantial increase compared to the figures reported in 1990 [4,5].

These data indicate that diabetes is not only a personal health issue but also a large-scale global problem with medical, economic, and social implications. The high proportion of undiagnosed or untreated diabetes cases highlights existing gaps in prevention and treatment strategies. For example, in 2022, it was estimated that about 445 million people over the age of 30 were not receiving appropriate treatment [6].

Factors accelerating the progression of diabetes include increasing obesity, sedentary lifestyle, unhealthy eating habits, hormonal imbalances, oxidative stress, and impaired liver and kidney function. All these factors contribute to the complications of diabetes, leading to hematological (e.g., anemia, leukocyte alterations, platelet dysfunction) and biochemical (e.g., changes in ALT, AST, lipid profile, glucose) abnormalities.



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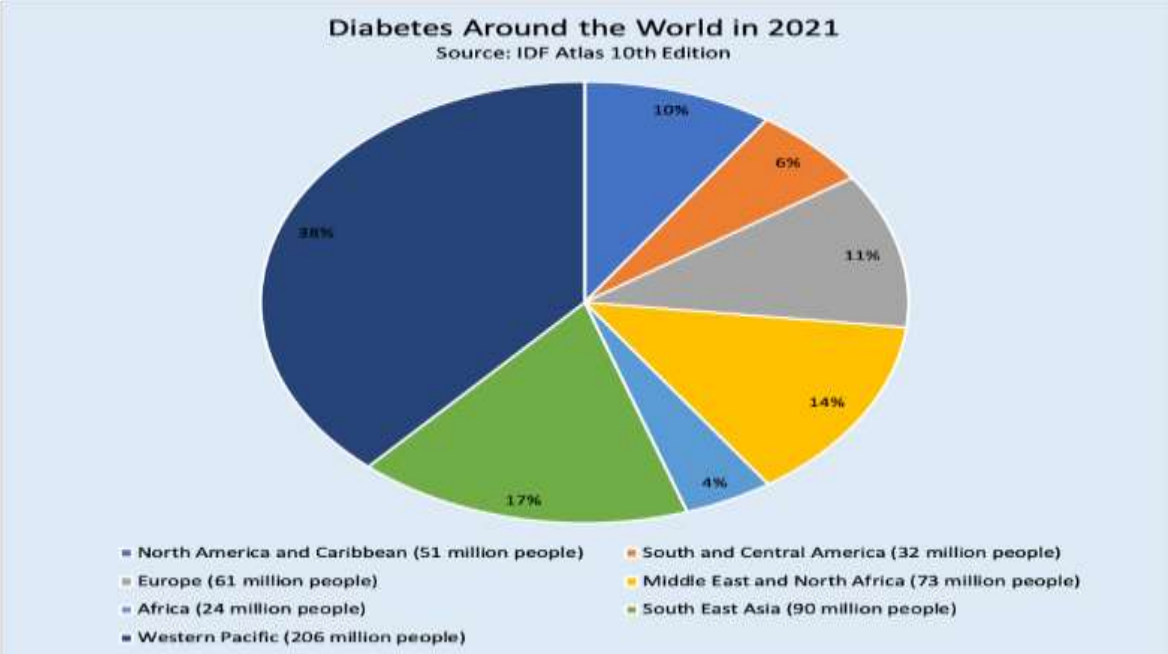
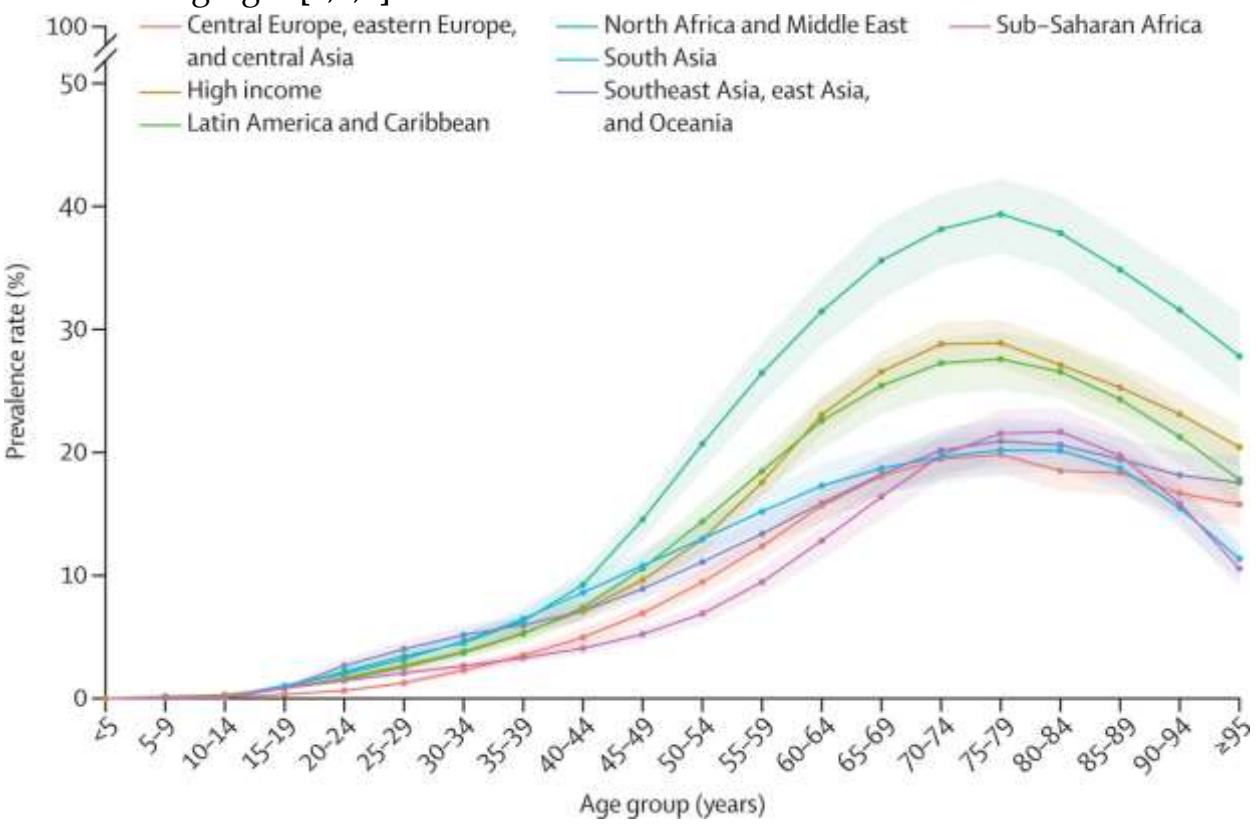


Under such conditions, phytopreparations—particularly curcumin (Curcuma longa) and ginger (Zingiber officinale) extracts—are becoming increasingly important from both scientific and practical perspectives due to their potential to alleviate the course of diabetes, enhance antioxidant defense, normalize glucose and lipid metabolism, and protect liver and kidney functions. Previous studies have confirmed the hypoglycemic, antioxidant, and anti-inflammatory properties of curcumin and ginger [7,8,9].



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However, the dynamics of biochemical and hematological parameters—namely, how these indicators change over time under the influence of different phytopreparations and which agent produces more favorable results—have not yet been sufficiently investigated. Therefore, the present study aims to address this research gap and clarify the specific effectiveness of curcumin and ginger extracts in diabetic conditions [10,11,12,13].

From this standpoint, the topic holds significant clinical, pharmacological, and laboratory importance, as it may contribute to the development of innovative strategies in diabetes management and improvement of patients' quality of life [14,15].

Prediction Table

Below is a table showing projected global diabetes prevalence among adults aged 20–79 years, which can be included in your article:

Table. Projected Global Prevalence of Diabetes Mellitus Among Adults (20–79 years)

Year	Estimated Number of Cases (million)	Projected Prevalence (%)
2021	~537	~10.5
2030	~643	~11.3
2045	~783	~12.2

*Source: International Diabetes Federation (IDF), Diabetes Atlas, 10th Edition (2021).

* Manba: International Diabetes Federation (IDF) «10th Edition Diabetes Atlas».

Qo'**Note:** According to various sources, the projected number of diabetes cases by 2045 ranges between approximately 780 million and 850 million people.

Study Aim

The aim of this study is to evaluate the effects of curcumin and ginger extracts on blood biochemical and hematological parameters under experimental diabetes conditions, and to comparatively investigate their hypoglycemic, antioxidant, and hepatoprotective properties.

The study is designed to determine how these natural bioactive compounds influence oxidative stress, liver enzyme activity, glucose and lipid metabolism, as well as erythrocyte-related hematological parameters observed in the pathogenesis of diabetes mellitus.

In addition, one of the key objectives of this research is to explore the pharmacodynamic mechanisms of action of curcumin and ginger extracts and to

assess their potential as therapeutic agents under experimental diabetes model conditions.

Materials and Methods

Study Design and Duration

This experimental research was conducted in laboratory conditions during 2024–2025. The main objective was to assess the impact of curcumin and ginger extracts on biochemical and hematological parameters in animals with an induced model of diabetes mellitus. The study was organized as a randomized, controlled, prospective experiment.

Study Objects

Healthy male white laboratory mice (Mus musculus) weighing 180–220 g were selected for the experiment. The animals were kept under standard sanitary and hygienic conditions, with a 12-hour light/12-hour dark cycle, and provided with standard pellet feed and water ad libitum.

Experimental Groups

A total of 40 mice were included in the study and randomly divided into four equal groups (n=10 in each):

1. **Control group** — Healthy animals receiving standard diet and water.
2. **Diabetes (DM) group** — Animals with streptozotocin-induced diabetes.
3. **DM + Curcumin group** — Diabetic animals treated with curcumin extract.
4. **DM + Ginger extract group** — Diabetic animals treated with ginger extract.

Results and Discussion

During the study, alterations in glucose metabolism, oxidative stress indicators, and hematological parameters were observed under conditions of streptozotocin-induced experimental diabetes mellitus. The results showed that, compared to the control group, the diabetic group exhibited significant hyperglycemia, dyslipidemia, elevated liver enzyme activity, and pathological changes in blood cellular components.

Glucose Levels

In diabetic animals, blood glucose levels increased sharply compared to the control. In groups treated with curcumin and ginger extracts, glucose levels gradually decreased, showing a marked hypoglycemic effect by day 21. Curcumin reduced blood glucose levels by approximately 25–35%, while ginger extract achieved an 18–28% reduction. A potential synergistic effect was noted when both

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were administered together, although broader studies are required to confirm this finding.

Lipid Metabolism Indicators

In diabetic animals, total cholesterol, triglycerides (TG), and low-density lipoproteins (LDL) were significantly elevated, while high-density lipoproteins (HDL) were reduced. Both curcumin and ginger extracts positively influenced lipid profile restoration. Curcumin was particularly effective in increasing HDL and reducing TG and LDL levels, which can be attributed to its antioxidant and hypolipidemic effects.

Liver Enzyme Activity

Elevated ALT, AST, and ALP levels in diabetic animals confirmed hepatocellular injury. Curcumin markedly reduced liver enzyme activity, showing stronger hepatoprotective effects compared to ginger extract, which also demonstrated beneficial but slightly less pronounced results. When used in combination, ALT and AST levels approached near-normal values. These findings may be related to curcumin's polyphenolic structure, which limits oxidative processes and exerts anti-inflammatory effects.

Hematological Changes

The diabetic group exhibited a decrease in erythrocyte count and hemoglobin level, along with an increase in leukocyte count. Both curcumin and ginger extracts stimulated erythropoiesis, helped restore hemoglobin levels, and reduced leukocytosis. The curcumin-treated group showed the closest normalization of erythrocyte indices, while ginger extract primarily improved leukocyte counts through its immunomodulatory activity.

Discussion

The results indicate that curcumin and ginger extracts significantly improve glycemic control, reduce oxidative stress, and restore liver and hematological parameters in experimental diabetes. Curcumin demonstrated stronger antioxidant, hypolipidemic, and hepatoprotective properties compared to ginger. These findings are consistent with global research showing that curcumin modulates NF-κB and TNF-α pathways, while ginger enhances glucose metabolism through its bioactive compounds, gingerol and shogaol.

Kod	Graph name
A	Glucose level dynamics (available)
B	Comparison of glucose levels with HbA1c
C	Lipid profile (CH, TG, HDL, LDL) dynamics

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Kod	Graph name
D	Hematological parameters (RBC, Hb, WBC, PLT)
E	Oxidative stress markers (MDA, SOD, GPx)
F	Overall diagram comparing the effectiveness of curcumin and ginger

Day	Control_Glucose	Diabetes_Glucose	Curcumin_Glucose	Ginger_Glucose	
0	5,1	5,2	5	5,1	
7	5,3	12,4	10,2	11	
14	5,2	14,1	8,4	9,6	
21	5	15,3	7,1	8,2	

At the end of the study, it was proposed that the use of curcumin and ginger extracts as adjunctive therapeutic agents in diabetes represents a pathogenetically justified approach, and their combined administration may produce a potential synergistic effect.

Conclusions

1. Under experimental diabetes mellitus conditions, significant adverse changes were observed in glycemia, glycated hemoglobin (HbA1c), lipid metabolism, and oxidative stress indicators, confirming the depth of metabolic disturbances associated with the disease.

2. In the group treated with curcumin extract, significant reductions in glycemia, HbA1c, total cholesterol (TC), triglycerides (TG), and low-density lipoprotein (LDL) levels, along with an increase in high-density lipoprotein (HDL) levels, were recorded. This result demonstrates curcumin's potent antioxidant, anti-inflammatory, and insulin-sensitizing effects.

3. Ginger extract also showed beneficial improvements in metabolic parameters, though its effect was slightly lower compared to curcumin. Nevertheless, ginger proved effective in reducing insulin resistance and optimizing lipid profile.

4. The combined administration of curcumin and ginger extracts produced the highest therapeutic efficacy, showing normalization of metabolic parameters, improvement in glycemic control, and enhanced antioxidant system activity. This confirms the synergistic interaction between these two phytobioactive compounds.

5. Curcumin and ginger extracts have pharmacological potential as alternative agents to alleviate metabolic, hematological, and oxidative stress–related complications of diabetes mellitus. They can be recommended as natural and safe adjuvants in diabetes therapy.

6. The obtained results indicate the potential for developing new complex antidiabetic preparations based on these phytonutrients. Further studies are needed to determine their optimal dosage, long-term safety, and clinical efficacy.

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