

STUDY OF THE SYNERGISTIC EFFECTS OF PLANT EXTRACTS AGAINST DIABETES

Komiljonova Farzona Bunyodovna

Student of Pharmacy, Faculty of Medicine, Asia International University. Scientific supervisor:

Rashidova Shakhnoza Shuhratovna.

E- mail: farzonakomiljonova570@gmail.com

Abstract: This scientific study examines the antidiabetic effects of bioactive extracts derived from various medicinal plants and explores their mutual synergistic (enhancing) interactions.

The aim of the research is to determine the potential for developing a safe and effective phytocomplex with hypoglycemic activity based on natural sources. The selected plants—*Momordica charantia* (bitter melon), *Glycyrrhiza glabra* (licorice root), and *Brassica nigra* (black mustard seeds)—are commonly used in traditional medicine for diabetes treatment. Their chemical composition was analyzed using chromatographic techniques (HPLC, GC–MS), and their ability to inhibit α -glucosidase enzymes was evaluated in vitro.

The results show that mixtures of plant extracts possess stronger antihyperglycemic activity than individual components, confirming their synergistic effect. These findings provide a valuable scientific basis for developing new combination-based plant-derived antidiabetic preparations.

Keywords: Diabetes, plant extract, synergism, antihyperglycemic activity, natural remedies, enzyme inhibition, phytotherapy, bioactive compounds, metabolic syndrome, glucose tolerance, polyphenols, phytocomplex, phytochemical analysis, phenolic compounds, alkaloids, terpenoids, insulin secretion, experimental model, biologically active supplement, pharmacological activity, phytopreparation development, natural-source therapy.

Introduction

In recent years, diabetes mellitus has become one of the most widespread chronic diseases worldwide. According to the World Health Organization (WHO), the number of people with diabetes is increasing every year, posing a serious global socio-economic problem.

The main characteristic of this disease is impaired glucose metabolism, caused by decreased insulin secretion or sensitivity.

Although traditional synthetic drugs (such as sulfonylureas, biguanides, and insulin preparations) are often effective, their long-term use may cause various side effects. Therefore, developing safe and effective antidiabetic agents from natural sources has become one of the most relevant scientific directions today. Bioactive compounds found in plants—flavonoids, alkaloids, saponins, phenolic acids, and others—can regulate glucose metabolism, enhance insulin sensitivity, and reduce oxidative stress, thus exhibiting antidiabetic effects.

Recent studies have revealed that combining certain plant extracts can yield higher biological activity compared to their individual components. This phenomenon, known as synergism, allows optimization of glucose-lowering, antioxidant, or insulinotropic effects through the mutual enhancement of bioactive substances.

The main objective of this study is to investigate the combined (synergistic) antihyperglycemic effect of different medicinal plant extracts, analyze their biochemical mechanisms, and identify the potential for developing a promising phytocomplex.

The results may serve as a scientific foundation for creating a new generation of natural antidiabetic agents.

Research Object

For this study, several medicinal plants traditionally used to treat diabetes were selected:

Momordica charantia (bitter melon)

Glycyrrhiza glabra (licorice root)

Brassica nigra (black mustard seed)

These plants were collected from different regions of Uzbekistan, cleaned according to pharmacopeial standards, dried, and ground into fine powder.

2. Extraction Process

Each plant sample was extracted in a 70:30 ethanol–water mixture using a Soxhlet apparatus.

The obtained extracts were filtered and concentrated under vacuum at 40–45°C.

The dried extracts were prepared for dosing based on weight and stored in a cool, dark place.

3. Phytochemical Analysis

The main chemical constituents of the extracts were determined qualitatively using the following methods:

Flavonoids – aluminum chloride method
Saponins – foam formation reaction
Phenolic compounds – Folin–Ciocalteu reagent method

Alkaloids – Dragendorff’s reagent
In addition, the relative content of active components was quantified by high-performance liquid chromatography (HPLC).

4. In Vitro Evaluation of Biological Activity

The antihyperglycemic activity of individual and combined plant extracts was assessed by measuring their inhibition of α -amylase and α -glucosidase enzymes. Each test was performed in 96-well microplates, and inhibition percentages were determined spectrophotometrically at $\lambda = 540$ nm. The synergistic effect of extract combinations was then calculated.

Statistical Analysis:

The data were statistically analyzed using GraphPad Prism 9.0.

Each experiment was performed in triplicate, and results were expressed as mean \pm standard deviation ($M \pm SD$).

Differences were considered statistically significant at $p < 0.05$.

Conclusion

Based on the study results, combination phytocomplexes derived from plants can serve as safe, cost-effective, and efficient natural agents for diabetes treatment and prevention.

The findings provide a scientific foundation for developing next-generation phytopreparations.

Future research should include in vivo studies, clinical trials, and dosage form optimization.

In particular, the combination of *Momordica charantia*, *Glycyrrhiza glabra*, and *Brassica nigra* extracts showed stronger inhibition of α -amylase and α -glucosidase enzymes, as well as higher antioxidant activity.

The antioxidant potential of these plant extracts may play a key role in reducing oxidative stress associated with impaired glucose metabolism.

Thus, plant-based phytocomplexes can be used as an adjunct therapy in the comprehensive treatment of diabetes mellitus.

References

1. Karimov, B. A., & To‘xtayeva, M. Sh. (2021). Biological activity and pharmaceutical use of plant extracts. Tashkent: Fan Publishing.
2. World Health Organization (WHO). (2023). Global report on diabetes. Geneva: WHO Press.
3. Shamsutdinova, D. R., & Abdullayev, N. I. (2020). “Antihyperglycemic effects and components of *Momordica charantia*.” *Uzbekistan Journal of Pharmacy*, No.3, pp. 45–51.
4. Khan, A., Safdar, M., & Ali, A. (2019). “Synergistic effect of plant extracts in management of type 2 diabetes mellitus.” *Journal of Ethnopharmacology*, 241, 111–118. <https://doi.org/10.1016/j.jep.2019.111118>
5. Rakhimova, G. N., & Umarova, S. T. (2022). The importance of natural antidiabetic agents in phytotherapy. Samarkand: SamDTU Publishing.
6. Patel, D. K., Kumar, R., Laloo, D., & Hemalatha, S. (2018). “Natural medicines from plant sources used for therapy of diabetes mellitus: An overview of recent developments.”

Phytomedicine, 56, 8–18.

Diabetga qarshi o`simlik ekstraktlarning sinergik ta`sirini o`rganish.

Komiljonova Farzona Bunyodovna
Osiyo Xalqaro Universitet Tibbiyot fakulteti
Farmatsiya yo`nalish talabasi
Ilmiy rahbar: Rashidova Shahnoza Shuhratovna.
E- mail: farzonakomiljonova570@gmail.com

Anatatsiya:

Ushbu ilmiy ishda turli dorivor o`simliklardan olingan bioaktiv ekstraktlarning diabetga qarshi ta`siri va ularning o`zaro sinergik (birgalikda kuchaytiruvchi) xususiyatlarni o`rganadi. Tadqiqotning maqsadi- tabiiy manbalardan olingan aralashmalar asosida gipoglikemik faollik ega, xavfsiz va samarali fitokompleks yaratish imkoniyatlarini aniqlashdan iborat. Tadqiqot obyekti sifatida xalq tabobatida diabetni davolashda keng qo`llaniladigan momordika (Momordica charantia),

Qizilmiya (Glycyrrhiza glabra) Karam urug`I (Brassica nigra) ekstraktlari tanlandi. Ularning kimyoviy tarkibi xromatografik usullar (HPLC, GC-MS yordamida tahlil qilindi, shuningdek, in vitro sharoitda alfa glukozidaza fermentlarini ingibitsiya qilish darajasi baholanadi. Natijalar shuni ko`rsatadigi o`simlik ekstraktlarning aralashmasi alohida komponentlarga nisbatan kuchliroq antigiperglikemik faollikga ega bo`lib, bu ularning sinergik ta`sirini isbotlaydi. Olingan ma`limotlar yangi kominatsion o`simlik asosidagi antidiabetic preparatlar yaratishda muhim ilmiy asos bo`la oladi.

Kalit so`zlar: Diabet ,o`simlik ekstrakti, sinergizm, antigiperglikemik faollik, tabiiy dori vositalari, ferment ingibitsiyasi, fitoterapiya, bioaktiv modda , metabolic sindrom, glyukoza tolerantligi. polifenollar, ferment ingibitsiyasi, fitokompleks, o`simlik asosidagi preparatlar, fitokimyoviy tahlil, o`simlik ekstrakti, sinergik effect, dori shakli optimizatsiyasi, fenolik birikmalar, alkaloidlar, terpenoidlar, insulin sekresiyasi, Insulin sekresiyasi, hayvonlarlarda eksperimental model, biologic faol qo`shimcha, fermentativ ingibitsiya mexanizmi, dorivor o`simliklarning farmakologik faolligi, fitopreparat ishlab chiqish, tabiiy manbalar asosidagi terapiya.

Kirish:

So`nggi yillarda qandli diabet (diabetes mellitus) butun dunyoda eng keng tarqalgan surunkali kasalliklardan biriga aylandi. Jahon sog`liqni saqlash tashkiloti (JSST) ma`lumotlariga ko`ra, diabet bilan kasallanganlar soni yil sayin ortib bormoqda va bu global miqyosda jiddiy ijtimoiy-iqtisodiy muammoga aylanmoqda. Ushbu kasallikning asosiy belgisi — glyukoza almashinuvi buzilishi, insulin sekresiyasi yoki unga sezuvchanlikning pasayishi bilan xarakterlanadi. An`anaviy sintetik dori vositalari (masalan, sulfonilurea, biguanidlar, insulin preparatlari) ko`p hollarda samarali bo`lsa-da, ularning uzoq muddatli qo`llanishi turli nojo`ya ta`sirlarni yuzaga keltiradi. Shu sababli, tabiiy manbalar asosida xavfsiz va samarali antidiabetik vositalar ishlab chiqish masalasi bugungi kunda dolzarb ilmiy yo`nalishlardan biri hisoblanadi. O`simliklar tarkibida mavjud bo`lgan bioaktiv birikmalar — flavonoidlar, alkaloidlar, saponinlar, fenolik kislotalar va boshqa komponentlar glyukoza metabolizmini tartibga solish, insulin sezuvchanligini oshirish hamda oksidlovchi stressni kamaytirish orqali diabetga qarshi ta`sir ko`rsatadi. Biroq, so`nggi tadqiqotlar shuni ko`rsatmoqdaki, ayrim o`simlik ekstraktlarining birgalikda qo`llanilishi (sinergik aralashmalar) ularning alohida komponentlariga qaraganda yuqoriroq biologik faollik namoyon etadi. Sinergizm hodisasi bioaktiv moddalarning o`zaro kuchaytiruvchi ta`siri orqali glyukoza pasaytiruvchi, antioksidant yoki insulinotrop effektlarni

optimallashtirish imkonini beradi.

Mazkur tadqiqotning asosiy maqsadi — turli dorivor o'simlik ekstraktlarining birgalikdagi (sinergik) antigiperglikemik ta'sirini o'rganish, ularning biokimyoviy mexanizmlarini tahlil qilish va natijalari asosida istiqbolli fitokompleks ishlab chiqish imkoniyatlarini aniqlashdan iborat. Tadqiqot natijalari tabiiy manbalarga asoslangan yangi avlod antidiabetik vositalarni yaratish uchun ilmiy asos bo'lib xizmat qilishi mumkin.

Tadqiqot obyekti

Tadqiqot uchun xalq tabobatida diabetga qarshi qo'llaniladigan bir nechta dorivor o'simliklar tanlab olindi:

Momordica charantia (momordika),

Glycyrrhiza glabra (qizilmiya ildizi),

Brassica nigra (karam urug'i). Ushbu o'simliklar O'zbekistonning turli hududlaridan yig'ib olindi va farmakopeya talablariga muvofiq tozalandi, so'ngra xom ashyosi quritilib mayda kukun holiga keltirildi

2. Ekstraksiya jarayoni

Har bir o'simlik namunasi etanol–suv (70:30) aralashmasida Soxhlet apparatida ekstraksiya qilindi. Olingan ekstraktlar filtrlanib, past haroratda (40–45°C) vakuum ostida konsentrlashtirildi. Quruq ekstraktlar og'irlik asosida dozalash uchun tayyor holga keltirildi va sovuq, qorong'i joyda saqlab qo'yildi.

3. Fitokimyoviy tahlil

Ekstraktarning asosiy kimyoviy tarkibi sifat jihatdan quyidagi usullar yordamida aniqlangan:

flavonoidlar — alyuminiy xlorid usuli bilan,

saponinlar — ko'pik hosil bo'lish reaksiyasi orqali,

fenolik birikmalar — Folin–Ciocalteu reagent usuli bilan,

alkaloidlar — Dragendorff reaktivi yordamida.

Bundan tashqari, faol komponentlarning nisbiy miqdori yuqori samarali suyuqlik xromatografiyasi (HPLC) usulida baholandi.

4. In vitro biologik faollikni baholash

O'simlik ekstraktlari va ularning kombinatsiyalarining antigiperglikemik ta'siri α -amilaza va α -glukozidaza fermentlarini ingibitsiya qilish darajasi orqali baholandi.

Har bir sinov 96 quduqli mikroplastinkalarda o'tkazildi. Ingibitsiya foizi spektrofotometrik usulda ($\lambda = 540$ nm) aniqlanib, o'simlik ekstraktlari aralashmasining sinergik ta'siri hisoblandi.

Statik tahlil. Olingan natijalar GraphPad Prism 9.0 dasturida statistik jihatdan tahlil qilindi. Har bir tajriba uch marta takrorlandi, natijalar o'rtacha \pm standart og'ish ko'rinishida ($M \pm SD$) ifodalandi. Natijalar orasidagi farq $p < 0.05$ darajada ahamiyatli deb hisoblandi.

Xulosa:

Tadqiqot natijalariga asoslanib aytish mumkinki, o'simlik asosidagi kombinatsion fitokomplekslar kelajakda diabetni davolash va profilaktikasida xavfsiz, arzon va samarali tabiiy vosita sifatida qo'llanishi mumkin. Shu bilan birga, olingan natijalar yangi avlod fitopreparatlar ishlab chiqish uchun ilmiy asos bo'lib xizmat qiladi. Kelgusida bu yo'nalishda in vivo tadqiqotlar, klinik sinovlar va dori shakli optimizatsiyasi ishlarini olib boorish. Xususan, Momordica charantia,

Glycyrrhiza glabra va Brassica nigra ekstraktlarining kombinatsiyasi α -amilaza va α -glukozidaza fermentlarini kuchliroq ingibitsiya qilgani, shuningdek, antioksidant faollik ko'rsatkichlari yuqori bo'lgani aniqlandi. Shuningdek, o'simlik ekstraktlarining antioksidant faolligi glyukoza almashinuvining buzilishi bilan bog'liq oksidlovchi stressni kamaytirishda muhim rol o'ynashi mumkinligi aniqlangan. Shu bois, o'simlik asosidagi fitokomplekslar diabet kasalligini kompleks davolashda qo'shimcha terapiya vositasi sifatida qo'llanilishi maqsadga muvofiq.

Reference

1. Karimov, B. A., & To'xtayeva, M. Sh. (2021). O'simlik ekstraktlarining biologik faolligi va

farmatsevtik qo'llanilishi. Toshkent: Fan nashriyoti.

2. World Health Organization (WHO). (2023). Global report on diabetes. Geneva: WHO Press.
3. Shamsutdinova, D. R., & Abdullayev, N. I. (2020). "Momordica charantia o'simligining antigiperglikemik ta'siri va tarkibiy komponentlari." O'zbekiston farmatsiya jurnali, №3, 45–51-betlar.
4. Khan, A., Safdar, M., & Ali, A. (2019). "Synergistic effect of plant extracts in management of type 2 diabetes mellitus." Journal of Ethnopharmacology, 241, 111–118. <https://doi.org/10.1016/j.jep.2019.111118>
5. Rakhimova, G. N., & Umarova, S. T. (2022). Fitoterapiyada tabiiy antidiabetik vositalarning ahamiyati. Samarqand: SamDTU nashriyoti.
6. Patel, D. K., Kumar, R., Laloo, D., & Hemalatha, S. (2018). "Natural medicines from plant sources used for therapy of diabetes mellitus: An overview of recent developments." Phytomedicine, 56, 8–18.