



OPTIMIZATION OF PHARMACEUTICAL TECHNOLOGY FOR COMBINED ANTIDIABETIC PREPARATIONS IN UZBEKISTAN

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Abstract

The rapid increase in diabetes mellitus cases in Uzbekistan has created a need for innovative pharmaceutical solutions capable of improving therapeutic effectiveness and reducing treatment-related complications. Combined antidiabetic preparations containing herbal components and synthetic active substances have become an important direction in pharmaceutical research due to their multifunctional pharmacological activity. The present article analyzes pharmaceutical technological approaches aimed at optimizing the production of combined antidiabetic medicines in Uzbekistan. The study focuses on innovative extraction methods, granulation technologies, bioavailability enhancement, and stabilization of active compounds in combined dosage forms. Particular attention is devoted to local medicinal plants with hypoglycemic potential and their incorporation into modern pharmaceutical formulations. The findings demonstrate that technological optimization significantly improves product stability, dissolution properties, and pharmacological efficiency.

Keywords

combined antidiabetic preparations, pharmaceutical optimization, medicinal plants, granulation technology, bioavailability, Uzbekistan, diabetes mellitus

Introduction

Diabetes mellitus is currently regarded as one of the leading chronic metabolic disorders affecting public health worldwide. In Uzbekistan, the growing prevalence of diabetes has increased the demand for effective therapeutic agents with minimal adverse reactions. Although synthetic antidiabetic drugs remain the main therapeutic option, long-term administration may negatively influence liver function, gastrointestinal activity, and metabolic balance.

In recent years, pharmaceutical researchers have increasingly focused on combined dosage forms that integrate synthetic hypoglycemic agents with biologically active plant extracts. Such formulations allow simultaneous correction of several metabolic disturbances associated with diabetes, including oxidative stress, inflammation, and hepatic dysfunction.

The pharmaceutical industry of Uzbekistan possesses considerable opportunities for developing combined antidiabetic preparations due to the availability of local medicinal plants rich in flavonoids, alkaloids, phenolic compounds, and polysaccharides. Optimization of pharmaceutical technology plays a decisive role in improving the therapeutic efficiency and industrial feasibility of these medicines.

Materials and Methods

The study was conducted through comparative analysis of pharmaceutical technological data, pharmacopeial requirements, and scientific publications related to combined antidiabetic medicines. Scientific literature published between 2020 and 2025 was reviewed.

The technological processes evaluated during the study included:

- preparation of medicinal plant raw materials;
- extraction and purification procedures;
- granulation technologies;
- tablet compression parameters;
- optimization of excipient composition;
- stability assessment of combined formulations.

Particular attention was paid to wet granulation and dry granulation technologies used in tablet production because these methods significantly influence dissolution rate and uniformity of active compounds.

Table 1. Technological Characteristics of Components Used in Combined Antidiabetic Preparations

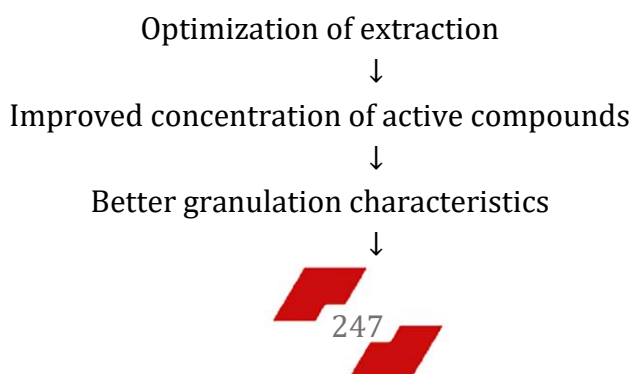
Component	Technological role	Pharmaceutical effect	Formulation significance
Metformin	Primary synthetic agent	Reduces blood glucose	Main active ingredient
Licorice extract	Herbal additive	Antioxidant activity	Improves metabolic balance
Milk thistle extract	Hepatoprotective component	Protects liver cells	Reduces adverse effects
Microcrystalline cellulose	Binder and filler	Improves tablet hardness	Enhances compressibility
Magnesium stearate	Lubricant	Improves production process	Prevents sticking

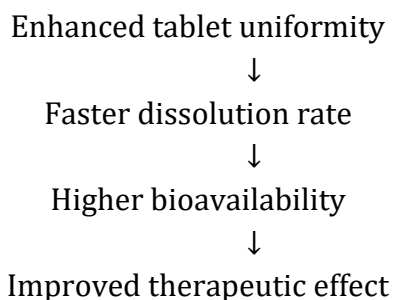
Results and Discussion

The performed analysis demonstrated that optimization of pharmaceutical technology directly influences the therapeutic quality of combined antidiabetic preparations. One of the most important technological stages is granulation. Wet granulation methods improve flowability of powder mixtures and ensure homogeneous distribution of plant extracts within tablet mass. However, excessive moisture may reduce stability of biologically active compounds.

Dry granulation technologies are considered more suitable for thermolabile plant extracts because they minimize exposure to moisture and elevated temperatures. The choice of granulation method therefore depends on physicochemical characteristics of active ingredients.

Diagram 1. Influence of Pharmaceutical Optimization on Drug Quality





Another important aspect of optimization involves the regulation of dissolution kinetics. Combined preparations containing both synthetic and herbal components require balanced release profiles to achieve maximum pharmacological effectiveness. Modern pharmaceutical technologies use hydrophilic polymers and modified excipients to control active compound release.

The incorporation of herbal extracts into combined formulations also creates additional technological challenges. Plant extracts may demonstrate hygroscopicity, instability during storage, and interactions with synthetic components. Therefore, stabilization technologies including microencapsulation and protective film coating are increasingly used in pharmaceutical manufacturing.

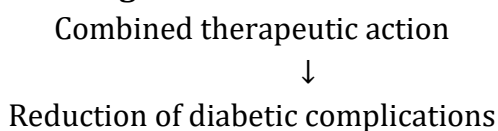
Table 2. Comparison of Technological Approaches Used in Combined Antidiabetic Preparations

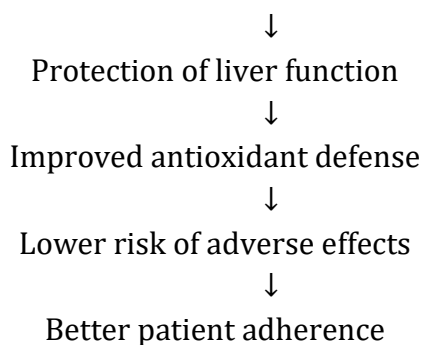
Technology	Advantages	Limitations	Industrial relevance
Wet granulation	Uniform distribution of components	Moisture sensitivity	Widely used
Dry granulation	Suitable for unstable extracts	Higher equipment requirements	Promising
Microencapsulation	Protects active compounds	Complex production	Innovative approach
Film coating	Improves stability	Additional processing stage	Highly effective

Pharmaceutical studies conducted in Uzbekistan indicate that combined antidiabetic formulations containing metformin and herbal extracts demonstrate improved tolerability compared to monocomponent therapy. Licorice and milk thistle extracts contribute not only to hypoglycemic activity but also to hepatoprotective and antioxidant effects.

The development of locally produced combined medicines is economically important for Uzbekistan because it may reduce pharmaceutical import dependency and support the national pharmaceutical industry. At the same time, implementation of GMP standards and modern analytical control methods remains necessary for ensuring safety and reproducibility of pharmaceutical products.

Diagram 2. Advantages of Combined Antidiabetic Preparations





Conclusion

Optimization of pharmaceutical technology for combined antidiabetic preparations represents a strategically important direction for pharmaceutical science and industry in Uzbekistan. Modern technological approaches such as dry granulation, microencapsulation, and film coating improve stability, dissolution characteristics, and therapeutic effectiveness of combined formulations.

The integration of local medicinal plant extracts with synthetic antidiabetic agents creates opportunities for developing multifunctional medicines with enhanced pharmacological properties and reduced toxicity. Combined preparations may simultaneously regulate carbohydrate metabolism, reduce oxidative stress, and protect liver function.

Further scientific investigations should focus on industrial standardization, pharmacokinetic evaluation, and clinical assessment of combined antidiabetic formulations developed from local medicinal resources.

References:

- 1.Karimov, U. R. (2022). Modern pharmaceutical technologies in combined drug production. Tashkent Medical Publishing.
- 2.Rasulov, H. A., & Abdullayev, S. T. (2023). Pharmaceutical optimization of herbal dosage forms. *Pharmaceutical Journal of Uzbekistan*, 4(1), 27–34.
- 3.World Health Organization. (2023). Global report on diabetes. Geneva: WHO.
- 4.Yuldashev, S. O. (2024). Granulation technologies in pharmaceutical production. *Uzbek Chemical and Pharmaceutical Journal*, 8(2), 40–46.
- 5.International Diabetes Federation. (2024). IDF Diabetes Atlas (10th ed.). Brussels: IDF.
- 6.Nurmatov, F. K. (2021). Combined herbal medicines in modern therapy. *Asian Pharmaceutical Review*, 9(3), 112–118.
- 7.Sultonov, M. A. (2022). Pharmaceutical excipients and their technological role. Tashkent.
- 8.State Pharmacopoeia of the Republic of Uzbekistan. (2021). Tashkent.
- 9.Khushbaktova, N. B. (2020). Herbal components in diabetes treatment. *Medical Bulletin of Central Asia*, 5(2), 55–60.

