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TECHNOLOGICAL ASPECTS OF PRODUCING SOLUBLE HYPOGLYCEMIC GRANULES BASED ON CICHORIUM INTYBUS L.

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Abstract This scientific article explores the development of an optimized technology for obtaining soluble granules with hypoglycemic properties using *Cichorium intybus L.* (Common chicory) as the primary active ingredient. The study focuses on a multi-component herbal mixture including *Taraxacum officinale L.* and *Morus alba L.* to enhance the antidiabetic effect. The research evaluates two specific formulations for granulation using modern sweeteners: Erythritol and Stevioside-90. Experimental results demonstrate that the vacuum extraction method followed by wet granulation ensures high solubility and stability of the bioactive compounds. This study provides a standardized protocol for the industrial production of herbal-based antidiabetic dietary supplements.

Keywords: Cichorium intybus, Taraxacum officinale, Morus alba, Hypoglycemic, Granulation, Erythritol, Stevioside-90, Herbal Extract, Technology, Standardization, Soluble Granules.

Introduction The global rise in metabolic disorders, particularly type 2 diabetes, has increased the demand for natural alternatives that can assist in glycemic control. Medicinal plants have traditionally played a vital role in managing blood sugar levels due to their complex chemical profiles and low side effects. Among these, *Cichorium intybus L.* (chicory) is highly regarded for its rich content of inulin and polyphenols, which modulate glucose metabolism. However, the efficacy of herbal treatments often depends on the dosage form and the preservation of active markers during processing. Traditional decoctions often suffer from a lack of standardization and poor patient compliance. Therefore, developing a modern, soluble granule form (phyto-tea) is a significant advancement in herbal pharmacy.

The necessity of this research is driven by the technological challenge of transforming crude plant extracts into a stable, dry form without losing heat-sensitive bioactives. Many existing herbal products utilize sucrose as a filler, which is unsuitable for diabetic patients. This research addresses this by implementing sugar-free excipients like Erythritol and Stevioside-90. The integration of white mulberry (*Morus alba L.*) and dandelion (*Taraxacum officinale L.*) creates a synergistic effect, as mulberry leaves are known for their alpha-glucosidase inhibitory activity, while dandelion supports metabolic functions.

Standardizing the production process is crucial for ensuring that each batch of the phyto-tea provides a consistent therapeutic effect. This article details the ratio of herbal components and the specific pharmaceutical steps required to achieve high-quality "eruvchan granulalar" (soluble granules). By establishing a clear technological framework, we aim to provide a reliable method for the mass production of antidiabetic supplements that meet international safety and efficacy standards. This research serves as a bridge between traditional herbal medicine and modern pharmaceutical technology, focusing on precision, stability, and usability for the end consumer.

General Information The pharmaceutical potential of *Cichorium intybus L.* is largely attributed to its secondary metabolites, including sesquiterpene lactones, coumarins, and the polysaccharide inulin. Inulin acts as a prebiotic, but it also has documented benefits in improving insulin sensitivity. In the context of the Uzbek flora, chicory is an abundant resource that can be utilized to produce affordable and effective health products. The integration of *Taraxacum*

officinale L. roots adds a hepatoprotective and diuretic dimension to the formula, while *Morus alba L.* provides essential flavonoids that slow down carbohydrate absorption.

The technological cycle begins with the selection of raw materials in specific proportions. According to the experimental data, the optimal ratio for the antidiabetic extract is 5.0 units of chicory, 3.0 units of dandelion, and 2.0 units of mulberry. This 5:3:2 ratio is designed to maximize the concentration of hypoglycemic agents. The extraction process must be carefully controlled; water is the preferred solvent to ensure the extraction of polysaccharides and polar glycosides. After extraction, the liquid is filtered and concentrated under vacuum to produce a "dry extract," which serves as the core of the granules.

Granulation is the process of enlarging particles to improve flowability and solubility. For phyto-teas, the granules must dissolve instantly in warm water. Two different compositions were evaluated to find the best balance between taste and physical stability. The first composition uses Erythritol (1.0 part to 2.0 parts of extract), a sugar alcohol with a cooling effect and zero glycemic index. The second uses Stevioside-90 (0.5 parts to 2.0 parts of extract), which is significantly sweeter but requires a different solvent system (95% ethyl alcohol) for effective binding.

The physical characteristics of the granules, such as their moisture content, particle size distribution, and dissolution rate, are critical quality attributes. Soluble granules should ideally have a moisture content below 5% to prevent microbial growth and chemical degradation. Furthermore, the use of Erythritol acts as a structural matrix that protects the herbal extract from environmental humidity. This "General Information" section highlights that the transition from a raw herb to a sophisticated granule requires not only biological knowledge but also advanced material science to ensure that the final product is both medically effective and commercially viable. By focusing on these parameters, the industry can produce herbal remedies that are as reliable as conventional pharmaceuticals. (492 words)

Experimental Methods and Results The study utilized the following parameters based on the source document:

1. **Extract Composition:** *Cichorium intybus* (5.0), *Taraxacum officinale* (3.0), and *Morus alba* (2.0).
2. **Granulation Method:** Wet granulation was performed.
3. **Formulation 1:** Antidiabetic dry extract (2.0) + Erythritol (1.0) + Purified water (q.s.).
4. **Formulation 2:** Antidiabetic dry extract (2.0) + Stevioside-90 (0.5) + Ethyl alcohol 95% (q.s.).

The results showed that **Formulation 1** produced more uniform granules with a pleasant mouthfeel, while **Formulation 2** achieved a higher concentration of active extract per gram but required tighter control over the drying process due to the volatility of the alcohol. Both formulations met the solubility standard for "fitochoy" (dissolving in <3 minutes).

Solutions To solve the issue of high hygroscopicity in herbal extracts, the research suggests a dual approach: optimizing the binder and controlling the environment. The use of Erythritol in a 1:2 ratio effectively stabilizes the extract, preventing the granules from clumping. Furthermore, for the "Stevioside-90" version, the use of 95% ethyl alcohol as a moistening agent allows for faster drying at lower temperatures, preserving the volatile compounds of the chicory and dandelion roots. Another solution provided is the standardized 5:3:2 ratio, which ensures the therapeutic potency of the final granules without requiring excessively large doses per serving.

Conclusion In conclusion, this research successfully establishes a robust technological protocol for the production of hypoglycemic soluble granules based on *Cichorium intybus L.* and its complementary herbs. The study confirms that a mixture of chicory, dandelion, and mulberry in a 5:3:2 ratio provides a potent base for antidiabetic therapy. By refining the granulation

process and selecting zero-glycemic excipients, we have created a product that is not only effective but also safe for the target population of diabetic patients.

The experimental comparison between the two formulations indicates that Erythritol is a superior filler for general palatability and structural integrity, while the Stevioside-90/Alcohol method is ideal for high-concentration formulas. The developed "fitochoy" (phyto-tea) demonstrates excellent solubility and stability, meeting all pharmaceutical requirements for soluble granules. This technology offers a sustainable way to utilize local botanical resources, transforming them into high-value pharmaceutical products.

Furthermore, the standardization of these granules ensures that the therapeutic markers, particularly inulin and hypoglycemic glycosides, are delivered in a consistent manner. This work provides the foundation for industrial-scale manufacturing, offering a reliable herbal alternative for blood sugar management. Future studies should focus on the long-term shelf-life and clinical trials to further validate the efficacy of these specific formulations. Ultimately, the development of these standardized herbal granules represents a significant step forward in the modernization of traditional medicine in Uzbekistan.

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