



TECHNOLOGICAL AND BIOPHARMACEUTICAL ADVANTAGES OF SUPPOSITORIES PRODUCED IN UZBEKISTAN AND EUROPE: A COMPARATIVE STATISTICAL ANALYSIS.

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Abstract. *Suppositories represent one of the widely used dosage forms in modern pharmaceutical practice, particularly in pediatrics, gynecology, and proctology. This study presents a comparative statistical analysis of the technological, biopharmaceutical, and economic characteristics of suppositories manufactured in Uzbekistan and European countries. The results demonstrated that the average bioavailability of European-manufactured suppositories reached 96%, whereas in Uzbekistan this indicator ranged from 88% to 90%. The stability of suppositories was 97% in Europe and 88% in Uzbekistan, respectively [1,2]. These findings indicate significant technological differences between the regions and highlight the importance of implementing advanced pharmaceutical manufacturing standards.*

Keywords: *suppositories, bioavailability, pharmaceutical technology, Uzbekistan, Europe, comparative analysis*

INTRODUCTION

Suppositories are solid dosage forms intended for insertion into body cavities, where they melt, soften, or dissolve at body temperature, ensuring rapid release and absorption of the active pharmaceutical ingredient [2]. This route of administration allows drugs to partially bypass hepatic first-pass metabolism, thereby improving bioavailability [3].

According to the World Health Organization, suppositories account for up to 10% of global pharmaceutical dosage forms and play an essential role in pediatric and geriatric therapy [1].

In European countries, suppository production is carried out in strict compliance with Good Manufacturing Practice (GMP) standards, ensuring high quality, stability, and therapeutic effectiveness [4].

In Uzbekistan, the pharmaceutical industry has experienced rapid growth over the past decade, and suppository production has increased approximately 2.5-fold over the last five years [5].



MATERIALS AND METHODS

The study was conducted using a comparative statistical analysis based on the following parameters:

- *production volume*
- *bioavailability*
- *melting time*
- *stability*
- *shelf life*

Statistical analysis was performed using Student's t-test to evaluate the significance of differences between the groups [6].

Data were obtained from pharmaceutical industry reports, pharmacopoeial standards, and international regulatory publications.

RESULTS

Table 1. Suppository production volume (2024)

<i>Region</i>	<i>Production volume (million units)</i>
<i>Europe</i>	<i>540</i>
<i>Uzbekistan</i>	<i>18</i>

These results indicate that European production exceeds Uzbekistan's production by approximately 30 times, reflecting the higher level of industrial development [7].

Table 2. Bioavailability comparison

<i>Region</i>	<i>Bioavailability (%)</i>
<i>Europe</i>	<i>96</i>
<i>Uzbekistan</i>	<i>89</i>

This difference demonstrates the higher therapeutic efficiency of European suppositories, primarily due to advanced formulation technologies [3].

Table 3. Melting time

<i>Region</i>	<i>Melting time (minutes)</i>
<i>Europe</i>	<i>12</i>
<i>Uzbekistan</i>	<i>18</i>

Shorter melting time contributes to faster drug release and therapeutic effect [8].

Table 4. Stability comparison

<i>Region</i>	<i>Stability (%)</i>
<i>Europe</i>	<i>97</i>
<i>Uzbekistan</i>	<i>88</i>

Higher stability ensures longer shelf life and better product quality [4].

DISCUSSION

The results indicate that European suppositories have significant technological and biopharmaceutical advantages. These advantages are mainly associated with strict compliance with GMP requirements, advanced manufacturing equipment, and high-quality raw materials [9].

European manufacturers use pharmaceutical-grade bases such as cocoa butter and polyethylene glycol, which improve drug release and absorption characteristics [2].

In contrast, Uzbekistan's pharmaceutical industry is still in the process of technological modernization, and improvements in production standards are needed to enhance product quality and competitiveness [5].

ECONOMIC ANALYSIS

Table 5. Market size comparison

<i>Region</i>	<i>Market size (million USD)</i>
<i>Europe</i>	<i>2300</i>
<i>Uzbekistan</i>	<i>42</i>

This substantial difference reflects the economic strength and technological advancement of the European pharmaceutical sector [7].

STATISTICAL ANALYSIS

Student's t-test showed statistically significant differences between the studied parameters:

$$p < 0.05$$

This confirms the reliability and scientific validity of the observed differences [6].

EXPANDED CONCLUSION

The results of this study clearly demonstrate significant technological and biopharmaceutical differences between suppositories produced in Uzbekistan and those manufactured in European countries.

European suppositories showed superior performance in all evaluated parameters, including bioavailability, stability, melting characteristics, and overall pharmaceutical quality. The average bioavailability of European products reached 96%, which was approximately 7–





8% higher than that of Uzbek products. This difference is primarily attributed to the use of advanced pharmaceutical technologies, high-quality excipients, and strict compliance with international GMP standards [4,9].

In addition, European suppositories demonstrated higher stability and longer shelf life, which enhances their storage safety, transportation efficiency, and export potential. The statistical analysis confirmed that these differences were significant and scientifically reliable ($p < 0.05$) [6].

Although Uzbekistan's pharmaceutical industry has made considerable progress in recent years, further improvements are necessary to achieve international competitiveness. These improvements should include:

- *full implementation of GMP standards*
- *modernization of production technologies*
- *increased investment in pharmaceutical research*
- *improvement of quality control systems*
- *expansion of export-oriented production*

Implementation of these measures will significantly enhance the quality, safety, and global competitiveness of suppositories produced in Uzbekistan.

In the long term, technological modernization and international integration of Uzbekistan's pharmaceutical sector will play a crucial role in strengthening the national healthcare system and expanding its presence in the global pharmaceutical market.

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