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GLOBAL FEATURES AND MODERN TECHNOLOGIES IN THE PRODUCTION OF HERBAL-BASED OINTMENTS AND CREAMS

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Abstract: Herbal-based ointments and creams have gained significant attention in the global pharmaceutical and cosmetic industries due to their natural origin, therapeutic potential, and favorable safety profile. The increasing demand for phytopharmaceutical and cosmeceutical products has stimulated the development of advanced manufacturing technologies and quality control systems. This paper discusses the major global features of herbal ointment and cream production, including the use of standardized plant raw materials, implementation of Good Manufacturing Practice (GMP) and Good Agricultural and Collection Practice (GACP) standards, and the application of environmentally sustainable "green" technologies. Special attention is given to modern biotechnological approaches, including plant cell culture technologies, nanoemulsions, liposomes, phytosomes, and controlled-release delivery systems, which improve the stability, bioavailability, and therapeutic efficacy of herbal formulations. The study also highlights the importance of microbiological safety, analytical standardization, and innovative packaging technologies in ensuring product quality and stability. Furthermore, the rapid development of the cosmeceutical sector and the integration of pharmaceutical and cosmetic sciences are discussed as important trends in the global market. Overall, herbal ointment and cream production continues to evolve toward safer, more effective, and environmentally sustainable formulations with broad applications in dermatology, cosmetology, and regenerative medicine.

Keywords: Herbal ointments; Herbal creams; Phytopharmaceuticals; Cosmeceuticals; Nanoemulsions; Liposomes; Phytosomes; Green technologies; GMP; GACP; Biotechnological production; Plant extracts; Drug delivery systems; Dermatology; Regenerative medicine.

The production of herbal-based ointments and creams is one of the fastest-growing sectors of the global pharmaceutical and cosmetic industry. Contemporary trends are focused on the utilization of natural phytocomponents, environmentally sustainable technologies, quality standardization, and the implementation of innovative biotechnological approaches.

A major characteristic of herbal ointment and cream manufacturing is the complexity of plant-derived raw materials. Unlike synthetic substances, plant extracts contain multicomponent complexes of biologically active compounds, including flavonoids, terpenoids, alkaloids, tannins, essential oils, saponins, and polyphenols. Consequently, strict quality control is required throughout all stages of production, beginning from plant cultivation and harvesting to the release of the final product. International standards such as Good Agricultural and Collection Practice (GACP) and Good Manufacturing Practice (GMP) are widely implemented worldwide to regulate the quality of medicinal plant materials and manufacturing processes.

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One of the key global trends is the transition toward “green” manufacturing technologies. Manufacturers aim to reduce the use of organic solvents, synthetic emulsifiers, and preservatives. Instead, natural oils, waxes, lecithin, biopolymers, and biodegradable ingredients are increasingly employed. Considerable attention is also given to environmentally friendly packaging and the reduction of the carbon footprint associated with production.

At the global level, biotechnological methods for obtaining plant-derived compounds are actively developing. One of the most advanced technologies involves the in vitro cultivation of plant cells and tissues. This approach enables the production of standardized biologically active substances independent of climatic conditions, seasonal variations, and limitations of natural resources. Such technologies are particularly widespread in Europe, South Korea, Japan, and the United States for the manufacture of premium-class cosmeceutical creams and phytopharmaceutical products.

Another important feature is the application of advanced emulsion technologies. To enhance the bioavailability of phytochemicals, the following systems are widely utilized:

-nanoemulsions;

-liposomes;

-phytosomes;

-microemulsions;

-controlled-release delivery systems.

These technologies improve the penetration of active compounds through the skin, increase product stability, and prolong therapeutic efficacy. In international practice, low-energy self-emulsification and nanohomogenization technologies are developing particularly rapidly.

An additional challenge in the production of herbal formulations is the high sensitivity of plant-derived components to microbial contamination, oxidation, and light exposure. Therefore, global manufacturers implement:

-aseptic manufacturing conditions;

-microbiological quality control;

-antioxidant stabilization systems;

-hermetically sealed packaging;

-vacuum mixing technologies.

Microbiological safety control is especially critical for preparations containing aqueous herbal extracts.

In global manufacturing practice, herbal creams and ointments are also characterized by rigorous standardization of active compounds. Analytical techniques commonly employed include:

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High-Performance Liquid Chromatography (HPLC);

Gas Chromatography–Mass Spectrometry (GC–MS);

spectrophotometry;

chromatographic mass spectrometry.

These methods enable the quantitative determination of marker compounds and ensure the reproducibility of pharmacological activity.

The modern global market demonstrates a growing integration of pharmaceuticals and cosmetology, which has led to the rapid development of cosmeceuticals — products combining therapeutic and cosmetic properties. The most demanded creams and ointments are based on:

Calendula officinalis;

Aloe vera;

Centella asiatica;

Chamomilla recutita;

Arnica montana;

Cannabis sativa;

Curcuma longa.

Such products are extensively applied in dermatology, cosmetology, regenerative medicine, and anti-aging therapy.

Thus, the global production of herbal-based ointments and creams is characterized by:

1. strict quality standardization;
2. implementation of GMP and GACP standards;
3. integration of biotechnological methods;
4. application of nanotechnologies and advanced emulsion systems;
5. environmentally sustainable manufacturing approaches;
6. enhanced microbiological control;
7. orientation toward sustainable and green production;
8. rapid development of the cosmeceutical sector.

In conclusion, the production of herbal-based ointments and creams currently represents one of the most innovative and promising sectors of the global pharmaceutical and cosmetic

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industry. The growing demand for these products is associated with the increasing interest in natural, safe, and biologically active plant-derived compounds. Modern manufacturing processes are organized in accordance with GMP and GACP standards to ensure the quality, safety, and therapeutic efficacy of the final products.

Furthermore, the implementation of biotechnological approaches, nanoemulsion systems, liposomal and phytosomal delivery technologies significantly enhances the bioavailability of plant constituents, improves formulation stability, and prolongs pharmacological activity. The transition toward environmentally sustainable and "green" technologies has also become an important factor contributing to the sustainable development of pharmaceutical and cosmetic manufacturing.

In the future, the production of herbal ointments and creams is expected to further advance through the development of innovative drug delivery systems, standardized phytocomponents, and the expanding cosmeceutical sector. These advancements create broad opportunities for the development of next-generation formulations with enhanced efficacy in dermatology, cosmetology, and regenerative medicine.

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