

FOREIGN SCIENTIFIC SUPERVISOR'S REPORT

**for the dissertation work of PhD student Assel Baidildayeva on the topic
“Research of microencapsulation technology of leather for footwear of people
with pathological deviations of the feet” submitted for the degree of Doctor of
Philosophy (PhD) in the educational program 8D07211 – Leather goods
industry**

Footwear plays a crucial role in protecting the feet from external factors, with material selection being a key determinant of its effectiveness. Natural materials, such as textiles and leather, are favoured choices. Diverse studies aim to improve shoe materials, primarily by incorporating additives such as microencapsulated essential oils, aloe extracts, natural minerals, and bioactive silver ions, to enhance physical, mechanical, and hygienic properties.

Factors like increased humidity, temperature variations, foot perspiration, and shoe-skin proximity can incite bacterial and fungal growth, leading to potential infections. Therefore, enhancing the antimicrobial properties of materials is critical for advancing footwear of people with pathological deviations of the feet.

The scientific work done by the candidate was focused on the exploration of microencapsulation technology for leather footbeds and linings. In this study, spray drying, a method known for its high encapsulation efficiency and rapid processing was used to encapsulate Laurel essential oil. Chitosan was chosen as the shell polymer due to its proven antimicrobial properties in the footwear industry.

The Laurel essential oil-loaded microparticles were applied to leather footbeds and linings using two techniques: spraying and dip-coating. Between the two used methods, it was demonstrated that the spraying method is a more appropriate technique for applying microparticles to the leather footbeds and linings than the dip-coating method. Because it showed spray applications resulted in a more uniformly distributed layer of microparticles beneath a thin, continuous coating.

The resulting microparticles notably displayed a remarkably spherical shape, uncommon for this method, attributed to meticulous emulsion preparation processes. The microparticles were characterized through techniques including scanning electron microscopy, particle size measurement, Fourier transform-infrared spectroscopy, and evaluation of production yield. Key factors such as encapsulation efficiency, oil loading, and in vitro oil release were assessed. A comparative analysis of antimicrobial properties in leather footbeds was conducted, evaluating different application techniques and finishing solutions, including Laurel essential oil, Laurel essential oil-loaded microparticles, and blank chitosan microparticles. Additionally, the potential medical applications of these findings were explored. This research aims to enhance shoe antimicrobial properties through a detailed analysis of application techniques and finishing solutions, in response to the growing emphasis on footwear hygiene and foot-related issues.

The analytical findings of this research work verified that applying laurel oil-chitosan microparticles on leather footbed surfaces offers a successful, all-natural



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hygienic control method. Research study suggests that advancements in production methodologies have the potential to substantially enhance foot health and hygiene. In addition, employing this optimized method has a significant potential to manufacture footbeds with a rapid and enduring antimicrobial effect. Therefore, this work is promising, especially for the footwear industry, for footwear of people with pathological deviations of the feet.

The majority of research work was conducted in the laboratories of Ege University and Dokuz Eylul University, located in Izmir, Turkiye. Assel Baidildayeva completed her scientific internship in January-February 2022. And did all research work in accordance with the requirements. Based on the results, one article was published on the basis of Web of Science and Scopus, and one article was published in an international conference indexed on Scopus.

After analysis of the thesis, it is my opinion, as a foreign scientific supervisor, that Baidildayeva Assel Kuanyshevna has the full conditions to be awarded the Doctor of Philosophy (PhD) degree in the educational program 8D07211 – Leather goods industry. (03.12.2025)


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17/03/2026