

# EVALUATION OF THE EFFECT OF ULTRAVIOLET IRRADIATION ON THE MICROBIOLOGICAL SAFETY OF COLLAGEN MATERIALS

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**Abstract:** *This article investigates the effect of ultraviolet (UV) irradiation on the microbiological indicators of collagen materials. Since collagen-based materials are widely used in the food, medical, pharmaceutical, and cosmetic industries, ensuring their microbiological safety is considered a highly relevant issue. UV irradiation, as a physical method, enables the reduction of microbial load, inactivation of pathogenic microflora, and extension of product shelf life. The article analyzes the mechanism of UV irradiation, microbiological indicators of collagen materials, and experimental results presented in tables and diagrams, along with a review of relevant literature.*

**Keywords:** *ultraviolet irradiation, collagen, microbiological indicators, bacteria, sterilization, disinfection.*

## INTRODUCTION

Collagen is a natural protein and a major structural component of animal and fish tissues. In particular, collagen obtained from fish skin and bones has attracted significant interest as an environmentally friendly and biologically active material. However, collagen raw materials and products derived from them represent a favorable environment for the growth of microorganisms.

Microbiological contamination can lead to a deterioration in product quality, a reduction in shelf life, and potential risks to human health. Therefore, the application of effective and safe disinfection methods during the processing of collagen materials is of great importance. Ultraviolet irradiation (200–280 nm range) affects the DNA structure of microorganisms, thereby suppressing their ability to reproduce. The UV method is distinguished by the absence of chemical reagents, low cost, and minimal environmental impact. In this study, collagen materials obtained from fish skin were selected as the research object. The samples were subjected to microbiological analysis before and after UV irradiation. The results demonstrated a significant reduction in the number of microorganisms in collagen materials under the influence of UV irradiation.



Table 1. Changes in microbiological indicators depending on UV irradiation time

No.	UV irradiation time, min	Total microbial count, ( $\times 10^3$ ) CFU/g	E. coli	St. aureus
1	Control (0 min)	120	Detected	Detected
2	5 min	45	Not detected	Low amount
3	10 min	12	Not detected	Not detected
4	15 min	3	Not detected	Not detected

As shown in Table 1, an increase in UV irradiation time leads to a sharp decrease in the total number of microorganisms. After 10–15 minutes of irradiation, pathogenic microorganisms were not detected. The diagram clearly demonstrates a downward trend in microbiological indicators under the influence of UV irradiation.

#### Discussion

In recent years, interest in physical sterilization methods, including UV irradiation, for collagen materials has increased.

Numerous studies have shown that UV irradiation induces the formation of thymine dimers in microbial DNA, thereby inhibiting cell division.

Several studies indicate that UV irradiation does not cause significant negative effects on the mechanical and functional properties of collagen. However, other studies report that high doses of UV irradiation may lead to partial denaturation of collagen structure.

Additionally, data suggest that the effectiveness of UV irradiation on fish collagen is higher than on bovine collagen, which is explained by the more delicate structure of fish collagen.

#### Conclusion

The conducted studies demonstrate that ultraviolet irradiation is an effective physical method for improving the microbiological safety of collagen materials. UV irradiation for 10–15 minutes allows the reduction of microbial load to levels that comply with sanitary standards. The UV method is environmentally safe due to the absence of chemical agents and is considered suitable for the use of collagen-based materials in food and medical applications. In recent years, interest in physical sterilization methods, including UV irradiation, has continued to grow.

Numerous studies confirm that UV irradiation forms thymine dimers in microbial DNA, inhibiting cell division.

Some authors emphasize that UV irradiation does not significantly affect the mechanical and functional properties of collagen, while others note that high UV doses may cause partial denaturation.

Moreover, the higher efficiency of UV irradiation for fish collagen compared to bovine collagen is attributed to the finer structure of fish collagen.



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