# ABSTRACT

The aim of the research was to determine the capacity of reactive forms of resistance to the action of yeast and filamentous fungal ultraviolet radiation type C. To achieve this goal was pursued attending the following objectives:

- To establish a reproducible experimental model to test the effect of ultraviolet radiation type C on some strains of filamentous fungi
- To study the germicidal action of type C ultraviolet radiation on yeast and filamentous fungi are in the form of matter and form pellicular
- Testing the reactive capacity of organized yeast fungi form biofilms;
- Test the action of decontaminating type C ultraviolet radiation in laboratory conditions
- Testing decontaminating action of type C ultraviolet radiation under a pilot.

To achieve these goals has been made electromagnetic radiation generating plant type UVC with a wavelength of 254 nm, while programmable. The facility offered biological and radiological safety conditions for conducting experiments.

Theses comprise a total of 254 of pages. The level of knowledge, consists of 59 pages, representing 23,33% of the work consists of four chapters that are aggregated data of 256 selected bibliography sources of Romanian and foreign literature related to the topic.

Part II the (personal research) - is carried out over 185 pages, representing. 76,67% of the work. Personal research results are presented in seven chapters, following the purpose and objectives, and finally general theses ends with conclusions, recommendations and references. Each chapter is composed of material and working method, results, discussion and partial conclusions.

Research has been conducted in the laboratories of veterinary hygiene and environment-mycotoxicological Zoo-hygiene and Mycology of the Faculty of Veterinary Medicine, University of Agricultural Sciences and Veterinary Medicine „Ion Ionescu de la Brad" Iasi.

These laboratories with their annexes, like special animal housing offered the necessary performance objectives.

In Chapter VI of this thesis are the results of implementation and testing of an experimental model for studying the effect of type C ultraviolet radiation. We made a generating facility type C ultraviolet radiation with a wavelength of 254 nm, timed, needed in further studies. CID effect of UVC radiation was tested on six strains of filamentous fungi: *Aspergillus niger, Aspergillus flavus, Aspergillus fumigatus, Aspergillus ochraceus, Neosartorya fischeri* and *Aspergillus terreus.*

The installation provides the possibility of performing experiments in biological and radiological safety conditions. The experiments were conducted in a specially arranged site - test mode - isolated from the outside, allowing the control and maintenance of microclimate parameters during testing.

The analysis results showed that the strain with the highest sensitivity to UV radiation is Aspergillus terreus, and the resistant strain is Aspergillus niger. As we have seen, the differences in sensitivity between species are not statistically significant (≤0.05), but increasing the value of p denotes a staggering degree of sensitivity: *A. niger.* < *A. flavus* < *A. fumigatus* < *A. ochraceus* < *Neosartorya* < *A. terreus.*

The scientific data presented in Chapter VII concerns the study of type C ultraviolet radiation action on filamentous fungi and yeast. Purpose of the research was to track and quantify the effect of fungicide of type C ultraviolet radiation (λ = 254 nm) from the filamentous fungal strains (*Aspergillus niger, Aspergillus flavus, Aspergillus ochraceus, Aspergillus fumigatus, Penicillium roqueforti, Penicillium crysogenum*) and yeast (*Candida albicans strain ATCC 10231, Candida dubliniensis, Saccharomyces cerevisiae* and *Rhodotorula rubra*).

This study sought to determine the RUV-C germicidal capacity in fungal spores are in dry form (dry film spore suspension slowly desiccated to room temperature) and liquid (suspension of spores).

Filamentous fungi spores had a similar sensitivity of the two experimental models described. From the species tested, spores of *A.niger*, proved to be the most resistant, these being destroyed at a rate of 99.99% just after irradiation for 30 minutes or 60 minutes in both modes of exposure to fungal spores the RUV. *A.ochraceus* spores of the species were most sensitive, being reduced by RUV-C in amounts exceeding 99.9%, regardless of time of physical contact between them and the agent being tested.

From the two tested species belonging to the genus *Penicillium*, the most resistant *Penicillium roqueforti* with a reduction percentage < 99% compared with *Penicillium crysogenum* whose index of logarithmic reduction ≥ 3. Yeast fungi species tested showed a high

sensitivity to ultraviolet irradiation type C ratios had lower logaritmic reduction ≥ 3, respectively, reduction percentages of over 99.99%, values indicating a strong antifungal effect.

The results of fungi organize in biofilms, reactive capability on the action of ultraviolet-C radiation are presented in Chapter VIII of this work. To test the effect of type C ultraviolet radiation on fungal biofilms, the experimental protocol followed two stages: the selection of strains producing and testing biofilms known radiation conditions. Selection of strains producing biofilms was performed in a total of 150 strains belonging to the genera *Candida* and *Saccharomyces* isolated from different sources: fungemii immunocompromised patients (oral thrush, vaginal candidiasis balances, denture stomatitis, oropharyngeal candidiasis), from semen breeding boars and from food industry, like dairy sour.

50 strains were chosen which proved to be generating biofilms after repeated tests. We identified 27 strains of *Candida parapsilosis*, 5 isolates of *Candida krusei*, *Candida glabrata* strains 6, 8 strains of *Candida albicans*, *Candida norvegensis* strain, a strain of *Candida catenulata*, a strain of *Candida pelliculosa* and *Candida tropicalis* strain. Phase II of the study researched the effect of type C ultraviolet radiation on yeast biofilms for 24 hours and 48 hours, made on two types of surfaces: plastic wells and sterile watch glass.

UV doses applied to biofilms formed in wells were appropriate irradiation distance of 50 cm and the contact time biofilm-RUV-C for 5 minutes, 15 minutes, 30 minutes and 60 minutes. The values of these doses were: 9,3 mW*s/cm$^2$, 27,91 mW*s/cm$^2$, 55,82 mW*s/cm$^2$ şi 111,65 mW*s/cm$^2$. After irradiation, developed biofilms on the flat surface was observed to obtain cid insignificant effect by irradiation of 50 cm for 5, 15 or 30 minutes or a destructive effect evident after irradiation for 60 minutes. We observed an effect of reducing the number of colony forming units on biofilms developed after irradiation on the clock glass surface, after irradiation for 60 minutes by placing the UV lamp at both 20 cm and 50 cm. Cid total effect was obtained by prolonging the contact time to 90 minutes regardless of distance and duration of irradiation on formed biofilm.

Chapter IX contains the results obtained by testing the ability of decontaminating RUV C in laboratory conditions. The purpose of this research was to assess the antifungal effect against ultraviolet radiation applied on suspensions of *Candida albicans ATCC 10231* spores, *Alternaria tenuissima* and *Aspergillus niger*, by putting both seeded plates under UV lamp at a distance of 1 m and the lateral left and right, so the angle of UV light and Petri dishes to be 45 degrees.

This study was motivated by the practical applicability of ultraviolet radiation generating sources used in various medical and industrial facilities in order to decontaminate various surfaces, but also to reduce fungal load in the air. The results showed that, in terms of strains irradiated type yeast species, *Candida albicans ATCC 10231* was found to be most sensitive to

this adverse factor, the total effect being met at all cid plates placed perpendicular to the sources irradiation, regardless of length of exposure to UV radiation action. These results correspond with results obtained in previous examinations that studied the effect of RUV cid type C on yeast fungi are able plankton.

As the result obtained by placing the plates seeded with yeast suspension side of the UV source such that the angle of UV light and Petri dishes to be 45 °, it can be concluded that the effect of these yeasts cid is diminished compared with the effect obtained fungi plates placed under UV lamp. Lowest sensitivity to UV radiation fungicidal action was present in the species Aspergillus niger. This strain was not reduced completely, even after the longest contact times studied, 6 and 12 hours. However, fungal load reduction was obtained only after 6 hours of continuous irradiation of plates placed perpendicular to the UV source.

The results obtained from testing the ability of decontaminating RUV C under a pilot are presented in Chapter X of this thesis. The aim of the research was to assess the antifungal effect of type C ultraviolet radiation generated by an artificial source, the fungal load in the air and some existing areas in a pilot station in which broilers were reared on permanent litter. The research was carried out in stages by successive irradiation and then we assessed the effciency of decontamination in air and surfaces in the room.

After the first experiment, by placing the UV lamp at 2 m height, length of membership of reductions percentage was set between 20.51%, after irradiation for 120 minutes and cleaning, and 98.25%, after irradiation for 60 minutes and cleaning. We also have obtained a reduction of 98.22% after completing the experiment T11 (360 minutes of UV action after toilet cleaning fluid). Mechanical cleaning carried out after irradiation resulted in a reduction of fungal load in air of 68.71% after 30 minutes of UV action and 85.44% after 60 minutes of UV irradiation. Irradiations for 30 and 60 minutes made after cleaning have yielded some reducing of 91.03% and 98.25% compared to the number of registered air UFC/m3 after sanitation operation.

By placing the UV lamp at a distance of 1.5 m from the floor, the percentage of reductions fungal load in air values were above 69.50%. Thus, after continuous irradiation period of 30 minutes was performed after mechanical cleaning, micoaeroflorei obtained was with 81.01% decrease. We also obtained a percentage reduction of 92.29% after 60 minutes of UV irradiation after mechanical cleaning. Irradiation performed for 120 minutes after mechanical cleaning, the percentage of airborne fungal load reduction was 73% and after 360 minutes of action UV reduction was 93.77%.

After hydro-sanitary cleaning and irradiation of 1.5 m for 30 minutes reduction percentage was 69.50%. The values of air fungal load were 85.63% and 90.64% and this reduction was achieved after irradiation for 60 and 120 minutes post-sanitary cleaning fluid. The

largest percentage reduction in air fungal load of 98.03%, was obtained after application of radial flow UVC for 360 minutes and then compared to the number of registered air UFC/m3 after sanitation operation.

Also, during the experiment we observed the persistence of genera *Aspergillus* and *Cladosporium* fungi, regardless decontamination tehnique used or UV irradiation applied time. Also it can be observed the absence of fungi from genus *Scopulariopsis* after irradiation for 30 minutes and mechanical cleaning. Micromicetes genus *Penicillium* were grown in open Petri dishes during the experiment after the first eight experimental mommets (T1. .. T8), then these fungi can not be found on the medium plates. Fungi of the genus *Fusarium* had a constant dynamic, just like they are absent after irradiation of 30 and 360 minutes and after mechanical cleaning and after last irradiation.

A particular strength was shown by Mucoraceae family, as well as those of the genus *Aspergillus* var. *Glaucus* as they have increased the average area of cultivation and the plates exposed for longer times on irradiation (60, 120 and 360 minutes) after hydro-sanitary cleaning. After the second experiment, by making mechanical cleaning pilot plant has generated an increase in fungal load of 7.91 times in the air. After conducting a decontamination UV contact time of 30 minutes (T3), the number of airborne fungi was reduced by 91.55% compared with the existing load in the air after mechanical cleaning. Also, increasing the duration of irradiation at 60 minutes resulted in a percentage reduction of 91.45% compared to the value recorded after the first operation of sanitation.

After the experiment T5, corresponding to irradiation for 120 minutes, the percentage reduction was 65.18%. By increasing the contact time between air flow and radiant site at 360 minutes we have obtained for the percentage reduction of 95.43% fungal load compared to the value recorded after mechanical cleaning.

The second operation of sanitation, clean hydro-health, had the effect of reducing fungal aeroflorei a rate of 77.82% compared with the amount recorded as T2. UV irradiation for 30 and 60 minutes caused reduction in fungal load after cleaning by 87%, or 73.55%. The use of irradiation for 6 hours led to obtaining a 91.48% reducing the fungal load recorded by hydro-sanitary cleaning.

On the surface during the first determinations we observed strong fungicidal effect on fungal flora of most surface analysis after continuous irradiation for 360 minutes. Thus, reducers were obtained 94.93% of the fungal load in the wall, floor level 95.02% and 67.33% in the metal grille. After the second series of tests, most obvious cid effect on fungal flora of the area under study was obtained after 120 and 360 minutes of UV irradiation, the values of reductions

percentage over 50, 91.66% on the wall above floor level and over 99% at water recipients and metallic grid.

The general conclusions of this study are presented in Chapter XI. The paper concludes with the presentation of recommendations and listing the major bibliographic titles analyzed.