MICROBIOLOGICAL ASSESSMENT OF AIR QUALITY IN A PLANT PROCESSING FACILITY

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INTRODUCTION

Nowadays, raw plant materials are increasingly used in many industries, primarily in food processing, cosmetology, and medicine. Care for health and safety at work means that, in recent years, more and more attention has been paid to the fact that employees of plants processing raw materials of plant origin may be exposed to many harmful factors (chemical and biological pollution, mechanical vibrations, noise, electromagnetic fields, lighting, static electricity, and changing microclimate). Because the production rooms of plants processing raw plant materials are a specific environment, concerns expressed by employees are increasingly related to the health effects associated with exposure to biological aerosols. In industry, additional sources of biological aerosol are production and processing. In this situation, it is necessary to determine the degree of microbiological pollution of the work environment in this type of plant and the potential health effects resulting from the inhalation of microbial particles.

THE AIM OF THE STUDY

The aim of the study was to assess bacterial aerosols in a plant processing facility in Poland.

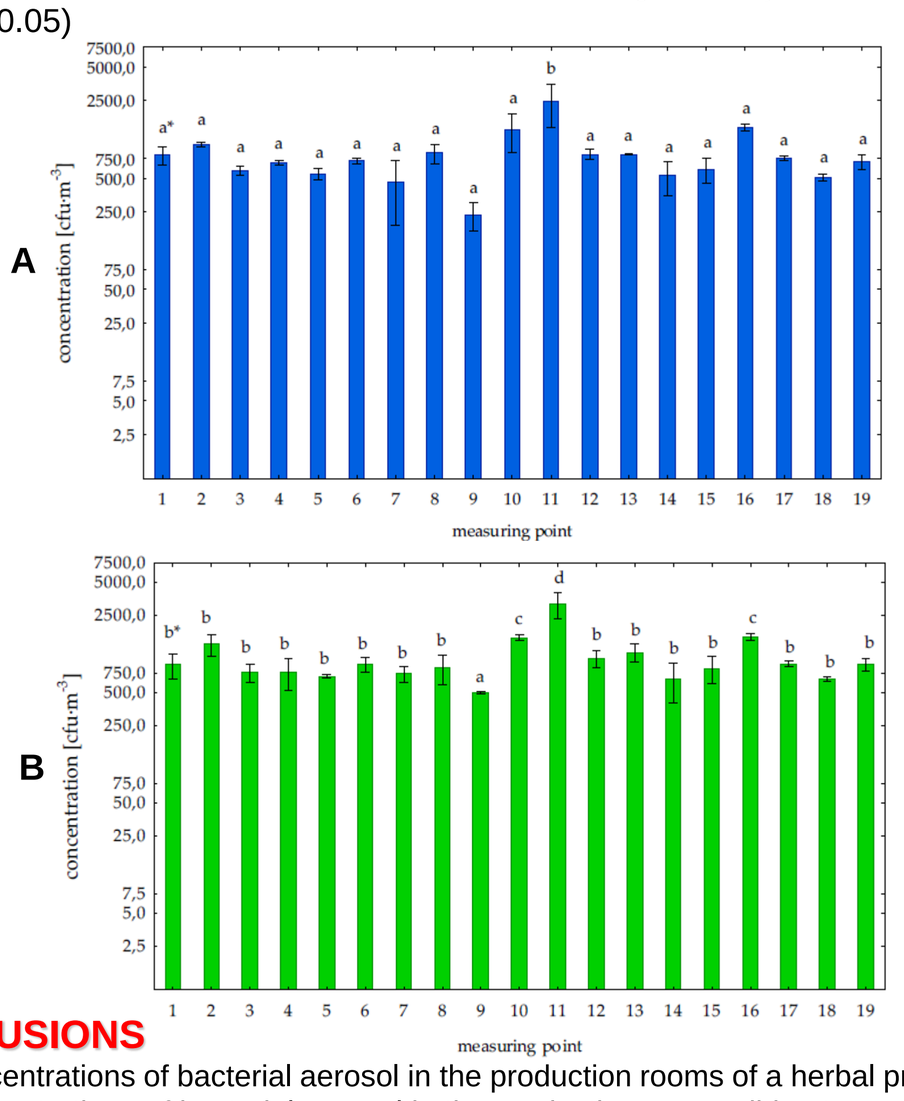
MATERIALS AND METHODS

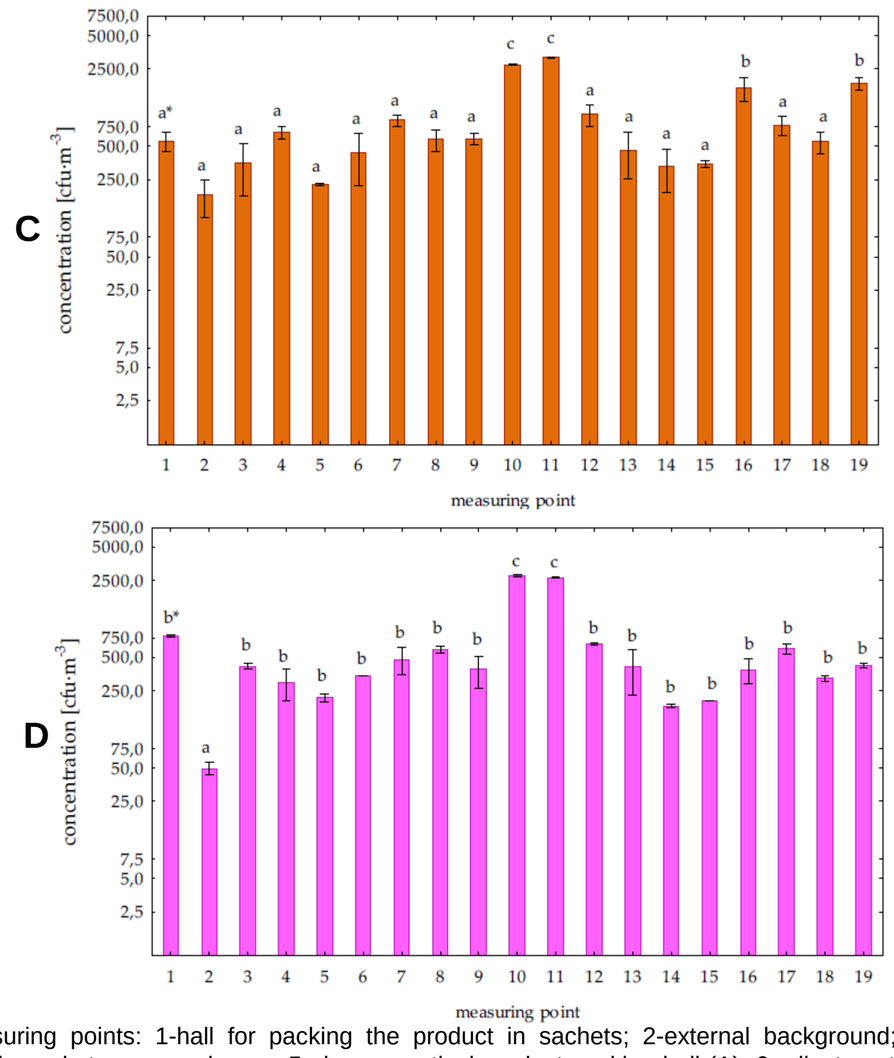
The study was carried out on the premises of a herbal processing plant in Poland. The selected herbal processing facility produces food and medicinal products based on herbs. The study object was a 3-storey production building. In the facility, 17 measuring points were selected, located along the plant's technological line, starting from the admission chamber for raw plant materials and ending with the final product warehouse. Bioaerosol samples were also collected at a point designated outside the plant for the determination of the "external background" and inside the facility, in a room separate from the production rooms for the determination of the "internal background" (a total of 19 measuring points). Bioaerosol measurements were carried out in a seasonal cycle (in spring, summer, autumn, and winter), twice each season. The samples at each of the measuring points were collected during the day and during facility operating hours with the normal routine production process. The air samples were collected by using a six-stage Andersen's cascade sampler. Bacteria were collected on tryptic soy agar with a 5% addition of defibrinated sheep blood. After collection and incubation, the bacterial colonies were counted. The concentration of bioaerosol was calculated as the number of colony forming units per cubic meter of air (cfu·m^{-3}). At each measuring point, during the bioaerosol sampling, the relative humidity and air temperature were simultaneously measured using the Kestrel 5000 device, and the concentration of particulate matter (fraction 1.0 µm, 2.5 µm, 4.0 µm, and 10.0 µm) was measured using a DustTrak II dust analyzer. All bacterial strains isolated from the air were identified using the MALDI-TOF MS technique.

RESULTS

Fig. 1. Average concentrations of bacterial aerosols (cfu·m^{-3}) (± SD) in the external environment and the production rooms of a herbal processing facility: (A) spring season, (B) summer season, (C) autumn season, (D) winter season

***averages** marked with the same letters are not significantly different by Tukey's test (α = 0.05)





measuring points: 1-hall for packing the product in sachets; 2-external background; 3-mixer charge; 4-active substance warehouse; 5-pharmaceutical product packing hall (A); 6-adjustment hall; 7-dryer hall; 8-Siebler packing hall; 9-pharmaceutical product packing hall (B); 10- packing hall-Cofpack automatic packaging; 11-offices (internal background); 12-chamber of admission of raw materials plant; 13-active substance production hall; 14-warehouse of output materials after quality control; 15-final products warehouse; 16-mixer room; 17-the Cofpack line charge; 18-the Siebler line charge; 19-weighing room.

Fig. 2. Particle size distributions of bacterial aerosols in the measuring seasons: a) spring, (b) summer, (c) autumn, (d) winter-in three groups of measuring points: ¬ external background, ¬ internal background, ¬ production rooms

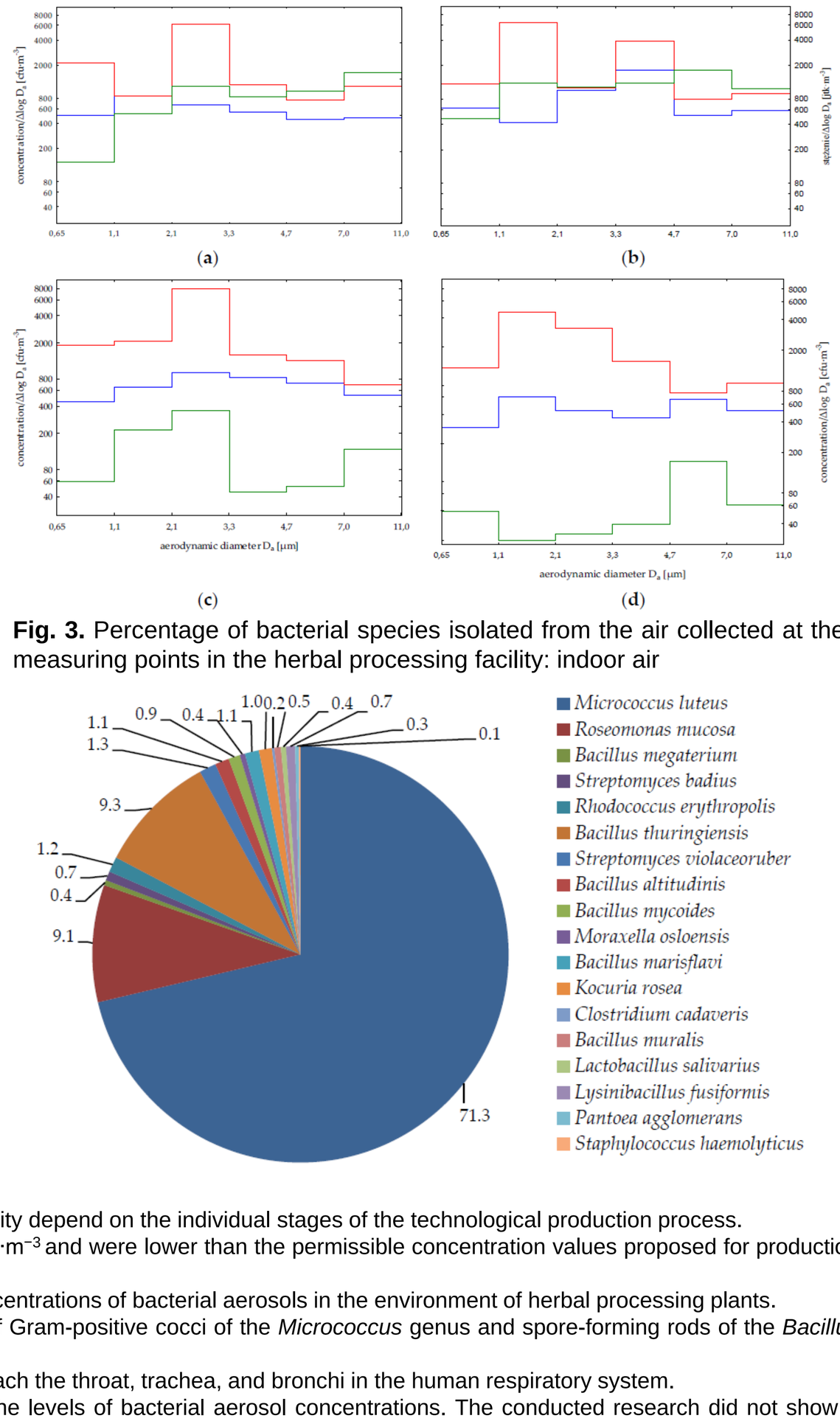


Fig. 3. Percentage of bacterial species isolated from the air collected at the measuring points in the herbal processing facility: indoor air

CONCLUSIONS

- The concentrations of bacterial aerosol in the production rooms of a herbal processing facility depend on the individual stages of the technological production process.
- The concentrations of bacterial aerosol in the production rooms did not exceed 7.6·10^3 cfu·m^{-3} and were lower than the permissible concentration values proposed for production rooms contaminated with organic dust.
- The results indicate that seasonal variability is a very important factor that impacts the concentrations of bacterial aerosols in the environment of herbal processing plants.
- The qualitative analysis of microorganisms isolated from the air showed the dominance of Gram-positive cocci of the *Micrococcus* genus and spore-forming rods of the *Bacillus* genus, i.e. microorganisms typical for an indoor environment.
- The analysis of particle size distribution showed that the "load" of bacterial particles can reach the throat, trachea, and bronchi in the human respiratory system.
- The results showed that air temperature had a statistically significant positive effect on the levels of bacterial aerosol concentrations. The conducted research did not show a significant correlation between the concentration of bacterial aerosol and the concentration of particulate matter.