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AIR MICROBIAL QUALITY IN THE FACTORY FOR CONFECTIONARY PRODUCTS

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Abstract

The atmosphere in food factories may not be the first concern as a source of microbial contamination, but in most cases it is certain that contain airborne microorganisms, some of which may cause product spoilage, or be food borne pathogens. Some types of bacterial and fungal spores survive remarkably well in the atmosphere.

In the absence of mandatory standards, it makes good sense for individual food businesses to examine the need for control and monitoring of airborne microbes using a HACCP approach, taking into account the vulnerability of product and process, the surrounding environment and other factors.

During our research, performed in confectionary factory with implemented HACCP system, we collected data from microbiological analysis of following groups of microorganisms: Total number of bacteria, and number of yeasts and moulds in:

- Air (production area, packaging area)

- Water (production area)

Results analysis showed higher number of pathogenic microorganisms in the air. In conclusion we can add that controlling levels of microbial contamination in the air around sensitive processing and packing operations are becoming important part of hygienic food manufacturing in recent years.

Research shows that the effective control measures, for controlling level of air borne microorganism are:

– Controlling the frequency of filters change in food processing areas and packaging areas

– Application of suitable cleaning methods

– Positive/negative pressure control.

Key words: *Airborne microorganisms, air, positive pressure/negative pressure.*

1. Introduction

Are there microorganisms in the air that can contaminate food products? What is the permitted number of pathogen microorganisms in one cubic meter (m^3) of air?

When there is no air contamination standards/rules, do companies need to examine the microbiological air contamination?

It is interesting to mention that in practice the analysis of water, contact surfaces, swabs taken from employees and raw materials show results which are within referenced values, and we eliminate them as a potential source of microbiological contamination. However, very often, the air analysis shows presence of microorganisms in greater numbers compared to the previously listed sources, thus presenting a real threat for the safety of food products.

Due to this, we have decided to make several subsequent analyses of air and water in order to compare the count of microorganisms. The results of several subsequent analyses showed that the number of microorganisms is highest in the air, underlining the air as a significant source of microbiological contamination.

One way to significantly reduce the risk of microbiological contamination of food products is to establish effective control measures for preventing microbiological air contamination.

This, of course, points to the need of establishing international standards for critical limits (Kakurinov [3]) of microbiological air contamination, which on one hand would be of great importance for the hygienic design of food production facilities, and on other hand it would enable us to establish an effective control on the level of microorganisms in the air.

2. Materials and Methods

The examinations were made in the production plant of a confectionery production company. The locations from which the samples were taken are listed in Table 1.

Table 1. Locations for taking samples for microbiological analysis

Location	Water	Air (height)
Production line	Tap no. 1	Floor
		1-1,5 m
		3 m
Packing department	Tap no. 2	Floor
		1-1,5 m
		3 m

During the research the focus was put on establishing the total count of microorganisms, and the count of yeasts and fungi from the water and air on two selected locations within one confectionary factory:

a) The production line,

b) The packing department (physically separated from the production plant).

3 measurings were performed, during which the samples were taken at the same locations. The time interval between each measuring was 14 days, in a total time frame of 45 days.

The examinations were made in authorized laboratories. The number of microorganisms in the air was examined by the Microbiological Laboratory at the Faculty for Agricultural Sciences and Food, University St. Cyril and Methodius - Skopje, while the water was examined by the Microbiological Laboratory in the Public Health Institution, Public Health Institute of Republic of Macedonia, by using appropriate reference methods (Table 2).

Table 2. Reference methods for establishing the total number of microorganisms in the air and water and number of yeasts and fungi in the air

Sample /group of examined microorganisms	Method
Water / Total number of microorganisms	ISO 6222:1999 Water quality -- Enumeration of cultivable micro-organisms -- Colony count by inoculation in a nutrient agar culture medium
Air / Total number of microorganisms	ISO 4833:2003 Microbiology of food and animal feeding stuffs -- Horizontal method for the enumeration of microorganisms -- Colony-count technique at 30 degrees C
Air / Number of yeasts and fungi	ISO 7954:1987 Microbiology -- General guidance for enumeration of yeasts and moulds -- Colony count technique at 25 degrees C

The number of microorganisms in the air is expressed in microorganism / 1mL of water.

Each of the examined parameters has been measured five times. The obtained results are calculated as a mean arithmetical value, while the results of air and water were compared by using the comparative test method.

3. Results and Discussion

The results from the measurings are presented in Tables 3 and 4.

Table 3. Number of microorganisms in the production plant air and water

Measuring number:	Medium	Total number of microorganisms:	Yeasts and fungi	Medium	Total number of microorganisms:	Yeasts and fungi
1	Air	4×10^3	5×10^3	Water	N.D.	-
2		4×10^3	4×10^3		N.D	-
3		12×10^4	1×10^3		N.D	-

*ND - Not determined; - No growth

Table 4. Number of microorganisms in the packing department air and water

Measuring number:	Medium	Total number of microorganisms:	Yeasts and fungi	Medium	Total number of microorganisms:	Yeasts and fungi
1	Air	3×10^3	4×10^3	Water	N.D.	-
2		2×10^3	1×10^3		N.D	-
3		5×10^3	2×10^3		N.D	-

*ND - Not determined; - No growth

The comparison of the results obtained from air and water, shows that the count of microorganisms in the air is significantly higher than in the water, where in all subsequent measuring no microorganisms were found.

By comparing the results obtained from the production plant, with those obtained from the packing department, it can be concluded that *the contamination with microorganisms is more expressed in the production plant*.

The greatest number of microorganisms is detected in the third measuring in the production plant. The sample was taken during the cleaning of the plant, which points to the fact, that the manner of cleaning is an important factor contributing to high number of microorganisms in the air.

When comparing the two measurings showing greatest number of microorganisms, those of the production plant air and of the packaging department air, it can be concluded that the significantly greater number of microorganisms in the air of the production plant is proportional with the degree of production activity.

The results obtained show that the air is a major source of microbiological contamination which can affect the final product safety.

It is extremely important to underline that the greater number of microorganisms in the packaging department is by itself a risk factor for the final product safety. In this department, it is necessary to introduce and maintain a highest level of hygiene.

These results challenge us to continue with the research in this direction, and determine the real risk, caused by microbiological air contamination, for food safety.

The research which clearly establishes a link between the contaminated product and the air as a reason for that microbiological contamination, would clearly point out the need for developing an international norm defining the critical limits for microbiological contamination.

4. Conclusions

- In the current situation, when we lack a comprehensive research in this area, we need more comprehensive examinations of the presence of microorganisms, yeasts and fungi in the air as a medium, and of the probability for product contamination (Lawley et al. [2]).
- The results obtained in this research point to the fact, that the air is a source of microbiological contamination and an excellent vector for their transmission. Their number depends on the degree of hygiene, the type and the scope of production activity etc.
- These research accents the need to define effective control measures in the already established food safety systems and their regular validation (Lawley et al. [2]).
- This type of research can also offer effective solutions for hygiene engineering and design of unconstructed facilities, enabling to determine the possible risks even in the pre-construction phase, and to offer specific control measures. In this why the following things would be defined: the set up of the facility, the air flow in the facility, the relation of over-pressure/bellow-pressure, pre-entrance area, selection of production materials, direction of movement for employees, raw materials and products.
- In the production processes with open and semi-open production lines it is necessary to establish a methodology for determining the level of microbiological air contamination (Forsythe and Hayes [1]).
- Proposed measures which would prevent microbiological air contamination in the already existing facilities are as follows:
  - Defining for filters changing frequency in the cooling/ventilation systems.
  - Defining the manner of cleaning and possibilities for aerosols creation.
  - Defining frequency and type of movement in the production plants/packing departments and their communication with the other parts of the production plant.
  - Employee's hygiene.

5. References

[1] Forsythe S.J., and Hayes P.R. (1998). *Food Hygiene, Microbiology and HACCP*. Third edition, Aspen Publishers, Inc, Gaithersburg, Maryland

[2] Lawley R., Curtis L., and Davis J. (2008). *The Food Safety Hazard Guidebook*. Ars Lamina Publishing Ltd, Skopje, Macedonia.

[3] Kakurinov V., Srbinovska S., Petanovska I.B., Kolevska L., Kocarev P., Depinovska A., Sekulovski P. and Kostadinova K. (2006). *Food quality and safety: Glossary of terms*. Reprint, Skopje, Macedonia.