



MONITORING OF EMPLOYEES' PERSONAL HYGIENE IN THE FOOD PROCESSING PLANT AS A TOOL TO PREVENT FOOD-BORNE DISEASES

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ABSTRACT

One of the most vital elements of hygiene in the food industry is hand hygiene. The spread of germs from the hands of food workers to food is a common cause of food-borne diseases. From the point of view of the employees hand hygiene working in the food industry, it is not only important to use soap and regularly wash hands, but also to control the correct hand washing technique. The use of the bioluminescence method in food industry has its justification. The bioluminescence method is one of the new modern methods, the advantages of which are primarily speed, simplicity, time and personnel simplicity, easy manipulation, detection of the presence of impurities and the possibility of immediate correction. Currently, methods based on bioluminescence are starting to be used more and more widely. The application of bioluminescence in hygiene control is based on the measurement of the ATP (adenosine triphosphate)

amount found in all living cells or in their particles, as well as in microorganisms, in which it serves as an energy source. The amount of light released during the bioluminescence reaction of ATP (adenosine triphosphate) with specific chemical reagents is directly proportional to the amount of ATP, and therefore also to the amount of microorganisms. The course of reaction is very fast, the amount of light produced can be objectively quantified using a sensitive device (luminometer), which is able to capture and measure even a very small amount of light produced. In our work, we focused on the monitoring of worker's personal

hygiene working in a food processing plant using the ATP method. We evaluated the hand hygiene of workers working in the puff pastry production section and in the puff pastry packaging section before starting production, during production and the end of work shift. From the total 40 ATP swabs taken from workers working in the puff pastry production area, only two swabs were hygienically unsatisfactory. We detected contamination of the workers hands no. 2 and no.4. At the beginning of the work shift, we detected 570 RLU (relative light unit) on the hands of worker no.4. Before the end of the work shift, we detected 3652 RLU on the hands of worker no. 2. From the the total number of 20 swabs taken from workers working in the puff pastry packaging section only one ATP swab was unsatisfactory. An unsatisfactory swab was detected on the hands of worker no. 2 at the beginning of the shift with the number of 520 RLU.

KEYWORDS: Personal hygiene, ATP, Bioluminescence method, workers, Food-borne diseases.

INTRODUCTION

Food safety is an important part of public health linking health to agriculture and other food production sectors.^[1]

Microorganisms are part not only of the surrounding environment, but also of the internal environment of animals and humans. Some microorganisms can cause a decrease in the quality of raw materials in a food company and can contribute to the occurrence of illness in consumers. They are usually not detected by the human senses, and with incorrect or insufficient sanitation, microorganisms can contaminate products and cause foodborne illnesses.^[2]

According to the World Health Organization, unsafe food is responsible for 600 million cases and 420, 000 deaths each year globally.^[3]

Hand disinfection is cornerstone of infection prevention, and many studies have demonstrated that alcohol-based hand rubs are to be preferred over handwashing with water and soap. Hand disinfection can be carried out simultaneously with hand washing, as long as the soap used also contains disinfectant ingredients in sufficient concentrations.^[4] Hygienic hand disinfection must be carried out daily before starting work, when working with suspicious material, infected or pathogenic material, after using the toilet and every time it is

necessary.^[5] Repeated hand washing is mandatory during working hours whenever handling raw food, soiled dishes, cleaning tools or other contaminated objects.^[6]

Hygiene control of employees hands from the point of view of food-borne diseases prevention has its justification. Currently, methods based on bioluminescence are increasingly being used to control hand hygiene.^[7]

Control of disinfection efficiency using the bioluminescence method is based on the principle of determining adenosine-5'-triphosphate in biological material and using it to determine the number of microorganisms. Every living, dead and non-decomposed microbial cell contains ATP, which represents a source of energy for microorganisms and is an indicator of viability.^[8]

The disadvantage of using the classic microbiological method is the cultivation of microorganisms on the plates, which takes several days. On the other hand, bioluminescence method offers fast results and should therefore be more valuable. In a comparative study from 2021, the effectiveness of the disinfectant polyhexamethylene biguanine in different concentrations on the viability of *Staphylococcus aureus* and *Aspergillus brasiliensis* was evaluated using the microbiological swab method and the ATP method. The ATP method was evaluated as a more effective method because it was able to distinguish even damaged cells, while the microbiological method evaluated only cells capable of cultivation.^[9]

The work is focused on the monitoring and evaluation of worker's personal hygiene working in food processing plant using the ATP method from the point of view food-borne diseases prevention.

MATERIAL AND METHOD

Evaluated food processing plant is located in central Slovakia, it is one of the large operations, the final product of which is frozen puff pastry and cakes. The production of deep-frozen puff pastry is separated from cakes on a weekly basis.

In the work, we evaluated the personal hygiene of employees working in the puff pastry production area (Figure 1) and the packaging room, where personnel come into contact with raw materials or products by ATP method. ATP swabs from the employees' hands were taken during one working day, in the morning (before the start of production), during production (before the lunch break) and before the end of the work shift.



Figure 1: Puff pastry production line.

In front of the entrance to the production hall, there are hygiene stations with a sink and dispenser of liquid antibacterial soap Extreme Antibacterial, as well as a dispenser with rinse-free hand disinfection Soft Care Med.

Extreme Antibacterial liquid soap with an antibacterial additive, contains the active substance triclosan, intended for primary disinfection of the skin and possibly surfaces. This substance has a strong antibacterial and antifungal (biocidal) effect.

Disinfection stations with Soft Care MED H5 disinfectant are intended for hand disinfection without rinsing. Soft Care MED H5 is a clear, colorless and rinse-free hand disinfectant gel based on alcohol (71.5 %) with the active ingredients isopropyl and n-propanol.

This mixture of alcohols creates a highly effective disinfectant that is effective against resident and transient microorganisms on the skin such as bacteria and fungi. The manufacturer of this hand sanitizer is Diversey, Slovakia.

We evaluated the personal hygiene of employees using the Clean-Trace monitoring device. The Clean-Trace device consists of a luminometer and a sampling pen (Figure 2).

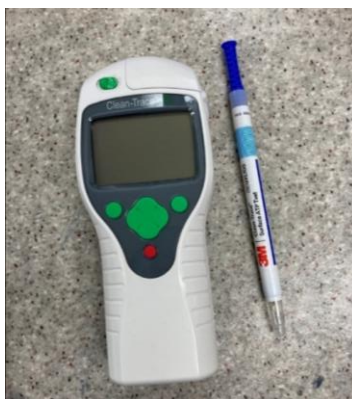


Figure 2: Monitoring device Clean-Trace.

The luminometer analyzes how much light was emitted in a reagent chamber that contains the enzyme luciferase. ATP tampons are taken from an area of 10 cm² with a sampling pen using the side-to-side method in both horizontal and vertical positions (Figure 3).

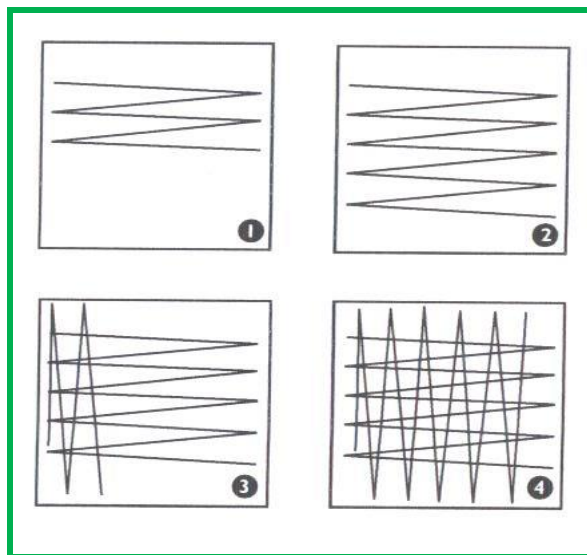


Figure 3: The technique of taking a swab using the ATP method.

The value of emitted light in the reagent chamber is evaluated in luminescence units RLU, which are directly proportional to the amount of adenosine triphosphate in the tested sample. The amount of ATP in the sample correlates with the amount of microbial bodies on the surface. Adequate ATP values are up to 150 RLU.

RESULTS AND DISCUSSION

We monitored the personal hygiene of the workers in the food company using the ATP method, we determined the RLU values with the Clean-Trace device. Table 1 shows the RLU values determined by monitoring the personal hygiene of employees.

Table 1: Average ATP values determined by monitoring the personal hygiene of workers in the puff pastry production area.

Employees	before starting production (RLU)	during production (RLU)	the end of work shift (RLU)
worker no.1	80	85	100
worker no.2	78	126	3652
worker no.3	95	106	117
worker no.4	570	86	136

Based on the criteria for food processing plant and the RLU values found in table 1, we divided ATP swabs into hygienically compliant and hygienically non-compliant. RLU values

higher than 150 are considered hygienically unsatisfactory. From all ATP swabs taken at workers working in the production of puff pastry, two swabs were hygienically unsatisfactory. Hands of worker no.4 were polluted at the beginning of the work shift. We detected on his hands 570 RLU. On hands of worker no. 2 we were detected contamination with count 3652 RLU before the end of the work shift. RLU values up to 150 were recorded in the further measurements. Based on these results, we assess the personal hygiene of the employees as sufficient.

Personnel is considered the biggest source of contamination in clean production areas. The worker's hands can become a source of microorganisms colonies which can contaminate food that comes into direct contact with the hands.^[10]

Over a million microbes live on every square centimeter of skin. There are approximately 500 different species.^[11]

ATP is the life energy for all living cells and therefore is an indicator of the presence, concentration and viability of microorganisms. A certain amount of ATP can also be measured in dead cells. The amount of RLU is directly proportional to the amount of ATP in the examined sample, and the amount of ATP is directly proportional to the amount of microbial contamination.^[12] Different species of bacteria have different amounts of ATP as well as the physiological state of the microorganism and the size of the cell.^[13] Adequate cleaning and disinfection of production equipment, work surfaces, premises and personal hygiene of workers is the most effective tool for eliminating unwanted microflora of the skin.^[5]

In table 2 are recorded the average values of ATP swabs from workers hands working in the puff pastry packaging section.

Table 2: Average ATP values determined by monitoring the personal hygiene of workers in the puff pastry packaging section.

Employees	before starting production (RLU)	during production (RLU)	the end of work shift (RLU)
worker no.1	80	100	120
worker no.2	520	122	36
worker no.3	50	101	115
worker no.4	120	136	140

From all ATP swabs taken of workers hands working in the section of puff pastry packaging section, only one ATP swab was hygienically unsatisfactory. An unsatisfactory swab was detected on the hands of worker no. 2 at the beginning of the shift with the number of 520 RLU.

RLU values up to 150 were recorded in the remaining measurements. Based on the obtained results, we assess the personal hygiene of the workers working in the puff pastry packaging section as sufficient. Extremely high demands are placed on employees in production, and quality personnel is a decisive element of GMP (good manufacturing practice).^[14]

Employee hand hygiene is considered one of the ways to prevent the transfer of pathogens from employees to food.^[15]

Effective disinfection of premises and sufficient personal hygiene of employees eliminates the risk of manufactured products contamination, which prevents the occurrence of infectious or food-borne diseases. A highly contaminated environment can lead to the production of low-quality food products.^[16] The importance of maintaining and controlling hygiene in the food industry is therefore unquestionable.^[17]

CONCLUSION

For food production in food processing plant, it is optimal to combine permanent monitoring of the hygiene level with the provision of laboratory examination results at a time when corrections can be made in case of unfavorable findings. Therefore, the application of the bioluminescence method in food production has its justification. On the basis of the obtained results in the monitored food enterprise, we can conclude that the personal hygiene of workers working in the monitored enterprise, evaluated using the bioluminescence method, is sufficient during the entire production work shift. From the all ATP swabs taken of the monitored worker hands working in the food processing plant, only 3 swabs were unsatisfactory. The results from the assessment of personal hygiene in the monitored food processing plant point to appropriately set and implemented personal hygiene procedures. Antibacterial soap Extreme Antibacterial and the alcohol-based disinfectant Soft Care Med confirmed their disinfectant effectiveness.

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