

FOOD QUALITY AND SAFETY MANAGEMENT IN KINDERGARTENS

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Abstract

Main motive for this investigation were number of alimentary poisoning and food spoilage in two Macedonian kindergartens. The investigation was focused on implemented food safety system (HACCP) failures and air quality from microbiological point of view, or more precisely: equipment hygienic design and its maintenance, GHP and GMP, and presence of the following groups of micro-organisms in the air and drains: total number of bacteria, number of coliforms and *E. coli*, and number of yeasts and fungus in the kindergarten kitchens and premises where children were eating.

The average total number of bacteria in the air was 297 cfu/cm³, while in the drains before cleaning it was 924 cfu/cm², and after cleaning the number decreased to 347 cfu/cm².

The average number of coliform bacteria in the air was 29/cm³. After the sanitation, in the first kindergarten on the kitchen working surface level were counted 10 coliforms/cm³ and in the second kindergarten, were counted 16 coliform bacteria/cm³ on level above the cooker aspirators (1.80 m). The average number of coliform bacteria in drain before cleaning was 322 cfu/cm³.

The conclusion is that in kindergartens, there are made three types of failures:

1. In general, equipment has bad hygienic design.
2. Equipment choice, placement and fittings were not suitable and easily accessible for sanitation.
3. There was a big human factor influence (disregarding standard operational procedures, even where the equipment has a good hygienic design).

Key words: Total number of bacteria, coliforms, air, drains, hygienic design.

1. Introduction

The subjects of the scientific research in this paper are the kindergartens Orce Nikolov and Majska Cvet in Skopje, Republic of Macedonia.

Nutrition-related food poisonings in children of preschool age and deterioration of foodstuff were the main motive for reexamination of possible

omissions in the implemented food safety system and its maintenance and closer attention was given to manners of airborne microorganisms, namely sources, their number and pathways of distribution.

2. Materials and Methods

In the kindergartens were investigated two sets of parameters:

1. Implemented GHPs and GMPs and
2. Microbiological air quality in the food preparation premises and in the playrooms area (area where the children also eat) and kitchen water drainage system. We have examined the following groups of microorganisms: total number of bacteria, coliforms, *Escherichia coli*, fungi and yeasts.

1. The implemented GHPs and GMPs systems and procedures were examined using following methods:

- Checking the facilities (the exterior and interior) on the spot
- Interviews with the staff, according the Questionnaire on the necessary working conditions (Codex Alimentarius Food Safety Enhancement Program), adjusted and supplemented by Kakurinov [1].
- Documents review (on equipment, installations etc)
- Checking standard operational procedures, in accordance with Schmitt's [2].
- Ventilation of the premises, according Kocev [3].
- Storage and distribution of entry materials and finished, according Arbuster and Brown [4].

All production facilities, equipment, and each step of the production process was photographed and kept as photo documentation.

2. Number of microorganisms in the air was examined by sedimentation method. Microbiological air quality in the food preparation premises was sampled at three control points: control point 1 (near the auxiliary entry), control point 2 (near the equipment for thermal processing of food) and control point 3 (near the air conditioners). On the Figures 1 and 2 we have represented the both kitchens architectural schemes, with marked locations of the air sampling points.

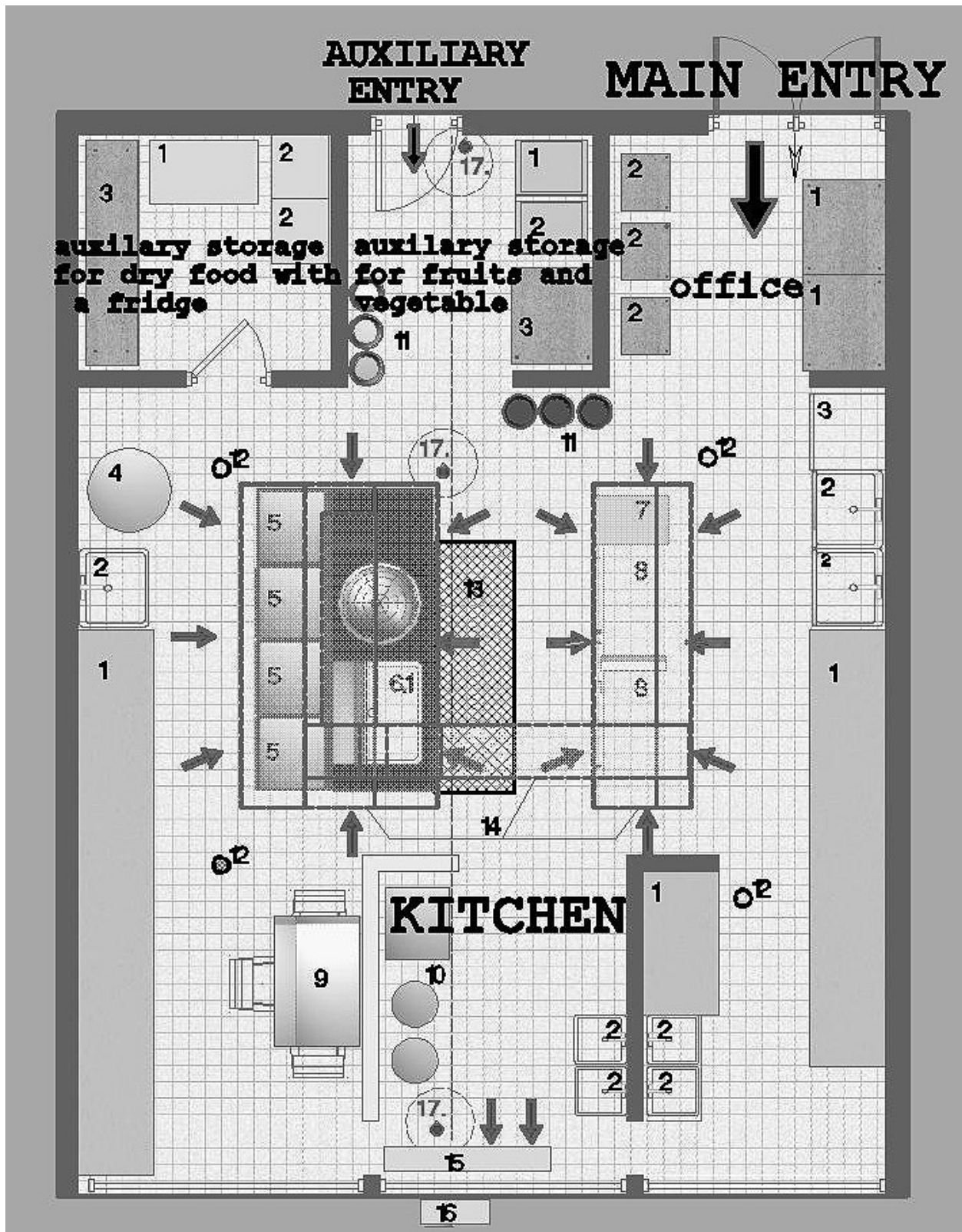


Figure 1. Architectural scheme of the kitchen in the kindergarten of Orce Nikolov along with marked control points

Office (a part of kitchen area for a particular kind of job) - 1. refrigerator (horizontal, for deep freezing), 2. refrigerator, 3. shelves for packaging food. *Shelves storage for vegetables and fruits* - 1. box for vegetables, 2. box for fruits, 3. shelves. *Kitchen* - 1. working area, 2. dishwasher, 3. dishwasher machine, 4. potato pill machine, 5. oven, 6. cooker, 6.1. dump truck cooker, 7. helping table for food preparation, 8. stove, 9. table with chairs, 10. machines, 11. trash can, 12. drain, 13. drain hole, 14. aspirator, 15 air conditioner, 16. air conditioner external part, 17. **control points**.

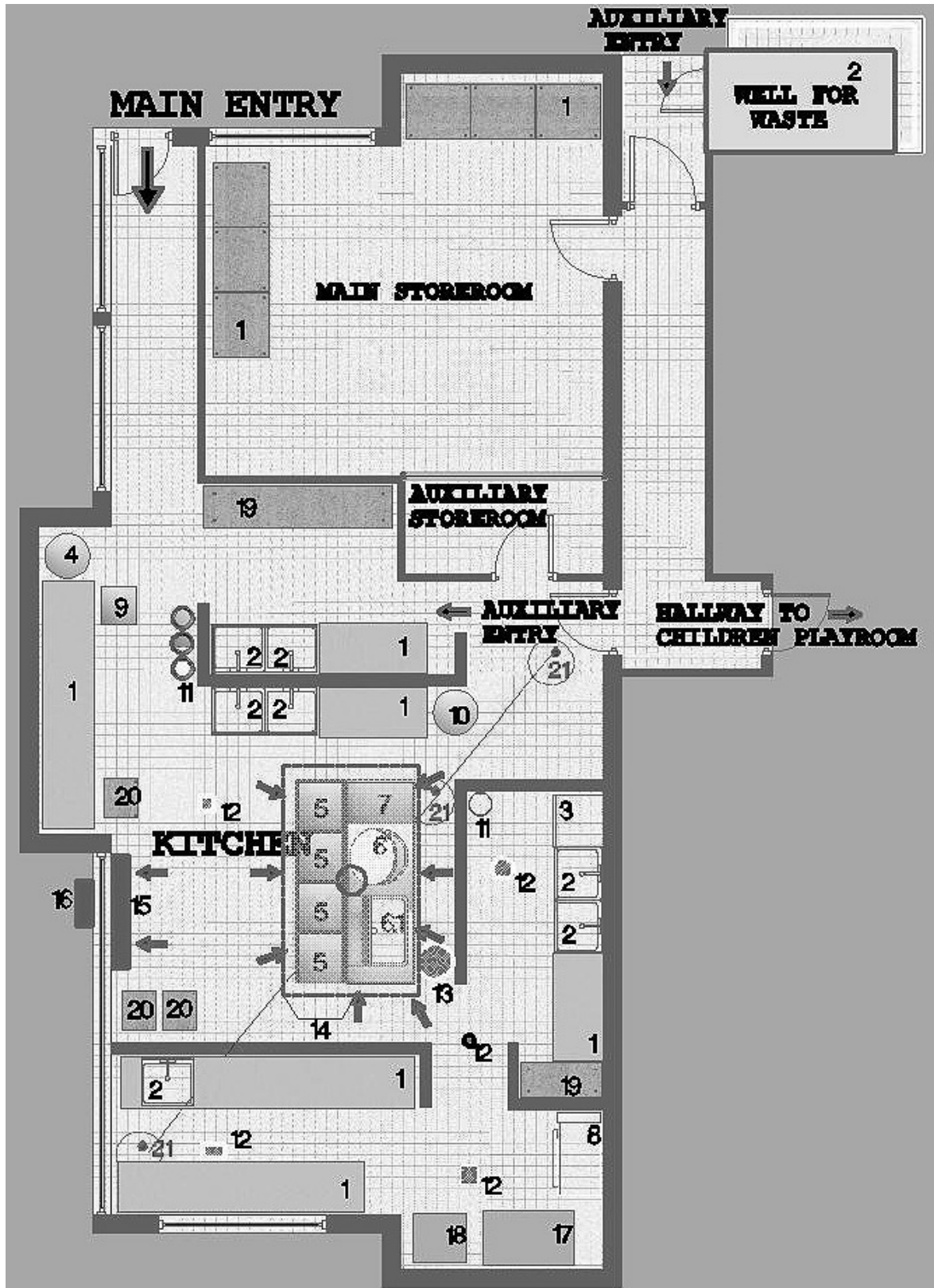


Figure 2. Architectural scheme of the kitchen in the kindergarten of Majski Cvet along with marked control points

Main storage, auxiliary storage, exit with garbage box – 1. shelves for packaging food, 2. garbage box. Kitchen – 1. working area, 2. dishwasher, 3. dishwasher machine, 4. potato pill machine, 5. oven, 6. cooker, 6.1 dump truck cooker, 7. auxiliary table for food preparation, 8. stove, 9. cutting machine for bread, 10. blender, 11. trash can, 12. drain, 13. drain hole, 14. aspirator, 15. air conditioner, 16. air conditioner external part, 17. refrigerator (horizontal, for deep freezing), 18. refrigerator, 19. shelves for clean dishes, 20. food carriage, 21. control points.

The sampling at these points was done at the following heights: floor level (0.0 cm), at the level of working surfaces (0.60 cm) and near the air conditioners (at height of 1.60-1.80 cm). In the playrooms area, the air was sampled within the whole playrooms space at the height of 50 cm (height of the tables where the children are eating).

Kitchen water drainage system was sampled as follows: sample was taken from the interior of each drainage opening with sterile swab, from the area of 1 cm². Sampling times were: before and after drainage cleaning.

The sampling was done in the following timing: before the beginning of the business day (07:00 AM), during the food preparation of (11:00 AM), 30 minutes after the food distribution in the playrooms area (11:30 AM) and after kitchen cleaning (12:00 AM). All the sampling was repeated three times (in June, July and August).

In order to establish the total number of bacteria we have used nutrient media of meat peptone agar-MPA. Coliform bacteria and *Escherichia coli* were examined on selective nutrient medium of Endo agar. In order to detect, isolate and count yeasts, we have used the following nutrient media: Malt extract bouillon-MEB, malt extract agar-MEA and Sabouraud agar. As for the fungi, we have used the following media: Sabouraud agar and Chzapeck agar. (Ziberoski [5]).

The samples were kept in the transport fridge at the temperature 0-4 °C. All the samples were tested in the Microbiological laboratory of the Faculty of Agricultural Sciences and Food - Ss. Cyril and Methodius University - Skopje in the timeframe of 24 hours.

Numbers of each individual group of investigated microorganism group is expressed as arithmetical mean value.

3. Results and discussion

Regarding implemented GHPs and GMPs in both kindergartens it was established that:

1. In general, equipment has bad hygienic design.
2. Equipment choice, its placement and fittings were not suitable and easily accessible for sanitation.
3. Employees were not following established standard operational and cleaning procedures.

All of this is clearly showed in the numbers of microorganisms in the air (Figures 3 and 4) for both kindergartens.

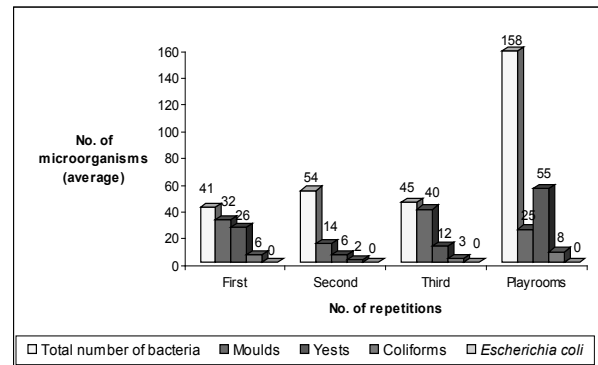


Figure 3. Results from the total average number of microorganisms /L air during the three repeated examinations in the kitchen (first, second and third), including the playrooms area in the kindergarten Orce Nikolov

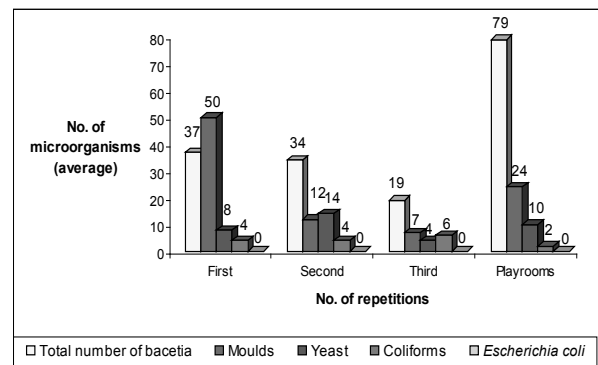


Figure 4. Results from the total average number of microorganisms/L air during the three repeated examinations in the kitchen (first, second and third), including the playrooms area in the kindergarten Majski cvet

In both **kindergartens playrooms**, total number of bacteria in the air is highest. This is due the reason because kids are eating in the same rooms where they are playing and the air is saturated from the microorganisms coming from their shoes, rugs. These microorganisms are almost all the time flowing in the air because the kids are playing all the time. The only time when they are passive and sitting is when they are eating which allows to air microorganisms to fall down in their food. This way all the efforts for GHP and GMP in both kindergartens kitchens are failing. The reason for this is very simple. The nurses most of the times allows children to eat in playrooms which is strictly forbidden by the written GHP and GMP rules.

Regarding kitchen in **kindergarten Orce Nikolov** (Figure 3), is noticeable that total number of bacteria is relatively high in all repetitions which is explained by poor ventilation design. The number of moulds is decreasing in second repetition, but in the third there is sudden increase which is explained by bringing in

the kitchen one can spoiled, molded cheese which was thrown away after one day. All of this points out disregarding storage and waste disposal procedures in this kitchen.

Bacteria: In the playrooms area, we have established the significant presence of 158 cfu/1L air, compared to the highest values determined in the second repeated examination in the kitchen (54/L air).

Coliforms: In the playrooms area, we have established the presence of 8/L air, compared to the highest values determined in the first repeated examination in the kitchen (6/L air).

No determined presence of *E. coli*.

Yeasts: In the playrooms area, we have established significant presence of 55/L air, and their value in the kitchen during the three repeated examinations was highest in the first repeated examination (26/L).

Moulds: In the playrooms area, they are present in minimal numbers (25/L), compared to the highest values determined in the first repeated examination in the kitchen (32/L air).

In the **kindergarten Majski cvet** (Figure 4) situation is not very different. It is worth to be noticed that the number of moulds in the kitchen is decreasing between all repetitions. This is due the fact that after first sampling, kitchen employees cleaned the moulds from the walls. Figure 4 shows the total average number of microorganisms/L air, according to examinations carried out in the kitchen and the playrooms area, as well as the total number of microorganisms/L air during the three repeated examinations.

Bacteria: In the playrooms area, we have established the presence of 79 cfu/1L air, compared to the highest values determined in the first repeated examination in the kitchen (37/L air).

Coliforms: In the playrooms area, we have established the presence of 2/L air, compared to the highest values determined in the third repeated examination in the kitchen (6/L air).

No determined presence of *E. coli*.

Yeasts: In the playrooms area, we have established insignificant presence of 10/L air, and their value in the kitchen during the three repeated examinations was highest in the second repeated examination (14/L).

Moulds: In the playrooms area, they are present in minimal numbers (24/L), compared to the highest values determined in the first repeated examination in the kitchen (50/L air).

Examinations according to control points and heights of samplings

Bacteria: At CP 2, at height of 60 cm, which is considered as the most sensitive point due to the cooking equipment (cauldrons, stoves, etc) and the extractor hood, we have determined presence of bacteria cfu of 15/L air in the kindergarten Orce Nikolov, and 11/L air in the kindergarten Majski cvet.

Coliforms: In the kindergarten Orce Nikolov, we have determined an insignificant number of coliform bacteria (1/1L air), whereas the number is twice higher in the kindergarten Majski cvet. At the working area level, the number of coliforms is 1/L air, whereas at the floor area, and at height of 1.50 to 1.80 cm, the average number reaches 2/1L air.

No determined presence of *E. coli*.

Yeasts and fungi: If one analyses and compares the CP data for fungi and yeasts, it can be noted that their presence in both kindergartens is higher at the CP at heights of 1.60-1.80 cm and at CP at height 0.0 cm, where the values reach 90/L air (but only in one isolated case). At the level of working areas, the values in both kindergartens range from 2 to 11/L air.

Results from testing water samples taken from drains before and after cleaning

Before cleaning in the kindergarten Orce Nikolov: the number of microorganisms was reduced from 450 to 250/cm². In the second repeated examination, the highest number of bacteria colonies was detected, 440/cm² and yeasts 250/cm², and in the third repeated examination, the results were as follows: 376/cm² coliforms, and fungi 10/cm².

After cleaning in the kindergarten Orce Nikolov: bacteria 216/cm², coliforms 23/cm², yeasts 30/cm² and fungi 6/cm². All results are from the second repeated examination.

Before cleaning in the kindergarten Majski cvet: bacteria 752/cm² in the third repeated examination, coliforms (282/cm²), but also a high value for bacteria (720/cm²) in the first repeated examination, yeasts (352/cm²) in the third repeated examination. Insignificant number of fungi (24/cm²) in the second repeated examination.

After cleaning in the kindergarten Majski cvet: the number of microorganisms was reduced from 800 to 250/cm². The bacteria in the second repeated examination were 216/cm², coliforms 23/cm² and yeasts 30/cm². The fungi were completely eliminated after the cleaning.

This scientific paper contains several crucial conclusions: Lack of experts and persons responsible for the managing the foodstuff quality, human factor (lack of trained staff) which leads to omissions in the DHP and DPP and the obsolete and inadequately set equipment, accompanied by poor hygienic and

sanitation habits.

The research and obtained results in this scientific paper are unique in the Republic of Macedonia. And it was a challenge to work on the topic – Food Quality and Safety Management, especially in the kindergartens which are attended by pre-school age children. There were certain conveniences (architectural-civil engineering according to JUS), as well as some drawbacks due to the voluntarily redesigning of particular premises in the facilities, which resulted into certain difficulties during the research.

DHP and DPP, renewal of the obsolete equipment and proper usage and sanitation, professional education of the personnel and an expert who shall manage the food safety issue in the kindergarten, are considered to be the solution to the problem.

4. Conclusions

- The results of the research show that in both kindergartens, which were subject to research, there is a lack of a managing team with a responsible person who follows all AOKKT principles, which is a legally prescribed obligation in the Republic of Macedonia. The written law must be complied with from the legal point of view, but the obligation pertaining to the children's' health must be complied with from the moral point of view.
- The human factor (DHP and DPP) is a current problem, especially in the insufficiently developed countries, such as ours. The presence of aerobic bacteria in the playrooms areas continuously reaches high values, which cannot be allowed. The DPP and DHP effect in the kitchen shows opposite effect in the playrooms areas. The food route (distribution) from the kitchen to the playrooms areas is lengthy and risky, from microbiological point of view. This fact must be taken into consideration. Apart from the bacteria, there are also fungi and yeasts, whereas the coliforms are present in insignificant numbers. Nevertheless, when children are involved, the determined presence of coliforms shows poor personal hygiene which is responsibility of the personnel in charge of the children caretaking.
- The standard operational procedure examinations for drain cleaning have shown significantly good results. One can conclude that the sanitation means are appropriate and are used properly.
- The future guidelines to be undertaken are as follows: changing the internal policy pertaining to issue for food control and safety in the kindergartens by the Administration responsible for facilities management; internal reconstruction of the facility and upgrading of particular restaurant areas in which children eat. The playrooms areas (resulting from the afore-mentioned) are places in

which diseases and infections occur. The ventilation equipment has to be completely changed, as well as the other kitchen appliances.

- The most importantly, in my opinion, is the preparation of a written protocol (standard operational procedure) which shall HAVE to be complied with in hierarchical terms.
- Increased engagement of the responsible Ministry on the relevant problem, i.e. "stomach virus", which actually could be a result from food poisoning. My future engagements would be to alarm the state institutions on this topic, and mainly to RAISE THEIR AWARENESS so as to properly inform the public and enable timely reaction thus reducing the consequences from this problem. This could be achieved through the means of: marketing, advertising, debate TV shows, information caravans. All ideas on this issue are welcomed.

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5. References

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