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MICROBIAL LIMITS USED FOR VARIOUS TYPES OF FOOD PROCESS SURFACES BASED ON CASE STUDY EVALUATIONS

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Abstract

In a hygiene survey the hygiene level in a food factory can be seen from statistics drawn from results classified as good, adequate and poor hygiene level. At the moment the risk management team in the food factories have to set the limits for the hygiene levels in their food factory based on the products produced and the shelf-life set for these products.

The aim of this study is to show the effect of various limits on hygiene surveys performed. In this study microbes were detected on both contact and environmental surfaces using 3M™ Petrifilms for aerobic bacteria, fungi and coliforms. The samples were taken after cleaning, just before work shift started, which means that at least the contact surfaces should be of good hygiene level.

The limits for the various microbes were set in three scales (loose, normal and strict) for the three levels (good, adequate and poor hygiene level) using real results from 10 food factories in Finland, Estonia, Turkey and Romania.

Key words: *Hygiene survey, hygiene level, surface hygiene, surface colony forming unit limits, surface cfu-limits, aerobic bacteria, fungi and coliforms*.

1. Introduction

The quality control methods are used more and more for preventing risks that can occur in food during processing (Mayers and Mortimore [1]). Temperature, pH and storage time are relatively easy to measure and adjust, but cleanliness of food contact surfaces as a control point is challenging. Measurement of the microbial load on the surfaces is mainly carried out using various microbial culturing methods with either swabs or contact agars. An international collaboration test showed that the recovery of microbes on surfaces is approximately 10-15% independent of the method used (Salo *et al*. [2, 3]). However, the major disadvantage of the culturing methods is the incubation time, which can be 3-5 d in room temperature and even 7-10 d in cold temperatures, to reach results on which corrective actions can be carried out. There is also a need for support in the interpretation of results. What limits should be set for various types of surfaces and how should the surfaces be classified is not clear either? In most food processes the process line surfaces must not be sterile, because putting a too high level in the process hygiene means that there are no food process - all efforts go to cleaning and disinfection procedures. With this we do not mean that cleaning and disinfection is not needed, we mean that each process should carefully be evaluated to see what the processed products stand (Lelieveld *et al*. [4]). It is also to be noted that the microbial load on surfaces should be remarkable lower at the beginning of the processing that in the middle of the shift or at the end of the production shift before cleaning takes place (Salo *et al*. [5], Wirtanen and Salo [6]). Setting of limits for microbial loads allowed is not unambiguous. Different food products can tolerate different microbial loads before food spoilage takes place. And furthermore the type of contaminants is also affecting the severity of the spoilage (Brown and Stringer [7]). Heat treated milk product is very prone to microbial contamination, whereas raw meat products can contain high loads of spoilage microbes before cooking and subsequent consumption and therefore the there is a need for various limit levels for various food processes. The efficiency of cleaning procedures can be observed based on microbial culturing results obtained from the surfaces (Salo *et al*. [5]). The condition of utensils and tools can also be studied by following the microbial results of these surfaces (Salo *et al*. [5]). The hygienic condition of the environmental surfaces in the food processing area e.g. floors, walls and doors is not so significant in all process phases but movements by workers and through draughts are possible vehicles for transportation of microbes from an environmental surfaces to a food processing contact surfaces. If this happens during cleaning and the surfaces are

left in humid condition at room temperature one microbial cell can divide into millions in 8-10 h and thus the cleaning efforts carried out are omitted. You can imagine that if the contaminant furthermore is a pathogen then the problem is more severe! (Brown and Stringer [7]). Frequently found loads with high microbial counts can also mean that the facilities need mending and thus the places needing corrective actions can be found in broad hygiene surveys, in which the limits are correctly set (Lelieveld *et al*. [4]). The company's risk management team should adjust the microbial limits according to the product(s) with set shelf-life aspects. Depending on the food product and its quality the team can preferably start with a normal limit and if needed tighten the limits if the shelf-life set is not acquired with the normal limits set (Mayers and Mortimore [1]). The aim of this study is to show the effect of various limits on hygiene surveys performed in the real food processing. The hygiene surveys were performed in Finland, Estonia, Turkey and Romania 2008-10 (Wirtanen and Salo [6]).

2. Materials and Methods

Hygiene surveys were carried out in 10 food factories; 3 dairies, 3 bakeries, 2 meat processing plants, 1 slaughter house and 1 food pilot test factory. Microbes on surfaces were detected based on the contact agar method using various 3M™ Petrifilms (3M Microbiology Products, St. Paul, MN, USA): Petrifilm™ Aerobic Count Plate (Petrifilm AC; 25 °C, 5 d), 3M™ Petrifilm™ Yeast & Mold Count Plate (Petrifilm YM; 25 °C, 5 d), 3M™ Petrifilm™ and *E. coli*/Coliform Count Plate (Petrifilm EC; 37 °C, 48 h). Surfaces studied were categorised as food contact surfaces (including also surfaces with indirect contact with high risk to contaminate product) and environment surfaces. Samples were taken after cleaning, just before work shift started. The limits for the various microbes were set as loose, normal and strict scales (Table 1).

Table 1. The limits for coliforms, aerobic bacteria, yeast and moulds were set as loose, normal and strict scale for both contact and environmental surfaces

Contact surfaces	Coliforms cfu/20 cm²	Aerobic bacteria cfu/20 cm²	Yeasts cfu/30 cm²	Moulds cfu/30 cm²
Loose				
Good quality	< 1	£ 50	£ 3	£ 3
Adequate / not recommended	1 ≥ … £ 5	50 > … £ 150	3 > … £ 50	3 > … £ 50
Poor	> 5	> 150	> 50	> 50
Normal				
Good quality	< 1	£ 20	£ 1	£ 1
Adequate / not recommended	1≥ … £ 3	20 > … £ 100	1 > … £ 30	1 > … £ 30
Poor	> 3	> 100	> 30	> 30
Strict				
Good quality	< 1	£ 15	£ 1	£ 1
Adequate / not recommended		15 > … £ 50	1 > … £ 20	1 > … £ 20
Poor	≥ 1	> 50	> 20	> 20
Environmental surfaces	Coliforms cfu/20 cm²	Aerobic bacteria cfu/20 cm²	Yeasts cfu/30 cm²	Moulds cfu/30 cm²
Loose				
Good quality	< 5	£ 100	£ 10	£ 10
Adequate / not recommended	5 ≥ … £ 15	100 > … £ 250	10 > … £ 100	10 > … £ 100
Poor	> 15	> 250	> 100	> 100
Normal				
Good quality	< 1	£ 50	£ 3	£ 3
Adequate / not recommended	1 ≥ … £ 5	50 > … £ 150	3 > … £ 50	3 > … £ 50
Poor	> 5	> 150	> 50	> 50
Strict				
Good quality	< 1	£ 20	£ 1	£ 1
Adequate / not recommended	1≥ … £ 3	20 > … £ 100	1 > … £ 30	1 > … £ 30
Poor	> 3	> 100	> 30	> 30

3. Results and Discussion

In the hygiene survey the hygiene level in a factory can normally be seen from statistics of the results, which have been divided into classes e.g. good, adequate and poor, independently of if the factory is using strict, normal or loose scales. At the moment the risk management team in the food factories have to set the limits for these hygiene levels, because there are no ISO standards in which surface hygiene limits are available (Farquharson [8]). In setting the different surface limits the product produced and the shelf-life set for the products must be taken into account (Figures 1-2).

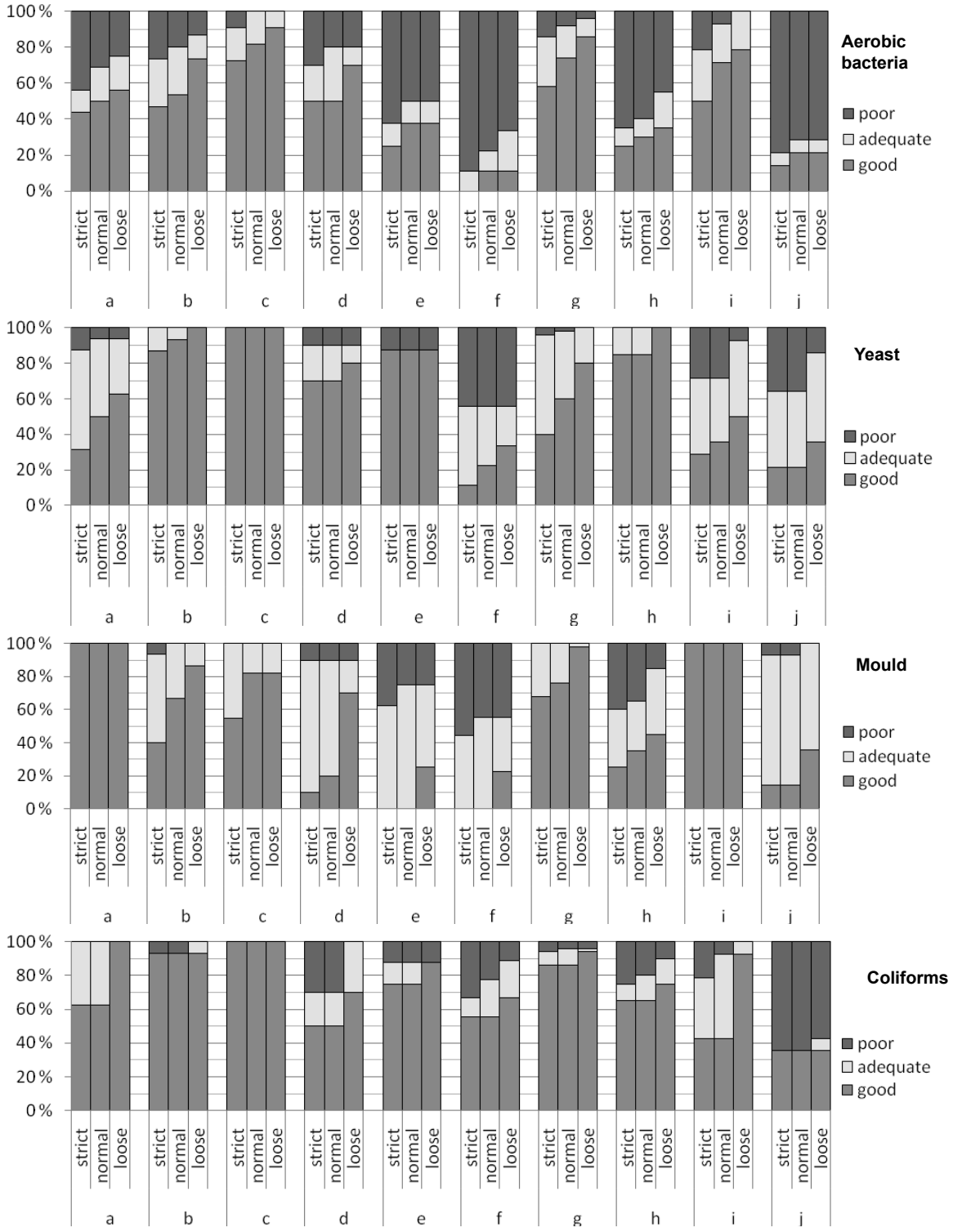

Figure 1. The share of good, adequate and poor hygiene on environmental food processing surfaces in 10 food factories as a total of: a) 16, b) 15 & c) 11 surfaces in 3 dairies, d) 10, e) 8 & f) 9 surfaces in 3 bakeries, g) 50 surfaces in a food pilot factory, h) 20 & i) 14 surfaces in 2 meat factories and j) 14 surfaces in a slaughterhouse (See Table 1 for limits used)

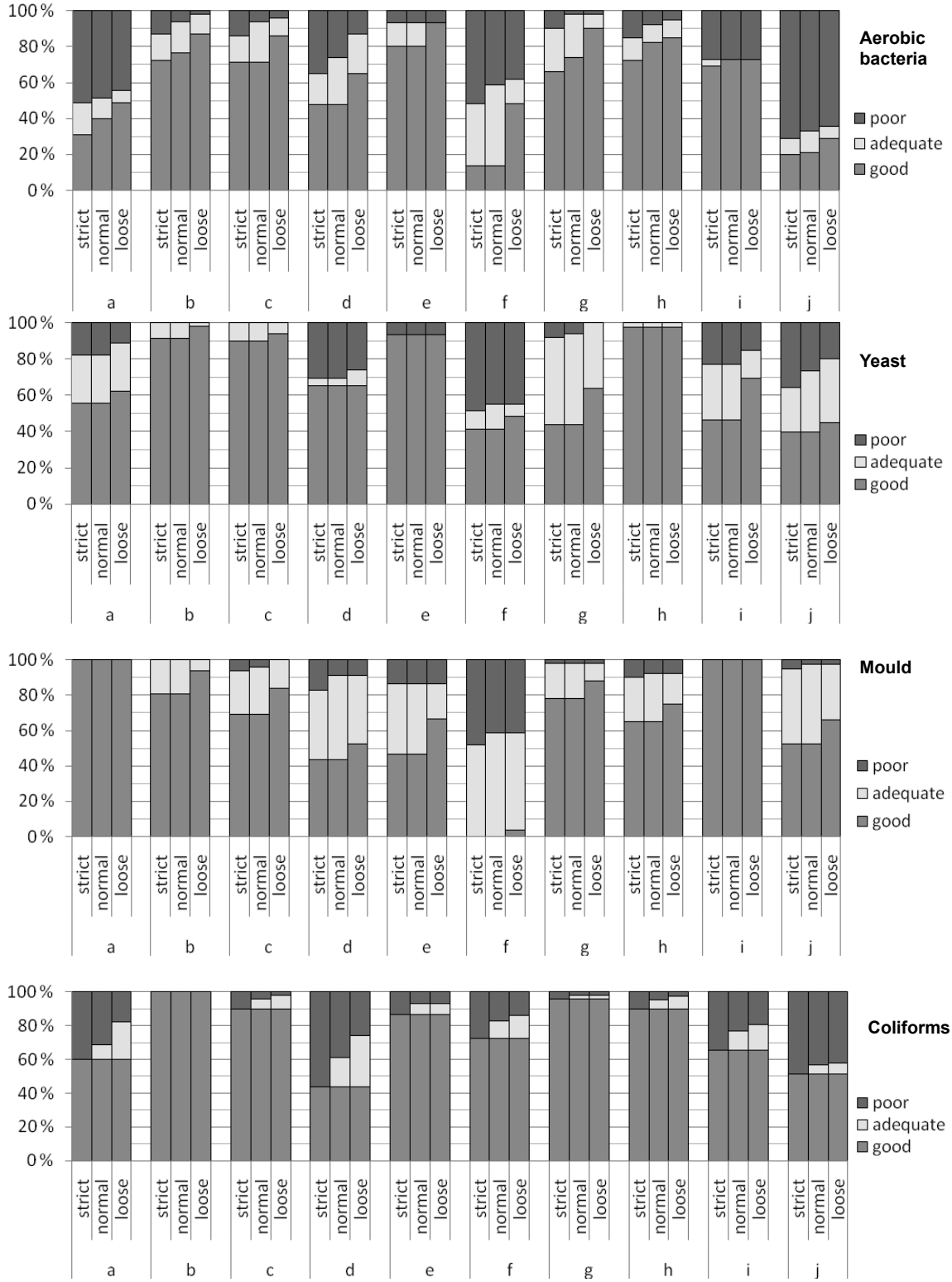

Figure 2. The share of good, adequate and poor hygiene on food contact surfaces in 10 food factories as a total of: a) 45, b) 47 & c) 49 surfaces in three dairies, d) 23, e) 15 & f) 29 surfaces in three bakeries, g) 50 surfaces in a food pilot factory, h) 40 & i) 26 surfaces in two meat factories and j) 76 surfaces in a slaughterhouse (See Table 1 for limits used)

When the limits for the various classes are set the spoilage sensitivity of product should be kept in mind. The more prone the product is to be spoiled the stricter limits should be used for the various scales. The main focus of hygiene control should of course be on the food contact surfaces. However, environment surfaces can also be a part of the contamination routes e.g. through cross contamination. The microbes found on environmental surfaces e.g. floors, walls, doors and shelves can have an impact on product quality especially in open processes. The microbes can be transported from the environmental surfaces to the food contact area by draught or by personal movements e.g. in slicing of heat-treated meat products in semi-open equipment. Note that the hygiene of the environmental surfaces can also affect the product produced in closed processes e.g. in dairies. During processing of milk in big tanks air is fed into the tank when product is pumped away. In case that the air filters are not properly maintained microbes can be transported into the system and the product can thus get spoiled by microbes from the air.

4. Conclusions

- Our conclusion and recommendation for testing the surface hygiene in the food processing area is to use aerobic bacteria, yeasts, moulds and coliforms as indicators.
- Information on aerobic bacteria is especially needed, when products with long self-life are produced. In relatively hygienic facilities the aerobic bacterial count also reveals places, which might need improvement.
- The coliform count is traditionally considered as an indicator for hygiene, since the presence of coliforms refer to poor hygiene.
- The fungal count is giving information on possible moist problems and lowered air quality.
- In food hygiene surveys specific microbes e.g. Listeria monocytogenes, Salmonella spp., Staphylococcus aureus and Echerichia coli can be added according to the risks of the products produced.

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