Original scientific paper

Comparison of wooden (*Abies* spp.) and plastic trays for pasta drying

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ABSTRACT

Food quality and food safety are vital in processes where products are in contact with various materials. In case of dried egg pasta trays with wooden frames were used for centuries, however with development of different materials, wood was slowly abandoned and replaced by plastic. Nevertheless there are some hygienic considerations using plastic frames in the industry of the dried egg pasta. In this research plastic and wooden trays were analysed by swabbing (N=150) and compared by total number of aerobic counts using Petrifilm™. Results of this research showed that the total CFU/20 cm^2 for wood trays, are statistically measured significantly ($p< 0.001$) lower (38 times) than plastic trays independent from location of taken swab and that 28 % swabs on plastic frames exceeded 200 CFU/20 cm^2. Wood in food industry can be as much hygienic as plastic material on condition that is sanitised and maintained properly.

KEY WORDS:

Wood, Plastic, Microorganisms, Swabs, Pasta draying.

Received: 27. 11. 2009
Accepted: 8. 12. 2009

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INTRODUCTION

Food system is a complex, concentrated, and dynamic chain of activities it begins with production of raw agricultural commodities on farms, orchards, and ranches then moves to value added processes to manufactured products for the retail food stores and foodservice establishment where they are merchandised, prepared, and sold to costumers [1]. Regarding the role of sanitation and food safety in the food industry, it is important to understand the uniqueness of each sector of the food system [2]. Today we manage food safety through the good practices at different levels of food production, distribution and consumption. Present maintenance of food safety in food supply chain can be easily broken down, because of different kind of barriers or simple misunderstanding among stakeholders including consumers [3].

Regarding the role of sanitation and food safety in the food industry, it is important to understand the uniqueness of each sector of the food system.

Barriers can be broken during production, processing, preparation, service and transport, therefore any food may be exposed to biological, chemical or physical agents with the potential to cause the illness [4,5]. Processing failure, especially time and temperature abuse can allow survival and proliferation of pathogenic bacteria, moulds and toxins [6-9]. To prevent adverse health effect, surface sampling is a tool for the hygiene evaluation and the indicator of the contamination sources [10-16]. It is also an effective method in the Hazard Analysis Critical Control Point (HACCP) verification process for internal control of hygiene. For choosing a suitable method for the detection of the microorganisms it is important to know what kind of information is needed. Also it is important to figure out the wideness of sampling, the amount of samples and the frequency of sampling when choosing the method [17,18].

To prevent adverse health effect, surface sampling is a tool for the hygiene evaluation and the indicator of the contamination sources.

In the past, wood has been used as traditional material for many applications in food industry. Today wood is getting discriminated in many sectors, both in utensils, as interiors, and in buildings as well as in pallets and in packaging. There are some studies [19,20] on the hygienic properties of wood that confirm that wood is as good as other materials to use in the food industry [21,22]. In food industry of dried egg pasta (e.g. spaghetti, elbow macaroni, screw-shaped pasta, spirals, butterflies, shells, ribbons, etc.) producing wooden trays are used for drying the fresh pasta. Traditionally, wood especially oak was used, however with development of materials; particularly PET (polyethylene terephalate) materials wood was gradually replaced. The most difficult and expensive stage in the manufacture of pasta products is the drying process [23-25]. Drying of egg pasta is preservation process and it can be named as critical control point. The aim of drying is to reduce the content of water under the 13.5 % according to legislation. Since the migration of water from the internal to the external layers and so to the surface takes place by capillarity, the pasta must maintain an appropriate structure (porosity) in relation to its current moisture required by law. [26-28].

The wood has been used as traditional material for many applications in food industry.

METHODS

In this research wooden (*Abies* spp.) and plastic – PET trays for pasta drying were analysed by swabbing and compared due to allowed total number of microorganisms in such materials. In both cases 25 plastic and 25 wooden trays were tested. In each trolley, made form stainless steel 21 trays were inserted. Therefore the 1st, 11th and 21st trays were swabbed in area 20 cm^2. Each tray was swabbed at three different locations; net (2), shortest (1) and longest edge (3) (Figure 1). Sterile swabs on plastic stick made of cotton were prepared with 5 mL of sterile 0.9 % NaCl solution. Plastic and wooden trays were washed in the washing machine, fresh pasta was added on trays and dried 8 hours at average temperature of 63 °C and at the end of process swabs were sampled.

After the swabbing, swabs were shaken for 2 minutes, 1 mL of solution was added on Petrifilm™ Aerobic Count Plate. Plates were incubated 72 hours at 30 °C according to AFNOR Validated Method 3M 01/1-09/89 and then countered. The results of microbiological tests were processed by the repeated measures analysis using the General Linear Model (GLM) procedure [26]. The statistical model included the main

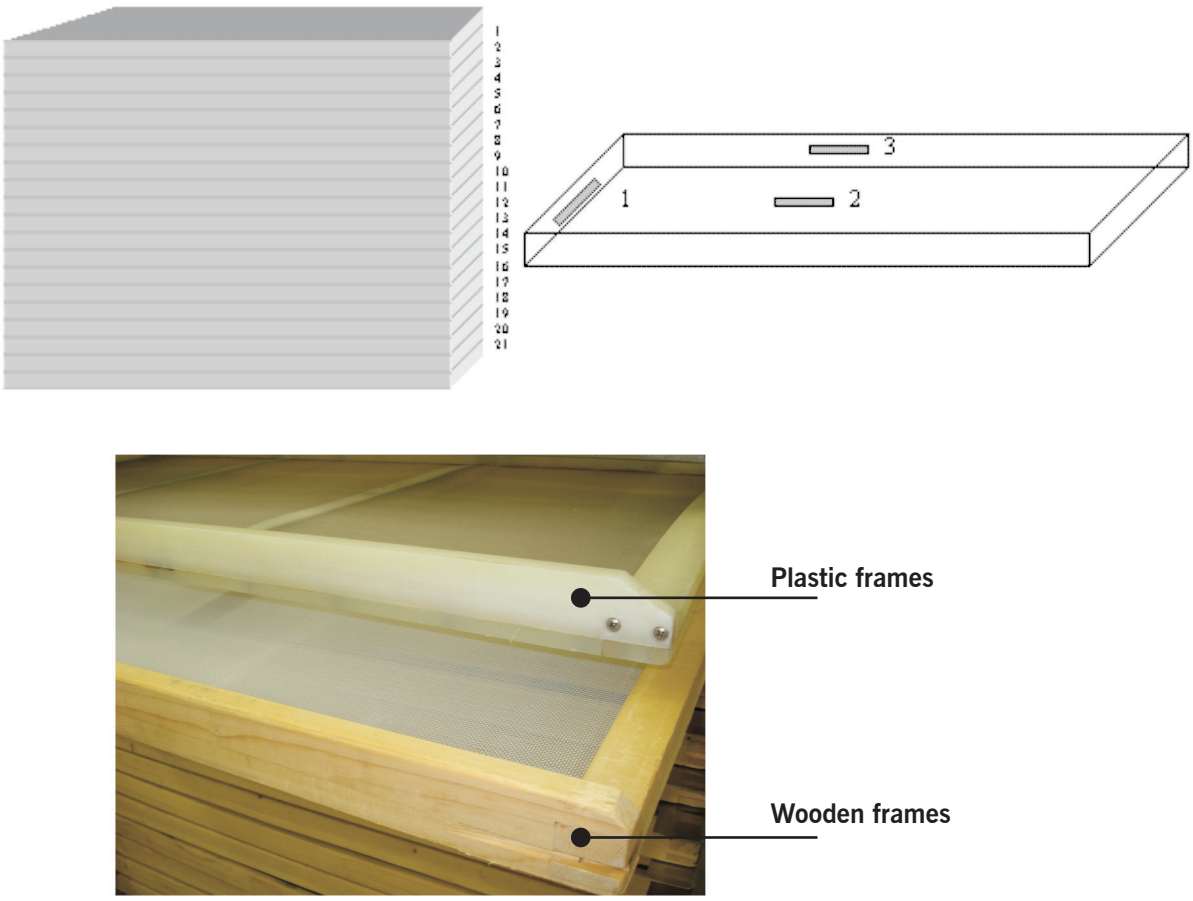

Figure 1:
Methodology of pasta trays swabbing.

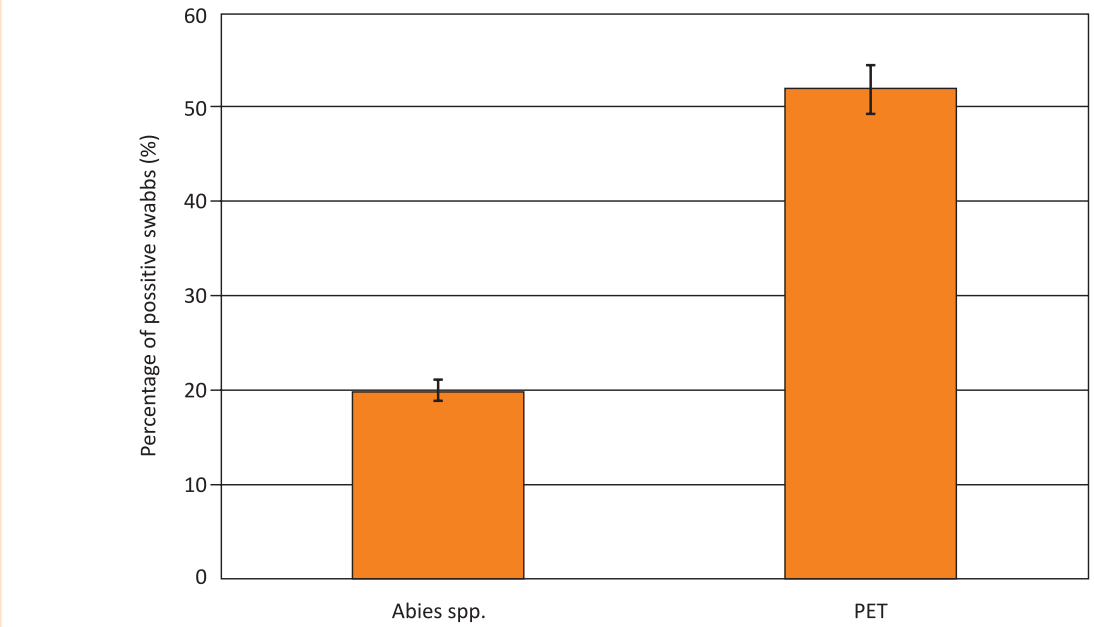

Figure 2:
Percentage of positive swabs taken from wood and PET materials.

effects material as well as the position of swab sampled. The least squares means that the experimental groups were obtained using the Least Square Means (LSM) procedure and were compared at the 5 % probability level [29].

The aims of the research were: (1) to evaluate total number of microorganisms on wood and on plastic material for pasta trays and (2) to make hygiene evaluation of analysed materials for application in pasta industry. The hypothesis was expressed as 'Does the material of tray and/or the location of sampled swab have influence on colony forming unit (CFU) /20 cm^2?"

RESULTS AND DISCUSSION

In the Table 1 results from total aerobic counts from swabs sampled from two types of trays made from different materials are given; for wood and for plastic material.

Total CFU/20 cm^2 for the wood trays is statistical significant lower (38 times) than plastic trays independent from location of the sampled swab. According to location of swab it can be confirmed that the material of tray have significant influence on CFU ($p \leq 0.001$). CFU from location 1 and 3 are statistical different depending on material of tray since the material of tray frame is different (wood or plastic). While location 2 represent the results from swab sampled from net that represent the ground from tray and is in both cases made from the same material and the difference is not significant ($p \geq 0.05$), therefore location 2 can be presented as control group. The Figure 2 shows that 20 % of swabs sampled from wood were positive, meanwhile from plastic one more than half (52 %). According to the Law on specific measures in food poisoning and their prevention, Slovenian official Gazette No.

Table 1:
Results of CFU on wooden and plastic pasta t

Parameter	Material		Statistic parameter	
CFU/20 cm^2 (mean values)	wood n = 75	plastic n = 75	p-value	Significance
Total, n = 150	1.26^a	38.73^b	0.000139	***
Location 1, n = 50	1.60^a	9.80^b	0.000886	***
Location 2, n = 50	1.00^a	1.60^a	0.343518	NS
Location 3, n = 50	1.00^a	106.8^b	0.000042	***

CFU colony forming unit, n number of observation, *** Significant at $p \leq 0.001$; ** significant at $p \leq 0.01$; * significant at $p \leq 0.05$; NS not significant ($p > 0.05$), Values in a row followed by a different letter are significantly different in the Duncan (0.05) test rays.

24/1981 the maximum number of total bacteria is 200 per 20 cm^2. In case of wood and net, none of the swabs exceeded maximum level, but 28 % swabs on plastic trays exceeded this level.

Beside the hygroscopic properties of wood the high content of extractives in certain species e.g. pine proved to have a good antibacterial effect.

Schönwälder at al [19] pointed out that there seem to be evidence that pine and especially heartwood of pine is superior to other frequently used species. Beside the hygroscopic properties of wood the high content of extractives in certain species e.g. pine proved to have a good antibacterial effect. Nevertheless Beyer et al [21] showed that not only the wood species but also the wood moisture is decisive for the extent of hygiene in connection with food. Increasing wood moisture implies better conditions of life for bacteria, so dry conditions are the way to prevent bacterial growth. Contrariwise Gough and Dodd [6] studied survival and disinfection of *Salmonella typhimurium* on chopping board surfaces of wood and plastic and found out that there was no significant difference between wood and similarly treated plastic surfaces. Meanwhile Milling et al [30] studied microbial survival on pine (*Pinus silvestris*) larch (*Larix decidua*) and maple (*Acer pseudoplatanus*) wood which are commonly used in Europe, found out that total number of bacteria on wood is smaller compared to the plastic. Different bacterial species showed a completely different survival on the rates on wooden samples followed by enterococci and streptococci [30].

From technological point of view plastic is unsuitable since is twisting, expanding and shrinking under drying room conditions.

And since in drying room extreme conditions are present, a material used is such processes must be durable. From technological point of view plastic is unsuitable since is twisting, expanding and shrinking under drying room conditions. In heating stage of draying process plastic trays can expand so intensively that cannot be moved in trolley but on the other hand in stage of cooling they are shrinking so that thay can fall out of trolley. Nevertheless the plastic trays are also heavier than wood what represent unnecessary burdening for workers. On market it can be found also trays made of aluminium which are lighter but costs are extremely high. Wooden trays are more rigid and more resistant to conditions changes and are also lighter. Average air temperature in drying chamber is 65 °C. Time of drying vari due to pasta type, however it is between 6 hours to 14 hours and relatively humidity is decreased from 28 % – 34% to lower than 12 %. The water activity in final prod-

Wooden trays are more rigid and more resistant to conditions changes and are also lighter.

uct is lower than 0.6 [31]. Nevertheless if the wood is used in food industry it has to be cleaned and maintained properly to minimize not only microbiological, but also chemical and physical hazards in process of food making.

CONCLUSION

Food safety is furthermore nutritional value and sensory, one of foundation for food quality parameters. In process of producing, food can be in contact with various materials, therefore is vital, that substance do not influence the product. The use of wood has however decreased, and other materials like plastic, stainless steel and aluminium have taken its place. The reason for this negative development seems to be declining market demands, partly caused by legislation in Europe and elsewhere [22]. There are several studies which results show that wood can be as hygienic as others materials and even more, some species of wood have antimicrobial property [19-21,30]. This study proved the hypothesis, that material has influence on CFU, since on plastic frames for pasta trays much more microorganisms are developed than on wooden ones ($p<0.001$) and that on net that is in both cases made of the same material, difference is not significant ($p>0.05$). Although analysed PET material is made purposely for food industry one third of swabs exceeded maximum level of 200 CFU and more than half were positive. For this reason materials used in process of pasta making must be on one hand durable, but on the other assure safety of final product and wooden trays showed great potential.

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In further research not only total aerobic count, but also bacterial species should be identified and also physical and chemical properties of the selected materials.

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