



# **FOOD SAFETY OF PAPRIKA FROM MICROBIOLOGICAL ASPECTS**

**Thesis**

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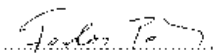
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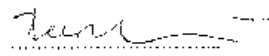
**A doktori iskola**

**megnevezése:** Élelmiszertudományi Doktori Iskola  
**tudományága:** Élelmiszertudományok  
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**A doktori iskola- és a témavezető jóváhagyó aláírása:**

A jelölt a Budapesti Corvinus Egyetem Doktori Szabályzatában előírt valamennyi feltételnek eleget tett, a műhelyvita során elhangzott észrevételeket és javaslatokat az értekezés átdolgozásakor figyelembe vette, ezért az értekezés védési eljárása bocsátható.

  
Az iskolavezető jóváhagyása

  
A témavezető jóváhagyása

# 1. INTRODUCTION

Paprika as spice in Hungary known almost 300 years ago, more than 150 years of its commercial spice and some 100 years ago looking for a specific export product. It is therefore surprising that from time to time some question in the food safety issue arises in relation to our country. Already in the 1990s, there was a food safety risk of lead-based color additive, or even incorporated in brick dust due to the consumption of red pepper, but in the 2004 "paprika scandal" was the most vocal, probably because it has been reported from abroad, the case closure has still not reached a final paragraph of the appeals. Without exception paprika products were taken off the shelves in supermarkets and in many cases even the paprika powder containing spice mix may have disappeared from the stores. The manufacturers and distributors in Hungary is very distressed, because consumers have lost confidence in the industrially produced red pepper. Result of the scandal the black and grey market is even more likely to flourish, but this can only be inferred from the distribution data.

The Hungarian cuisine is traditionally very spicy foods mean most abundant paprika, pepper and garlic use. The consumption of paprika in our country the greatest in the world. The majority of Hungarian dishes must meet three requirements: to be the color, smell, and taste. The color of the paprika is responsible for the design: a wide variety of shades are provided. The Hungarians known paprika just from the Napoleonic wars, it was began to be used after a short circuit, even for poor people: the pepper has tried to replace paprika. Paprika came to us Turkish mediation in the 1500s, the popular name derives from this period: turkish pepper, pagan pepper.

A plant food-borne illnesses today is increasingly important because of the changed consumption patterns. Microbiological contamination of foods of plant origin of the crop, harvest, transport, processing and packaging done.

Predictive microbiology has traditionally been deal with pathogen and spoiled bacteria, but fungi are not appropriate methods of breeding to establish the predictive microbiology researchers also attracted the interest. The mold contamination in food, however, a group of may be a serious problem, primarily because of toxin-producing molds. The mycotoxin producing molds growth modeling is one very important area of microbiological research

## 2. AIMS

Primary objectives of the Hungarian paprika powder, food safety risk assessment was full and related seasoning products testing. The powder production process from farm through to the finished meals were followed, in doing so, and the production of raw paprika examined the different steps of the microbiological point of view.

Secondary objectives of the different varieties, the growth of mold modeling of various environmental factors on the assessment of mold growth in vivo. The growth of mold that best describes a mathematical model to find. Characterization of mold growth in paprika with inoculum in vitro conditions.

### 3. EXPERIMENTAL MATERIALS AND TEST METHODS

#### 3.1. Experiments and samples

- Treating the microbial contamination of paprika and the effect of post-ripening by Meteorit, Fesztivál and Napfény paprika
- Washing efficiency of paprika: laboratory and industrial experiment
- Paprika semi-finished products: 60 paprika of Hungary and foreign  
Paprika powder: a total of 14 home-made and seven commercial  
During manufacturing paprika: paprika pollutions and technological points three times of stagnant caps and three different times of the semi-finished product at the beginning and end of production
- Moulds growth characterization in vivo: *P. vermiculosum*, *Aspergillus niger* growth two (0.98 and 0.90), water activity, five different temperatures (10, 15, 25, 30, 37 ° C)
- Moulds used for monitoring growth in paprika: two home made and one American paprika semi-finished products

#### 3.2. Applied methods

- Microbiological determinations according to ISO
- Ergosterol determination: a new HPLC method development (Daood et al., 2008)  
Mycotoxin Determination: immunaffin extraction column purification and HPLC techniques
- Determination of water activity: Novasina Lab-Master
- Bacterial growth modesl (Gompertz, Baranyi) and linear correlation
- The experimental results are evaluated by mathematical-statistical methods

#### 4. RESULTS

The microbial contamination of paprika and potential sources of contaminants from the ground to the table were followed, in so doing, examined the factors affecting the microbial status of paprika, red pepper so the kinds of post-curing how and when the semi-finished product product processing and storage, as well as the final product was completed. The results show that the tested paprika varieties (Meteor, Fesztivál, Napfény has no effect on the microbial status. The microbial status is much more influenced by environmental factors like pollution of the soil, the weather (wind, precipitation, temperature) and harvest method. Testing the post-curing methods, both stack and Raschel bag post-curing method, microbiological point of view it was appropriate, where the wind picked seasoning and moisture out of reach were post-curing. The time of the post-curing did not change significantly the result of microbial status, but the industrial experience has shown that the longer post-curing occurred mold contamination and microbial degradation. The washing test results shown that the vinegar and the Tween 80 do not feasible to wash under industrial conditions, because one is a strong smell, and the other scum. In addition, the color of vinegar paprika, laundry hampers, and a significant reduction in microbial counts could not be achieved by this method. The chlorine wash, which is used in Serbia, significantly reducing the microbial plate count, but the chlorine washing is not permitted in our country. The microbial status of post-curing paprika only significant effect of washing and slicing: the plate count increases, and the drying, which significantly reduces the plate count.

The water activity of semi-finished product the drying effect of seasoning is so low that reproduction does not occur microbial growth, only when moisture (humidity) reaches the semi. The semi-finished product storage of chilled and examined ways in which the barn for storage, as well as woven and a plastic bag for storage modes. Based on the results can not clearly say which method is the best microbiological point of view, therefore, considered commercially refrigerated storage per product.

The semi-finished product state of microbiological examination failed to detect a significant difference in the place of origin, or the growers, but their vintage little impact has been demonstrated in three yearly, microbiological point of view. The mold contamination of semi-finished products in the 2004 and the year 2005 was very similar, but for the 2006 year of live mold contamination was higher.

There was no connection between mycotoxin content, ergosterol content and living mould contamination of semi-finished product. The mycotoxin content of semi-finished products, the content of ergosterol was no connection between mold contaminations, because the drying kills the microbes. Between the red pepper and water activity of semi-finished products plate count was no connection, because of low water activity values did not allow the growth of microorganisms. The semi-finished products were the same microbiological point of view of general microbial contamination of spices, so the total aerobic microbial plate count, mold, yeast, and the Coliforms and *Escherichia coli* count is in line with expectations.

There is no difference between the spice products when comparing in terms of food safety for home-made and industrial paprika powder. The plate counts, the ergosterol and mycotoxin contents were very similar. Based on the results of food safety point of view of home-made and industrial produced is not possible to distinguish between the paprika.

According to my findings, contaminating fragments derived from paprika on production line, can not contaminate the powder during production. Pepper cultivation conditions determine the microbiological status of a later meal, post-ripening the production line is only possible as a result of serious human error.

On the basis of samples taken from the industrial paprika production line, no single step can be designated which affect on the microbial contamination same way in each case, and constantly fluctuate. Bacterial growth models were used to characterize mold growth in vivo. The Gompertz model is not reliable, because it does not take into account the nutrient concentrations and the exact mechanism of lag-phase, the Baranyi model, by contrast, proved to be applicable. In case of *Penicillium vermiculatum* the growth rate was significantly lower, the lag phase was longer than the values of all *Aspergillus niger*, with the exception of a temperature of 10 ° C in both water activity value, and 0.98 water activity value at 15 ° C case. The water activity value of 0.98 for both more conducive to mold growth, such as water activity of 0.90 (lag phase, growth rate). The 10 and 15 ° C is not favorable to *Aspergillus niger*, 37 ° C in the growth of *Penicillium vermiculatum*. The lag-phase, more precisely, further experiments are necessary.

In case of artificially contaminated paprika with mould, determination of mould contamination based on ergosterol content gave good fit at Baranyi model, but at linear growth model was inadequate

#### **4.1. New scientific results**

Based on the experiments confirmed that the current local weather conditions, the aflatoxin contamination in paprika was not significant because of the mycotoxins producing molds in paprika plants grow less, and the manufacturing process are not in conditions that are more favorable to the growth of molds producing aflatoxins.

The OTA contamination can be easily able to cross the Hungarian limit, it is therefore appropriate for OTA testing of imported paprika powder.

It was proved that the estimated value of mold contamination in paprika, the ergosterin content and mold content co-determination can be identified. The technology that occurred during the heat treatment the microorganisms increase (of the plate is destroyed), it will justify the determination of the chemical mold contamination (ergosterol determination).

A new chromatographic method was developed for the determination of ergosterol in paprika, which is very accurate, efficient, and suitable for a few number of components of paprika such as ergosterol, contamination for the simultaneous detection.

The Baranyi model was successfully applied first to the *Penicillium vermiculatum* and *Aspergillus niger* growth characterization of 0.90 and 0.98 water activity values, at 10, 15, 25, 30, 37 ° C.

The Baranyi bacterial growth model was successfully applied first in paprika in the case of mould growth characterization.



## 5. CONCLUSIONS AND SUGGESTIONS

The drying and storage per product in the analysis of the circumstances established that the drying of a significant reduction of plate count results in a practical point of view, no matter what method is used in seasoning post-ripening case.

The storage conditions such as temperature, bag in some cases may have influence. Interestingly, the cold storage did not improve significantly compared to the microbiological status of non-refrigerated. The quality of the storage net, woven or nylon is also not proved to be an important factor. The spice is not enough to establish mould contamination with conventional microbiological method. *Penicillium vermiculatum* and *Aspergillus niger*, the selected experimental conditions used in the model of Baranyi's characterization of mold reproduction.

## PUBLICATIONS RELATED TO THE THESIS

### Publication In journals

#### IF's journal:

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