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Food Engineering Department



INTERNATIONAL FOOD CONGRESS

Novel Approaches in Food Industry

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PREFACE

It is our pleasure to introduce you **The International Food Congress** entitled "**Novel Approaches in Food Industry**" which will be held in Çeşme, Izmir, TURKEY. The congress will take place on 26-29 May, 2011 and include a variety of hot topics such as novel food products and technologies, thermal and non-thermal food processing technologies, applications of nanotechnology in food processing, innovations in food science and technology. This congress will highlight the most important areas of recent Research & Development in Food Science and Technology as well as explore relevant and interesting topics for the future. The congress will also provide accurate and updated scientific information and trends for the discipline of food science and technology. 400 leading scientists from all over 40 countries will contribute to the congress as oral or poster presentations.

This congress will provide a forum for the exchange of ideas and authoritative views by leading scientists, as well as business leaders and investors in the food industry. **More than 32 leading food industry companies became sponsor or supporting organization to our congress.** Outstanding keynote speakers and well-known leading scientists and experts from around the world will be sharing their knowledge with us. Company executives, as well as speakers from universities, research centers and governmental institutions will discuss scientific and technical developments in detail.

We would like to thank all contributors including authors of oral and poster presentations and our sponsors for contributing to the success of this congress.

On Behalf of the Executive Committee
Prof. Dr. Sebnem TAVMAN

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Influence of the practices used in lettuce salads preparation in a catering unit in terms of food safety

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Abstract

Nowadays, the consumption of vegetables has assumed particular importance. Several studies over the last decade have shown that the consumption of vegetables may reduce the occurrence of cancers and lessen the risk of coronary heart disease. However, leafy green vegetables may represent some microbiological hazards. In spite of this, catering units that offer these kinds of products have to guarantee their quality and safety.

The present study intended to evaluate the practices used in lettuce salads preparation in a catering unit and their influence on the quality and safety of the final product. Physic-chemical and microbiological analyses were performed on lettuce subjected to two treatments of disinfection - diluted solutions of vinegar and chlorine-tablets, applied for 5, 10 and 15 minutes. The practice of cutting the lettuce was also evaluated.

In all assays performed no disinfectant residue was found in the lettuce washing solution obtained after the disinfection treatment. Moreover, it was found that the only type of chlorine specie found in solutions obtained with the chlorine-tablet disinfection method was free chlorine and monochloroamines, dichloroamines and trichloroamines were not detected. In microbiological terms (yeasts, mesophiles, coliforms, *E. coli* and molds), the treatment with vinegar was not effective to make the product satisfactory. On the other hand, the chlorine tablet was effective in reducing the microbial population to values considered acceptable, provided that the lettuce was not subjected to cutting prior to the disinfection process.

Key Words: Lettuce, practices, disinfection, safety.

Introduction

In the last two decades, there has been a noticeable increase in the consumption of fresh fruits. Diets which are low in fat and high in fiber have shown to be protective against many cancers and reduce the risk of coronary heart disease. However, vegetables can be a vehicle of transmission in several outbreaks. For this reason, the hygienic quality of this product must be monitored to minimize or reduce the microbial populations and the foodborne disease risk (Francis et al., 1999).

Disinfection is one of the methods used to sanitize vegetables. Sodium hypochlorite or potassium permanganate solutions are possible disinfectants against a wide number of microorganisms. Nevertheless, the interest on using vinegar, acetic acid and peracetic acid is increasing due to the toxicity of chlorine.

Nowadays, catering units have assumed an important role in society as a result of the changes observed in consumer attitudes. In fact, people have less time to prepare their food and so catering units are frequently used. In spite of this, vegetable products and in particular green salads must be safe for the consumer. In addition, it must be guaranteed that there are no chemical and biological dangers that can injure the consumer's health.

Thus, the present study intended to evaluate the practices used in lettuce salads preparation in a catering unit and their influence on the final quality and safety of the product when two treatments of disinfection were applied, namely diluted solutions of vinegar and chlorine-tablet which were applied for 5, 10 and 15 minutes. The practice of cutting the lettuce was also evaluated.

Material and Methods

Sampling. Lettuce salads samples were taken in the catering unit. The lettuce was subjected to two treatments of disinfection - diluted solutions of vinegar and chlorine-tablet. Both treatments involved the following steps: cut off the stalk, cut the leaves into strips and mix them. Then, 30g of lettuce were weighted and immersed in the diluted disinfection solutions for 5, 10 and 15 minutes. The lettuce was then immersed in water and collected for subsequent microbiological analysis. All of these steps were repeated three times.

In a second trial, the same steps described above were followed with the exception of using the whole leaves instead of the strips. In this assay, only the time period of 10 and 15 minutes were tested.

In both trials, a control was always made, consisting in the immersion of the lettuce only in water. The solutions of the first and second immersions were collected for the determination of physico-chemical parameters. For microbiological analyses all lettuce samples of the second immersion (water) were collected, as well as an initial sample of lettuce without any treatment in order to evaluate the initial microbiological load. All samples for microbiological analyses were then placed in sterilized plastic bags, transported in ice chests to the laboratory and cultured on the same day.

Physico-chemical analyses. The pH and the chlorine species were measured in the washing solutions. The chlorine species – free chlorine, monochloroamines, dichloroamines and trichloroamines – were determined by the colorimetric method of the N,N-*p*-phenylenediamine. All measurements were performed in triplicate.

Microbiological analyses. A 10g sample was mixed with 90 ml of a sterile peptone water solution and homogenized with a Stomacher for 2 min. As required, decimal dilutions were prepared in the same diluent and plated in duplicate on appropriate media. The media and the conditions of incubation were the following for the microorganisms: (I) Mesophiles: Plate Count Agar (PCA, Oxoid) incubated at 35°C for 2h; (II) Yeasts and molds: Potato dextrose agar (PDA, Oxoid) with chloranphenicol incubated at 25°C for 5 days; and (III) Coliforms and *Escherichia coli* by the SimPlate® method.

Statistical analyses. All data was analyzed by a statistical software package (JMP). Means were compared by ANOVA and Tukey's tests. Statistical differences were documented at $P < 0.05$ with superscript letters in each table indicating values having significant differences within each column.

Results and Discussion

In both assays, the pH values of the chlorine-tablet solutions and of the control were identical to those of the water that is supplied to the catering unit (Table 1). Although, this water comes from a well, it meets the parametric values established for water used for human consumption (Law-Decree nº 306/2007 of 27th August), that establishes the range of ≥ 6.5 to ≤ 9 as adequate.

Table 1. pH values determined in the first immersing solutions for the treatments studied in the first (lettuce cut) and second (whole leaves) assays

Treatment	First Assay	Second Assay
Water	7.66	7.81
Control	7.54 – 7.58	7.82 – 7.91
Chlorine-tablet	7.29 – 7.43	7.00 – 7.29
Vinegar	5.58 – 5.72	4.58 – 7.47

In contrast, lower pH values were obtained with the vinegar solutions. This acidity was expected, since vinegar contains acetic acid at a concentration of at least 4% (v/v). This is an organic acid that penetrates into bacterial cells, acidifies their interior, causing damage or destruction (Smulders et al. 1986). Nevertheless, after the second dipping of the lettuce, all the solutions had pH values above 7 (in the first assay: 7.47 to 7.76; second assay: 7.49 to 7.82) and even for the vinegar disinfection treatment.

In relation to the chlorine-tablets treatments, the only species found in the first washing was the free chlorine. Monochloroamines, dichloroamines and trichloroamines were not detected. In the second washing solution none of the chlorine specie types was detected. These results reinforce the importance of the second washing to remove all traces of disinfectant.

The microbiological analyses of lettuce cut into strips (first assay) showed that vinegar (Table 2) and chlorine-tablet (Table 3) treatments applied for 5, 10 and 15 minutes were not effective in reducing the microbial population to satisfactory levels. Santos (2005) suggests a maximum acceptable concentration of 6, 5, 3, 4 and 2 log CFU/g for aerobic mesophiles, yeasts, molds, total coliforms and *E. coli*, respectively.

Table 2. Mean values (\pm SD, n = 3) of the log CFU/g of yeasts, mesophiles, coliforms and molds in the initial sample, control samples and samples disinfected with vinegar applied for 5, 10 and 15 minutes in lettuce cut into strips

Treatment	Yeasts	Mesophiles	Coliforms	Molds
Initial sample	5.90 \pm 0.28 a	5.19 \pm 0.15 a	7.18 \pm 1.11 a	2.80 \pm 0.73 a
Control 5	5.90 \pm 0.20 a	5.33 \pm 0.14 a	5.72 \pm 0.74 a	3.76 \pm 1.53 a
Control 10	6.05 \pm 0.26 a	5.00 \pm 0.17 a	6.33 \pm 0.76 a	2.65 \pm 1.13 a
Control 15	4.99 \pm 0.47 b	5.10 \pm 0.19 a	5.93 \pm 0.55 a	3.30 \pm 1.33 a
Vinegar 5	5.06 \pm 0.42 b	4.43 \pm 1.29 a	6.10 \pm 0.45 a	3.36 \pm 0.34 a
Vinegar 10	5.20 \pm 0.23 ab	5.05 \pm 0.06 a	6.80 \pm 0.64 a	3.06 \pm 0.17 a
Vinegar 15	5.30 \pm 0.18 ab	5.00 \pm 0.10 a	4.95 \pm 2.33 a	3.14 \pm 1.03 a

As the water supplied to the catering unit might be a possible contamination source, its microbiological load was also evaluated. The results obtained showed that the number of colonies at 22 and 37°C were within the legal limits for these parameters, 100 and 20 CFU/mL (Law-Decree nº 306/2007 of 27th August).

In both assays, the initial sample of lettuce (unwashed) presented a high microbial load because the yeasts and coliforms levels were higher than those considered as acceptable for this kind of products, namely, higher than 5 and 4 log CFU/g, respectively (Santos, 2005). To our knowledge, there is no Portuguese or even European legislation regarding microbiological criteria for most of ready-to-eat products. For coliforms, values higher than 4 log CFU/g are generally indicative of products inappropriate for human consumption due to nutritional losses and risk of deterioration and foodborne illnesses.

Table 3. Mean values (\pm SD, n = 3) of the log CFU/g of yeasts, mesophiles, coliforms and molds in the initial sample; control samples and samples disinfected with chlorine-tablet applied for 5, 10 and 15 minutes in lettuce cut into strips

Treatment	Yeasts	Mesophiles	Coliforms	Molds
Initial sample	5.93 \pm 0.36 a	5.94 \pm 0.52 a	5.90 \pm 0.52 a	3.28 \pm 0.14 a
Control 5	5.84 \pm 0.80 a	5.26 \pm 0.59 a	5.73 \pm 0.55 a	2.07 \pm 0.16 b
Control 10	6.09 \pm 0.28 a	7.22 \pm 1.59 a	6.19 \pm 0.67 a	2.00 \pm 0.00 b
Control 15	6.22 \pm 0.08 a	5.76 \pm 0.28 a	6.12 \pm 0.15 a	2.00 \pm 0.00 b
Chlorine-tablet 5	5.34 \pm 0.02 b	5.73 \pm 0.29 a	5.67 \pm 0.03 a	1.99 \pm 0.02 b
Chlorine-tablet 10	5.33 \pm 0.16 b	5.40 \pm 0.45 a	5.83 \pm 0.47 a	1.97 \pm 0.02 b

Chlorine-tablet 15 5.21 ± 0.16 b 5.79 ± 0.33 a 5.37 ± 0.22 a 1.97 ± 0.02 b

The treatments were ineffective because the cutting of the lettuce probably favored the microorganism growth. Cutting increases the respiration, originates mechanical damages and promotes the release of enzymes and exudates present in the cells (Embrapa, 2004).

When using the whole leaves with the vinegar treatment, only a significant decrease in yeast and mold populations was observed in relation to the initial sample (Table 4). However, in terms of the yeasts, the decrease was not sufficient to make the product safe. For the mesophiles and coliforms, a significant decrease was not observed. In spite of this, the vinegar treatment was not effective to make the product satisfactory.

In regards to the chlorine-tablet treatment, better results were obtained in comparison to the other methodologies. A significant reduction was observed for all the microbiological parameters for the 10 minutes treatment, making the product acceptable.

Table 4. Mean values (\pm SD, n = 3) of the log CFU/g of yeasts, mesophilic, coliform and mold in initial sample; control samples and samples disinfected with vinegar and chlorine-tablet applied for 10 and 15 minutes in whole leaves.

Treatment	Yeasts	Mesophiles	Coliforms	Molds
Initial sample	6.36 ± 0.09 a	6.56 ± 0.23 a	6.92 ± 0.40 a	3.32 ± 0.11 a
Control 10	5.24 ± 0.17 b	6.25 ± 0.26 ab	6.32 ± 0.19 a	2.65 ± 0.28 b
Vinegar 10	5.16 ± 0.23 b	6.21 ± 0.19 ab	6.24 ± 0.27 a	2.82 ± 0.16 b
Chlorine-tablet 10	4.95 ± 0.56 bc	5.07 ± 0.79 c	3.91 ± 1.06 b	1.97 ± 0.02 c
Chlorine-tablet 15	4.27 ± 0.24 c	5.31 ± 0.14 bc	5.82 ± 0.12 a	1.99 ± 0.02 c

Nevertheless, for the 15 minutes disinfection a significant reduction on microbiological population was observed, with the exception of coliforms. In relation to the other treatments (control and vinegar), a similar reduction was observed for yeasts and molds. The reduction level of coliforms was insufficient to make the product acceptable (4 log CFU/g). When comparing these results with those obtained for the chlorine-tablet 10 minutes immersion, the higher values observed for the 15 minutes may be justified due to the high microbial load of the raw-material and of its non-uniformed distribution, causing some variability in the obtained results. Moreover, in the first assay (Tables 2 and 3) the high microbial loads of the raw material were also observed. This indicates the use of inappropriate agricultural practices that may contaminate the crops, for example, using water with high organic load in the irrigation. These results are similar to those referred by Oliveira *et al.* (2006) for lettuces sold in markets in the city of Belém (Brasil). In all assays *E. coli* was never detected.

The results of this study are similar to the ones reported by Nascimento *et al.* (2002) and Santos *et al.* (2004), where the efficacy of different preparation methods of lettuce (diluted vinegar solutions and sodium hypochlorite) was evaluated. The most efficient was the sodium hypochlorite method.

Conclusions

The present study shows that lettuce washing after disinfection treatment is of great importance in order to eliminate any chemical trace of the disinfectant solution used.

Vinegar and chlorine-tablets were inefficient in reducing the microbiological load of lettuce cut into strips before its disinfection. When using the whole leaves, the vinegar solution was again ineffective. In contrast, the chlorine-tablet treatment was effective in reducing microbial population to values considered acceptable. In spite of this, we recommend the use of the chlorine-tablets for lettuce disinfection.

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