Introduction

Fruits and vegetables eaten raw are potential vehicles of pathogens due to the impossibility of applying thermal treatments, which would considerably reduce biological hazards that might be present (De Roever, 1998; Viswanathan and Kaur, 2001). Many of the contaminant microflora are part of the production environment or may also occur during harvesting, transportation, processing, storage, marketing or even in a consumer’s home (Beuchat, 1998). Lettuce is one of the most consumed salad vegetables in Portugal and absorption of nutrients is favoured by the consumption of raw leaves, which remain uncovered from environment or may also occur during harvesting (Allekruse et al., 1997). These types of products are usually consumed raw, are grown in contact or near the soil, are exposed to intensive handling from harvesting until consumption and in the case of the fruits, they are not usually washed before peeling. Therefore, the aim of this study was to evaluate the microbial load on the surface of fruits with rough and very pronounced textured peels, namely pineapples and melons, as well as lettuce peels, analyzing the varieties, countries of origin and distribution sites of these products.

Methods

Between June 2009 and June 2010, 120 samples (40 lettuces, 40 pineapples and 40 melons) were collected with different geographic origins and sold in several distribution sites in northern Portugal. Some lettuces were taken directly from the growing crop field. Two varieties of lettuce (Lactuca sativa L. var. capitata and Lactuca sativa L. var. crispa) and melons (Cucumis melo L. var. cantalupensis Naudin and Cucumis melo L. var. reticulatus Naudin) were studied (Fig. 1). Different varieties of pineapple were used, one of them from Azores (Ananas dos Açores) (Fig. 1). The fruits washed 24 h before peeling were analyzed after storage at 4 °C overnight. Leaves of lettuces were analyzed directly without any treatment. Enumeration of aerobic plate count, Enterobacteriaceae, Escherichia coli and coagulase-positive staphylococci, as well as detection of Listeria monocytogenes and Salmonella spp., were performed for all samples. For characterization of coagulase-positive staphylococci isolates, a DNA extraction (Aires de Sousa et al., 1996) and Multiplex PCR (Zhang et al., 2004) were done to evaluate the presence of a set of Staphylococcus genus-specific primers and verify if Staphylococcus aureus were present in the samples. For characterization of L. monocytogenes isolates, a DNA extraction and a Multiplex PCR (Doumith et al., 2004) were performed to identify the serovars present in the samples. The minimum inhibitory concentration (MIC) of several antibiotics was determined for coagulase-positive staphylococci and L. monocytogenes isolates by the agar dilution method (CLSI, 2007). An analysis of variance (one-way ANOVA) was performed to test significant differences in bacterial counts between varieties of the products, countries of origin and distribution sites.

Results and Discussion

Fig. 2. A. E. coli counts in lettuce comparing distribution sites. B. Aerobic plate counts in pineapple comparing countries of origin.

There were no significant differences in the varieties of the products in this study (p>0.05), but significant differences were observed in lettuce samples according to distribution sites (p<0.05); samples purchased at supermarkets showed lower E. coli counts than those of other establishments (Fig. 2A). Faecal contamination (E. coli) was found in 47.5 % of lettuce samples, 15 % were contaminated with L. monocytogenes and 7.5 % with coagulase-positive staphylococci. Significant differences were observed between fruit peels according to country of origin and distribution sites (p<0.05). Pineapples from Ecuador and melons from Morocco had higher aerobic plate counts (Fig. 2B) and Enterobacteriaceae counts (data not shown), respectively, than other countries. The fruits purchased in hypermarkets showed lower bacterial counts when compared with other establishments (data not shown). 5 % of pineapples presented faecal contamination, 2.5 % were contaminated with L. monocytogenes and 2.5 % with coagulase-positive staphylococci. 2.5 % of melon samples were contaminated with L. monocytogenes but neither E. coli nor coagulase-positive staphylococci were found in these samples. L. monocytogenes isolates belonged to serovars 2 (1/2c or 3c) or 4 (4b, 4d and 4e) and none were found to be resistant to antibiotics commonly used in therapy of listeriosis. None of the coagulase-positive staphylococci was S. aureus neither did they exhibit multidrug resistance. Salmonella spp. was not detected in fruits and vegetables analyzed in this study.

References

