Commercial Mushrooms and Bean Sprouts Are a Source of Pseudomonas aeruginosa

Although Pseudomonas aeruginosa is widely reported to be ubiquitous in the environment, attempts to reliably isolate this opportunistic pathogen from environmental sources have often had limited success. In many cases, if present, P. aeruginosa is not detectable in quantifiable amounts and requires amplification through enrichment steps (2).

P. aeruginosa is a common nosocomial pathogen infecting burns, wounds, the immunocompromised, patients with spinal injuries, and those with certain chronic lung diseases such as cystic fibrosis (CF), chronic obstructive pulmonary disease, and bronchiectasis. P. aeruginosa is also the second-most-common organism associated with cutaneous infection among contact lens wearers (1). Within infected patients in a hospital setting a proportion of isolates of P. aeruginosa may be regarded representing members of a group of flora that are endemic in the hospital, and such infected patients are the reservoir for transmission of these strains. For certain CF clinics specific epidemic strains have been identified that account for a significant percentage of infections. Generally, however, CF sufferers who attend outpatient clinics appear to acquire their own unique strains, and current studies suggest that there is little transmission of these “nonepidemic” isolates from one CF sufferer to another. A low percentage of the population carry P. aeruginosa fecally (3) and, although this accounts for a large number of people, the bacterial numbers present are usually low; high levels of fecal contamination would appear to be needed to transmit strains.

The scientific consensus is that most P. aeruginosa infections are acquired from the environment, but there have been no clearly identified environmental sources that represent a high risk to susceptible groups. It is therefore important to understand the routes of infection and colonization and to attempt to locate significant environmental reservoirs of this organism.

Previously, P. aeruginosa isolates were reported to be found in samples of mushroom capping compost within one experimental mushroom-growing unit (4). A representative selection of these isolates was subsequently characterized by multilocus sequence typing; the results showed that these environmental isolates were related to clinical isolates. We have since been able to consistently isolate P. aeruginosa without enrichment, by serial dilution of stomached samples of whole mushrooms followed by plating directly on to Pseudomonas CN Selective Agar (4). We have achieved this using all commercial button and open-cap mushrooms (Agaricus bisporus) purchased from leading supermarkets and using spent mushroom compost purchased from garden centers as a soil improver. These isolates were identified as P. aeruginosa by a methodology previously described (4) and confirmed by the Health Protection Agency, Laboratory of HealthCare Associated Infection, Centre for Infections. P. aeruginosa was also intermittently isolated directly from packets of bean sprouts but was not detected in a selection of other common supermarket fruit and vegetables.

Fifteen packets or bags of mushrooms, purchased from several supermarkets, originally grown in five different countries were all positive for P. aeruginosa (from France, two samples [3.4 \times 10^5 and 8.3 \times 10^5 CFU/g]; from Germany, three samples [4.1 \times 10^5, 1.2 \times 10^6, and 1.8 \times 10^6 CFU/g]; from Holland, four samples [4.8 \times 10^5, 1.4 \times 10^5, 5.6 \times 10^5, and 4.8 \times 10^6 CFU/g]; from Ireland, four samples [3.2 \times 10^6, 6.4 \times 10^6, 7.2 \times 10^6, and 1.0 \times 10^7 CFU/g]; and from the United Kingdom, two samples [3.2 \times 10^7 and 3.6 \times 10^7 CFU/g]). This contamination was predominantly identified on the mushroom surface. The number of CFU per gram in the outer layer was therefore much higher than for whole mushrooms. Mushroom growers’ compost (four samples) direct from the producer carried between 2.1 \times 10^7 and 7.4 \times 10^7 CFU/g, and commercially available spent mushroom growers’ compost (one sample), used for gardening, carried 6.4 \times 10^7 CFU/g. Additionally, two samples of packaged bean sprouts (of four samples found to be contaminated by P. aeruginosa) carried 7.1 \times 10^5 and 8.4 \times 10^5 CFU/g. The presence or absence of P. aeruginosa in bean sprouts appeared to relate to different producers, suggesting that differing treatment regimes in production or packaging may be able to control contamination. However, Pseudomonas species are required to initiate mushroom fruit body formation; therefore, control of P. aeruginosa in mushroom production may be problematic.

Antibiotic susceptibility testing was performed on 24 isolates of P. aeruginosa from five different countries of origin. Use of the breakpoints from the British Society for Antimicrobial Chemotherapy Working Party revealed that all isolates from mushrooms and bean sprouts were highly susceptible to amikacin, aztreonam, ceftazidime, ciprofloxacin, colistin, gentamicin, imipenem, meropenem, piperacillin, and tobramycin. These results indicate an environmental rather than clinical reservoir for the contamination of mushrooms by P. aeruginosa.

Susceptible patients (as detailed above) across Europe should be made aware of the potential risks associated with handling uncooked mushrooms (A. bisporus) and bean sprouts and of the necessity of appropriate food hygiene measures in their preparation. As with other foodborne pathogens, the high temperatures associated with thorough cooking should be sufficient to kill P. aeruginosa.

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