

A Research Note

Evaluation of the Botulism Hazard in Fresh Mushrooms Wrapped in Commercial Polyvinylchloride Film

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ABSTRACT

The botulism hazard in fresh mushrooms wrapped in commercial polyvinylchloride (PVC) film appears to be minimal. At the end of their normal shelf-life, 1,078 packages of PVC-wrapped mushrooms were all free of botulinum toxin. Since inoculated mushrooms were occasionally found to be toxic (14 in 250 packages) when only one 1/8-inch hole was punched in the wrapper, and none became toxic when two holes were present, it seems prudent to recommend that PVC-wrapped tills of mushrooms have two holes in the wrapper.

Mushrooms are often regarded as a delicacy, as the major portion, or as the garnish in a variety of dishes. However, since fresh mushrooms are readily perishable, it was desirable to find some means of prolonging their marketable condition. Producers found that mushrooms packaged in papier maché tills and wrapped and sealed in a polyvinylchloride (PVC) film had a longer shelf-life than bulk mushrooms. The till absorbs moisture and the wrapper permits very little gas exchange between the contents and the outside atmosphere. Respiration of the mushrooms, therefore, could be expected to use up the available O₂ and produce CO₂, which would result in an anaerobic atmosphere, favorable to the growth of *Clostridium botulinum*.

Analysis of headspace gas in these packages by Sugiyama and Yang (2) showed that the O₂ in the container was quickly reduced to less than 2%. Mushrooms inoculated with large numbers of *C. botulinum* spores of type A or type B and sealed in tills with a PVC wrap developed botulinum toxin while still appearing to be acceptable. Both types of spores grew and produced toxin, but type A grew more readily than type B. Later, Sugiyama (Private Communication, 1977) showed that if one or two holes of 1/8-inch diameter were punched in the PVC wrap without being blocked by either a mushroom or the till, mushrooms inoculated with *C. botulinum* would not become toxic.

In 1976, Craig (Private Communication) found *C. botulinum* type A spores in all samples of mushroom compost and topping which he tested, and Hauschild et

al. (1) reported low numbers of *C. botulinum* spores in all examined samples of uninoculated mushrooms. The purpose of this study, therefore, was to examine packaged mushrooms wrapped in PVC as offered to the public, for the presence of botulinum toxin after holding them at room temperature for their approximate shelf-life.

MATERIALS AND METHODS

By special arrangement with a local supermarket, mushrooms were obtained as soon as they were received from the producers. The mushrooms were kept in the tills in which they were received but were rewrapped with fresh PVC film without holes. The PVC used was that used commercially for wrapping mushrooms, either Borden's Resinite VC-71 60-gauge polyvinylchloride film or commercial plasticized PVC (0.65 mil thick).

After being held for 7 days at room temperature, mushrooms were tested for toxicity in mice. In preparation for toxicity testing, mushrooms were macerated in a Waring Blendor without addition of liquid and were centrifuged to sediment the pulp. The supernatant fluid was diluted 1:5 and 1:10 in gel-phosphate buffer (pH 6.2), and 0.5 ml of both dilutions was injected intraperitoneally into each of two mice. The mice were observed for 72 h for symptoms of botulism.

RESULTS AND DISCUSSION

The possibility of botulism resulting from mushrooms wrapped in PVC appears to be minimal. Of the 1,078 packages of fresh mushrooms examined in this study, all remained free of botulinum toxin as shown by mouse toxicity testing. The results of Hauschild et al. (1) indicate that the number of viable spores on the mushrooms which they examined was very low, and the results of Sugiyama and Yang (2) indicate that detectable toxin is not produced unless large numbers of spores are inoculated into the mushrooms. Experiments in our own laboratories have produced results similar to those of Sugiyama with one difference: Some of our inoculated mushrooms wrapped in PVC with only one hole became toxic, whereas those with two holes did not (Unpublished data). Although these experiments do not determine the extent of the problem, they do show the possible hazard

and how it can be prevented.

It seems unlikely that the number of spores required for toxin production would normally be present in fresh mushrooms. However, since our experiments showed that inoculated mushrooms occasionally became toxic (14 in 250 packages) when only one 1/8-inch hole was made in the wrapper, it seems prudent to recommend that PVC-wrapped tills of mushrooms have two

unblocked holes in the wrapper.

REFERENCES

1. Hauschild, A. H. W., B. J. Aris, and R. Hilsheimer. 1975. *Clostridium botulinum* in marinated products. Can. Inst. Food Sci. Technol. J. 8:84-87.
2. Sugiyama, H., and K. H. Yang. 1975. Growth potential of *Clostridium botulinum* in fresh mushrooms packaged in semipermeable plastic film. Appl. Microbiol. 30:964-969.