A Research Note

Incidence of Patulin in Apple, Pear, and Mixed Fruit Products Marketed in New South Wales

KATARINA BURDA

New South Wales Health Department, Division of Analytical Laboratories, P.O. Box 162, Lidcombe, New South Wales, 2141, Australia

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ABSTRACT

Three hundred twenty-eight (328) apple, pear, and mixed fruit products including juices, sauces, purees, jellies, diced apples, and apple pulps from 38 Australian producers were analyzed for patulin using the technique of high pressure liquid chromatography analysis. Patulin was detected in 75 of 258 juice and juice concentrate samples ranging from 5 to 50 μg/L and in 73 samples ranging from 51 to 1130 μg/L. Of 70 samples other than juices, patulin was detected in 18 samples at levels below 50 μg/kg of patulin. The detection limits for patulin in juice and other products were 5 μg/L and 5 μg/kg, respectively.

Patulin is a mycotoxin produced by several Penicillium and Aspergillus species. It has been found in apples (13) and other fruits spoiled by Penicillium expansum and confined to areas of spoiled tissue (2). Levels of patulin in fruit products can be reduced by removing rotten tissue from the raw fruit. Patulin can therefore be used as an indicator of the quality of processed apple juices and fruit products since appreciable concentrations of the toxin remain in food after processing (8,10). Patulin has been shown to exhibit toxic effects in animal systems (9) and caused localized tumors in rats at the site of injection (3).

Several investigations in a number of countries have reported the presence of patulin in apple products available for human consumption (1-5,7). Certain European countries have adopted a maximum limit of 50 μg/L or kg (6,10,11).

The objective of this study was to screen apple, pear, and mixed fruit juices and other products marketed in New South Wales (N.S.W.), Australia, for patulin content.

MATERIALS AND METHODS

Sampling

This study encompassed a total of 328 samples of apple and mixed fruit juices (either fresh, long life, or concentrated), sauces, purees, jellies, diced apples, and apple pulps. The samples were collected from various retail outlets and directly from some producers in Sydney and rural N.S.W. between August 1989 and May 1990 by inspectors of the N.S.W. Health Department. Samples were stored below 4°C prior to analysis and were analyzed immediately upon opening between September 1989 and May 1990.

Apparatus

Patulin was determined by high pressure liquid chromatography (HPLC) (4). The analyses were performed using a Waters Model 590 pump equipped with a Waters 715 Ultrawisp autosampler and a Waters 490 Programmable Multiwavelength detector. Quantitation was by an external standard method, with analytical results being computed via a Waters Maxima 825 Chromatography Workstation. Diode Array Detector HP 1040A and Hewlett-Packard HPLC Chem Station HP 9000 were used for patulin confirmation.

Chemicals

All reagents and solvents were analytical grade. Patulin standard was obtained from Calbiochem, San Diego, CA.

Chromatographic conditions

a) Column, Spheri-10 RP-18, 4.6 mm inside diameter x 25 cm, 10 μm, Brownlee Lab; b) mobile phase, 2% acetic acid (vol/vol); c) flow rate, 1.5 ml/min; d) wavelength, 276 nm; e) absorbance mode, 0.001 absorbance units, full scale; and f) injection volume, 50 μl.

Analytical procedure

Juices (5 ml) and solid samples (2- to 3-g) were extracted with two 5-ml portions of ethyl acetate. The combined ethyl acetate extract was cleaned up by extraction with 2 or 3 ml of 1.5% sodium carbonate solution, respectively. The aqueous phase was extracted with 5 ml ethyl acetate. The combined ethyl acetate extracts were evaporated to almost dryness with a rotary evaporator and then to dryness under a stream of nitrogen. The residue was dissolved in 2.5 or 1 ml of 2% acetic acid (vol/vol), respectively (4).

Patulin working standard solutions 50, 100, and 200 μg/L were prepared from patulin stock standard solution in chloroform by evaporating appropriate aliquots to dryness under nitrogen and dissolving the residue immediately in 2% acetic acid to get the desired concentrations.

For juices and solid samples, spiking of negative samples with patulin at several levels above the detection limit up to 250 μg/L was completed.
RESULTS AND DISCUSSION

A total of 328 samples of apple, pear, and mixed fruit products from 38 producers were analyzed for patulin content.

The results of the patulin analyses for 258 apple, pear, and mixed fruit juices and concentrates are presented in Table 1 and show that patulin levels exceeded 50 µg/L in 28.3% of all juice samples analyzed. Patulin was detected (detection limit 5 µg/L) in 57.5% of the samples. Similar results were reported in the first Australian investigation of patulin contamination in apple juices carried out in Victoria in 1988-89 (12). In that study, the concentration of patulin was found to exceed 50 µg/L in 29.2% of apple juices, with the mycotoxin detected in 65.5% of 113 juice samples analyzed (detection limit 5 µg/L). The maximum patulin concentration found was 629 µg/L (12). These two studies indicate both a high incidence and range of patulin levels in juices available in Australia and, from a public health viewpoint, do not compare favorably with most studies reported from other countries recently. A survey conducted in the United Kingdom during 1980 (5) showed that patulin was detected in 70% of 20 apple juice samples, ranging from 1 to 38 µg/L. In 1985, another United Kingdom survey reported only one apple juice sample out of 24 contained patulin, at a concentration of 56 µg/L (7). In a Swedish survey (6), 38 apple and pear juice samples were reported to have a patulin content less than 10 µg/L, while in a United States study, 29 samples out of 40 contained less than 50 µg/L of patulin (1). A New Zealand survey reported that 15% of apple juice samples contained patulin levels ranging from 106 to 216 µg/L (14).

Of the 70 apple and mixed fruit products other than juices examined in the present survey, patulin was not detected in 52 samples (detection limit 5 µg/kg). The remaining 18 samples contained patulin ranging from 5 to 32 µg/kg (Table 1).

Our results indicated varying ranges of patulin contamination between processors. Patulin contamination in fruit juices produced by nine companies out of 38 investigated, from which a minimum of five samples were analyzed, are presented in Table 2. A high percentage of patulin contamination was found in the products of companies A and B. The majority of products made by company A contained more than 50 µg/L of patulin, and the maximum level found was 660 µg/L. Patulin contamination in nonreconstituted apple juices, made by company B, varied between batches and ranged from 55 to 1130 µg/L. Products of company H were found to be free of patulin, and only one mixed juice sample produced by company I contained patulin, at a concentration of 14 µg/L. These two companies are producers of infant food.

The overall conclusion of this study is that the incidence of patulin in apple and mixed fruit juices marketed in New South Wales is high, with a significant proportion of products exhibiting levels above the 50 µg/L limit set by certain European countries.

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