# COMMISSION RECOMMENDATION

## of 11 August 2003

## on the prevention and reduction of patulin contamination in apple juice and apple juice ingredients in other beverages

*(notified under document number C(2003) 2866)*

**(Text with EEA relevance)**

(2003/598/EC)

THE COMMISSION OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Community, and in particular the second indent of Article 211 thereof,

Whereas:

(1) Commission Regulation (EC) No 1425/2003 [1] establishes maximum levels for patulin for, *inter alia*, apple juice and apple juice ingredients in other beverages.

(2) An exposure assessment of patulin by the population of EU Member States has been performed in the frame of Council Directive 1993/5/EEC of 25 February 1993 on assistance to the Commission and cooperation by the Member States in the scientific examination of questions relating to food [2] (SCOOP). It can be concluded from the assessment that the average exposure seems to be quite below the PMTDI of 0,4 µg/kg body weight. Nevertheless, taking into consideration specific groups of consumers, especially small children, and assuming worst cases the exposure to patulin is more significant but still below the PMTDI.

(3) The maximum level for patulin in apple juice has been established taking into account the toxicological evaluation, the outcome of the exposure assessment and the feasibility. However, it is recognised that it is necessary that all efforts should be done to further reduce the presence of patulin in apple juice.

(4) The apple processing industry should therefore be encouraged to adopt good manufacturing practices. In particular they should discard spoilt fruit from their production process, their appearance being a good indicator of the level of contamination. However, as patulin can also occur in fruits not visible damaged or spoilt at the outside surface the contamination cannot be completely eliminated by trimming away all visible damaged and spoilt fruit. The full implementation of the 'Code of Practice for the prevention reduction of patulin contamination in apple juice and apple juice ingredients in other beverages' will result in a further reduction of the contamination level.

(5) To ensure the efficient working of the internal market, the European Union shall apply uniformly the 'Code of Practice for the prevention and reduction of patulin contamination in apple juice and apple juice ingredients in other beverages'. Therefore, it is recommended that the Code of Practice shall be introduced in the European Union.

(6) Commission Regulation (EC) No 466/2001 [3], as last amended by Regulation (EC) No 563/2002 [4], provides for a revision of the maximum levels for patulin in fruit juices, concentrated fruit juices, fruit nectars, spirit drinks, cider and other fermented drinks derived from apples or containing apple juice by 30 June 2005 with the aim of reducing the maximum level taking account of the progress of scientific and technological knowledge and the implementation of 'Code of practice for the prevention and reduction of patulin contamination in apple juice and apple juice ingredients in other beverages',

HEREBY RECOMMENDS THAT MEMBER STATES:

1. take the necessary measures so that the 'Code of Practice for the prevention and reduction of patulin contamination in apple juice and apple juice ingredients in other beverages' as described in the Annex to this Recommendation, is implemented by all operators in the apple processing industry.
2. ensure that all the appropriate measures, including — if necessary — corrective actions, are taken by the operators in the apple processing industry to achieve lower levels than the maximum level of 50 µg/kg for apple juices with the aim of achieving the level of 25 µg/kg patulin as target.

Done at Brussels, 11 August 2003.

*For the Commission*

David BYRNE

*Member of the Commission*

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[1] See page 1 of this Official Journal.
[2] OJ L 52, 4.3.1993, p. 18.
[3] OJ L 77, 16.3.2001, p. 1.
[4] OJ L 86, 3.4.2002, p. 5.

*ANNEX*

**Code of Practice for the reduction and prevention of patulin contamination in apple juice and apple juice ingredients in other beverages**

*Introduction*

1. Patulin is a secondary metabolite produced by a number of fungal species in the genera *Penicillium, Aspergillus* and *Byssochlamys* of which *Penicillium expansum* is probably the most commonly encountered species. Patulin has been found as a contaminant in many mouldy fruits, vegetables, cereals and other foods, however, the major sources of contamination are apples and apple products.

2. Alcoholic fermentation of fruit juices destroys patulin and, therefore, fermented products such as, cider and perry will not contain patulin. However, patulin has been found in fermented products to which apple juice has been added after fermentation. Ascorbic acid has been reported to cause the disappearance of patulin from apple juice, although the optimal conditions for inactivation have not been fully established. Patulin is relatively temperature stable, particularly at acid pH. High temperature (150 °C) short-term treatments have been reported to result in approximately 20 % reduction in patulin concentrations. However, thermal processing alone is not sufficient to ensure a product free of patulin.

3. Patulin occurs mainly in mould-damaged fruits although the presence of mould does not necessarily mean that patulin will be present in a fruit but indicates that it may be present. In some instances, internal growth of moulds may result from insect or other invasions of otherwise healthy tissue, resulting in occurrence of patulin in fruit, which externally appears undamaged. However, it can also occur in bruised fruit after controlled atmosphere storage and exposure to ambient conditions both with and without core rot being present. Washing of fruit, or removal of mouldy tissue, immediately prior to pressing will not necessarily remove all the patulin present in the fruit since some may have diffused into apparently healthy tissue.

4. Although the spores of many of the moulds capable of producing patulin will be present on fruit whilst it is still on the tree, they will generally not grow on fruit until after harvest. However, mould growth and patulin production can occur in fruit pre-harvest if the fruit becomes affected by disease or damaged by insects or where fallen fruit is gathered for processing. The condition of the fruit at harvest, the way in which the fruit is handled subsequently (especially during storage) and the extent to which storage conditions are inhibitory to the growth of moulds, will all affect the likelihood of patulin contamination of juice and other products prepared from fresh and stored fruit.

5. The recommendations for reducing patulin contamination in apple juice in this code are divided into two parts:

   I. Recommended practices based on Good Agricultural Practice (GAP).

   II. Recommended practices based on Good Manufacturing Practices (GMP).

## I. **RECOMMENDED PRACTICES BASED ON GAP**

### **Preharvest**

6. During the dormant season cut off, remove and destroy all diseased wood and mummified fruits.

7. Prune trees in line with good commercial practice producing a tree shape, which will allow good air movement through the tree and light penetration into the tree. This will also enable good spray cover to be achieved.

8. Measures should be taken to control pests and diseases which directly cause fruit rots or allow entry sites for patulin-producing moulds. These include canker, eye rot (*Botrytis* spp and *Nectria* spp), codling moth, fruitlet mining tortrix moth, winter moth, fruit tree tortrix, blastobasis, sawfly and dock sawfly.

9. Wet weather around the time of petal fall and of harvesting is likely to increase the risk of rot and appropriate measures, such as application of fungicide to prevent spore germination and fungal growth should be considered.

10. Apples of poor mineral composition are more likely to suffer physiological disorders in store and hence are more susceptible to particular types of rot especially by *Gloeosporium* spp and secondary rots such as *Penicillium*. Consignments of apples for the fresh fruit market which do not meet the recommended mineral compositional standards, as determined by fruit analysis, should therefore be excluded from long-term storage i.e. storage for longer than three to four months.

11. Where levels of minerals in the fruit for the fresh fruit market are outside optimum range, improving calcium and phosphorus levels in the fruit, particularly increasing the calcium/potassium ratio by controlled fertilizer usage, will improve cell structure, which will then reduce susceptibility to rotting.

12. Records of rot levels should be kept each year for individual orchards since historical data is the best guide, at present, to potential rot levels, which will indicate the need for fungicide application and the storage potential of the fruit from that orchard.

**Harvesting and transportation of fruit**

13. Apples for processing are classified into two categories:

(a) *Mechanically harvested fruit*

14. Mechanically harvested fruit is obtained by shaking the tree and collecting the fruit from the ground with appropriate mechanical machinery.

15. All fruit should be handled as gently as possible and every effort made to minimize physical damage at all stages of the harvesting and transportation procedures.

16. Before shaking the trees, deteriorated fallen fruit (rotten, fleshed etc.) should be removed from the ground in order to make sure that only fresh and/or sound fruit is collected.

17. Mechanically harvested fruit has to be transported to processing plants within three days after harvest.

18. All containers used to transport harvested fruit should be clean, dry and free of any debris.

(b) *Fruit for the fresh fruit market*

19. Fruit from orchards with a history of high levels of rot should be harvested separately and not considered for storage.

20. Ideally all fruit should be picked in dry weather conditions, when the fruit is mature, and placed in clean bins or other containers (e.g. boxes) suitable for transportation directly to store. Bins or boxes should be cleaned, ideally by hosing with clean water or preferably by scrubbing with soap and water, and fruit and leaf debris should be removed. Cleaned bins and boxes should be dried prior to use. Avoid exposure of fruit to rain.

21. Adequate training and supervision should be provided to ensure good damage-free picking practice.

22. All fruit in which the skin is damaged, or with the flesh exposed, as well as all diseased fruit, should be rejected in the orchard at the time of picking and fruit bruising should be minimized as far as possible.

23. All soil-contaminated fruit, i.e. rain splashed fruit or fruit on the ground, should be rejected for storage purposes.

24. Care must be taken to avoid the inclusion of leaves, twigs etc. in the picked fruit.

25. Fruit should be placed in cold storage within 18 hours of harvest and cooled to the recommended temperatures (examples, see Table 1) within three to four days of picking.

TABLE 1

Examples of recommended temperatures for storage of apples in air

| Variety | Temperature (°C) |
|---|---|
| Bramley | 3,0 — 4,0 |
| Cox's Orange Pippin | 3,0 — 3,5 |
| Discovery | 1,5 — 2,0 |
| Egremont | 3,0 — 3,5 |
| Golden Delicious | 1,5 — 2,0 |
| Crispin | 1,5 — 2,0 |
| Idared | 3,5 — 4,0 |
| Jonagold | 0,0 — 0,5 |
| Red Delicious | 0,0 — 1,0 |
| Spartan | 0,0 — 0,5 |
| Worcester | 0,0 — 1,0 |

26. During transport and storage, measures should be taken to avoid soil contamination.

27. Care must be taken during handling and transport of the bins or boxes in the orchard, and between the orchard and store, to avoid soil contamination of the container and the fruit and to minimize physical damage e.g. bruising of the fruit.

28. Harvested fruit should not be left in the orchard overnight but moved to a hard standing area, preferably under cover.

**Post-harvest handling and storage practices of fruit for the fresh fruit market**

29. All fruit, whether for the fresh market or for later processing, should be handled as gently as possible and every effort made to minimize physical damage e.g. bruising at all stages of post-harvest handling prior to pressing.

30. Apple growers, and other producers of juice who do not have controlled storage facilities, need to ensure that fruits for juicing are pressed as soon as possible after picking.

31. For controlled atmosphere storage ensure that stores are checked for gas tightness, where appropriate, and that all monitoring equipment is tested before harvesting commences. Pre-cool stores thoroughly before use.

32. Where appropriate post harvest fungicide treatments may be applied in accordance with the provisions of the relevant EU legislation.

33. Stored apples should be examined regularly, at least once a month, for rot levels; a record of the levels should be maintained from year to year. The sampling procedure used should minimize the risk of atmospheric changes occurring in the store (see paragraph 36).

34. Random samples of fruit should be placed in suitable containers (e.g. net bags) situated close to the inspection hatches to permit monitoring of fruit condition during the storage period (see paragraph 35). Samples should be examined for rots, general fruit condition and shelf life at least every month. Shorter intervals may be recommended in stores where the fruit storage conditions are less than optimum and/or the fruit has a predicted storage life of less than three months, because of adverse growth and/or harvesting conditions.

35. Where samples indicate problems with fruit condition appropriate action should be taken to remove the fruit for use before extensive damage occurs.

36. Mould growth normally occurs in a warm environment. Rapid cooling and maintenance of store atmosphere conditions will improve fruit condition. Ideally fruit should be loaded and cooled to less than 5 °C in three to four days and to optimum temperatures within a further two days. Controlled atmosphere conditions should be achieved within 7 to 10 days from the start of loading, and ultra-low oxygen regimes (i.e. less than 1,8 % oxygen) should be established within a further seven days.

**Post-storage grading of fruit for the fresh market or juice manufacture**

37. All rotten fruits, even those with only small areas of rot, should be eliminated as far as possible and wholesome fruit should be kept in a clean bulk container.

38. When containers are removed from storage to select fruit for retail distribution, the containers of fruit remaining for juicing should be specifically marked and returned to cold store within 12 hours of sorting. The time the fruit is at ambient temperatures should be kept to a minimum. Ideally fruit for juicing should be kept at < 5 °C between withdrawal from store and juicing and should be utilized as soon as possible.

39. Fruit, which is to be sent for juicing, should be utilized as soon as possible and within the normal shelf life, which would be recommended for fruit from the same store. Any bruising will encourage patulin formation hence bruising should be kept to a minimum, especially if fruit is to be stored for longer than 24 hours at ambient temperature before juicing.

## II. **RECOMMENDED PRACTICES BASED ON GMP**

**Transportation, checking, and pressing of fruit**

*Mechanically harvested fruit and fruit for the fresh market*

(a) Fruit for the fresh market

40. Stored fruit should be transported from the cold store to the processor in the shortest time possible (ideally < 24 hours to pressing unless cold stored).

41. Varieties with an open calyx are particularly susceptible to core rots. These varieties should be examined for internal rots by regular checks immediately prior to pressing. An appropriate random sample of apples should be preferably taken from each separate batch of fruit. Each apple is then cut across its equator and examined for signs of mycelial growth. If the frequency of core rots exceeds an agreed level the consignment should not be used for juicing. The processor should specify the maximum proportion of supplied fruit which can have any sign of rotting, taking into account the capacity of the processor to remove the rotting fruit during pre-process inspection. If this proportion is exceeded the whole consignment of fruit should be rejected.

42. On arrival at the factory the fruit should be checked for quality, particularly for evidence of both external and internal mould damage (see paragraph 43).

(b) Mechanically harvested fruit and fruit for the fresh market

43. During processing and prior to pressing, the fruit should be sorted carefully to remove any visually mouldy fruit (check randomly and routinely for internal mould by cutting some fruit as in paragraph 41) and washed thoroughly, using potable or suitably treated water.

44. Juice presses and other manufacturing equipment should be cleaned and sanitized in accordance with industry 'best practices'. Juice presses and other equipment will generally be washed down with pressured water hoses and sanitized by application of a suitable sanitiser, followed by a further rinse with potable cold water. In some plants, which operate almost continuously, this should preferably be a once per shift or once per day cleaning operation.

45. After pressing samples of juice should be taken for analysis. A representative bulk production sample should analysed for patulin by an appropriate method in a laboratory, which is accredited to carry out such analyses.

46. The juice should preferably be chilled to < 5 °C and maintained chilled as well kept under ultra-low oxygen conditions until it is concentrated, packaged or pasteurized.

47. Juice should only be sent for packing on a positive release basis after patulin analysis has been confirmed as being below the maximum limit.

**Packaging and final processing of juice**

48. Moulds, which are capable of producing patulin, may occur, together with other moulds and yeasts, particularly in 'Not From Concentrate (NFC)' juice. It is essential to prevent the development of such organisms during transport and storage to prevent spoilage of the product and by the same means prevent the production of patulin.

49. If juice is to be held for a period prior to use the temperature should preferably be reduced to 5 °C or less, in order to reduce microbial development.

50. Most juice will be heat processed to ensure destruction of enzymes and spoilage organisms. It must be recognized that whilst such processes will generally destroy fungal spores and vegetative mycelium the process conditions will not destroy any patulin which is already present.

**Quality assessment of juice**

51. Specifications for the purchase of apple juice or apple juice concentrates should include the maximum limit for patulin based on an appropriate method of analysis complying with the provisions laid down in Commission Directive 2003/78 (OJ L 203, 12.8.2003, p. 40) laying down the sampling methods and the methods of analysis for the official control of the levels of patulin in foodstuffs.

52. A sampling plan should be developed for random sampling of product to assure that the finished product is within the maximum limit for patulin.

53. The packer must satisfy himself that the juice supplier is able to control properly his own operations to ensure that the recommendations given above are carried out.

54. Assessment of the quality of apple juice by the packer will include Brix, acidity, flavour, colour, turbidity, etc. The microbiological quality should be carefully monitored since this indicates not only the risk level of potential organisms for the production of patulin but also the hygienic aspects of the previous stages in the production cycle.

55. Further checks should be carried out on the packaged product to ensure that no deterioration has taken place during the packaging stage.

**CONCLUSION**

56. This Code of Practice contains general principles for the prevention of patulin in apple juice. It is important that these general principles are given sanction by national authorities, taking into account the local varieties of apples, climate, storage facilities and production conditions, in order to make them more useful for the growers and processors.

57. A post-harvest management system based on HACCP for reduction of patulin in apple juice is recommended.