

Microbiological Investigation of Swollen Commercially Canned Grapes and Peaches

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Abstract

Swollen commercially canned grapes and peaches were collected to investigate the microorganisms involved in their spoilage. 6 of 52 grape and 19 of 23 peach samples were found to be spoiled by microorganisms. Yeasts were the only spoilage microorganisms of canned grapes with *Saccharomyces cerevisiae* as the leading spoilage yeast. Yeasts and bacteria were found from spoiled canned peaches. *S. cerevisiae* and *Torulopsis stellata* were the most important spoilage yeasts of canned peaches. Lactic acid bacteria, belonging to genera of *Lactobacillus* and *Leuconostoc*, were the most frequently found spoilage bacteria. Only one spore-forming bacterium, *Bacillus licheniformis*, was involved in the spoilage of canned peaches.

Introduction

Yeasts and aciduric bacteria are the major groups involved in the spoilage of pasteurized fruit juices and their concentrates.^(6,7,9,11)

The lowest pH limit for the growth of microorganisms is not clearly defined in the literature⁽¹⁶⁾ since many factors such as acid used to adjust pH, salt, sugar and other constituents will have considerable influence on it.⁽¹³⁾ Nearly all species of yeasts can grow over a wide range of pH levels.⁽¹³⁾ Among bacteria, lactic and acetic acid bacteria were the groups usually involved in bacterial spoilage of high acid foods with pH values lower than 4.0.⁽⁸⁾

The objective of this paper was to survey the spoilage microorganisms responsible for the swell of canned grapes with a normal pH range of 3.1-3.4 and canned peach halves with a normal pH range of 3.6-4.3.

Materials and Methods

Samples

Swollen grape and peach cans were collected from wholesale and retail stores in Seoul area. 15 each of normal canned grapes and peaches were randomly purchased from local retail stores to obtain a normal pH range of unspoiled products.

Collection and tests of gas in the head space

Gas was collected and tested as described by Frazier

et al.⁽⁴⁾ Gas was collected by puncturing a hole through the opposite end of cans with an apparatus consisting of a pointed hollow punch encased in a soft rubber stopper, a rubber tubing and a U-shaped glass tubing. Gas escaped from a can due to internal pressure was gathered into the water-filled test tubes (10 × 60mm) which were kept under water. Two tubes of gas were collected for each sample.

Approximately 1ml of 1% KOH was added to a gas tube and closed by a finger. A vacuum as evidenced by suction on the finger when shaken was the indication of the presence of CO₂.

A match flame was applied to the opening of the other tube immediately after removal of the finger from the upright tube for test of H₂. A light "pop" indicated the presence of H₂.

pH measurement

The pH of the juices was measured by a Corning Research Model 12 pH meter.

Isolation and identification of spoilage microorganisms

A loopful amount of juices was streaked on yeast extract (0.3%)-malt extract (0.3%)-peptone (0.5%)-glucose (1.0%) agar for the isolation of yeasts and molds and tryptic soy agar (Difco Laboratories, Detroit, MI) for bacteria. Triplicate plates were prepared for each sample and were incubated at 30°C until growth was apparent under anaerobic condition by using an anaerobic jar and GasPak

(BBL Microbiology Systems, Cockeysville, MD).

Yeasts were identified by using the methods of Barnett *et al.*⁽¹¹⁾ and Lodder⁽¹⁰⁾ Bergey's manual of determinative bacteriology⁽²⁾ was used for bacterial identification.

Results

Grapes

Six out of 52 samples were spoiled due to microbial growth, while the rest of 45 cans was by H₂ swell. The pH range of normal canned grapes was 3.1-3.4 (data not shown). Yeasts were the only spoilage microorganisms of canned grapes and all of them were strains of *S. cerevisiae*.

Peaches

Nineteen among the 23 samples were spoiled due to microbial growth while the rest of 3 were by H₂ swell. The pH range of normal canned peaches was 3.6-4.3 (data not shown) and that of microbially spoiled canned peaches was 3.4-4.7. Eighteen strains of yeasts and 5 strains of bacteria were isolated from the 19 microbially spoiled peaches. A strain of the spoilage bacteria coexisted with a yeast.

S. cerevisiae and *T. stellata* were the leading spoilage yeasts of canned peaches. Lactic acid bacteria (*Lactobacillus* and *Leuconostoc*) were the most frequently found bacteria. *B. licheniformis*, a spore-former, was the only non-lactic acid bacterium.

Table 1. Characteristics of microbially spoiled canned grapes and peaches

ID No.	Gas	pH	Spoilage microorganisms
Grapes			
G3	CO ₂	3.5	<i>Saccharomyces cerevisiae</i>
G4	H ₂ , CO ₂	4.1	<i>S. cerevisiae</i>
G8	H ₂ , CO ₂	4.5	<i>S. cerevisiae</i>
G12	CO ₂	3.2	<i>S. cerevisiae</i>
G13	CO ₂	3.1	<i>S. cerevisiae</i>
G19	CO ₂	3.2	<i>S. cerevisiae</i>
Peaches			
P1	CO ₂	4.0	<i>Torulopsis stellata</i>
P2	H ₂ , CO ₂	4.6	<i>S. cerevisiae</i>
P3	CO ₂	3.9	<i>S. cerevisiae</i>
P4	CO ₂	3.8	<i>Torulopsis globosa</i>
P5	CO ₂	4.0	<i>Torulopsis lactis-condensi</i>
P7	CO ₂	4.0	<i>Kloeckera apiculata</i>
P8	CO ₂	3.7	<i>T. stellata</i>
P9	CO ₂	3.9	<i>S. cerevisiae</i>
P11	H ₂ , CO ₂	4.1	<i>S. cerevisiae</i>
P13	CO ₂	3.8	<i>Hansenula anomala</i>
P14	CO ₂	3.4	<i>Bacillus licheniformis</i>
P15	CO ₂	3.9	<i>Candida parapsilosis</i>
P16	H ₂ , CO ₂	4.7	<i>T. stellata</i> , <i>Leuconostoc mesenteroides</i>
P17	H ₂	4.9	<i>Lactobacillus casei</i>
P18	CO ₂	4.1	<i>T. stellata</i>
P20	CO ₂	4.2	<i>T. stellata</i>
P21	H ₂ , CO ₂	4.4	<i>Lactobacillus brevis</i>
P22	H ₂ , CO ₂	4.3	<i>L. mesenteroides</i>
P23	CO ₂	4.0	<i>S. cerevisiae</i>

Discussion

Only 11.5% (6/52) of the swollen grapes and as much as 82.6% (19/23) of the swollen canned peaches were found to be spoiled by microorganisms. This different spoilage profile seemed to be due to the difference in pH values of the products. Canned grapes belong to high acid food and canned peaches to acid food according to Cameron⁽²⁾. Yeasts were the leading spoilage microorganisms of both grapes and peaches. Canned grapes were not spoiled by bacteria while some canned peaches were. Among the bacterial strains found in spoiled canned peaches, lactic acid bacteria were most important. Jay⁽⁵⁾ defined the minimum pH for the growth of *Lactobacillus* species to be 3.8-4.4

Containment of both H₂ and CO₂ and the generally higher pH values of 2 grape (G4, G8) and 6 peach (P2, P11, P16, P21, P22) samples can be interpreted that these samples were spoiled by both microorganisms and H₂ swell.

L. casei, a homofermentative and non-gas former, was isolated from a swollen canned peach, probably because it happened to be in a can spoiled by H₂ swell. Canned grapes were not as frequently spoiled by microorganisms as canned peaches. The low pH of grapes should have facilitated pasteurization and inhibited the growth of surviving less-aciduric microorganisms.

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간포도 및 복숭아 통조림의 부패미생물에 관한 연구

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팽창된 간포도 및 복숭아 통조림을 시중에서 수거하여 부패현상을 검사한 결과 pH가 비교적 낮은 간포도 통조림은 52개의 팽창관중 6개가 또 pH가 비교적 높은 복숭아 통조림은 23개 중 19개가 미생물에 의해 부패되었음을 알았다. 간포도 통조림의 주요 부패미생물은

*Saccharomyces cerevisiae*였고, 복숭아 통조림의 주요 부패미생물은 *S. cerevisiae* 및 *Torulopsis stellata*로 밝혀졌다. 기타 *Lactobacillus* 및 *Leuconostoc*속의 젖산균도 흔히 발견되었으며, 포자형성세균으로는 *Bacillus licheniformis*가 한개의 통조림에서 발견되었다.