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T. S. Oesterle

Lynn V. Ogden

Oscar A. Pike
oscar_pike@byu.edu

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Oesterle, T. S.; Ogden, Lynn V.; and Pike, Oscar A., "Quality and adequacy for long-term storage of dehydrated apple slices packaged in No. 10 cans" (2003). Faculty Publications. 35. https://scholarsarchive.byu.edu/facpub/35

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Quality and adequacy for long-term storage of dehydrated apple slices packaged in No. 10 cans

Oesterle, T.S., L.V. Ogden, and O.A. Pike
Department of Nutrition, Dietetics and Food Science Brigham Young University Provo, UT 84602

ABSTRACT

Dehydrated food-commodities can be packaged in restaurant-size No.10 cans intended for long-term storage for such uses as personal storage, emergency relief efforts and military rationing. Because foods packaged for long-term storage are seldom opened soon after purchase, the quality of the product or the adequacy of the packaging could be unknown to the buyer for months or even years. The objective of this research was to compare the quality of various brands of dehydrated apple slices sold at the retail level in No.10 cans and to evaluate the adequacy of the packaging for long-term storage.

Nine brands of dehydrated apples packaged in No. 10 cans were obtained from retail distributors in four states. All brands were labeled as being pre-treated with sulfur dioxide for prevention browning. All cans contained oxygen absorbers and were labeled as having an oxygen-free environment. A 50-member consumer panel evaluated aroma, flavor, and overall acceptability using a 9-point hedonic scale. Other observations included headspace oxygen, can seam evaluation, product color, water activity and Vitamin C content.

Hedonic scores for overall acceptability ranged from 4.8 to 5.8 with significant differences between brands. Headspace oxygen ranged from <0.01% to 2.1%. Four of the nine brands exhibited headspace oxygen levels of 2% or greater. Wide variation in can seam quality was observed, with a direct correlation between poor seams and high head space oxygen levels. No significant differences in Hunter color measurements were observed. Water activity ranged from 0.20 to 0.31. Only 5 brands listed Vitamin C content on their label, and the actual content in each brand was less than half the amount listed.

There appears to be wide variation in head space oxygen levels and can seam quality of dehydrated apples packaged for long-term storage and available for sale at the retail level. Manufacturers need to ensure accurate labeling and proper packaging to optimize product quality during extended storage.

INTRODUCTION

Apples have been called the most important temperate fruit in the world (Taiwo 2001). Dehydrated apples (approx. 3% moisture) are commonly stored in No. 10 cans for long-term storage purposes such as emergency relief efforts, military rations and personal storage. Dehydrated apples have been found to retain their flavor, color, and odor for as long as three years when properly stored (Smock and Neubert 1950; Norris 1986).

Because foods packaged for long-term storage are seldom opened soon after purchase, the quality of the product or the adequacy of the packaging could be unknown to the buyer for months or even years. The objective of this research was to compare the quality of various brands of dehydrated apple slices sold in No. 10 cans and to evaluate the adequacy of the packaging for long-term storage.

METHODOLOGY

Samples

Nine brands of dehydrated apples, packaged in No. 10 cans, were obtained from retail distributors in four states. Eight of the brands were apple slices and one brand was cubes. All the brands were stored under nitrogen or oxygen-free environments, contained oxygen absorbers and were pre-treated with sulfur dioxide. Product codes indicated the samples were less than 1 year old. Duplicate samples of each brand were evaluated.

Headspace Oxygen, Can Seams, and Water Activity

Headspace oxygen was measured using the 3500 Series Headspace Oxygen Analyzer (Dionex Instruments, Inc., Sunnyvale, CA). Can seams were evaluated using the SeamMate System (Cheshire Corporation, Westerville, OH) to measure the following seam dimensions: thickness, width, body hook, cover hook, and overcut. Seam tightness was rated on a scale of 0-100%. The seams were given an overall rating of good, fair, and poor by an experienced evaluator. Water activity was measured using an Aquapic CR-2 (Decovision, Inc., Pullman, WA).

Sensory Evaluation

Sensory analysis was conducted at the BYU Sensory Laboratory using standard procedures. Samples were served from the can, without further preparation, in a randomized manner to a 50-member consumer panel in 4 visits. Panels evaluated aroma, flavor, and overall acceptability using a 9-point hedonic scale.

Vitamin C

Vitamin C content was analyzed by following the method of Rumack (1986) using an Agilent Model 1100 high performance liquid chromatograph (Agilent Technologies, Palo Alto, CA) equipped with a C18 reverse phase column (Phenomenex, Torrance, CA) and a diode array detector. Determinations were carried out under sub-lit sublight.

Data Analysis

Data was analyzed for significance using Statistical Analysis System software (SAS Institute, Inc., 1999). A mixed model analysis of variance (PROC MIXED) with Duncan’s Multiple Range Test was used for the sensory data. Significant differences were defined as p<0.05.

RESULTS

Headspace Oxygen, Can Seams, and Water Activity

Headspace oxygen varied between brands, with the lowest at <0.01% and the highest at 20.8% (Fig. 1). Can seam quality also differed between brands as shown in Fig. 2. The two brands containing atmospheric levels of oxygen also had poor can seams. Water activity within brands ranged from 0.20 to 0.31 (Fig. 3). The cubed apple pieces had the lowest water activity of all the brands.

Color

CIEL*a*b* color values were measured using a HunterLab ColorFlex Spectrophotometer (Hunter Associates Laboratory, Inc., Reston, VA) with three measurements taken on each sample.

Vitamin C

Vitamin C content of each brand is shown in Fig. 5. There was some variation between brands, but all brands exceeded the USDA National Nutrient Database for Standard Reference amount for dehydrated apples (22 g/g). The high content is likely due to an osmotic dehydration process that includes ascorbic acid in the syrup. A drastic increase in oxygen levels increase water loss during processing (Monsavoir-Gonzalez 1993). Ascorbic acid was not reported as a preservative or nutritional additive by any of the brands. Brands A, E, F, G, and H reported vitamin C on their labels, but each of these brands had measured amounts that were less than half the label amount. Brands A and B reported 0% vitamin C though it was found in both brands. Brands D and I did not show a nutrition facts label, but Vitamin C was present in both brands.

CONCLUSIONS

There appears to be wide variation in head space oxygen levels and can seam quality of dehydrated apple slices packaged for long-term storage and available for sale at the retail level. Manufacturers need to ensure accurate labeling and proper packaging to optimize product quality during extended storage.

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ACKNOWLEDGEMENTS

The authors appreciate the funding for this research provided by Ira Fulton and the contributions of the following individuals: Devin Ross, Alan Stier, John Bome, Heather Farnsworth, Michelle Lloyd, Mike McSwain, Theresa Gradl, Melia Haling and spring Zhu.