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Quality attributes of dried milk products packaged for long-term storage

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ABSTRACT

There is a market for dehydrated foods, such as nonfat dry milk (NFDM), that are packaged for long-term storage for use in natural disasters or other emergencies. This study evaluated 10 brands of dried milk for nutritional quality and sensory acceptability. Ten brands were used to determine the quality and nutritional quality of dried milk products in No. 10 cans for long-term storage. These data were analyzed for significance using Statistical Analysis System (SAS) procedures. Samples were reconstituted to 9% solids and served in a randomized block design. Sensory analysis was conducted at the BYU Sensory Laboratory using standard procedures. Headspace oxygen was measured using the 3500 Series Headspace Oxygen Analyzer (Sasken Instruments, Inc., Saskatoon, SK). Water activity was measured using an Aqualab CX-2 (Decagon Devices, Inc., Pullman, WA).

INTRODUCTION

Many studies have evaluated the quality of NFDM stored for up to one year (Ford, 1983; Hurrell, 1983; deBoer, 1984; Okamoto, 1985; Parris, 1989). The industry standard for shelf-life of NFDM milk is 18-24 months, but some studies (Gomis, 2000) have shown that NFDM can last much longer under proper conditions (Henry, 1947; Driscoll, 1985). Various manufacturers of dried milk products have packaged product in No. 10 cans in a reduced oxygen environment to lengthen shelf-life. The objective of this research was to determine the variation in quality between 10 brands of dried milk products packaged for long-term storage.

METHODOLGY

Samples

Ten brands of dried milk products (5 instant NFDM, 3 regular NFDM, and 2 whey beverages) packaged in No. 10 cans were obtained from retail distributors. For each product, 7 samples were packaged in 4 bleacher-seams. Product codes indicated the samples were less than 1 year old, except brand J (2 years), and brands A and C (unknown). A duplicate samples of each brand were evaluated.

Headspace Oxygen and Water Activity

Headspace oxygen was measured using the 3500 Series Headspace Oxygen Analyzer (Sasken Instruments, Inc., Saskatoon, SK). Water activity was measured using an Aqualab CX-2 (Decagon Devices, Inc., Pullman, WA).

Can Seam Evaluation

Can seams were evaluated by using the SeamMate System (Onexision Corporation, Westville, OH) to measure the following seam dimensions: thickness, width, body hook, cover hook, and overlap. Seam tightness was calculated as a ratio of 0-100. The seams were given an overall rating of excellent, good, fair, or poor by an independent evaluator.

Sensory Analysis

Sensory analysis was conducted at the BYU Sensory Laboratory using standard procedures. Samples were reconstituted to 9% solids and served in a randomized block design to a 50-member consumer panel in 4 visits. Panels evaluated aroma, flavor, and overall acceptability using a 9-point hedonic scale.

Vitamin Determination

Vitamin analyses were conducted using an Agilent Model 1100 high performance liquid chromatography (HPLC) Technology, Palo Alto, CA, equipped with a C18 (4.6x250 mm) reverse phase column (Phenomenex, Torrence, CA) and a fluorescent detector (Kromosil 5u C18, 4.6x250 mm, Novabread). A blank was injected after every third sample to monitor mass of vitamin A. Standards were prepared using a Kromosil 5u C18 (Phenomenex) column. Determinations were carried out under subdued light.

Data Analysis

A correlation matrix was performed for significance using Statistical Analysis System software (SAS Institute, 1989). A nested model analysis of variance (PROC MIXED) with Fisher’s LSD was used for the sensory data. PROC GLM with Duncan’s Multiple Range Test for the water activity and vitamin data. Significant differences were defined as p<0.05.

RESULTS

Headspace Oxygen, Seams, and Water Activity

Headspace oxygen (Fig. 1) varied widely from brand to brand, influenced by oxygen removal method and can seam quality (Fig. 2). Cans with higher than expected oxygen levels also had poor seams. Oxygen absorbers reduced the headspace oxygen better than a nitrogen flush, as long as the seams were hermetic.

The water activity varied from 0.14-0.28 (Fig. 3), but all values were in a typical range, corresponding to 3%-5% moisture (Walstra, 1999).

Sensory Results

There were significant differences in aroma, flavor, and overall acceptability between the samples (Fig. 4). The brand that scored highest in overall acceptability had a poor can seam, suggesting that quality would not last over an extended storage time.

Regular NFDM samples had a mean flavor score significantly higher than the instant NFDM; but there were no significant differences in overall acceptability (Fig. 5). The whey beverages scored significantly lower than the other samples in flavor and overall acceptability.

Vitamin Content

Thiamin content (Fig. 6) was not significantly different between brands, with the exception of one of the whey beverages, which was extremely high at 17.0 μg/g. The other samples were closer to the USDA Nutrient Database value of 4.13 μg/g.

Riboflavin content (Fig. 7) varied between the brands, from 0.2 to 3.0 μg/g, which was somewhat lower than the USDA Nutrient Database value of 17.43 μg/g.

All of the products claimed to have been fortified with vitamin A, yet it was detected in only 4 of the 10 brands (Fig. 8). Those brands containing vitamin A were near or at the target fortification level of 2000-3000 IU/quart.

CONCLUSIONS

There is wide variation in sensory and nutritional quality of dried milk products available at the retail level packaged in cans for long-term storage.

Good manufacturing practices must be observed to optimize product quality, giving careful attention to can seam quality, product labeling, and vitamin fortification levels.

Consumers would be well advised to evaluate several brands of dried milk products prior to large quantity purchases.

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