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Effects of long-term storage on quality of regular and quick rolled oats

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ABSTRACT

There exists a need for food packages for long-term storage, for such uses as emergency relief efforts, military rations, and personal storage. The purpose of this research was to investigate the quality of regular and quick rolled oats, commercially packaged in cans, for long-term storage. Twenty samples of rolled oats packaged in 10 cans representing seven brands were obtained from donors in five states. Samples had known packaging dates and approximate storage conditions, and ranged in age from 1.5-28 years. A 5 point hedonic scale was used to evaluate flavor, texture, aftertaste, and overall acceptability. Using regression analysis, age of sample significantly affected hedonic scores for aroma, texture, flavor and overall acceptability. Flavor and texture were significantly affected by oxygen level. Texture was significantly affected by type of rolled oats. Vitamin B₃ amounts varied and were actually higher in some older samples. Vitamin E levels and hexanal concentrations were used to evaluate the quality of these samples.

INTRODUCTION

Traditional shelf life studies of cereal staples have investigated oxygen over a period of several years. Research has found that rolled oats stored 3 years at 38°C still had acceptable sensory properties. However, there is a market for products that will last much longer periods. Rolled oats are used as emergency relief efforts, military rations, and personal storage. Rolled oats in hermetically sealed cans are available on the retail level, yet little work has been done in long-term storage on quality.

The objective of this research was to investigate the quality of regular and quick cooking rolled oats packaged in cans for long-term storage.

METHODOLOGY

Samples

Twenty samples of rolled oats packaged in 10 cans representing seven brands were obtained from donors in five states. Samples had known packaging dates and approximate storage conditions, and ranged in age from 1.5-28 years. A 5 point hedonic scale was used to evaluate flavor, texture, aftertaste, and overall acceptability. Using regression analysis, age of sample significantly affected hedonic scores for aroma, texture, flavor and overall acceptability.

RESULTS

Vitamins, B₁ and E determination

Vitamin analyses were conducted using an Agilent Model 1100 high performance liquid chromatography (HPLC) equipped with a quaternary pump, column oven, autosampler and diode array detector (Agilent Technologies, 1200 Series). The separation was done using a Phenomenex, Luna C₁₈ 5μm column and the detector was set at 254 nm. The samples were acidified with 0.5% aqueous H₂SO₄ and 0.1% deuterium oxide (D₂O) using the method of Peterson (1995) with a normal phase in-cylinder column (Waters Corp). Methyl viologen diozonide determinations were carried out under subdued light.

Headspace Hexanal Concentration

Hexanal was measured using a 3500 Series Headspace Sampler Model 850-DL (PGC Instruments, Inc., NC). Headspace oxygen was measured using a 3500 Series Headspace Oxygen Analyzer (PGC Instruments, Inc., NC). Headspace samples were collected in 20 ml gas-tight vials and analyzed with a Bioanalytical Systems GC-1700 Gas Chromatograph equipped with a flame ionization detector (BIOANALYTICAL SYSTEMS, Inc.). Headspace oxygen was measured using a 3500 Series Headspace Oxygen Analyzer (PGC Instruments, Inc., NC). Headspace oxygen was measured using a 3500 Series Headspace Oxygen Analyzer (PGC Instruments, Inc., NC).

Vitamin Content

Vitamin B₁ content varied between brands with values ranging from 2.3 to 4.0 μg/g (µg/g). The USDA National Nutrient Database for Standard Reference value for vitamin B₁, in dried rolled oats is 3.7 µg/g. (USDA, 2002). Most samples fell below the amount. Similarly, many of the older brands had higher vitamin B₁ levels than many of the newer brands. There was no significant difference in vitamin B₁ content between types of rolled oats.

Vitamin E levels varied significantly among brands, with values ranging from 1.3 to 3.6 mg/g. The 4.50 mg/g is considered the upper limit for atmospheric temperature at 20°C would be acceptable to 100% of the population for use in an emergency situation. Six of the samples had total local levels similar to this level, indicating it is possible to store rolled oats such that the low level of vitamin E would be acceptable.

Headspace hexanal concentrations varied from 0.002 to 0.138 µg/g. (Fig. 4). One of the heat abused samples had high hexanal levels and the other had very low levels. This distribution is similar to 1.00% oxygen in the headspace of the respective samples. Hexanal correlated with percent Headspace oxygen levels, with an r² value of 0.40 (data not shown). Hexanal and vitamin E levels correlated with an r² value of 0.40 (data not shown). Treating the effectiveness of vitamin E in delaying lipid oxidation of the samples. However, higher hexanal concentrations were observed in quick cooking rolled oats. It is possible that off-flavors present in the uncooked product were catalyzed during cooking.

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REFERENCES


CONCLUSIONS

There was a loss of some aspects of quality in commercially packaged canned rolled oats in residential storage throughout the time period studied. However, even after 28 years of storage all samples were considered acceptable for use in an emergency situation by at least three-fourths of consumer panels. Manufacturers must observe good manufacturing practices to ensure the longest possible shelf life and consumers must store rolled oats beyond recommended storage conditions to maximize shelf-life. Rolled oats can be an important part of a long-term food storage package in lieu of investment in nutritional safety when properly packaged and stored.