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Quality of dehydrated whole egg packaged in No. 10 cans

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Quality of dehydrated whole egg packaged in No. 10 cans

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ABSTRACT

Dehydration reduces egg mass and increases shelf-life without significantly affecting most functional properties. This has created a demand for dehydrated whole egg in military rations, emergency relief programs and personal storage. However, because such products are usually stored before use, the buyer may be unaware of product quality until long after purchase. The purpose of this study was to investigate the quality of several brands of dehydrated whole egg commercially packaged in No. 10 cans.

Eight brands of dehydrated whole egg were obtained from food retailers. All but 1 brand were labeled as having a low oxygen environment. A 50 member consumer panel evaluated appearance, aroma, flavor, texture, and overall acceptability using a 9-point hedonic scale. Other observations included color of egg solids, can headspace oxygen, can seam quality and water activity.

Hedonic scores for overall acceptability ranged from 3.5 to 6.3, indicating wide variation between brands. Appearance, flavor and texture scores mirrored overall acceptability scores. A significant difference in Hunter color values was observed, with two brands visibly brown in the dry solid state and after reconstitution and cooking. Headspace oxygen ranged from 0.28 to 18.8% with more than half of the brands having > 2% oxygen. Water activity ranged from 0.16 to 0.42. The brand which scored highest in overall acceptability had 18% headspace oxygen, suggesting a detrimental effect on shelf life. Although all samples were purchased immediately before the study, can codes indicated a 3-year age difference between brands. This was reflected in panel results. The quality of dehydrated whole egg available for retail sale varies widely, as does the quality of packaging. Manufacturers need to adhere to good manufacturing practices and buyers should be aware of product variability between brands of dehydrated whole egg.

INTRODUCTION

During the development of whole egg dehydration procedures, many studies focused on product quality and storage life of dried eggs (Lightbody and Fevold 1948). Since that time there have been major advances in the production and packaging of dehydrated egg (Stadelman and Cotterill, 1995). However, there is a lack of recent research on dried egg product quality, in spite of the current use of whole dehydrated egg in military rations, emergency relief efforts and personal food storage. Because the product often is not used immediately, the buyer may be unaware of product quality until long after purchase. The objective of this study was to evaluate the quality of various brands of dehydrated whole egg commercially packaged for retail sale in No. 10 cans.

METHODOLOGY

Samples

Eight brands of dehydrated whole egg were obtained from food retailers representing manufacturers in 4 states. All brands but 1 were labeled as having a low oxygen environment. Can codes indicated 4 brands were less than one year old. Three brands did not have a manufacturing date on them. The code on one can indicated the product was over 3 years old. Duplicate samples (2 cans) of each brand were evaluated.

Headspace oxygen, can seam and water activity

Headspace oxygen was measured using a rigid-pack sampler with a 0.2 µm filter and sampling wand attached to a 3500-Series Headspace Oxygen Analyzer (Illinois Instruments, Inc. Johnsburg, IL) calibrated to atmospheric oxygen. A septum was placed on each can top, and the rigid pack sampler punctured the can through the septum. Once the oxygen reading stabilized, a small hole was drilled in the side of the can near the bottom to break the vacuum inside the can and obtain the lowest, most accurate headspace oxygen reading. This was reached just before external air from the drilled hole increased the reading. Can seams were evaluated using the SeamMate System (Onevision Corporation, Westerville, OH) to measure the following seam dimensions: thickness, width, body hook, cover hook, and overlap. Seam tightness was rated on a scale of 0-100%. The seams were given an overall rating of good, satisfactory, or poor by an experienced evaluator. Water activity was measured using an Aqualab CX-2 (Decagon Devices, Inc., Pullman, WA).

Sensory evaluation and color

Sensory analysis was conducted at the BYU Sensory Laboratory using standard procedures. Panelists were recruited from university employees and students willing to evaluate reconstituted dehydrated eggs. Both genders were equally represented and there was approximately equal representation of age groups from 20 to 59 years. Samples were reconstituted to 18.6% solids and scrambled on a Jade 3-burner gas griddle, model JGT 24361 (Jade Products Company, Commerce, CA), with each burner set at 135° C. Eggs were kept in 15 cm deep stainless steel 1/6 pans in a steam table held at 71-77° C and samples were replaced every hour. Eggs were served in a randomized manner to a 50 member consumer panel in 4 visits. Data was collected using Compusense software (Compusense Inc., Guelph, Ontario, Canada). Panelists evaluated the appearance, aroma, flavor, texture, and overall acceptability using a 9-point hedonic scale. Samples were analyzed for color using a Hunter ColorFlex colorimeter (HunterLab, Reston, VA) to obtain L*, a*, b* values.

Data analysis

Data was analyzed for significance using Statistical Analysis System software (SAS Institute, 1999). Sensory data were analyzed with a mixed model analysis of variance (PROC MIXED) , and headspace oxygen and water activity were analyzed with a General Linear Model procedure (PROC GLM) . Both analyses used Duncan's Multiple Range test. Significant differences were defined as $p<0.05$.

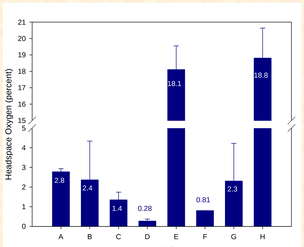

Fig. 1. Headspace oxygen in canned dehydrated egg. Bars represent standard deviation.

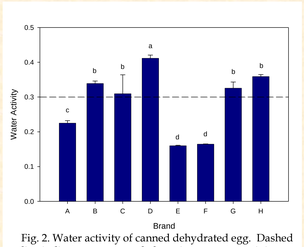

Fig. 2. Water activity of canned dehydrated egg. Dashed line indicates recommended maximum water activity. Identical superscripts indicate no significant difference ($p>0.05$). Bars represent standard deviation.

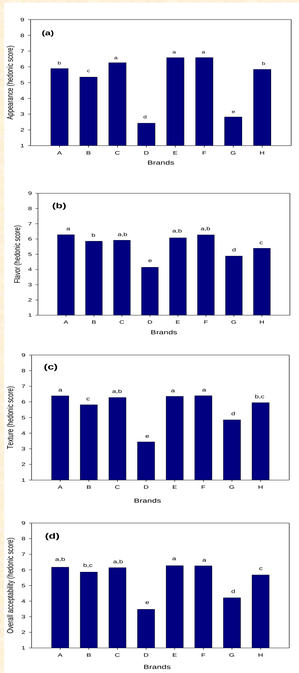

Fig. 3. Mean hedonic scores for appearance (a), flavor (b), texture (c), and overall acceptability (d) of canned dehydrated egg. Identical superscripts indicate no significant difference between samples ($p>0.05$).

Fig 4. Visual appearance of reconstituted cooked eggs. Letters indicate brand.

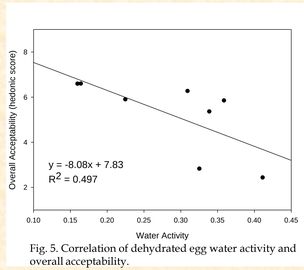

Fig. 5. Correlation of dehydrated egg water activity and overall acceptability.

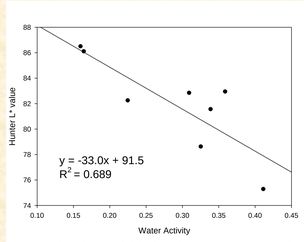

Fig. 6. Correlation of dehydrated egg water activity and Hunter L* value.

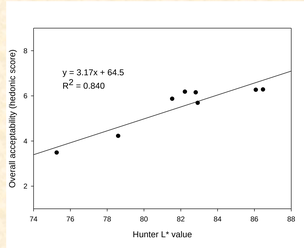

Fig. 7. Correlation of dehydrated egg Hunter L* value with overall acceptability.

RESULTS AND DISCUSSION

Headspace oxygen, can seam, and water activity

Headspace oxygen ranged from 0.28 to 18.8%, with 5 of 8 brands having > 2% oxygen (Fig. 1). Headspace oxygen levels did not correlate with can seam quality, oxygen reduction method, powder color or hedonic scores. All can seams were acceptable (data not shown). The majority of cans were rated 'good.' Water activity ranged from 0.16 to 0.42 (Fig. 2). The maximum recommended water activity of unpacked dried egg at 20° C is 0.30 (Labuza and Rahman 1999), but 5 of 8 brands had a mean water activity above this maximum.

Sensory analysis and color

Hedonic scores for overall acceptability ranged from 3.5 to 6.3 with significant differences between brands (Fig. 3). Appearance, flavor and texture scores mirrored overall acceptability scores. The lowest scores for all parameters tested was received by Brand D, which was 3 years old as indicated by the can code. Brand E scored highest in overall acceptability but had 18% headspace oxygen, suggesting quality would deteriorate over time.

A significant difference in cooked product color was observed (Fig. 4). Two brands (D and G) were visibly brown in the dry solid state as well as after reconstitution and cooking.

The negative correlation between water activity and overall acceptability score (Fig. 5) suggests the importance of controlling water activity during production of dehydrated egg. Likewise, the negative correlation between water activity and Hunter L* values (data not shown) graphed in Fig. 6 indicates the critical nature of water activity in preventing browning in dehydrated egg. Finally, the positive correlation between Hunter L* values and overall acceptability is shown in Fig. 7. As would be expected, lighter product was scored higher by consumer panelists.

CONCLUSIONS

The sensory quality of dehydrated whole egg available for retail sale in No. 10 cans varies widely.

Buyers should be aware of product variability between brands of dehydrated whole egg and should be selective when purchasing dehydrated whole egg.

Manufacturers need to adhere to good manufacturing practices and should ensure the product has an acceptable water activity (< 0.30).

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