The storage effects of calcium-fortified orange juice concentrate in different packaging materials

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Abstract. Orange juice concentrate has been fortified with calcium in order to fulfil part of the recommended daily allowance of calcium and to overcome the problem of the shortage of milk and dairy products in Egypt. The loss of quality of calcium-fortified and unfortified orange juice concentrate was evaluated in three different packaging materials and when stored for ten weeks at room temperature. The results showed that vitamin C content decreased during storage for both the fortified and the unfortified samples. The trend of ascorbic acid breakdown was similar in all packaging treatments. The total titratable acidity declined during storage period; however, the decline was higher in the unfortified sample than in the fortified one. Also, the pH values increased along with the storage period. The results illustrated that the color values of both the fortified and unfortified diluted orange juice concentrate changed little at the end of the storage period. However, the samples packaged in low density polyethylene bags had the higher orange in the color values R and Y. The changes in the iron content for both samples was negligible during the storage period. However, a very slight change in the calcium content (4.5% and 4%) was observed after ten weeks of storage for both the unfortified and the fortified samples respectively. The acceptability of fortified orange juice rated higher than the unfortified one. The panelists' evaluation values were affected by the packaging treatment and storage time. The samples packaged in low density polyethylene bags had a higher level of decline of the panelists' evaluations than the ones packaged in laminated pouches or cans, while the latter had a lower level of decline.

Introduction

Calcium is an essential nutrient for humans [16]. The intake of calcium to build bones and teeth is extremely important to children and, therefore, the consumption of dairy products is essential because they are the best available dietary source of calcium. Children who do not drink milk should have their diet supplemented with other calcium containing foods or calcium from medicinal sources [6].

Since dairy products are the major dietary source of calcium, avoidance of these foods generally results in submarginal calcium intake [17]. A large percentage of Egyptian children are not getting enough calcium because of
the shortage of milk production and this, of course, affects their skeleton and may cause bone disorders [4].

The fortification of citrus juice with calcium as an alternative calcium source has been investigated by many researchers. Ponderos and Erdman [17] found that products which contain colloidal calcium phosphate of calcium caseinate may be better calcium sources than those that contain only ionic calcium. They also reported that ascorbic acid, which is present in orange juice, may enhance the absorption of calcium by forming a soluble complex in the gastrointestinal tract. Improved absorption of calcium in women with orange juice supplementation has been demonstrated [12]. In another study [14], grapefruit juice supplementation increased calcium retention in rats by 7%.

Citrus is one of the largest fruit crops grown in Egypt with $2 \times 10^6$ metric tons grown during the 1989 season [18]. With this large volume of citrus being produced each year, adding a source of calcium to orange juice can provide the children with a good part of the recommended daily allowance of that crucial mineral. The objectives of this study were:

1. To study the possibility of adding calcium to orange concentrate in order to overcome the problem of that mineral’s shortage and also to use it as a milk and milk product substitute in schools and hospitals in order to provide children and pregnant women with a part of their recommended daily allowance of calcium.

*Fig. 1.* Retention of vitamin C for fortified and unfortified diluted orange juice concentrate in different packaging materials during storage.