WFL Publisher
Science and Technology
Journal of Food, Agriculture & Environment Vol.2 (3&4) : 45-46. 2004
www.world-food.net

Shelf-life extension with solid enrichment and water encapsulation of fruits

Sailen Ghosh

Food Technology Division, Bhabha Atomic Research Centre, Mumbai 400 085, India. e-mail: sghos@magnum.barc.ernet.in

Received 22 July 2004, accepted 15 November 2004.

Abstract

A new concept using reverse osmosis to enrich solid contents in the food and subsequently encapsulating the free moisture within the food using additive resulted in extension of shelf-life of pineapples. The sample prepared by this new technique is better in look, texture and accepted by the taste panelists over the conventionally prepared freeze-dried sample. Sample was stored up to 6 months at room temperature and 1 year in 0-2°C without much appreciable change in the acceptance. The method adopted was found to be suitable in preservation of large varieties of fruits.

Key words: Reverse osmosis, encapsulation, additive, freeze-drying, shelf-life, fruits.

Introduction

There is an enhancement in the per capita food supply over the years and thus the opportunity to develop value added product including extension of shelf-life. Extensive research is underway to develop new process and products with an overall objective to have food of conveniences [2].

A new process has been developed using the concept of solid enrichment in the fruit followed by encapsulation of water contents in the fruit. The process is a combination of reverse osmotic enrichment with a mixture of invert sugar and polysaccharide as additive and encapsulation of free water in the food at moderate temperature through the properties of additive used in the above mixture. The additive used posses a property to react with water and bind it, thus making it unavailable for spoilage. The drying temperature does a dual role of removing excess water of the food and initiates the process of binding the water present in the food with the additive. The present article will focus on the process developed based on the above concept and the product developed using pineapple slices was compared with conventionally dried and freeze-dried product.

Materials and Methods

Fresh pineapple was dressed, cleaned, sliced (4 mm thick), blanched and enriched in a 50% invert sugar–food additives mixture for 30 minute. Sample was then removed from the mixture and dried in a fixed plate drier. Air at temperature 60°C and RH 55% was circulated in the cabin. Control sample was blanched and directly transferred to the drier and dried under identical conditions. Another set of sample was freeze-dried as per the standard method [3]. All samples were withdrawn at regular interval, cooled, weighed and assessed for moisture [1]. Water activity was determined using Aqualab ex2T equipment (Decagoan Devices, USA).

The schematic diagram for preparation of sample is shown in Fig 1. The weight distribution of pineapple's different components are 11% crown, 21% outer skin, 7% eyes (the irrating part), 61% dressed core material. This dressed material was subjected to

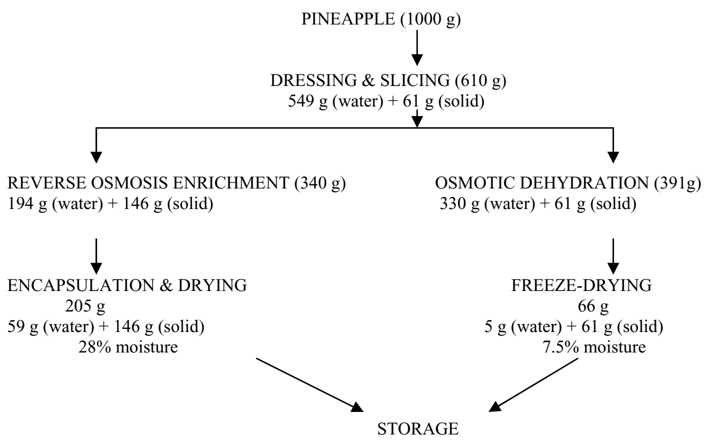

Figure 1. Schematic diagram with material balance.

enrichment and subsequent operations. The enrichment step reduced the water-% from initial value of 90% to 57% and enhancement of solid contents by almost 2.4 times. Sample was then dried at the temperature of 60°C. During this stage, the product was dried to 28% moisture level and encapsulation of water took place, resulting a product with aw=0.427 at 28.1°C. The product was stored at room temperature without any appreciable change in appearance up to 6 months of storage. The dried slices were tasty, chewable and did not spoil due to the control of aw. The control sample had a moisture content of 56% after 6 h of drying and aw= 0.852 at 25°C. The appearance was dull, hard and not tasty. The freeze-dried sample with moisture content of 7.5% was stored at room temperature and compared with the treated sample.

Results and Discussion

Percentage loss of moisture during drying of both the control and treated sample are shown in Fig. 2. Initial moisture of the sample was 90%. The control sample subjected to drying had 56% moisture after 6 h of drying at the temperature of 60°C. Treated sample dropped its moisture to 58% during the combined process of blanching and enrichment. Thus the loss of moisture during 6 h of drying was almost achieved by the enrichment treatment carried out at 60°C for 30 minutes. The final moisture in the treated sample after 6 h of drying at the same condition was 28%. Thus a drop of 37% for control and 52% for treated sample were noticed at the end of 6 h. The maximum loss of weight was between 1-3 h of drying which subsequently dropped with time of drying. The rate of moisture loss was comparatively higher in the control sample than in the treated sample. In control sample, the loss of moisture declined between 3-5 h, indicating the period of critical drying time. Treated sample on the other hand, had a sharp fall in weight loss up to 4 h of time and thereafter was almost stagnant. This may be due to the non-availability of free water in the sample which is bound to the additive used during the enrichment stage. There was no appreciable change in solid gain during drying.

A correlation of water activity for treated sample with respective moisture contents during the drying stage was also studied. Reduction in moisture from 90 to 58% resulted change in aw from 0.981 to 0.895 during enrichment. However, moisture loss of 30% during drying resulted a drop of aw from 0.895 to 0.427. This sharp decline in aw during the drying stage emphasizes the binding of water with the additive and thus the availability of water for contribution of aw is restricted. Control sample could not be dried beyond 56% level due to the case of hardening noticed after 6 h of drying. The aw for control sample was 0.852 against the treated sample's 0.427 at 25°C. The low water activity was instrumental in keeping the sample for longer period of storage at room temperature. Samples were also stored at different temperatures i.e. –15°C and 0-2°C. Sample stored at room temperature developed noticeable change in colour after 6 months of storage and developed moist texture. However, there was no apparent change in colour, taste and firmness of the sample stored at low temperature even after 1 year of storage. It was also observed that there was no change in the appearance or chew ability of the sample even on defrosting.

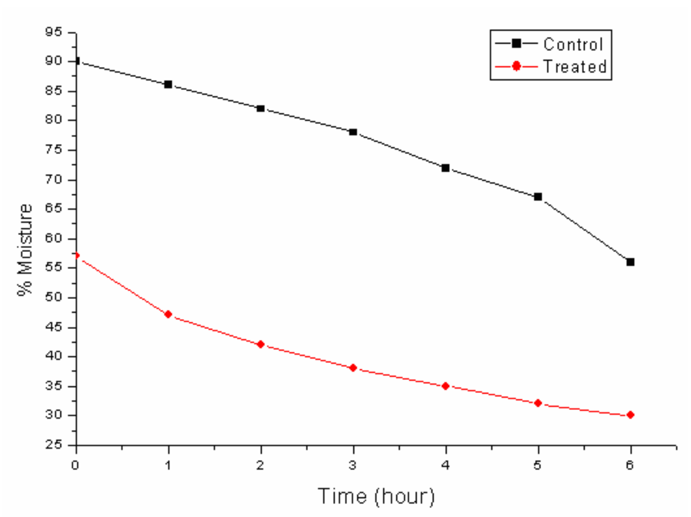

Figure 2. Moisture loss (%) with drying of control and treated pineapple.

The sample developed contained 28% moisture compared to freeze-dried product which contains 8-10% moisture. This high moisture content helps the product to maintain better chewability and flexibility. The process involved is cheaper against the freeze-dried process which consumes high energy due to the maintenance of low pressure and temperature against the required temperature of 60°C in case of the present process. In fact energy required for processing is less than that of freeze-dried process where almost 7.5% moisture against 30% in the present case.

Food additive used in the experiments has the capability of arresting moisture. Thus availability of moisture for spoilage is restricted. Drying is used to remove the excess moisture and to initiate the arresting reaction. The product could be stored at room temperature up to 6 months due to the encapsulation of water although moisture content is as high as 28% in the product. The concept was applied to other varieties of fruits e.g. banana, apple, chikku and mango and worked accordingly. The concept can be used in extending the shelf-life of highly perishable fruits and providing a new medium moisture (28-30%) of dried fruits against the hard dried fruits (8-10%) available in the market. The process is simple, cheap and economically viable and can provide a new range of products.

Acknowledgement

The author thanks Mr. M. S. Pawar for his technical assistant for preparing this article.

References

[1]AOAC 1980. Official methods of analysis. 13th edition, Association of Official Analytical Chemists,Washington, p.125.

[2]Gould, G. W. (ed.). 1995. Newer methods of food production. Blackie Academic & Professional.

[3]Ramamurthy, M.S., Bongirwar, D.R. and Bandyopadhyay 1978. Indian Food Packer **32**:108.