Comparison of Radiant Energy under Vacuum (REV) Technology and Conventional Drying Methods (Air-Drying and Freeze-Drying) on Quality Attributes and Nutritional Value of Dehydrated Pineapple

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Abstract

The objective of this study was to compare the quality attributes, nutritional value, as well as the processing time of dehydrated pineapple pieces produced using four different drying technologies.

The pineapples were dried to the same final moisture by air-drying (AD), freeze-drying (FD), Radiant Energy under Vacuum at above freezing point (*quanta*REV), and under freezing point (*freeze*REV).

The highest average density was observed in the air dried pineapple; while *quanta*REV produced pineapples had relatively lower density ,followed by the *freeze*REV and freeze-dried samples.

Rehydration times were found to be lower for FD and *freeze*REV dried samples, than for *quanta*REV, and highest for AD. Antioxidant activity was measured using (ORAC) and (ABTS) methods. ORAC showed no significant differences in antioxidant activity of all dried samples, whereas ABTS exhibited the highest antioxidant activity for *freeze*REV and the lowest for AD. The ascorbic content of dried pineapples was 367, 338.7, 325, and 188.1mg/100 g for FD, *freeze*REV, *quanta*REV, and AD respectively.

In conclusion, the use of REV technology for industrial drying of fruits such as pineapple could produce puffed and attractive fruit snacks with better rehydration rate and retention of nutritional properties, and significantly shorter processing time and capital cost saving.

Background

Radiant Energy under Vacuum (REV) technology uses a combination of vacuum pressure and microwave energy to deliver a high-speed, low-temperature food dehydration process. The technology can be used to dry fruits, vegetables, herbs, meats and seafood under (*freeze*REV) or above(*quanta*REV) their freezing points (1,2).

REV technology is now being marketed by EnWave Corp. primarily in North and South America and Europe for the dehydration of food products for low-fat consumer snacks foods, baked goods and ingredients. In this study quality attributes, nutritional value, as well as the processing time of the *freeze*REV and *quanta*REV dehydration methods were compared with air-drying (AD), and freeze-drying (FD).

Methods

The pineapples were dried to almost the same final moisture by air-drying (AD), freeze-drying (FD), Radiant Energy under Vacuum at above freezing point (*quanta*REV), and under freezing point (*freeze*REV).

Table 1: Drying time and maximum temperature for the different dehydration methods

Drying method	Time (hours)	Max temp (° C)
AD	13	70
*quanta*REV	1.4	68
*freeze*REV	7.6	30
FD	72	25

Density Measurement: Approximately 2g of sample was taken from a batch with its weight measured using an analytical balance. Its volume was measured using the displacement method with grains inside a graduated cylinder.

Rehydration Time: Sample was taken from a batch with its dry sample weight recorded. The dry sample was soaked in 500ml of distilled water at 30C, and then the rehydrated sample was drained until a constant weight was achieved (3).

Antioxidant Activity: ORAC and ABTS methods were applied for evaluating the antioxidant activities (4)

Ascorbic Acid (Reduced): Iodometric Titration method was used to measure reduced ascorbic acid (5).

Results

Table 2: Moisture and water activity of dried samples

Drying method	Moisture	aW
AD	6.65±0.12	0.32±0.004
*quanta*REV	7.06 ±0.08	0.33±0.004
*freeze*REV	7.16±0.09	0.31±0.002
FD	5.00±0.14	0.25±0.002

Drying method	Density (g/mL)	Rehydration Time (min)	Antioxidant activity µmol Trolox equivalent /g solid ORAC	Antioxidant activity µmol Trolox equivalent /g solid ABTS	Ascorbic Acid (mg/100 gr)
AD	1.12 ± 0.05^{a}	160 ± 24^{a}	63 ± 1.8^{a}	12 ± 0.5^{c}	188 ± 1^{c}
*quanta*REV	0.36 ± 0.03^{b}	70 ± 7^{b}	62 ± 4.9^{a}	18 ± 1^{ab}	325 ± 7.9^{b}
*freeze*REV	0.31 ± 0.03^{b}	48 ± 3.5^{c}	59 ± 4.8^{a}	20 ± 0.6^{a}	339 ± 3.9^{b}
FD	0.15 ± 0.01^{c}	45 ± 7^{c}	62 ± 3.2^{a}	17 ± 1.5^{ab}	367 ± 4^{a}

Table 3: quality attributes and nutritional values of different dried samples

Conclusion

The results of this research demonstrated the potential of Radiant Energy under Vacuum at above freezing point (*quanta*REV), and under freezing point (*freeze*REV) for industrial drying of fruits such as pineapple. REV dehydration could produce puffed and attractive fruit snacks with acceptable rehydration rate and retention of nutritional properties, and significantly shorter processing time and capital cost saving compare to conventional drying technologies.

References

1. Leusink, G. J., D. D. Kitts, P. Yaghmaee, T. Durance (2010). Retention of Antioxidant Capacity of Vacuum Microwave Dried Cranberry." Journal of Food Science 75(3): C311-C316.
2. R. Noorbakhsh, P. Yaghmaee, T. Durance (2013). Radiant energy under vacuum (REV) technology: A novel approach for producing probiotic enriched apple snacks. Journal of Functional Foods 5 (3):1049-1056
3. D. Argyropoulos, A. Heindl, J. Muller, 2011. Assessment of convection, hot-air combined with microwave-vacuum and freeze-drying methods for mushrooms with regard to product quality. International Journal of Food Science and Technology. 46: 333–342.
4. I Elisia, C. Hu, D.G. Popovich, D. D. Kitts (2007). Antioxidant assessment of an anthocyanin-enriched blackberry extract. Food Chemistry101: 1052–1058
5. D. C. Harris, Quantitative Chemical Analysis. 5th ed.: W. H. Freeman & Company, New York, 2000. Chapter 7.