脫水鳳梨之製造及其在貯藏期間維生素C含量之變化試驗

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一、前　言

鳳梨爲本省特產之一，而鳳梨加工事業亦爲本省主要產業之一。近年來鳳梨罐頭之生產量，年在90萬箱以上，多係出口換取外滙。出口罐頭需要有完整圓形之切片，以爭取品級，於是稍差之片及不整齊片之產量激增，雖然四分片及碎片罐頭亦可運往省內市場銷售，但其價格之低廉，誠不堪想像。年來鳳梨公司多將之榨爲果汁以代替糖液使用，殊爲可惜，作者等利用鳳山熱帶園藝試驗分所原有之脫水設備——兩段式隧道脫水機 (Two stage tunnel Dehydrator) 以試製脫水鳳梨，企圖在保存鳳梨原有的色香味及其營養分之條件下，以提高不整齊片(包括四分片與碎片)之利用價值及經濟價值。

二、試驗材料與方法

1. 原料：本分所栽培之開英種 (Smooth Cayenne) 鳳梨、白砂糖及亞硫酸鈉 (Sodium sulfite) 或亞硫酸氫鈉 (Sodium bisulfite) 等。

2. 製造方法：本試驗因無鳳梨罐頭工廠之殘餘果肉可資利用，故逕以鮮果爲原料。其製造程序分爲①鳳梨去皮切片與整形②汽蒸或殺菁③浸糖④脫水等步驟。分述如下：

①鳳梨先用去皮機除去果皮及芯，次用罐頭切片機輪切成片，再運至細切片機切爲1/6的片(以罐頭鳳梨之切片爲準)，然後用人工修整之。

②汽蒸或稱殺菁 (Steam blanching)：切好之片放在蒸籠上，於常壓下用蒸汽蒸六分鐘。其目的有二：一爲破壞其細胞組織，使其細胞膜允許糖分子滲透入細胞內；一爲破壞酵素 (Enzyme) 組成，避免在脫水及貯藏期間變爲褐色。

③浸糖：浸糖法可採用者有兩種，即乾糖法與濕糖法。乾糖法者爲將汽蒸完了之鳳梨片，放於磁皿或鋁盆中，然後用相當於果肉重量一半的糖，覆於其上，使其自然溶解和浸入。此法用糖量多，但收回的糖液濃度大，可移作其他用途。濕糖法者爲將砂糖配製成 60 Brix 的糖液，取汽蒸完了之鳳梨片浸入其中。此法所得之糖液稀薄，於濃縮時色易變深。

依據 Hazel Friar 及 Phyllin Von Holtos 兩氏 (1945) 之研究結果，鳳梨可以製成良好的脫水產品，爲阻止其暗色化，需用 SO_2 加以處理，在有限期的貯藏試驗中，顯示無充分硫化 (Sulfured) 之鳳梨，其變色在高溫下進行非常迅速；其經充分硫化者，則其回復性好而有良好之香氣，故用殺菁 (Blanching) 處理之硫化的鳳梨，是一種很好的蜜餞糖果。

本試驗係採用濕糖法，即將汽蒸完了以後的果肉取出，分爲兩組：一組加入相當於果肉重量 0.3% 的亞硫酸鈉液，用噴壺噴灑於果肉上，翻拌均勻。另一組則不加此藥品，然後各組浸漬糖液 12小時，即可脫水。

關於鳳梨之硫化，原擬直接用 SO_2 氣體，因無氣體分析裝置，無從測出 SO_2 之濃度，乃用亞硫酸鈉代替之。

④脫水 (Dehydration)：將淋去糖液之碎片，以每平方呎不超過 1.5 磅之乾燥面積平鋪於脫水盤上，然後以 180°F 乾燥 3 小時，再以 150°F 乾燥至含水分15%以下爲度。

表一　鳳梨脫水情形記載

Table 1. List of Process of Dehydration of Pineapple

樣品號數 Sample No.	鳳梨重 Weight of Pineapple	皮重 Weight of Peel	果肉重 Weight of Fruit Meat	砂糖重 Weight of Cane Sugar	汽蒸時間 Time of Steam Blanching	浸糖時間 Time of Immersed into Sugar	成品重 Weight of Product
	公斤(kg.)	公斤(kg.)	公斤(kg.)	公斤(kg.)	分鐘(min.)	小時(hr.)	公斤(kg.)
1	40	21.40	18.60	10	6	12	5.10
2	40	19.10	20.90	10	6	12	5.90
3	40	18.20	21.80	10	6	12	6.00
平均 Average	40	19.57	20.43	10	6	12	5.67

三、包裝及貯藏

本試驗以所用包裝材料之不同，分爲三組：第1組係用塑膠盒 (Polyethylene Box)，第2組爲臘紙盒 (Paraffined Paper Box)，第3組爲塑膠紙袋 (Polyethylene Bag) 外罩以牛皮紙者。每一組又分兩小組：一爲脫水前用亞硫酸鈉液處理者，一爲脫水前未用藥品處理者。

當鳳梨卸出脫水機後，分別裝於各種盒子中，暫不加蓋及密封，一併放入大木箱中，用溴化甲烷 (Methyl Bromide) 氣體燻之，以免有蟲卵附着或混入而致損壞其品質。

關於盒子之封閉方法爲：臘紙盒用臘熱封其口；塑膠紙袋先行熱封後，其硬紙殼部份復用漿糊封之；塑膠盒當其加蓋蓋閉後，其四週之縫隙用液體塑膠封固之。

將各組包裝好之脫水鳳梨製品放入同一貯藏室中，對於溫度和濕度不加控制，每貯藏三個月六個月九個月及一週年時，各測定抗壞血酸 (Ascorbic Acid) 或維生素 C (Vitamin C) 一次，並觀察其色澤品質之變化情形，以便明瞭在何種包裝情形下，維生素C之損失量最小。

四、脫水鳳梨色澤風味之檢查與維生素量 C 之鑑定

關於脫水鳳梨在貯藏期間之色澤與風味的檢查結果，簡記如次：

（1）　脫水前未用亞硫酸鈉處理之脫水鳳梨，無論用何容器包裝，經貯藏三個月，已變質變味。惟用亞硫酸鈉處理過者，不論用何容器裝盛，其色澤風味無何變化。

（2）　未用亞硫酸鈉處理過之脫水鳳梨，不論裝於何種容器，經貯藏六個月，均全部敗壞，不能食。但用亞硫酸鈉處理過者，仍保持原狀。

（3）　用三種不同容器裝入曾用亞硫酸鈉處理之脫水鳳梨，經貯藏一週年後，除用塑膠盒包裝者仍保持原狀外，其他二種包裝貯藏者，雖未變色，但質地已變成軟綿狀，仍勉强可以食用，然風味已不如初製成時之佳良也。

各種不同包裝的脫水鳳梨製品在不同貯藏時期之維生素C含量，詳載於第二表。

表二　脫水鳳梨在不同貯藏時期之維生素C（或抗壞血酸）量變化情形

Table 2. Variation of the Vitamin C or Ascorbic Acid Content of Dehydrated Pineapple During the Storage Period

包裝別 Kinds of Packing Materials	處理別 Kinds of Treatment	初製成時之抗壞血酸 Ascorbic Acid of Original Products (公絲/100公克) (mg/100g)	貯藏三個月之抗壞血酸 Ascorbic Acid of Products after Storage of 3 Months (公絲/100公克) (mg/100g)	貯藏六個月之抗壞血酸 Ascorbic Acid of Products after Storage of 6 Months (公絲/100公克) (mg/100g)	貯藏九個月之抗壞血酸 Ascorbic Acid of Products after Storage of 9 Months (公絲/100公克) (mg/100g)	貯藏一週年之抗壞血酸 Ascorbic Acid of Products after Storage of One Year (公絲/100公克) (mg/100g)	貯藏一年後之全損失量 Loss of Weight for One Year's Storage (公絲/100公克) (mg/100g)	貯藏一年後之損失百分率 Loss of Percentage, of One Year's Storage (%)	貯藏一年後之存留百分率 Ascorbic Acid Remained after Storage of One Year (%)
用臘紙盒包裝者 Packed With Paraffined Paper Box	脫水前未用亞硫酸鈉液處理者 No Treat with Na_2SO_3 before Dehydration	32.55	24.80	已全部敗壞 All are Putrefied	—	—	—	—	—
	脫水前曾用亞硫酸鈉液處理者 Treat with Na_2SO_3 before Dehydration	18.26	13.57	5.88	3.73	3.38	14.88	81.49	18.51
用塑膠盒包裝者 Packed With Polyethylene Box	脫水前未用亞硫酸鈉液處理者 No Treat with Na_2SO_3 before Dehydration	32.55	23.83	已全部敗壞 All are Putrefied	—	—	—	—	—
	脫水前曾用亞硫酸鈉液處理者 Treat with Na_2SO_3 before Dehydration	18.26	12.88	5.81	4.54	4.18	14.08	77.11	22.89
用塑膠紙袋外罩以牛皮紙包裝者 Packed with Polyethylene bag and Packing Paper on the Outside	脫水前未用亞硫酸鈉液處理者 No treat with Na_2SO_3 before Dehydration	32.55	22.80	已全部敗壞 All are Putrefied	—	—	—	—	—
	脫水前曾用亞硫酸鈉液處理者 Treat with No_2SO_3 before Dehydration	18.26	14.62	5.34	4.43	4.03	14.23	77.93	22.07

備考 Remarks

1. 以上測得之抗壞血酸量，係還原抗壞血酸，並非代表全抗壞血酸量。
   All the above experimental data of Ascorbic acid are Reduced Ascorbic acid, but not represent the Total Ascorbic acid.
2. 抗壞血酸或維生素C之測定，係根據美國維生素化學家聯合會主編之 Methods of Vitamin Assay (1951)第76～81頁所載之方法。
   Progress of Vitamin C anaeyses are according to "The Methods of Vitamin Assay," p. 76-81, (1951) Prepared and edited by the Association of Vitamin Chemists, Inc., U. S. A.

五、結　　論

1. 製造脫水鳳梨之原料，如爲減輕工廠成本計，自以採用鳳梨製罐後之殘餘果肉爲宜。

2. 脫水鳳梨之製造程序，如以整個鮮果爲原料，分爲①鳳梨去皮切片與整形②汽蒸或殺菁③浸糖④脫水等步驟；如採用鳳梨製罐後之剩餘果片，則可省去第①步手續。又果肉在汽蒸(或殺菁)完了後，如用 SO_2 處理，或加入0.3%的亞硫酸鈉液(以果肉之重量爲基準)，再行浸糖脫水，則將來的製品用適當容器包裝後可保存一相當時期，不致變色變味。

3. 就色澤之變化方面言，如鳳肉果肉之脫水溫度高於 200 °F 時，則其成品變爲棕黃色之速度快。其原因爲溫度增高，則糖之轉化作用 (Inuersion) 加速，且更有促使糖分焦化 (Caramelize) 之可能。

4. 經過亞硫酸鈉處理之製品經包裝以後，若放於陰涼處，在不增加水分含量之情形下，色澤可保持年餘而不變；但如遇到陽光直射時，則在四小時內卽可褐變。

5. 用一般牛皮紙包裝脫水鳳梨時，因其吸收水分之故，甚易變色。若用塑膠盒裝好放於冰箱或冷藏庫中，則貯藏時期較長，而色澤品質俱臻佳良也。

6. 用三種不同容器裝盛曾用亞硫酸鈉處理過之脫水鳳梨，放在普通貯藏室經貯藏一週年後，除用塑膠盒包裝者仍保持原狀外，其他二種包裝貯藏者，雖未變色，但質地已變軟綿狀，不如以前裝盒時風味之優良也。

7. 根據貯藏一週年測定維生素 C (Vitamin C or Ascorbic Acid) 之結果，此三種容器之損失量均相當大，但比較起來以用塑膠盒與塑膠紙袋(外罩以牛皮紙)包裝者，損失稍小。例如前者維生素C較初製時損失達 77.11%，後者損失爲 77.93%。

本試驗之進行，多賴本系李彬書朱仙和二君之協助，作者等附致謝意。

參 考 文 獻

(1) 嚴雋寶：鳳梨外銷前途　國際貿易月刊 2 卷11期(46年11月)
(2) 鳳梨脫水試驗初報　農業試驗所民國39年年報 317 頁
(3) 鳳梨脫水試驗報告　農業試驗所民國44年年報 108 頁
(4) 脫水鳳梨之包裝貯藏試驗　農業試驗所民國45年年報91～92頁
(5) HAZEL FRIAR and PHYLLIS Von HOLTON: A Study on the Dehydration of Pineapple, Fruit Products Il., 24:70–89, 1944.
(6) HARRY W. Von LOESECKE: Drying and Dehydration of Foods, 1943.
(7) HARRY W. Von LOESECKE: Drying and Dehydration of Foods, 2nd edition (1955)
(8) Ass'n of Vitamin Chemists, Inc.: Methods of Vitamin Assay, 2nd edition (1951)
(9) PARKEN, HARVEY and STATELER: Elements of Food Engineering, Volume II (1954)

A STUDY ON THE DEHYDRATION OF THE PINEAPPIE AND VARIATION OF THE VITAMIN C CONTENT OF THE DEHYDRATED PINEAPPLE WITH DIFFERENT PACKAGES DURING THE STORAGE PERIOD

by

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SUMMARY

The canned pineapple has become an important food industry in Taiwan. About more than 900,000 wooden cases of canned pineapple were exported each year. In order to maintain the best quality for foreign trade, only whole slices are selected to fill into cans, but the broken or quarter slices and pieces are remained an appreciable quantity in the course of canning. Those can be utilized as raw materials for dehydration. Many experiments have been done for the dehydration of pineapple during the past several years for its economical importance. Modifiied method of dehydrating pineapple is as follows:

(1) Peeling and Coring: This is done by machine, the peeling and coring being accomplished in one operation. The peeled trimmed fruit may be sliced into 1/16 part of the original slice or diced in one oubic centimeter cubes.

(2) Steam blanching: Diced slices should be steamed for 6 minutes before sulfiting, this is necessary in order to get a translucent product.

(3) Dipping: After blanching, one group is immersed in a 0.3% of sodium sulfite or sodium bisulfite solution (which based on the weight of fruit meat), and the other group is not immersed in sodium sulfite solution as control. Afterwards both groups are wholly dipped into the sugar solution (that concentration is 60 Brix) for twelve hours.

(4) Dehydration: After dipping, both groups are ready for dehydration. This is preferably done in a two-stage tunnel dehydrator. Each tray is loaded not exceeding 1.5 pound per square foot of drying area. In the first stage, the drying temperature should be kept in 180°F. about 3 hours, and in the second stage, it should be continuously dried at 150°F. until the moisture content is below 15%. After dehydration is complete, then packing and storing.

As regard for the packing and storing of the dehydrated products, three differerent packing materials are used for the dehydrated pineapple in this experiment. They are polyethylene bags, polyethylene boxes and paraffined paper boxes. Before packing, dehydrated pineapple are often fumigated with methyl bromide. After fumigation, the products are field and pressed into insect-proof bags and boxes, and subsequently the containers should be heat-sealed, but in the case of polyethylene boxes covering with lid, itis coated with the laminated cellophane. Finally storing the dehydrated

products in the common storage warehouse for one year. The Vitamin C or ascorbic acid is determined at the end of 3 months, 6 months, 9 months and one year respectively.

Results of this experiment are in the following:

1. Change of the color: During the process of dehydration, if the drying temperature exceeds 200°F., it tends to accelerate the rate of color change from yellow to yellowish brown. It is necessary to avoid high humidity during drying, otherwise the discoloration will result. Furthermore, when the product is in the high temperature, the inversion of sugar will be increased and finally invert sugar (the mixture of glucose and fructose) will be produced, Meanwhile the sugar became easily caramel.

2. After the blanching, if the products is treated with sodium sulfite and placed in a cool place, and if the moisture coutent is not increased, the color can be maintained more than one year. If the products are exposed directly to sunshine, the color will be changed within four hours. It is assumed that light probably destroyed the color constitution in the dehydrated pineapple.

3. Color and flaver of dehydrated products, which are not treated with sodium sulfite solution, changed after 3 months' storage; but treated with sodium sulfite, are not changed even after 6 months' storage. The former is entirely decayed, while the latter has been kept in good quality.

4. Dehydrated products which are packed with polyethylene boxes are not changed after one year's storage. Those packed with other two kinds of containers became soft with a decreasing of palatability, but the color is not changed.

5. Temperature is an important factor in the storage life of dehydrated products. The lower the temperature of the storage, the longer the storage life. During the storage of dehydrated pineapple, there is a decrease in Vitamin C content and palatability, the extent of this decrease depends upon the storage temperature, moisture content of the products. The reduction of Vitamin C content in the three different packages are made during this experiment. In the common storage room, there are over 77% of the Vitamin C lost in all package treatments. There is no significant difference in the reduction of Vitamin C among the three packaged materials. Packing with polyethylene boxes give 77.11% of Vitamin C loss, while those packed with polyethylene bags give a 77.93% of loss.