KOREAN J. FOOD SCI. TECHNOL.
Vol. 9, *No.* 1(1977)

Development of a Simultaneous Seed Separation and Drying Method of Red Pepper

Part II. Dehydration Effect on the Impact Seed Separation of Red Pepper

by

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(Received December 30, 1976)

고추의 同時脫種 乾燥方法의 開發에 관한 연구

제 2 보 熱風乾燥가 고추씨의 衝擊分離에 미치는 영향

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(1976년 12월 30일 수리)

Abstract

Seed separation out of fresh red pepper by impact methods was effective but impossible to separate over 45% of seed. For the increase of seed separation, dehydration effect was studied with the slices of pepper. Heat deformation during the course of drying at hot air of 0.61m/sec velocity at temperature of 65°C, increased the separation up to 93% with a halfcut pepper. Seed separation was remarkably different upon the location of cut, but it was completed prio tothe completion of drying in every cutting orientations. From these results a simultaneous seed separation and drying operation techniques is successfully developed.

Introduction

Impact application to the red pepper pod caused the seed separation from the pepper and its important position in relation to pepper processing was discussed in the previous paper[1]. Seed separation rate change during the continuous application of impact was a similar pattern to that of dehydration of red pepper. This fact strongly suggests a simultaneous seed separation and drying operation (SSSD-operation) be possible. If the case proved to be true, a drastic change would be open up to processing technology of red pepper which is the main spice in Korea and other countries. As an effective and practical way of seed separation, screen drum apparatus was proved as a practical one from previous study[1]. In order to couple the seed separation into drying operation, drying effect on seed separation was studied in this experiment.

Material and Method

Red Pepper

Fully mature red pepper, *Capsicum annum* var.

longum wash arvested and cut transversely in two parts. The both parts of half-cut pod were used for this experiment.

Seed Separation Drying Equipment

A cylindrical screen drum, diameter 44cm, height 20cm, with screen aperture 6mm, was connected to pulley so that seed separation could be carried out at various rotational speed. The drum was covered with plywood for the insulation and heated with hot air as it needed as shown in Fig. 1.

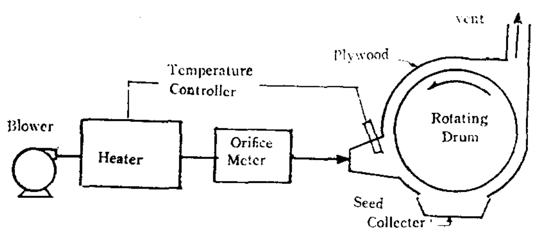

Fig. 1. Rotary screen seed separation apparatus with heating system

Measurement

a. Seed weight: Seed weight was measured with conventional balance with ± 0.1g accurany

b. Temperature: For the temperature measurement alcohol-thermometer was used.

c. Volume: Volume changes of red pepper during heating were calculated by the following equation from the convertion table in Perry's Handbook[2] after reading out the height of red pepper bulk h, in the cylindrical drum of diamenter D and width W.

Volume=(Area corresponding to the quotinent h/D) $\times W$

d. Density: Density was calculated from volume and weight data.

e. Void space: The change of void space, inner space between placenta and pod tissue, were measured as the following way; red pepper was cut transversely in 2mm thickness with blade and put on the bronze wire gauze. Cotton thread was used to fasten the pepper cut to the wire gauze to prevent a deformation of outer layer of pepper. The wire gauze with sample was subjected to heating in the stream of hot air at 65°C. Heat-deformed pepper slice on wire gauze was projected on a good-quality paper with overhead projector and the void space traced was cut off and weighed to calculate area change in centimeter square.

Result and Discussion

1. Seed Separation in Rotary Screen Apparatus.

Complete seed separation out of red pepper pod is theoretically possible, when impact is increased, but mechanical damage to its food quality must be taken into account. After compromise between impact and food quality, seed at inner location of the pepper remained without release out of the pod. It is clearly illustrated in the fact that only 45% of seed was separated at 21 revolutions per minute in seed separator (Fig. 1) as shown in Table 1.

Table 1. Seed separation data in rotary screen seed separation apparatus

Time (h)	Seed separated(g)	Seed separedat(%)
1	27	24.68
2	6	5.48
3	3	2.74
4	2	1.83
5	2	1.83
6	1	0.91
7	2	1.83
8	1	0.91
9	1	0.91
10	1	0.91
11	2	1.83
12	1	0.91
Total	49	44.79

This result suggested that other way of effective seed separation should be considered, such as heat deform ation.

2. Hot Air Drying Effect on Red Pepper Structure

As illustrated in Fig. 2-a, there is little space enough for separated seed to escape from placenta out of the pod.

It is well known that vegetable tissue undergoes some degree of shrinkage, or heatdeformation during the drying.[3][4] This shrinkage phenomena of red pepper drying may influence its seed separation from the pod. When red pepper slice was exposed to hot air stream space change occured to so significant extent as shown in Fig. 2 that easy seed movement could be ensured. Another favorable result for seed separation is cracking orientation of inner tissue which makes placenta seed-carrying section oriented gradually toward the bell tissue and better impact transfer is secured as shown in Fig. 2-b, c, since impact absorbing sponge like placenta tissue was substantially disappeared. Void space change, represented as cross sectional area, showed remarkable increment in the early stage of dehydration and after a slight decrease due to out layer shrinkage, void space remained unchanged, as shown in Fig. 3.

This apparently indicated that free moving space for seed is enlarged during the course of drying, as contracted the placenta and thined the inner tissue.

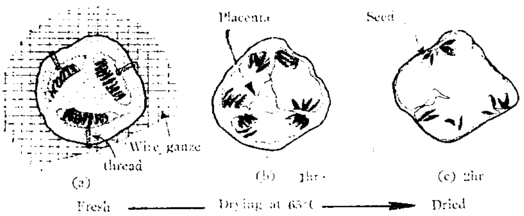

Fig. 2. Cross sectional view of heat deformation of red pepper during the course of dehydration.

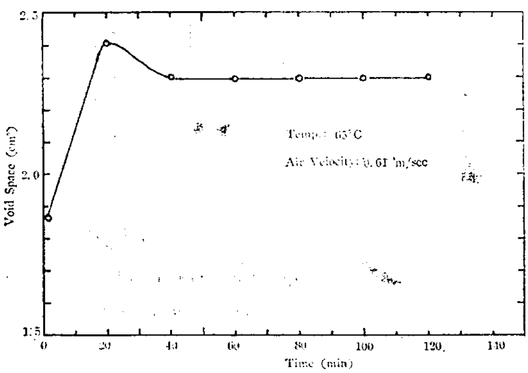

Fig. 3. Change of void space during the drying

3. Drying Effect on Seed Separation in Rotary Screen Separator

One kilogram of half-cut pepper was put in the rotating seed separation apparatus as shown in Fig. 1, and the separation was carried out at 30 revolution per minute until no substantial separation was detectable for 2 hours. And then the operation was continued under a stream of hot air at temperature of 70°C, volocity of 0.61m/sec so that drying of red pepper was started. After a warmingup period, seed separation rate was increased and most of remaining seed was able to collect from the pod as shown in Fig. 4.

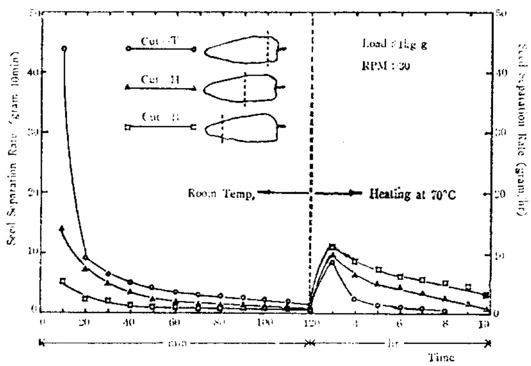

Fig. 4. Cutting orientation and drying effect on seed separation rate

The result of half-cut, Cut-H was compared with those of other cut-pepper; Cut-T and Cut-B as denoted in Fig. 4. In spite of same amount of impact was applied to every cuts, Cut-B showed the lowest seed separaration in fresh state and then the highest one under drying condition. This upsetting result of drying period can be explained with that unescaped seed due to the structual difficult succeeds to escape out of the pod upon the increase of void space, and that impact transfers effectively to the seed holding section as previously metioned.

This result clearly shows that shringkage phenomena observed in vegetable drying acts in favorable way to the seed separation, and supports the possibiliy of a "SSSD-operation" in chili process technology.

4. Simultaneous Seed Separation and Drying of Red Pepper

A simultaneous seed separation and drying of red pepper was attempted as following; 2kg of half-cut pepper was subjected to seed separation under hot air stream of 65°C, and 0.61 m/sec velocity in the rotary screen seed separator as a dryer as shown in Fig. 1. From this experiment, it is found that seed separation has been completed prio to the completion of drying as clearly indicated in Fig. 5. Dried pepper produced in this way contained no seed and only negligible amount of seed was found in some cases, if any.

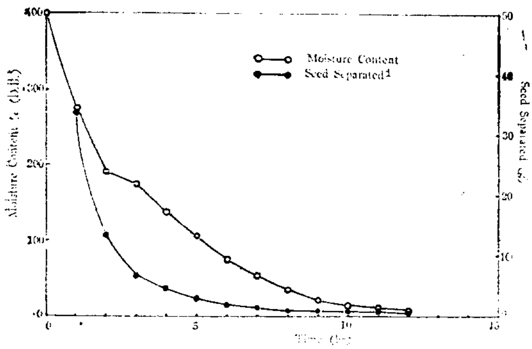

Fig. 5. Drying and seed separation in rotary screen drier

5. Volume and Density Changes during SSSD-Operation

Volume decrease is accompanied with vegitable dehydration by the loss of moisture and shrinkage phenomena. In the case of red pepper, weight decrease is observed one tenth in whole pod basis[5]. It is required to know the volume change, which is an important design factor for red-pepper dryer. Therefore, volumetric change of half-cut red pepper in the course of the SSSD-operation, was investigated by the method previously described. After five hours of drying period, equivalent to one half whole drying period, two third of original volume was decreased as shown at Fig. 6.

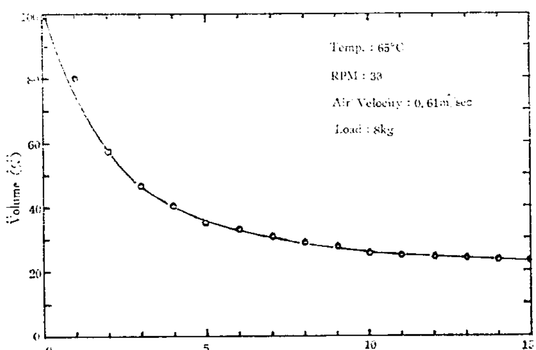

Fig. 6. Volume decrease during the drying

This result indicates that three fold increment of drying capacity can be achieved with the SSSD-operation because only volume is the controlling factor determining the capacity.

Densities of fresh and dried pepper were 0.73 and 0.24, respectively, and its time course change during the SSSD-operation was similar tendency to that of volume as shown in Fig. 7. Such a nearly simultaneous volume and density changes is considered to b the other important design factor of a red pepper dryer.

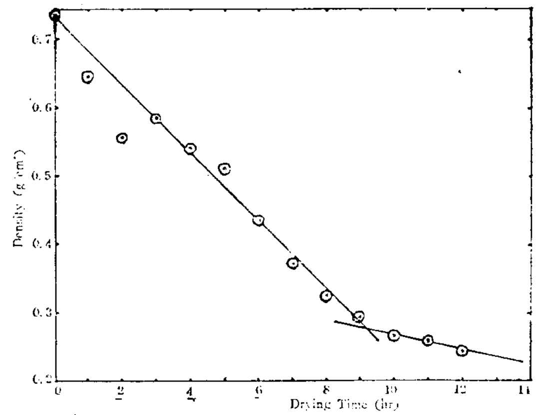

Fig. 7. Density changes during the red-pepper drying in rotary screen drier

From the above results, we can conclude that incomplete seed separation by impact method can be completed with simultaneous drying effect. The SSSD-operation, therefore, is expected to apply to red pepper dehydration, or processing, which is now under a further study in this laboratory.

要 約

衝擊方法에 依하여 고추씨를 分離할 수 있으나 그 收率을 45%以上 올릴 수는 없었다. 따라서 보다 높은 씨分離收率을 이룩하기 위하여 고추 組織에 對한 加熱効果를 試圖한 結果 씨의 分離가 容易하게 이룩될 수 있는 고추 內의 空隔이 增加되었다. 이와같은 加熱効果를 씨의 分離에 利用키 위하여 回轉篩式圓筒型 씨분리機에 65°C, 0.61m/sec의 熱風을 送入하면서 씨를 分離할 경우 93%까지 分離收率을 높일수 있었다. 熱風下에서의 씨의 分離는 고추의 切斷部位에 따라 差異는 있었으나 고추 乾燥가 完了되기 以前에 씨의 分離를 完了할 수 있었으므로, 同時脫種 乾燥方法이라는 새로운 고추의 加工方法을 開發하게 되었다.

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