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Research Notes

Effect of Cook Temperatures on Firming Rate of Cooked Rice

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Abstract

The effect of cook temperatures, 100-120°C, on firming rate of cooked rice stored at 4°C for 72 hours was studied. The cook temperatures had a definite effect in retarding the firming rate of cooked rice. The time constants, reciprocal of firming rate constants, of cooked rice cooked at 110°C and 120°C were 1.2 and 1.5 times greater, respectively, than that at 100°C. The total material available for crystallization and the Portion of material that durings storage were decreased as the cook temperature increased.

Introduction

Firming rates of cooked rice depend on rice variety and storage temperature[1-4]. However, little information is available for the effect of cook temperature on the firming rates of cooked rice.

In this study, two nonwaxy rice varieties were employed to examine the effects of cook temperatures on the firming rate of cooked rice stored at 4°C.

Materials and Methods

Nonwaxy varieties of a Japonica type (Chunmabyeo) and an J/Indica type(Kayabyeo) were dehulled and abrasively polished 8% by weight.

To one gram of rice, 1.4*ml* of water was added and rested for 30 min. Cooking was carried out using a brass vessel[5] at 100, 110 and 120°C.

The cooked rice in the vessel was stored at 4°C for 72 hours. The firmness of cooked rice grain was determined using a rheometer (I&T Co., Ltd., Tokyo) The experiment was repeated twice. The operating conditions of the rheometer were: measuring load, 2 *kg*; table speed, 15 *mm/sec*; chart speed, 120 *mm/min*; and clearance, 1 *mm*.

The firmness data were analyzed to determine the rate constant(k) and Avrami exponent(n) according to the following equation[1,6]:

$$\log(-\ln\frac{E_L-E_t}{E_L-E_O}) = \log k + n \log t$$

where E_0 and E_t are firmness at time 0 and t, respectively. E_L is limiting firmness, which was obtained from the cooked rice stored at 4°C for 6 days.

Results and Discussion

The Avrami exponents of cooked rice were unity, regardless cook temperatures (Table 1), indicating that the basic mechanism of aging of cooked rice is not effected by cook temperature.

The time constants (1/k) calculated are given in Table 1. The time constants of cooked rice cooked at 110°C, and 120°C were 1.2 and 1.5 times greater than that at 100°C, respectively which indicate that the firming rate of cooked rice cooked at higher temperature was slower.

The data on firmness of cooked rice are tabulated in Table 2. In case of Chunmabyeo, the total material available for crystallization on aging(E_L-E_O, B) was 3.28. The portion of material that crystallized during storage (E_{72}-E_0, A) was 2.84. The ratio (A/B) was 0.86; that is, 86% of the total material was crystallized during storage

Table 1. Avrami exponent(n) and time constant(1/k) for cooked rice

Rice	Cook temperature (°C)	n	1/k (day)
Chunmabyeo	100	0.9799	1.4933
	110	0.9967	1.8038
	120	0.9754	2.2400
Kayabyeo	100	0.9863	1.3800
	110	1.0079	1.6533
	120	1.0056	2.0729

Table 2. Data on rheometer firmness of cooked rice

Cook temperature(°C)		Chunmabyeo	Kayabyeo
100	E_O	3.74	3.69
	E_{72}	6.58	6.84
	E_L	7.02	7.25
	E_{72}-E_O(A)	2.84	3.15
	E_L-E_O(B)	3.28	3.56
	A/B × 100	86.59	88.48
110	E_O	3.41	3.38
	E_{72}	5.68	5.84
	E_L	6.21	6.32
	E_{72}-E_O(A)	2.27	2.46
	E_L-E_O(B)	2.80	2.94
	A/B × 100	81.07	83.67
120	E_O	3.12	3.09
	E_{72}	4.86	4.93
	E_L	5.47	5.50
	E_{72}-E_O(A)	1.74	1.84
	E_L-E_O(B)	2.35	2.41
	A/B × 100	74.04	76.35

at 4°C for 72 hours. As evident in Table 2, the ratio of A over B was decreased as cook temperature increased. The effects of cook temperatures on the firmness data for cooked Kayabyeo rice were similar to those for cooked Chunmabyeo rice (Table 2).

From the results in Tables 1 and 2, it can be concluded that higher cook temperature reduced the starch components available for crystallization of cooked rice.

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취반온도가 밥의 노화속도에 미치는 영향

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취반온도가 밥의 저장(4℃, 72시간)중 노화속도에 미치는 영향을 조사하였다. 취반온도(100~120℃)가 올라갈수록 밥의 노화속도는 감소하였다. 노화시간 상수(속도상수의 역수)는 110℃ 및 120℃에서 취반한 밥이 100℃의 밥보다 각각 1.2 및 1.5배 큰 값을 보였다. 취반온도가 올라갈수록 밥의 저장중 노화될 수 있는 물질의 양 및 노화된 물질의 양은 모두 감소하였다.