Eating Qualities of Milled Rice under Carbon Dioxide Storage

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Introduction

The eating quality of rice is one of the most important factors in determining overall rice quality. It is defined by various characteristics of the cooked rice including appearance, cohesiveness, tenderness, glossiness, odour, and colour. All these characteristics undergo significant changes during storage.

Rice ages during storage, the process involving changes in physicochemical characteristics, such as development of off-odour, harder texture, reduced stickiness and glossiness, which influence its cooking, eating, and nutritional qualities.

As part of ACIAR Project 8307 on 'Long term storage of grain under plastic covers', cooking and eating qualities of rice were evaluated following long term storage under CO^2, with a view to assessing any effects of the gas.

Materials and Method

Milled rice samples stored under either CO_2 or ambient air were collected and cooked for sensory evaluation after 4 and 8 months storage. The rice stored under CO_2 was tightly sealed in a PVC enclosure and purged with CO_2 gas at a dosage of 2 kg/t rice for insect disinfestation. Thirty samples taken from a 200t stack were bulked into a single working sample and used for sensory evaluation for each storage method and sampling period.

The rice was washed twice with tap water and cooked in an electric cooker with a rice-to-water ratio of 1:2. One sample from each storage method was served for evaluation. The quality of cooked rice was evaluated on the basis of its palatability. Fifteen trained panelists judged the odour, tenderness, cohesiveness, colour, glossiness, and overall acceptability of the cooked rice using a rating scale of 1–9 (Fig. 1). The eating qualities of the rice stored under CO_2 and the untreated control rice were statistically compared by t–test.

Results

After 4 months storage the rice stored by both methods showed similar eating qualities (Table 2). The odour, tenderness, and glossiness of the rice scored moderately (mean score 5), implying normal acceptance or no indication of deterioration. The creamy–white colour (score of 7), though indicative of initial signs of aging associated with storage, did not adversely affect local preference as indicated by good overall acceptance (score of 6). However, as regards cohesiveness, the rice from both treatments showed an decrease in stickiness, a change at variance with the preference of a large section of the local population.

Fig. 1. Form used for scoring quality characteristic of cooked rice following storage.

Sensory Evaluation of Cooked Rice
Name:
Date:
Sample:

Characteristics			
A	Odour		
		9	– none
		7	– weak
		5	– moderately strong
		3	– strong
		1	– very strong
B	Tenderness		
		9	– very tender
		7	– tender
		5	– moderately tender
		3	– slightly hard
		1	– hard
C	Cohesiveness		
		9	– well separated
		7	– partially separated
		5	– sticky
		3	– very sticky
		1	– pasty
D	Colour		
		9	– white
		7	– creamish white
		5	– greyish white
		3	– light brown
		1	– brown
E	Glossiness		
		9	– very glossy
		7	– glossy
		5	– moderately glossy
		3	– dull
		1	– very dull
F	Overall acceptability		
		9	– very good
		7	– good
		5	– fair
		3	– poor
		1	– very poor

After 8 months storage, the control stack began to show initial deteriorative changes (score 5) indicated by the off–odour, a less glossy appearance, and stickiness. Changes in the odour and overall palatability of the control rice were significantly greater than those of rice stored under CO_2 whose overall level of acceptability remained good. Nevertheless, the colour of rice from both treatments was creamy–white, which is a notch below the 'full–white' appearance associated with rice fresh from the mill.

Discussion

The odour of milled rice changes very readily during storage due to accumulation of volatile off–odour compounds in the intergranular air (Barber 1972). As compared with the results of previous investigations (Kongseree et al. 1985; Primo et al. 1970;

Table 2. Comparison of mean score of eating qualities between milled rice stored under CO_2 and ambient environments at different storage period.

Storage period (months)	Mean Score of CO_2–Treated vs Ambient					
	Odour	Tender - ness	Cohesive- ness	Colour	Glossiness	Overall Acceptability
4 (Treated –Ambient)	5.3 – 5.2	5.7 – 5.6	3.9 – 4.3	7.6 – 7.0	5.5 – 5.8	6.8 – 6.1
8 (Treated –Ambient)	8.1 – 4.6*	6.1 – 5.8	5.0 – 4.8	8.5 – 8.0	4.2 – 4.8	6.7 – 4.4
4 vs 8 (Treated –Ambient)	5.3 – 8.1*	5.7 – 6.1	3.9 – 5.0*	7.6 – 8.5	5.5 – 4.2*	6.8 – 6.7

*Significant at 5%

Yasumatsu et al. 1965), which reported off–odour within 2 weeks to 4 months of storage, the scoring standard used in this study indicated a very slow development of off–odour in rice stored under ambient conditions for 8 months. The apparently stronger odour from rice stored under CO_2 after longer storage (mean score of 8 after 8 months compared with 5 at 4 months) might have been due to aroma induced by the presence of CO_2 gas, though variations due to the preferences of the panelists themselves are also a possibility.

Colour is the most stable among the eating qualities evaluated. This finding is similar with observations from other investigations (Pelshenke and Hampel 1967; Yasumatsu and Morita 1964) which reported no significant changes in colour after 6 months storage for white rice under ordinary conditions. In the present study, both CO_2 treatment and ambient storage showed no effect on colour.

The cohesiveness of the rice is known to decrease with storage (Barber 1969; Irwin 1959; Yasumatsu 1968). In this study the rice from both storage treatments showed reduced stickiness following as little as 4 months storage.

The tenderness of rice was expected to decrease, resulting in firmer texture, as observed in the investigations already cited. However, our studies revealed stabilisation in texture following both treatments.

The significantly better overall palatability of milled rice stored under CO_2 as compared with rapidly deteriorating qualities observed in rice stored under ambient conditions as shown in this study indicates a need for in–depth studies with regard to the interaction between the rice and the CO_2 gas during storage.

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