Relating Sensory Evaluation to Other Quality Factors in Stored Rice

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Introduction

Storage of rice affects its quality as judged by the consumer. Many tests have been developed which purport to categorise rice quality in terms of its acceptability to consumers. There are, however, few data that relate consumer judged quality with other tests for quality change occurring in stored rice. Storage time and conditions have been related to change in yellowness in rice (Gras et al. 1989) as measured by the CIE b* value (Anon. 1986). This value is objective and simple to measure, whereas sensory evaluation is subjective, labour intensive, and time consuming. The relationship between change in yellowness resulting from storage to the changes in sensory quality of the stored rice is therefore of particular interest. The aim of this study was to relate the results of several standard quality tests with consumer rating of cooked and raw rice for samples of grain stored under a range of controlled conditions.

Materials and Methods

Paddy rice cv. Pelde (1985 and 1986 harvests) was exposed to a range of storage gas atmospheres, humidities, temperatures, and exposure times (Gras et al. 1989). Samples were taken from conditioned grain immediately before exposure and after intermediate and long storage periods. Samples were de-husked using a Satake rice huller (THU-35A), and polished using a Satake grain testing mill (TM-05). Established methods were used to determine alkali spreading value (Little et al. 1958), chalky kernels, milling recovery, head rice yield (Cristobal 1983), fat acidity values (AACC 1965), gel consistency (Cagampang et al. 1973), cooking time, optimum cooking water, percent height increase, and percent weight increase (del Mundo 1979). Yellowness was measured using the b* coordinate (Anon. 1986) of the Minolta Chroma Meter model CR-110 (Anon. 1984). Volume expansion was determined by cooking 40 g of rice in a wire basket (100 mm high × 40 mm diameter, gauge 1 mm) for 20 minutes and calculating the ratio of the heights before and after cooking. The proportion of discoloured (yellowed) kernels was determined by hand sorting 50 g subsamples.

Sensory evaluation (del Mundo 1979) of samples was carried out in Barangay Lamot II, Laguna, Philippines, using a panel of 33 untrained consumers to determine the acceptability and ranked preference of both raw and cooked rice. Each presentation consisted of four samples, of which one was a control (cv. Sinandomeng). Non-sensory quality tests were performed in duplicate, and the means used for comparisons with each other and with the data from sensory evaluations. The raw preference data were adjusted by subtracting the control value in each presentation to make values from different presentations comparable. The percentage acceptability values were normalised by converting to a percentage of the within-presentation control. All of the quality parameters were compared using pairwise correlation. Multiple regression was used to compare sensory data (as the dependent variables) to the other quality data (independent variables), with terms not contributing significantly to the fit progressively removed.

Results and Discussion

There was a positive relation between the cooked and raw sensory qualities, which were in turn negatively related to the yellowness of the grain (Figs 1 and 2). Preliminary analyses indicated that the natural logarithm of the yellowness was well correlated with the sensory scores and was used in all subsequent analyses.

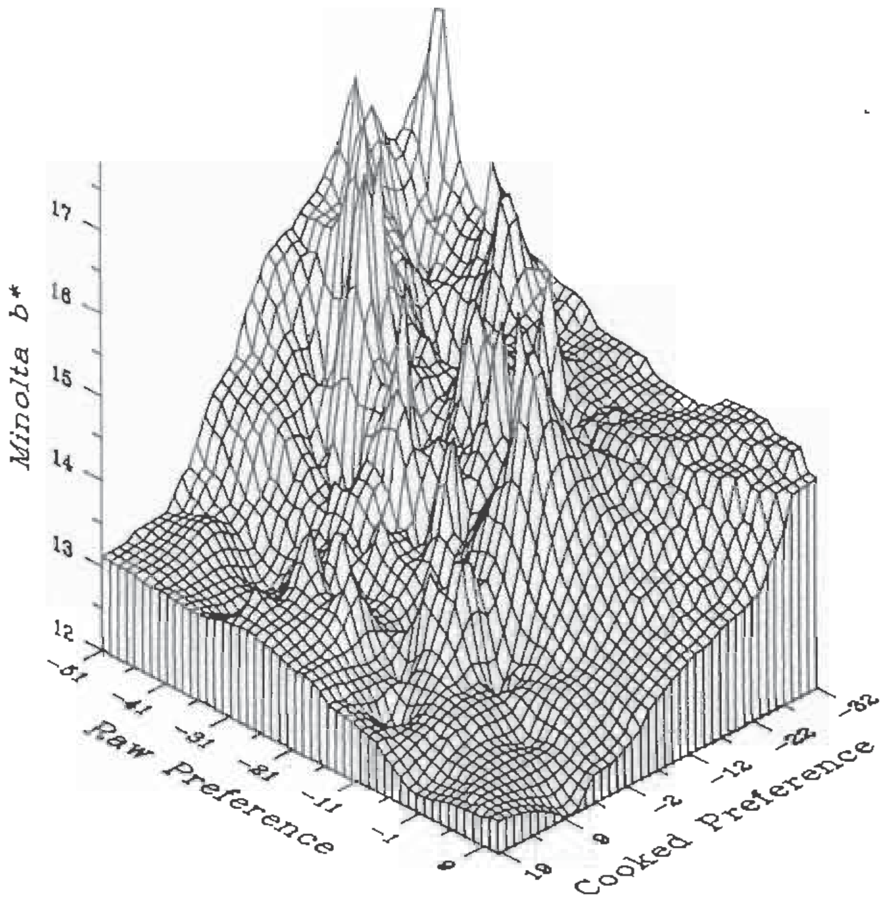

Fig. 1. Relationship of raw preference, cooked preference, and Minolta b* value for stored rice cv. Pelde.

The highest correlations observed were between the four sensory measures (cooked rice preference, raw rice preference, cooked rice acceptability, and raw rice acceptability), between the yellowness and the four sensory measures, and between the percent chalky grains and head rice yield. There was a strongly negative correlation between the yellowness and all four sensory measures; that is, yellowness increased during storage but acceptability and preference decreased. Consequently, significant change in the yellowness during storage appears to

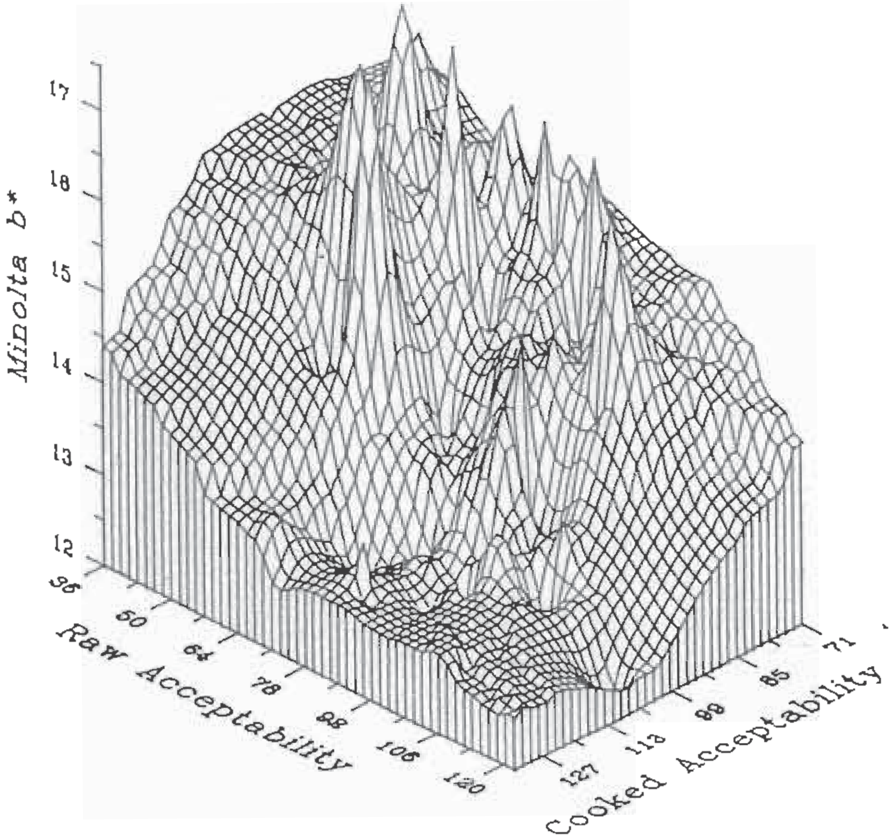

Fig. 2. Relationship of raw acceptability, cooked acceptability, and Minolta b* value for stored rice cv. Pelde.

provide an objective and simple test to assess change in sensory acceptance of rice during storage.

There were smaller but still significant correlations between the sensory measures and the other quality parameters tested. In particular, cooked rice sensory quality was negatively correlated with alkali spreading value, fat acidity, head rice yield, milled rice yield, volume expansion, and percent yellows. Most of these parameters are known to increase during storage (Juliano 1985), whereas preference and acceptability decrease. Therefore, these correlations may also be attributable to storage changes within the rice.

Multiple regressions of all the non-sensory quality parameters against each of the four sensory parameters showed that the largest part of the explained regression variance could, in every case, be attributed to the yellowness. Other factors that significantly contributed to the fit were the percent chalky grains and fat acidity in the cooked rice evaluation, and the alkali spreading value, cooking time, fat acidity, milling recovery and percent weight increase in the raw rice evaluation. The overall fit of the regressions for cooked rice acceptability and preference ($r^2 = 0.589$ and 0.465, respectively) was not much less than that obtained by regressing the two sensory parameters for cooked rice against each other ($r^2 = 0.608$). The limited degree of correlation between the two measures of cooked rice sensory quality illustrates the subjective nature of these evaluations. This indicates that the overall fit of the cooked rice sensory quality with the non-sensory parameters was reasonably close to the best that could be expected.

Consumer preference of rice varies between countries and even between regions in some places (Juliano 1985). Nonetheless storage usually has an effect on consumer preference. Therefore, the change in yellowness resulting from storage will probably provide a measure of sensory quality in most places, but the magnitude of the relationship will vary from place to place. Further work is required to quantify this relationship in other areas.

Conclusions

Sensory evaluation of the stored rice was most closely related to the yellowness, percent chalky kernels, alkali spreading value, cooking time, milling recovery, percent weight increase, and fat acidity value. The most discriminating of these was the yellowness. Changes in this value therefore provide a simple and objective means of monitoring changes in consumer acceptance of stored rice.

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