EATING QUALITY OF PROMISING RICE VARIETIES EVALUATED AT SEVERAL LOCATIONS IN PAPUA NEW GUINEA

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ABSTRACT

Consumer acceptability assessment of rice varieties in different locations in PNG showed significant differences in the taste preferences for eight rice varieties (1-5 scale; 1-worst score, 5-best score). Commercially available 'Trukai' rice was the most preferred in almost all locations, with a mean score of 4.23. NR 1 (3.97) had good eating quality comparable with Trukai. Varieties NR 16 (3.75), FB-91 (3.67) and N6-94 (3.47) were moderately preferred while preference for NR 2, NR 4 and NR 15 was significantly lower. Significant differences were also observed between sites and in the variety x site interaction. Mean scores showed that consumers at Ramu (3.83) liked rice more than the other site tested, while those at Bogia (3.26) and Balama (3.28) gave the lowest mean scores. The variety x site interaction shows that the order of preference of rice varieties differed significantly between test sites, indicating that there are site-specific differences in consumer preference for rice varieties.

Keywords: *Consumes acceptability, rice varieties, eating quality, Oryza sativa (L.).*

INTRODUCTION

Rice *(Oryza sativa L.)* has become an accepted food staple and a preferred component of the diet of many people in Papua New Guinea (PNG). Rice consumption rose from very low levels to 30.4kg per person per year in 2000 (Gibson 2001a). On a per capita basis, consumption is either relatively stable or declining but has been maintained by introduction of a new and cheaper brand sold as 'Roots Rice' (Gibson 2001b). The yield of some of the varieties presently cultivated appears to be low. Their quality is also said to be inferior compared to 'Trukai', which is the preferred imported blend of several varieties (Amoa *et al.* 1996).

The National Agricultural Research Institute (NARI) has been screening several promising rice varieties at several locations to identify and recommend superior, ecosystems-oriented and high-yielding varieties possessing good eating quality traits. New rice varieties need evaluation for consumer acceptability, sensory characteristics, specific end uses and preferred physico-chemical traits. Past research and development efforts placed little attention on incorporating these factors in the rice breeding and selection work.

Acquired tastes for certain types of rice may differ from one area to another due to differences in social structure, economic status and cultural traditions. Therefore, site-specific taste panels composed of judges from the seven areas listed in (Table 1) were conducted. Details of these sites can be obtained from (Hanson *et al.* 2001). The work of (Amoa *et al.* 1995) on three modern rice varieties, Wantok, Niupela and Taichung Sen 10 (TCS 10), was the first reported eating quality assessment of rice varieties in PNG.

Table 1. **Details of multi-location consumer preference tasting trials**

Site No.	Name of site	Local Level Government	District	Province	Date of trial	Number of tasters
1	Wareo	Kote	Finschhafen	Morobe	30/05/02	42
2	Usino	Igoi Sop	Usino Bundi	Madang	20/08/02	66
3	Balama	South Ambenob	Madang	Madang	23/08/02	70
4	Bogia	Bogia Coastal	Bogia	Madang	30/08/02	64
5	Ramu	Ramu	Upper Ramu	Madang	13/09/02	60
6	Intoap	Umi Atzera	Kaiapit	Morobe	18/09/02	29
7	Garaina	Garaina	Bulolo	Morobe	01/12/02	48

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The objectives of the current study were to identify locally adapted rice varieties with good eating quality, as well as to see if there were differences from one location to another in consumer preferences.

MATERIALS AND METHODS

Sample preparation

Milled samples of pure rice varieties from the NARI farm at Bubia were used in the tests. The varieties studied were NR 1 (IR-19661-23-3-2-2), NR 2 (Ayung), NR 4 (BG 379-2), NR 15 (Salumpikit), NR 16 (Azucena), N6-94 (Niupela 1994, line 6) and FB-91 (Finschhafen Brown 91). Trukai blend was purchased from shops and used as the standard. Unless specified, all experimental procedures for sample preparation and sensory evaluation were standardized at each location. Samples were pre-soaked for 10 minutes in excess water, drained and cooked in electric rice cookers following the method used by (Myklestad *et al.* 1968). In Garaina and Wareo, where electricity was unavailable, ordinary cooking pots were used. In all sites, the ratio of rice to water was the same (ie 1 cup rice: 2 cups water). Cooking was done with no added salt or other ingredients. Cooked samples were left to "steam off" for 15 minutes before being placed into bowls covered with aluminum foil. Each sample was labeled using unidentifiable code names.

Sensory evaluation

Sensory evaluations were conducted in open air spaces, resembling typical village settings in PNG. Both males and females ranging from 25-40 years old were selected as tasters. Each taster received a dessertspoonful of the samples, served warm on paper plates. Each plate was divided and labelled accordingly to accommodate four samples at any one time.

The order in which the varieties were evaluated was the same for each panelist (Durbin 1951). Scoring was done only once using a Hedonic scale (5=like extremely, best score; 1=dislike extremely, worst score) following the methods used by (Myklestad *et al.* 1968, Lamond 1977 and Amoa *et al. 1995*).

Data analysis

Acceptability scores at each site were analysed using panelists as replicates to compare varieties within sites. An analysis of the variety means from each site was also carried out, using sites as replicates to provide an overall perspective. Where varieties were missing at some sites, estimated values were calculated. Site by variety interactions were tested following the method of "Restricted Maximum Likelihood" (REML), a modelling-based procedure in GenStat.

RESULTS

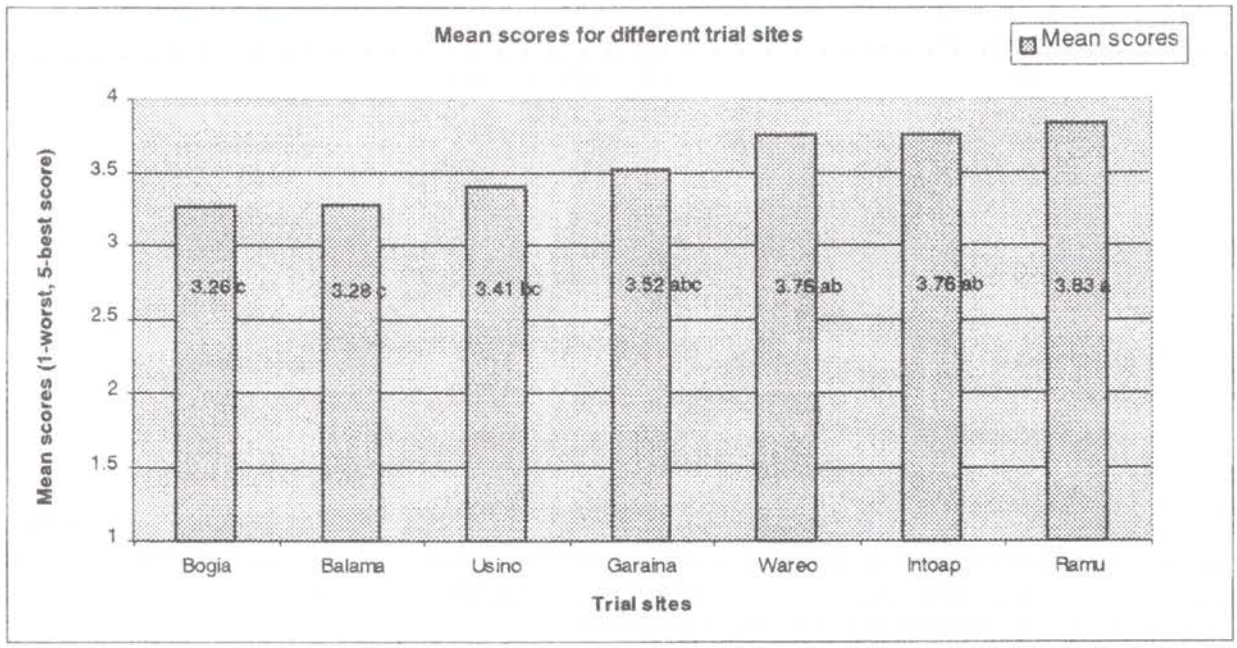
Site-specific consumer preference trials conducted in these sites showed significant differences in taste preferences for the rice varieties (Table 2). Overall, Trukai came out as the most preferred variety with a mean score of 4.23, but NR 1 was close behind with a score of 3.97, not significantly different to Trukai. At three sites, Usino, Bogia and Garaina, Trukai was significantly better than NR 1. In all other sites, no significant differences were observed between NR 1 and Trukai. NR 16 was the next most preferred, scoring highly at Ramu and Intoap. FB-91 was the most preferred variety at Ramu and also scored well at Wareo, where it is the variety grown traditionally by the farmers. Varieties NR 2, NR 4 and NR 15 gave consistently low scores at all sites.

Table 2. Mean scores for taste preference of different rice varieties

Rice variety	Mean scores for taste preferences at different sites							
	Garaina	Wareo	Usino	Balama	Bogia	Ramu	Intoap	Variety Mean
NR 1	3.66 b^{+}	4.10 a^{+}	3.98 b^{+}	3.89 a^{+}	3.89 b^{+}	4.10 ab^{+}	4.14 ab^{+}	3.97 ab^{+}
NR 2	2.87 d	2.98 c	2.97 de	2.79 e	3.09 de	3.68 bcd	3.17 cd	3.08 d
NR 4	3.68 b	3.58 ab	2.78 e	2.89 de	2.25 f	3.42 cde	3.35 cd	3.14 d
NR 15	3.02 cd	3.79 ab	2.76 e	2.94 de	2.86 e	3.17 e	2.93 d	3.07 d
NR 16	3.53 bc	na	3.32 cd	3.31 cd	3.42 cd	4.27 a	4.41 a	3.75 bc
N6-94	2.70 d	na	3.41 c	3.40 bc	3.16 de	na	4.17 ab	3.47 cd
FB-91	3.98 b	3.98 ab	3.14 cde	3.26 cd	3.67 bc	4.40 a	3.72 bc	3.67 bc
Trukai	4.68 a	4.02 ab	4.89 a	3.77 ab	4.56 a	3.83 bc	4.66 a	4.23 a

$^{+}$Mean scores in a column followed by the same letter are not significantly different ($p \leq 0.05$)
na = not assessed

Figure 1. **Graph showing mean scores for different experimental sites**



Average scores for acceptability for rice varieties differed from one location to another (Figure 1). Consumers at Bogia and Balama in the Madang Province gave rice lower mean scores than consumers at the other sites. The mean score for Ramu was higher than at any other site tested, though similar to Wareo and Intoap.

Based on the REML analysis, significant interactions between sites and varieties were observed. Trukai rice scored highest at four sites, NR 1 at two sites and FB-91 at one site. The lowest score was given to NR 15 (3 sites), NR 2 (2 sites), NR 4 (1 site) and N6-94 (1 site).

DISCUSSION

The results of eating quality assessment of rice varieties confirm that taste preference for different rice varieties exist and does vary from one site to another. These differences could be due to cultural differences, social structure, economic levels and distinct geographic environments in these communities. Not all varieties were tested at each site, giving an 'unbalanced' design for evaluating site x variety interactions. This was approximated by employing the chi-square distribution for Wald's test using the REML method. Differences in scores at different sites could also be due to use of different samples at different sites.

Lower mean preference scores at Bogia, Balama and Usino could be attributed to the fact that rice is a new food crop in these areas. At Wareo in the Finschhafen district, rice has been grown for well over a century so the taste has been acquired, giving a higher mean score. Consumers at Ramu liked rice more than at any other site, maybe because they consume rice more often due to their close proximity to commercial outlets.

In these rural settings, ideal laboratory conditions could not be employed and this may have affected the results. Logistical constraints meant that the order in which the rice varieties were tasted had to be the same for each panelist. This could have led to a certain amount of bias in the results. Scoring for a particular sample could have been influenced, depending on whether the previous sample was liked or disliked. The use of cooking pots rather than rice cookers at Garaina and Wareo could also have affected the results.

Results also show that traditional landrace varieties and newly introduced, modern lines in PNG generally have less preferred eating quality compared to Trukai (Amoa *et al.* 1996). Trukai has been widely accepted in the PNG market since 1970. Since Trukai is a blend of several varieties, people have become habituated to it. It is used as a yardstick to measure other varieties and pure varieties may be at a disadvantage in assessment of eating quality compared with Trukai. The results also indicate that consumers at Wareo in the Finschhafen district have acquired a taste for FB-91. This rice is a traditional landrace variety that has been cultivated for more than a century. This suggests that consumers can acquire a taste preference for certain types of rice over time.

Taste preference scores for NR 1, NR 16, FB-91 and N6-94 (an improved line of Niupela) were promising (3.5 and above) and indicate high consumer acceptability. These findings support the work of previous researchers including Sajjad (1995) and (Amoa *et al.* 1995). NR 1 has been commercialised in the last few years by Trukai Industries Limited and is widely consumed by the local population as a component of a blend called 'Roots Rice'. On the other hand, N6-94 is an agronomically promising variety for upland cultivation (Wohuinangu and Sajjad 1992) and has acceptable eating quality. NR 16 has good eating quality, although scoring lower than NR 1 in most locations. Low preference scores for NR 2, 4 and 15 indicate that consumers may not accept these varieties. It should also be noted, however, that these varieties were not strongly disliked. Some adaptation of cooking methods to meet the needs of specific varieties may increase their acceptability. Future research may need to evaluate grain quality characteristics with a view to improving the eating quality of these varieties.

Variety selection and recommendation for PNG should incorporate eating quality results alongside other parameters such as yield, suitability for mechanization, adaptability to different soils, and pest and disease resistance. In future, similar work should cover other areas of the country to generate site-specific data on preferences for new rice varieties.

CONCLUSION

Trukai rice scored consistently well in all locations, while significant differences were observed among pure lines. Variety NR 1 had good eating quality for consumer acceptability comparable with Trukai, scoring well in almost all sites. Other varieties that scored well were NR 16, FB-91 and N6-94 while taste preference scores for NR 2, 4 and 15 were significantly lower. Maybe adaptation of cooking methods may improve their acceptability scores in taste tests. Acceptability of rice differed from one location to another with consumers at Ramu, Intoap, Wareo and Garaina scoring rice more highly than at all other sites.

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