Relationship between yellow alkaline noodle quality and flour properties in Japanese hard wheat

Fujita M[1,2], Seki M[2], Matsunaka H[2], Kiribuchi-Otobe C[2], Hiwatashi A[3], Okumoto Y[4], Kitano J[5], Kanda Y[5], Miyamoto K[5]

[1]National Agricultural Research Center for Kyushu Okinawa Region, 496 Izumi Chikugo Fukuoka 833-0041, Japan, [2]Natl. Inst. of Crop Sci., [3]Toyo Suisan Kaisha Ltd. [4]Graduate School of Agric. Kyoto Univ., [5]Mie Pref. Agric. Res. Inst.

INTRODUCTION

In Japan, most of the wheat available is of the soft variety, which is mainly used for making Japanese noodles. Recently, however, there has been a strong consumer demand for yellow alkaline noodles (YAN) and bread made from Japanese wheat. These products are commonly made from hard wheat; therefore, we have started breeding hard wheat varieties that are adapted to the climate of Japan. In this study, YAN made from various hard wheat varieties and breeding lines in Japan was evaluated by sensory assessment, and the effects of seed color, protein content, amylose content, and dough properties on YAN quality were investigated.

MATERIALS AND METHODS

We used 20 Japanese wheat samples comprising 9 wheat varieties and breeding lines (shown in Table 1) grown at 2 different sites (Ibaraki and Mie) from the 2003–2004 and/or 2004–2005 seasons. Australian prime hard wheat (PH) was used as a reference. High molecular weight glutenin (HMWG) subunits were determined by the electrophoresis pattern based on SDS-PAGE (Nagamine *et al.* 2000).

Table 1 Wheat varieties and lines used in this study

Varieties and lines	Glu-A1 (subunit)	Glu-B1 (subunit)	Glu-D1 (subunit)	Amylose type	Grain color
Tamaizumi	c (null)	a (7)	f (2.2 + 12)	normal	white
Kanto 128	b (2*)	b (7 + 8)	f (2.2 + 12)	slightly low	red
Kanto 130	c (null)	c (7 + 9)	d (5 + 10)	normal	red
Kanto 134	b (2*)	c (7 + 9)	d (5 + 10)	low	white
Tanikei RA4960	b (2*)	b (7 + 8)	d (5 + 10)	low	red
Nishinokaori	c (null)	b (7 + 8)	a (2 + 12)	normal	red
Tozan 40	c (null)	c (7 + 9)	d (5 + 10)	slightly low	red
Tanikei RA4959-2-1	c (null)	b (7 + 8)	f (2.2 + 12)	low	red
Tanikei RA4959-2-2	b (2*)	c (7 + 9)	d (5 + 10)	low	red
PH	unknown	unknown	unknown	normal	white

Wheat samples were milled to 60% extraction with a Buhler test mill. The protein content of the flour was measured by rapidN (Elementar). The apparent amylose content of the flour was calorimetrically determined using a Technicon Autoanalyzer. The farinograph characteristics (development time (DT) and valorimeter value (VV)) were measured with a 50 g bowl by the AACC method.

YAN was prepared on the basis of a Japanese method. The ingredients—flour (100 g), salt (1 g), *kansui* (made from phosphoric salt, 1.3 g), trehalose (1 g), 59% ethanol (3 ml), and water (33 ml)—were mixed with a mixer. After mixing, the crumbly dough was sheeted 5 times through rolls to a final thickness of 1.4 mm. The sheets were cut into noodle strips and were stored at 10°C for 24 h. The commercial flour for YAN was used as a standard. The noodles were boiled for 2 min.

Trained panelists performed a sensory evaluation of the color and texture of the noodles; color, spot, and eating quality (hardness, elasticity, and smoothness) of the noodles at 0 and 8 min after cooking were scored on a scale of 1 to 10. A larger score is considered to reflect a better quality, and the standard score is 7. The total eating quality was the sum of each eating quality score.

RESULTS AND DISCUSSION

The HMWG subunits, amylose type, and grain color of the wheat varieties used in this study are shown in Table 1. The coefficient of correlation among the flour properties and noodle quality was calculated. The main calculated results are shown in Table 2.

Table 2 Coefficient of correlation among certain flour properties and noodle quality

		Protein content	Amylose content	Farinogram	
				DT	VV
	Farinogram DT	0.766**	–0.255		
	Farinogram VV	0.814**	–0.258	0.963**	
noodle	Smoothness immediately after cooking	0.265	–0.477*	0.228	0.239
noodle	Hardness at 8 min after cooking	0.473*	0.014	0.519*	0.614**
noodle	Elasticity at 8 min after cooking	0.566**	–0.317	0.536**	0.638**
noodle	Total eating quality	0.502*	–0.094	0.576**	0.665**

* and ** indicate significance levels at 5% and 1%, respectively.

The protein content of the flour ranged from 8.1% to 12.5%, and was lower than that of PH (13.5%). The noodle color highly correlated with the protein content (r = –0.653**) and spots in the noodles (r = 0.878**). The color of the noodles made from white seed varieties was superior to that of noodles made from red seed varieties (Figure 1). Spots are considered to be microscopic bran in the flour; thus, seed color is one of the important factors for determining YAN quality. However, white seed varieties are commonly susceptible to pre-harvest sprouting. In Japan, wheat is harvested at the beginning of the rainy season. Thus, breeding for tolerance to pre-harvest sprouting is important. “Tamaizumi” is the only commercial white seed variety available in Japan.

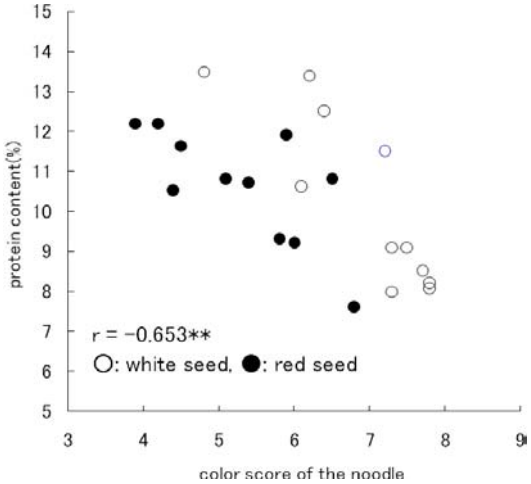

Figure 1 Relationship between noodle color and protein content

The amylose content of the flour ranged from 19.0% to 30.4%, and was related to the smoothness of the noodles immediately after boiling (r = –0.477*, Table 2). The texture of noodles made from low-amylose content flour was very smooth. In the case of Japanese noodles, the amylose content of the flour is also related to the smoothness and elasticity of the noodles. Thus, a considerable number of low-amylose content wheat varieties for making Japanese noodles were released in Japan recently. Tanaka *et al.* (2006) also reported that YAN made from low-amylose content wheat is very smooth compared to the normal amylose content wheat. This texture is useful from the viewpoint of new YAN products.

The hardness, elasticity, and total eating quality of noodles at 8 min after cooking, which were important determinants of YAN quality, were highly correlated with the protein content, farinogram DT, and VV (Table 2). Compared with PH, the dough properties of most of the tested flour were weak (Figure 2). Many of Japanese soft noodle wheat varieties have a null HMWG subunit at the *Glu-A1* allele and 2.2 + 12 at the *Glu-D1* allele (Nakamura 1999), which are related to weak dough properties (Takata *et al.* 2000). Some of the Japanese hard wheat varieties have one or both these HMWG subunits (Table 1). Because Japanese soft noodle wheat varieties are currently used as one of the cross-parents for hard wheat breeding. These results indicated that the YAN quality in the case of Japanese hard wheat varieties can be improved by genetically introducing HMWG subunits that effectively strengthen the dough property (e.g., 5 + 10 subunit).

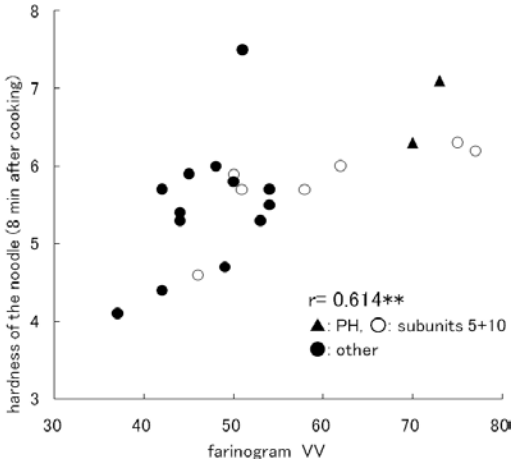

Figure 2 Relationship between farinogram VV and hardness of the noodle

ACKNOWLEDGEMENT

This research was supported by the Research Project for Utilizing Advanced Technologies in Agriculture, Forestry and Fisheries, MAFF.

REFERENCES

Nagamine, T. *et al.* (2000) Allelic variation at the *Glu-1* and *Glu-3* loci in southern Japanese wheats, and its effects on gluten properties. J. of Cereal Sci. 32:129–135

Nakamura, H. (1999) Identification of alleles for complex gene loci, *Glu-A1*, *Glu-B1* and *Glu-D1* which code for high-molecular-weight subunits of glutenin in Japanese hexaploid wheat varieties. J. of Agric. and Food Chem. 47(12)：5273–5277.

Takata, K. *et al*. (2000) Effect of high molecular weight glutenin subunits on bread-making quality using near-isogenic lines. Breeding Science 50:303–308.

Tanaka, Y. *et al.* (2006) Physical properties of yellow alkaline noodles from near-isogenic wheat lines with different Wx protein deficiency. Starch 58:186–195.