A Method of Flour Quality Assessment for Japanese Noodles

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ABSTRACT

The relationships between amylogram values of starches, amylose content of flours, and eating qualities of Japanese noodles (udon) made from the flours were studied for 13 market classes of wheat. Results showed that amylogram values, amylose content, and eating qualities evaluated by a scoring method correlated well, and that Norin No. 61 (a Japanese domestic wheat) and Australian standard wheats gave a similar and suitable quality to Japanese noodles.

Many studies of Japanese noodles (udon) have concerned the physical and chemical characterization of wheat flours used to manufacture them (Bean et al 1974, Shimizu et al 1958), but very little information is available about the simple and reliable assessment of the flour quality needed for Japanese noodles.

Flour, the raw material of Japanese noodles, has traditionally been evaluated by its physical characteristics during noodle processing and particularly by the eating quality of the cooked noodle (Nagao et al 1976, Shibata 1976). Eating quality has been assessed by many panels, but this laborious and time-consuming procedure still involves some uncertainty and low reproducibility because of the individual preferences among panel members. Development of a method that enables the eating quality of noodles to be evaluated without processing the flour is highly desirable. Correlations between amylogram values of the starch, amylose content of the flour, and eating quality of Japanese noodles prepared from a wide selection of market classes of wheat are reported in this study.

MATERIALS AND METHODS

Thirteen market classes of commercial wheat were used in this investigation. These were No. 1 Canada western red spring, dark northern spring, dark hard winter high protein, dark hard winter, hard winter ordinary, western white, soft red winter, U.S. durum, Australian prime hard Queensland, Australian standard white New South Wales, Australian standard white Victoria, Australian standard white West Australia, and Japanese domestic wheat Norin No. 61. They were milled to 60% extraction in a Buhler laboratory mill.

Separation of Starch

One-hundred grams of flour and 60 ml of water were mixed by hand to prepare a dough ball. After the dough ball was left in water for 1 hr at 25°C, starch was washed from the dough with 2 L of cold water (25°C). The starch slurry was passed through a 100-mesh nylon bolting cloth to remove particles of bran and gluten, and then this starch milk was diluted with water to 5 L. The starch was allowed to settle in a beaker for 3 hr. The supernatant was discarded by suction, and the starch slurry was filtered by Buchner funnel with filter paper (TOYO No. 2). The starch cake on the paper was air dried, ground, and passed through a 30-mesh sieve. Moisture content of the starch samples varied from 13 to 19%.

Amylose Determination

The amylose content of the flour was determined colorimetrically with iodine by a simplified procedure of Juliano (1971), originally developed for rice flour.

Gelatinization Curve

Starch gelatinization curves were obtained with an amylograph, using the following method. A starch-water suspension was made with 45 g of starch (dry basis) and 450 ml of water. The temperature was raised from 30 to 94.5°C, held at 94.5°C for 10 min, and cooled to 80°C at a rate of 1.5°C per min. A typical amylogram is shown in Fig. 1. Values for T (time to peak height of curve) and D (difference between peak viscosity and viscosity after holding at 94.5°C for 10 min) were recorded.

Noodle (Udon) Preparation and Eating Quality Test

Three-hundred grams of flour and 102 g of salted water containing 6 g of salt were mixed in a Hobart mixer for 5 min. The stiff, crumbly dough was sheeted through a Japanese noodle testing machine furnished with sheeting and cutting rolls (Nagao et al 1976). The dough sheet was folded and again put through the sheeting rolls to combine the two layers. The sheet was then put through the sheeting rolls at closer roll settings two or three times in order to adjust the thickness of the sheet. Finally the sheet was cut through cutting rolls (No. 12) into strips approximately 30 cm in length with a 0.20 × 0.25-cm cross section. One-hundred grams of wet noodle strips were cooked in 1 L of boiling water for 15 min and then rinsed with cold water.

Eating quality (which consisted of feeling the smoothness,

TABLE I
Values of Starch, Flour, and Noodles

Wheat Sample[a]	Starch Amylogram Values		Flour Content[d]		
	D[b] (BU)	T[c] (min)	Protein[e] (%)	Amylose (% ± SD)[f]	Noodle Eating Quality[g]
1CW	60	46.0	12.9	24.5 ± 0.23	−1.42
DNS	100	43.8	13.3	24.9 ± 0.24	−0.58
HP	80	45.6	11.7	24.5 ± 0.31	−1.42
DHW	70	45.1	10.4	25.0 ± 0.39	−1.25
HWO	20	44.5	9.2	···	−0.75
QLD	105	43.5	13.0	···	+0.08
ASW-NSW	135	43.8	9.4	···	+0.25
ASW-VIC	145	42.8	8.2	···	+0.08
ASW-WA	200	41.3	8.5	21.9 ± 0.25	+0.67
WW	90	44.1	7.7	23.9 ± 0.18	−0.75
SRW	70	44.4	8.5	···	−0.92
Durum	30	47.2	13.2	25.0 ± 0.15	−1.58
JDW	160	43.5	9.0	23.8 ± 0.15	0

[a] 1CW = Canada western red spring, DNS = dark northern spring, HP = dark hard winter high protein, DHW = dark hard winter, HWO = hard winter ordinary, QLD = Australian prime hard Queensland, ASW = Australian standard white, NSW = New South Wales, VIC = Victoria, WA = West Australia, WW = western white, SRW = soft red winter, Durum = U.S. durum, JDW = Japanese domestic Norin No. 61.
[b] D = Difference between peak viscosity and viscosity after holding at 94.5°C for 10 min.
[c] T = Time to peak height of curve.
[d] 60% extraction.
[e] N × 5.7.
[f] Standard deviation (n = 6).
[g] +3 = most preferred, −3 = least preferred.

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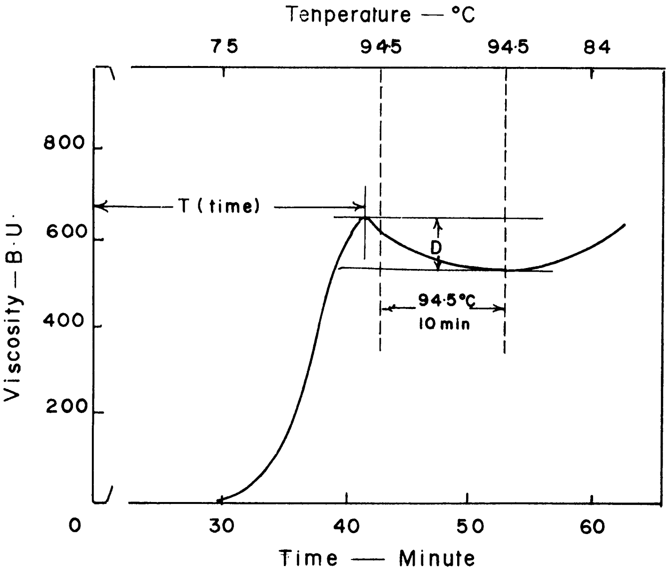

Fig. 1. Illustration of measurements taken from a typical amylograph chart. T = time (min) to peak height of the curve, D = difference (BU) between peak viscosity and viscosity after holding at 94.5°C for 10 min.

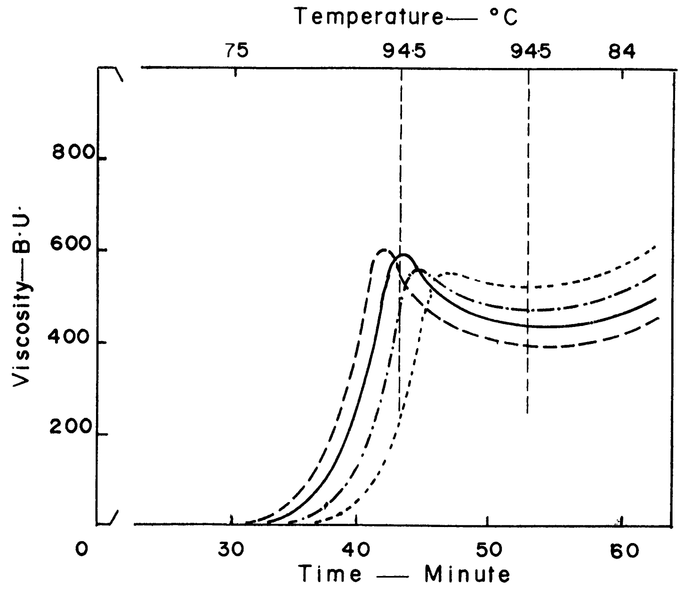

Fig. 2. Selected charts of amylograms. —— = Japanese domestic wheat Norin No. 61, --- = Australian standard white West Australia, —·—·— = western white, ------ = U.S. durum.

TABLE II
Correlation Coefficients Among Variables

	Starch Amylogram Values		Flour Content	
	D[a]	T[b]	Amylose	Protein
T	−0.839**[c]	···	···	···
Amylose content	−0.870**	+0.825*[d]	···	···
Protein content	−0.406	+0.556*	+0.686	···
Eating quality	0.851**	−0.844**	−0.854**	−0.448

[a] D = Difference between peak viscosity (BU) and viscosity after holding at 94.5°C for 10 min.
[b] T = Time (min) to peak height of curve.
[c] ** = Significant at 1% level.
[d] * = Significant at 5% level.

softness, and tenderness during mastication) was determined by a panel of 12 members, who ate the cooked noodles with a soy-sauce soup. Scoring of the cooked noodles was done by the following scale: +3, most preferred; +2, moderately more preferred; +1, slightly more preferred; 0, equal to the control; −1, slightly less preferred; −2, moderately less preferred; and −3, least preferred.

RESULTS AND DISCUSSION

Eating quality scores of udon made from the various flours used in this study, amylose and protein contents of these flours, and amylogram values T and D of starches extracted from them are summarized in Table I.

Flour slurries (51 g of flour, dry basis, per 450 ml of water) containing an amylase inhibitor (0.01% $HgCl_2$) were also subjected to amylograph evaluation, but amylograms of these flours did not correlate with the eating quality of noodles prepared from the flours.

In evaluating the eating quality, Japanese domestic wheat Norin No. 61 was used as the control because this wheat is generally known in Japan as one of the most preferred wheats for Japanese noodle products. Each eating quality score was the average of 12 evaluations.

The amylograms of some wheat starches used in this study are shown in Fig. 2. Medcalf and Gilles (1965) reported that the amylograms of starches from various U.S. wheat varieties were different. We also observed a similar tendency.

The data presented in Table I show that differences exist between the wheat varieties investigated. Correlation coefficients among variables studied are shown in Table II. Correlation coefficients were high among amylogram values, amylose content, and eating qualities, but protein was poorly correlated with eating quality. Therefore, a high value of D, and low values of T and amylose content relate well to the eating quality of Japanese noodles.

These results show that Australian standard wheats have good quality characteristics for the preparation of Japanese noodles and that durum wheat does not produce acceptable noodles. This is because of the difference in masticatory feeling between udon and spaghetti; softness, smoothness, and some degree of sticky feeling is desirable in udon, but a hard, elastic, and chewy feeling is more desirable in spaghetti.

Correlation of eating quality with amylogram value and amylose content seems reasonable; we suggest that the quality characteristics of the starch, which is the major component of flour, are very important to the eating quality of Japanese noodles. From the data obtained, the physical and chemical characteristics of wheat flour appear useful in assessing flour quality for use in Japanese noodles.

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