Milling Flour for Asian Products

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ABSTRACT

Asia represents one of the largest and most diversified markets for wheat products. These products require flour that meets certain specifications in terms of both processing and end-product quality. The long-standing prevalence of end products such as noodles, steamed buns, and dumplings relates to their deep roots as traditional foods of choice in most parts of Asia. In recent years, products that have long been popular in Western countries have made inroads in Asia, gaining in popularity along with rapid growth in the hospitality industry, expanding fast-food franchises, and changing lifestyles. Products such as sandwich bread, rolls, baguettes, croissants, and sweet goods are also becoming popular wheat-based products. Asian products that were historically enjoyed in limited geographic regions have seen their popularity grow beyond regional borders over the years, through travel, migration, and globalization; for example, instant noodles are now enjoyed by consumers worldwide due to their ease of preparation, flavor, and long shelf life. From the perspective of milling suitable flours for this diverse range of products, there are a variety of flour types that are produced to cater to the individual needs of specific end users. This is reflected in the large number of different types of flours produced by individual flour mills, which can easily exceed 100 types, depending on the range of end products.

Consumer preferences for any food product are highly influenced by sensory attributes, convenience, and cost. In recent times, a stronger emphasis on healthy dietary choices has also played an increasingly important role. Of these factors, sensory attributes continue to play the most significant role in the Asian market. Within each product type (e.g., noodles), there are a number of different subtypes among which sensory attributes can vary considerably. Typically, end users provide millers with flour specifications for each product that will best suit their processing environment. Millers must then blend various types of wheat and employ appropriate processing techniques to meet the required quality specifications at a reasonable cost. These steps are described below.

Flour Quality Requirements

Noodles. There are many different types of noodles produced in Asia, with varying characteristics to meet their processing and end-quality requirements. Although noodles began as a relatively simple product at the time of their origins in China (1), they now demonstrate extensive variation. The diversity that exists among flour quality requirements can be observed by reviewing some basic representative quality specifications for various markets:

Japan

Yellow alkaline noodles (ramen): Flour ash 0.33–0.37%; protein 11.0–11.5% (8)

White salted noodles (udon): Flour ash 0.34–0.42%; protein 7.0–9.0% (8)

Korea

Fresh noodles: Flour ash <0.38%; protein 8.0–9.0%

Instant noodles: Flour ash 0.40–0.45%; protein 10.0–11.0%

Indonesia

High-end wet noodles: Flour ash 0.38–0.42%; protein 9.2–9.7%

Malaysia

Wanton noodles (raw): Flour ash 0.48–0.53%; protein 12.0–13.0%

Hokkien noodles: Flour ash 0.48–0.52%; protein 9.5–10.5%

Thailand

Alkaline noodles: Flour ash 0.42–0.47%; protein 12.4–13.0%

Dried noodles: Flour ash 0.47–0.50%; protein 12.8–13.2%

Steamed Bread. Wheat for steamed breads is also subject to considerable regional variation within Asia. Representative regional differences include the following:

China (Northern): In Northern China, a heavy, dense, chewy crumb structure is prevalent and so works well with available higher protein wheat that has relatively stronger dough properties and a higher flour extraction rate. Flour protein is 11% or higher.

China (Southern): In Southern China, a flour protein of around 10% with a medium dough strength works well.

China (Cantonese): High-quality flour with a short extraction rate (patent), bright white color, and lower protein content of 8.0–9.0% is used. These flours are also produced in countries such as Thailand and Malaysia using a blend of medium and soft wheats with short extraction rates, and this fraction often is pin-milled and air-classified to produce low-protein, fine white flour.

Malaysia: Steamed bread flour: Flour ash 0.48%; protein 8.5–9.5%.

Thailand: Steamed bread flour: Flour ash 0.42%; protein 8.0%.

Philippines: Very short extraction flour of about 3.0–5.0% is produced from a blend of hard wheat for localized steamed bread that typically has a savory filling—referred to as *siopao*. The ash content is 0.40 or less. The balance of the flour produced is used in baking applications. *Siopao* is reported to be a Philippine adaptation of the Cantonese *char siu bao* dumpling (5).

Dumplings. The flour protein requirement for dumplings is around 10.0%, and the flour is often produced as a patent flour. High hot-paste viscosity is desired to impart a soft elastic texture and eating quality. Patent flour extraction with minimal bran specks and bright color and extensible gluten quality for handling and processing is desirable.

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Baked products. General flour specifications for bread flour with respect to ash content ranges from 0.42 to 0.53%; protein content ranges from 12.0 to 13.0%; and there is much less relative emphasis on specks because they are not as conspicuous in baked products as they are in thin strands of noodles.

Milling Operation

To observe the flour specifications for various high-end noodles and steamed breads, most flour types generally require a low ash content and bright flour color, with minimal or no bran specks. Production of desirable bran-free flour requires attention to detail in every aspect of the milling operation, including: selection and blending of wheat; good cleaning; tempering; milling process; stream selection and flour grades; and flour treatment.

Selection and Blending of Wheat Based on Quality Requirements

Because flour mills are engaged in producing a large number of flours with varying specifications, it is common practice to utilize a number of wheat types to provide a wide spectrum of quality attributes to allow millers to produce a variety of flour types. Wheat blending provides the following benefits to millers:

- Flexibility in producing flour types of varying quality.
- Mitigating availability issues due to lack of supply (e.g., crop conditions, logistics)—a factor that is particularly important in markets where flour additives are not permitted to compensate for deficiencies in the quality of the wheat blend.
- Blending to meet quality specifications and reduce the cost of the wheat mix.

Appropriate selection of wheats and their judicious blending has a significant influence on the resulting flour quality. Furthermore, the opportunity for cost optimization offers tremendous potential benefits, particularly when considering the fact that the cost of wheat constitutes the largest single cost component of flour production. Before blending of wheat types can be determined, it is essential to know the quality of flour required for the principal products that are to be produced.

Wheat quality. The quality of wheat is a function of its variety (genetics) and environment. High milling-quality wheat naturally produces high yields of white flour, both in terms of quantity and quality. Environment plays an important role as well, with its impact manifesting in a number of ways, such as lower test weight and kernel weight, disease and weather related damage (e.g., higher levels of immature kernels, sprout damage, and midge damage) (2). High sprout damage results in higher levels of α-amylase activity that can impact noodle quality by promoting increased discoloration and weaken starch gel strength. All of the above factors contribute to increased levels of specks in milled flour.

The first step in the production of high-quality flour is to begin with high-grade wheat that has the required functional properties. Using higher grades of wheat restricts or eliminates damaged and diseased wheat kernels by grade definition, helping to produce higher flour yields with lower ash content.

Asian mills rely on a supply of high-quality wheat of higher grades from Canada, the United States, and Australia. Medium-quality filler wheats from the Black Sea and other areas are also being used in Southeast Asia.

The following quality attributes are considered key factors in the selection of wheat for milling:

- Protein content and quality
- Starch properties (soft and elastic texture)
- Milling properties (high flour yield at low ash and bright color)

Protein Content and Quality. Protein content is critical in attaining the desired level of firmness in noodles specific to their expected range and also contributes to maintaining noodle integrity. For example, Japanese white salted noodles (udon) are characterized by their softer elastic texture; thus, lower protein, soft to medium hard wheat blends with suitable starch properties are used (4). On the other hand, for yellow alkaline noodles (ramen), higher protein, hard wheat blends are used to provide a firm texture and texture retention in hot broth and soup.

Protein quality is an essential requirement to provide desired dough-handling behavior during processing. In noodle processing, good sheeting properties are important because dough is sheeted through sequential rolls. Doughs using a hard wheat mix should not be too stiff, causing tearing, while softer doughs should not be too sticky. An appropriate balance specific to each noodle type is a desirable processing value, and this balance is required at a dough water absorption of ~32–34%. Rheological properties, as measured in bread doughs, may only be used to obtain some indication of dough handling in the absence of any appropriate estimation, because these tests are carried out using double the percentage of water. As a result, rheological measurements may not be reliable metrics.

Starch Properties. Starch properties are an important focus in wheat selection for most noodle flour production because these properties influence noodle texture. Gelatinized starch plays an important role in noodles with respect to enhancing elastic texture. High hot-paste viscosity, as measured by a rapid visco analyzer, or peak viscosity, as measured by an amylograph, is expected to be high in noodle flours. This is particularly ap-

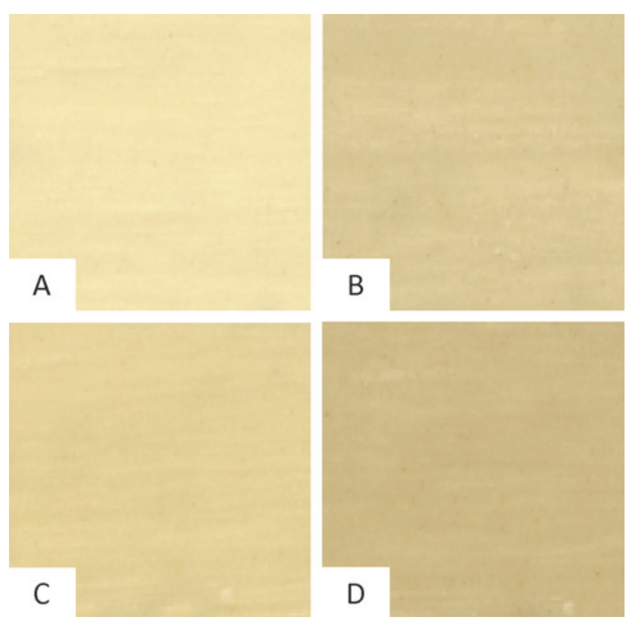

Fig. 1. Impact of time on noodle appearance. Noodle dough sheet from flour 1 after 3 and 24 hr (**A** and **B**, respectively), and noodle dough sheet from flour 2 after 3 and 24 hr (**C** and **D**, respectively).

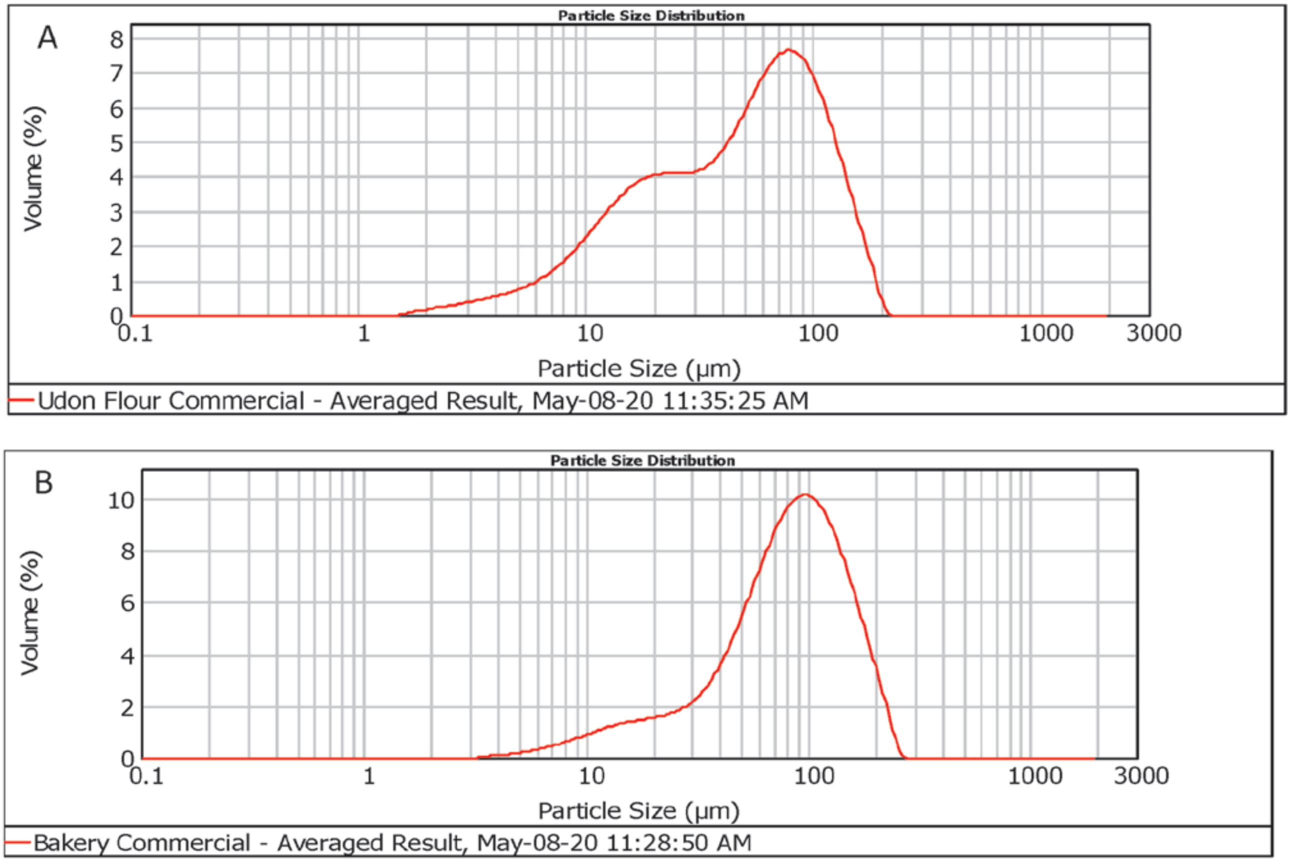

Fig. 2. Particle size distribution of commercial flours. **A,** Udon flour from North Asia; **B,** bakery flour from North America.

plicable for white salted noodles to ensure a soft elastic texture is obtained, as is preferred in Japan (8).

Milling properties. One of the primary milling quality requirements for most Asian products is to produce refined white flour of brighter color, low ash content, and free of bran specks.

Bran specks show up easily in a noodle dough sheet, and this is progressively enhanced over time. Higher extraction flour (dull color), as well as flour made from sprout-damaged wheat, tends to be seriously affected in this respect (6). There is also a preference for good color stability, meaning that the color degrades very gradually over time. Some varieties of wheat are more susceptible to such color degradation (Fig. 1), as well as flour with higher extraction levels (6). This is particularly undesirable for uncooked (fresh) noodles.

Fine flour particle size is desired because finer flour appears brighter, and this is reflected in noodle brightness. Fine flour particle size also aids in rapid and uniform hydration, which assists in improved processing of noodles. In general, the goal is to produce finer flour particles without elevating starch damage because this may result in excessive cooking loss and poor eating quality (7). A higher than required protein content for a given noodle flour also impacts brightness, because more starch granules reflect more light compared with protein.

Comparing the particle size distribution (PSD) of a sample of udon flour from Asia with a sample of bakery flour from North America, a much higher volume of fine particles are observed under the udon flour curve relative to the bakery flour curve (Fig. 2). Volume weighted mean (D[4,3]) for udon flour shows a value of 58.1 µm relative to that of bakery flour at 88.9 µm, which is a significant difference in flour particle size (Table I).

Table I. Particle size distribution determined using laser diffraction[a]

Flour Sample[b]	Particle Size Distribution			
	d(0.1), µm	d(0.5), µm	d(0.9), µm	D[4,3], µm
Udon	11.0	49.7	120.1	58.1
Bakery flour	23.6	82.4	161.4	88.9

[a] Mastersizer 2000 (Malvern Instruments Inc.).
[b] Udon flour sample obtained from North Asia, and bakery flour sample obtained from North America.

The next critical tool millers have at their disposal is in the milling operations with respect to preparation of wheat for milling, the milling process, overall flour extraction rate, the selection of flour streams, and treatment.

Preparation of Wheat for Milling

Wheat Cleaning. Asian mills, in general, are very well equipped with appropriate cleaning equipment that allows them to remove undesirable, diseased, and damaged materials, as well as wheat with superficial discoloration. Introduction and wide application of optical (color) sorters in the cleaning house have helped millers improve their cleaning efficiency immensely. Thorough cleaning and scouring of wheat ensures safe raw material for milling into flour, but it also helps reduce deoxynivalenol (DON) levels from *Fusarium* spp., as well as keep the microbial load under control. This is particularly important because many Asian countries have stricter DON standards than in North America. In Korea, low microbial counts in wheat are required so that they are able to attain low counts in the flour used for the cold noodles enjoyed by consumers during the summer.

Tempering (Conditioning). Tempering is a key step in the preparation of wheat for milling. Asian mills temper wheats to optimize their condition for milling. This paves the way for easier separation of bran from the endosperm during the ensuing milling steps. Bran naturally resists shredding, especially when moisture is higher. Generally speaking, tempering time in North America is shorter than what is practiced in Asia for corresponding wheat types (Table II).

Flours produced for baked goods are relatively less sensitive to bran specks than those used for most Asian products. Longer tempering time with higher milling moisture, apart from toughening the bran, also facilitates easier reduction of the endosperm granules into flour (3). This enables control of any elevated levels of starch damage, particularly with respect to hard wheat milling. Optimum tempering moisture and time, when maintained, also produces consistent quality flour at uniform moisture content—a key requirement for end users.

Milling Process. Very gradual reduction of wheat into flour facilitates production of flour with minimal bran specks. The goal in milling is to break open the wheat kernels very gradually in the break system, which consists of 4–5 break passages, using corrugated rolls that help release the endosperm in large granular form with minimal shredding of bran and production of flour. The bran is cleaned by the time it reaches the last break passage and then sent to the bran bin following removal of the last traces of endosperm in the bran finisher. The granular endosperm material released in the break system is graded in the sifter according to particle size and then directed to purifiers. Purifiers remove any bran particles of the same size as endosperm particles through a combination of shaking sieves under an overhead air exhaust system. The purified endosperm particles are then passed on to reduction grinding passages equipped with smooth rolls. Following grinding in each reduction passage, flour is removed and sent to a flour collection system, while material that requires further reduction is passed on to the next passage, and the process continues until most endosperm particles are reduced into flour and residual material is separated as by-product.

In a simplified system (Fig. 3), the released endosperm particles from the first, second, and third break passages are combined in a single grader for grading into three grades. In a more elaborate grading system (Fig. 4), these may fall into five or more grades, allowing graded material with a very narrow range within each band. The endosperm particles released in the first, second, and third break passages are handled separately in the first, second, and third graders based on particle size. This assists the purifiers in performing an effective operation that separates most bran material from the endosperm. This separation results in higher yields of pure endosperm particles that are ready to be ground into fine flour particles with low ash content, bright flour color, and minimum numbers of bran specks.

The benefits of using a comprehensive grading system can be observed when examining the cumulative ash curves for each type of system (Fig. 5). The difference in the yield of low-ash

Table II. Milling practices for appropriate flour refinement—tempering

	Milling Moisture (%)			Tempering Time (hr)		
Region	**Hard Flour**	**Medium Hard Flour**	**Soft Flour**	**Hard Flour**	**Medium Hard Flour**	**Soft Flour**
Asia	16.0–17.0	15.0–16.0	14.0–15.0	24–48	15–20	10–15
North America	15.5–16.5	15.0–15.5	14.0–14.5	10–18	8–12	4–8

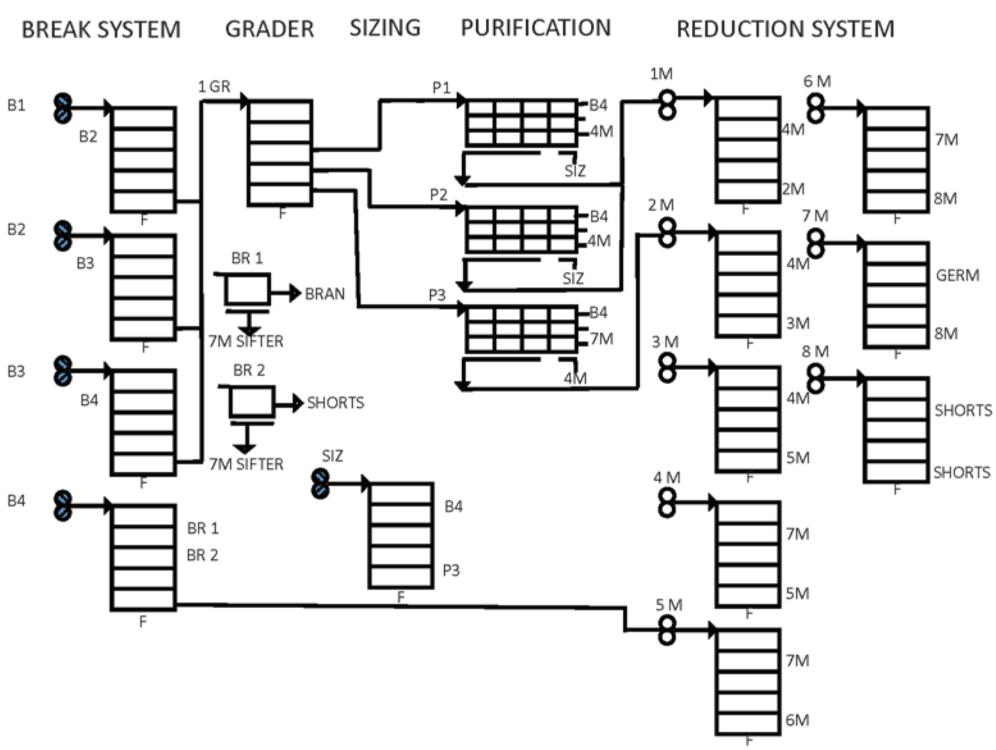

Fig. 3. Flowsheet of a simplified grading system. B = break; GR = grader; BR = bran duster; F = flour; SIZ = sizing; P = purifier; M = middlings.

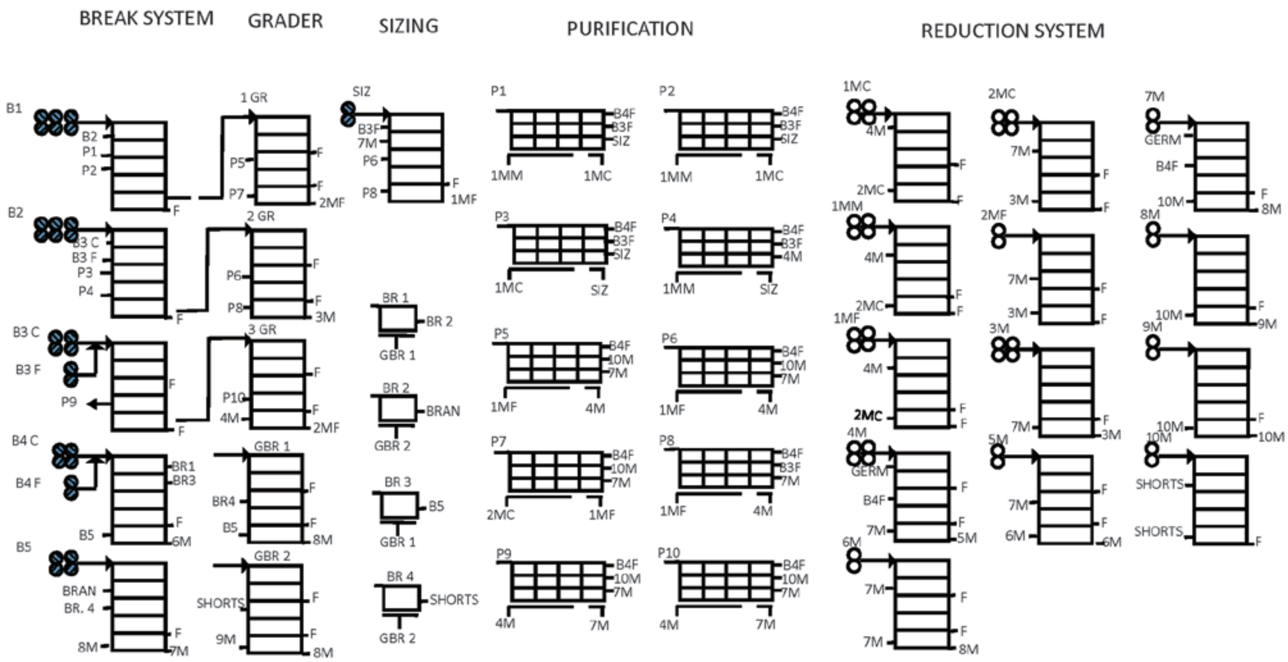

Fig. 4. Flowsheet of a comprehensive grading system. B = break; GR = grader; BR = bran duster; F = flour; SIZ = sizing; P = purifier; M = middlings; MC = middlings coarse; MM = middlings medium; MF = middlings fine.

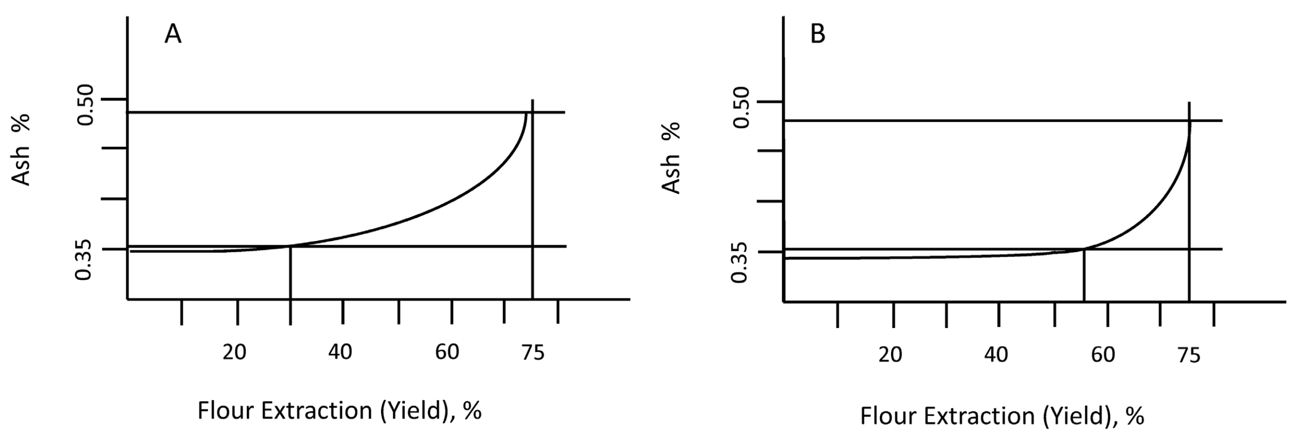

Fig. 5. Cumulative ash curves for a simplified grading system (**A**) versus a comprehensive grading system (**B**).

flour at ~0.35% can be substantially higher (20.0–25.0%) for the comprehensive milling process compared with the simplified process.

The purified endosperm particles collected from the purifiers are sent to the early reduction passages, often referred to as middling passages, consisting of smooth grinding rolls for production of clean, bright white flour with the lowest ash content. Heavy grinding should be avoided, however, to minimize the risk of inflicting physical starch damage as a result of any undue aggressive grinding. Furthermore, it is important to produce the white flour as early in the process as possible, as repeated grinding increases the risk of bran contamination and elevated levels of damaged starch due to overgrinding of the residual material.

In some Asian markets where fine particle size is considered critical for high-quality products, it is important to use flour sieves with finer apertures, which requires flour to be ground finer. In such scenarios, grinding rolls with a 300 mm diameter are used instead of the usual 250 mm diameter. The increased diameter presents a bigger grinding zone, facilitating more release of flour relative to a 250 mm diameter. In these situations, proper tempering to keep endosperm particles mellow is critical, especially when milling hard wheat mixtures. In addition to achieving proper tempering, a more gradual system requiring more grinding passages, grading passages (sifters), and purifiers and a more elaborate reduction system is helpful (Fig. 4). The specific roll and sifter surfaces are required to be relatively generous in such a system (Table III).

Globally, flour is sold on the basis of ash specification, along with other desired attributes. The performance of a flour mill operation is evaluated by their cumulative ash curve. In a short, compromised system with limited grading, the ash curves tend to ascend early, while the curve remains flat across most of the flour yield in a more elaborate system, indicating higher yields of flour with lower ash content (Fig. 5).

Preparation of Flours for End Products

A commercial mill produces a large number of flour streams with varying levels of protein and ash and different functional properties. In most markets, it often pays to segregate these flour streams on the basis of ash content into multiple groups referred to as flour grades (Table IV) rather than to produce just one flour with all streams combined (straight grade flour). Depending on the market, the flour grades may vary anywhere from 2 to 4. For example, in Japan flour streams are typically divided into four grades, whereas in Korea flour streams are divided into three grades. The lower grades are often used for starch and gluten separation and feed and industrial purposes.

Typically, the purest flour streams with the lowest ash contents, brightest color, and minimal or no specks are extracted from head reduction passages (first through fourth passages). The latter part of the reduction system (firth through eighth passages) is fed with endosperm released from lower break passages and from residual material going over the flour sieves of the fourth reduction passages. As the flour progresses from the head reduction passages to the lower reduction passages, the ash content, color, and specks in these flour streams progressively get poorer or worse.

As previously outlined, Asian premium products require bright white flour color with low ash content, appropriate protein level, and desirable attributes, such as starch properties. These requirements are met by selecting appropriate wheat types for blending to attain the required protein level and then by selecting appropriate flour streams of low ash to make up the flour grade with the highest flour yield possible while meeting the required specifications. Depending on the flour yield of the premium flour grade, the second grade can also be of high value and in demand. Typically, the first and second flour grades together can make up anywhere from 60 to 70% of total flour yield, and in some cases slightly higher.

Bread Flour. Bakery products, although not native to Asia, have shown a steady increase in demand in all Asian markets. It has been reported that in Southeast Asia the use of wheat is around 30% for bread, while in Japan it is 40%. Within Asia, the quality of bread is superior in North Asia, such as Japan and Korea, compared with Southeast Asian countries. In Japan, high protein content in the wheat blend for bread flour, coupled with mellow and extensible gluten, fulfills an important quality requirement. The quality of the flour, together with the baking process used, yields a soft, tender, and moist texture that is appealing to Japanese consumers.

Table III. Comparison of specific roll and sifter surfaces for Asian mills relative to North American mills

Region	Roll Surface (mm/100 kg/24 hr)	Sifter Surface (M^2/100 kg/24 hr)
Asia	13.0–18.0	0.08–0.1
North America	10.5–11.5	0.06–0.07

Table IV. Example of flour grades[a]

Quality Parameter	Short Patent	Medium Patent	Straight Grade
Flour extraction (%)	40.0	50.0	75.0
Protein (%)	13.1	13.7	14.3
Ash (%)	0.36	0.39	0.51
Wet gluten (%)	37.1	39.3	40.5
Amylograph peak viscosity (BU)	850	830	640

[a] Source: Sarkar (9).

Bread flours in Japan are produced using a short-patent (extraction), first grade flour from a blend of high-protein (13.5–14.0%) hard red spring wheat with a flour ash content of 0.35–0.40% and a protein content of 11.5–12.1%. Second grade flour with an ash content of 0.48–0.52% and protein content of 12.2–13.0% is also used for bread applications. Third and fourth grades are used for starch and gluten separation and feed and industrial uses.

In South Korea, three flour grades are usually generated. As in Japan, a blend of high-protein hard red spring wheat is milled for bread flour. First grade flour is used for principal products and could be considered similar to Japanese first and second grade flours combined. Similar to Japan, high-end bread flour has an ash content of 0.38–0.42% and a protein content of 11.9–12.2%.

Bread flours produced in Southeast Asian countries also use high-protein hard red spring wheat. The flour yields are higher; consequently, flour ash contents are also high (Table V). The flour yields range from 70.0 to 77.0%, with ash and protein contents ranging from 0.48 to 0.60% and 12.0 to 14.0%, respectively, depending on the country and the type of baking process used by the bakery. High-quality bakeries using a sponge-and-dough baking process require lower ash and higher protein contents relative to bakers using a no-time dough process.

Generally, the overall flour yield in most mills ranges between 78.0 and 80.0%. Second grade flour, after collecting bread flour, is only about 3–10% of the residual low-grade flour and is used primarily for feed and industrial applications.

Noodle Flours. Visual quality of noodles is very important, and therefore, bright color with no discoloring specks is of great importance. The visual appearance of the finished product is largely dependent on flour quality, which is a function of milling technology and wheat quality attributes. The next critical factors are cooking properties, texture, and eating quality, which are largely dependent on flour quality attributes and noodle processing.

In Japan, the production of high-quality yellow alkaline Chinese noodles (ramen) requires a short-patent (extraction) flour with low ash content that is produced from a blend of high-protein hard red spring wheat and a small percentage of hard red winter wheat as appropriate. This yields a flour with bright color that is free of specks and provides very good cooking stability and texture retention in hot broth and soup. Typically, it is drawn from first grade flour with an ash content of 0.33 to 0.37% and a protein content of 11.0 to 11.5% (8). Second grade flour from this blend is used for confectionery bread (sweet dough) and has an ash content of 0.50 to 0.52% and a protein content of about 11.8 to 12.2%.

The other major noodle type produced in Japan is udon (white salted noodles). The sensory properties expected for udon require a soft elastic texture with a softer outer core and firmer inner core. This textural property in udon is derived from the intrinsic starch quality in wheat. A medium to soft wheat blend of a lower protein partial waxy ASW from Austra-

Table V. Bread flour specifications in some Southeast Asian countries

Country	Flour Yield (%)	Flour Ash (%)	Flour Protein (%)
Malaysia	75.0–77.0	0.50–0.60	12.0–13.5
Philippines	76.0–77.0	0.55–0.60	12.8–13.2
Thailand	70.0–75.0	0.48–0.55	13.5–14.0

lia and domestic Japanese wheat is considered very suitable for this purpose. The udon flour is drawn from the first grade, with low ash, good color, and no specks. Flour ash content is 0.34–0.42%, and protein content is 7.0–9.0% (8). Second grade flour is primarily used as "all-purpose" flour.

In South Korea, noodle flours are drawn from first grade flour with low ash content and generally consist of a blend of medium wheat with good color (Australian). Premium udon-type noodles have a low ash content of 0.37 to 0.39% and protein content of 8.0 to 9.0%.

High-quality white dried noodle and instant noodle flours all have a low ash content of 0.42 to 0.45% and a protein content ranging from 9.0% to 10.0–11.0%, respectively.

Noodle flours produced in Southeast Asian countries generally have higher extraction rates relative to Japanese and Korean markets. There are a variety of specific noodle types produced in each country, and these are somewhat different from one another, except instant noodles, which tend to have less stringent flour specifications (Table VI).

The principal noodle types produced in Malaysia are *hokkien*, *wanton*, and instant noodles. *Hokkien* noodle flour is produced from a blend of medium protein wheat primarily from Australia. The protein and ash contents are 9.5–10.5% and 0.48–0.53%, respectively. The flour extraction ranges from 72.0 to 74.0%.

Wanton is produced from higher protein wheat blends from Australia and a blend of hard red spring wheat with high protein content from Canada (CWRS) or the United States (DNS). The color is important. Protein and ash contents are 12.0–13.0% and 0.48–0.55%, respectively. Flour extraction varies from 72.0 to 75.0%.

The two major types of noodles produced in Thailand are alkaline noodles (*bamee*) and instant noodles. Flour for *bamee* noodles is produced with a blend of high-protein hard red spring wheat from the United States or Canada. The flour ash contents are low at 0.42–0.47%. The protein contents are high, typically varying from 12.4 to 13.0%. Flour extraction rates are lower, ranging from 60 to 66%. The remaining flour (second grade) has high protein and is primarily used for shrimp feed. Sometimes second grade flour streams are selected for blending to create flour with higher value.

The noodle market in the Philippines is somewhat smaller than in other Southeast Asian countries. The most popular noodle type is instant noodles, and they are produced with a blend of lower protein U.S. NS (70%) and soft wheat (30%). The flour extraction rate is ~77.0%, with a protein content of 11.0 to 12.0% and an ash content of 0.50 to 0.52%.

The instant noodle market is big in Vietnam. Economical wheat blends are used to generate high-extraction flour for the instant noodle market. Packaged instant noodles are sold at an affordable price for the general population.

Steamed Bread Flour. Steamed bread flour has been described in more detail earlier in the article. In Malaysia, there are two types of flour produced. Flour produced for steamed bread with filling, or *mantou*, has 10.0–11.0% protein and an ash content of <0.48%, using a long-patent flour from a medium protein wheat blend. The second flour is produced with a blend of medium to soft wheat with a lower extraction rate and protein content of 8.0 to 9.0% and ash content of 0.45 to 0.48%. This flour is used for Hong Kong *dim sum pau*. A low-protein soft wheat flour is also used for spring roll skins, with a protein content varying between 7.5 and 8.5% and ash content below 0.48%.

In Thailand, very fine white flour is produced with a blend of medium and soft wheat with low extraction, an ash content below 0.40%, and a protein content of about 8.0 to 8.5%. This flour is generated by pin-milling and air-classification of flour produced by the flour mill.

All-Purpose Flour. In most markets, there is also a flour type produced that is referred to as "all-purpose" flour. In some cases, higher quality all-purpose flour may also be used for making noodles, as in Korea. The quality specifications for this flour is less stringent in Southeast Asian countries, and in Malaysia it is referred to as general-purpose flour. This flour can often be extracted as a straight grade flour or as a second grade flour with adequate yield. Usually medium to low protein economical wheat blends are used for such purposes in Malaysia for home and institutional use for a variety of ethnic food products, such as, *roti canai*, pita, tortillas, Chinese pastries, and *yu tau*, a Chinese snack. *Roti canai* is a popular local flat bread with fat in the formulation. The protein content varies from 9.5 to 10.5% and ash contents from 0.50 to 0.60%. The flour is milled to a high extraction rate of 77.0%.

Table VI. Noodle flour specifications in some Southeast Asian countries

Country	Flour Yield (%)	Flour Ash (%)	Flour Protein (%)
Malaysia	72.0–75.0	0.48–0.55	12.8–13.0
Philippines	76.0–77.0	0.50–0.52	11.0–12.0
Thailand	60.0–66.0	0.42–0.47	12.4–13.0

Flour Treatment

In many markets, including North America, flour often is shipped shortly after its production. In these markets, benzoyl peroxide-based bleaching agents and azodicarbonamide commonly are utilized to improve the color and maturation of the flour; they typically are added at rates of 50 and 2–6 ppm, respectively. This practice has utility for noodle and steamed bread flours; however, millers generally rely on naturally whiter and brighter flour color produced by the wheat and enhanced by the milling process (refined and finer particle size). Bleaching obviously is not suitable for noodle types for which the desired natural color is yellow.

Starch may be used, if required, to impart a sticky, gummy feel to the bite in white salted noodles. A typical addition rate is ~10%. Vital gluten may be added, if necessary, to yellow alkaline noodles to improve firmness (8).

Conclusions

Milling processes across the globe are fundamentally similar in terms of equipment and the principles of milling. What differentiates milling processes in Asia from other parts of the world is the fact that there is a consistent, strong demand for low-ash, white flour with minimal bran contamination. These flours are required for the production of premium Asian products, such as high-quality noodles and steamed breads. There is also strong market demand for Asian products made from other flour types with less stringent quality requirements, including all-purpose flours and flours used for instant noodles. Regional variation in quality requirements are also found among different Asian markets, with North Asia having some of the most stringent requirements and other markets, such as China, also demonstrating steadily growing demands for high-quality, low-ash flours. The emphasis on high quality has also been seen in the continually expanding segment of baked goods in the Asian market, with end products earning accolades at international baking competitions. Such demand should continue to maintain the need for high-quality flour in Asia. The cost of flour produced using a comprehensive system is understandably higher in terms of both capital investment and operating costs; however, the market demand for higher quality flour justifies utilizing the approach.

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