Asian noodle technology

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ASIAN NOODLE

TECHNICAL BULLETIN

Published Since 1979

Editor—Gur Ranhotra | Volume XX, Issue 12 | December, 1998

ASIAN NOODLE TECHNOLOGY

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INTRODUCTION

Wheat flour noodles are an important part in the diet of many Asians. It is believed that noodles originated in China as early as 5000 BC, then spread to other Asian countries. Today, the amount of flour used for noodle making in Asia accounts for about 40% of the total flour consumed. In recent years, Asian noodles have also become popular in many countries outside of Asia. This popularity is likely to increase. This bulletin is written to provide information on formulation, processing technologies, and other related aspects of Asian noodles.

ASIAN NOODLES VERSUS PASTA

Asian noodles are different from pasta products in ingredients used, the processes involved and their consumption patterns. Pasta is made from semolina (coarse flour usually milled from durum wheat) and water, and extruded through a metal die under pressure. It is a dried product. After cooking, pasta is often eaten with sauces. Asian noodles are characterized by thin strips slit from a sheeted dough that has been made from flour (hard and soft wheats), water and salt—common salt or alkaline salt. Noodles are often consumed in soup. Eggs can be added to each product to give a firmer texture. Asian noodles are sold in many forms (discussed later).

THE BASICS

Wheat flour is the main ingredient for making Asian noodles. About three parts of flour are usually mixed with one part of salt or alkaline salt solution to form a crumbly dough. The dough is compressed between a series of rolls to form a dough sheet. The gluten network is developed during the sheeting process, contributing to the noodle texture. The sheeted dough is then slit to produce noodles. The noodles are now ready for sale, or are further processed to prolong shelf life, to modify eating characteristics or to facilitate preparation by the consumer. In the preparation of instant fried noodles, the steaming process causes the starch to swell and gelatinize. The addition of alkaline salts (kan sui, a mixture of sodium and potassium carbonates) in some Chinese type noodles gives them a yellow color and a firmer, more elastic texture.

CLASSIFICATION OF ASIAN NOODLES

There is no systematic classification or nomenclature for Asian noodles; wide differences exist between countries. There is a need to standardize noodle nomenclature using a universal classification system. Classification below is based on the current state of the knowledge.

Based on Raw Material

Noodles can be made from wheat flour alone or in combination with buckwheat flour. Wheat flour noodles include Chinese and Japanese type noodles. There are many varieties in each noodle type, representing different formulation, processing and noodle quality characteristics. Noodles containing buckwheat are also called soba, meaning buckwheat noodle. These noodles are typically light brown or gray in color with a unique taste and flavor.

Chinese type noodles are generally made from hard wheat flours, characterized by bright creamy white or bright yellow color and firm texture. Japanese noodles are typically made from soft wheat flour of medium protein (discussed later). It is desirable to have a creamy white color and a soft and elastic texture in Japanese noodles.

Based on Salt Used

Based on the absence or presence of alkaline salt in the formula, noodles can be classified as white (containing salt) noodles or yellow (containing alkaline salt) noodles. Alkali gives noodles their characteristic yellowness. White salt noodles comprise Japanese noodles, Chinese raw noodles or dry noodles. Chinese wet noodles, hokkien noodles, Cantonese noodles, chuka-men, Thai bamee, and instant noodles fall under the yellow alkaline noodle category.

Based on Size

According to the width of the noodle strands, Japanese noodles are classified into four types (1) (Table I). Since the smaller size noodles usually soften faster in hot water than the larger size, so-men and hiya-mughi noodles are usually served cool in the summer, and udon and hira-men are often eaten hot in the cool seasons. Other noodle types also have their own typical size.

TABLE I
NOODLES BASED ON WIDTH

Name	Characteristics
So-men	Very thin, 0.7-1.2 mm wide
Hiya-mughi	Thin, 1.3-1.7 mm wide
Udon	Standard, 1.9-3.8 mm wide
Hira-men	Flat, 5.0-6.0 mm wide

Based on Processing

The simplest way to classify noodles based on processing is hand-made versus machine-made noodles. This is too generalized, however. Hand-made types, still available in Asia because of their favorable texture, were prevalent before the automatic noodle machine was invented in the 1950s. In some places, stretching noodles by hand is considered an art rather than noodle making. Noodle machines are best suited to mass production.

Noodle processing operations include mixing raw materials, dough sheeting, compounding, sheeting /rolling and slitting. This series of processes remains constant among countries for all noodle types. Noodle strands are further processed to produce different kinds of noodles, and this can be a means of classification (Table II).

None of the approaches discussed above are sufficient to define each noodle type. For instance, boiled noodles contain fully cooked and parboiled types. Parboiled types include both hokkien and Chinese wet noodles. In addition, wet noodles are parboiled in most of Asia, but are fresh, uncooked noodles in Japan. Therefore, a possible nomenclature should incorporate key aspects such as formulation and basic processing to fully describe the nature of each noodle type.

TABLE II

NOODLE CLASSIFICATION BASED ON PROCESSING

Noodle Type		Processing
Fresh	–	Noodle strands coming out of slitting rolls are cut into certain lengths for packaging without any further processing. Typical examples are Chinese raw noodles, udon noodles, chuka-men, Thai bamee, Cantonese noodles and soba noodles. These are often consumed within 24 hours of manufacture due to quick discoloration. Their shelf life can be extended to 3-5 days if stored under refrigeration.
Dried	–	Fresh noodle stands are dried by sunlight or in a controlled chamber. Chinese raw noodles, Cantonese noodles, chuka-men, udon noodles, and soba noodles can be in dried form. Noodle shelf life is dramatically extended, but fragile noodles may have handling problems.
Boiled	–	Fresh noodle strands are either parboiled (90% complete cooking) or fully cooked. This type includes: Chinese wet noodles, hokkien noodles, udon noodles, and soba noodles. After parboiling, Chinese wet noodles and hokkien noodles are rinsed in cold water, drained and coated with 1-2% vegetable oil to prevent sticking. Boiled udon and soba noodles are not coated with oil. Boiled noodles are re-cooked for another 1-2 minutes before serving.
Steamed	–	Fresh alkaline noodle strands are steamed in a steamer and softened with water through rinsing or steeping. This type is also called “Yaki-Soba”, and it is often prepared by stir-frying for consumption.

WHEAT USED IN NOODLES

Sources

The key noodle wheat growers and suppliers are the United States, Australia and Canada. In the US, hard red spring, hard red winter, soft red winter, and soft white wheats are used—alone or blended—for making noodle flour. A new wheat class—hard white—has been expanding in production in recent years, targeting Asian products such as noodles and Chinese steamed breads apart from Western foods. Australian wheat has been known for decades for its superior performance in Japanese type noodle making because it gives desirable noodle color and unique texture. Australian standard white, Australian premium white, Australian hard, Australian prime hard, and Australian noodle wheat are major types of noodle wheats. Canada western red spring, Canada western red winter, Canada prairie spring white and Canada prairie spring red wheats are also competitive in noodle production. In many cases, different classes of wheat are often blended to achieve relatively consistent quality noodle flour. Due to the complexity of noodle types (discussed later), there is no single wheat type that can meet all quality requirements, not to mention that the consistency of wheat quality and supply also varies.

Quality Requirements

In many cases, physical quality measurements of wheat and wheat test methods are similar and independent of end products made. For example, wheat should be clean and sound, high in test weight, and uniform in kernel size and hardness. These characteristics result in efficient milling and high flour extraction, and, possibly, optimum quality end products.

The US Federal Grain Inspection Service grades a wheat according to the test weight, defects, wheat of other classes present and other contamination. The Falling Number test is done to determine wheat sprout damage level. Wheat kernel hardness, diameter, weight and their distribution can be measured using a Single Kernel Characterization System. Wheat kernel hardness deserves particular attention since it affects the tempering conditions, flour starch damage level, flour particle distribution and milling yield. Damaged starch not only absorbs more water but may also reduce noodle cooking and eating quality. Accordingly, noodle wheat should not be too hard, and milling processes should be controlled to avoid excess starch damage. The uniformity of wheat kernel hardness appeared to improve milling performance (2).

Low ash content in flour is always an advantage for noodles since flour ash is traditionally viewed as causing noodle discoloration. One of the important noodle flour specifications is ash content, although there is no guarantee that low ash flour can always make desirable color noodles. The presence of the enzyme polyphenol oxidase (PPO) in the flour is believed to be partially responsible for noodle darkening. Thus, it may be useful to measure the activity of this enzyme in the wheat.

Wheat protein content is often determined, and gluten strength can be evaluated by a sedimentation test. Different noodle types require different protein contents and dough strength (discussed later). Generally speaking, Chinese type noodles need hard wheat of high protein content and strong gluten, and Japanese noodles require soft wheat of medium protein content.

Flour Quality Characteristics

The above discussion of wheat sources and quality requirements provides a valuable yardstick in aiming for desired flour quality. However, each noodle type requires its own specific flour quality criteria. Table III lists flour specifications for various types of Asian noodles. Flour protein, ash content and flour-pasting characteristics are major specifications. Protein content varies according to the noodle type to achieve the desired eating quality. Generally, flour protein content has a positive correlation with noodle hardness and a negative correlation with noodle brightness. Thus, there is an optimum flour protein content required for each noodle type. Japanese udon noodles require soft wheat flour of 8.0-9.5% protein. Other noodles require hard wheat flours of high protein content (10.5-13.0%), giving a firmer bite and springy texture.

Flour ash content has been rated as one of the important specifications because it affects noodle color negatively. Flour ash content is largely determined by the wheat's ash content. Wheat with an ash content of 1.4% or less is always an advantage. Most noodle flours require ash content below 0.5%, but premium quality noodles are often made from flours of 0.4% or less ash. However, ash content is not the only noodle flour quality indicator. In some cases, flour color may be more related to noodle color. Flour color L * >90 measured with a Minolta Chroma Meter is often required.

Starch pasting characteristics (as measured on the amylograph or Rapid Visco Analyzer) also play an important role. The ratio of amylose to amylopectin content determines a starch's pasting characteristics. Flour amylose content between 22-24% is often required for Japanese type noodle making. Measurement of the pasting viscosity of flour or wholemeal also relates to noodle quality, and eliminates a starch isolation step. However, the presence of excessive alpha-amylase activity (breaks down starch) in the flour or wholemeal will undermine the prediction results because even a small quantity of the enzyme is likely to reduce the paste viscosity. The addition of certain alpha-amylase inhibitors into the test solution has been shown to improve the correlation between the viscosity of flour or wholemeal and the eating quality of Japanese type noodles (3).

Dough properties measured by other relevant tests (sedimentation test, and farinograph and extensigraph measurements) are often also included in noodle flour specifications because they affect noodle processing behavior and noodle eating quality. High sedimentation volumes indicate a strong dough, which is good for Chinese style noodles that require a firm bite and springy texture. Extensigraph parameters measure the balance of dough extensibility versus elasticity. Too much extensibility results in a droopy dough, while too much elasticity causes difficulty in controlling final noodle thickness. Farinograph stability time has shown a positive relationship with Chinese raw noodle texture and tolerance in hot soup. It should be cautioned that a noodle dough is much lower in water absorption than bread dough (28-36% versus 58-64%). Rheological tests, initially developed to evaluate bread dough performance, may not be applicable to noodle dough evaluation. There is a need to develop new tests specifically for relating a noodle dough's rheological properties to eating quality.

NOODLE FORMULATION

Seven Major Types

Tremendous varieties of Asian noodles exist around the world and within a country (Table IV). These varieties are the result of differences in culture, climate, region and a host of other factors. Table V shows the formulation of seven major types of noodles. Both Chinese raw noodles and Japanese udon noodles have the most simplified formulas, containing only flour, water and salt. However, as indicated earlier, Chinese raw noodles are made from hard wheat and medium to high protein flour, and Japanese udon noodles are produced from soft wheat flour of medium protein content. Chinese raw noodles have been shown to be very useful in screening noodle color due to their simple formulation.

Chinese wet noodles and chuka-men (alkaline noodle) are characterized by the presence of kan sui (alkali salt), while Malaysian hokkien noodles are characterized by the presence of sodium hydroxide, giving the noodles their characteristic yellowness, alkaline flavor, high pH and improved texture. Both Chinese wet and hokkien noodles are parboiled types, while chuka-men can be either uncooked or cooked.

Instant fried noodles usually contain guar gum or other hydrocolloids, making the noodles firmer and easier to rehydrate upon cooking or soaking; polyphosphates allow more water retention on the noodle surface, thus, giving them better mouth-feel. Native or modified potato starch or other equivalent starches are often added in premium instant fried noodles, providing springy texture and improved steaming and cooking quality due to reduced gelatinization temperature. Thailand bamee noodles are characterized by having 10% eggs in the formula. Therefore, egg source and quality are additional variables in bamee noodle quality.

TABLE III

FLOUR SPECIFICATIONS FOR ASIAN NOODLES

	Flour Specifications (14% Moisture Basis)				
Noodle Type	**Protein (%)**	**Ash (%)**	**Farinograph Stability (Min)**	**Amylose Content (%)**	**Amylograph Peak Viscosity [a]**
Chinese Raw	10.5-12.5	0.35-0.41	≥ 10	—	≥750 BU
Japanese Udon	8.0-9.5	0.35-0.40	—	22-24	—
Chinese Wet	11.0-12.5	0.40-0.45	—	—	≥750 BU
Malaysian Hokkien	10.0-11.0	≤ 0.48	—	—	—
Chuka-men	10.5-11.5	0.33-0.40	—	—	—
Instant Fried	10.5-12.5	0.36-0.45	—	—	≥750 BU
Thailand Bamee	11.5-13.0	≤ 0.46	—	—	—

[a] **Method**: 65 g flour (14% mb) + 450 ml distilled water. Amylograph heating cycle: heat from 30 to 95^{0}C at 1.5^{0}C/min; hold at 95^{0}C for 20 min; and cool to 50^{0}C at 1.5^{0}C/min.

Unit: Expressed in Brabender Units (BU). 750 BU is equivalent to 170 Rapid Visco Unit (RVU) as determined by Rapid Visco Analyzer (RVA). RVA: 3.5 g flour (14% mb) + 25 ml distilled water. The RVA heating cycle (3): hold at 60^{0}C for 2 min; heat from 60 to 95^{0}C in 6 min; hold at 95^{0}C for 4 min; cool to 50^{0}C in 4 min; and hold at 50^{0}C for 4 min.

TABLE IV

MAJOR TYPES OF ASIAN NOODLES CONSUMED

Region	Type
China/Hong Kong	Instant fried, Chinese raw, dried, hand-made
Indonesia	Instant fried, Chinese wet
Japan	Chuka-men (Chinese style yellow alkaline noodle), Japanese types (include hira-men, udon, hiya-mughi, so-men), soba
Korea	Instant fried, dried, udon, soba
Malaysia	Hokkien, instant fried, Cantonese (alkaline raw), dried
Philippines	Instant fried, dried, Chinese wet, udon
Singapore	Hokkien, Cantonese, instant fried
Taiwan	Chinese wet, Chinese raw, instant fried, dried
Thailand	Bamee, dried, instant fried
Europe, Africa	Instant fried
Latin/South America	Instant fried or dried
North America	Instant fried or dried, Chinese raw, udon, soba

TABLE V

FORMULAS FOR MAJOR TYPES OF ASIAN NOODLES
(Baker's Percent)

	Noodle Type						
Ingredient	**Chinese Raw**	**Japanese Udon**	**Chinese Wet**	**Malaysian Hokkien**	**Chuka-men[a]**	**Instant Fried**	**Thailand Bamee**
Flour	100	100	100	100	100	100	100
Water	28	34	32	30-33	32	34-37	28
Salt	1.2	2	2	2	1	1.6	3
Potato Starch	—	—	—	—	—	0-12	—
Sodium Hydroxide	—	—	—	0.5	—	—	—
Sodium Carbonate	—	—	0.45	—	0.4	0.1	1.5
Potassium Carbonate	—	—	0.45	—	0.6	0.1	—
Eggs	—	—	—	—	—	—	10
Guar Gum	—	—	—	—	—	0-0.2	—
Polyphosphates	—	—	—	—	—	0-0.1	—

[a] Chuka-men is a Chinese style yellow alkaline noodle widely consumed in Japan

NOODLE PROCESSING TECHNOLOGY

The basic processing steps for machine-made noodles are outlined in Figure 1. These steps involve mixing raw materials, resting the crumbly dough, sheeting the dough into two dough sheets, compounding the two sheets into one, gradually sheeting the dough sheet into a specified thickness and slitting into noodle strands. Noodle strands are further processed according to noodle types.

Mixing Ingredients

Mixing formula ingredients (Table V) is often carried out in a horizontal or vertical mixer for 10-15 minutes. Since the horizontal mixer seems to have better mixing results, it is more commonly used than the vertical one in commercial noodle production. Mixing results in the formation of a crumbly dough with small and uniform particle sizes. Since the water addition level is relatively low (vs. bread doughs), gluten development in noodle dough during mixing is minimized. This improves the dough sheetability, sheeted dough smoothness and uniformity. Limited water absorption also slows down noodle discoloration and reduces the amount of water to be taken out during the final drying or frying processes.

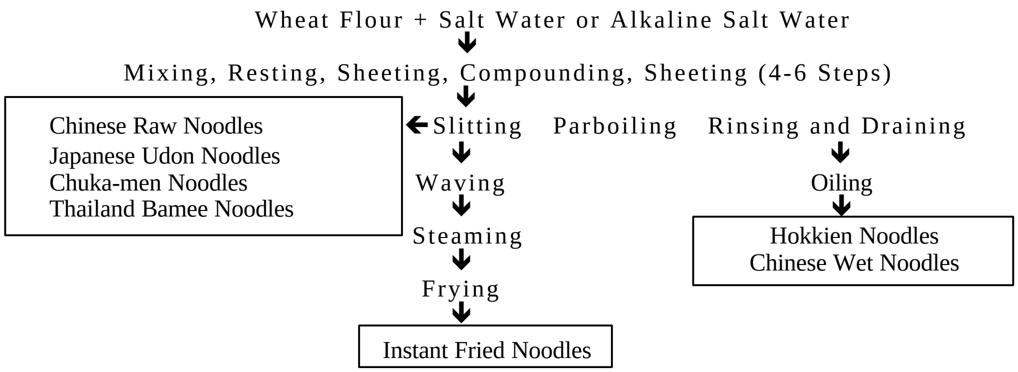

Figure 1. Noodle making process

Flour proteins, pentosans and starch (especially damaged starch) determine the flour water absorption level. Even so, the water absorption level in noodle dough is not so sensitive to processing as is that in bread dough. Variations in noodle dough water absorption among different flours is generally within 2-3%, and this is usually determined by dough handling properties. Flour particle sizes and their distribution affect the time water penetrates into the flour. Large particle flours require a longer time for water to incorporate and tend to form larger dough lumps. It is desirable to have relatively fine and evenly distributed particle size flours to achieve optimum dough mixing.

Dough Resting

After mixing, the dough pieces are rested for 20-40 minutes before compounding. Dough resting helps water penetrate into dough particles evenly, resulting in a smoother and less streaky dough after sheeting. In commercial production, the dough is rested in a receiving container while being stirred slowly.

Sheeting and Compounding

The rested, crumbly dough pieces are divided into two portions, each passing through a pair of sheeting rolls to form a noodle dough sheet. The two sheets are then combined (compounded) and passed through a second set of sheeting rolls to form a single sheet. The roll gap is adjusted so that the dough thickness reduction is between 20-40%. The combined dough sheet is often carried on a multi-layer conveyor belt located in a temperature and relative humidity controlled cabinet. This step is to relax the dough for easy reduction in the subsequent sheeting operation. The resting time takes about 30-40 minutes.

Sheeting, Slitting and Waving

Further dough sheeting is done on a series of 4-6 pairs of rolls with decreasing roll gaps. At this stage, roll diameter, sheeting speed and reduction ratio should be considered to obtain an optimum dough reduction. Noodle slitting is done by a cutting machine, which is equipped with a pair of calibration rolls, a slitter, and a cutter or a waver. The final dough sheet thickness is set on the calibration rolls according to noodle type (Tables I and VI) and measured using a thickness dial gauge. Noodle width determines the size of noodle slitter to be used (noodle width, mm = 30/slitter number). The sheet is cut into noodle strands of desired width with a slitter. Noodles can be either square or round in shape by using various slitters. Noodle strands are cut into a desirable length by a cutter. At this stage, Chinese raw noodle, Japanese udon noodle, chuka-men and Thailand bamee noodle making is complete. For making instant noodles, noodle strands are waved before steaming and cutting.

Cooking Noodles

Cooking processes include parboiling, boiling, and steaming. Hokkien noodles and Chinese wet noodles are usually parboiled for 45-90 seconds to achieve 80-90% gelatinization in starch. The noodles are then coated with 1-2% edible vegetable oil to prevent the strands from sticking together. Parboiled noodles have an extended shelf-life (2-3 days) and high weight gain (60-70%). They are quickly re-cooked by boiling or stir-frying prior to consumption.

Japanese udon noodles are boiled for 10-15 minutes, rinsed and cooled in running water, steeped in dilute acidic water before packing, and further steamed for more than 30 seconds in a pressurized steamer. This type of noodle usually has a shelf-life of 6 months to one year. It is also called longevity noodle.

Several steps can be taken to assure optimal cooking: (a) the weight of cooking water is at least 10 times that of the uncooked noodles, (b) the size of the boiling pot is properly chosen, (c) the pH of the boiling water is 5.5-6.0, (d) the cooking time is precisely controlled to give optimal results to the product, and (e) the cooking water temperature is carefully maintained at 98-100^0 C throughout the boiling process.

In making instant noodles, the wavy noodle-strands are conveyed to a steamer to cook the noodles. As mentioned earlier, the purpose of steaming is to gelatinize the starch and fix the noodle waves. The steaming time varies according to noodle size, but can be determined by squeezing a noodle strand between two clear glass plates. If the white noodle core disappears, the noodles are well cooked. Steam temperature, steam pressure, and steaming time are key process factors affecting the product quality.

Drying Noodles

Noodle drying can be achieved by air drying, deep frying or vacuum drying. The air drying process has been applied to many noodle types, such as Chinese raw noodles, Japanese udon noodles, steamed and air-dried instant noodles, and others. Air drying usually takes 5-8 hours to dry regular noodles (long and straight) and 30-40 minutes to dry steamed and air-dried instant noodles. Drying by frying takes only a few minutes. Vacuum drying of frozen noodles is a newer technology making it possible to produce premium quality products.

For the manufacture of regular dry noodles, raw noodle strands of a certain length are hung on rods in a drying chamber with controlled temperature and relative humidity. Air drying usually involves multi-stage processes since too rapid drying causes noodle checking, similar to spaghetti drying. In the first stage, low temperature (15-20^0 C) and dry air are applied to reduce the noodle moisture content from 40-45% to 25-27%. In the second stage, air of 40^0 C and 70-75% relative humidity is used to ensure moisture migration from the interior of the noodle strands to outside surfaces. In the final stage, the product is further dried using cool air.

For the manufacture of air-dried instant noodles, wavy noodle-strands are first steamed for 18-20 minutes at 100^0 C, then dried for 30-40 minutes using hot blast air at 80^0 C. The dried noodles are cooled prior to packaging. Air-dried instant noodles have a low fat content so some people prefer them. They also have a longer shelf-life because little fat rancidity is involved. Steaming appears to be very critical to this type of noodle since it affects the water rehydration rate of the product. However, slow output of the process and lack of pleasant shortening taste and mouthfeel make the product less popular in Asia compared with instant fried noodles.

Drying by frying is a very fast process. Water vaporizes quickly from the surface of the noodles upon dipping into the hot oil. Dehydration of the exterior surface drives water to migrate from the interior to the exterior of the noodle strands. Eventually, some of the water in the noodles is replaced by oil. Many tiny holes are created during the frying process due to the mass transfer, and they serve as channels for water to get in upon rehydration in hot water. It usually takes 3-4 minutes to cook or soak instant fried noodles in hot water before consumption.

EVALUATING NOODLES

The evaluation (scoring) of noodles focuses mainly on three characteristics—process performance (machining), noodle color and noodle texture. Table VII lists the score allocation of each noodle attribute for different noodle types. The process effect is generally weighted higher for instant noodles due to

TABLE VI

DIMENSIONS OF ASIAN NOODLE STRANDS

Noodle Type	Thickness (mm)	Width (mm)	Slitter Number
Chinese Raw	1.2	2.5	12
Japanese Udon	2.5	3.0	10
Chinese Wet	1.5	1.5	20
Malaysian Hokkien	1.7	1.7	18
Chuka-men	1.4	1.5	20
Instant Fried	0.9	1.4	22
Thailand Bamee	1.5	1.5	20

TABLE VII

BREAKDOWN OF SUBJECTIVE NOODLE EVALUATION SCORES

Noodle Type	Characteristics and Scores (%)			
	Noodle Process	Noodle Color	Noodle Texture	Others
Chinese Raw	25	30	45	0
Japanese Udon	Not Applicable [a]	20	50	30 [b]
Chinese Wet	15	20	40	25 [c]
Malaysian Hokkien	25	40	20	15 [d]
Chuka-men	Not Applicable [a]	30	40	30 [e]
Chinese Instant Fried	35	10	55	0
Korean Instant Fried	50	14	30	6 [f]
Philippine Instant Fried	15	10	75	0
Thailand Bamee	10	45	20	25 [g]

[a] Noodle process evaluation is not included in scoring
[b] Appearance, 15%; taste, 15%
[c] Cooking weight gain
[d] Cooking weight gain, 10%; shelf-life after 48 hours, 5%
[e] Specks of raw noodle, 20%; taste, 10%
[f] Taste
[g] Dryness, 10%; cooking quality, 10%; cooked noodle surface smoothness, 5%

more steps involved and high speed production. Noodle color is particularly important for Chinese raw, Japanese udon, chuka-men and Thailand bamee because of the lack of heat treatment, which allows more rapid darkening. As for Malaysian hokkien noodles, color is also very important because it is evaluated on both parboiled and uncooked noodles. Hokkien noodles have a typical shelf-life of 2-3 days. Although good noodle color is required, desirable texture is essential in all the markets. Other quality characteristics are weighted lower, but they can be very critical to overall noodle performance. For example, both Chinese wet noodles and Malaysian hokkien noodles are sold in a parboiled form, so the cooking weight gain (%) is a very important quality attribute to noodle makers. If a noodle can take up more water within a fixed cooking time and maintain its texture characteristics, it will be a more desirable and profitable product.

Each noodle type has its own evaluation sheet due to a different focus on the noodle quality preferences. An example of a Chinese raw noodle evaluation sheet is shown in Table VIII. Within the categories of processing, noodle color or noodle texture, there are a number of evaluation items.

Noodle Processing

Table IX (page 10) details noodle processing steps and evaluation criteria for them. Evaluation should be done at each stage of processing since the performance of dough and noodles has an impact on end product quality. Steaming is one of the critical control points in noodle processing. The degree of starch gelatinization in instant fried noodles determines the noodle rehydration rate, firmness and visco-elasticity, and is most controlled by the steaming process. During frying, because the moisture content in noodles drops rapidly, starch gelatinization is very limited.

Noodle Color

Noodle color quality requirements are summarized in Table X (page 10). All noodle types require good brightness. Color can be either white or yellow depending on the absence or presence of alkali salts. Minimal noodle darkening within 48 hours is desirable. This may not be a problem for the instant noodles because they are dried and the color is very stable.

Noodle Texture

Contrary to color, noodle texture characteristics are more complicated and less understood. Table XI (page 10) describes the general texture attributes for each noodle type. There is a distinction in noodle bite between the Japanese type and other noodle types in that the Japanese type is softer, while others are harder or firmer. Chinese raw, wet and instant fried, chuka-men, Malaysian hokkien, Philippine instant fried and Thailand bamee noodles are hard in bite, while Korean instant fried noodles are firm in bite. The hard bite noodles require high protein flour, while the firm bite noodles require medium protein flour with strong starch. Korean instant fried noodles are somewhat similar to Japanese udon in that both require flours of high peak viscosity and large breakdown measured by an amylograph. However, the flour protein content of Korean instant noodles (bag type) is 9.0-10.5%, higher than that of Japanese udon noodle flour (8.0-9.5%). Thus, the Korean instant fried noodle is also harder.

SUMMARY

Asian noodles have been in existence for thousands of years. They are now also becoming popular in the Western countries. Several types, mostly machine-made, are produced worldwide. Research on Japanese udon noodles is ahead of other noodle types. Process properties, noodle color and noodle texture are the three key quality attributes in the evaluation of a wheat flour for any noodle making. Noodle process behavior is of particular importance in modern industrial production, but this property is often ignored in laboratory evaluation. In terms of noodle color, brightness is required, and whiteness or yellowness is essential depending on the noodle type. Noodle texture, however, is more complicated in the characterization of each noodle type, and progress can only be made to understand this property by involving Asian flour and noodle industrial representatives. Instrumental measurements of noodle color and texture are important in establishing their relationship to sensory characteristics of noodles.

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TABLE VIII

CHINESE RAW NOODLE EVALUATION SHEET

Date ________________ **Name** ________________________________ **Sample Lab No.** ________________

Points	Property	Evaluation Item	Score [a](1-10)	Subscore [b]
20	Machining	Mixing (10)		
		Sheeting (6)		
		Slitting (4)		
5	Dough Sheet Appearance			
30	Noodle Color Stability	2 Hour (10)		
		24 Hour (20)		
20	Texture After Cooking for 5 min	Bite (10)		
		Springiness (6)		
		Mouthfeel (4)		
25	Texture After Cooking for 5 min and Holding for 5 min in Hot Water	Bite (12)		
		Springiness (5)		
		Mouthfeel (3)		
		Noodle Tolerance (5)		
100	Total Score			

[a] On a scale of 1-10, the control sample is scored 7 for each item

[b] Subscore is the product of (score x maximum point)/10. Example: If a sample's sheeting is scored 8 (scale: 1-10) and its maximum point is 6, the subscore is (8 x 6)/10 = 4.8

TABLE IX

ASIAN NOODLE PROCESSING EVALUATION

Process	Evaluation Criteria
Mixing	Optimal water absorption; dough particle sizes are small and uniform; no big lumps
Sheeting	Easy to sheet; smooth surface; not streaky; free of specks
Slitting	Clean cut; sharp edges; correct noodle size
Waving	Uniform and continuous waves
Steaming	High degree of starch gelatinization; not sticky; good wave integrity
Frying	Uniform noodle color; good shape; not oily; characteristic fried noodle aroma
Parboiling	High cooking yield; low cooking loss; good cooking tolerance
Cooking	Short cooking time; good texture tolerance to overcooking

TABLE X

ASIAN NOODLE COLOR EVALUATION

Noodle Type	Color Requirement
Chinese Raw	Bright and white color; little discoloration within 24 hours
Japanese Udon	Bright and creamy white color; little discoloration within 24 hours
Chinese Wet	Bright yellow color; little discoloration within 24 hours
Malaysian Hokkien	Bright yellow color; little discoloration within 48 hours
Chuka-men	Clear bright yellow color; little discoloration and specks within 24 hours
Chinese Instant Fried	Bright yellow color
Korean Instant Fried	Bright yellow color
Philippine Instant Fried	Bright yellow color
Thailand Bamee	Bright, intense yellow color; little discoloration within 24 hours

TABLE XI

ASIAN NOODLE TEXTURE EVALUATION

Noodle Type	Texture Requirement
Chinese Raw	Good bite and elastic; good mouthfeel; stable texture in hot water
Japanese Udon	Soft and elastic; smooth surface; good mouthfeel
Chinese Wet	Good bite, chewy and elastic; less sticky; stable texture in hot water
Malaysian Hokkien	Good bite, chewy and elastic; less sticky
Chuka-men	Good balance of softness and hardness; elastic; smooth; less texture deterioration in hot water
Chinese Instant Fried	Optimum bite and chewy texture; smooth surface; stable texture in hot water
Korean Instant Fried	Firm and visco-elastic; good mouthfeel
Philippine Instant Fried	Good bite and springy; good mouthfeel; stable texture in hot water
Thailand Bamee	Good bite, springy and smooth texture