Traditional Chinese Rice Noodles: History, Classification, and Processing Methods

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Rice is a main staple in the Asian diet that has many unique attributes, including ease of digestion, a mild flavor, and hypoallergenic properties (9). China is the largest producer and consumer of rice in the world, with an average per capita consumption of 102 kg of rice-based food products (11). The main rice variety used for rice noodles is *indica*, which is widely cultivated in south China for its high yield and adaptability to local weather conditions. *Indica* is more suitable for rice noodle applications than *japonica* because it contains more amylose (14).

Rice noodles, also called *mifen, mixian, hefen,* or *mimian*, are a popular and traditional food in China. Processing procedures used to make traditional Chinese rice noodles include soaking, grinding, heating (steaming or boiling), molding (extruding or cutting), cooling, and drying (13).

Rice noodles originated during the Qin dynasty (259–210 B.C.) and have been consumed for more than 2,000 years in China. Historical records suggest that when people from northern China invaded the south, they preferred noodles made from wheat flour because they were not accustomed to eating rice. To adapt, northern cooks tried to prepare "noodles" using rice, thus inventing rice noodles. Over time rice noodles and their processing methods have been introduced around the world, becoming especially popular in Southeast Asia (13).

Their ease of preparation and diverse flavors have made rice noodles popular both in home-cooked foods and in restaurants in southern China for many years. Thanks to the development of rice noodle production and distribution industries people around the world can now enjoy rice noodles (4).

Today, rice noodles are served as both a food staple and as a side dish. They may be mixed with meats and vegetables and stir-fried or boiled in broth and served as soup noodles (6). Methods used to produce traditional Chinese food have not been systematically reported; therefore, this article reviews the classification and processing of rice noodles to better understand this traditional Chinese food.

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Classification of Chinese Rice Noodles

There are various types of rice noodles available in the market. The most well-known products are from the provinces of southern China, such as Jiangxi, Guangdong, Guangxi, Yunnan, and Hunan. Influenced by the districts in which they are produced, special manufacturing processes, cultures, and historical backgrounds, different types of rice noodles have acquired characteristics specific to their geographic origins. *Jiangxi-mifen, Guangzhou shahe-fen, Guilin-mifen, Yunnan guoqiao-mixian,* and *Changde-mifen* are examples of typical local products that are classified based on the district in which they are produced and the manufacturing process used. Chinese rice noodles are further categorized based on their shape, which is affected by the molding method used, and moisture content.

Classification Based on Molding Method. The most important classification criterion is the method used to mold rice noodles. There are three major molding methods:

1) Cutting noodles (termed *qiefen* in Chinese). Steamed rice noodle sheets are cut into rectangles that are 1 mm thick, 4–6 mm wide, and ≈200 mm long. Representative products include *bianfen*, *qiefen*, and *Shahe-fen*.

Extruding noodles (termed *zhafen* in Chinese). Steamed rice paste is extruded into strips using different molds. The length of the strips is ≈200–400 mm, while the diameter ranges from 1 to 3 mm. Representative products include *guoqiao-mixian*, *Guilin-mifen*, *Changde-mifen*, and *fenli*. *Fenli* is a special type of extruded rice noodle with a shorter length and larger diameter.

2) Spreading and rolling noodles (termed *changfen* in Chinese). Rice noodle wrappers containing various fillings are rolled. *Changfen* is a representative product.

The three major classifications of rice noodles based on molding method are described in Table I. Major rice noodle products are illustrated in Figure 1.

Classification Based on Moisture Content. Moisture content affects the shelf life of a product, as well as how the rice noodle is consumed. Chinese rice noodles are classified into two groups based on moisture content: dehydrated and fresh

(Table I). The moisture content of dehydrated products is ≈15–25%, whereas the moisture content of fresh products is 40–65% (3,10). Moisture content is also the main factor that affects the flavor and quality of rice noodles.

Two different types of drying equipment, a continuous drying cabinet or a drying room, are widely used. Noodles are dehydrated to prolong shelf life, which can be extended for as long as 2 years. Fresh noodles that have not been dehydrated are thought to have a smoother and more delicate flavor, and they generally are more convenient for consumers.

Processing Chinese Rice Noodles

Currently, most rice noodles are produced by machines similar to those used to make traditional handmade rice noodles. Although the production process used for a particular type of rice noodle may differ from region to region to meet local needs, the basic principles are generally the same.

There are several major steps in processing raw rice into rice noodles. The procedure consists of selecting raw rice, followed by cleaning, soaking, grinding, heating (steaming or boiling), molding (extruding or cutting), and cooling (and drying). The major processing steps for manufacturing different kinds of rice noodles are diagrammed in Figure 2.

Selection of Raw Rice. Rice noodles are made with milled rice grain, and almost all of their components, such as starches, proteins, lipids, low molecular weight sugars, and ash, affect the consistency of the noodles. Studies have shown that raw rice with high amylose and protein contents produce high-quality rice noodles (5). Traditionally, the variety *indica* is used in rice noodle formulations. *Indica* rice can be categorized as early- or late-harvest, depending on when the rice is harvested during the growing season. Compared to early-harvest cultivars, late-harvest rice has a lower production yield and is less expensive and stickier (12). Although early-harvest rice is the main rice used in rice noodle formulations, it is more economical to use late-harvest rice. Taking price and quality into consideration, a mixture of early- and late-harvest *indica* rice is often used to produce noodles. Different early- and late-harvest rice ratios have been used: for example, 1:0.25 to 1:0.67 (20), 7:3 (2), and 1:1.5 (7).

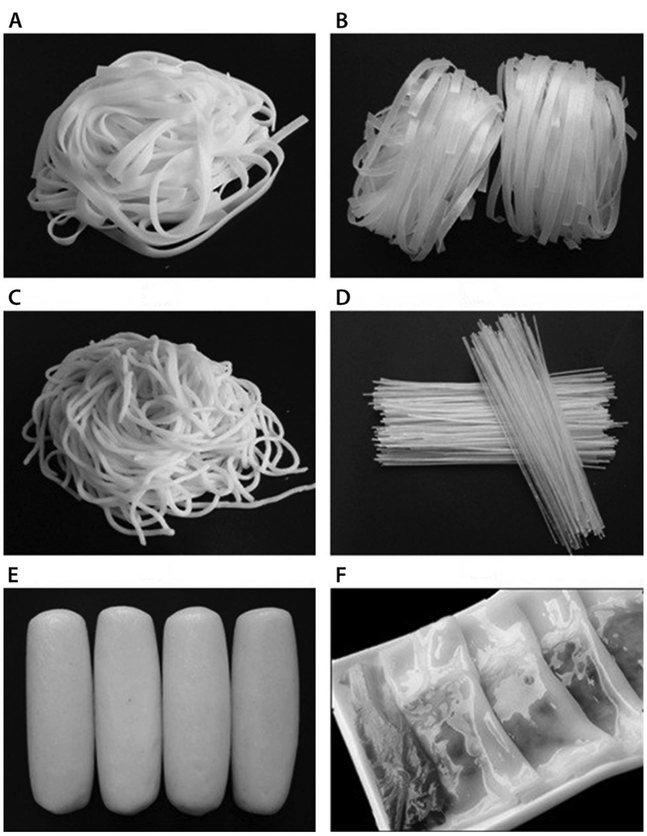

Fig. 1. Common types of rice noodles: **A,** fresh *qiefen*; **B,** dehydrated *qiefen*; **C,** fresh *zhafen*; **D,** dehydrated *zhafen*; **E,** *fenli*; **F,** *changfen*.

Cleaning Raw Rice. Procedures for cleaning raw rice are essential for removing dust and other foreign materials.

Soaking. The length of time the rice is soaked can range from several hours (short time) to several days (long time) and depends on whether the end product will be unfermented or fermented rice noodles, respectively. Natural fermentation occurs after rice has soaked for a long time.

The purpose of soaking for a short time is to allow water to penetrate into the rice kernel, which results in a high moisture content and less rigid structure without initiating fermentation. It takes 2–3 hr in summer and 4–5 hr in winter for the moisture content to reach 26–30% at room temperature (1).

Soaking rice for a long time is essential for producing naturally fermented rice noodles. During this procedure, rice is soaked not only to absorb water, but also to allow natural fermentation to occur. Normally, this process takes 2–3 days in summer and 4–5 days in winter. Fermentation is facilitated by various microbes, especially lactic acid bacteria (LAB) and yeasts (12). Fresh rice noodles made from fermented *indica* rice have a unique texture and consistency compared with fresh noodles made from rice that has been soaked for only a short time (8,15,17,21).

The effect of LAB and other bacteria during fermentation is a decrease in pH. The rice and soaking water have an initial pH of 7 (neutral), and this decreases to a pH of 4 when fermentation is complete. In a study by Lu et al. (16), the pH of the supernatant decreased to 4.2 after 24 hr and remained constant at a pH of 4.1. The main organic acids in the supernatant were lactic acid and acetic acid. Lactic acid was predominant, indicating that some of the LAB involved were heterofermentative (16). It has also been reported that fermentation plays an important role in improving the nutritional content, flavor, and texture of rice noodles (18).

Grinding and Sieving. Once soaked rice achieves the appropriate moisture content, it is ground and then sieved (only after dry grinding). Two different grinding methods are used: dry and wet.

Dry Grinding. A hammer mill is widely used for dry-grinding soaked rice. When ground to the proper size, rice particles can pass through 60 or 80 mesh sieves. Typically, rice soaked for a short time is suitable for dry grinding, whereas dry-grinding rice with higher moisture levels (>26–28%) may lead to rice agglomeration or plugging of the mesh sieve (19).

Wet Grinding. A wheeled grinder is widely used for wet-grinding rice, during which water is added. Rice soaked for a long time, which has a moisture content of ≈45%, is suitable for wet grinding. Wet grinding produces a rice slurry with a smooth consistency.

Molding. Molding, or the process of shaping ground rice, is categorized by two methods: extrusion and cutting.

Extruding Rice Noodles (*Zhafen*). Extrusion is an important molding method that produces rice noodles with a rounded shape. Rice slurry is first transported by a band carrier in sheets that are ≈5 mm thick. The sheets are then presteamed for

4–5 min at 90°C. Finally, the steamed sheets are extruded into rice noodles and boiled to ensure they have completely gelatinized.

Extruders are relatively simple to operate and can perform heating and molding simultaneously. Materials are continuously fed into the machine, and after heating to the proper temperature, they are extruded into noodles. The size and shape of extruded rice noodles can be adjusted to meet the specifications of the end product.

Cutting Rice Noodles (**Qiefen*****).*** Rice noodles can also be cut into appropriate shapes. Before cutting, ground rice must undergo two heating procedures. First, a portion of the ground rice (≈20–30%) is presteamed, after which the remainder of the ground rice is added to make a thick rice slurry that is formed into 1–3 mm thick sheets. The sheets are then fully steamed, and band carriers transport the steamed rice sheets to be cut into rectangular noodles.

Heating (Steaming or Boiling). The purpose of heating is to completely gelatinize the starch in the rice to its α-state. Heating occurs in two steps: steaming, which is performed before molding, followed by boiling.

Steaming pregelatinizes rice noodles and is performed in two types of pressurized cabinets: common pressure or high pressure (>0.05–0.06 MPa) (19). Common-pressure steaming under normal air pressure takes more time than high-pressure steaming. High-pressure steaming under higher pressure and temperatures (>100°C) also is faster (20) than low-pressure steaming. In high-pressure steaming, noodles are steamed continuously in a tunnel for 3 min. The noodles are then boiled at 98°C for 1–2 min, at which point the rice noodles are completely gelatinized. Heating temperature and time must be strictly controlled to avoid excessive gelatinization.

Cooling. Cooling involves placing steamed or boiled rice noodles in cool water (0–10°C) to rapidly decrease their temperature to 24–26°C and form a stronger gel. The cooling procedure facilitates noodle separation and creates a smooth, slippery noodle texture. This step takes ≈1.5–2.5 min.

Staling. After steaming, noodles undergo a staling process. Steamed, gelatinized rice noodles are aired in a special room for 12–24 hr to convert starches to their β-state. This produces noodles with a nonsticky, stable structure and increased flexibility. Noodles are carded at this stage so they do not overlap.

Dehydrating. To prolong their shelf life, rice noodles may be dehydrated to a low moisture content. Drying decreases the moisture content of rice noodles from 40–65% to 15–25%. To dehydrate noodles, two types of equipment are widely used: a continuous drying cabinet and a drying room.

In a continuous drying cabinet indirect steam is used for heat exchange—heat is exchanged between the heated steam and air in the cabinet. To achieve satisfactory quality, rice noodles should be turned over manually one or two times during drying.

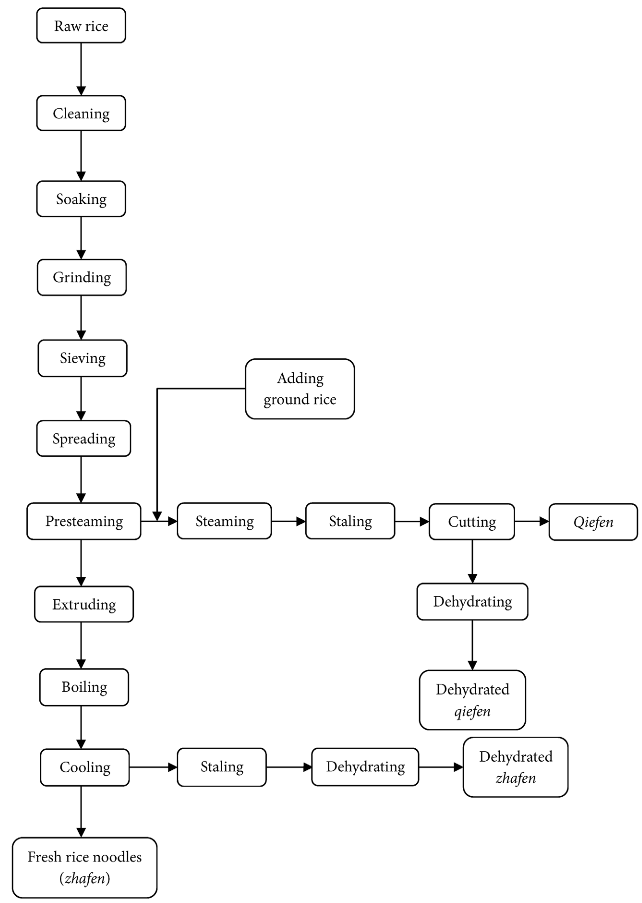

Fig. 2. Primary processing steps in the production of different types of rice noodles.

Table I. Rice noodle classification based on molding method

Noodle Type	Molding	Shape of Transect	Description of Rice Noodle	Moisture Content[a] (%)	Final Product
Qiefen	Cutting	Rectangle	Thickness: 1 mm Width: 4–6 mm Length: 200 mm	High: 40–65 Low: 15–25	*Bianfen*, *qiefen*, *Shahe-fen*
Zhafen	Extruding	Round	Diameter: 1–2 mm Length: 200–400 mm	High: 40–50 Low: 15–25	*Guoqiao-mixian*
			Diameter: 20 mm Length: 50 mm	High: 40–50 Low: 15–25	*Fenli*
			Diameter: 2–3 mm Length: 200–400 mm	40–50	*Guilin-mifen*
			Diameter: 2–3 mm Length: 200–400 mm (fermented *mifen*)	40–50	*Changde-mifen*
Others	Spreading and rolling	Irregular	Thickness: 1 mm Width: 20–30 mm (stuffing is rolled in it)	55–65	*Changfen*

[a] Use of high or low distinguishes whether the rice noodles are dehydrated (low) or not (high).

A drying room is another widely used system for dehydrating rice noodles. A temperature and moisture gradient is used to treat rice noodles throughout the drying process. Although drying at low-temperatures (<50°C) takes longer (≈8 hr), drying rice noodles in this manner produces noodles with excellent quality, including a white color, good transparency, and high uniformity (20).

Conclusions

To facilitate technological progress, improve quality control, and increase product uniformity, knowledge concerning Chinese rice noodle production is required. Although significant work has been done to study these products for the purpose of upgrading traditional techniques, further studies are required to gain scientific understanding of each processing step.

Gaining knowledge about different production methods for different types of Chinese rice noodles will stimulate standardization and optimization, allowing this traditional Chinese food to be increasingly recognized and appreciated by international markets.

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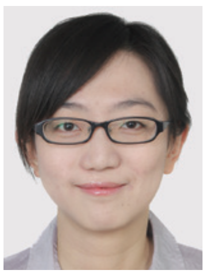

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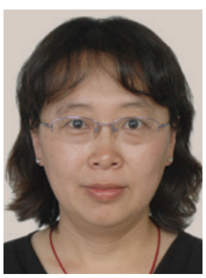

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