Quality Attributes of White-Salted Noodles

Won-Jae Lee¹ · Dan-Bi Woo² · Mee-Ryung Lee²*

¹Dept. of Animal Bioscience (Inst. of Agric. & Life Sci.), Gyeongsang National University, Jinju 660-701, Korea
²Dept. of Food and Nutrition, Daegu University, Gyeongsan 712-714, Korea

Received: DEC. 29. 2014, Revised: JAN. 28. 2015, Accepted: JAN. 28. 2015

ABSTRACT

Noodles have been a part of our diet for a long time. In Asia, white-salted, Cantonese and instant fried types of noodles are widely consumed. White-salted noodles, also called Udon noodles, are consumed as wet or dried form. White-salted noodles are deeply favored in Korea and Japan and more consumption of Cantonese noodles are observed in other Asian countries. The quality attributes of white-salted noodles are predominantly dependant by wheat flour components, such as starch, protein and pigments, as wheat flour, water and salt are main raw materials of white-salted noodles. In several studies, the ratio between amylose and amyllopectin is a key determinant of textural properties of white-salted noodles; hardness of white-salted noodles did have a significant ($p<0.05$) increase when amylose content in wheat flour was increased. The textural properties of white-salted noodles was not affected much by the protein content, especially protein content of flour was in the range of 10% ~ 13%. It seems that starch plays more important role than protein in the textural properties of white-salted noodles. Carotenoids and flavonoids pigment are major contributors of color of white-salted noodles.

Key words - Amylose, Flour component, Textural property, Wheat protein

*Corresponding author: Mee-Ryung Lee
Tel: +82-53-850-6837
Fax: +82-53-850-6839
E-mail: mrlee@daegu.ac.kr
I. Introduction

Noodles have been consumed for nearly two thousand years and are one of the most important staple foods in most Asian countries (Huang & Morrison, 1988). Approximately 40% of the total wheat consumption is used as a raw material to prepare various noodle products in Asia (Oda, 1982; Hou & Kruk, 1998).

The basic ingredients for Asian noodles are wheat flour, water, salt and/or alkali. The dough is mixed to a crumbing mass, pressed together with rolls, sheeted a number of times, and cut into strips (Baik, 1994).

There are many varieties of noodles available with various forms, such as white salted noodles, Cantonese noodles and instant fried noodles (Hoseney, 1998).

White-salted noodles are very popular in Korea, China and Japan. Most white salted noodles are made from flours of 0.36 - 0.40% ash content and 8 - 10% protein content. White salted noodles are prepared by mixing wheat flour, salt and water to dough, sheeting the dough and cutting the dough into noodles strands. White salted noodles are available either in fresh or dried forms (Akashi et al., 1999).

Cantonese noodles are made from flours of 0.33 - 0.38% ash content and 10.5 - 12.0% protein content, and are made with the addition of alkaline salts called kansui or “lye water”, sodium and potassium carbonates solution, which affect the flavor, color and eating quality of the noodles (Akashi et al., 1999). Alkaline salts toughen the dough and change pasting properties, as well as inhibit enzyme activity (Moss et al., 1986). Instant fried noodles are made from soft white wheat flour, salt and/or alkali, cut, waved, precocooked with steam, formed into individual servings and dried by deep-fat frying to 5 - 8% moisture. Instant fired noodles have a taste different from taste of other noodles, probably because they absorb about 20% fat during frying (Hoseney, 1998).

The quality attributes of white-salted noodles, such as texture, are mainly determined by wheat flour properties. In this review, factors influencing quality of white salted noodles are to be discussed and the relationships between wheat flour component, such as starch, and quality attributes of white-salted noodles are to be elucidated.

II. Quality of noodles

The most important characteristics of noodles are color and texture, followed by taste, surface appearance, weight and volume after cooking (Toyokawa et al., 1989a). Acceptable white-salted noodles are smooth, soft and elastic in texture with a clean, bright appearance and a cream color (Konik et al., 1992). White-salted noodles preferred in Korea and China are firmer in texture than those popular in Japan (Lee et al., 1987; Huang & Morrison, 1988). The preferred texture of Cantonese noodles is firm and springy with a smooth surface (Nagao, 1992). The weight of noodles after cooking and cooking loss of noodles are also important qualities of noodles. Cooking time influences both the weight of noodles after cooking and cooking loss of noodles. The longer the cooking time is, the heavier the cooked noodle weight is, and the larger the cooking loss of noodles is.

2.1 Noodle texture

Texture is one of the primary quality attributes of Asian noodles. Texture is defined as how the food feels in the mouth on manipulation and on manipulation and on mastication, and how the food...
handles during transport, preparation and on the plate (Szczeniak, 1963). Noodle texture can be measured by subjective sensory tests and objective instrumental tests. In a sensory evaluation of noodle texture, Crosbie et al. (1992) reported that elasticity, softness or hardness and degree of elasticity or springiness are major components of noodle texture. Sensory evaluation is a direct method for method for the determination of noodle acceptability to consumers. However, sensory evaluation is subjective method and not suitable for a large number of test sample with limited panels.

Since sensory evaluations are limited in value, several instrumental methods were developed and extensively studied to measure the texture properties of noodles. Oh et al. (1983) reported that the maximum cutting stress and resistance to compression of cooked noodles measured using an Instron Universal Testing instrument are reliable and convenient for the evaluation of the textural properties of cooked noodles and that the instrumental textural parameters correlate well with the sensory evaluation of firmness and chewiness of noodles. Yun et al. (1997) verified that Instron texture analysis can accurately predict the softness of cooked noodles from sensory tests.

2.1.1 Texture profile analysis (TPA)

Texture profile analysis (TPA) is a complex texture measuring system developed by General Foods researchers in the early 1960s (Brandt et al., 1963; Friedman et al., 1963; Szczeniak, 1963; Szczeniak et al., 1963). TPA is conducted with the General Foods Textrometer (General Foods Co., Tarrytown, NY) to obtain a force-time curve using two compressions of specimen, to imitate the initial chewing motion of the human mouth (Friedman et al., 1963). Bourne (1968) applied the Instron universal testing machine (UTM) to TPA of ripening pears. Using the UTM, constant speed of Instron compression was achieved. TPA is also used to evaluate noodle quality.

TPA is one of imitative instrumental methods providing the rheological properties of food to be masticated or deformed. In TPA, a flat-ended plate is used to break down food samples to imitate the human mastication. This method can generate several textural attributes such as hardness, springiness, adhesive force, cohesiveness, gumminess and chewiness through 1st and 2nd compression two-bite cycles, which are summarized in Table 1 (Steffe, 1996; Van Vliet, 1999; Bourne, 2002).

2.2 Role of flour components on noodle texture

Since Asian noodles are made using formula or flour, water and salt, the influence of flour components on product quality is much greater than in other food products (Nagao, 1992). The major flour components that contribute to noodle texture are starch and protein (Huang & Morrison, 1988; Konik et al., 1992; Baik, 1994; Akashi et al., 1999). Lipids in flour can affect noodle texture. Removal of free lipids from flour before noodle making has been found to increase cutting stresses and decrease surface firmness of cooked noodles (Rho et al., 1989).

2.2.1 Starch

Starch properties are one of the most important quality parameters influencing textural properties of white-salted noodles (Oda et al., 1980). Various determination of starch properties are being applied to predict the noodle making quality of wheat flour. Konik et al. (1992) related starch viscosity along with other non-starch flour quality parameters to noodle eating quality. Other researchers defined
desired starch properties for white-salted noodle texture, including high paste viscosity (Oda et al., 1980), low gelatinization temperature (Endo et al., 1988) and high breakdown (Oda et al., 1980) from the viscoamylograph curve. Starch swelling power and starch swelling volume are significantly \((p<0.05)\) correlated with total texture score of cooked white salted noodles (Crosbie, 1991). Baik (1994) also reported that high starch swelling power and amylograph peak viscosity and amylograph breakdown are important in the quality parameters of satisfactory white-salted noodles. Higher swelling power and peak viscosity of starch lowers firmness and elasticity, and increases surface smoothness of cooked Cantonese noodles in sensory and instrumental tests (Miskelly & Moss, 1985; Konik et al., 1993; Ross et al., 1997).

The amylose content of flour is negatively correlated with amylograph peak viscosity and with salted noodle eating quality (Oda et al., 1980). Toyokawa et al. (1989b) observed that increased concentrations of amylose in white-salted noodles decreased the water binding and elasticity of cooked noodles and increased the firmness of noodles. High swelling power of flour is derived from low amylose content in the starch portion of flour (Akashi et al., 1999).

Baik and Lee (2003) investigated the role of starch amylose content on textural properties of white-salted noodles without interference of protein content by reconstitution study (Fig. 1). In this study, starch amylose content of white salted noodles was varied from 0% to 23% and protein content of white salted noodles was not varied; starch amylose content showed a significantly \((p<0.05)\) positive correlation with hardness of cooked white-salted noodles and a significantly \((p<0.05)\) negative correlation with cohesiveness of cooked white salted noodles.

### 2.2.2 Protein

While extensive study is conducted on the influence of starch components on noodle texture, relatively little information is available about the role of protein on noodle texture. Nagao et al. (1977) reported that the most favorable wheat for production of white-salted noodles has a protein content of

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Textural Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness</td>
<td>Maximum height of the first compression peak</td>
</tr>
<tr>
<td>Cohesiveness</td>
<td>Ratio between the area under the second compression peak to the area under the first compression peak.</td>
</tr>
<tr>
<td>Adhesive force</td>
<td>Difference of forces between the first and second compression peaks</td>
</tr>
<tr>
<td>Springiness</td>
<td>Recovered height after first compression</td>
</tr>
<tr>
<td>Gumminess</td>
<td>The multiplication of hardness and cohesiveness</td>
</tr>
<tr>
<td>Chewiness</td>
<td>The multiplication of gumminess and springiness</td>
</tr>
</tbody>
</table>

*Adapted and modified from: Steffe, 1996; van Vliet, 1999; Bourne, 2002.

![Graph](Image)

**Fig. 1.** Typical amylograph curves of waxy wheat starch and regular wheat starch. Adapted and modified from Baik & Lee, 2003.
around 10%. Noodles prepared from flour with 12–14% protein exhibits to require longer cooking time and to have higher cutting stress than noodles prepared from flour with 8–10% content of protein (Oh et al., 1985).

Texture properties of noodles are affected not only by protein quantity, but also by protein quality. Protein quality determined by the sodium dodecyl sulfate (SDS) sedimentation test significantly ($p<0.05$) correlated with maximum cutting stress and maximum compression stress of cooked white-salted noodles and Cantonese noodles (Huang & Morrison, 1988). Also, the TPA parameters of cooked noodles were more highly and more significantly correlated with SDS sedimentation volume than with protein content of flour, demonstrating that both protein quality and quantity must be considered in the noodle making process (Baik, 1994).

Protein content of flour also affected the textural properties of white-salted noodles. When protein content of white-salted noodles was increased from 9.5% to 13% (amylose content of white-salted noodles was not varied in this study), the hardness and cohesiveness of cooked white-salted noodles had a significant increase ($p<0.05$) from 635 g to 679 g and from 0.4556 to 0.4731, respectively (Guo et al., 2003). Guo et al. (2003) also reported that textural properties of white-salted noodles is more significantly ($p<0.05$) correlated with amylose content of white-salted noodles than with protein content of white-salted noodles.

III. Color of noodles

Color is one of the most important quality factors in noodles, since consumers evaluate noodle quality by their appearance (Cole, 1991). Bright white color is preferred for white-salted noodles, while yellow color is preferred for Cantonese noodles.

The color of noodles originates from two sources: the pigment in wheat bran and the enzymatic browning products resulting from during the processing of the noodle dough (Oh et al., 1985). Carotenoid and flavonoid pigments are two major types of pigments in wheat flour. Carotenoid pigments give wheat flour a creamy yellow color. Carotenoid pigments can easily be bleached by using a bleaching agent such as chloride. The flavonoid pigments are relatively stable and are colorless at acidic pH, but give a yellow color at high pH. Thus, flavonoids are the source of the yellow color in Cantonese noodles, since an alkaline solution (Sodium and Potassium Carbonate solution) is used for Cantonese noodle making. Polyphenol oxidase is responsible for the dark discoloration of freshly prepared noodles (Hoseney, 1998). Since wheat bran is rich in polyphenol oxidase, phenolics and pigments, noodles prepared from high extraction flour generally exhibits darker color than prepared from low extraction flour (Yasunaga & Uemura, 1962). Miskelly (1984) reported that the brightness and yellowness of noodles were attributable to wheat cultivar, milling extraction rate, protein content, starch damage and carotenoid and flavonoid pigments.

It seems that the major flavonoids components in yellow alkaline noodles are flavones-C-diglycosides; originally flavones-C-diglycosides are only present in the germ and are redistributed during milling procedure (Asenstorfer et al., 2006).

IV. Concluding Remarks

White-salted noodles are a very popular and staple form of diet in most Asian countries. Soft and
cohesive texture of white-salted noodles is preferred in Korea and Japan while firm texture of yellow alkaline noodles is more favored in China.

Flour components, such as protein and starch, are major determinant on the textural properties of white-salted noodles. Amylose content, which constitutes approximately 25% of starch in most wheat flour, is highly significantly (p<0.05) correlated with textural properties of white-salted noodles. The white-salted noodles without amylose failed to attain a desirable attributes. The protein content of flour did have an effect on the textural properties of white-salted noodles; but higher correlation was observed with starch components than with protein components.

**Literature cited**


Van Vliet, T. 1999. Rheological classification of...
