

## **Wheat Quality Evaluation Program**

### **Principal Investigators:**

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### **Project Description:**

The purpose of this project is to develop a noodle quality evaluation capability at South Dakota State University. We will build upon the wheat evaluation capabilities acquired in 2007. To date, equipment for chemical composition, wheat milling, dough rheology and end-product product evaluation provide valuable information relating to mixing properties and dough extensibility are in the breeding program. We will implement scale validated bench-scale AACC Methods for noodle quality in selected varieties in both the Winter Wheat and Spring Wheat programs.

The SD Wheat Commission has provided key equipment that is central to specific wheat functionality capabilities (experimental baking, flour milling, dough testing). Wheat Quality Evaluation will expand the scope of products and processes in the wheat quality program. We hope to use this data on SD white wheat for the Asian noodle market. This data will be useful in marketing SD wheat.

### **Specific Objectives:**

1. Development of technical capability in Asian Noodle production and assessment
2. Acquisition of commercial noodle maker for Chinese noodles.
3. Training of personnel in all aspects of noodle technology.
4. Establishment of a transparent reporting format for accessibility of end-use quality information by producers.
5. Determination of varietal and environmental factors influencing noodle color, protein strength, cooking quality, etc.

### **Justification and Approach:**

About 40 percent of wheat flour consumed in Asia is consumed as noodles. This class of products, is therefore of interest to us. White wheat varieties being produced in SD may be very suitable for the noodle market in view of the flour and functionality traits seen in them. Dr. Krishnan will provide technical assistance to ensure the optimal use of the noodle production equipment. A wide array of equipment such as the Farinograph, Mixolab, Quadrumat Brabener Mill, Texture Analyzer, Minolta Colorimeter, Kernel Hardness Tester, Protein Analyzer, Cross Flow Blender, Proofing cabinets, Mixing Equipment and Food Production equipment are available to ensure the success of the proposed objectives.

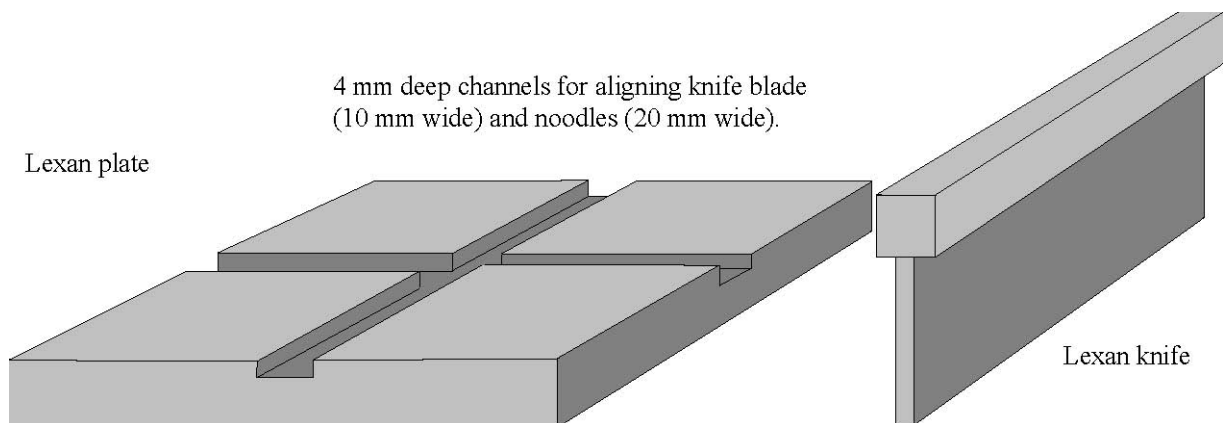
As SD provides varied growing conditions for its crops, the state provides an opportunity for the determination of the influence of variety, growing conditions, and agronomic practices on the constituents in the grain.

## Appendix – Test methods for measuring the firmness of Asian Noodles and comparison of Asian Noodle dough using the Kiefer Extensibility Rig and Extensigraph.

Virtually every country in Asia has a rich variety of noodles with unique textural preferences. The Asian Products Laboratory (APL) of the Wheat Marketing Center in Portland, Oregon has conducted extensive research into the quality attributes of US wheats for Asian consumer acceptability of oriental noodles. The APL conducts an ongoing Asian Noodle Protocol project for the development of test protocols, standard processing methods, and quality measurements for hard and soft wheats. The APL, Oregon State University, and technical teams from Asia also research the nuances of consumer acceptability and instrumental textural differences of noodles made from wheats which are exported through the Columbia River basin (among them hard red spring wheat, hard red winter wheat, soft white and white club wheat).

### **Texture Profile Analysis Test for Firmness & Mouthfeel Characteristics**

The APL uses a modified Lexan plate and knife blade for the firmness test. The rig (TA-47PB), depicted below, consists of a Lexan knife blade and a 3" by 4" Lexan plate which helps the operator to consistently line up the noodles (\*\*). The plate is held in place with the TA-90 Base Platform. The plate has 4 mm deep channels which are 20 mm wide for five strands of noodles (laying side by side), and 10 mm wide for the knife blade. The Lexan knife blade is 30 mm long, 5 mm wide, and 55 mm tall.

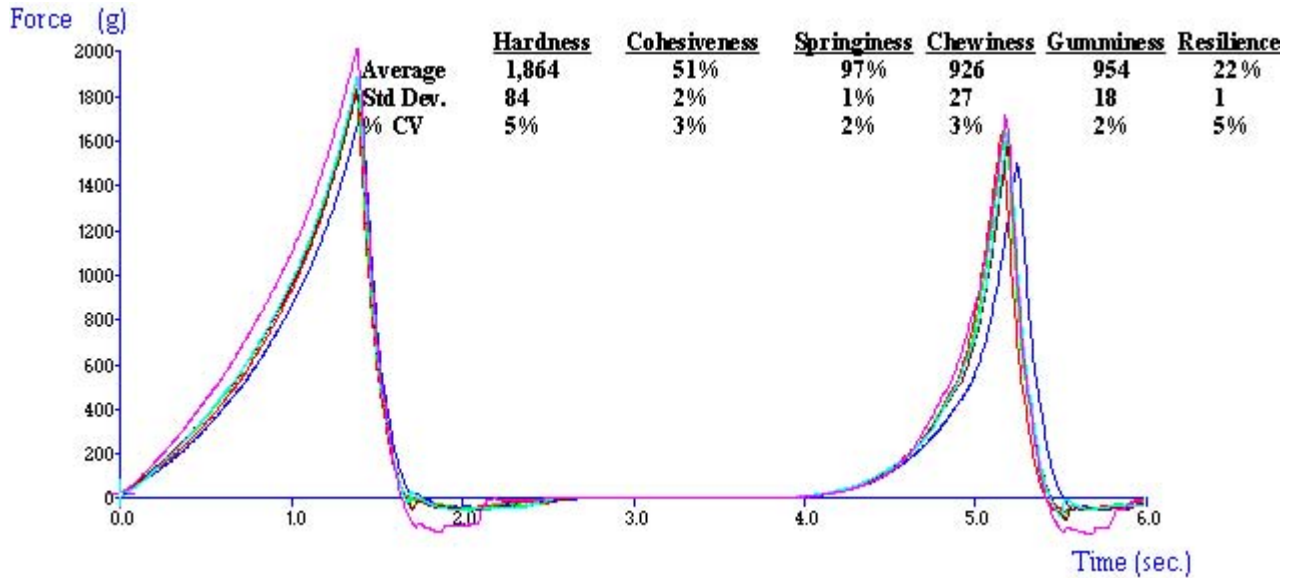


Asian noodles have so many varieties that there is no fixed preparation and cooking standards for all varieties. The ideal time to test noodle texture is when they would otherwise be ready for the consumer to eat. Accordingly each variety of noodles should be prepared and cooked consistently between batches and in a manner which reflects how they would be ordinarily manufactured and consumed.

Most Asian noodles are made from hard and soft wheat flours, which are mixed and passed through multiple reducing sheeting rollers until the desired dough sheet thickness is achieved. The sheeted noodle dough is then slit. Chinese raw noodles, for example, would simply be cooked for a preset time before being rinsed, drained and served. For hokkien noodles, noodle strands are parboiled, rinsed, drained and oiled. Ramen noodles, on the other hand, would be fried after being steamed and then packaged before being rehydrated with boiling water for the consumer to eat. For each type of noodles, the sample preparation steps should be standardized, including: cooking times, duration and rinsing water temperature, type and duration of the draining basket, treatment of noodles between test repetitions, etc. The Texture Profile Analysis test consisted of compressing 70 percent strain through the noodles (five strands of noodles laying side by side) after its surface was detected at 10 grams of force with the TA.XT2's

auto detection feature. The compression test and post-test speeds were at 1.0 mm/second. The pre-test speed was at 4.0 mm/second. The waiting period between each compression was 1.0 second. The test is typically repeated at least three times on freshly made noodles.

### TPA Tests on Cooked Chinese White Salted Noodles

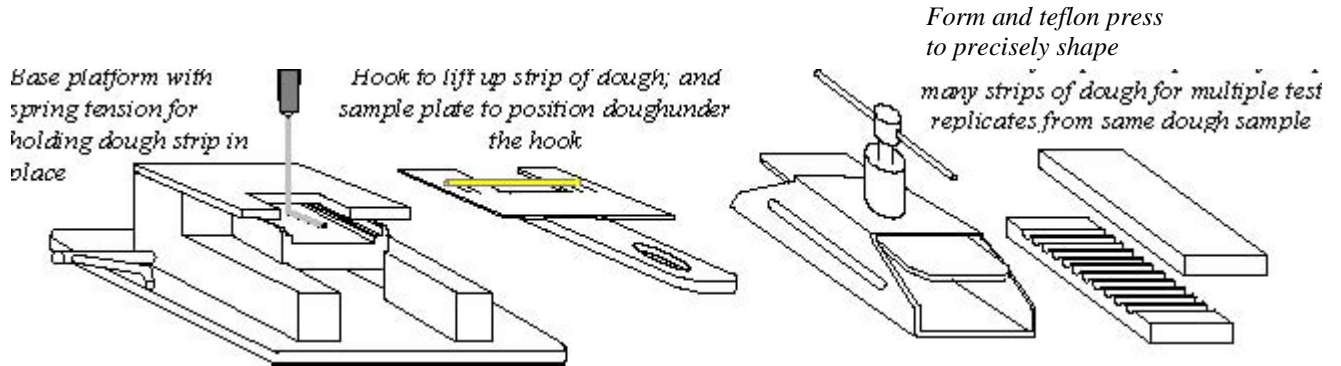


TPA test results on noodles are typically very repeatable as indicated above, although the consistency of the sample preparation will affect the repeatability. The Wheat Marketing Center has determined that the same TPA parameters do not correlate with the same sensory attributes of all types of Asian noodles. For example, the cohesiveness values correlate well with all sensory texture scores for Ramen instant noodles; whereas hardness values correlate well with the sensory bite score for hokkien noodles. The Wheat Marketing Center is conducting an ongoing evaluation of the instrumental parameters for a broad range of Asian noodles and correlating the results with consumer expectations and mouthfeel judgments.

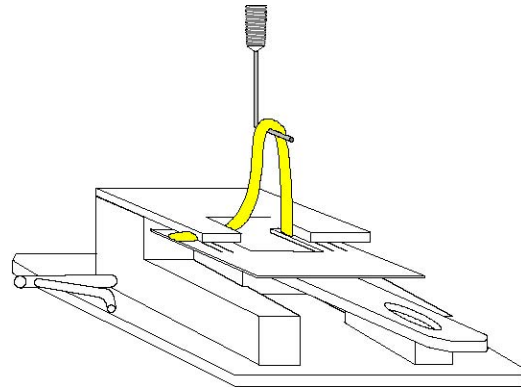
## Extensibility Tests

Extensibility tests are typically conducted on doughs to evaluate their tensile strength and extensibility characteristics based on the wheat's protein and gluten quality. Extensibility tests on noodles were conducted for similar reasons. The dough extensibility test results can also be correlated with texture profile analysis results for cooked noodles. The premise is that cooked noodle texture can be quantified by examining dough extensibility characteristics, eliminating the need to actually make the noodles. While not the focus of this paper, the Wheat Marketing Center has actually correlated the extensibility of noodle dough to the texture of cooked noodles.

The Wheat Marketing Center used a TA-105 SMS/Kieffer Dough and Gluten Extensibility Rig (depicted below) to evaluate the extensibility profiles of a variety of noodle doughs, and compared the test results with those attained with a Brabender Extensigraph.



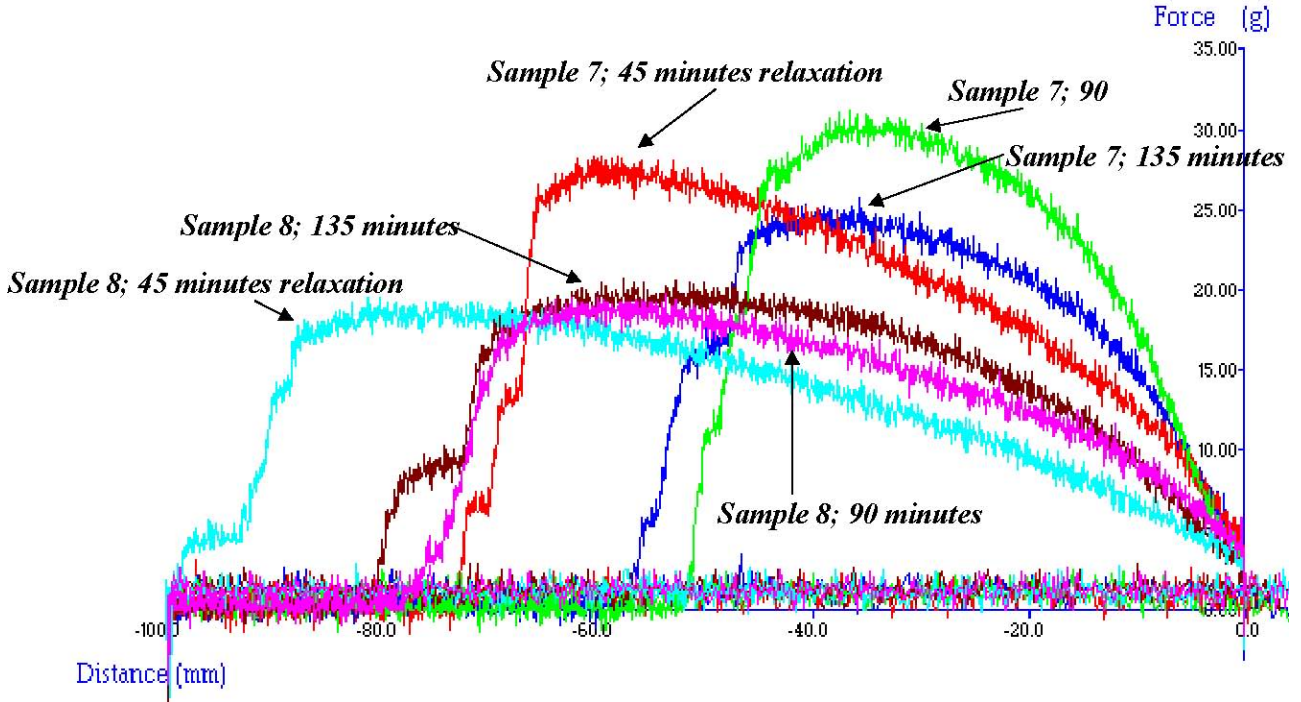
The adjacent diagram illustrates how the Kieffer hook lifts up on a strip of dough once the strip is placed in the rig. Note that, unlike the Extensigraph, the SMS/Kieffer Extensibility Rig uses a very small sample size (approximately 10 grams of dough) for multiple test replicates and greater statistical comparability with a short testing period (typically 40 minutes). Test replicates with an Extensigraph is very time consuming when a statistically appropriate number of replicates is desired.



The settings for the SMS/Kieffer Dough Extensibility Rig were as follows: Measure force in tension, pre-test speed of 2.0 mm/second, test speed of 3.3 mm/second, post-test speed of 10.0 mm/second, distance between 80 and 130 mm (variable), and an automatic trigger force of 5 grams.

Outlined below are the averages of extensibility tests using the SMS/Kieffer Rig on two types of noodle doughs under different relaxation periods. Each graph plot represents the average of four test replicates. Note that the software allows you to create average profile graphs, archive the information in your lab computer, and overlay individual and/or average graphs for graphically illustrating differences between samples.

### Kieffer Extensibility Results for Chinese Raw Salted Noodle Dough



As the relaxation period for the dough increases, the doughs' extensibility distance becomes shorter. Note that the peak force of Sample 7 significantly increases when the dough was allowed to develop for 90 minutes, but it lost extensibility. The strength decreased when the dough was allowed to relax further to 135 minutes. The Sample 8 dough lost extensibility after it was allowed to develop beyond 40 minutes, but its strength profile remained unchanged. Please refer to the statistics for these tests in the following chart. The statistics indicate that the tests were very repeatable as indicated by the very low coefficients of variance.

#### 45 Minutes Rest

#### 90 Minutes Rest

#### 135 Minutes Rest

Peak Force (g)	Area of Work (g mm)	Extensibility (mm)	Peak Force (g)	Area of Work (g mm)	Extensibility (mm)	Peak Force (g)	Area of Work (g mm)	Extensibility (mm)			
7DO1	30.3	1,285	66.75	7DO1A	29.0	926	46.08	7DO1B	25.7	845	47.79
7DO2	31.7	1,555	72.97	7DO2A	32.6	1,188	51.26	7DO2B	28.5	1,136	54.42
7DO3	30.8	1,441	70.02	7DO4A	34.5	1,111	48.57	7DO4B	27.6	1,067	57.09
7DO4	30.3	1,355	67.20	7DO5A	35.4	1,298	52.27	7DO5B	26.2	1,058	58.10
<b>Mean</b>	<b>30.8</b>	<b>1,409</b>	<b>69.23</b>	<b>Mean</b>	<b>32.9</b>	<b>1,131</b>	<b>49.54</b>	<b>Mean</b>	<b>27.0</b>	<b>1,026</b>	<b>54.35</b>
<b>Std Dev</b>	<b>0.6</b>	<b>101</b>	<b>2.50</b>	<b>Std Dev</b>	<b>2.5</b>	<b>135</b>	<b>2.42</b>	<b>Std Dev</b>	<b>1.1</b>	<b>109</b>	<b>4.02</b>
<b>% CV</b>	<b>2%</b>	<b>7%</b>	<b>4%</b>	<b>% CV</b>	<b>7%</b>	<b>12%</b>	<b>5%</b>	<b>% CV</b>	<b>4%</b>	<b>11%</b>	<b>7%</b>
8DO1	20.7	1,284	99.74	8DO1A	21.6	1,010	72.61	8DO2B	22.5	1,140	72.12
8DO2	21.1	1,248	93.07	8DO2A	20.7	1,004	74.41	8DO3B	22.5	1,164	79.81
8DO3	21.6	1,296	92.31	8DO3A	22.1	1,077	71.29	8DO4B	21.6	1,090	72.51
8DO4	21.6	1,262	90.53	8DO4A	21.1	1,133	78.03	8DO5B	23.4	1,320	81.28

**Mean 21.3 1,272 93.91 Mean 21.4 1,056 74.08 Mean 22.5 1,179 76.43 Std Dev 0.4 19 3.49 Std Dev 0.5 53 2.53 Std Dev 0.7 86 4.15 % CV 2% 1% 4% % CV 2% 5% 3% % CV 3% 7% 5%**