

## Development of Naked oats convenient noodles

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**Abstract:** Based on oat flour and wheat flour as the main raw materials, the determination of convenient oat noodles by orthogonal test, sensory evaluation, and strip breaking rate are used. The method is as follows: the mixing ratio of oat flour and wheat flour is 4: 6, the amount of water added is 45%, and 8% egg white, 2% salt were added. Knead the dough and roll it 12 times. After the dough is cooked for 5 minutes, roll and cut into noodles with a length of 15 cm, a width of 0.4 cm and a thickness of 0.1 cm. Cook the noodles at 100 °C for 5 minutes, cool it down and drain, and dry with hot air to make a healthy, convenient and natural instant noodle.

**Key words:** Naked oats noodles; Formula; Process optimization

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### I. Introduction

Naked oats, also known as oatmeal, belongs to the genus *Gramineae* and is an annual herbaceous crop. Oatmeal is recognized as a food species with high nutritional value in the world, and is one of the best full-price nutritious foods in cereals. Naked oat contains 12.2%-14% protein, higher than other cereals. Its total amino acid content reached 2.08%, and the proportion of each amino acid was relatively balanced, among which glutamate accounted for the highest proportion, followed by alanine, valine and aspartic acid [1]. Naked oats contain part of the fat, more than 80% is unsaturated fatty acid, oleic acid accounted for 30%-40% of unsaturated fatty acid. In addition, linoleic acid accounts for 38-52% of total fatty acids. The ratio of monounsaturated, saturated and polyunsaturated fatty acids was 2:1:2 [2]. Naked oats also contains a lot of dietary fiber, which is 9 times as rich as powerful powder [3]. The main type of dietary fiber contained a water-soluble dietary fiber- $\beta$ -glucan,  $\beta$ -glucan has more physiological functions [4] and has high nutritional value. In addition, naked oats in Ca, Mn, Zn, Fe, P, Mg and other mineral composition content are higher than other grains [1]. Naked oats food has a variety of health care functions such as lowering blood pressure, preventing cancer, promoting wound healing, preventing osteoporosis and delaying aging. Therefore, it is listed as a recommended health food by the international health organization [5]. Based on this, this paper uses naked oats as the main raw material to make a daily staple instant noodles. Eating such noodles can well supplement the nutrients required by the human body.

### II. Materials and methods

#### 1. Materials

Oat flour (old traditional oat noodles, a speciality of Harahira City), wheat flour (Yantai Yanlong flour high tendency original flour), GX-G413 electric cooker (Chaoan City, Cai Tang Town, star stainless steel products factory), ACS-30 electronic tariff scale (Hua Ying weights & measures Co.), K70 kitchen electronic scale (Zhongshan Leyi electronic technology Co.), MP10001 electronic balance (Shanghai sunyu hengping scientific instruments Co.), UV752 ultraviolet visible spectrophotometer (Guangzhou yongcheng experimental instrument Co.)

#### 2. Methods

##### 2.1 Process flow and operating points

Avena flour, wheat flour, salt, egg white  $\rightarrow$  weighing  $\rightarrow$  warming  $\rightarrow$  rolling  $\rightarrow$  cutting  $\rightarrow$  boiling  $\rightarrow$  cooling  $\rightarrow$  nat noodles  $\rightarrow$  to be dried.

Operation points: accurately weigh the oat and wheat flour and mix it well, mix the amount of egg white, water and 2% salt in advance; make the dough cooked for 5min, roll it into thin cakes, and cut it into noodles of 15cm in length, 0.4cm in width and 0.1cm in thickness; put the oat and wheat noodles into boiling water and cook it, then cool it and wait to dry.

## 2.2 Determination of the best cooking time for oat and oat noodles [6]

Take 10 noodles and put them in 500mL of boiling water to start the timer, take out three noodles at 2s intervals starting from 20s, use two pieces of transparent glass to flatten the noodles to see if there is a white core in the middle.

## 2.3 Determination of the fracture rate of oat noodles [6]

Take 100 noodles and boil them in 1L of boiling water until the optimal cooking time, then immerse them in cool water, count the number of broken noodles and calculate the noodle breakage rate.

$S = (n1/100) \times 100\%$  Where: S is the noodle breakage rate/%; n1 is the number of noodles broken.

## 2.4 Determination of the recipe for oat noodles

The conditions of the noodle making process are certain, and it is also necessary to determine the ratio of oat and wheat flour and the most suitable adding range of water and egg white.

### 2.4.1 The choice of mixing ratio of oat and wheat flour

On the premise of adding 2% of salt, 45% of water and 8% of egg whites, set different mixing ratios of oat and wheat flour, 2:8, 3:7, 4:6, 5:5, 6:4 respectively.

### 2.4.2 Options for adding water

On the premise of adding 2% of salt, 8% of egg whites and 4:6 of oat and wheat flour mixing ratio, set different water additions, respectively: 35%, 40%, 45%, 50%, 55%

### 2.4.3 Choosing the amount of egg whites to add

With 2% salt, 45% water and 4:6 wheat flour to wheat flour mix, set different egg whites to add 5%, 6%, 7%, 8%, 9%, respectively.

### 2.4.4 Orthogonal test

Select the suitable mixing ratio of oat and wheat flour and the additions of water and egg whites to carry out L9(3<sup>3</sup>) orthogonal test, and finally arrive at the best technological conditions for making oat noodles.

### 2.4.5 Sensory evaluation standard for oat and oat noodles [6]

Ten noodles were taken, boiled in 500mL of boiling water until the best time to fish out, cooled in cold water and evaluated for sensory purposes. A tasting panel consisting of seven judges tasted the noodles and scored them on a scale of 100.

**Table 1 Sensory evaluation items and scoring criteria of noodles**

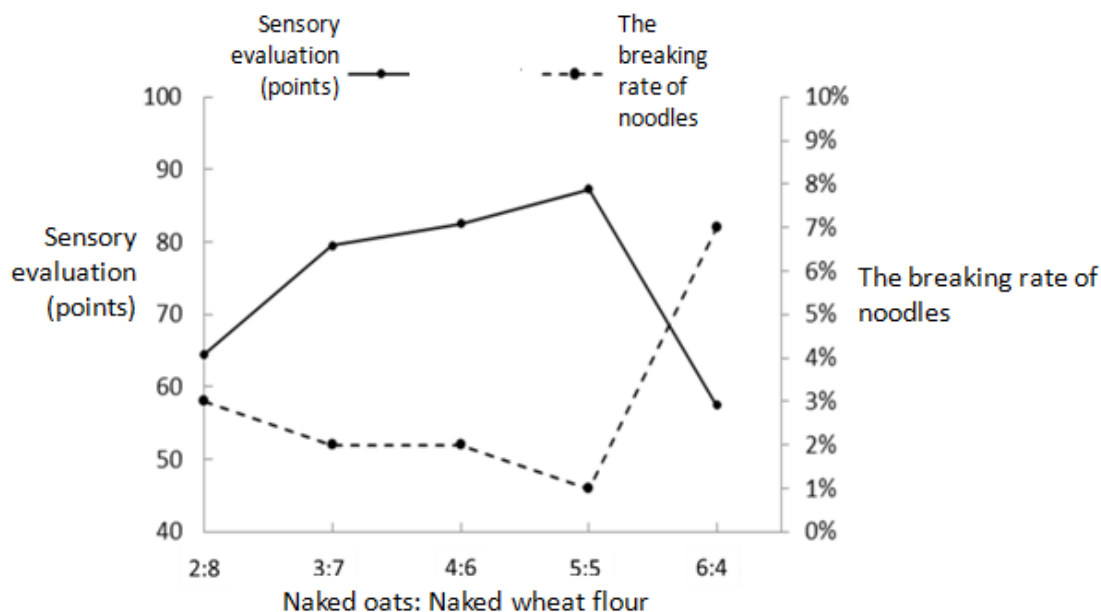
Items	Full points	Definition	Standard for evaluation
Color and lustre	10	The color of the noodles	Naked oats noodles were naked oats pale brown 8.5-10 points Near naked oats color for 6-8.4 points
The apparent state	10	Surface flatness and expansion	Surface structure fine, smooth 8.5-10 points The second score is 6.0 to 8.4 points
Palatability	20	The force needs to break a noodle with your teeth	Score 17-20 points for moderate strength Slightly hard or soft 12-17 points
Tenacity	25	The size of the bite and elasticity of noodles while chewing	A score of 21-25 for bite and elasticity Bite slightly poor, elastic for 15-21 points
Viscosity	25	The degree to which the noodles are sticky during chewing	Chew refreshing, non - sticky teeth for 21-25 points Relatively refreshing, slightly sticky teeth for 15-21 points
Smoothness	5	The smoothness of the noodles	Smooth: 4.3-5 marks The second score is: 3-4.3
Taste	5	The taste of it	Naked oats fragrance: 4.3-5 points Basically no odor: 3-4.3 points

## III. Results and analysis

### 1. Determination of the range of raw material formulation parameters

#### 1.1 Determine the mixing ratio of oat and wheat flour

The effect of the mixing ratio of oat and wheat flour on the sensory evaluation of the quality of oat noodles and the breakage rate is shown in Figure 1.

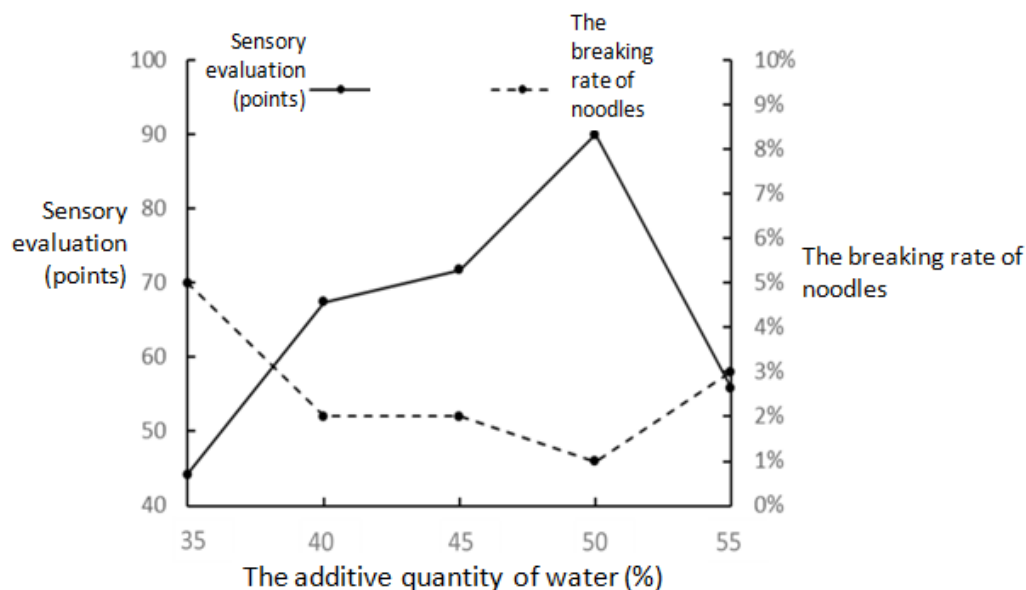


**Figure 1** The effect of the mixing ratio of oat and wheat flour on the sensory evaluation of the quality of oat noodles and the breakage rate

When the ratio of oat flour: wheat flour is from 2:8 to 5:5, the sensory rating of oat flour noodles gradually increases, the breaking rate of oat flour noodles is between 1%-3%, oat flour noodles are better in taste, flavor and other sensory evaluation. With the ratio of oat flour to wheat flour exceeding 5:5, the breakage rate of oat noodles increased significantly to 7%, which also affected the sensory evaluation and led to a significant decrease in the score. This is because oat flour is not easy to form gluten network, and it is necessary to add the right amount of wheat flour to increase the content of gluten protein in oat flour. Wheat gluten and wheat gliadin are present in wheat flour, and when mixed with water, the two interact to form a gluten network that forms sticky dough [7]. The molecular weight of gluten of oat flour is small, and does not have viscous-elasticity; the dough formed after adding water has no gluten, no disulfide bond and sulfur-hydrogen bond, making the dough hard and easy to break [8]. According to this, oat flour and wheat flour selected 3:7, 4:6, 5:5 three levels for orthogonal test.

### 1.2 Determination of water addition

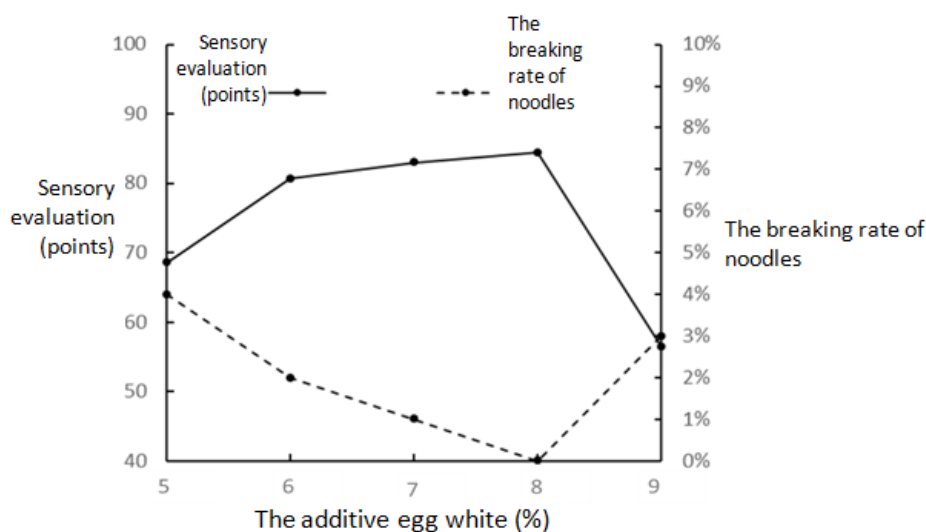
The effect of adding water on the sensory evaluation and breakage rate of oat noodles is shown in Figure 2. From Figure 2 can be seen, when the water is added in 35%-55%, with the increase of the added amount, the sensory evaluation of oat noodles was first rising and then falling trend, the breaking rate was first falling and then rising trend, when the added amount increased to 50%, the sensory evaluation of oat noodles is high, the breaking rate is low. How much water is added is one of the main factors that affect the effectiveness of the mixing. The purpose of flour mixing is to form dough with a certain viscoelasticity, plasticity and extensibility, in order to achieve this requirement, the protein in the flour must fully absorb water to form gluten, starch absorbs water to expand, thus adding water is a necessary condition to achieve the mixing effect [9]. With little water added, gluten tissue is not fully formed and gluten is not elastic enough and can be easily pulled off. When too much water is added, the starch paste is too much, the noodles are softer and less likely to cut [10], and the number of noodle breaks increases. Based on the above analysis, three levels of water addition were selected for the orthogonal test: 40%, 45% and 50%.



**Figure 2** Effect of water addition on sensory evaluation and strip breaking rate of naked oats noodles

### 1.3 Determination of the amount of egg whites to be added

Egg whites have a higher consistency. Adding a certain amount of egg whites to the oat flour can improve the protein content and wet gluten content in the oat flour. Egg white protein and gluten protein have similarities in structure, is beneficial to enhance the strength of the protein mesh structure, can improve the toughness of oat noodles, but also to a certain extent to prevent oat noodles from breaking [9]. The effect of the amount of egg white added on the sensory evaluation and breakage rate of oat noodles is shown in Figure 3.



**Figure. 3** Effect of egg white addition on sensory evaluation and strip breaking rate of naked oats noodles

As can be seen in Figure 3, the addition of egg whites at 5%-9% improved the sensory quality of the noodles. When the additive amount is 8%, the highest, basically prevented the oat noodles from breaking in the cooking process, the sensory score value is also higher to 85 points, the oat noodles breakage rate is significantly reduced. When the amount added exceeds 8%, the proportion of broken noodles of oatmeal is still low, but the hardness of the noodles increases, the taste becomes worse, and the quality of the senses decreases. Adding egg white to oat noodles can increase the protein content of oat noodles [11] and improve the taste and flavor of oat noodles. With the addition of egg whites, the amount of water and protein in the pasta increases, making the pasta gluten network structure stronger [10]. The orthogonal test was performed at three levels: 6%, 7% and 8%. Adding egg white to oat noodles can increase the protein content of oat noodles [11] and improve the taste and flavor of oat noodles. With the addition of egg whites, the amount of water and protein in the pasta increases, making the pasta gluten network structure stronger [10]. The orthogonal test was performed at three levels: 6%, 7% and 8%.

## 2. Orthogonal test

According to the results of the most suitable range of the one-factor test (sensory scoring combined with the breakage rate), the orthogonal test was conducted with the ratio of oat flour as 3:7, 4:6, 5:5, the addition of water as 40%, 45%, 50%, and the addition of egg white as 6%, 7%, 8%, and the best recipe for cooking oat noodles was determined according to the breakage rate and sensory scoring of each group of noodles.

From Table 2 can be seen, the raw material recipe factors influencing the sensory quality of oat noodles are in the order of  $RA > RB > RC$ , the ratio of oat flour and wheat flour is the main factor influencing the oat noodles, followed by the addition of water and egg white. Comprehensive oat and wheat noodles sensory quality scoring standard, the scheme determined by the K value of orthogonal test is  $A_2B_2C_3$ , oat noodles sensory scoring is high, that is, oat flour: wheat flour is 4:6, the added water is 45%, the added amount of egg white is 8%. The main order of factors affecting the breaking rate of boiled oat noodles is: oat flour: wheat flour  $>$  Added water = Added amount of egg white, the optimal level of the lowest breaking rate of boiled oat noodles is  $A_2B_2C_3$ . The main order of factors of raw material recipe is consistent with the optimal level of the lowest breaking rate of boiled oat noodles. The structure of naked oat noodles is fine and smooth, the noodles have a certain bite, elasticity, when chewing is more refreshing, no peculiar taste. From this, it is determined that the best recipe for cooking oat noodles is  $A_2B_2C_3$ , that is, oat and wheat flour: wheat flour is 4:6, the added water is 45%, the added amount of egg white is 8%.

**Table 2 Orthogonal test results**

No.	Factors			Sensory evaluation (points)	The breaking rate of noodles (%)	
	A Oat flour: wheat flour	B Water	C Egg white			
1	1 (3:7)	1 (40%)	1 (6%)	40.3	3	
2	1	2 (45%)	2 (7%)	54.5	2	
3	1	3 (50%)	3 (8%)	49.5	2	
4	2 (4:6)	1	2	66.8	1	
5	2	2	3	89.3	1	
6	2	3	1	77.9	2	
7	3 (5:5)	1	3	73.5	4	
8	3	2	1	76.5	4	
9	3	3	2	71.5	5	
Sensory evaluation	K <sub>1</sub>	144.3	180.6	194.7	-	-
	K <sub>2</sub>	234	220.3	192.8	-	-
	K <sub>3</sub>	221.5	198.9	212.3	-	-
	k <sub>1</sub>	48.1	60.2	64.9	-	-
	k <sub>2</sub>	78	73.43	64.27	-	-
	k <sub>3</sub>	73.83	66.3	70.77	-	-
	R	29.9	13.23	6.5	-	-
Primary and secondary factor: $A > B > C$						
Optimum proposal: $A_2B_2C_3$						
The breaking rate of noodles	K <sub>1</sub>	7	8	9	-	-
	K <sub>2</sub>	4	7	8	-	-
	K <sub>3</sub>	13	9	7	-	-
	k <sub>1</sub>	2.33	2.67	3	-	-
	k <sub>2</sub>	1.33	2.33	2.67	-	-
	k <sub>3</sub>	4.33	3	2.33	-	-
	R	3	0.67	0.67	-	-
Primary and secondary factor: $A > B = C$						
Optimum proposal: $A_2B_2C_3$						

## 3. Comparative tests

We compared the noodles made from oat and wheat (A) with the noodles made from commercially available oat and wheat (B) through the breakage rate, and the results are shown in Table 3.

**Table 3 Comparison results of noodle broken rate (%)**

Testing number		1	2	3	4	5	6	7	8	9	10	Total	Average
Sample	A	1	3	2	2	1	1	2	4	1	2	19	1.9
	B	0	2	2	1	1	1	2	2	1	2	14	1.4
Difference of breaking rate	d	1	1	0	1	0	0	0	2	0	0	5	0.5
	d2	1	1	0	1	0	0	0	4	0	0	7	

Note: A is a test product; B is a commercially available product.

With a scorer's freedom of 9, the t-distribution table was checked to obtain the corresponding critical value  $t(9(5\%))=2.262$  at the 5% significant level [11], and the t-value calculated from the data in Table 3 is 1.299. Since  $1.299 < 2.262$ , there is no significant difference between the oat noodles after process optimization and the corresponding products in the market.

**Table 4 Comparison test**

	Test product	Commercial product
Sensory evaluation (points)	89.3	90.5
Braking rates (%)	4	0

According to SB/T10137-93 standard, the sensory evaluation of noodles should be considered in terms of color, appearance, palatability, toughness, stickiness, smoothness, taste and other aspects, and at the same time, the total score of ordinary grade wheat flour products should be  $\geq 75$  points and the breakage rate  $\leq 5\%$ . The sensory scores and breakage rates of the test products and commercially available products in Table 4 are in accordance with the requirements.

#### IV. Conclusion

The main order of the recipe for cooking oat noodles is oat flour: wheat flour > add water > add amount of egg white. The optimal technology conditions are: the ratio of oat flour and wheat flour in the mixed flour is 4:6, add 45% of water, 8% of egg whites, add 2% of salt, knead into dough after rolling 12 times, the dough ripening time is 5min, cut the noodles of 15cm in length, 0.4cm in width, 0.1cm in thickness, cook under  $98^{\circ}\text{C}$  for 5min, then cool and drain hot air to dry. In this way, light brown, no white core, fresh taste, delicious and healthy oat and wheat instant noodles can be produced.

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