KOREAN J. FOOD SCI. TECHNOL.
*Vol.*8, *No.*4 (1976)

Preparation and Evaluation of Dried Noodles Using Barley-Wheat and Barley-Soybean Flours

by

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(Received September 6, 1976)

보리-밀 및 보리-콩 複合粉의 製麵性 및 製品特性에 關한 硏究

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(1976년 9월 6일 수리)

Abstract

A barley (20—30%)—wheat (80—70%) flour gave generally acceptable noodle-making characteristics, in which naked barley flour showed somewhat better results than covered barley flour. And also for over 40% barley flour in the barley-wheat flour, the addition of xanthan gum improved the noodle-making characteristics. A naked barley-defatted soy flour could make dried noodles with only high NSI (Nitrogen Solubility Index) defatted soy flour, however this mixture was not considered to be feasible for noodle-making.

In cooking characteristics of barley-wheat flour noodles, naked barley flour was more acceptable than covered barley flour and xanthan gum influenced the water absorption and volume expansion of noodles during cooking.

The firmness, cohesiveness and gumminess in cooked noodles made of the barley-wheat flour increased and then decreased as the amounts of barley increased. The mixing of defatted soy flour (high NSI) to naked barley flour increased the firmness and gumminess of cooked noodles.

Introduction

Noodles are usually made from wheat flour, buckwheat flour and starches,[1] however the reports are available on the noodle-making properties of triticale [2] and coconut[3] flours. The studies on the characteristics of noodles prepared from various mixtures of wheat flour and other cereal flours showed that barley had good noodle-making characteristics[4]. Glyceryl monostearate, sodium polyacrylate, hydroxypropyl methyl cellulose and seaweed (*Undaria pinatafita*) extract were effective in improving noodle quality[5,6].

The present paper describes noodle-making properties and product qualities made from various composite flours consisting of barley(naked or covered) and wheat flours, or barley and soy flours. In addition, a possible effect of xanthan gum on the noodle-making charact-

Table 1. Proximate composition and amylograph characteristics of various flours

Flours	Proximate composition			Amylograph characteristics		
	Moisture (%)	Crude protein (%)	Ash (%)	Gelatinization temp. (°C)	Temp. at maximum viscosity (°C)	Maximum viscosity (B.U.)
Naked barley flour (NBF)	12.3	10.0(N×5.8)	0.7	75	87	460
Covered barley flour (CBF)	10.2	11.8(N×5.8)	0.9	73	86	340
Wheat flour(WF)	11.0	9.9(N×5.7)	0.5	72	88	260
Defatted soy flour(FD)*	8.6	49.0(N×6.25)	6.3	—	—	—
Defatted soy flou(DT)*	10.0	51.2(N×6.25)	6.5	—	—	—

* NSI for FD and DT was 63 and 23, respectively.

eristics of such composite flours was investigated.

Materials and Methods

1. Materials

Covered barley flour and wheat flour were obtained from the Daehan Flour Milling Co. (Korea). The defatted soy flours, DT (Nitrogen Solubility Index, NSI: 23) and FD (NSI:63) grade, were obtained from Dongbang Oil and Flour Mills Co. (Korea). Naked barley flour was prepared by a local miller. Their proximate composition and amylograph characteristics are shown in Table 1. Xanthan gum(XG: Keltrol) was supplied by Kelco Co. (U.S.A.).

2. Methods

A set of composite flour formulation was mixed using a Univex mixer (Universal Mixer Co., U.S.A.). The composite flour (2Kg) was mixed with water(See Tables 2 and 3) and salt(3% based on flour weight). The mixture was kneaded for 10 to 12 min at room temperature, sheeted 4 times in kneading rolls of noodle-making machine (Shinhung Industrial Co., Korea), and allowed sleeping for 20 to 40 min depending upon the kind of composite flour. It was then made into sheets (1.5±0.1mm thickness), cut in rounded noodles and air-dried. The average diameter of the dried noodles was 1.4mm.

The hardness of the dried noodles was determined with a Texturometer(General Foods-Zenken Co., U.S.A.). The conditions were: plunger set at V shape, platform flat, clearance 0.15mm, voltage 1.0 volt, bite speed low, and chart speed at 750mm/min.

Noodle cooking qualities were measured with the method of Tanaka[7]. Dried noodles(20g) were cooked for 5 or 10 min in 1 liter of boiling water. The weight and the volume of the cooked noodles and the solid extracts of the cooked water were measured. The solid extracts of the cooked water were expressed as turbidity which was measured spectrophotometrically at 675nm. For the measurement of texture characteristics of cooked noodles, the noodles boiled for 5 min, were cooled for 1 min in cold water and then held for 2 min in a plastic net container to drain water. Firmness, cohesiveness and adhesiveness of two strings of cooked noodles were then measured using the Texturometer. The conditions for the Texturometer were eth same as those described previously, except luicite 18(plunger) and 5.0 volt(voltage). The amylograms were obtained with a Brabender Amylograph using 8.6% solid concentration according to AACC Methods [8]. The NSI of soy flours was evaluated by AOCS Methods[9] and proximate composition of flours was determined by AACC Methods[8].

Results and Discussion

1. Noodle-making properties of composite flours

The noodle-making properties of the barley-wheat flour are shown in Table 2. As the barley flour level increased, optimal water addition also increased,but no differences in optimal water addition were observed between naked and covered barley flours. The sheet formation became gradually difficult as barley flour level increased. However, the substitution of wheat flour with barley flour up to 30% showed acceptable

Table 2. Noodle-making properties of the barley-wheat flour

Composite flour*	Optimal water addition** (%)	Sheet formation	Dried noodles		
			Hardness (Kg/wt)	Color	Appearance
WF(100)	31	good	2.9	creamy	good
CBF(20)+WF(80)	35	good	3.2	white	good
CBF(30)+WF(70)	37	pretty good	2.8	grey white	rough
CBF(40)+WF(60)	40	fair	2.4	grey white	coarse
NBF(20)+WF(80)	35	good	4.0	white	good
NBF(30)+WF(70)	37	pretty good	3.7	grey white	rough
NBF(40)+WF(60)	39	pretty good	3.2	grey white	coarse
NBF(60)+WF(40)	42	bad	2.7	dark grey	coarse
NBF(80)+WF(20)	46	very bad	2.3	dark grey	coarse & brittle
NBF(40)+WF(60)+XG(0.5)	39	good	3.2	grey white	coarse
NBF(60)+WF(40)+XG(0.5)	43	fair	2.9	dark grey	coarse
NBF(80)+WF(20)+XG(0.5)	46	bad	2.8	dark grey	coarse
NBF(100)+XG(1.0)	49	fair	2.8	dark grey	coarse & brittle
NBF(100)+XG(2.0)	51	fair	2.9	dark grey	coarse & brittle

*(1) See Table 1 for abbreviation, XG stands for xanthan gum.
(2) The figures in the parenthesis indicate flour formulation ratio.

** Optimal water addition ratio $= \frac{\text{optimal water amount}}{\text{quantity of composite flour}} \times 100$

noodle-making properties including sheet formation and cutting. At the level of 40% coved barley flour in the composite flour mixture as compared to naked barley flour showed a worse result in sheet formationa and cutting. At the levels of 60% naked barley flour, sheet formation was a little difficult practically. With 80% naked barley flour, the final sheet could hardly be made. Although the addition of xanthan gum to the composite flours had no significant effect on water absorption, it had marked effect in improving sheet formation (Table 2). With naked barley alone, 2% xanthan gum addition for noodlemaking was fairley acceptable. Xanthan gum, which was known as a bread-making improver[10,11] was also effective in noodle-making of naked barley flour or composite flour. The hardness of dried noodles made from barley-wheat flour was the highest at the level of 20% naked barley flour. Generally the hardness of noodles made from barley-wheat flour was greater than that of covered barley-wheat flour, and xanthan gum slightly increased the hardness of noodles prepared from barley-wheat flour. As amounts of barley flour increased, the color of the dried nooodles changed from a white-creamy color to grey to dark, giving a bad appearance (See Table 2).

Table 3 shows noodle-making characteristics of naked barley-soy flour. The defatted soy flour with low NSI showed poor noodlemaking characteristics. However, with higher than 20% of the defatted soy flour with high NSI a sheet formation was feasible, and at the level of 40% the sheet formation and cutting were pretty good. In the naked barley-soy flour the effect of xanthan gum was not significant. As amount of soy flour increased, water addition decreased, the hardness of the dried noodles greatly increased, and the color turned to dark brown. Even though the defatted soy flour with high NSI rather than the low NSI in barley-soy flour showed better noodle-making characteristics, it is considered that barley-soy combination for noodle-making was not practicable.

2. Cooking characteristics of noodles made from composite flours

Table 4 shows cooking characteristics of noodles made from barley-wheat flour with or without xanthan gum. The weight, volume and soup turbidity of the noodles boiled for 5 or 10 min varied with the kind and amount of barley flour used.

The weight of the cooked noodles increased as the

Table 3. Noodle-making characteristics of naked barley-defatted soy flour

Composite flour*	Optimal water addition (%)	Sheet formation	Hardness of dried noodles (Kg/wt)
NBF(90)+DT(10)	—**	impossible	—**
NBF(80)+DT(20)	—**	impossible	—**
NBF(80)+DT(20)+XG(1.0)	—**	impossible	—**
NBF(90)+FD(10)	—**	very bad	—**
NBF(80)+FD(20)	40	bad	—***
NBF(80)+FD(20)+XG(1.0)	42	fair	4.7
NBF(70)+FD(30)	38	fair	5.3
NBF(60)+FD(40)	36	pretty good	5.8

* See footnotes in Table 1.

** Sheet formation could hardly be made, so optimal water addition and hardness could not be determined.

*** Sheet formation could be made, however cutting was difficult. Hardness of dried noodle was not determined.

boiling time increased, probably due to increased water absorption. The addition of covered barley up to 40% gave an increased weight of noodles with 5 or 10 min boiling as compared to wheat flour alone. Naked barley addition of 20 and 30% in the flour, showed a similar weight of those of wheat flour alone. However, the addition of 40 to 80% of naked barley gave a slightly increased weight at 5 min boiling. The volume of the cooked noodles changed similar to the weight changes. The turbidity of the noodle soup after boiling increased with the increase in amounts of barley flour,and turbidity for naked barley-wheat flour was lower than for covered barley-wheat flour. In the cooking characteristics of the noodles, naked barley flour in mixture as compared to covered barley flour was generally lower in water absorption and volume expansion, and in turbidity of the noodle soup.These results suggest that naked barley-wheat flour is more advantageous than covered barley-wheat flour in noodle cooking characteristics, and noodles made from naked barley (20—30%)-wheat (70—80%) flour had desirable cooking characteristics comparable to those of wheat alone.

On the other hand, the effect of xanthan gum on

Table 4. Cooking characteristics of noodles made from the barley-wheat flour

Composite flour*	Weight of cooked noodles(g)		Volume of cooked noodles(ml)		Turbidity of soup after cooking	
	5 min	10 min	5 min	10 min	5 min	10 min
WF(100)	165	222	150	203	0.10	0.12
CBF(20)+WF(80)	173	224	165	207	0.13	0.15
CBF(30)+WF(70)	174	232	165	217	0.13	0.17
CBF(40)+WF(60)	176	237	165	220	0.12	0.18
NBF(20)+WF(80)	166	215	150	198	0.09	0.13
NBF(30)+WF(70)	168	218	145	202	0.12	0.14
NBF(40)+WF(60)	173	221	155	197	0.12	0.17
NBF(60)+WF(40)	172	222	162	198	0.18	0.27
NBF(80)+WF(20)	179	227	163	210	0.21	0.31
NBF(40)+WF(60)+XG(0.5)	174	228	150	205	0.12	0.19
NBF(60)+WF(40)+XG(0.5)	178	234	163	220	0.18	0.26
NBF(80)+WF(20)+XG(0.5)	190	254	174	240	0.18	0.32
NBF(100)+XG(1.0)	210	262	184	255	0.23	0.37
NBF(100)+XG(2.0)	216	273	189	262	0.20	0.40

*See Table 1.

Table 5. Cooking characteristics of dried noodles made from the naked barley-defatted soy flour

Composite flour*	Weight of cooked noodles(g)		Volume of cooked noodles(ml)		Turbidity of soup after cooking	
	5 min	10 min	5 min	10 min	5 min	10 min
WF(100)	165	222	150	203	0.10	0.12
NBF(80)+FD(20)+XG(1.0)	145	176	128	160	0.15	0.17
NBF(70)+FD(30)	136	168	121	150	0.12	0.14
NBF(60)+FD(40)	132	158	118	140	0.07	0.10

* See footnotes in Table 1.

the cooking characteristics of the noodles made from the naked barley-wheat flour is shown in Table 4. The addition of xanthan gum to flours slightly increased the cooked noodle's weight and volume, but no noticeable change was observed in the turbidity of its soup. It is considered the xanthan gum influences the water absorption and volume expansion of the noodles during cooking.

Table 5 shows cooking characteristics of noodles made from a comopsite flour of naked barley and defatted soy. As the mixing level of defatted soy flour to naked barley flour increased, the weight and volume of cooked noodles, and soup turbidity greatly decreased. It was also observed that the composite flour with 60—80% naked barley flour and 20—40% FD gave a lower weight and volume of noodles than the case of wheat flour alone.

3. Texture characteristics of cooked noodles made from composite flours

Texture characteristics including firmness, cohesiveness, gumminess and adhesiveness of composite flour noodles boiled for 5 min are shown in Table 6.

Up to 40% barley in the barley-wheat mixture the firmness and gumminess of cooked noodles were rather higher than those of wheat flour, and highest values of those were shown at 20% of barley flours. However, cohesiveness and gumminess slightly decreased in cooked noodles made from the barley-wheat flour mixture as the amounts of barley increased. On the other hand the adhesiveness increased as the barley flour increased. There were no marked differences in texture characteristics between naked and covered barley flour. The values of maximum viscosity in amylogram characteristics (See Table 1) showed that

Table 6. Texture characteristics of cooked noodles made from the barley-wheat flour

Composite flour*	Firmness (Kg/wt)	Adhesiveness (cm^2)	Cohesiveness	Gumminess
WF(100)	0.94	0.04	0.77	72.4
CBF(20)+WF(80)	1.01	0.06	0.84	84.8
CBF(30)+WF(70)	0.98	0.06	0.80	78.5
CBF(40)+WF(60)	0.99	0.06	0.76	75.2
NBF(20)+WF(80)	0.99	0.05	0.85	84.2
NBF(30)+WF(70)	0.98	0.06	0.80	78.4
NBF(40)+WF(60)	0.97	0.06	0.7	75.2
NBF(60)+WF(40)	0.96	0.08	0.70	67.2
NBF(80)+WF(20)	0.94	0.09	0.72	67.7
NBF(40)+WF(60)+XG(0.5)	0.99	0.05	0.79	76.6
NBF(60)+WF(40)+XG(0.5)	0.95	0.05	0.78	74.1
NBF(80)+WF(20)+XG(0.5)	0.94	0.05	0.75	70.5
NBF(100)+XG(1.0)	0.92	0.06	0.75	69.0
NBF(100)+XG(2.0)	0.93	0.05	0.76	70.7

* See footnotes in Table 1

Table 7. Texture characteristics of cooked noodles made from the naked barley-defatted soy flour

Composite flours*	Firmness (Kg/wt)	Adhesiveness (cm^2)	Cohesiveness	Gumminess
WF(100)	0.94	0.04	0.77	72.4
NBF(80)+FD(20)+XG(1.0)	1.50	0.05	0.73	109.5
NBF(70)+FD(30)	1.75	0.04	0.77	134.8
NBF(60)+FD(40)	2.23	0.03	0.92	205.2

* See footnotes in Table 1.

barley flours had higher viscosity than wheat flour. There is some possibility that viscosity is related to increases of the adhesiveness or to characterize the other texture properties of cooked noodle. The addition of xanthan gum to the naked barley-wheat flour indicated that from 40 to 80% barley flour in the mixture the firmness of cooked noodles of those remain similar with and without xanthan gum, whereas the cohesiveness and gumminess were slighly higher with xanthan gum. On the other hand, adhesiveness was lower in the presence of xanthan gum(See Table 6).

Texture characteristics of cooked noodles made from defatted soy flour with naked barley flour are give in Table 7. It can be noted in particular that the firmness and gumminess of the cooked noodles made from barley-soy flour are much higher than those of the barley-wheat flour, and even of wheat flour alone. Especially the firmness of the cooked noodles markedly increased as more defatted soy flour was added. Paulsen [12] reported from their tests on spaghetti-making that addition of soy flour increased the spaghtti firmness.

Acknowledgements: The authors are grateful to Dr. H.E. Snyder, Dept. of Food Technology, Iowa State University, USA for his advice in the early stages of this work. We are also indebted to J.H. Nam,Food Resources Laboratory of this institute for technical assistance. This work was supported by a grant from Denver Research Institute, USA.

요 약

보리가루—밀가루(중력분) 복합분에 있어서 보리가루 30%수준까지는 면대형성 및 절출등의 제면성이 양호하였고 겉보리가루보다는 쌀보리가루가 약간 우수한 제면성을 보였다. 이때 xanthan gum의 첨가는 이들복합분의 제면성을 향상시켰다. 그리고 쌀보리가루—탈지콩가루 복합분에서는 NSI(Nitrogen Solubility Index)가 높은 탈지콩가루만이 건면을 만들 수 있었으나 대체로 불량한 제면성을 보였다.

쌀보리가루—밀가루 복합분으로 만든 건면의 조리특성은 겉보리가루—밀가루의 그것보다 우수한 경향을 보였으며, xanthan gum의 첨가는 조리중 수분흡수 및 부피의 팽창을 촉진시켰다.

보리가루—밀가루 복합분으로 만든 건면의 조리후견고성 및 gumminess는 보리가루 혼합수준이 60%이상에서만이 밀가루 단독의 경우보다 저하되었으며, 쌀보리가루—탈지콩가루 복합분으로 만든 건면의 조리후 견고성은 특이하게 높은 현상을 보였다.

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