

Studies on Application of Texture Analyzer to the Quality Evaluation of Dough and Bread

ZHENG Tie-song

(Department of Food Science and Engineering, Nanjing Normal University, Nanjing 210097, China)

Abstract: Nine quality indexes of dough based on eight kinds of wheat flour have been measured with the Texture Analyzer in this paper. Then nine indexes of dough were elasticity, adhesive force, adhesiveness, fracture force 1, 1st fracture work done, 1st fracture deformation, recoverable work done 1, and recoverable deformation 1. These quality indexes of dough with bread quality (volume and elasticity change rate) and wheat flour characteristic were also studied by correlation analysis. The results showed that correlations between hardness, adhesive force with the volume of bread were significant. Their correlation coefficients were 0.546, 0.568, respectively. The correlation between elasticity and the volume of bread was negative, and the correlation coefficient was -0.606. The correlation between adhesive force and elasticity change rate of bread keeping at room temperature in 24 hours was significant, and the correlation coefficient was 0.707. The texture of dough and wheat flour characteristic had obvious correlation.

Key words: texture analyzer; dough bread; flour; quality

质构仪在面团和面包品质评定中的应用研究

郑铁松

(南京师范大学食品科学与工程系, 江苏 南京 210097)

摘 要: 以八种品牌面粉为试验材料, 采用英国 CNS-FARNELL 公司制造的质构仪测试了面团的硬度、弹性、粘力、粘着性、断裂力、断裂能量、断裂回复形变程度、回复能量、回复形变程度等九种指标, 并通过相关分析研究了这些指标与面包品质(面包体积和弹性变化率)以及与小麦面粉的品质性状的相互关系。研究结果表明: 面团的硬度、粘力与面包的体积呈正相关, 相关系数分别为 0.546、0.568, 弹性与面包的体积呈负相关, 相关系数为 -0.606; 粘力与 24h 后室温下弹性变化率呈显著的正相关, 相关系数为 0.707。面团的质构特性与面粉的品质指标的相关性也非常明显。

关键词: 质构仪; 面包; 面团; 品质

中图分类号 TS213.21

文献标识码 A

文章编号 1002-6630(2004)10-0037-04

There is close relationship between bread quality and dough characteristics. So the bread quality could be evaluated by determining dough characteristics, such as gluten content, SDS sedimentation value, development time, stability, degree of softening, Farinograph quality number and ratio of extensibility to resistance^[1~3].

Some new methods have been recently used for evaluating qualities of dough and bread. Dobraszczyk B et al^[4] used rheometer to measuring dough hardness for forecast the bread volume. The results showed that the higher the

dough hardness was, the bigger the bread volume. Cheng Guowang et al^[5] reported a new method to evaluate the qualities of dough and bread by Swelling Test. Digital Image Analysis was also used to control the bran content of flour to insure producing high quality bread^[6].

Few studies have been reported on evaluation of dough and bread qualities with Texture Analyzer up to now. A lot of quality indexes of dough have been measured with Texture Analyzer in this paper. The relationship between dough and bread was also analyzed. The results showed that the bread

quality could be evaluated by measuring the dough quality with the Texture Analyzer. This research provided reference for industrialization and quality control of bread.

1 Materials and Methods

1.1 Materials

Eight kinds of flour A, B, C, D, E, F, G and H, were supplied by Shanghai Bud Food Co., Ltd.

1.2 Methods

1.2.1 Assays of wheat flour qualities

Gluten content, gluten index and gluten water holding of the flour were assayed with Glutograph^[7].

Falling number and viscosity of the flour was assayed with Falling Number and Viskograph^[8].

1.2.2 Making bread and bread evaluation

Ingredients for making bread: flour: 1000g; water: 554g; sugar: 200g; butter: 80g; yeast: 11g; salt: 10g

Processing line: material→mixing→fermentation(28℃, relative humidity 75%)→divide→round→ intermediate proof (28℃, 75%, 8~15min)→mould→final proof(35~38℃, 80~85%, 60min)→baking→ cooling

Elasticity of the bread was assayed with the Texture Analyzer (CNS-Farnell Company, England)^[9].

1.2.3 Assays of the dough qualities

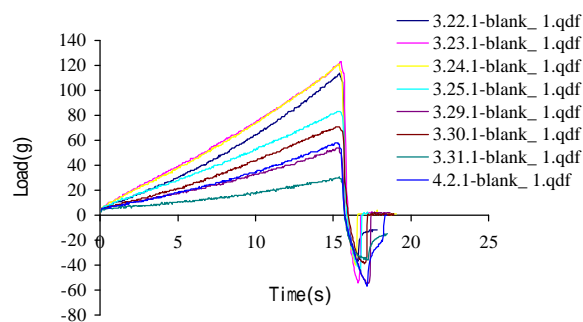
The qualities of 100g of fermented dough were assayed with the Texture Analyzer (CNS-Farnell Company, England).

The operation indexes of the Texture Analyzer were probed: column of diameter: 6mm; working mode: compression; trigger: 4g; total cycles: 1; test speed: 60mm/min; return speed: 1000mm/min; target unit: length; and target value: 15mm. The assay indexes were hardness, adhesiveness, elasticity length, adhesive force, fracture force 1, 1st fracture deformation, 1st fracture work done, recoverable deformation 1, recoverable work done 1.

2 Results and Discusses

2.1 The characteristics of the eight kinds of dough

The characteristics of the eight kinds of dough were assayed with Texture Analyzer. The results showed they had different qualities (Fig. 1, Table 1, 2).



3.22.1-blank A; 3.23.1-blank B; 3.24.1-blank C; 3.25-blank D; 3.29.1-blank E; 3.30.1-blank F; 3.31.1-blank G; 4.2.1-blank H

Fig. 1 The texturography of the 8 kinds dough

Table 1 The characteristics of the eight kinds of dough

Dough	Hardness (g)	Elasticity (mm)	Adhesive force(g)	Adhesiveness (gs)	Fracture force1(g)
A	114	10.18	-37	-33.49	6
B	123	9.82	-54	-30	0
C	121	8.61	-40	-16.73	0
D	83	14.11	-45	-28.01	14
E	54	22.66	-55	-58.61	6
F	71	16.58	-39	-32.74	7
G	31	23.97	-36	-65.4	5
H	58	22.78	-57	-78.71	7

Table 2 The characteristics of the eight kinds of dough

Dough	1 st Fracture work done (gs)	1 st Fracture deformation (mm)	Recoverable work done 1 (gs)	Recoverable deformation 1 (mm)
A	3.75	0.1	14.89	-5.44
B	0	0	18.11	-3.86
C	0	0	18.6	-5.3
D	126.75	1.35	12.26	-4.46
E	17.25	0.33	8.96	-2.77
F	28.88	0.52	12.58	-5.48
G	4.5	0.12	2.85	-2.76
H	34.5	0.61	7.09	-3.55

2.2 Bread qualities

The volumes and spring changing rates of the kinds of bread, kept in room temperature for 24 hours made from the 8 kinds of dough were assayed (Table 3). The elasticity changing rate of the bread stood for the aging rate of the bread.

Table 3 The volumes and spring changing rates of different kinds of bread

Flour	A	B	C	D	E	F	G	H
Bread volume(ml)	218.7	197	200.3	182.2	145.3	165.7	199.1	171.1
Bread elasticity change rate(%)	30.8	40.9	48.4	44.4	13.5	53.6	55.2	22.7

Table 4 The characteristics of the 8 kinds of flour

Flour	Wet gluten(%)	Dry gluten(%)	Gluten index(%)	Gluten water holding(%)	Falling number	Viscosity
A	31.44	11.02	98.98	185.19	285	69.6
B	29.09	10.39	98.82	178.71	296	75.7
C	29.27	10.67	99.53	174.30	367	70.3
D	34.24	12.32	98.21	177.96	350	72.2
E	31.29	10.35	90.29	202.22	267	102.6
F	33.45	11.82	96.74	183.42	360	66.2
G	26.61	9.52	99.12	179.46	354	66.1
H	32.53	10.68	86.04	204.53	264	110

The higher the spring changing rate of the bread was the higher the aging rate of the bread.

2.3 The characteristics of the 8 kinds of flour

Gluten content, gluten index and water holding of gluten of the flour were assayed with Glutograph. Falling number and viscosity of the flour were assayed with Falling Number and Viskograph. The results indicated that there were differences among the 8 kinds of flour (Table 4).

2.4 The relativity between the dough quality indexes and the bread quality indexes

2.4.1 The relativity between the dough quality indexes and the bread volume

The results in the Table 5 showed that there were much marked positive relativity between adhesive force or hardness of the dough and the bread volume. Their correlative coefficients were 0.568 and 0.548 respectively. The bread volume would augment along with the rising of the adhesive force or hardness of the dough. There was much marked negative relativity between the elasticity length of the dough and the bread volume. Its correlative coefficient was -0.606 . The bread volume will descend along with the rising of the elasticity length of the dough.

The results in the Table 5 also showed that there were positive relativity between adhesiveness or recoverable work done 1 of the dough and the bread volume. Their correlative coefficients were 0.403 and 0.358 respectively. There were negative relativity between 1st fracture deformation, recoverable deformation 1 or fracture force 1 of the dough and the bread volume. Their correlative coefficients were -0.402 , -0.398 and -0.320 respectively. But 1st fracture work done of the dough had a little effect on bread volume.

2.4.2 The relativity between the dough quality indexes and the bread volume

The elasticity changing rate of the bread stands for the aging rate of the bread. The higher the elasticity changing rate

Table 5 The correlative coefficients between the dough quality indexes and the bread quality indexes

Bread quality	Bread volume	Bread elasticity changing rate
Hardness	0.54770	0.08436
Elasticity length	-0.60638	-0.27791
Adhesive force	0.56816	0.70771
Adhesiveness	0.40298	0.45634
Fracture force	-0.32029	-0.09309
1 st Fracture work done	0.04782	0.04782
1 st Fracture deformation	-0.40222	-0.02936
Recoverable work done 1	0.35778	0.12068
Recoverable deformation 1	-0.39775	-0.36148

of the bread is, the higher the aging rate of the bread. The results in the Table. 5 showed that there were much marked positive relativity between adhesive force or adhesiveness of the dough and the elasticity changing rate of the bread. Adhesive force of the dough affected greatly on the elasticity changing rate of the bread especially. Its correlative coefficients was as high as 0.708. So if we would have to refresh bread well, we might reduce the adhesive force or adhesiveness of the dough. There was negative relativity between the recoverable deformation 1 or elasticity length of the dough and the elasticity changing rate of the bread. Their correlative coefficients were -0.361 and -0.278 respectively. They could retard the bread aging. But the results in the Table 5 also showed that the other quality indexes of the dough affected very little on bread aging.

2.4.3 The relativity between the dough quality indexes and the flour quality indexes

The results in the Table 6 showed that there were much marked positive relativity between the wet gluten content or water holding of gluten and the elasticity length of the dough. Their correlative coefficients were 0.561 and 0.684 respectively. The higher the wet gluten content or water

Table 6 The correlative coefficients of dough quality indexes and the flour quality indexes

Flour indexes	Wet gluten content	Gluten index	Gluten water holding	Falling number
Hardness	-0.5258	0.5661	-0.5008	-0.0355
Springiness length	0.56096	-0.73277	0.6838	-0.17259
Adhesive force	-0.04629	0.69357	-0.83442	0.86004
Adhesiveness	-0.5383	0.84450	-0.77925	0.31535
Fracture force	-0.30471	-0.11823	0.02404	0.404673
1st Fracture work done	-0.52867	0.02750	-0.04071	0.24031
1st Fracture deformation	-0.37877	-0.12849	0.08263	0.18377
Recoverable work done 1	-0.46644	0.56892	-0.48432	-0.08448
Recoverable deformation 1	0.31237	-0.59095	0.72201	-0.41417

holding of gluten of flour, the longer the elasticity length of the dough. There was much marked negative relativity between the wet gluten content or water holding of gluten and the adhesiveness of the dough. Their correlative coefficients were -0.534 and -0.779 respectively. That is the wet gluten content and water holding capability of gluten almost showed the same effects on the dough. But the gluten index of flour had a marketed reverse effect on the elasticity length and adhesiveness of the dough. There was much marked negative relativity between the gluten index of flour and the elasticity length of the dough. But there was much marked positive relativity between the gluten index of flour and the adhesiveness of the dough. Their correlative coefficients were -0.732 and 0.844 respectively.

The results in the Table 6 also showed that there was marked positive relativity between the falling number of flour and adhesive force of the dough. But there was negative relativity between the falling number of flour and recoverable deformation 1 of the dough. Their correlative coefficients were 0.860 and -0.414 respectively.

The results in this paper showed that the bread quality could have been evaluated by measuring the dough quality with the Texture Analyzer. This research provided reference for industrialization and quality control of bread.

References:

- [1] Blackman J A, Gill A A. A comparison of some small-scale tests for bread-making quality used in wheat breeding[J]. J Agric Sci Camb, 1980, 95: 29-34.
- [2] Moonen J E, Scheepstra A, Graveland A. Use of the SDS sedimentation test and SDS polyacrylamide gel electrophoresis for screening breeder's samples of wheat for bread-making quality[J]. Euphytica, 1982, 31: 677-690.
- [3] Zhao Tingting, Mao Renzhao, Zhao Liancheng, et al. Path analysis among quality characters related to bread-making of foreign introduced wheat[J]. Acta Agric Boreali-Sinica (Chinese), 2000, 15: 189-193.
- [4] Dobraszczyk B, Liu Guoqin, Li Weili. Relationship between strain hardening of dough and breadmaking quality[J]. J Zhengzhou Institute of Technology (Chinese), 2003, 24(2): 32-35.
- [5] Cheng Guowang, Wang Haobo, Huang Qunce, et al. A new method for assessment of gluten quality in bread wheat varieties[J]. Food Sci Techno (Chinese), 2002, (10): 58-59.
- [6] Ciffo D. Bran index: a new flour quality parameter[J]. World Grain, 2002, (2): 46-51.
- [7] Liu Jiangnan. A practical handbook for baking industry[M] (Chinese). Beijing: Chinese Light Industry Press, 2003.
- [8] Wang Zhaoci. Food quality analysis of cereal and oil[M] (Chinese). Beijing: Chinese Light Industry Press, 1994.
- [9] Voisey P W, Larmond E, Wasik R J. Measuring the texture of cooked spaghetti[J]. J Inst Can Sci Technol Aliment, 1978, 11: 142-148.

中文核心期刊 中国期刊方阵双效期刊