

Study on the Optimal Steamed Bread Quality Characteristics of New Wheat Variety Jimai0435 with High-Quality

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Abstract: Wheat variety Jimai0435 is recently released with high quality. It has excellent quality characteristics, especially the quality of steamed bread. In order to explore the optimal processing conditions for its steamed bread, its quality characteristics were introduced firstly, and then the effects of the fermentation time and pressing times on the steamed bread quality were focused. And the effects of fermentation time and pressing times on the quality of its steamed bread were mainly studied in laboratory. The analysis of difference significance showed that the steamed bread quality was most affected by the fermentation time before pressing, followed by the pressing times, the internal quality was affected by the fermentation time and pressing times. Based on the multiple comparison and graphic analysis of the external and internal qualities, it was found that with the prolong of fermentation time, the pressing times needed to be correspondingly increased in order to make good quality steamed bread, and the proper pressing times is 15 when the dough is fermented for 20 min, while 20 times was needed when the fermentation time is prolonged to 25-30 min.

Keywords: Wheat (*Triticum aestivum* L), Chinese Steamed Bread, Quality

1. Introduction

The total wheat supply is sufficient in China, but the production of special wheat with high quality is seriously insufficient. By “the twelfth five”, the quantity of high-quality wheat varieties bred in Shandong province was low, even in the whole country, and the quality situation needed to be further improved [1-9], then there was a lack of high-quality wheat varieties that could truly meet the needs of processing enterprises. During the period of “the thirteenth five”, improving protein and gluten quality was the focus of wheat quality breeding, meanwhile improving flour color, and the quantity and quality were greatly increased of high-quality varieties [10, 11], however, the supply of commodity grain still could not meet the demand of

processing all kinds of special flour, so about 8 million tons of wheat was still need to import annually, mainly the special wheat with high-quality. Under this background, Jimai0435, a new wheat variety was released in 2021, which has high quality characteristics, high yield potential, strong water-saving and stress-resistance.

Steamed bread is always been used as the staple food of the Chinese people, especially in the northern area, as for the consumption of wheat flour, about 70% of the total amount is used to make steamed bread [12]. Since the 20th century, People's living standard has been improved greatly, and its demand for steamed bread quality is become higher and higher, it should not only have good appearance and white color, but also have strong wheat flavor, good palatability and great tenacity. The reports showed that the quality of steamed bread was significantly affected by the quality of wheat flour

[13-17], such as flour color, protein content, gluten strength, sedimentation value and starch properties [18-24], in addition, it was also affected significantly by the calendaring, kneading and pressing, and fermentation time [25-29].

Jimai0435 is a new wheat variety with high quality developed by Crop Research Institute of Shandong Academy of Agricultural Sciences. To explore the optimal conditions for making steamed bread, its quality characteristics were introduced firstly, and then the effects of the fermentation time and pressing times on the quality of steamed bread were focused. By the way, it could provide some data for the processing steamed bread.

2. Material and Methods

2.1. Field Production

wheat variety Jimai0435 was planted in Jinan experimental base, Institute of Crop Research, Shandong Academy of Agricultural Sciences in 2021-2022. The field management of the trial was conducted following the same measures as the large area field production, and was harvested, air-dried and stored, separately.

2.2. Flour Milling and Experimental Treatments

The flour was ground by Buhler mill according to the AACC26-21A method, steamed bread was made and scored according to the national standard GB/T 17320-2013 «Laboratory Method of Making and Evaluating Steamed Bread ». Five treatments of fermentation time (FT) were used, which were 10, 15, 20, 25, 30 minutes, and be marked as FT10, FT15, FT20, FT25, FT30, respectively. Meantime, three treatments of pressing time (PT) were used, which were 10, 15, 20 times, and be marked as PT10, PT15, PT20, respectively. 11 traits related to steamed bread quality were evaluated, including shape, color, external structure, elasticity, internal structure, tenacity, viscosity, odour, specific volume

score, height score and elongation. All these treatments were conducted for 3 repetition.

2.3. Data Processing

All data were averaged before they were plotted by EXCEL system. And the difference significance and multiple comparison were analyzed by software SAS 9.4.

3. Results

Jimai0435 was bred by pedigree method. The advanced line 10J435 with excellent agronomic traits was used as female parent, meanwhile, the variety Jishi02-1 with outstanding quality traits was used as male parent. As a result, a new variety was born aggregating the excellent properties of the parents.

The most outstanding characteristic of this variety is its excellent quality characteristics. Since it has been test by the Yellow & Huaibei regional trial, its quality characteristics are excellent and stable (Table 1). Such as the protein content (dry base) was ranged from 14.9% to16.2%, the wet gluten content was 30.4-35.7%, the water absorption was 60.8-67.57%, the stability time was 13.9-40.2 min. So, its grain quality level reached the grade of strong gluten wheat. With its strong odour of wheat flour, the quality level of steamed bread was the first-rate. It also has high yield potential, such as the average yield was 571.75 kg per mu, which was 2.37% higher than that of Jimai 22 in the national regional trial during year 2018 to 2020. And its resistance was strong, including the average water-saving index of drought resistance was 1.090 during year 2018 to 2020, the rate of lodging degree (the lodging level \leq 3) was 100%, the average dead stem rate of cold resistance evaluation was 2.1% with the first grade cold resistance, and the resistance to sheath blight was medium.

Table 1. The main quality characteristics of Jimai0435.

Years	Protein content (%)	Wet gluten content (%)	Water absorption (%)	Stability time (min)	Maximum resistance (B.U)	Area (cm ²)	Test Unit
2018-2020	16.2	35.7	62.9	13.9	541.5	94.9	National Regional Test (Average) Grain quality supervision, inspection and Testing Center, Ministry of Agriculture and rural areas (Beijing)
2019-2020	15.74	32.5	60.8	24.4	746	171	
2019-2020	15.81	30.37	62.8	30.65			Sino-australian joint quality laboratory
2020-2021	14.90	30.4	62.4	40.2			
2021-2022	15.73	33.59	67.57	23.23			
2021-2022	superior grade of steamed bread quality						Food appraisal meeting

The analysis of difference significance showed that fermentation time and pressing times had different effects on the quality traits of steamed bread (table 2). The effect of fermentation time on the quality traits of steamed bread, such as shape, color, external structure, elasticity, internal structure, tenacity, viscosity, specific volume and elongation, was extremely significant. And the influence of the pressing times on the color, external structure, internal structure, tenacity

and viscosity was extremely significant. Meantime, the interaction of fermentation time and pressing times had extremely significant effect on the internal structure and tenacity, and significant effect on the shape and color, while no significant or no effect on the height and flavor. All these showed that the steamed bread quality of Jima0435 was most affected by the fermentation time, followed by the pressing times, meanwhile, the internal quality of steamed bread was

more affected by the fermentation time and the pressing times. So, the reasonable fermentation time and pressing

times are the sound basis to make good quality steamed bread of Jimai0435.

Table 2. The significant difference among quality traits of steamed bread.

Treatment	Mean Square value										
	Shape	Color	External structure	Elasticity	Internal structure	Tenacity	Viscosity	Flavor	Score of specific	Score of height	Score of extension rate
Fermentation time (FT)	4.19**	0.65**	7.23**	19.60**	22.40**	17.60**	4.40**	0.0	151.58**	0.05	0.04**
Pressing times (PT)	2.80	13.30**	8.28**	0.53	19.60**	20.80**	10.0**	0.0	0.93	0.15	0.01
Interaction (FT/PT)	1.86*	0.43*	0.78	0.68	1.85**	0.80**	2.0**	0.0	2.35	0.11	0.01

Note: * and ** indicated significant and extremely significant differences, respectively.

The shape changes of steamed bread were reflected by the shape score, and the top score was 10. The multiple comparison of shape scores showed that (table 3) when the pressing times were 10, the shape scores under fermentation time 20 and 25min were extremely significantly higher than those of other treatments, when the pressing times were 15, the shape score under fermentation time 20 min was higher than 25 min and was significantly higher than the other treatments, when the pressing times were 20, the shape score under fermentation time 15-30 min was significantly higher than that of 10 min. The graph analysis showed (Figure 1) that the shape score was relatively higher when the fermentation time was 20 min with 15 pressing times, or the fermentation time was 25 min with 20 pressing times, respectively. This shows that the steamed bread with good shape can be obtained when the fermentation time and pressing times are reasonable, that is if the fermentation time was 20 minutes and the pressing times should be 15, if the fermentation time was 25 minutes and the pressing times should be 20.

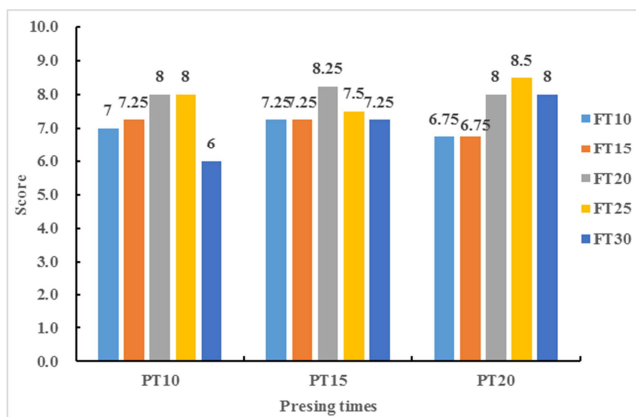


Figure 1. The changes of shape.

The multiple comparisons of the color scores of steamed bread (table 3) showed that there was no significant difference among the fermentation time when the pressing times was 10, while with the 15 pressing times, the color of steamed bread fermented in 20-30 min was significantly better than that in 10-15 min, and with the 20 pressing times, the color in 30 min was the highest, followed by that in 25

min, which was significantly better than that in other treatments. The graph analysis showed (Figure 2) that the color of steamed bread with 15-20 pressing times was better than that with 10 pressing times, furthermore, the color of steamed bread with 30 minutes fermentation and 20 pressing times was the best.

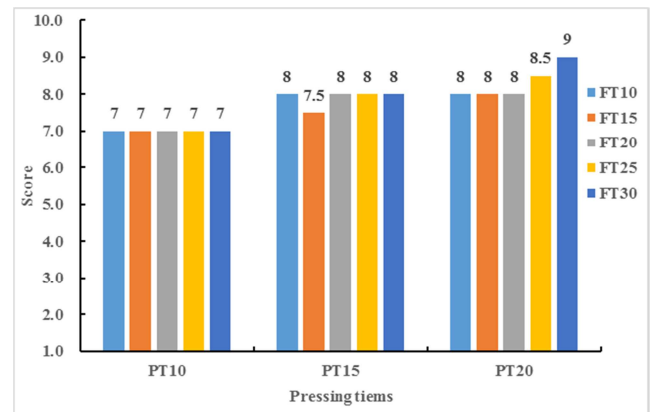


Figure 2. The changes of color.

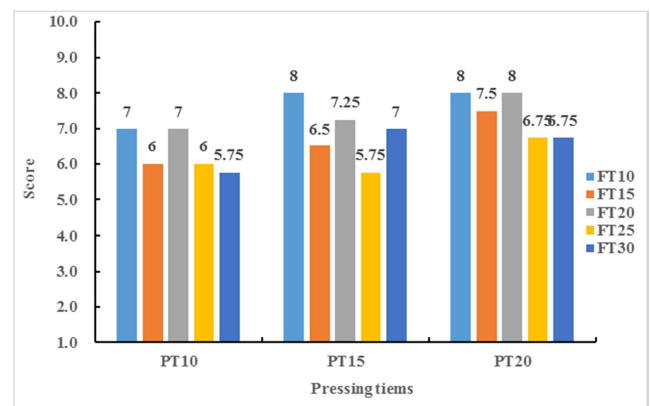


Figure 3. The changes of external structure.

The multiple comparison of the external structure scores of steamed bread showed that (table 3), in the 10 times of pressing, the external structure of steamed bread was significantly affected by the fermentation time, and the external structure of 20 min fermentation time was significantly better than that of other treatments. In the 15 or 20 times of pressing, the difference level of the external

structure among fermentation time treatments was significant or not. The graphic analysis showed that (Figure 3) the external structure of steamed bread was better when the fermentation time was 10-20 min and the pressing was 15-20 times.

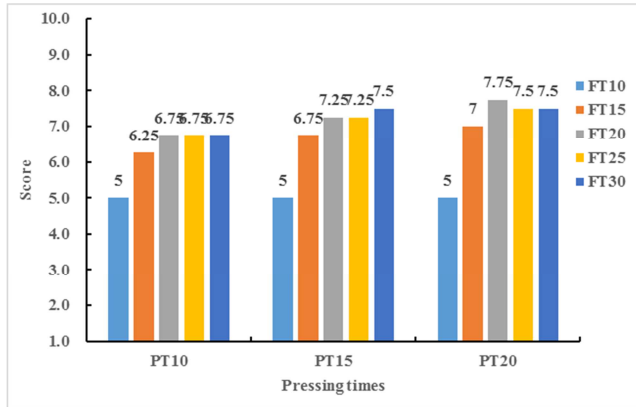


Figure 4. The changes of elasticity.

The multiple comparison of the elastic scores of steamed bread showed that (table 3), in the 10 times of pressing, the elasticity of fermentation 20-30 min was significantly better than that of 10 min, but not significantly different from that of 15 min, in the 15 times of pressing, the elasticity of fermentation 15-30 min was significantly higher than that of 10 min, and the elasticity of 30 min was the best, while in the 20 times of pressing, the elasticity of 20-30 min was significantly better than that of 10-15 min. The graph analysis showed that (Figure 4) the elasticity of steamed bread was the best when the fermentation time was 20-30 min with the pressing 15-20 times.

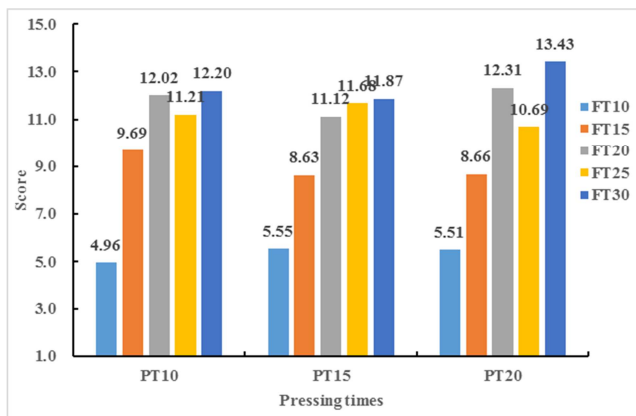


Figure 5. The changes of score of specific volume.

The results of multiple comparisons showed that (table 3), the fermentation time had extremely significant effect on the specific volume score of steamed bread. In 10 pressing times, the specific volume score increased significantly at 20min, and no significant difference between 25-30min and 20min, as for 15 pressing times, the specific volume score in fermentation 20-30 min was significantly higher than that of other treatments, under the condition of 20 pressing times, the specific volume score of fermentation time longer than 20

min was significantly higher than that of 10 and 15 min, meantime, the highest specific volume score was reached at 30 min. The map analysis showed that (Figure 5), the specific volume score of 20-30 min was significantly higher than that of 10-15 min, and the specific volume score of 30 min was the highest.

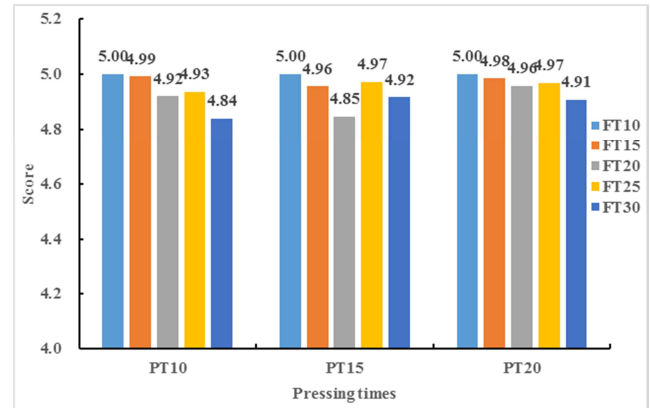


Figure 6. The changes of score of extensibility.

The extensibility is not a national standard index of steamed bread, but it can reflect the shape of steamed bread to a certain extent. The results of multiple comparisons (Table 3) showed that, in the 10 pressing times, the extensibility scores with 10-15 min of fermentation time were significantly higher than those of 30 min, while that of 20-25 min were not significantly different from those of the former. In the 15 pressing times, the elongation rate of 10 min fermentation was significantly higher than that of 20 min, but not significantly different from that of other treatments. In the 20 pressing times, the elongation rate of 10-15 min was significantly higher than that of 30 min, but that of 20-25 min was not significant difference from the two former. The mapping analysis (Figure 6) showed that, the elongation rate score was different among the treatments of different fermentation time, and the elongation rate score of 10 min was the highest, while with the increase of fermentation time the elongation rate score decreased.

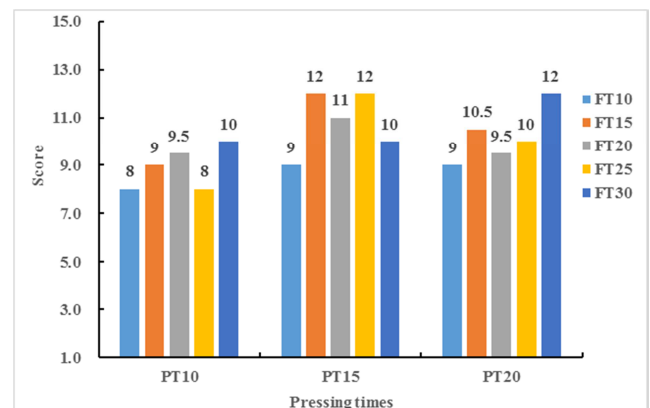


Figure 7. The changes of internal structure.

Multiple comparisons of the internal structure scores of steamed bread (table 3) showed that the internal structure

with 30 min fermentation time was significantly better than that of other treatments under the condition of 10 pressing times, and in 15 pressing times, the internal structure of 15 and 25 min was significantly better than that of other treatments, and the internal structure of 30 min fermentation was significantly better than that of other treatments under the condition of 20 pressing times. The diagraph analysis showed that there was a significant difference in the internal structure score of steamed bread among treatments (Figure 7). The 15 pressing time was better when the fermentation time was 15-25 min, but more pressing was needed when the fermentation time was 30 min, and 20 times is better.

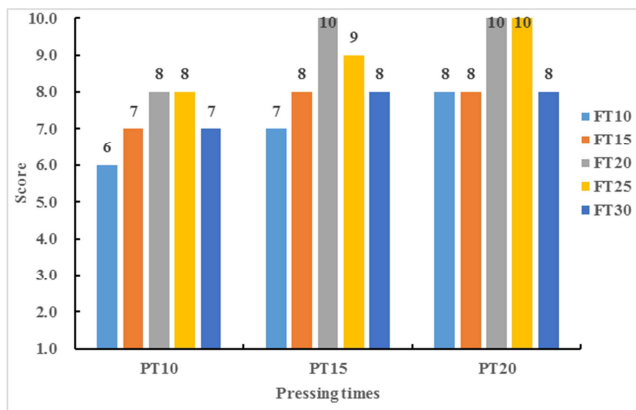


Figure 8. The changes of tenacity.

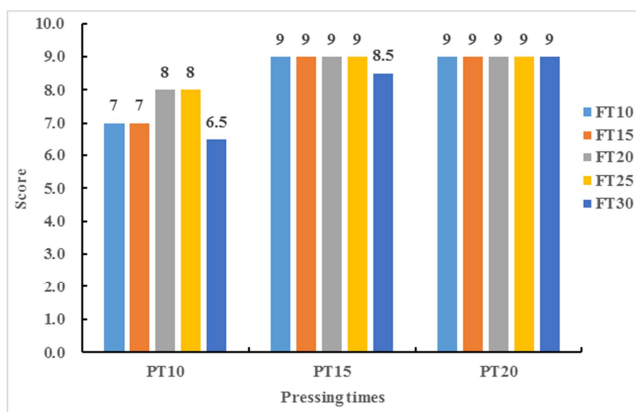


Figure 9. The changes of viscosity.

Multiple comparisons of the tenacity scores of steamed bread (table 3) showed that the tenacity with 20-25 min fermentation time was significantly better than that of other treatments with 10 times of flaking, while the tenacity with 15 times of flaking with 20 min fermentation time was

significantly better than that of other treatments, and the tenacity with 20-25 min fermentation time under 20 times pressing was significantly better than that of other treatments. The diagraph analysis showed that (Figure 8) the tenacity of steamed bread was better under the treatment of 20-25 min fermentation time and 15-20 pressing times.

The multiple comparisons of the viscosity scores of steamed bread showed that the viscosity was the best when the pressing times was 10 with the fermentation time 20-25 min, and when the pressing times was 15, the viscosity in fermentation time 10-25 min was no difference but better than that of 30 min. The diagraph analysis showed (Figure 9) that the stickiness of steamed bread with 15-20 pressing times was better than that with 10 pressing times.

4. Discussion and Conclusion

In the past five years, the number of released wheat varieties has been increasing rapidly in China, and the number of high-quality varieties has also increased, and they are classified into different types of suitable for food production [30-33]. Different varieties have different internal network structure due to the difference of protein and starch composition and content, which determines the different quality characteristics, and then it has the excellent character to make different kind food. The excellent quality characteristics and wheat flavor of variety Jimai0435 laid a good foundation for making good quality steamed bread [32], and proper processing technology is the prerequisite for making good quality steamed bread. In this paper, the quality of steamed bread was improved by improving the fermentation time and the pressing times in laboratory, the shape, color, external structure, elasticity, internal structure, tenacity, viscosity, specific volume and elongation of steamed bread were all affected by fermentation time and pressing times at some extent. The proper number of pressing times is 15 when the dough is fermented for 20 min, while 20 times is needed when the dough is fermented 25-30 min. Studies also have shown that the quality of hand-made steamed bread is quite different from that of machine-made steamed bread with the same flour [34]. Therefore, it is imperative to study the processing technology of machine-made steamed bread with Jimai0435 flour, such as the fermentation time and pressing times, this is one of the key work that is being carried out at present, which will provide good data support for its application in steamed bread food processing.

Table 3. Multiple comparisons of effects of pressing times and fermentation time on quality traits of steamed bread.

Treats		Evaluation of quality traits of steamed bread										
Pressing times	Fermentation time	Shape	Color	External structure	Elasticity	Internal structure	Tenacity	Viscosity	Flavour	Score of specific	Score of height	Score of extension-rate
PT10	FT10	7B	7a	5.5B	5C	8D	6C	7ab	5a	4.96C	2.30ab	5.0a
	FT15	7.25B	7a	6B	6.25AB	9B	7B	7ab	5a	9.69B	2.5a	4.99a
	FT20	8A	7a	7A	6.75A	9.5C	8A	8a	5a	12.02A	2.35ab	4.92ab
	FT25	8A	7a	6B	6.75A	8D	8A	8a	5a	11.21AB	2.34ab	4.93ab
	FT30	6C	7a	5.75B	6.75A	10A	7B	6.5b	5a	12.20A	2.23b	4.84b

Treats		Evaluation of quality traits of steamed bread										
Pressing times	Fermentation time	Shape	Color	External structure	Elasticity	Internal structure	Tenacity	Viscosity	Flavour	Score of specific	Score of height	Score of extension-rate
PT15	FT10	7.25b	7.5b	8a	5b	9D	7D	9a	5a	5.55C	2.16ab	5.0a
	FT15	7.25b	7.5b	6.5bc	6.75a	12A	8C	9a	5a	8.63B	2.09b	4.96a
	FT20	8.25a	8a	7.25ab	7.25a	11B	10A	9a	5a	11.12A	2.07b	4.85b
	FT25	7.5ab	8a	5.75c	7.25a	12A	9B	9a	5a	11.68A	2.31ab	4.97a
	FT30	7.25b	8a	7ab	7.75a	10C	8C	8.5b	5a	11.87A	2.40a	4.92ab
PT20	FT10	6.75b	8C	8a	5C	9D	8B	9a	5a	5.51D	2.09b	5.0a
	FT15	8a	8C	7.5ab	7B	10.5B	8B	9a	5a	8.66C	2.29ab	4.98a
	FT20	8a	8C	8a	7.75A	9.5CD	10A	9a	5a	12.31A	2.43a	4.96ab
	FT25	8.5a	8.5B	6.75b	7.5A	10BC	10A	9a	5a	10.69B	2.23ab	4.97ab
	FT30	8a	9A	6.75b	7.5A	12A	8B	9a	5a	13.43A	2.35ab	4.91b

Notes: The uppercase and lowercase letters represent the difference levels of 0.01 and 0.05, respectively.

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Abbreviations

FT: Fermentation Time

PT: Pressing Times

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Conflicts of Interest

The authors declare no conflicts of interest.

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