



INFOGRAPHIC

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Tác giả:

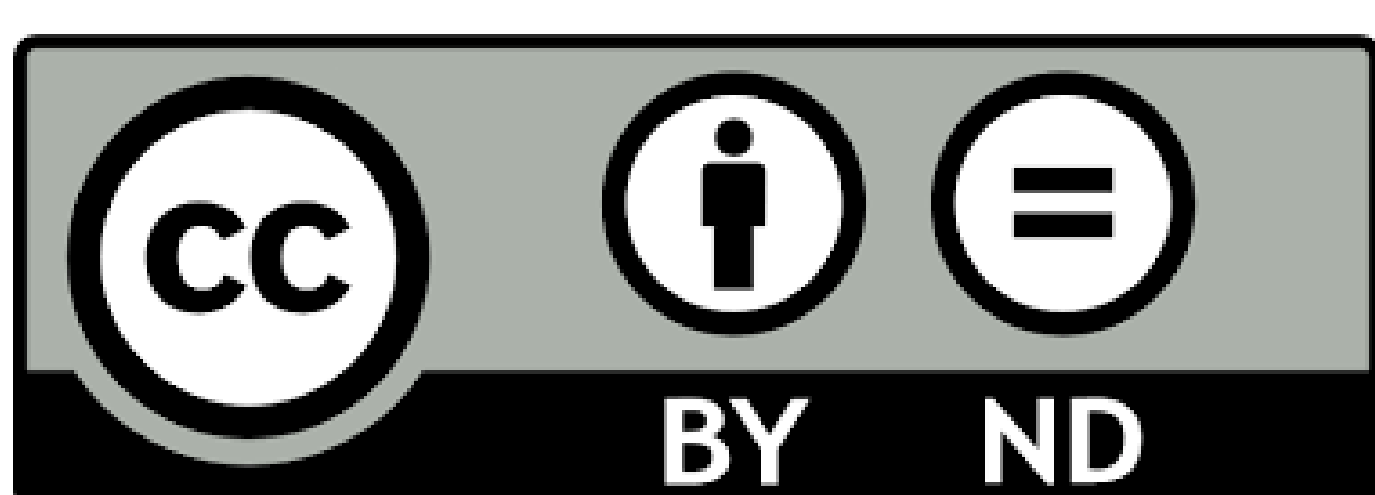
Nguyễn Thị Thanh Tuyền

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Study on the Fermentation Characteristics of Natural Yeast and Its Application in Bread Making

Nguyen Thi Thanh Tuyen , Nguyen Manh Ngoc Bao, MSc

Abstract

This study aimed to select suitable conditions for preparing a spontaneous wheat sourdough starter and to evaluate its application in breadmaking. Four experiments were conducted to examine flour-to-water ratios (1:0.6, 1:0.8, 1:1, 1:1.2, w/w), fermentation times (3, 5, 7, 9 days), fermentation temperatures (25, 30, 35, 40° C), and wet starter addition levels (10%, 20%, 30%) compared with a commercial-yeast control. A flour-to-water ratio of 1:1 and a 3-day fermentation period were selected based on acidification and leavening performance. A temperature of 35° C was provisionally selected because it provided high LAB counts and the highest numerical leavening capacity, although the difference was not statistically significant. Bread containing 10% wet natural starter (MN10) showed sensory acceptance comparable to the control. Therefore, 10% wet natural starter was the most suitable level among the tested conditions.

Introduction

Spontaneous sourdough is a complex microbial ecosystem of wild yeasts and lactic acid bacteria (LAB). During fermentation, LAB produce organic acids while yeasts generate CO₂, together influencing bread volume, crumb structure, flavor, and shelf life. Key factors affecting starter performance include flour-to-water ratio, fermentation time, fermentation temperature, and starter addition level. However, suitable conditions for spontaneous wheat sourdough in Vietnam remain underexplored.

Objective: This study aimed to select suitable conditions for preparing a spontaneous wheat sourdough starter and to evaluate its application in breadmaking.

Materials and Methods

Materials: Wheat flour No. 11, water, salt, commercial yeast (control), MRS agar, PCA, NaOH 0.1N, pH meter, texture analyzer (CT3), colorimeter, incubator, oven.

Experimental design: 4 experiments, 3 biological replicates each. Data expressed as mean ± SD. One-way ANOVA with LSD post-hoc (p < 0.05); Hedonic data analyzed by Repeated-measures ANOVA with Holm correction; ranking data by Friedman and Wilcoxon tests.

Exp.	Factor	Levels	Fixed conditions
1	Flour:water ratio (w/w)	1:0.6, 1:0.8, 1:1, 1:1.2	28–30°C, 7 days
2	Fermentation time	3, 5, 7, 9 days	1:1, 28–30°C
3	Temperature	25, 30, 35, 40°C	1:1, 3 days
4	Starter addition	10%, 20%, 30% vs. control	1:1, 3 days, 35°C

Formulations (Exp. 4):				
Component	CTRL	MN10	MN20	MN30
Total flour	500 g	500 g	500 g	500 g
Wet starter	0 g	50 g	100 g	150 g
Added flour	500 g	475 g	450 g	425 g
Added water	350 g	325 g	300 g	275 g
Salt (2%)	10 g	10 g	10 g	10 g
Commercial yeast	7.5 g	0 g	0 g	0 g

Sourdough preparation: Mix flour and water at designed ratio; incubate; refresh daily by removing 50% old starter and adding fresh flour and water.

Breadmaking: Autolyse 2 h → add starter and salt → knead 5–10 min → first fermentation (28–30°C, 2–3 h, fold 3 times) → divide and shape → final proof (35°C, 80–85% RH, 45–60 min) → bake at 230°C for ~35 min → cool 2 h.

Sourdough: pH (TCVN 6492), TTA (% lactic acid, NaOH 0.1N), LAB on MRS agar (log CFU/g), leavening capacity (volume increase after 6 h, %). Bread: volume (AACC 10-05.01), pH, moisture, TPA (hardness, springiness, cohesiveness, chewiness, resilience), crust and crumb color (L, a, b*). Sensory: 30 panelists; 9-point Hedonic scale (8 attributes), 3-point JAR scale (7 attributes), ranking test.

Results and Discussions

Effect of flour-to-water ratio on natural sourdough starter formation

Experiment 1 – Flour-to-water ratio

Parameter	Flour-to-water ratio			
	1:0,6	1:0,8	1:1	1:1,2
pH	3,74 ± 0,03 ^a	3,71 ± 0,007 ^a	3,69 ± 0,02 ^a	3,73 ± 0,04 ^a
TTA (% acid lactic)	2,21 ± 0,05 ^a	2,18 ± 0,13 ^a	1,36 ± 0,07 ^b	1,20 ± 0,05 ^c
Leavening capacity day 7 (%)	18 ± 20,49 ^b	160 ± 82,16 ^a	210 ± 89,44 ^a	170 ± 83,67 ^a

Values are mean ± SD; different letters in the same row indicate significant differences (p < 0.05).

Effect of fermentation time on the development of natural sourdough starter

Experiment 2 – Fermentation time

Parameter	Fermentation time			
	Day 3	Day 5	Day 7	Day 9
pH	3,45 ± 0,04 ^a	3,61 ± 0,03 ^b	3,62 ± 0,02 ^{bc}	3,67 ± 0,02 ^c
TTA (% acid lactic)	1,06 ± 0,03 ^c	0,98 ± 0,03 ^b	0,95 ± 0,01 ^b	0,89 ± 0,02 ^a
Volume increase after 6h (%)	176,67 ± 25,17 ^b	141,67 ± 10,41 ^{ab}	81,67 ± 7,64 ^a	3,33 ± 2,89 ^a

Values are mean ± SD; different letters in the same row indicate significant differences (p < 0.05).

The flour-to-water ratio did not significantly affect pH. The 1:1 treatment showed the highest numerical leavening capacity, although it was not significantly different from 1:0.8 and 1:1.2. Therefore, 1:1 was selected as a practical compromise between acidification and leavening performance.

Day 3 gave the lowest pH, highest TTA, and highest volume increase. Therefore, a 3-day fermentation period was selected based on combined acidification and leavening criteria.

Effect of Fermentation Temperature on the Fermentation Properties of Natural Sourdough Starter

Experiment 3 – Fermentation temperature

Parameter	Fermentation temperature			
	25°C	30°C	35°C	40°C
pH	3,90 ± 0,04 ^d	3,69 ± 0,08 ^a	3,74 ± 0,03 ^b	3,84 ± 0,01 ^c
TTA (% acid lactic)	0,85 ± 0,04 ^a	1,14 ± 0,03 ^b	1,23 ± 0,02 ^c	1,33 ± 0,02 ^d
LAB (log CFU/g)	8,22 ± 0,03 ^{ab}	8,39 ± 0,11 ^b	8,28 ± 0,06 ^b	7,76 ± 0,35 ^a
Leavening capacity after 6h (%)	66,67 ± 28,87 ^{ab}	83,33 ± 28,87 ^{ab}	133,33 ± 57,73 ^b	ND

ND = not detected; NS = not significant. Values are mean ± SD; different letters in the same row indicate significant differences (p < 0.05).

Effect of natural starter addition on bread

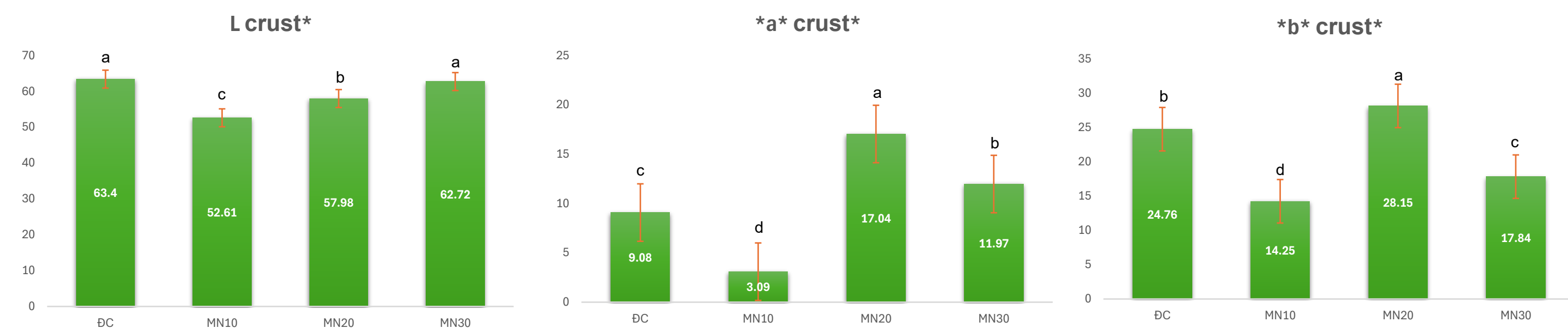
Experiment 4 – Starter addition in bread

Parameter	Formulation			
	CTRL	MN10	MN20	MN30
Hardness (g)	1608 ± 313,15 ^d	2956,80 ± 911,66 ^c	5895 ± 1020,57 ^b	ND
Springiness	0,96 ± 0,03 ^a	0,91 ± 0,11 ^a	0,98 ± 0,02 ^a	ND
Cohesiveness	0,91 ± 0,04 ^b	0,92 ± 0,05 ^b	0,99 ± 0,01 ^a	ND
Chewiness	1384,40 ± 324,50 ^b	2542 ± 1063,45 ^b	5682,60 ± 967,58 ^a	ND
Resilience	0,54 ± 0,03 ^{ab}	0,56 ± 0,01 ^a	0,49 ± 0,01 ^c	ND

ND = not determined (sample too hard for TPA). Values are mean ± SD; different letters in the same row indicate significant differences (p < 0.05).

Color palette of natural bread and commercial bread

Crust color parameters (L, a, b*)



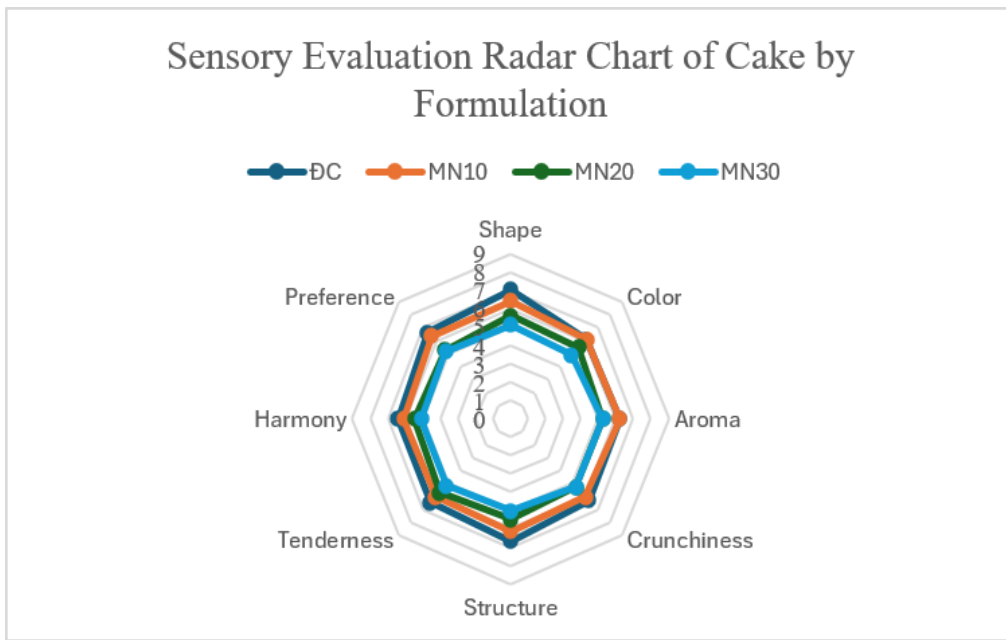
MN10 had the darkest crust (L* = 52.61); MN30 was closest to the control (62.72). MN20 showed the strongest red (a* = 17.04) and yellow (b* = 28.15) tones; MN10 showed the weakest red (3.09) and yellow (14.25) tones. Natural starter ratio significantly affected crust color, but not linearly.

Sensory evaluation – Overall liking (9-point scale)

Parameter	Treatment			
	CTRL	MN10	MN20	MN30
Shape/volume	6,63 ± 1,52 ^a	6,47 ± 1,89 ^a	5,60 ± 1,89 ^b	5,37 ± 1,78 ^c
Crust color	5,87 ± 1,59 ^{ab}	6,17 ± 1,31 ^a	5,40 ± 1,65 ^{ab}	5,33 ± 1,95 ^b
Aroma	5,97 ± 1,65 ^{ab}	6,07 ± 1,28 ^a	5,33 ± 1,52 ^b	5,60 ± 1,90 ^{ab}
Crunchiness	5,97 ± 1,35 ^{ab}	6,07 ± 1,53 ^a	5,34 ± 1,69 ^b	5,53 ± 1,85 ^{ab}
Crumb structure	6,33 ± 1,56 ^a	6,03 ± 1,67 ^a	5,53 ± 1,74 ^{ab}	5,43 ± 1,5 ^b
Tenderness	6,07 ± 1,55 ^a	5,93 ± 1,80 ^a	5,60 ± 1,57 ^a	5,53 ± 1,74 ^a
Harmony	6,03 ± 1,54 ^{ab}	6,03 ± 1,59 ^a	5,43 ± 1,5 ^{ab}	5,50 ± 1,78 ^b
Overall liking	6,23 ± 1,79 ^a	6,23 ± 1,68 ^a	5,33 ± 1,56 ^b	5,60 ± 1,87 ^b

n = 30; values are mean; different letters in the same row indicate significant differences (p < 0.05).

CTRL and MN10 showed similar sensory profiles and the highest overall liking scores (6.23), with no significant difference. MN20 and MN30 scored lower, especially in shape, structure, crunchiness, and overall liking.



Conclusion

A flour-to-water ratio of 1:1 and a 3-day fermentation period were selected based on acidification and leavening performance. A fermentation temperature of 35°C was provisionally selected because it provided high LAB counts and the highest numerical leavening capacity, although the difference was not statistically significant. Bread containing 10% wet natural starter (MN10) showed sensory acceptance comparable to the commercial-yeast control (overall liking 6.23; mean rank 1.77), despite differences in instrumental texture. Therefore, 10% wet natural starter was the most suitable level among the tested conditions.

Contact Information

Student: Nguyen Thi Thanh Tuyen; E-mail: thanhtuyen220604@gmail.com

Lecturer: Nguyen Manh Ngoc Bao, MSc; E-mail: nmnbao@nttu.edu.vn

Faculty of Applied Sciences and Technology, Nguyen Tat Thanh University, Ho Chi Minh City

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