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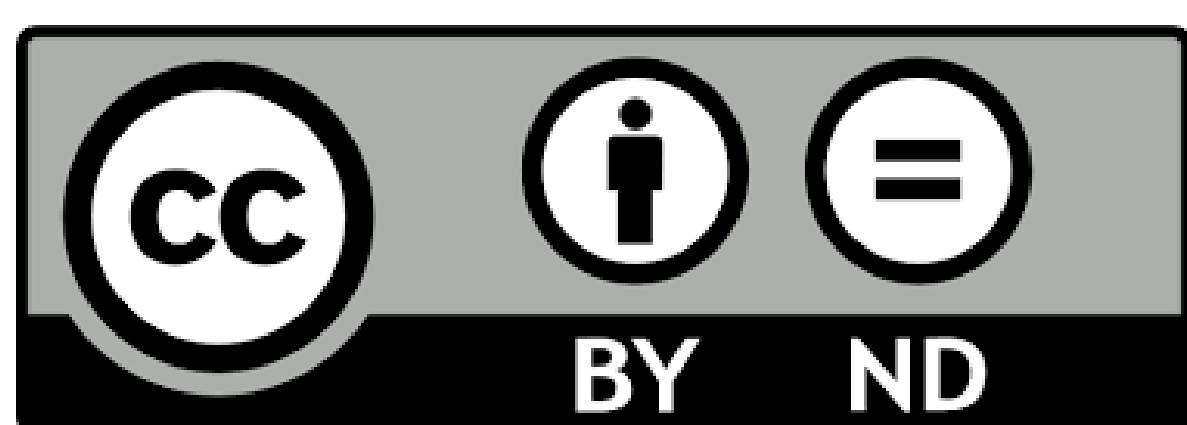
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Effect of chili variety and fermentation microorganisms on the basic composition and antioxidant activity of fermented chili products

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Abstract

This study investigated the effects of chili variety and fermentation microorganisms on the basic composition and antioxidant activity of fermented chili products. Three chili varieties (chili pepper, bird's eye chili and red bell chili) were fermented with different microbial combinations (lactic acid bacteria, yeast and their combination). The results showed that both the chili variety and the fermentation microorganisms significantly influenced the physicochemical properties, bioactive compounds and antioxidant activity of the final products. The fermented chili products exhibited high levels of reducing sugars, total phenolic content and antioxidant activity, suggesting their potential application in functional food development.

Introduction

Background

- Chili (*Capsicum spp.*) is a valuable crop, rich in bioactive compounds such as capsaicinoids, polyphenols, carotenoids and vitamin C, which contribute to antioxidant, anti-inflammatory and antimicrobial activities.
- Fermentation can enhance the release and bioavailability of these compounds, improve flavor and extend shelf life.

Objectives

- To evaluate the effect of chili variety and water-to-chili ratio (chili flesh : water) during grinding on the fermentation process of chili.
- To investigate the effect of salt concentration on chili fermentation.
- To investigate the effect of temperature on chili fermentation.

Materials and Methods

Materials



Methods

1. Preparation of chili and mixing culture

- Washing and cleaning
- Cutting and mixing
- Inoculation of microorganisms

2. Fermentation process

- Ratio chili : water (1:5)
- Salt concentration (0–10%)
- Temperature (25–45°C)

3. Analysis of physicochemical and bioactive compounds

- pH, total acidity, TSS, reducing sugar
- Total phenolic content, capsaicin
- Antioxidant activity (DPPH, ABTS, FRAP)
- Microbial count

4. Data analysis

- ANOVA and Tukey's test ($p < 0.05$)
- 3 replicates

Final product



FERMENTED CHILI

RESULTS AND DISCUSSION

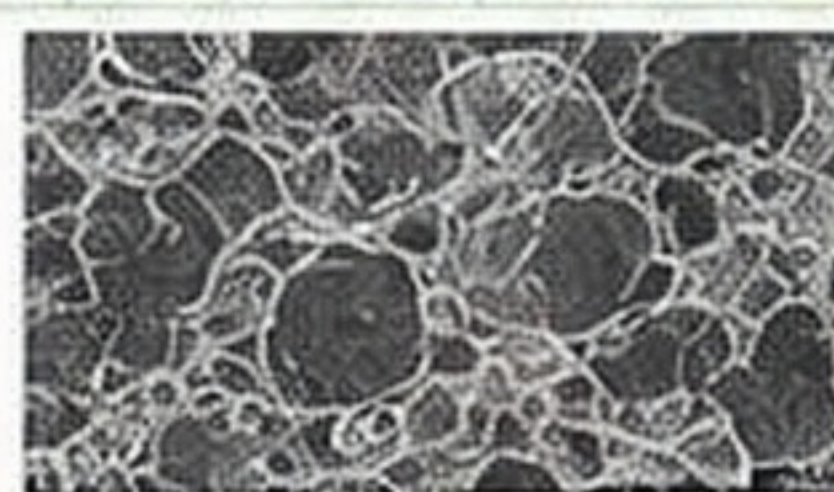
1 Effect of chili variety (ND1)

Table 1. Basic composition and antioxidant activity of fermented chili products from different varieties.

Parameter	Chili pepper	Bird's eye chili	Red bell chili
pH	4.12 ± 0.08	3.98 ± 0.07	4.35 ± 0.09
Total acidity (%)	1.32 ± 0.06	1.56 ± 0.07	1.08 ± 0.05
TSS (°Brix)	6.84 ± 0.32	7.21 ± 0.41	5.76 ± 0.38
Reducing sugar (%)	2.31 ± 0.15	2.86 ± 0.18	1.97 ± 0.12
TPC (mg GAE/mL)	18.42 ± 1.06	24.37 ± 1.32	12.56 ± 0.87
Capsaicin (mg/L)	8.76 ± 0.54	12.63 ± 0.78	5.21 ± 0.36
DPPH (%)	62.45 ± 2.17	73.82 ± 2.56	48.37 ± 1.98
ABTS (%)	68.21 ± 2.83	81.76 ± 3.12	56.47 ± 2.38
FRAP (mM Fe ²⁺ /L)	1.87 ± 0.09	2.43 ± 0.11	1.26 ± 0.07



(A)



(B)

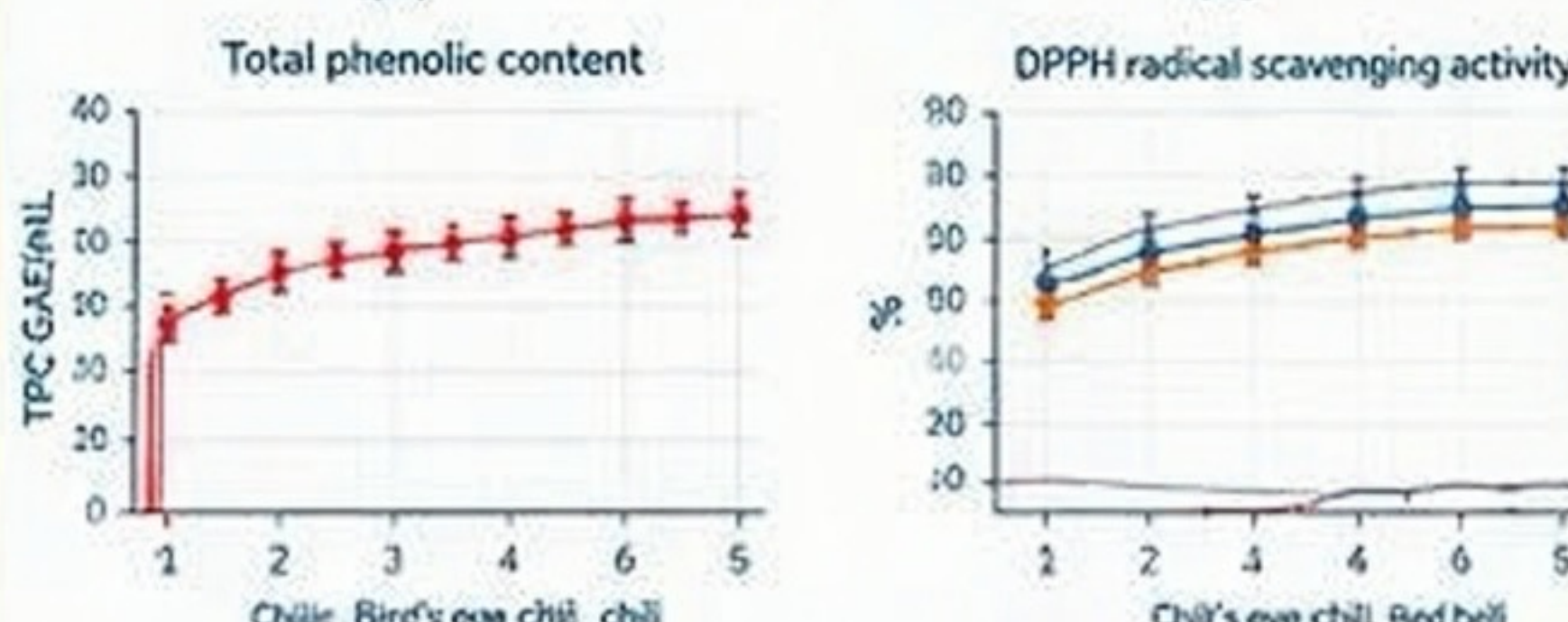


Fig 1. (A) Chili varieties; (B) SEM; (C) Total phenolic content; (D) DPPH radical scavenging activity.

2 Effect of salt concentration (ND3)

Table 2. Basic composition of fermented chili products with different salt concentrations.

Parameter	0%	2%	4%	6%	8%	10%
pH	4.21 ± 0.07	4.06 ± 0.06	3.98 ± 0.06	3.92 ± 0.07	3.87 ± 0.08	3.74 ± 0.09
Total acidity (%)	1.25 ± 0.05	1.46 ± 0.06	1.62 ± 0.07	1.71 ± 0.08	1.82 ± 0.09	1.96 ± 0.10
Reducing sugar (%)	2.08 ± 0.12	1.97 ± 0.10	1.82 ± 0.09	1.64 ± 0.08	1.45 ± 0.07	1.28 ± 0.06
TPC (mg GAE/mL)	16.37 ± 0.92	20.85 ± 1.06	23.76 ± 1.21	24.96 ± 1.37	22.41 ± 1.19	19.62 ± 1.03
ABTS (%)	58.73 ± 2.46	67.12 ± 2.99	76.35 ± 2.87	78.62 ± 3.16	74.28 ± 2.71	68.55 ± 2.34
FRAP (mM Fe ²⁺ /L)	1.56 ± 0.08	2.01 ± 0.12	2.41 ± 0.14	2.18 ± 0.11	1.76 ± 0.01	1.52 ± 0.09

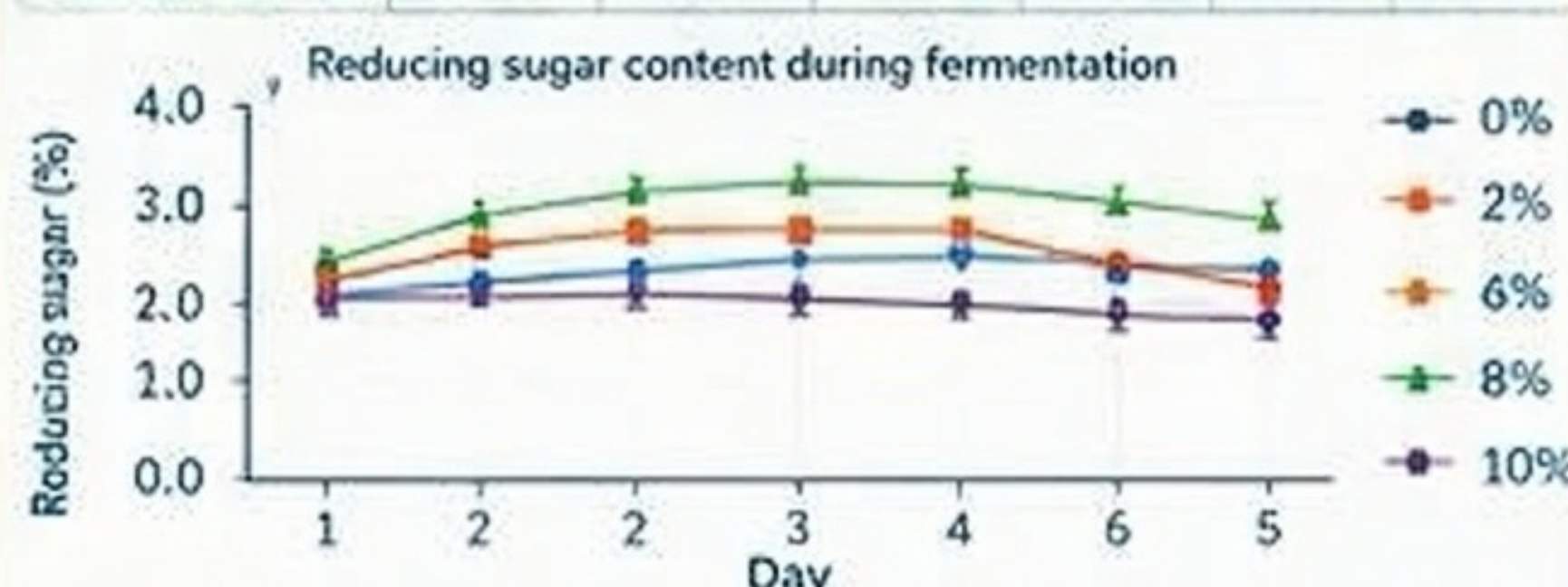


Fig 2. Reducing sugar content during fermentation.

3 Effect of fermentation temperature (ND4)

Table 3. Basic composition of fermented chili products with different fermentation temperatures.

Parameter	25°C	30°C	35°C	40°C	45°C
pH	4.28 ± 0.08	4.12 ± 0.07	3.98 ± 0.06	3.87 ± 0.07	3.76 ± 0.08
Total acidity (%)	1.42 ± 0.11	1.56 ± 0.09	1.72 ± 0.08	1.88 ± 0.10	2.06 ± 0.12
Reducing sugar (%)	2.46 ± 0.13	2.28 ± 0.11	2.02 ± 0.10	1.76 ± 0.09	1.52 ± 0.08
TPC (mg GAE/mL)	19.37 ± 1.05	23.76 ± 1.28	27.45 ± 1.46	29.56 ± 1.32	24.76 ± 1.18
ABTS (%)	66.42 ± 2.81	73.56 ± 3.17	81.76 ± 2.87	78.42 ± 3.20	70.12 ± 2.54
FRAP (mM Fe ²⁺ /L)	1.82 ± 0.10	2.16 ± 0.12	2.84 ± 0.15	2.31 ± 0.13	1.97 ± 0.11

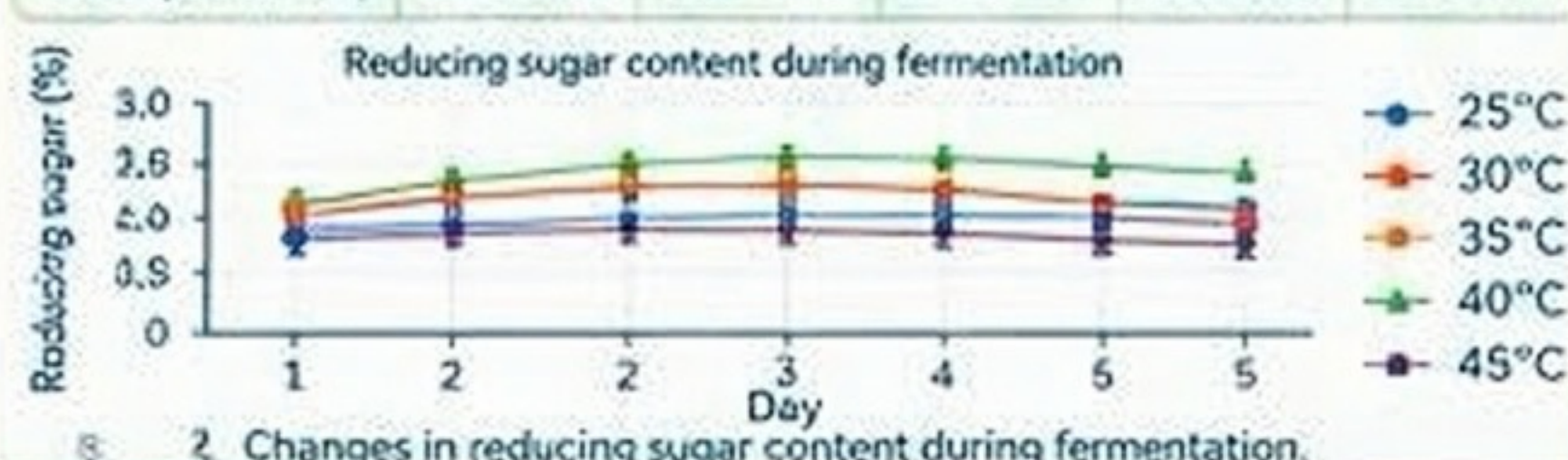


Fig 3. Changes in reducing sugar content during fermentation.

4 Overall comparison of the optimal conditions

4.1 Effect of chili variety (ND1)

Effect of chili variety on antioxidant activity

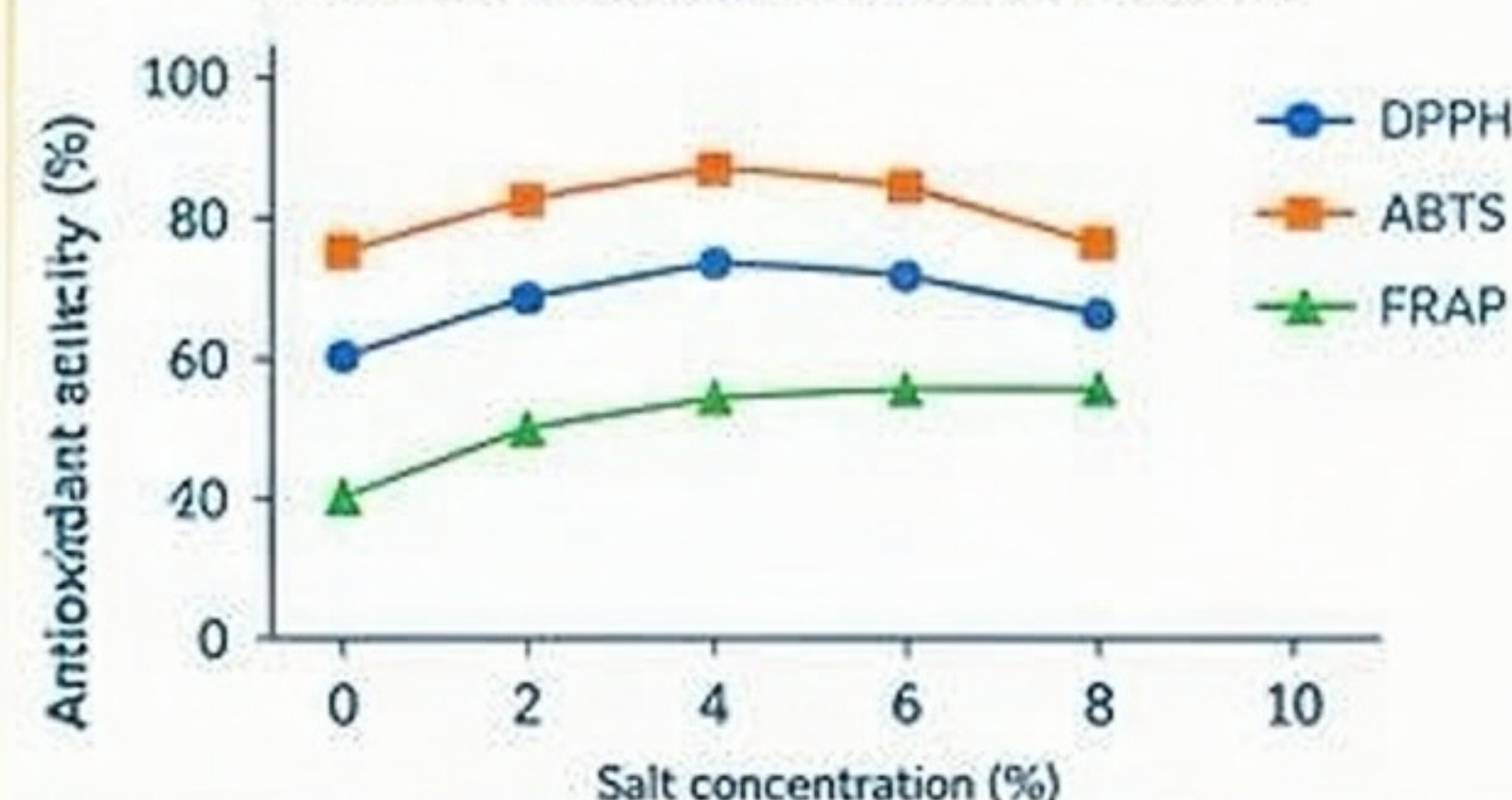


Fig 4. Effect of salt concentration on antioxidant activity.

4.2 Effect of salt concentration (ND3)

Effect of temperature on total phenolic content

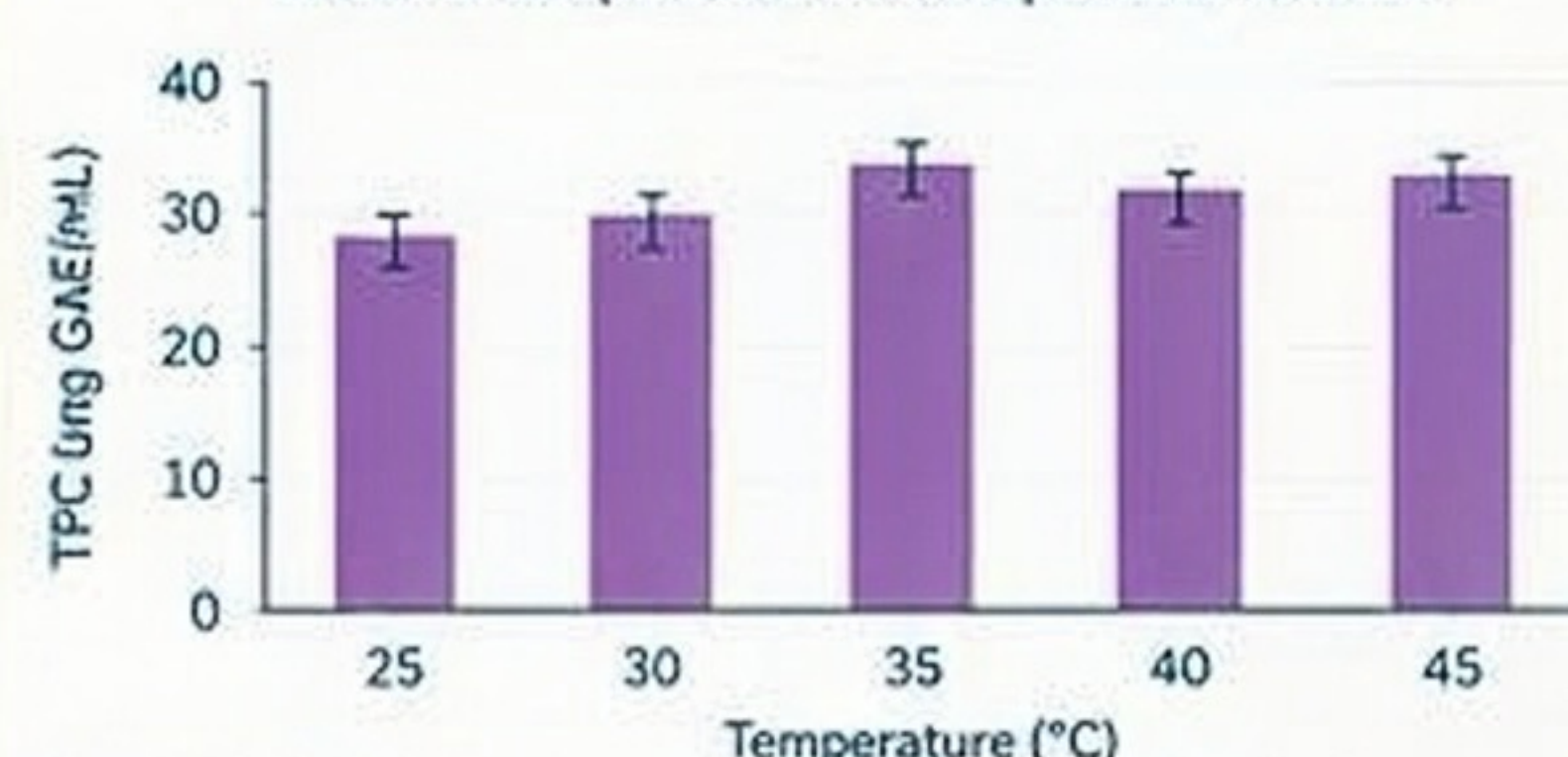


Fig 5. Effect of temperature on total phenolic content.

4.3 Effect of temperature

Overall comparison of the optimal conditions

Factor	Optimal condition
Chili variety	Bird's eye chili
Microorganisms	Lactobacillus + Yeast
Salt concentration	4%
Temperature	35°C
Ratio chili : water	1 : 5
Fermentation time	3 days



Fig 6. Final product of fermented chili sauce.

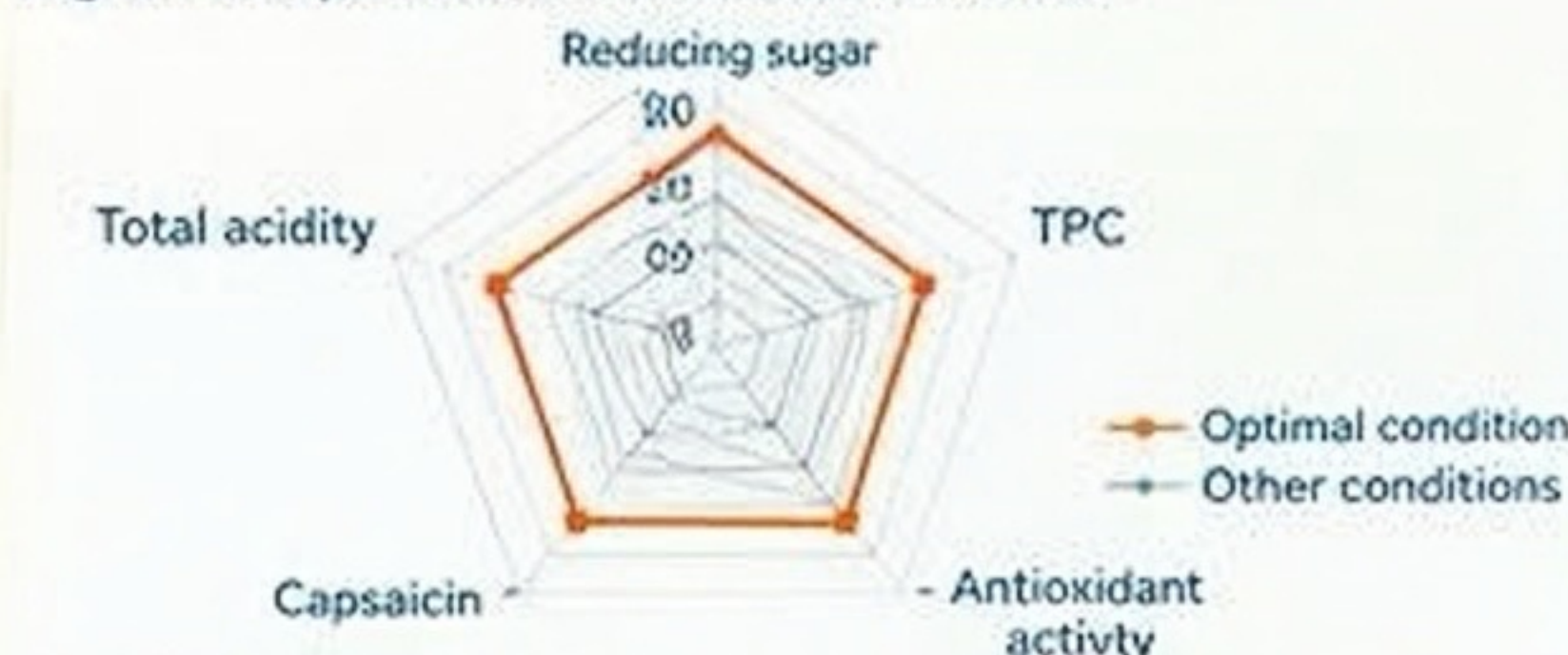


Fig 7. Sensory properties and antioxidant activity of fermented chili under optimal conditions.

CONCLUSIONS

Both chili variety and fermentation microorganisms significantly affected the basic composition and antioxidant activity of fermented chili products. The combination of bird's eye chili and *Lactobacillus* + Yeast, with 4% salt, 35°C and 1:5 ratio, gave the best results in terms of reducing sugar, total phenolic content and antioxidant activity. These findings provide a scientific basis for the development of functional fermented chili products with high bioactive value.

Future perspectives

- Investigate the effect of different starter cultures.
- Evaluate the sensory properties and shelf life.
- Apply the optimal conditions in pilot-scale production.

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