



# INFOGRAPHIC

## NGHIÊN CỨU CÁC YẾU TỐ ẢNH HƯỞNG TRONG QUÁ TRÌNH ĐÔNG TỤ SỮA LIÊN QUAN ĐẾN HOẠT TÍNH ENZYME ZONGBAI TỪ GỪNG

Tác giả:

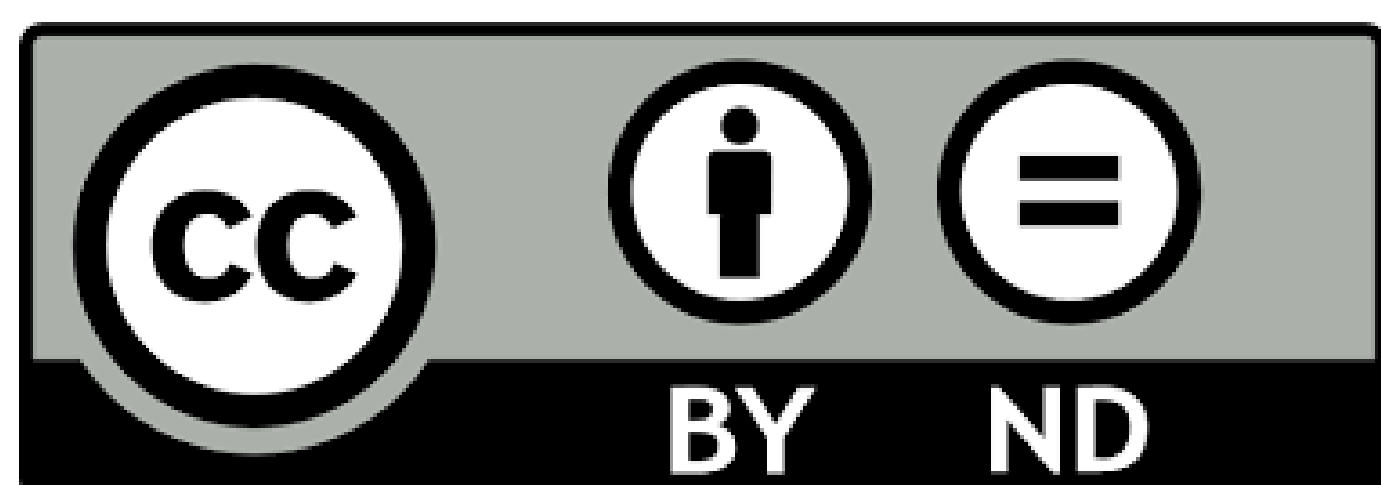
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Nghiên cứu các yếu tố ảnh hưởng trong quá trình đông tụ sữa liên quan đến hoạt tính Enzyme Zongbai từ gừng © 2026 bởi **Huỳnh Hữu Phi** được cấp phép theo CC BY-ND 4.0.

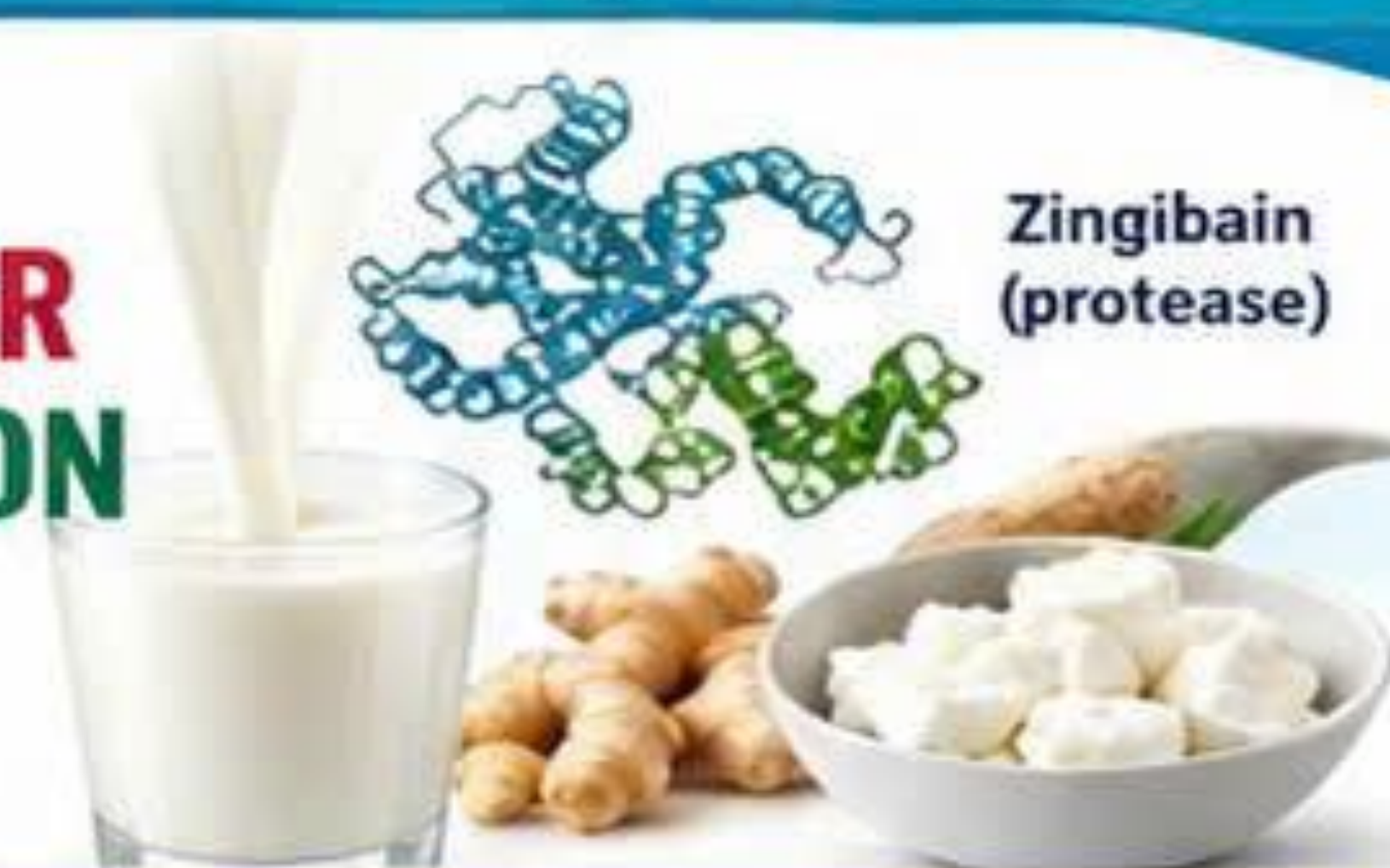


From natural resources  
to valuable food products

## STUDY ON FACTORS AFFECTING ZINGIBAIN ENZYME ACTIVITY FROM GINGER AND ITS APPLICATION IN MILK COAGULATION

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### 1. RESEARCH OBJECTIVES



Evaluate the factors affecting the activity of zingibain enzyme from ginger and apply it in the milk coagulation process to create natural, safe, and high-quality dairy products, contributing to the utilization of local agricultural resources and developing value-added food products.



#### SPECIFIC OBJECTIVES

- Determine the optimal conditions for ginger extraction.
- Evaluate soluble protein content, enzyme activity and specific activity.
- Study the effect of extraction concentration.
- Study the effect of incubation temperature and time.
- Study the effect of  $\text{CaCl}_2$  concentration.

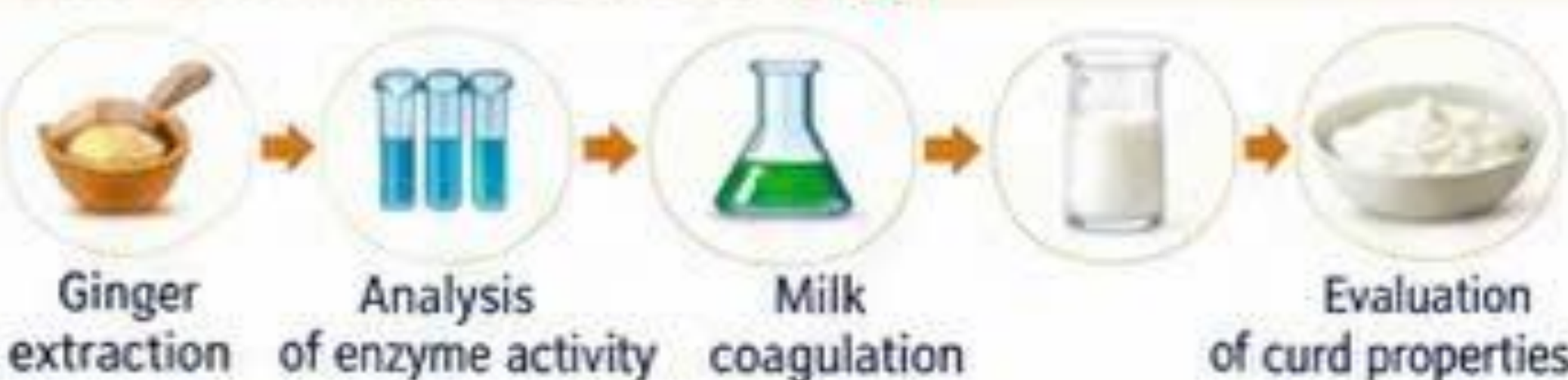
### 2. MATERIALS AND METHODS

#### 2.1. Materials

- Fresh ginger rhizomes (*Zingiber officinale*)
- Fresh cow's milk (unpasteurized)
- Chemicals:  $\text{CaCl}_2$ , buffer solutions
- Equipment: mixer, centrifuge, spectrophotometer, etc.



#### 2.2. Research methodology



### 3. EXPERIMENTAL DESIGN

Exp. 1

Determine optimal conditions for ginger extraction

Exp. 2

Effect of extract concentration on milk coagulation

Exp. 3

Effect of incubation temperature (45 – 75 °C)

Exp. 4

Effect of incubation time (1 – 5 minutes)

Exp. 5

Effect of  $\text{CaCl}_2$  concentration (0 – 0.25%)

## 4. RESEARCH RESULTS

### RESULTS OF EXPERIMENT 1

| Type of ginger | Soluble protein content (mg/mL) | Enzyme activity (U/mL) | Specific activity (U/mg) |
|----------------|---------------------------------|------------------------|--------------------------|
| Trâu           | 0,31±0,02a                      | 6,73±0,30b             | 21,68±2,07b              |
| Sê             | 0,54±0,04b                      | 15,38±0,46c            | 28,74±1,88c              |
| Lai            | 0,35±0,01a                      | 1,37±0,13a             | 3,95±0,29a               |

### RESULTS OF EXPERIMENT 2

| Ginger juice concentration (%) | Hardness (N) | Ductility (N) | Degree of linkage | Viscosity (mPa·s) | Resilience  | Water-holding capacity (%) |
|--------------------------------|--------------|---------------|-------------------|-------------------|-------------|----------------------------|
| 2.50                           | 5,53±0,30a   | 4,03±0,36a    | 0,73±0,03a        | 0,61±0,03a        | 0,92±0,05c  | 25,30±2,03a                |
| 5.00                           | 6,33±0,28a   | 5,50±0,58b    | 0,87±0,05bc       | 0,70±0,03ab       | 1,00±0,03cd | 31,31±1,58b                |
| 7.50                           | 7,46±0,36b   | 6,93±0,18c    | 0,93±0,02c        | 0,76±0,02bc       | 1,08±0,02d  | 32,60±1,37b                |
| 10.00                          | 8,48±0,40c   | 9,14±0,43d    | 1,08±0,05d        | 0,85±0,05c        | 1,19±0,06e  | 39,54±1,06c                |
| 12.50                          | 7,71±0,33bc  | 7,42±0,30c    | 0,96±0,04cd       | 0,95±0,05d        | 0,74±0,03b  | 33,16±1,79b                |
| 15.00                          | 6,32±0,29a   | 4,90±0,30ab   | 0,78±0,06ab       | 1,16±0,04e        | 0,55±0,03a  | 22,28±1,92a                |

### RESULTS OF EXPERIMENT 3

| Milk incubation temperature (°C) | Hardness (N) | Ductility (N) | Degree of linkage | Viscosity (mPa·s) | Resilience  | Water-holding capacity (%) |
|----------------------------------|--------------|---------------|-------------------|-------------------|-------------|----------------------------|
| 45.00                            | 5,83±0,16a   | 5,52±0,13a    | 0,95±0,02bc       | 0,65±0,04a        | 0,93±0,03a  | 32,01±2,79ab               |
| 50.00                            | 8,43±0,41b   | 9,01±0,76b    | 1,07±0,04c        | 0,82±0,05bc       | 1,12±0,07b  | 38,48±1,35c                |
| 55.00                            | 9,80±0,30c   | 13,58±0,84c   | 1,39±0,10d        | 1,07±0,05e        | 1,29±0,08c  | 45,08±2,37d                |
| 60.00                            | 8,23±0,36b   | 8,69±0,10b    | 1,06±0,06c        | 0,91±0,06cd       | 1,12±0,06b  | 36,95±1,27bc               |
| 65.00                            | 7,92±0,37b   | 6,76±0,46a    | 0,85±0,02ab       | 0,98±0,02de       | 1,02±0,04ab | 34,05±3,10bc               |
| 70.00                            | 7,47±0,48b   | 5,86±0,57a    | 0,78±0,03a        | 0,73±0,02ab       | 0,89±0,06a  | 27,24±1,19a                |

### RESULTS OF EXPERIMENT 4

| Incubation time (minutes) | Hardness (N) | Ductility (N) | Degree of linkage | Viscosity (mPa·s) | Resilience  | Water-holding capacity (%) |
|---------------------------|--------------|---------------|-------------------|-------------------|-------------|----------------------------|
| 1.00                      | 7,99±0,48a   | 9,62±0,63b    | 1,20±0,01b        | 0,89±0,05ab       | 1,06±0,03bc | 38,93±1,14a                |
| 2.00                      | 9,86±0,39c   | 13,89±0,57c   | 1,41±0,05c        | 1,07±0,05d        | 1,25±0,03d  | 45,51±2,96b                |
| 3.00                      | 9,35±0,28bc  | 12,64±0,69c   | 1,35±0,07c        | 1,11±0,05d        | 1,16±0,09cd | 42,73±1,55ab               |
| 4.00                      | 8,40±0,41ab  | 10,24±0,83b   | 1,22±0,04b        | 1,03±0,04cd       | 1,00±0,04ab | 43,63±0,12ab               |
| 5.00                      | 8,46±0,33ab  | 8,53±0,31ab   | 1,01±0,04a        | 0,91±0,05bc       | 0,94±0,03ab | 44,77±2,85b                |
| 6.00                      | 7,67±0,33a   | 7,07±0,62a    | 0,92±0,04a        | 0,79±0,03a        | 0,86±0,06a  | 45,06±1,34b                |

### RESULTS OF EXPERIMENT 5

| $\text{CaCl}_2$ concentration (%) | Hardness (N) | Ductility (N) | Degree of linkage | Viscosity (mPa·s) | Resilience  | Water-holding capacity (%) |
|-----------------------------------|--------------|---------------|-------------------|-------------------|-------------|----------------------------|
| 0.00                              | 9,92±0,37a   | 13,78±0,60a   | 1,39±0,06b        | 1,09±0,07a        | 1,21±0,05b  | 47,61±1,44ab               |
| 0.05                              | 10,02±0,29a  | 15,00±0,62ab  | 1,50±0,08bc       | 1,09±0,05a        | 1,25±0,04bc | 46,98±0,30ab               |
| 0.10                              | 12,12±0,74b  | 17,47±1,56bc  | 1,44±0,04bc       | 1,06±0,04a        | 1,32±0,07bc | 48,54±0,44b                |
| 0.15                              | 12,10±0,56b  | 18,93±1,57c   | 1,56±0,08c        | 1,07±0,05a        | 1,40±0,04c  | 49,24±1,44b                |
| 0.20                              | 14,40±0,32c  | 26,36±1,27d   | 1,83±0,06d        | 1,09±0,07a        | 1,63±0,05d  | 57,95±0,80c                |
| 0.25                              | 13,31±0,40bc | 15,99±1,15abc | 1,20±0,05a        | 1,20±0,05a        | 1,00±0,09a  | 44,85±1,76a                |

### 5. CONCLUSIONS AND OPTIMAL CONDITIONS



- Ginger is a potential source of natural milk-coagulating enzyme (zingibain).
- Optimal extraction conditions: 1:4 (w/v), pH 6.0–6.5, temperature ≤ 30 °C.
- Extract concentration: 15%.
- Milk incubation temperature: 55 °C.
- Incubation time: 2 minutes.
- $\text{CaCl}_2$  concentration: 0.20%.
- Ginger extract can be effectively applied in milk coagulation to produce high-quality dairy products.

### 6. APPLICATION IN MILK COAGULATION



### 7. PRODUCT POTENTIAL



- Diverse products with high added value.
- Suitable for the trend of natural and clean foods.
- Potential for commercial development and market expansion.
- Contributes to utilizing local agricultural resources.

### 8. SELECTED REFERENCES

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