



Technical Factors Influencing to Production of Galangal-Pickled Shrimp (*Litopenaeus Vannamei*)

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ABSTRACT

White shrimp (*Litopenaeus vannamei*) is a very important food due to high protein content and nutritional value. Galanga (*Alpinia galanga*) is highly evaluated as their specific flavor and aroma as well as plenty healthy effects. Fermentation is considered as a common approach in food storage; it contributes an essential duty in improvement of nutritional and functional characteristic of foodstuff. Pickled shrimp has good source of peptides and amino acids. Therefore, objective of this research focused on different chemical/ technical aspects such as the effect of NaCl, CaCl₂, sugar and ethanol concentration used for primary treatment; galangal ratio mixing with shrimp, fermentation temperature and time influencing to the amino acid content, pH, water activity and sensory characteristics galangal-pickled shrimp. Results revealed that 15% of NaCl, 2.0% of CaCl₂, 10% of sucrose, 8% of ethanol addition together with 10% sliced galangal in shrimp mixture; fermentation at 28°C for 28 days, the final galangal-pickled shrimp had the good a pleasant taste and appearance. This delicious pickled shrimp was highly welcomed by customers.

Keywords: White shrimp, Galangal, Salt, Sugar, Ethanol, Pickle.

INTRODUCTION

White shrimp (*Litopenaeus vannamei*) is one of the key brackish water species in Vietnamese shrimp farming. Vietnamese farmers move away from farming black tiger shrimp (*Penaeus monodon*) and change to the cheaper white shrimp (*Litopenaeus vannamei*). Regarding to nutritive composition of raised white leg shrimp *Litopenaeus vannamei*,

it has good source of protein, carbohydrate, lipid, moisture and ash, calcium, sodium, potassium, manganese, copper, chromium¹. Shrimps have low fat, less cholesterol and high PUFA content².

Galanga (*Alpinia galanga*) is a plant in the ginger family. Galangal is highly evaluated for their specific flavor and aroma. Various parts of this plant are utilized in the treatment of many diseases³.



Alpinia galanga contained flavonoids and volatile oil^{4,5}. Galangal is used as an alternative to replace antibiotics applied in shrimp farming⁶.

Fermented products from white shrimp (*Litopenaeus vannamei*) such as fermented shrimp paste, pickled shrimp are widely consumed in Vietnam. Fermented shrimps imparted delicacy and high nutritional properties⁷. Regarding to production of fermented shrimp paste, there were several outstanding researches. Shrimp was mixed with salt to ferment shrimp paste⁸. *Lentibacillus kapialis* sp. produced a red color in sodium chloride during shrimp paste fermentation⁹. Fermented shrimp products could be considered as umami¹⁰. Quality characteristics in different shrimp paste were compared¹¹. The changes in the biochemical, nutritional, and sensory properties of the shrimp paste during fermentation were studied¹².

The seafood pickle has good composition of protein, glycogen and minerals compared with vegetable one^{13,14,15}. There were several researches mentioned to the production of pickle seafood. Total viable count in prawn pickle in the range of 10³-10⁵ per g was reported¹⁶. Microorganisms associated with spoilage of prawn pickle was studied¹⁷. Microbiological characteristics of prawn pickle. *Staphylococcus* was reported in spoiled prawn pickle was examined¹⁸. The pickled prawn was produced¹⁹. The firmness in prawns (*Machrobrachium rosenbergii*) marinated in NaCl and acidity was evaluated²⁰. The white shrimp (*Litopenaeus vannamei*) was marinated with green curry to produced shrimp paste marinade²¹. The effects of different temperature and time during pasteurization on marinated green curry shrimp were examined²². However, there was not any research mentioned to production of pickle white shrimp (*Litopenaeus vannamei*). Therefore, objective of this research focused on different technical aspects such as the effect of NaCl, CaCl₂, sucrose and ethanol concentration used for primary treatment; galangal ratio mixing with shrimp, fermentation temperature and time influencing to the amino acid content, pH, water activity and sensory characteristics galangal-pickled shrimp.

MATERIALS AND METHOD

Material

We collected white shrimp (*Litopenaeus vannamei*) from Hoa Binh district, Bac Lieu province, Vietnam. They must be reared following VietGAP to ensure food safety. After collecting, they must be temporarily preserved by flake ice and conveyed to laboratory within 4 h for experiments. They were washed and sanitized under washing tank having 25 ppm chlorine with a support of air bubble blowing to remove foreign matters. Besides *Litopenaeus vannamei* we also used another material during the research such as chlorine, NaCl, CaCl₂, sucrose, ethanol, galanga, glass bottle. Lab. utensils and equipments included digital digital weight balance, water activity meter, pH meter, membrane filter, amino acid analyzer, and fermentor.

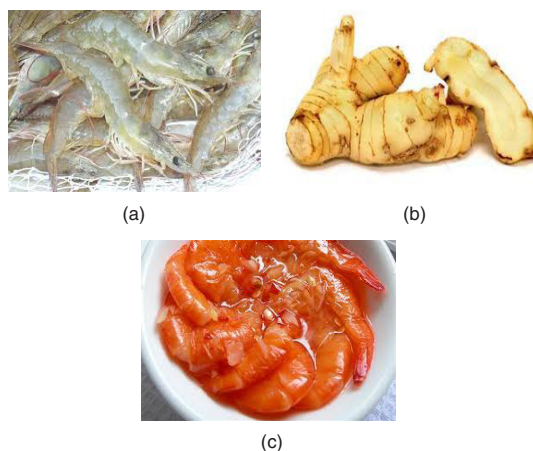


Fig. 1. (a) Raw white shrimp (*Litopenaeus vannamei*), (b) galangal (*Alpinia galanga*), (c) pickled white shrimp (*Litopenaeus vannamei*)

Effect of NaCl, CaCl₂, sucrose, ethanol concentration to amino acid, pH, water activity and sensory score of the galanga-pickled white shrimp (*Litopenaeus vannamei*)

White shrimps (*Litopenaeus vannamei*) were treated with different ratios: NaCl (5%, 10%, 15%, 20%, 25%), CaCl₂ (1%, 1.5%, 2.0%, 2.5%, 3.0%), sucrose (5%, 10%, 15%, 20%, 25%), ethanol (2%, 4%, 6%, 8%, 10%), sliced galanga (5%, 10%, 15%, 20%, 25%) to create a pleasant taste and appearance of galanga-pickled white shrimp. All samples fermented at 30°C in 26 days. Five galanga-pickled white shrimps were chosen randomly to analyse amino acid (g/100g), pH, water activity (aw), and sensory score.

Effect of fermentation temperature and time to amino acid, pH, water activity and sensory score of the galanga-pickled white shrimp (*Litopenaeus vannamei*)

White shrimps (*Litopenaeus vannamei*) were treated with different ratios: NaCl (5%, 10%, 15%, 20%, 25%), CaCl₂ (1%, 1.5%, 2.0%, 2.5%, 3.0%), sucrose (5%, 10%, 15%, 20%, 25%), ethanol (2%, 4%, 6%, 8%, 10%), sliced galanga (5%, 10%, 15%, 20%, 25%) to create a pleasant taste and appearance of galanga-pickled white shrimp. All samples fermented different temperature and time (26°C in 30 days, 28°C in 28 days, 30°C in 26 days, 32°C in 24 days, 34°C in 22 days). Five galanga-pickled white shrimps were chosen randomly to analyse amino acid (g/100 g), pH, water activity (aw), and sensory score.

Shelf-life of the galanga-pickled white shrimp (*Litopenaeus vannamei*) during storage

Galanga-pickled white shrimp (*Litopenaeus vannamei*) products were kept in ambient temperature condition (28±2°C). Amino acid (g/100g), pH, water activity (aw), sensory score were used as quality indicators by sampling in 3 months interval for 12 months.

Physico-chemical, microbial and sensory analysis

Amino acid was measured by using an amino acid analyzer. pH of samples was measured using a pH meter. Water activity was assessed by using a water activity meter. Sensory score of

fermented shrimp (*Litopenaeus vannamei*) paste was assessed by a group of panelist using the 9-point hedonic scale.

Statistical analysis

The experiments were performed in triplicate. Statistical analysis was based on the Startgraphics.

RESULT & DISCUSSION

Effect of NaCl, CaCl₂, sucrose, ethanol, sliced galanga ratio supplemented to shrimp mixture to amino acid, pH, water activity and sensory score of the galanga-pickled white shrimp (*Litopenaeus vannamei*)

White shrimps (*Litopenaeus vannamei*) were treated with different ratios: NaCl (5%, 10%, 15%, 20%, 25%), CaCl₂ (1%, 1.5%, 2.0%, 2.5%, 3.0%), sucrose (5%, 10%, 15%, 20%, 25%), ethanol (2%, 4%, 6%, 8%, 10%), sliced galanga (5%, 10%, 15%, 20%, 25%) to create a pleasant taste and appearance of galanga-pickled white shrimp. All samples fermented at 30°C in 26 days. Five galanga-pickled white shrimps were chosen randomly to analyse amino acid (g/100g), pH, water activity (aw), and sensory score. From Table 1, 2, 3, 4, 5; the best quality of galanga-pickled white shrimp (*Litopenaeus vannamei*) would be achieved by 15% of NaCl, 2.0% of CaCl₂, 10% of sucrose, 8% of ethanol addition together with 10% sliced galangal in shrimp mixture.

Table 1: Effect of NaCl concentration to amino acid, pH, water activity and sensory score of the galanga-pickled white shrimp (*Litopenaeus vannamei*)

NaCl	Amino acid (g/100 g)	pH	Water activity (a _w)	Sensory score
5%	41.69±0.03 ^e	5.87±0.01 ^a	0.74±0.01 ^a	5.22±0.01 ^c
10%	42.17±0.01 ^d	5.29±0.02 ^b	0.72±0.01 ^{ab}	6.39±0.02 ^b
15%	45.36±0.00 ^a	4.56±0.00 ^d	0.68±0.03 ^b	7.45±0.01 ^a
20%	44.10±0.01 ^b	5.03±0.03 ^c	0.65±0.02 ^{bc}	6.29±0.02 ^b
25%	43.29±0.02 ^c	5.21±0.02 ^{bc}	0.62±0.01 ^c	5.47±0.02 ^c

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant ($\alpha = 5\%$).

Table 2: Effect of CaCl₂ concentration to amino acid, pH, water activity and sensory score of the galanga-pickled white shrimp (*Litopenaeus vannamei*)

CaCl ₂	Amino acid (g/100g)	pH	Water activity (a _w)	Sensory score
1.0%	45.36±0.01 ^c	4.56±0.01 ^b	0.68±0.02 ^a	7.45±0.02 ^b
1.5%	45.88±0.02 ^b	4.58±0.03 ^{ab}	0.67±0.02 ^{ab}	7.66±0.01 ^{ab}
2.0%	46.13±0.01 ^{ab}	4.60±0.00 ^{ab}	0.66±0.03 ^{ab}	7.97±0.01 ^a
2.5%	46.17±0.03 ^a	4.63±0.02 ^{ab}	0.64±0.00 ^b	7.22±0.01 ^{bc}
3.0%	46.20±0.02 ^a	4.65±0.01 ^a	0.63±0.03 ^b	6.59±0.04 ^c

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant ($\alpha = 5\%$).

Table 3: Effect of sucrose concentration to amino acid, pH, water activity and sensory score of the galanga-pickled white shrimp (*Litopenaeus vannamei*)

Sucrose	Amino acid (g/100g)	pH	Water activity (a_w)	Sensory score
5%	46.13±0.01 ^b	4.60±0.00 ^a	0.66±0.03 ^a	7.97±0.01 ^b
10%	47.94±0.04 ^a	4.43±0.02 ^b	0.65±0.01 ^{ab}	8.24±0.03 ^a
15%	45.21±0.02 ^c	4.42±0.01 ^{bc}	0.63±0.04 ^b	7.35±0.01 ^{bc}
20%	45.01±0.01 ^{cd}	4.40±0.04 ^{bc}	0.62±0.02 ^{bc}	7.01±0.02 ^c
25%	44.79±0.04 ^d	4.39±0.02 ^c	0.60±0.02 ^c	6.56±0.02 ^d

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant ($\alpha = 5\%$).

Table 4: Effect of ethanol concentration to amino acid, pH, water activity and sensory score of the galanga-pickled white shrimp (*Litopenaeus vannamei*)

Ethanol concentration	Amino acid (g/100g)	pH	Water activity (a_w)	Sensory score
2%	47.94±0.04 ^b	4.43±0.02 ^{bc}	0.65±0.01 ^a	8.24±0.03 ^b
4%	48.55±0.02 ^a	4.42±0.01 ^c	0.64±0.04 ^{ab}	8.58±0.02 ^a
6%	47.30±0.03 ^{bc}	4.46±0.03 ^b	0.63±0.02 ^b	8.36±0.02 ^{ab}
8%	47.07±0.00 ^{cc}	4.48±0.02 ^{ab}	0.61±0.01 ^{bc}	8.01±0.01 ^{bc}
10%	46.49±0.02 ^d	4.51±0.00 ^a	0.60±0.03 ^c	7.95±0.04 ^c

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant ($\alpha = 5\%$).

Table 5: Effect of sliced galanga ratio supplemented to shrimp mixture to amino acid, pH, water activity and sensory score of the galanga-pickled white shrimp (*Litopenaeus vannamei*)

Galanga ratio	Amino acid (g/100g)	pH	Water activity (a_w)	Sensory score
5%	48.55±0.02 ^b	4.42±0.01 ^a	0.64±0.04 ^a	8.58±0.02 ^{bc}
10%	48.59±0.00 ^{ab}	4.39±0.02 ^{ab}	0.63±0.02 ^{ab}	8.76±0.01 ^a
15%	48.63±0.01 ^{ab}	4.35±0.01 ^b	0.63±0.01 ^{ab}	8.62±0.01 ^{ab}
20%	48.70±0.03 ^{ab}	4.33±0.04 ^{bc}	0.60±0.03 ^b	8.60±0.04 ^b
25%	48.73±0.01 ^a	4.31±0.01 ^c	0.60±0.00 ^b	8.44±0.02 ^c

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant ($\alpha = 5\%$).

Rainbow Sardines and mackerel were pickled according to this cure, salt ratio adopted being 1:3 by weight of fish²³. Salt concentration 1.0-3.5% and acetic acid 1- 2%, the stability of pickled fish was low²⁴. The firmness of marinated prawns (*Machrobrachium rosenbergii*) in various NaCl and acidity was evaluated. CaCl₂ and citrate solutions slightly accelerated the firmness of cooked prawn comparing with control. Tripolyphosphate didn't show effect while CaCl₂, citric acid and lemon juice accelerated the muscle firmness²⁰.

Nowadays people prepared seafood pickle by using organic solution with NaCl and spices²⁵. Green curry paste marinade for white shrimp (*Litopenaeus vannamei*) with additional amount of garlic was investigated to satisfy consumer

acceptability²¹. The effects of different temperature and time during pasteurization of marinated shrimp in green curry were evaluated. The treated shrimp was mixed with green curry paste with shrimp to green curry paste ratio 2:1 (w/w)²².

Effect of fermentation temperature and time to amino acid, pH, water activity and sensory score of the galanga-pickled white shrimp (*Litopenaeus vannamei*)

White shrimps (*Litopenaeus vannamei*) were treated with different ratios: NaCl (5%, 10%, 15%, 20%, 25%), CaCl₂ (1%, 1.5%, 2.0%, 2.5%, 3.0%), sucrose (5%, 10%, 15%, 20%, 25%), ethanol (2%, 4%, 6%, 8%, 10%), sliced galanga (5%, 10%, 15%, 20%, 25%) to create a pleasant taste and

appearance of galanga-pickled white shrimp. All samples fermented different temperature and time (26°C in 30 days, 28°C in 28 days, 30°C in 26 days, 32°C in 24 days, 34°C in 22 days). Five galanga-pickled white shrimps were chosen randomly to

analyse amino acid (g/100g), pH, water activity (a_w), and sensory score. From Table 6, the fermentation process should be conducted at 28°C for 28 days to get a pleasant taste of galanga-pickled white shrimp (*Litopenaeus vannamei*).

Table 6: Effect of fermentation temperature and time to amino acid, pH, water activity and sensory score of the galanga-pickled white shrimp (*Litopenaeus vannamei*)

Fermentation	Amino acid (g/100g)	pH	Water activity (a_w)	Sensory score
26°C : 30 days	48.59±0.00 ^b	4.39±0.02 ^{bc}	0.63±0.02 ^{bc}	8.76±0.01 ^{ab}
28°C : 28 days	49.74±0.00 ^a	4.35±0.01 ^c	0.62±0.01 ^c	8.85±0.02 ^a
30°C : 26 days	47.38±0.03 ^c	4.41±0.03 ^b	0.66±0.02 ^b	8.10±0.02 ^b
32°C : 24 days	46.14±0.01 ^d	4.46±0.02 ^{ab}	0.68±0.01 ^{ab}	7.69±0.01 ^c
34°C : 22 days	45.28±0.02 ^e	4.50±0.02 ^a	0.70±0.03 ^a	7.22±0.00 ^d

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant ($\alpha = 5\%$).

Fermentation was one of the preservative approaches to maintain the stability of the seafood storage for long time²⁶. Shrimp paste was produced by mixing with salt to ferment at ambient temperature⁸.

Shelf-life of the galanga-pickled white shrimp (*Litopenaeus vannamei*) during storage

Galanga-pickled white shrimp (*Litopenaeus*

vannamei) products were kept in ambient temperature condition (28±2°C). Amino acid (g/ 100g), pH, water activity (a_w), sensory score were used as quality indicators by sampling in 3 months interval for 12 months. From Table 7, quality of galanga-pickled white shrimp (*Litopenaeus vannamei*) was nearly stable at ambient temperature (28±2°C) during 12 months of storage.

Table 7: Shelf-life of the galanga-pickled white shrimp (*Litopenaeus vannamei*) during storage

Preservation (months)	Amino acid (g/100 g)	pH	Water activity (a_w)	Sensory score
0	49.74±0.00 ^c	4.35±0.01 ^a	0.62±0.01 ^a	8.85±0.02 ^{ab}
3	49.80±0.01 ^{bc}	4.32±0.00 ^{ab}	0.62±0.02 ^a	8.88±0.01 ^a
6	49.97±0.02 ^b	4.31±0.01 ^b	0.60±0.01 ^{ab}	8.80±0.02 ^b
9	50.18±0.02 ^{ab}	4.30±0.04 ^{bc}	0.59±0.03 ^{ab}	8.77±0.03 ^{bc}
12	50.33±0.04 ^a	4.28±0.01 ^c	0.57±0.01 ^b	8.75±0.01 ^c

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant ($\alpha = 5\%$).

During pickling process, a large quantity of specific amino acid was produced. Seafood pickle was safe without any toxic bacteria and maintaining durable stability over 6 months at room temperature¹⁶. The preparation of pasteurized marinated shrimp in green curry paste was safe for human consumption until the end of storage period for 15 days at 0-3°C²⁷.

CONCLUSION

Pickling is one of the easy and safe means of shrimp preservation. Pickled shrimps create

essential peptides and amino acids through autolytic and fermented reaction during the fermentation. However there was not any research mentioned to production of pickle white shrimp (*Litopenaeus vannamei*). The main production of this product is salt adding, fermenting, and curing. We have successfully examined different factors affecting to production of galanga-pickled white shrimp (*Litopenaeus vannamei*). By preserving under ambient temperature (28±2°C), the galanga-pickled shrimp could be maintained shelf-life for 12 months without any preservative. This simple technology can be easily approached to process in household scale.

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Conflict of Interest

Conflict of interest declared none.

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