



Synergistic Effect of Turmeric (*Curcuma longa*), Galanga (*Alpinia galanga*) Powder and Lemongrass (*Cymbopogon citratus*) Essential oil as Natural Preservative in Chilled Storage of White Hard Clam (*Meretrix lyrata*)

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<http://dx.doi.org/10.13005/ojc/360126>

(Received: December 10, 2019; Accepted: February 15, 2020)

ABSTRACT

Turmeric (*Curcuma longa*) is an essential spice and highly regarded in herbal medicine with multifunctional activities. Galanga (*Alpinia galanga*) is highly evaluated as its specific flavor and aroma as well as plenty healthy effects. Lemongrass (*Cymbopogon citratus*) Essential oil has active chemical constituents with various therapeutic properties. White hard clam (*Meretrix lyrata*) is one of molluscs (bivalve) with economical value. However, it is highly perishable due to microbiological growth, enzymatic degradation and lipid oxidation. In order to preserve quality and extend shelf life of this valuable seafood, there was an attempt to investigate a combination of natural preservatives such as turmeric (0.5%, 0.75%, 1.0%, 1.25%, 1.5%), galangal powder (0.5%, 0.75%, 1.0%, 1.25%, 1.5%) and lemongrass essential oil (0.5%, 0.75%, 1.0%) to create a synergistic antimicrobial effect. Results of this finding revealed that a combination of Turmeric powder %: Galanga powder % : Lemongrass essential oil % (0.5%: 0.5%: 0.75%) could prohibit bacterial proliferation (1.31×10^4 cfu/g), maintain firmness (1635.1 N) and overall acceptability (8.57) during 12 days of chilled storage.

Keywords: Turmeric, Galanga, Lemongrass, White hard clam, Synergistic.

INTRODUCTION

Extracts from plants and herbs containing bioactive compounds have shown remarkable antioxidant and antimicrobial activities¹. Turmeric (*Curcuma longa*) is one of the most useful herbal medicinal plants with a wide spectrum of pharmacological activities due to curcumin. It has various useful properties with antioxidant activities; against gastrointestinal disorder, inflammation, ulcer,

cancer, fungal, microbial renal and hepatoprotective². Galangal (*Alpinia galanga*) is also one medicinally important herb. The plant bears underground stems called rhizomes which have a strong aromatic aroma. Its rhizome is used as a spice and a source of essential oil³. *Alpinia galanga* rhizomes contained flavonoids and volatile oils possessed different pharmacological effects⁴. Lemongrass (*Cymbopogon citratus*) is a perennial tropical grass with thin, long leaves and is one of the main medicinal and aromatic



plants. Its essential oil is often used as fragrances, flavors, perfumery, cosmetics, detergents, and pharmaceuticals^{5,6}. Various chemical compounds in lemongrass essential oil possess antibacterial, antifungal, analgesic and mosquito repellent properties^{7,8,9,10}. White hard clam (*Meretrix lyrata*) contained a large amount of essential amino acids, polyunsaturated fatty acids with high level of DHA and EPA, It is also an excellent source of macro and micro minerals¹¹. It is highly perishable seafood due to microbiological growth, enzymatic degradation and lipid oxidation.

There were several researches mentioned to application of turmeric, galangal powder and lemongrass essential oil in seafood storage. Quality changes of sea bass slices wrapped with gelatin film incorporated with lemongrass essential oil were verified¹². The effect of turmeric on shelf life extension of shrimp *Penaeus semisulcatus* under chilled storage conditions was investigated¹³. Protective effect of sodium chloride and turmeric on physicochemical characteristics of sun-dried Tengra fish was examined¹⁴. Galanga (*Alpinia galanga*) was utilized to the pickled-shrimp fermentation¹⁵. Turmeric, galangal powder and lemongrass are all valuable herbs with multifunctional attributes. Seafoods are extremely perishable and susceptible to both chemical and microbiological spoilage during processing or storage¹⁶. Objective of our study focused on the synergistic effect of turmeric, galangal powder and lemongrass essential oil in chilled storage of white hard clam muscle.

MATERIALS AND METHODS

Material

Turmeric and galanga rhizomes were collected from Hau Giang province, Vietnam. They were dried and milled into powder. Lemongrass essential oil was supplied from Rainbow Technique Trading Co. Ltd, Ho Chi Minh City, Vietnam. White hard clams (*Meretrix lyrata*) were harvested from Ben Tre province, Vietnam. They were conveyed on ice and thoroughly washed with clean water before moving to laboratory as quickly as possible for experiments. 3M-Petrifilm plates were originated from Van Dai Phat Co. Ltd, Ho Chi Minh City, Vietnam.

Researching procedure

White hard clams (*Meretrix lyrata*) with the same size were selected for experiments. Cooking white hard clams (*Meretrix lyrata*) could remove meat of from shells easily. White hard clam meat was then treated with turmeric, galanga powder and lemongrass essential oil in different concentration to demonstrate their effects on physico-chemical, microbial and sensory characteristics during chilled storage. White hard clam meat was dipped in treatment solution for 15 min. at 28°C. Then it was dripped in 5 min. packed in polyethylene bags, stored in cool store at 4°C for 12 days. After that, samples were analyzed the firmness (N), total plate count (cfu/g), sensory score.

Physico-chemical, sensory and statistical analysis

Hardness (N) was evaluated by texture analyzer. Total plate count (cfu/g) was quantified by 3M-Petrifilm. Sensory score was evaluated by a group of panelist using 9 point-Hedonic scale. The experiments were run in triplicate with three different lots of samples. Statistical analysis was performed by the Statgraphics Centurion XVI.

RESULTS AND DISCUSSIONS

Effectiveness of turmeric powder (%) and lemongrass essential oil (%) on physico-chemical, microbial and organoleptic attributes of chilled white hard clam in 12 days of storage

Texture is a very important variable reflecting the seafood quality. Texture changes are due to loss of moisture-holding capacity and the emission of insoluble aggregates during cool storage. The negative effect of loss in texture leads to toughening, dry, stringy and hard to chew^{17,18}. During preservation, muscle components that are responsible for changes in seafood hardness are myofibrillar and connective tissue proteins which undergo degradation by proteases-primarily calpains, cathepsins and collagenases. These enzymes cause myofibril fragility and gaping, thus leading to decrease in hardness value^{19,20}. Lipid oxidation and enzymatic activity are also responsible for softening and mushiness in seafood leading to degradation of overall acceptability²¹. Total plate count (cfu/g) is the common method to determine the microbial spoilage of foodstuff. The turmeric treatment significantly reduced bacterial growth than that treated with salt²².

In our current research, different concentrations of turmeric powder (0.5%, 0.75%, 1.0%, 1.25%, 1.5%) combined with lemongrass essential oil 0.5% were examined on white hard clam muscle during 12 days of chilled storage. Texture hardness (N), total plate count (cfu/g)

and organoleptic attributes of white hard clam muscle were revealed in Table 1. It's obviously noticed that 1.0% turmeric powder combined with 0.5% lemongrass essential oil could effectively maintain physico-chemical, microbial and sensory characteristics of white hard clam muscle.

Table 1: Effectiveness of turmeric powder (%) and lemongrass essential oil (%) on physico-chemical, microbial and organoleptic attributes of chilled white hard clam in 12 days of storage

Turmeric powder %:	0.5%:	0.75%:	1.0%:	1.25%:	1.5%:
Lemongrass essential oil %	0.50%	0.50%	0.50%	0.50%	0.50%
Texture hardness (N)	1429.1 ±121.3 ^b	1489.4 ±112.9 ^{ab}	1521.3 ±215.8 ^a	1525.2 ±117.3 ^a	1529.1 ±102.5 ^a
Total plate count (10 ⁴ cfu/g)	6.24 ±0.05 ^a	4.79 ±0.01 ^b	4.41 ±0.03 ^b	4.03 ±0.01 ^c	2.87 ±0.02 ^d
Sensory score	6.75 ±0.03 ^c	7.12 ±0.02 ^b	7.58 ±0.01 ^{ab}	7.62 ±0.03 ^a	7.65 ±0.00 ^a

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

Extracts from turmeric combination with shallot extract (1.5% each, v/v) were demonstrated to maintain quality attributes of vacuum packaged rainbow trout during 20 days of frozen storage²³. Preservative effects of lemongrass essential oil and turmeric were demonstrated to improve the quality and extend the shelf life of the treated seafood products²⁴. The application of turmeric in peeled shrimp stored in ice (1:1 ratio) extended its shelf-life up to 8 days¹³. Turmeric treated sun-dried salted fish maintained biochemical values and sensory score at the end of 12 months¹⁴.

concentrations of galanga powder (0.5%, 0.75%, 1.0%, 1.25%, 1.5%) combined with lemongrass essential oil 0.5% were examined on white hard clam muscle during 12 days of chilled storage. Texture hardness (N), total plate count (cfu/g) and organoleptic attributes of white hard clam muscle were revealed in table 2. It's obviously noticed that 1.25% galanga powder combined with 0.5% lemongrass essential oil could effectively maintain physico-chemical, microbial and sensory characteristics of white hard clam muscle.

Effectiveness of galanga powder (%) and lemongrass essential oil (%) on physico-chemical, microbial and organoleptic attributes of chilled white hard clam in 12 days of storage

In our current research, different

In another research, with 10% sliced galangal in shrimp mixture, the final galangal-pickled shrimp had the good a pleasant taste and appearance¹⁵.

Table 2: Effectiveness of galanga powder (%) and lemongrass essential oil (%) on physico-chemical, microbial and organoleptic attributes of chilled white hard clam in 12 days of storage

Galanga powder %:	0.5%:	0.75%:	1.0%:	1.25%:	1.5%:
Lemongrass essential oil %	0.50%	0.50%	0.50%	0.50%	0.50%
Texture hardness (N)	1407.2 ±105.9 ^c	1449.7 ±203.6 ^b	1485.9 ±94.2 ^{ab}	1514.2 ±78.2 ^a	1520.4 ±93.1 ^a
Total plate count (10 ⁴ cfu/g)	7.85 ±0.02 ^a	5.42 ±0.03 ^b	4.19 ±0.00 ^c	3.84 ±0.04 ^{cd}	3.41 ±0.00 ^d
Sensory score	6.41 ±0.00 ^c	6.94 ±0.02 ^{bc}	7.12 ±0.01 ^b	7.67 ±0.03 ^{ab}	7.84 ±0.01 ^a

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

Synergistic effect of turmeric, galanga powder and lemongrass essential oil (%) on physico-chemical, microbial and organoleptic attributes of chilled white hard clam in 12 days of storage

Essential oil as an antimicrobial agent has positive effect on bacteria, while less is known about their action on yeast and molds²⁵. It can be applied either to inhibit the bacterial growth (bacteriostatic) or to kill bacterial cells (bactericide). *Gram-positive* bacteria are slightly more susceptible to essential oil than *Gram-negative* ones^{26,27}. The antimicrobial activity of essential oil can be attributed to mainly the phenolic constituents^{28,29}. Essential oil also creates mechanisms in prevention of chain initiation,

free-radical scavenging activity and retardation of lipid oxidation^{26,30,31}.

In our current research, different formulations of turmeric: galanga powder: lemongrass essential oil (0.25%: 0.75%: 0.5%: 0.5%: 0.5%: 0.5%: 0.75%: 0.25%: 0.5%: 0.5%: 0.5%: 0.5%, 0.75%: 0.5%: 0.5%: 1.0%) were examined on white hard clam muscle during 12 days of chilled storage. Texture hardness (N), total plate count (cfu/g) and organoleptic attributes of white hard clam muscle were revealed in Table 3. It's obviously noticed that turmeric: galanga powder: lemongrass essential oil (0.5%: 0.5%: 0.75%) could effectively maintain physico-chemical, microbial and sensory characteristics of white hard clam muscle.

Table 3: Synergistic effect of turmeric combined galanga powder (%) and lemongrass essential oil (%) on physico-chemical, microbial and organoleptic attributes of chilled white hard clam in 12 days of storage

	Turmeric powder %:	0.25%:	0.5%:	0.75%:	0.5%:	0.5%:
	Galanga powder %:	0.75%:	0.5%:	0.25%:	0.5%:	0.5%:
	Lemongrass essential oil %	0.50%	0.50%	0.50%	0.75%	1.00%
Texture hardness (N)	1544.8 ±115.3 ^c	1576.5 ±63.1b ^c	1593.2 ±112.4 ^b	1635.1 ±39.5 ^a	1641.6 ±23.7 ^a	
Total plate count (10 ⁴ cfu/g)	3.21 ±0.02 ^a	3.01 ±0.03 ^{ab}	2.75 ±0.02 ^b	1.31 ±0.02 ^c	1.27 ±0.05 ^d	
Sensory score	7.85 ±0.03 ^b	7.98 ±0.02 ^{ab}	8.34 ±0.00 ^{ab}	8.57 ±0.02 ^a	8.76 ±0.03 ^a	

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

Supplementation of herbal extracts to ice improved the seafood quality during preservation^{32,33}. The application of turmeric, galanga powder and lemongrass essential oil has great positive impact on preservation of white hard clam muscle as they maintained the organoleptic characteristics, texture firmness and reduced bacterial growth to some extent.

CONCLUSION

Successful application of turmeric, galanga powder and lemongrass essential oil treatments have been carried out on white hard clam muscle.

The combination of turmeric, galanga powder and lemongrass essential oil suppressed the degradation of raw white hard clam muscle as indicated by both microbiological and physicochemical characteristics.

ACKNOWLEDGMENT

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of Interest

The authors declare no conflict of interest.

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