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Physical Aspects Influencing to the Production of Dry-Salted Snakeskin Gourami *(Trichogaster Pectoralis)*

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ABSTRACT

Snakeskin gourami *(Trichogaster pectoralis)* is one of the most common fish in paddy field and river in Vietnam. It lives in waters at low dissolved oxygen and high organic accumulation. It has a high meat yield and favouritely consumed as dried fish in Vietnam. Farming area of snakeskin gourami has been opened dramatically in recent years. Therefore, it's necessary to have an appropriate processing and preserving approach to accelerate its commercial value in local and international markets. Objective of the present study focused on the different aspects such as ethanol treatment to eliminate fishy ordor; addition of salt, sorbitol, as well as dry temperature that affected to to water activity (aw), microbial load (coliform, cfu/g), sensory score of dried snakeskin gourami *(Trichogaster pectoralis)*. Shelf-life of the dried product was also evaluated during preservation. Results showed that 40% ethanol at ratio 20:80 for primary treatment; 2.0% of salt soaking; 1.0% of sorbitol addition; 46°C of drying were appropriate to maintain water activity (aw=0.65). By preserving under vacuum in PA bag, the dry-salted snakeskin gourami still extended the product shelf-life for 12 months without any deterioration.

Keywords: Snakeskin gourami, Ethanol, Salt, Sorbitol, Water activity, Shelf-life.

INTRODUCTION

Snakeskin gourami *(Trichogaster pectoralis)* has been considered as a valuable and suitable species for breeding in fresh and brackish water regions like Soc Trang, Bac Lieu and Ca Mau province, Vietnam. It tolerates a pH range between 6-8 and 22-28°C. It lives in lowland wetlands, marshes, swamps and canals. It feeds on zooplankton, crustaceans and insect larvae[1]. It achieves good maturity stages after 3 months under natural environment. The living area of snakeskin gourami *(Trichogaster pectoralis)* from wild stocks and traditional cultures has been declined in recent years. Many hatcheries like to buy their broodstock from grow-out farms. Most snakeskin gourami grow-out farmers keep broodstock and raise their own fingerlings. Others buy fingerlings from hatcheries. Cultivation of the snakeskin gourami is ussually arranged at a stocking density of 20-40

fingerling/m^2 to yield 18-22 tonnes/ha/crop. The medium fish size at harvest ranges from 6-8 fish/kg, but typically 7-8 fish/kg. There are various harvesting methods such as by draining based on low tides or using a cast net. Harvesting time requires 4-5 days to complete a one ha pond. By good commercial price, farming of the snakeskin gourami offers attractive income to attract farmers.

There was little research mentioned to the processing of dried snakeskin gourami *(Trichogaster pectoralis)*. The effect of various salt concentrations and other soluble elements on the moisture content and water activity (aw) of dried snakeskin fish was studied[2]. The influence of sorbitol and ethanol on the water activity and quality changes of dried snakeskin fish was examined[3].

The snakeskin gourami has a high commercial meat yield and favouritely consumed as dried fish in Vietnam. Commercial farming of snakeskin gourami has been developed rapidly in recent years. Therefore, it's necessary to have an appropriate processing and preserving approach to accelerate its commercial value in local and international markets. Objective of the present study focused on different aspects such as ethanol treatment to eliminate fishy ordor; addition of salt, sorbitol, as well as dry temperature affect to water activity, microbial load, sensory score of dried snakeskin gourami *(Trichogaster pectoralis* of dried product.). Shelf-life of the dried product was also evaluated.

MATERIALS AND METHOD

Material

We collected snakeskin gourami *(Trichogaster pectoralis)* from Ca Mau province, Vietnam. They must be reared following BAP/ACC 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 50 ppm chlorine with a support of bubble blowing to remove foreign matters. Besides *Trichogaster pectoralis* we also used another material during the research such as chlorine, salt, sorbitol, PA bag. Lab utensils and equipments included digital weight balance, Rotronic, stomacher, incubator, colony counter, vacuum sealing machine.

Fig. 1. Snakeskin gourami *(Trichogaster pectoralis)*

Researching procedure

Effect of ethanol treatment to eliminate fishy odor

Snakeskin gourami *(Trichogaster pectoralis)* was treated with ethanol 40% at different ratio (0:100, 5:95, 10:90, 15:85, 20:80, 25:75, 30:70) to elimated fishy odor. Sensory score was used to verify the appopriate ethanol ratio.

Effect of salt addition to water activity, microorganism and sensory score of the dried *Trichogaster pectoralis*

Snakeskin gourami *(Trichogaster pectoralis)* was treated with salt at different ratio (0%, 0.5%, 1.0%, 1.5%, 2.0%, 2.5, 3.0%) to create a pleasant taste of dried product. Water activity (aw), Coliform (cfu/g) and sensory score was used to verify the appopriate salt ratio.

Effect of sorbitol addition to water activity, microorganism and sensory score of the dried *Trichogaster pectoralis*

Snakeskin gourami *(Trichogaster pectoralis)* was treated with sorbitol at different ratio (0%, 0.25%, 0.5%, 0.75%, 1.0%, 1.25%, 1.5%) to create a pleasant taste of dried product. Water activity (aw), Coliform (cfu/g) and sensory score was used to verify the appopriate sorbitol ratio.

Effect of drying temperature to water activity, microorganism and sensory score of the dried Trichogaster pectoralis

Snakeskin gourami *(Trichogaster pectoralis)* was dried in different temperature (38°C, 40°C, 42°C, 44°C, 46°C, 48°C, 50°C) for 3 hour. Water activity (aw), Coliform (cfu/g) and sensory score was used to verify the appopriate drying temperature.

Shelf-life of the dried *Trichogaster pectoralis* during storage

Dired snakeskin gourami *(Trichogaster pectoralis)* products were kept in two different packing (zipper top, vaccum) ways in PA bag and two different temperature storage conditions

(4°C, 28°C). Sensory score was evaluated in 3 months interval for 12 months.

Physico-chemical and sensory analysis

Water activity (aw) was measured by Rotronic instrument. Coliform (cfu/g) was analysed by 3M-Petrifilm. Sensory score of *Trichogaster pectoralis* was assessed by a group of panelist using the 9-point hedonic scale.

Statistical analysis

The experiments were arranged in triplicate. Statistical analysis was performed by the Startgraphics.

RESULT & DISCUSSION

Effect of ethanol treatment to eliminate fishy odor

Snakeskin gourami *(Trichogaster pectoralis)* was treated with ethanol 40% at different ratio (0:100, 5:95, 10:90, 15:85, 20:80, 25:75, 30:70) to elimated fishy odor. Sensory score was used to verify the appopriate ethanol ratio. From Table 1, the fishy odor of *Trichogaster pectoralis* would be effectively eliminated by 40% ethanol at ratio 20:80 with fish.

Table 1: Effect of ethanol treatment to eliminate fishy odor of *Trichogaster pectoralis*

40% ethanol ratio: fish	Sensory score
0%	2.1±0.03e
5:95	4.3±0.02d
10:90	5.7±0.01c
15:85	6.6±0.02b
20:80	7.9±0.03a
25:75	8.0±0.02a
30:70	8.1±0.02a

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

The influence of different salt concentrations and other soluble elements on the moisture content and water activity (aw) of dried Snakeskin fish was studied. There was a dramatic decline in water activity on the product due to the addition of ethanol, sucrose, glucose in salted fish. Corresponding to dried fish, a water activity (aw) of 0.67 can be achieved due to the use of 21 ÷ 24 % salt, combined with 1% sucrose and 35 mL ethanol/kg salted fish[2].

Effect of salt addition to water activity, microorganism and sensory score of the dried *Trichogaster pectoralis*

Snakeskin gourami *(Trichogaster pectoralis)* was treated with salt at different ratio (0%, 0.5%, 1.0%, 1.5%, 2.0%, 2.5, 3.0%) to create a pleasant taste of dried product. Water activity (aw), Coliform (cfu/g) and sensory score was used to verify the appopriate salt ratio. From Table 2, the appropriate salt concentration should be used at 2.0% to get the lowest water activity, lowest microorganism while having the highest sensory score.

Table 2: Effect of salt addition to water activity, microorganism and sensory score of the dried *Trichogaster pectoralis*

Salt concentration (%)	Water activity (aw)	Coliform (cfu/g)	Sensory score
0	0.73±0.04^{a}	8.3x102±0.02^{a}	3.1±0.03^{f}
0.5	0.72±0.02^{ab}	4.8x102±0.03^{b}	4.4±0.01^{e}
1.0	0.70±0.03^{b}	2.7x102±0.02^{c}	5.2±0.03^{d}
1.5	0.69±0.01^{bc}	1.7x102±0.01^{d}	6.9±0.01^{b}
2.0	0.65±0.02^{c}	0.4x102±0.03^{e}	7.8±0.04^{a}
2.5	0.63±0.01^{cd}	1.1x101±0.04^{f}	6.2±0.03^{bc}
3.0	0.60±0.04^{d}	0.5x101±0.02^{g}	6.0±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 (α = 5%).

The preservative influence of salt is mostly based on the low water activity (aw) to prevent the growth of spoilage microorganisms[4].

Effect of sorbitol addition to water activity, microorganism and sensory score of the dried Trichogaster pectoralis

Snakeskin gourami *(Trichogaster pectoralis)* was treated with sorbitol at different ratio (0%, 0.25%, 0.5%, 0.75%, 1.0%, 1.25%, 1.5%) to create a pleasant taste of dried product. Water activity (aw), Coliform (cfu/g) and sensory score was used to verify the appopriate sorbitol ratio. From Table 3, the highest quality of dried snakeskin gourami (Trichogaster pectoralis) would be achieved by adding 1.0% of sorbitol.

Table 3: Effect of sorbitol addition to water activity, microorganism and sensory score of the dried *Trichogaster pectoralis*

Sorbitol concentration (%)	Water activity (aw)	Coliform (cfu/g)	Sensory score
0	0.65±0.02^{a}	0.4x102±0.03^{a}	7.8±0.04^{c}
0.25	0.64±0.01^{ab}	0.3x102±0.01^{ab}	7.9±0.01^{c}
0.5	0.64±0.04^{ab}	0.2x102±0.02^{b}	8.0±0.02^{bc}
0.75	0.63±0.02^{b}	1.4x101±0.04^{c}	8.4±0.02^{b}
1.00	0.62±0.01^{bc}	1.3x101±0.01^{cd}	8.5±0.01^{ab}
1.25	0.62±0.00^{bc}	1.0x101±0.00^{d}	8.5±0.03^{ab}
1.50	0.60±0.04^{c}	0.6x101±0.01^{e}	8.6±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 (α = 5%).

The influence of sorbitol on moisture movement and textural change of fish and squid muscles during aging and drying processes was demonstrated. When the aging muscles were dried, slow moisture vaporization happened at the initial drying period, and the critical moisture content significantly declined with an increase in the sorbitol content of the aging muscles. The tenderness of the dried muscles was significantly limited by sorbitol aging[5]. The simultaneous influences of sorbitol and ethanol on the water activity and quality changes of dried snakeskin fish were studied. The mixture of 8% sorbitol combined with 35 mL ethanol/kg salted fish were recommended as a critical value to the water activity changes of product (aw = 0.67). By application of this procedure, the dried fish quality was stable until 5 weeks of storage[3]. The influence of sorbitol would create the decrease of drying time and the reduction of the excess tenderness of dried fish[6].

Effect of drying temperature to water activity, microorganism and sensory score of the dried *Trichogaster pectoralis*

Snakeskin gourami *(Trichogaster pectoralis)* was dried in different temperature (38°C, 40°C, 42°C, 44°C, 46°C, 48°C, 50°C) for 3 hours. Water activity (aw), Coliform (cfu/g) and sensory score was used to verify the appopriate drying temperature. The drying process should be conducted at 46°C to maintained the lowest water activity, microorganism as well as the highest sensory score.

Table 4: Effect of drying temperature to the dried *Trichogaster pectoralis*

Drying temperature	Water activity (aw)	Coliform (cfu/g)	Sensory score
38°C	0.65±0.03^{a}	2.0x101±0.03^{a}	7.0±0.04^{d}
40°C	0.64±0.00^{ab}	1.8x101±0.01^{ab}	7.3±0.02^{cd}
42°C	0.64±0.04^{ab}	1.6x101±0.02^{b}	7.5±0.03^{c}
44°C	0.63±0.02^{b}	1.4x101±0.04^{bc}	8.2±0.01^{ab}
46°C	0.62±0.01^{bc}	1.3x101±0.01^{c}	8.5±0.01^{a}
48°C	0.60±0.03^{c}	1.1x101±0.02^{cd}	8.1±0.00^{b}
50°C	0.60±0.00^{c}	0.8x101±0.03^{d}	8.0±0.04^{b}

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

Salting and drying was one of the most effective ways of food preservation. For dried fish, salt was not enough as well as the temperature does not fit in the process of processing, preservation and distribution was the cause of boosting the growth of micro-organisms. To minimize the risk of poisoning, salt in the liquid phase in fish products must reach at least 3.5%[2]. The law of Raoult to explain the dependence of water activity (aw) on different levels of soluble substances and moisture content of the food system. There was a correlation of water activity in dried fish products to different levels of salt concentration. The concentration of salt concentration from 15% to 24% or salt time must be long enough[7]. The influences of 4 different temperatures and 4 different pre-treatment methods on the drying rate and the quality of catfish were examined[8].

Shelf-life of the dried *Trichogaster pectoralis* during storage

Oid oxidation is the major obstacles in the salted fish. Oil oxidation creates negative effect to taste, odor and color of salted fish. Vacuum packaging can be utilized as one method to maintain the stability and quality of a salted fish. Vacuum packaging is an effective approach to delay the oil oxidation by eliminating oxygen molecule.[9]

Dry-salted snakeskin gourami *(Trichogaster pectoralis)* products were kept in two different packing (zipper top, vaccum) ways in PA bag and two different temperature storage conditions (4°C, 28°C). Sensory score was evaluated in 3 months interval for 12 months. Results from Table 5 showed that the dry-salted snakeskin gourami *(Trichogaster pectoralis)* still mainted quality during 12 months of storage.

Table 5: Shelf-life (sensory score) of the dried *Trichogaster pectoralis* during storage

Storage time (month)	Dried Trichogaster pectoralis by the storage temperature (°C) kept in PA (zipper top)		Dried Trichogaster pectoralis by the storage temperature (°C) kept in PA (vaccum)	
	4°C	28°C	4°C	28°C
0	8.5±0.01^{a}	8.5±0.01^{a}	8.5±0.01^{a}	8.5±0.01^{a}
3	8.3±0.01^{ab}	8.2±0.00^{ab}	8.5±0.01^{a}	8.4±0.03^{ab}
6	8.2±0.01^{b}	8.0±0.04^{b}	8.4±0.02^{ab}	8.2±0.02^{b}
9	8.0±0.01^{bc}	7.9±0.02^{bc}	8.4±0.01^{ab}	8.0±0.01^{bc}
12	7.7±0.01^{c}	7.5±0.03^{c}	8.3±0.00^{b}	7.9±0.00^{c}

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

The stability of lakerda in stretch film and vacuum package preserved for 56 days at 4±2°C after the ripening and dry salting was compared. They showed that vacuum packaging is an useful way to maintain chemical and microbial characteristics of dry-salted lakerda kept at 4±2°C during the 56th days[10].

CONCLUSION

Snakeskin gourami *(Trichogaster pectoralis)* lives in different areas of river, paddy field and wamp to avoid predation from birds and other fishes. The intensive farming of snakeskin gourami culture creates large quantity, so it's necessary to commercial processing and storage of this species. The salting, fermenting, marinating, smoking and drying are effective approaches to preserve fish. Salting, drying and packaging can be considered as an appropriate strategy to maitained its product shelf-life. From this present study, vacuum packaging significantly increased shelf life of dry-salted snakeskin gourami *(Trichogaster pectoralis)*.

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CONFLICT OF INTEREST

Conflict of interest declared none.

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