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Importance of Cryoprotectants on Frozen Quality of Scrape Meat Utilized from Suckermouth Catfish (*Hypostomus plecostomus*)

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Suckermouth catfish (*Hypostomusplecostomus*) is an underutilized fish in Mekong delta. Its scrap meat is further processed as minced meat for the domestic consumption. This research evaluated the influence of different cryoprotectants like saccharose, trehalose, sorbitol, NaCl, glycerophosphate, sodium tripolyphosphate, albumin, modified starch in various concentrations (0÷4 %) on the textural firmness, drip loss and organoleptic property of scrape meat from suckermouth catfish during 6 months of frozen storage. Results showed that among various cryoprotectants, glycerophosphate showed the most appropriate substance in intensifying the textural hardness while retarding drip loss of scrape meat. During frozen storage, the overall acceptance of scrape meat of suckermouth catfish still achieved the highest sensory score. 2.5 % glycerophosphate would be appropriate to create cryoprotective effects against quality deterioration.

Keywords: Suckermouth catfish, cryoprotectant, textural hardness, drip loss, overall acceptance, frozen storage

INTRODUCTION

Suckermouth catfish (*Hypostomusplecostomus*) is a popular ornamental freshwater fish. It can monopolize nutrient resources, alter food webs, increase turbidity, cause bank erosion through nest building, and physically inhibit other aquatic organisms.It can compete for food and habitat with sympatric fishes and aquatic organisms, disturb nest sites, eat eggs of native fishes and disrupt trophic flows and nutrient cycling aquatic habitats (Hoover et al. 2014). It grows rapidly in slow-flowing, lower reaches of rivers between the lower falls and the estuarine zone, as well as lakes and swamps. It is commonly utilized as scrape meat. Filleting releases a great amounts of scrap meat which can be converted to various value-added products with a high economic efficiency (Thuy et al., 2010; Rathod et al., 2018). Freezing of suckermouth catfish is an important strategy to preserve the inherent nutritional and organoleptic properties for an extended duration (Ortiz et al., 2009). Freezing improves the freshness by retarding microbial proliferation (Geirsdottir et al., 2007) and limiting biochemical alteration (Fan et al., 2009). Unfortunately, the consumers' acceptability of frozen suckermouth catfish gradually degrade and texture hardness is one of the important variables reflecting the sensory acceptance. Negative effects of freezing fish products were texture degradation, drip loss and low water holding capacity (Etemadian et al., 2012). Frozen storage for prolonged duration induces rubbery texture in meat and fish products (Tanushree et al., 2018). In order to retard these undesirable changes in freezing, cryoprotectants were commonly supplemented owing to their cheap cost, safety and excellent cryoprotective effects (Xiao-Fei et al., 2020). Cryoprotectants are chemical substances having ability to retard cells or tissues against damage by freezing. Without cryoprotectants, biological cells turns decomposed therefore cells loses numbness and stiffness especially at low-temperature (Sankha and Bhupendra, 2016). Objective of our study was to demonstrate the impact of various cryoprotectants such as saccharose, trehalose, sorbitol, NaCl, glycerophosphate, sodium tripolyphosphate, albumin, modified starch in different concentration on the textural hardness, drip loss and organoleptic property of scrape meat from suckermouth catfish during 6 months of frozen storage.

MATERIALS AND METHODS

2.1 Material

Suckermouth catfish was collected in SocTrang province, Vietnam. Saccharose, trehalose, sorbitol, NaCl, sodium glycerophosphate, sodium tripolyphosphate, albumin, modified starch were all food grade.

2.2 Researching method

Scrape meat from suckermouth catfish was incorporated with different cryoprotectants such as saccharose, trehalose, sorbitol, NaCl, sodium glycerophosphate, sodium tripolyphosphate, albumin, modified starch in various concentrations (0÷4 %). After 6 months of frozen storage, samples were taken to determine textural hardness (g), drip loss (%) and overall acceptance (sensory score).

2.3 Physical and organoleptic evaluation

Texture hardness (g) was determined by texture analyzer.

Drip loss (%) = $(W-W_i) * 100\% / W$

W: the initial weight (g) of each sample

W_i: the weight (g) of each sample after 6 months storage

Overall acceptance was evaluated by a group of panelists using 9-point Hedonic scale.

2.4 Statistical analysis

The experiments were run in triplicate with different groups of samples. The data were presented as mean±standard deviation. Statistical analysis was performed by the Statgraphics Centurion version XVI.

RESULTS

Table 1 showed the impact of different cryoprotectant such as saccharose, trehalose, sorbitol, NaCl, sodium glycerophosphate, sodium tripolyphosphate, albumin, modified starch on the texture hardness (g) of scrap meat originated from suckermouth catfish after 6 months of storage. Among cyoprotectants, 2.5% sodium glyerophosphate revealed significant texture hardness with the highest value (804 g). Textural hardness in samples with cryoprotectants was significant higher than of control. Prolonged preservation resulted in decreased water retention capacity owing to protein denaturation because of surface dehydration, ice crystal formation and cell rupture (Satya and Krushna, 2011). Cryoprotectants improved the rheological and textural properties of food by modifying the viscosity and providing thermodynamic stability to ice cream to control the process of re-crystallization (Tanushree). Inclusion of cryoprotectants can restrain the denature rate of myofibril protein (Chairil et al. 2013).

Table 2 presented the impact of different cryoprotectant such as saccharose, trehalose, sorbitol, NaCl, sodium glycerophosphate, sodium tripolyphosphate, albumin, modified starch on drip loss (%) of scrap meat originated from suckermouth catfish after 6 months of storage. Among cryoprotectants, 2.5% sodium glyerophosphate showed significant drip loss with the lowest value (0.42 %). Drip loss in samples with cryoprotectants was significant lower than of control. The reduction of drip loss in samples supplemented by cryoprotectants from that of control during the frozen storage indicated the effect of cryoprotectant in preventing the protein denaturation (Satya and Krushna, 2011).

Table 3 reflected the influence of different cryoprotectant such as saccharose, trehalose, sorbitol, NaCl, sodium glycerophosphate, sodium tripolyphosphate, albumin, modified starch on overall acceptance (sensory score) of scrap meat originated from suckermouth catfish after 6 months of storage. Among cyoprotectants, 2.5% sodium glyerophosphate showed significant overall acceptance with the highest sensory score (8.91). Overall acceptance in samples with cryoprotectants was significant higher than of control.Textural modification and protein decomposition in frozen preservation of Nile tilapia at −18 ºC for 150 days were demonstrated. Salt-soluble protein and protein solubility decreased dramatically in the frozen preservation (Kanasi et al. 2015). Cryoprotectants induce an appropriate solution in limiting drip loss, maintaining the texture firmness and appearance (Xiao-Fei et al. 2020).

Table 1: Effect of cryoprotectants on texture hardness (g) of scrap meat utilized from suckermouth catfish

Concentration (%)	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Saccharose	179 ±2^{a}	287 ±1^{cd}	296 ±0^{cd}	304 ±2^{d}	312 ±3^{d}	**319** ±0^{d}	313 ±2de	306 ±3^{d}	300 ±1^{c}
Trehalose	179 ±2^{a}	295 ±0^{c}	313 ±3^{c}	341 ±1^{cd}	**398** ±0^{c}	364 ±2^{c}	322 ±1^{d}	307 ±0^{d}	284 ±2^{cd}
Sorbitol	179 ±2^{a}	260 ±4^{d}	275 ±1^{d}	296 ±3^{e}	323 ±2^{d}	359 ±1^{d}	**378** ±0^{c}	370 ±2^{c}	342 ±3^{b}
NaCl	179 ±2^{a}	316 ±1^{b}	379 ±3^{b}	421 ±0^{b}	449 ±1^{b}	463 ±0^{b}	477 ±3^{b}	480 ±1^{b}	485 ±0^{a}
Sodium glycerophosphate	179 ±2^{a}	435 ±3^{a}	517 ±0^{a}	603 ±1^{a}	711 ±3^{a}	**804** ±2^{a}	685 ±1^{a}	577 ±0^{a}	482 ±2^{a}
Sodium tripolyphosphate	179 ±2^{a}	242 ±0^{e}	271 ±1^{d}	299 ±3de	317 ±0^{d}	342 ±3^{cd}	**361** ±2^{cd}	323 ±3^{cd}	282 ±0^{cd}
Albumin	179 ±2^{a}	301 ±2^{bc}	318 ±3^{c}	366 ±0^{c}	397 ±2^{c}	**425** ±1^{bc}	409 ±0^{bc}	377 ±2^{c}	335 ±1^{bc}
Modified starch	179 ±2^{a}	243 ±1^{e}	266 ±0^{e}	293 ±3^{e}	**314** ±1^{d}	306 ±2^{e}	274 ±1^{e}	259 ±0^{e}	232 ±2^{d}

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

Table 2: Effect of cryoprotectants on drip loss (%) of scrap meat utilized from suckermouth catfish

Concentration (%)	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Saccharose	4.83 ±0.01^{a}	4.49 ±0.03^{b}	4.44 ±0.00^{bc}	4.39 ±0.03^{bc}	4.32 ±0.02^{b}	**4.01** ±0.01^{c}	4.15 ±0.02^{b}	4.20 ±0.03^{b}	4.26 ±0.01^{bc}
Trehalose	4.83 ±0.01^{a}	4.32 ±0.02^{bc}	4.27 ±0.01^{c}	4.21 ±0.02^{c}	**3.96** ±0.03^{cd}	4.07 ±0.02^{bc}	4.12 ±0.00^{bc}	4.20 ±0.01^{b}	4.25 ±0.03^{bc}
Sorbitol	4.83 ±0.01^{a}	4.60 ±0.00^{ab}	4.53 ±0.03^{b}	4.47 ±0.00^{b}	4.41 ±0.02^{ab}	4.35 ±0.00^{ab}	**4.20** ±0.03^{ab}	4.28 ±0.02^{ab}	4.39 ±0.00^{ab}
NaCl	4.83 ±0.01^{a}	4.03 ±0.01^{cd}	3.97 ±0.00^{d}	3.82 ±0.03^{d}	3.66 ±0.01^{d}	3.41 ±0.03^{d}	3.33 ±0.01^{d}	3.18 ±0.00^{c}	**3.15** ±0.01^{d}
Sodium glycerophosphate	4.83 ±0.01^{a}	3.41 ±0.02^{d}	3.02 ±0.03^{e}	2.59 ±0.02^{e}	1.97 ±0.00^{e}	**0.42** ±0.01^{e}	0.65 ±0.02^{e}	0.89 ±0.01^{d}	1.12 ±0.02^{e}
Sodium tripolyphosphate	4.83 ±0.01^{a}	4.77 ±0.00^{a}	4.63 ±0.02^{ab}	4.58 ±0.01^{ab}	4.50 ±0.03^{a}	4.39 ±0.02^{a}	**4.13** ±0.00^{bc}	4.21 ±0.03^{b}	4.32 ±0.00^{b}
Albumin	4.83 ±0.01^{a}	4.26 ±0.01^{c}	4.20 ±0.00^{cd}	4.11 ±0.03^{cd}	4.03 ±0.00^{c}	**3.68** ±0.03^{cd}	3.74 ±0.02^{c}	3.95 ±0.01^{bc}	4.06 ±0.02^{c}
Modified starch	4.83 ±0.01^{a}	4.77 ±0.03^{a}	4.70 ±0.02^{a}	4.61 ±0.00^{a}	**4.25** ±0.02^{bc}	4.32 ±0.00^{b}	4.40 ±0.03^{a}	4.51 ±0.02^{a}	4.59 ±0.03^{a}

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

Table 3: Effect of cryoprotectants on sensory score of scrap meat utilized from suckermouth catfish

Concentration (%)	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Saccharose	6.03 ±0.00^{a}	6.12 ±0.03^{cd}	6.34 ±0.02^{cd}	6.56 ±0.01^{de}	6.83 ±0.00^{d}	**7.01** ±0.01^{c}	6.92 ±0.00^{c}	6.74 ±0.03^{cd}	6.45 ±0.01^{c}
Trehalose	6.03 ±0.00^{a}	6.47 ±0.02^{bc}	6.63 ±0.01^{bc}	6.78 ±0.00^{c}	**7.19** ±0.03^{c}	7.04 ±0.02^{c}	6.89 ±0.03^{cd}	6.70 ±0.01^{d}	6.57 ±0.02^{bc}
Sorbitol	6.03 ±0.00^{a}	6.35 ±0.00^{c}	6.41 ±0.03^{c}	6.52 ±0.02^{e}	6.84 ±0.01^{d}	6.93 ±0.01^{cd}	**7.06** ±0.02^{bc}	7.00 ±0.00^{bc}	6.71 ±0.01^{b}
NaCl	6.03 ±0.00^{a}	6.89 ±0.01^{ab}	7.15 ±0.02^{ab}	7.49 ±0.03^{ab}	7.72 ±0.02^{b}	7.86 ±0.00^{bc}	7.89 ±0.01^{b}	7.93 ±0.03^{ab}	**7.95** ±0.00^{a}
Sodium glycerophosphate	6.03 ±0.00^{a}	7.05 ±0.03^{a}	7.48 ±0.01^{a}	7.78 ±0.02^{a}	8.46 ±0.01^{a}	**8.91** ±0.03^{a}	8.63 ±0.00^{a}	8.21 ±0.02^{a}	8.03 ±0.03^{a}
Sodium tripolyphosphate	6.03 ±0.00^{a}	6.01 ±0.02^{d}	6.17 ±0.03^{d}	6.34 ±0.01^{f}	6.52 ±0.00^{e}	6.74 ±0.01^{d}	**6.95** ±0.03^{c}	6.82 ±0.01^{c}	6.24 ±0.02^{cd}
Albumin	6.03 ±0.00^{a}	6.62 ±0.00^{b}	6.94 ±0.02^{b}	7.24 ±0.00^{b}	7.53 ±0.03^{bc}	**7.97** ±0.02^{b}	7.80 ±0.01^{b}	7.35 ±0.00^{b}	6.80 ±0.01^{b}
Modified starch	6.03 ±0.00^{a}	6.03 ±0.01^{d}	6.21 ±0.03^{d}	6.69 ±0.02^{cd}	**6.99** ±0.01^{cd}	6.80 ±0.00^{d}	6.43 ±0.02^{d}	6.11 ±0.03^{e}	6.04 ±0.02^{d}

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

CONCLUSION

Freezing is one of the most useful way to maintain the seafood quality in texture, aroma and overall acceptance upon freezing and subsequent frozen storage. Unfortunately it also results in deteriorative modification in textural firmness and drip loss of seafood due to temperature fluctuations directly affecting its marketability. Different cryoprotectants like saccharose, trehalose, sorbitol, NaCl, sodium glycerophosphate, sodium tripolyphosphate, albumin, modified starch impart different cryoprotective effects to quality of scarp meat utilized from suckermouth catfish (*Hypostomusplecostomus*). Sodium glycerophosphate revealed superior to other cryoprotectants in maintaining textural hardness, lowering drip loss and fulfilling the overall acceptance of scrape meat from this valuable suckermouth catfish during 6 months of storage.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

Nguyen Phuoc Minh arranged the experiments and also wrote the manuscript.

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