Journal of Food Innovation, Nutrition, and Environmental Sciences
Volume 1 (2024); Issue 1: 47-55
ISSN No:3078-5537

ORIGINAL ARTICLE

Effect of Temperature and Protease on The Desalting Process of Scomberoides commersonianus (Talang Queenfish)

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Article history
Received;
13 September 2024
Revised;
1 October 2024
Accepted;
October 2024

Keywords
Desalting, Retort Processing, Alcalase enzyme, Talang queen fish, texture profile analysis, Sensory evaluation.

ABSTRACT
This study evaluates the effects of temperature and protease (Alcalase) on the desalting process of salted Talang Queenfish (Scomberoides commersonianus) and the resulting textural and sensory properties of the fish. Salted fish samples were desalted using different temperatures (25°C, 40°C, 60°C, and 80°C) and Alcalase concentrations (1%, 2%, and 3%) at pH 7 and 60°C. The results showed that higher desalting temperatures or increased Alcalase concentrations significantly ($p < 0.05$) increased salt removal, reducing the salt content in the fish muscle. The addition of Alcalase accelerated the desalting process, reducing desalting time compared to traditional methods. Textural analysis indicated that the fish's hardness, cohesiveness, and chewiness decreased as desalting temperature and Alcalase concentration increased. Sensory evaluations revealed no significant changes in overall acceptability, with desalting at 60°C and 1% Alcalase yielding the best balance of saltiness and texture. Furthermore, retort-processed salted fish curry prepared from desalted samples maintained favorable sensory properties. These findings suggest that alternative desalting methods using Alcalase and elevated temperatures can enhance desalting efficiency while maintaining product quality.

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Peer review under responsibility of Journal of Food Innovations, Nutrition, and Environmental Sciences.

A Publication of EcoScribe Publishing company Limited, Uganda.

1. Introduction

Talang Queenfish (*Scomberoides commersonianus*) is a common fish in south-east Asian countries including Malaysia and Bangladesh. It is bluish green in color, with a compressed body, large mouth, upper jaw extending to well behind the eye (Kong, 1998; Scott, 1959) and is usually caught in shallow water by gill nets, hand-lines or traps. It has white meat but the quality in terms of taste is inferior when consuming it fresh. Therefore, it has a low market price when in fresh form. Normally, to increase its sensory properties and market value, it will be salted after it has been caught (Kong, 1998).

In many developing countries, salted fish is a major protein source due to its lower market price and stable shelf life (Sikorski, 1990). Salting is an effective method used around the world to preserve different types of fish. Besides being effective, salting is also a popular preservation method because of its simplicity and lower production costs (Martínez-Alvarez & Gómez-Guillén, 2013). There are three major types of salting fish: dry salting, wet salting and a combination of the two methods (Bellagha, Sahli, Farhat, Kechaou, & Glenza, 2007; Horner, 1997). When the salt diffuses into the fish muscle during salting, it causes release of liquid from the muscle until an osmotic equilibrium is achieved between the tissue and the surrounding area (Thorarinsdottir, Arason, Bogason, & Kristbergsson, 2004). Salting of fish results in reduced water activity within the muscles of the fish, with a consequential inhibition of bacterial growth, enzymatic spoilage and may protect the flesh from oxidative deterioration (Martinez, Salmerón, Guillén, Pin, & Casas, 2012; Rodrigues, Ho, López-Caballero, Vaz-Pires, & Nunes, 2003). The amount of salt diffused into the fish muscle is different due to different processing methods and the amount of salt applied (Hadizadeh, Mooraki, & Moini, 2014). In addition to its preservative properties, salting was also observed to enhance the physicochemical, textural and sensorial properties of fish flesh (Martinez, Salmerón, Guillén, Pin, & Casas, 2012).

Salted products can be classified into two: deeply salted products (fish, etc.) and lightly salted products (cheese, sausages, pickles, olives etc.). Lightly salted products can be consumed directly. However, high salt intake from salted fish may create negative health outcomes, including hypertension and kidney failure (He & MacGregor, 2009). Therefore, alternative desalting methods are required to remove/reduce the salt content in the salted fish. During home preparation of slated fish, the desalting is usually done by repeatedly soaking the salted fish in water for some time until the saltiness reaches suitable levels for consumption. However, with such a method, the quantity of salt removed is uncertain. In addition, the effect of desalting time and temperature on this method is also un documented. Protease is a type of enzyme which can hydrolyze or break the peptides bonds in a protein (Sriket, 2014). Proteases are mainly produced from animal, plant, fungal and bacteria. Whereas proteases from mesophilic microorganisms have specific and narrow range of pH, temperature and ionic strength, which limits their usage in industries, protease from halotolerant bacteria, *Bacillus licheniformis* is stable at different concentrations of NaCl (Jadhav, Jaybhaye, & Musaddiq, 2013). Proteases play a large role in food industries. They are used for meat tenderization, baking, cheese making process, soya hydrolysates preparation, fish protein hydrolysis and the list goes on (Li, Yi, Marek, & Iverson, 2013). During storage or improper post-mortem handling, the protein of fish muscle can be degraded by proteases with the consequence of changes in the texture of fish muscle such as softening or mushiness. This is due to the collapse of perimysium and endomysium connectives tissues including the proteins located in Z lines and H zones (Sriket, 2014). The idea that the degradation of peptide bonds by proteases might cause muscle softening and lead to higher salt release from the salted fish merits a study. The globalization of food patterns has led to rapid shifts in eating behavior from traditional patterns of eating, towards the consumption of fast food products which are convenient and ready-to-eat (Hu, 2008). Desalted salted fish products are still unknown to the mass and thus it has its own unique market potential for a very specific niche area (Barat, Rodríguez-Barona, Castelló, Andrés, & Fito, 2004). It could therefore be useful to promote the consumption of protein rich fish products by preparing ready-to-eat desalted salted fish products to meet the market demand. The objectives of this work were to evaluate the effect of desalting temperature, Alcalase concentration and desalting time on the desalting process of salted Talang queenfish, evaluate changes of texture and sensory properties of the salted fish after desalting process and to evaluate the textural and sensory properties of a retort processed ready-to-eat desalted salted product.

2. Materials and Methods

Salted Talang Queenfish was purchased from Chowrasta Market, Penang. The enzyme Alcalase used in this study is a serine endopeptidase cultivated from *Bacillus licheniformis* with the density of 1.25 g/m and activity value of ≥ 0.75 Anson units/ml. This enzyme was obtained from Merck, Denmark.

2.1 Desalting of the fish

The desalting was done as described by (Andrés, Rodríguez-Barona, Barat, & Fito, 2005) with modifications. The salted fish flesh was cut into slices of dimensions 4 cm x 1.5 cm x 1 cm and weight of 10 ± 0.3 g. These were placed in a beaker, to which 100 ml of tap water was added for desalting. The ratio of salted fish to water was 1: 10 (w/v). The desalting was carried out at different temperatures of 25 ºC, 40 ºC 60 ºC and 80 ºC at different time span which were 20, 40 and 60 min. The salted fish that was not subjected to desalting was labelled as Control. The desalting experiments for 40 ºC, 60 ºC and 80 ºC were performed by placing the beakers inside the water bath (Memmert, U.S.). For the effect of protease, the experiments were carried out by using different concentrations of Alcalase. The concentrations used were 1 % (ALC1), 2 % (ALC2) and 3 % (ALC3). The desalting experiments were performed at different time span which were 20, 40 and 60 min. The concentration values of the enzyme were calculated as 1 %, 2 % and 3 % of 100 ml tap water. The final volume of enzyme and tap water used was 100 ml. The experiments were performed at the optimum condition of the Alcalase enzyme which was 60 ºC and pH 7. The desalting experiments were performed by placing the beakers inside the water bath (Memmert, U.S.).

2.2 Determination of Salt Content

The salt content released into the water and the salt content retained inside the salted fish flesh were determined by using method described by (Noort, Bult, Stieger, & Hamer, 2010). The salt content (% w/ml) was determined by using sensION+ EC5 portable conductivity meter (Hach, U.S) with the reference of known salt concentration versus conductivity standard graph. The conductivity meter was calibrated by using standard solution of 84 µs/cm, 1413 µs/cm and 12880 µs/cm. The measurements were read when the constant reading was reached at 25 ºC. The salt content released into the water was determined by measuring the conductivity of the water used for desalting experiments. To determine the salt content retained in the fish flesh, the fish flesh after the desalting process was blended with 100 ml of tap water and the reading of conductivity was taken. The concentration of salt released into water and the concentration of salt retained in the fish flesh were calculated from the conductivity versus salt concentration standard graph with the equation of $y = 14.82x + 2.4373$ (Appendix A). The experiments were carried out with three replications.

2.3 Texture Profile Analysis (TPA)

TPA test was carried out by using the method described by (Casas, Martinez, Guillen, Pin, & Salmeron, 2006) with modifications. The salted fish samples were cut into slices with the dimensions of 3 cm x 3 cm x 1.5 cm and undergone desalting process with the ratio of salted fish to water, 1: 10 (w/v) for 60 min by following the desalting method described in 2.1 with different desalting temperatures and protease concentrations. Parameters for TPA including hardness, springiness, cohesiveness and chewiness were determined by using a software-controlled Texture Analyser instrument (TA-TX2 model, Stable Micro Systems, Surrey, UK) fitted with 30 kg load cell. The texture analyser was calibrated by using 5 kg load before the analysis. The return distance was set as 20 mm. The test was carried out by using a cylindrical probe with 20 mm in diameter. The test conditions were pre-test speed, 1.00 mm/s; test speed, 2.00 mm/s; post-test speed, 5.00 mm/s; strain, 30.00 %; time, 5.00 s; trigger type, auto and trigger force, 5 g. The TPA tests were carried out triplicates, results recorded and calculated by TA Exponent 32 software.

2.4 Preparation of ready-to-eat desalted salted fish curry

The salted fish was cut into slices with the dimensions of 3 cm x 3 cm x 1 cm and undergone desalting process with the ratio of salted fish to water was 1: 10 (w/v) for 60 min. 25C, 60C and ALC1 were chosen for the product preparation. The curry was cooked based on the formulation shown in Table 1. The cooking was done in a TDB/6-10 model steam jacketed kettle (Groen, U.S.). Shallot and garlic were blended into small pieces and cooked until golden brown in cooking oil. Curry powder was mixed with water and added to the mixture, shortly followed with addition of the salted fish slices and lastly, palm sugar and coconut milk. The cooking process ended after the curry boiled.

Table 1: Formulation of salted fish curry

Ingredient	Quantity
Salted fish	200 g
Shallot	50 g
Garlic	20 g
Curry powder	30 g
Palm sugar/ Melacca sugar	10 g

Water	100 ml
Coconut Milk	50 ml

2.5 Retort processing of the fish curry

The retort processing was done following the method described by Yeoh, Alkarkhi, & Easa (2014) with modifications. Approximate 200 g of salted fish slices were filled into an aluminium can (300 x 407). The gravy was filled in after that with the ratio of salted fish slices to gravy 60:40. The headspace left was approximately 7 mm. The cans were exhausted in a steam chamber at 95 ± 5.0 ºC for 20 min. The cans were double seamed by a can seamer (Metal Box No.1-A Double Seamer, London, U.K.). The cans were then retorted in a can sterilizing retort (United Engineers, U.S.) at 121 ºC to achieve a F_0 value of > 3 min. Cold water was used to cool the cans immediately after the retort processing.

2.6 Sensory evaluation

2.6.1 Sensory evaluation of fish after desalting process

The sensory tests were conducted at the sensory laboratory of Food Technology Division, Universiti Sains Malaysia with the participation of 30 students. Samples from 2.1 were put inside a plastic bag. The samples were coded with three-digit random numbers. The panellists were required to press the samples to 50 % of the original height and taste the samples. The panellists were required to rinse their mouths with water for three times between samples. A ranking test was performed as described by (Meilgaard, Carr, & Civille, 2006). The desalted salted fish samples were ranked according to their saltiness, hardness, springiness, cohesiveness and chewiness where "1" represents the least intensity of the attributes.

2.6.2 Sensory evaluation of canned salted fish curry

The preference of the panellists on the canned salted fish curry were evaluated by using seven-point hedonic scale method where "1" represents dislike very much and "7" represents like very much. The samples were taken from the cans and cut into small pieces with the dimensions of approximately 1.5 cm x 1.5 cm x 1.5 cm. The samples were coded with three-digit random numbers. Each of the samples with 1/2 tablespoon of gravy was served with one tablespoon of plain porridge. The porridge used in the sensory evaluation was cooked by adding rice into the water without addition of salt, sugar and flavour enhancer. The panellists were required to taste the samples with porridge. The samples were evaluated based on the saltiness, texture, taste, aroma and overall acceptability (Aminah, 2000).

2.7 Statistical Analysis

The data collected were analysed using analysis of variance (ANOVA) with a Duncan's Multiple Comparison test at a significance level $p<0.05$. All statistical tests and analyses were performed by using Statistical Package Social Science (SPSS) version 20. All results were presented as mean ± standard deviation.

3. Results and Discussion

3.1 Effect of desalting temperature and alcalase concentration on the effectiveness of desalting process

Fig. 1a shows the approximate salt concentrations removed at different desalting temperatures and alcalase concentrations as a function of time. The approximate salt concentrations retained in the fish flesh after desalting process at the conditions is shown in Fig. 1b. Generally, the amount of salt removal during the desalting process increased with the increase of desalting temperature. Besides, addition of Alcalase during the desalting process at optimum condition enhanced the desalting process. Increase in desalting temperature or addition of protease reduced the desalting time if compared to the traditional desalting method. Results from two-way ANNOVA revealed that desalting temperature and desalting time significantly affect ($p<0.05$) the concentration of salt removal from the fish flesh after the desalting process. For the effect of Alcalase concentration, enzyme concentration and desalting time showed a significant influence ($p<0.05$) on the desalting process. From the results, it can be seen that the domestic practice of soaking salted fish in tap water at 25 ºC for some times before cooking can successfully decrease the salt content in the salted fish. After 60 min desalting process, the salt content retained in the fish flesh was 0.94 % which was much lower than the original salt content of the salted fish, 1.88%. The longer the desalting time, the higher the amount of salt leaching out from the fish flesh into water. This leaching out subsequently causes a decrease in the salt retained in the fish flesh. Comparable results have been reported by Barat et al. (2004) where desalting can decrease the salt concentration in the salted fish. The amount of salt removed from the fish flesh showed an increasing trend with the increase in desalting temperature. On the contrary, the amount of salt retained in the fish flesh after desalting

Journal of Food Innovation, Nutrition, and Environmental Sciences
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ISSN No:3078-5537

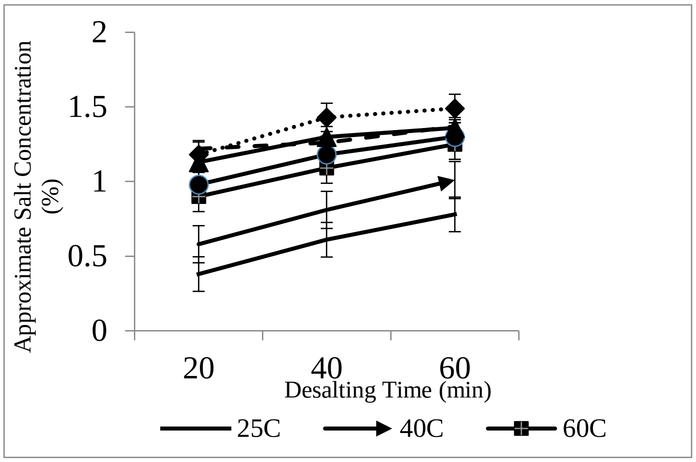

Fig. 1a. Approximate salt concentration of salted fish that had been removed as a function of various desalting methods using water or Alcalase and desalting time.

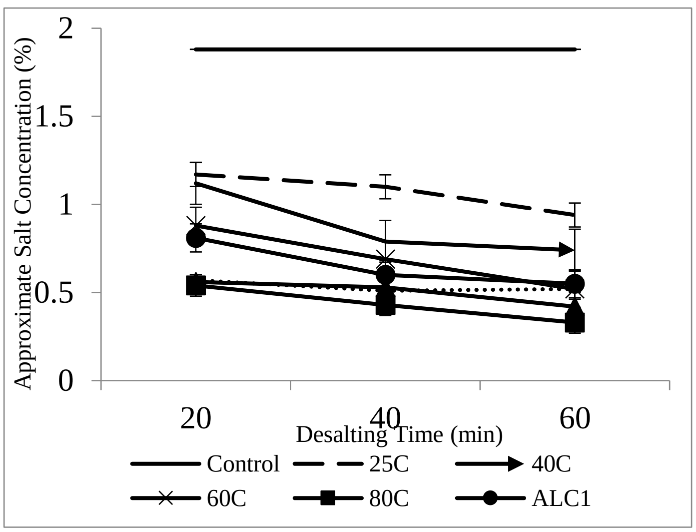

Fig. 1b. Approximate salt concentration that retained in the salted fish as a function of various desalting methods using water or Alcalase and desalting time

process showed a decreasing trend with the increase in desalting temperature. Besides, higher desalting temperature decreased the desalting time used in salted fish desalting process. Desalting process results in two main changes in the salted fish which are leaching of salt to the desalting water and the uptake of water into the fish flesh. It is known that heating dissolves the connective tissues and subsequently causes the fish muscle to collapse (Hyldig & Nielsen, 2001). Hence, desalting by using boiling water can collapse the muscle fibres and helps to increase the water holding capacity of the salted fish. The increase in water holding capacity enables the fish texture to become softer due to higher degree of water uptake during the desalting process (Barat et al., 2004). Thus, the texture of the desalted salted fish with higher desalting temperature tends to be softer than the desalted salted fish with lower desalting temperature (Andrés et al., 2005). This encourages the leeching out of more salt during the desalting process.

For the effect of Alcalase enzyme, it is envisioned that an increase in protease concentration will increase the concentration of salt removed from the salted fish during the desalting process. Desalting by using Alcalase was performed at optimum condition, pH 7 and 60 ºC. After the desalting process for 60 min, the approximate concentrations of salt removed from the salted fish were 1.30 %, 1.36 % and 1.37 % for ALC1, ALC2 and ALC3 respectively. On the other hand, the salt retained in the fish flesh showed a decreasing trend with the increase of enzyme concentration. The approximate salt concentrations retained in the fish flesh after 60 min desalting process were 0.55 %, 0.52 % and 0.42 % for ALC1, ALC2 and ALC3 respectively. These results agreed with those obtained by Herpandi et al. (2012) demonstrating a direct relationship between protein hydrolysis with time and protease concentration. Protease is an effective enzyme used in fish protein hydrolysis. During the desalting process with Alcalase, the enzyme will hydrolyse fish myofibrillar protein thus causes degradation in fish muscle. Perimysium and edomysium connective tissues including the proteins located in Z-line and also H-zones will also be hydrolysed. Degradation of the salted fish muscle causes mushiness or soft texture (Sriket, 2014). Thus, more salt that was trapped in the fish flesh can be leached out from the salted fish muscle into the water. The hypothesis that the application of protease during the desalting process may help to increase the salt removal was achieved.

3.2 Effect of desalting temperature and alcalase concentration on the texture and sensory properties of salted fish

The changes in texture parameters of salted fish after desalting process at different desalting temperature for 60 min are shown in Table 2a. Table 2b shows the results of the changes in sensory properties after the desalting process at different desalting temperature for 60 min. A ranking test was carried out with the participation of 30 panellists. Texture is the most important factor used to determine the quality of the fish (Sriket, 2014). Texture is affected by species, age, size and the nutritional condition of the fish (Hyldig & Nielsen, 2001). The firmness value is the most important parameter to determine the acceptability of the fish. Firmness value of the fish depends on the structure of the connective tissues and myofibrils which consist of actin and myosin (Casas, Martinez, Guillen, Pin, & Salmeron, 2006). An increase in desalting temperature significantly decreased ($p<0.05$) the hardness, cohesiveness and chewiness but not springiness. According to Dhanapal et al. (2013), cooking decreased the textural parameters of the fish in terms of hardness, cohesiveness and chewiness except springiness. The results obtained agreed with Dhanapal et al. (2013). The results from sensory evaluation showed significant differences ($p<0.05$) in terms of saltiness, hardness, springiness, cohesiveness and chewiness with the increase of desalting temperature.

From the results obtained, the salted fish that was not subjected to desalting process (Control) had the highest hardness values in both TPA test and sensory evaluation. It is known that salting of fish results in drier and harder muscle texture. During the salting process, protein denaturation and dehydration increase the hardness value of the fish muscle (Hyldig & Nielsen, 2001). On the contrary, the mechanism in the desalting process is reverse of the salting process. Desalting process results in the uptake of water which causes a decrease in hardness values of the salted fish flesh (Barat, Rodríguez-Barona, Castelló, Andrés, & Fito, 2004; Oliveira, Gonçalves, Nunes, Vaz-Pires, & Costa, 2015). The results obtained agreed with the statement mentioned earlier where the hardness values of the salted fish flesh (25C, 40C, 60C and 80C) after desalting were indeed lower than Control. Heating dissolves the connective tissues which subsequently facilitates the degree of water uptake into the fish. This thus causes a decrease in hardness value (Barat et al., 2004). The relationship between the effect of muscle softening due to higher desalting temperature and the effectiveness of salt removal during the desalting process was validated by the results of sensory evaluation. In the ranking test sensory evaluation, the Control was ranked as the saltiest while 80C was ranked as the least salty. Panellists found that 25C, 40C, 60C and 80C were less salty than Control. However, they failed to determine the differences between 25C, 40C and 60C in terms of saltiness due to the limitation of human sensory ability and perhaps the uneven distribution of salt during the salting process. These successfully proved the previous results that desalting process decreased the salt content in the salted fish and higher desalting temperature enhanced the degree of salt removal (Fig. 3.1a and Fig. 3.1b). Besides, the hypothesis that muscle softening might cause higher salt removal was also proved by the results from TPA test and also sensory evaluation.

For springiness, the values from the TPA test were constant with the increase in desalting temperature. However, the panellists were able to determine the difference in the springiness during the sensory evaluation. The Control gained the highest score while 80 ºC gained the lowest score. The springiness was lost after the desalting process with higher desalting temperature. Values for cohesiveness and chewiness for both TPA test and sensory evaluation decreased with the increase in desalting temperature. Heating dissolves the connective tissues in the fish muscle. Thus, the fish structure becomes flaky and easily slide open during compression (Hyldig & Nielsen, 2001). As a result, the cohesiveness and chewiness are affected.

The changes in texture of salted fish after desalting process by using different Alcalase concentration for 60 min are shown in Table 2c. The changes in sensory properties after the desalting process by using different Alcalase concentration for 60 min are shown in Table 2d. An increase in Alcalase concentration significantly decreased ($p<0.05$) the hardness and chewiness but not springiness and cohesiveness. For sensory evaluation, an increase in the Alcalase concentration significantly influence ($p<0.05$) the saltiness, hardness, springiness, cohesiveness and chewiness. ALC3 had the lowest hardness values while Control had the highest hardness value. The idea that the degradation of peptide bonds might cause muscle softening can lead to higher salt release from salted fish was validated by the results of sensory evaluation. Results from sensory evaluation showed the effectiveness of Alcalase used to enhance the salt removal in salted fish during the desalting process. Panellists were able to differentiate saltiness between salted fish without desalting process from salted fish that was desalted using Alcalase enzyme. However, panellists failed to clearly differentiate the saltiness in the salted fish when different concentrations of Alcalase were added into the salted fish during desalting process. This is probably due to small differences in terms of the salt retained in the salted fish after the desalting process (Fig. 1b). This again showed the weakness of humans' sensory ability.

For both springiness and cohesiveness, an increase in Alcalase concentration did not show any significant effect on both parameters in TPA test. However, the panellists were able to rank them during the sensory evaluation. Control received the highest score for both the parameters while ALC3 received the lowest score. Besides, an increase in Alcalase concentration decreased the chewiness for both TPA test and sensory evaluation. Alcalase results in fish protein hydrolysis and dissolve the connective tissue, thus the whole fish structure becomes soft and chewiness lost (Sriket, 2014).

Table 2a. Changes in texture parameters of salted fish as a function of desalting temperature for 60 min

Sample	Hardness (N)	Springiness	Cohesiveness	Chewiness(N)
Control	98.55 ± 2.20^{a}	0.72 ± 0.04^{a}	0.69 ± 0.02^{a}	49.25 ± 4.42^{a}
25C	67.48 ± 5.68^{b}	0.75 ± 0.03^{a}	0.68 ± 0.06^{a}	34.43 ± 4.56^{b}
40C	56.94 ± 2.62^{c}	0.64 ± 0.16^{a}	0.66 ± 0.05^{a}	24.58 ± 7.31^{c}
60C	51.32 ± 5.75^{c}	0.79 ± 0.06^{a}	0.59 ± 0.06^{ab}	23.78 ± 3.75^{c}

Values*Values are given as mean with standard deviation (n=3).
*a-d Values with different superscript letter in the same column are significantly different among samples ($p<0.05$).

Table 2b. Changes in sensory properties of salted fish as a function of desalting temperature for 60 min.

Sample	Saltiness	Hardness (N)	Springiness	Cohesiveness	Chewiness (N)
Control	3.83 ± 1.34^{a}	4.10 ± 1.00^{a}	3.63 ± 1.45^{a}	3.67 ± 1.24^{a}	3.70 ± 1.24^{a}
25C	2.90 ± 1.21^{b}	3.50 ± 1.17^{b}	3.47 ± 1.01^{ab}	3.40 ± 1.22^{ab}	3.60 ± 1.16^{ab}
40C	3.00 ± 1.36^{b}	3.10 ± 0.96^{bc}	3.43 ± 1.19^{ab}	3.23 ± 1.22^{ab}	2.97 ± 1.35^{b}
60C	3.07 ± 1.23^{b}	2.87 ± 1.17^{c}	2.93 ± 1.08^{b}	2.93 ± 1.14^{b}	3.17 ± 1.18^{ab}
80C	2.20 ± 1.52^{c}	1.43 ± 1.14^{d}	1.53 ± 1.25^{c}	1.77 ± 1.50^{c}	1.67 ± 1.17^{c}

*Values are given as mean with standard deviation from 30 panellists.
*$^{a-d}$Values with different superscript letter in the same column are significantly different among samples ($p<0.05$).

Table 2c. Changes in texture parameters of salted fish as a function of Alcalase concentration for 60 min.

Sample	Hardness (N)	Springiness	Cohesiveness	Chewiness (N)
Control	98.55 ± 2.20^{a}	0.72 ± 0.04^{a}	0.69 ± 0.02^{a}	49.25 ± 4.42^{a}
25C	67.48 ± 5.68^{b}	0.75 ± 0.03^{a}	0.68 ± 0.06^{a}	34.43 ± 4.56^{b}
60C	51.32 ± 5.75^{c}	0.79 ± 0.06^{a}	0.59 ± 0.06^{b}	23.78 ± 3.75^{c}
ALC1	48.63 ± 0.62^{c}	0.69 ± 0.70^{a}	0.55 ± 0.05^{b}	19.51 ± 2.70^{cd}
ALC2	36.30 ± 1.34^{d}	0.73 ± 0.45^{a}	0.54 ± 0.04^{b}	14.31 ± 1.07^{de}
ALC3	29.44 ± 1.42^{e}	0.77 ± 0.08^{a}	0.50 ± 0.04^{b}	11.17 ± 0.43^{e}

*Values are given as mean with standard deviation (n=3).
*$^{a-e}$ Values with different superscript letter in the same column are significantly different among samples ($p<0.05$).

Table 2d: Changes in sensory properties of salted fish as a function of Alcalase concentration for 60 min.

Sample	Saltiness	Hardness	Springiness	Cohesiveness	Chewiness
Control	4.83 ± 1.64^{a}	5.07 ± 1.57^{a}	4.40 ± 1.77^{a}	4.77 ± 1.52^{a}	4.83 ± 1.86^{a}
25C	3.97 ± 1.71^{b}	3.90 ± 1.52^{b}	4.33 ± 1.69^{a}	4.10 ± 1.94^{ab}	3.90 ± 1.65^{b}
60C	3.23 ± 1.41^{bc}	3.53 ± 1.46^{b}	3.97 ± 1.40^{ab}	3.87 ± 1.17^{b}	3.47 ± 1.47^{bc}
ALC1	2.90 ± 1.47^{c}	3.37 ± 1.25^{bc}	3.23 ± 1.43^{bc}	3.37 ± 1.27^{b}	3.30 ± 1.39^{bc}

ALC2	3.13 ± 1.46^{bc}	2.70 ± 1.44^{cd}	2.57 ± 1.30^{c}	2.50 ± 1.43^{c}	2.80 ± 1.27^{c}
ALC3	2.90 ± 1.80^{c}	2.40 ± 1.75^{d}	2.50 ± 1.61^{c}	2.40 ± 1.59^{c}	2.70 ± 1.74^{c}

*Values are given as mean with standard deviation from 30 panellists.
*$^{a\text{-}d}$ Values with different superscript letter in the same column are significantly different among samples ($p<0.05$).

The varying results from both TPA tests (Table 2a and Table 2c) can be explained by the variability in the chemical and physical compositions of the salted fish which affect their textural properties (Cases et al., 2006). Besides, the size of the fish muscle samples was difficult to be standardized because the salted fish muscle is not uniform. This is likely to cause huge variation in TPA test results (Hyldig & Nielsen, 2001). In addition, the complexity of the fish structure increased the difficulties for the panellists to evaluate and describe the characteristics of the samples (Table 2b and Table 2d). Uneven salt content in the salted fish might have also contributed to the inconsistency in the results.

Conclusions

The study demonstrated that desalting of salted Talang Queenfish can be significantly improved through the use of higher desalting temperatures and Alcalase enzyme, which enhance salt removal and reduce desalting time. While these methods resulted in softer fish textures, they did not negatively affect the sensory acceptability of the desalted fish. The best results were achieved at a desalting temperature of 60°C with 1% Alcalase, which balanced salt reduction with favorable sensory properties. These findings offer an improved desalting technique that can be used to prepare desalted, ready-to-eat products, providing an alternative to traditional domestic methods.

Conflict of interest

The authors declare that there is no conflict of interest concerning the publication of this paper

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